GPI Atlantic

Genuine Progress Index for Atlantic Canada / Indice de progrès véritable - Atlantique

MEASURING SUSTAINABLE DEVELOPMENT

APPLICATION OF THE GENUINE PROGRESS INDEX TO NOVA SCOTIA

THE NOVA SCOTIA GENUINE PROGRESS INDEX FOREST ACCOUNTS

VOLUME 2
A WAY FORWARD: CASE STUDIES IN SUSTAINABLE FORESTRY

Prepared by:
Linda Pannozzo, B.Sc., B.Ed., B.J.
Minga O'Brien, M.Sc.

November, 2001

revised to March 1, 2002

National Library of Canada Cataloguing in Publication Data

Wilson, Sara Justine, 1967-
The Nova Scotia genuine progress index forest accounts

Includes bibliographical references.
Contents: v. 1. Indicators of ecological, economic & social values of forests in Nova Scotia – v. 2. A way forward.
ISBN 0-9689923-1-5 (v. 1).—ISBN 0-9689923-2-3 (v. 2)

1. Sustainable forestry—Nova Scotia. 2. Forest policy—Nova Scotia. I. Colman, Ronald, 1947- II. O'Brien, Minga, 1969-
III. Pannozzo, Linda IV. GPI Atlantic V. Title.

SD146.N6W54 2002 333.75'09716 C2002-901108-6

EXECUTIVE SUMMARY

"It's all a question of story. We are in trouble just now because we do not have a good story. We are in between stories. The old story is no longer effective."

- Thomas Berry

Volume 1 of the Nova Scotia GPI Forest Accounts indicates that Nova Scotia's forests are at a watershed juncture. Clearcutting and the liquidation of the province's forest wealth are occurring at unprecedented rates in the interests of immediate economic gain. This trend is undermining the province's ecological, social and economic fabric, and depriving future generations of Nova Scotians of their natural inheritance.

While economics are touted as the rationale behind current practices, the full-cost accounting methods of the Genuine Progress Index demonstrate that current harvest practices actually contravene basic economic investment principles. Our natural capital - the principal, or what is left in the 'forest account,' has been reduced to a fraction of its former value. This trend is supported by an economic accounting system that has measured and valued only the timber extracted from the forest, without accounting for what remains in the forest. Clearly, "the old story" is not working any more.

This second Volume of the GPI Forest Accounts portrays "the new story." It describes a way forward, by describing actual viable, working examples of efforts to maintain and restore forest natural capital. It describes the harvest methods and economics of these operations in considerable detail, in order to provide practical, concrete information to interested wood lot owners and forest industries, and to governments willing to play a leadership role in supporting such efforts through appropriate incentives. The new story must also be supported by a new economic accounting system that values the standing forests as well as the products extracted from them. That is a key function and purpose of the Genuine Progress Index.

"Changing the story" in Nova Scotia represents a particular challenge because of the ownership structure of the province's forests. Twenty-eight per cent of forestland is provincial crown or publicly owned land, 3% is federal land and 69% is in private hands. Fifty-two percent of privately owned lands are small land holdings (less than 400 hectares) and the rest is owned by the forest industry.

Private woodlots account for most of the wood that ends up at sawmills and pulp mills. According to the Nova Scotia Department of Natural Resources (NSDNR), private woodlots are being "over-harvested" in Nova Scotia. According to one l997 NSDNR report, "overharvesting is a potentially serious problem demanding immediate attention….softwood harvests have exceeded the sustainable supply....The increasing demand for forest products is leading to the harvesting of immature stands that should form part of the future wood supply."

Between the periods l981-l985 and l991-l995, the total amount of timber harvested in Nova Scotia increased by 43%. Most of this cut occurred on small private woodlots where the average annual harvest doubled over this same period. This trend is not ecologically, socially or economically sustainable in the long-term.

Another emerging trend in Nova Scotia is a dramatic shift in forest age structure towards ever younger age-classes. The most recent forest inventory (l999) indicates that nearly 70% of the province's forests are younger than 60 years of age. By contrast, forests over 100 years old account for only 0.15% of the province's total forest area, a 50-fold drop from 8% of the total in 1958. Old-growth forests are endangered and exist only in very small, isolated pockets. We are currently witnessing the disappearance of the natural site-evolved species, structure and age characteristics of the once dominant Acadian forest.

In addition, in the last two decades, the area clearcut has also doubled. In l997 the area of crown and private land clearcut reached an all-time high at 68,718 hectares. This means that, on average, 188 ha (465 acres) of forest in Nova Scotia were being clearcut every day.

Today, 98.9% of forest harvesting in Nova Scotia uses clearcutting methods (including shelterwood). Volume 1 of these forest accounts indicates that clearcutting adversely affects soil and water quality, and degrades intrinsically valuable ecosystems that provide habitat for forest-dependent wildlife and aquatic species. At current harvest levels, clearcutting is also producing an overall loss in age diversity and shade-tolerant tree species. The quick removal of trees for short-term economic gain also has a negative impact on communities that rely on stable long-term employment.

In short, Volume 1 demonstrated that our current forestry practices have resulted in the substantial degradation of a valuable natural asset, in the loss of services that a forest ecosystem provides "for free" (as outlined in Chapter 1 of this Volume), and in an overall decline in the economic value of our forests.

In the midst of what Thomas Berry refers to as the "dark age of exploitation," there are, nevertheless, inspiring examples of a 'way forward.' -- of sustainable forest practices that can restore the value of the province's forests and leave a rich inheritance of natural wealth to future generations of Nova Scotians. The following remarkable stories were selected because these forestry operations protect the full range of forest values and are therefore sustainable in the long term. They provide working models for both large and small scale operators in the province and demonstrate a way to turn around the destructive practices of the past.

In all of the following case studies, the forest managers have adopted a long-term vision that considers all the values of the forest and all the costs of forestry practices. These costs include the costs to forest ecosystems, the costs to society, and the costs of foregone income in the short-term for the purpose of longer-term gains. These case studies demonstrate how present generations are paying the costs of a legacy of poor forestry practices in the past, and how current forest restoration efforts are investments of which future generations will be the primary beneficiaries. They also represent examples of what Berry refers to as the struggle to enter into an "ecological age."

Windhorse Farm, Pictou Landing and the woodlot of Jeremy Frith are examples of small woodlots in Nova Scotia where ecologically sustainable forestry and restoration forestry practices provide a model for other small woodlot owners in the province. Algonquin Park in Ontario and Menominee Tribal Enterprises (MTE) in Wisconsin are examples of large industrial operations that provide models of sustainable forestry practices that could be adopted by the large industrial forest companies operating in Nova Scotia. Finewood Flooring and Lumber Ltd. is an example of a very successful value-added wood products company in Nova Scotia that demonstrates how the number of jobs per unit of biomass harvested can be sharply increased.

It must be emphasized that sustainable forest management is *not* the whole answer to protecting the functions and value of Nova Scotia's forests. Even with the most careful harvesting techniques, forestry practices will have some impact on forest ecosystems. While there is an enormous difference between clearcutting and selection harvesting systems, they both involve the construction of roads and the removal of biomass. Therefore, no matter how admirable the following models are, they do not constitute a substitute for an adequate network of representative protected areas in Nova Scotia. In Volume 1, protected areas are separately described as an indicator of forest health. The focus of these case studies on harvesting methods must therefore be seen in the context of an effective protected areas strategy.

WINDHORSE FARM (CHAPTER 1)

Located in southwest Nova Scotia near New Germany, Windhorse Farm contains a rare 36-hectare remnant of the province's original Acadian forest that has never been cleared. Despite 160 years of logging, this hemlock-dominated forest retains its original sylvan magnificence and boasts trees as much as 450 years old. This extraordinary 36-hectare parcel is part of a 60-hectare holding at Windhorse Farm that includes 5 ha. of farmland and crops, and another 19 ha. of woodland that had historically been cleared for pasture but is now in active restoration.

While only 1.1% of Nova Scotia's forest area remains in the over-80-year-old age class, by contrast, trees over 80 years old dominate 90% of the 55 hectares of forest stands at Windhorse Farm. These old trees dominate 100% of the 36-ha. old forest, and 71% of the additional 19 ha. parcel that is being restored. Even though the Windhorse Farm forest has been logged every year since l840, the volume, quality and value of wood not only remains undiminished, but has been enhanced, because the logging has been conducted according to ecological principles.

Jim Drescher, the owner of the woodlot, uses a technique called slow-grading, in which a tree is cut if it is slow-growing relative to nearby trees of the same species and if it has relatively high economic value. If it is one of a small group of slow-growing valuable trees, the whole patch of 4 to 5 trees might be cut, opening up a gap in the canopy that allows light to penetrate to the forest floor. Drescher says selection cutting mimics the natural disturbances (single and multiple tree fall) of the region. At Windhorse Farm, the tallest trees are never cut in order to ensure high canopy height and structural diversity within the stands.

The woodlot currently has 2 million board feet of trees over 8 inches in diameter. In total, over 8 million board feet have been cut since l840 – a far greater volume than would have been obtained from the woodlot had it been clearcut every 50 years.

In total, Drescher harvests about 110,000 board feet of wood annually, some from his own woodlot and the rest from land belonging to neighbors. He purchases another 40,000 board feet and directly employs the equivalent of 7 full-time people at his sawmill and in the woods. According to Drescher, ecoforestry employs five times more people per unit of wood than do current industrial practices. “If Nova Scotia were to move toward an ecoforestry paradigm, we could double the employment on half the harvest.”

Restoration costs paid today are the unpaid costs of past forest exploitation. As with any investment, says Drescher, costs go down when capital assets function at full capacity. At Windhorse Farm, he says, all forest stands are in various stages of restoration, and all profits are reinvested in forest restoration.

PICTOU LANDING FIRST NATION (CHAPTER 2)

Pictou Landing provides an excellent model both for landowners interested in restoring seriously degraded woodlots and for communities interested in gaining greater control over their forest lands. The Pictou Landing (PL) forests have been subjected to more than 300 years of land clearing, cultivation, burning, high-grading, and clearcutting. The large-sized, long-lived trees of the Acadian forest, like white pine, red oak and sugar maple, have all but disappeared. Today, the PL forests are dominated by short-lived, low value tree species.

PL forests are unusual in that they are owned and managed by the Pictou Landing First Nations Band, for the long-term economic, environmental and social benefit of the community. They are also unusual in that the forests are being managed to promote a similar tree species mix, abundance, and age class distribution as that which existed in this part of Nova Scotia prior to European settlement. To this end, low impact forestry practices have been adopted, including single tree selection, group selection, and shelterwood harvesting techniques. The harvesting systems employed favour the remnant, long-lived, shade and semi-shade tolerant tree species that were once dominant in the region.

While the economic benefits of forest restoration will only be realised well in the future, the social benefits for the Pictou Landing community are already beginning to be realised. They include:

- community control of forest management operations;
- optimizing hunting and wildlife-viewing opportunities for band members;
- restoring a sense of pride and accomplishment among community members;
- re-introduction and promotion of culturally valuable species, like black ash;
- training and employment opportunities in the woods; and
- provision of basic supplies, such as firewood and poles.

PL was recently recognized for its forest management practices by achieving Forest Stewardship Council (FSC) certification. The FSC is an international body that puts a ‘green’ stamp on wood products derived from forest management practices that adhere to strict environmental and socio-economic standards, and that protect Indigenous People’s rights. Pictou Landing is the first FSC certified operation in the province, the first certification in Canada held by a First Nations band, and only one of a handful of woodlots across the country holding the distinction of FSC certification.

JEREMY FRITH (CHAPTER 3)

After more than 200 years of high-grading, clearcutting and land clearing by prior owners, Jeremy Frith inherited a degraded, devalued woodlot of young, mostly even-aged forests. His woodlot is typical and largely representative of the condition of many Nova Scotia forests.

Frith embarked upon a management regime that utilizes the existing degraded forest to hasten the restoration of a healthy mixed forest. His long-term goals include:

- enhancing growth rates and standing timber volumes;
- increasing the health and insect/disease resistance of trees;
- creating product diversity to capitalize on timber markets when at their best; and
- leaving his land in much better condition than when he bought it – with more standing timber volume and value, and producing more oxygen, clean water, and abundant wildlife.

Early on, Frith ignored the advice of local forestry officials, who recommended converting his mixed wood stands to softwood monocultures. Frith knew that this would only increase vulnerability to pests, disease and other disturbances, and he opted instead for selection harvesting systems. Frith is convinced that selection harvesting is the only harvesting system that will enable the volume and quality of standing timber in the forest to increase continually, allowing for greater future harvested volumes and a steadily increasing canopy height.

The recurring theme in Frith's approach to forest management is his investment in the future. From pruning, to thinning, to reintroducing tree species once common to the region, to avoiding damage to residual trees - all of these activities are carried out with an expectation of future returns. Over the last 8 years, Frith has pruned spruce, fir, maple and birch, and thinned and removed poorly formed and suppressed trees. In 10-15 years, Frith hopes to begin harvesting white birch sawlogs at prices that greatly exceed those for spruce logs.

Frith argues that his woodlot is a better investment in time and effort than his RRSP: restoration forestry increases forest value directly by increasing canopy height, age and species diversity, and the proportion of valuable wide diameter, clear lumber. Restoration also has many indirect benefits, including the gradual improvement of soil quality and timber productivity.

MENOMINEE TRIBAL ENTERPRISES (CHAPTER 4)

The Menominee Indian Tribe in Wisconsin was recognized by the United Nations in 1995 for its expertise in sustainable forest management and the tribe was given the first ever U.S. Presidential award for Sustainable Development in 1996. Today, it is the only Native American tribe to have its forests certified by two Forest Stewardship Council-approved certifiers, SmartWood and Scientific Certification Systems.

The Menominee's 89,000 ha forest has been logged for 147 years and there is more wood there today than there was when the reservation was first established in l854. The Menominee cut about 58 million board feet of timber last year and have harvested more than 2 billion board feet since cutting began in l865. Yet the most recent forest inventory indicates a higher volume and quality of saw timber now than when the land was first surveyed.

Fifty percent of the harvesting that takes place in the Menominee forest uses the selection method, where only single trees or small patches of trees are cut. Highly regulated clearcutting is used in approximately 25% of the forests and the shelterwood method in the remaining 25%. Within any given year 3,240 ha are harvested using these various methods (less than 4% of the total forested area). Within the areas where selection methods are used, what gets cut depends on "vigor and risk." "If a tree is 30 inches in diameter and it's healthy and vigorous, we leave it alone," says Marshall Pecore, the Menominee Forest Manager. "Those that are risky, that won't be alive in 15 years when we re-enter that forest, they're removed." This "slow-grading" method has improved the quality of the Menominee forest.

More than 30 species of trees can be found in the Menominee forest, some as old as 350 years. The dominant forest cover types within the Menominee forest include northern hardwoods (maple, red oak and basswood), hemlock hardwoods, mid-tolerant hardwoods, pine stands (jack, white and red), aspen, scrub oak and swamp forest. As well there are countless species of wildlife. "We still have lots of things that there's a shortage of everywhere else. Hawks, songbirds, bears, butterflies – every time they come looking for them, they find them here," says Pecore.

In addition to the 89,000 ha of forested land, more than 240 km of rivers and streams move through the reservation and 123 lakes cover approximately 1,600 ha. These features, together with the surrounding forest, provide a wide range of ecological, social, recreational and spiritual opportunities for the Menominee as well as providing habitat for forest dependent species. SmartWood describes the Menominee forest as a "fully structured forest" and "arguably the most unique biological resource in the region."

Of the 8,500 Menominee on and off reservation, 450 work in the sawmill, as loggers, or in the administration of the forestry center. Approximately 70% of those employed in the mill and other forest operations are Menominee Tribal members, and approximately 25% of the work force on the reservation is employed directly in forest-based industries.

Maintaining a sustainable harvest in the Menominee forest has been an economic and social challenge. On many occasions, the short-term economic circumstances of the tribe could have been temporarily improved by the liquidation of the forests. If the Menominee were to clearcut their forests today, the timber alone would be worth more than US$700 million. However, the Menominee have resisted this temptation. Much like the Mi'kmaq of Pictou Landing in Nova Scotia, the culture of the Menominee has put constraints on the harvest of timber. For them, the liquidation of their forests is not a social or cultural option.

ALGONQUIN PARK (CHAPTER 5)

Algonquin Park is an example of a large-sized forest management operation on a scale comparable to many in Nova Scotia, but with a management approach that embodies ecologically, socially and economically sustainable forestry practices. As large operations, both the Algonquin Park and Menominee forest management systems provide a potential model for Stora Enso, J.D. Irving, Bowater Mersey, Kimberly Clarke, MacTara, and other large companies operating in Nova Scotia.

Since 1975, the Algonquin Forest Authority (AFA) has focused on restoring the quality of managed stands by practicing selection and uniform shelterwood harvesting, and by investing in silviculture activities like tree marking, stand improvement, planting, and manual cleaning.

For Algonquin Park, "the level of harvesting is based on what is sustainable over the long term. The wood supply available to industry is a function of sustainable forestry practices and is not influenced by industrial demand" (AFA 2001). In other words, the forest managers are not forcing the forest succumb to market demands, but are instead allowing markets to adapt to what the forest can produce over time.

One of the guiding principles of management in Algonquin Park is to "regenerate the forest to the appropriate species for a site" using "the most current scientific forest management techniques" (AFA 2001). Great attention is paid to the silvics (conditions for growth and reproduction) of individual tree species in order to promote the vigorous regeneration of preferred species as well as species best adapted to a site. Over the past 30 years, the AFA has not only maintained the proportion of shade tolerant hardwoods and softwoods in the park, but invested in their long-term health and improvement.

Algonquin Park is an example of how public pressure resulted in improved harvesting practices on publicly owned land. Public pressure has ensured that forest, water and recreational values are maintained for all park users, and that timber extraction is limited to specific areas within the park, at certain times of year, and by low impact harvesting methods. As a result, Algonquin Park has managed to sustain both a vibrant tourism industry, including high quality recreational and wilderness experiences, and a healthy forest industry. This successful combination can be attributed in part to the management systems adopted by the Algonquin Forest Authority, which "almost always mean that trees remain standing on the land at all times, and many people would be hard pressed to realise that logging had even taken place in most areas just a few years later" (Strickland 2000). Flying over the park today, an observer has difficulty distinguishing cut areas from uncut areas.

One of the AFA's most distinguishing features is its openness to public input and participation, both in the Authority's structure and in its actual management processes. A local citizens committee has been established to assist the planning team in the preparation of Forest Management Plans. Plans are also available for public review, and the Algonquin Forest Authority hosts open house sessions to invite public input into Plan preparation.

The key to accommodating all the various users of Algonquin Park is a well-designed land use plan that separates activities both spatially and temporally. The entire park is zoned for different land-use activities. Forest management activities are only permitted within the recreation/utilization zone. Almost nineteen percent (18.8%) of Algonquin Park is protected from logging activities in wilderness, nature reserve, and natural environment zones. An additional 21% is protected in reserves for watercourses, non-productive forestland, non-forested areas, and islands.

After only 25 years of careful and responsible management, Algonquin Park is already producing higher-grade lumber while continuing to enhance the value of the park's standing timber. One sawmill owner, who is now starting to receive logs from areas cut 20 years ago, has reported that mills are now sawing a much higher proportion of valuable, higher grade logs (47% 'number one common') from the managed hardwood stands. Ten years ago, the same mills were experiencing 'number one common' and better yields of only 25%. As Jeremy Frith (above) noted on a much smaller scale, a responsible investment and restoration approach to forest management enhances the longer term economic value of the forest.

The Algonquin Park harvest methods and employment patterns contribute significantly to local community stability and resilience, providing steady and reliable employment opportunities for local residents year after year. By contrast, clearcutting has created high unemployment among many forest-dependent communities in Canada which have lost their resource. Over 280 people are employed steadily in forest operations in Algonquin Park, and at least 1,800 people are employed in the 7 sawmills, 2 veneer plants, one pole plant, one pulp mill, and one oriented strand board mill that receive wood from Algonquin Park. The employment opportunities created by the forest industry in Algonquin Park have occurred primarily within the communities immediately adjacent to the park. All the mills and plants that process wood from Algonquin Park are located within 50 km of the perimeter of the park.

Investments in the quality of forest stands, and in the variety of products derived from forests have given Ontario the best record among forest industries in Canada for 'living off the interest' of forested natural capital assets. Ontario has the highest value-added per cubic metre of wood harvested of any province in Canada: in 1997/8, Ontario's value-added was $273/$m^3$, compared to Quebec at $204/$m^3$, New Brunswick at $122/$m^3$, British Columbia at $110/$m^3$, and Nova Scotia, at $82/$m^3$.

FINEWOOD FLOORING AND LUMBER LTD. (CHAPTER 6)

Finewood Flooring and Lumber Ltd. on Cape Breton Island, Nova Scotia, was built by Peter and Candace Christiano with private financing in l982. A drying kiln on the site produced 300,000 board feet of dried, graded hardwood lumber. To make the enterprise economically viable, the owners realised they had to make a finished product. By l984 they were manufacturing hardwood flooring, and by l985 they had entered into the trim and molding markets.

One of the goals of sustainable forest use is to reduce the quantity of wood harvested without reducing the economic value of the forest and forest products and the employment they provide.

The goal at Finewood is to add value per unit of biomass harvested in order to get the maximum value from each cubic metre of wood harvested.

Through manufacturing, Finewood Flooring adds 10 times more value per unit of wood harvested than the local pulp mill owned by Stora Enso. For example, pulp and paper revenues are approximately \$118 per m^3 of wood, compared to Finewood's finished products, which fetch an average of CDN \$1,200 per m^3 on the domestic market and CDN \$1,600/ per m^3 on the foreign market.

In addition, for every 1,000 cubic metres of wood processed, Finewood Flooring directly employs approximately 10 people full-time, whereas the pulp and paper industry produces only 1.4 jobs for every 1000 m^3 of wood processed.

Finewood Flooring has experienced 20 –30% growth over the last three years and currently exports 60% of its product, a testimony to its economic viability and to the great potential for enhancing both employment and the economic contribution of Nova Scotia's forests while reducing the harvest to sustainable levels.

CRITERIA FOR CHOOSING THESE CASE STUDIES

The key to ecologically-based forestry is that any manipulation of a forest ecosystem should try to mimic the natural disturbance patterns that were dominant on the landscape prior to extensive anthropogenic disturbance. Ecological forestry practices also maintain the integrity of natural patterns and processes, even when it becomes financially difficult or inconvenient to do so. Ecological forestry means harvesting wood without compromising the wide range of vital ecological services provided by a forest and without undermining the natural systems that allow the forest to function effectively in all its aspects. This approach maintains the long-term ecological, social and economic values of a forest.

GPI Atlantic recognizes that all forestry operations will have some level of impact on forest ecosystems. Even with selection logging operations, biomass is removed and roads are built. However, these case studies provide examples in which the maintenance of ecological integrity is paramount, in which the impacts of forest practices are explicitly recognized, and in which efforts are made to minimize these impacts. Clearly, the best way to protect the full-range of forest values is to establish protected areas, where there is little, if any, human alteration of the landscape. Conservation biologists argue that a 30% protected set-aside is essential to maintain forest biodiversity. However, if logging is to take place, then the case studies in this Volume are testimony to the possibility of harvesting wood products in such a way as to minimize the negative impacts while sustaining viable forest-dependent communities.

In sum, the six case studies in this Volume all met the following criteria:

- The key to ecologically-based harvesting is to harvest wood without compromising the ecological services and systems of a forest, thus maintaining the ecological, social and economic values of a woodlot.

- Any manipulation of the forest ecosystem should emulate the dominant natural disturbance patterns of the region prior to extensive anthropogenic alterations, i.e. the forest conditions prior to European settlement.
- Forest practices overall protect the integrity of naturally developed ecosystems and promote tree and wildlife species in terms of distribution, abundance, age structure and individual quality, genetic diversity, and fitness.
- Forest practices are geared toward maintaining the native ecological integrity of the forest based on forest conditions prior to European settlement.
- Efforts are made to maintain or improve forest ecosystem health in ways that recognize the multiple uses of a forest.
- Forest practices are sustainable for present and future generations.
- Communities surrounding the forest are sustained by stable, long-term employment.
- Harvesting is accompanied by in increase in the quality and volume of wood grown over time.
- Harvested timber volumes are consistent, stable and justified.
- Efforts are made to increase the value per unit of wood (value-added), and therefore the jobs per unit of biomass harvested.
- Efforts are made to restore the natural ecological integrity of degraded forestland.
- Attempts are being made to internalize the real human and ecological costs of forestry.
- Forest operations are locally owned and controlled by members of the community, ensuring that costs and benefits are accounted for locally and thus internalized to a greater degree.

It will be recognized that, in almost every instance, these principles and practices stand in sharp contrast to those that currently dominate the Nova Scotia forest industry and that have resulted in the serious degradation of the province's forests described in Volume 1. In particular, the two-fold increase in clearcutting in the l990s has degraded Nova Scotia's forests at a more rapid rate than at any previous time in the province's recorded history, and sharply diminished the province's natural wealth. Restoration forestry, accompanied by a "moratorium" on current practices will, in the long term, bring back the forest's natural capital and gradually rebuild its value.

The case studies described in this report are examples of operations that are now paying the costs for past practices that have degraded forest values. They also provide evidence that some benefits of current restoration efforts can be realised within 10-25 years, but that, for the most part, restoration is a long-term investment, the benefits of which will be enjoyed primarily by future generations. In the words of Wendell Berry:

> *"A forest makes things slowly; a good forest economy should therefore be a patient economy. It would also be an unselfish one, for good foresters must always look toward harvests that they will not live to reap."*

The case studies adhere to the approach, framework and indicators in Volume 1:

The case studies follow the description and valuation of forest functions and services outlined in Volume 1 of these GPI forest accounts. In other words, they are literally micro-level case studies of principles, indicators, and practices previously applied on the provincial level. This approach has the disadvantage of lengthening this report by repeating the description of each forest function in each case study, but it has the advantage that any one case study can provide the reader with a window on the overall framework and approach of the GPI forest accounts.

The fundamental approach of the GPI natural resource accounts as a whole is to assess the health of a resource in accordance with its capacity to perform all of its functions optimally and effectively. Thus, a healthy forest is one that protects soils, watersheds, biodiversity, and habitat for wildlife; regulates the climate; sequesters carbon from the atmosphere; and provides timber, employment, recreational opportunities, and other services to human society. The case studies that follow adhere to this approach and framework, in order to illustrate the extent to which sustainable harvesting practices protect and promote the capacity of forests to perform their varied functions effectively.

In an attempt to adhere to the structure and indicators presented in Volume 1, the reader will therefore find some degree of repetition in these case studies, as some evidence is relevant to different indicator sets. Indeed, the same evidence (for example, age structure) may be an indicator of effectiveness for several different forest functions. Because we are still at an early stage in the development of natural resource accounts, GPI Atlantic has opted for repetition at the expense of elegance of presentation, in order to retain transparency in presenting the specific evidence on which all conclusions are reached.

Part II of this Volume also explores the implications of the six case studies for forest policy in Nova Scotia, and contrasts the evidence from the case studies with the impact of current forest practices, including the reduced value of lumber under clearcutting systems. It also examines the implications of the evidence for employment in the forest industry, for mechanization, and for the potential incentives and disincentives that can be offered by governments to reduce the current level of environmental damage.

ACKNOWLEDGEMENTS

GPI*Atlantic* gratefully acknowledges funding for this project provided by the National Round Table on the Environment and the Economy, and by the Nova Scotia Voluntary Planning Agency.

The authors also wish to thank the subjects and main contacts for each case study, namely, Jim Drescher, Bill McKay, Jeremy Frith, Marshall Pecore, Gord Cumming, and Candace and Peter Christiano. We are grateful to each of these people for finding the time to co-operate and share detailed information with us regarding their forest operations and for carefully reviewing the descriptions of these operations. We would also like to thank Elaine Jeffrey, who provided additional information for the Pictou Landing case study.

The authors would also like to thank Dr. Ronald Colman, whose ongoing advice, support and guidance made the completion of this work possible. They are also grateful to Art Lynds, Wade Prest, and Phil Clements, who reviewed this second Volume of the GPI Forest Accounts, and whose suggestions and viewpoints were valuable and necessary for the completion of this report. Wade Prest, President of the Nova Scotia Woodlot Owners and Operators Association, provided ongoing input and support throughout this project.

Andrew MacLaughlin of Grant Thornton, Peter MacQuarrie and Ken Snow of the Nova Scotia Department of Natural Resources, Jennifer Scott, Brian Starzomski, Laurie Gravlines of the Ontario Ministry of Natural Resources, Jim Buntain and Greg Matheson, and many others generously provided information for this study and gave their time in interviews.

Thanks also to the efforts of various helpful volunteers who bailed us out of technical difficulties, including Tim Farmer, Colin Dodds, Anne Monette, Cliff Esler, Bob Whynot, and Waye Jason. Anne Monette has also skillfully worked with report formatting, proofreading and production.

Inspiration for the Nova Scotia Genuine Progress Index came from the ground-breaking work of Redefining Progress, which produced the first GPI in the United States in 1995. Though **GPI***Atlantic*'s methods differ in many ways, particularly in not aggregating index components for a single bottom line, we share with the original GPI the attempt to build a more comprehensive and accurate measure of wellbeing than can be provided by market statistics alone. **GPI***Atlantic* also gratefully acknowledges the pioneers in the field of natural resource accounting and integrated environmental-economic accounting on whose work this study and the GPI natural resource accounts build.

Needless to say, any errors or misinterpretations, and all viewpoints expressed, are the sole responsibility of the authors and GPIAtlantic.

 Copies of this report and of other **GPI***Atlantic* publications may be ordered through the GPI web site at www.gpiatlantic.org. Membership information is also available at this web site. Members receive a 25% discount on all publications and subscriptions to *Reality Check: The Canadian Review of Wellbeing,* published four times a year, and to the *GPI News,* published eight times a year, which contains updates on **GPI***Atlantic* activities, work in progress, latest results, and useful statistics on social, environmental and economic realities.

TABLE OF CONTENTS

PART I
CASE STUDIES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AFA	Algonquin Forest Authority
AOC	Area of Concern
APEC	Atlantic Provinces Economic Council
ATV	All Terrain Vehicle
CDN	Canadian (refers to dollars)
DNR	(Nova Scotia) Department of Natural Resources
GIS	Geographic Information Systems
Ha	Hectare
IRM	Integrated Resource Management
m^3	cubic metres
Mfbm	Thousand foot board measure
MTE	Menominee Tribal Enterprises
NSDNR	Nova Scotia Department of Natural Resources
OMNR	Ontario Ministry of Natural Resources
PSP	Permanent Sample Plot
RRSP	Registered Retirement Savings Plan
SFL	Sustainable Forest License
SMZ	Special Management Zone

COMPENDIUM OF QUOTATIONS

The old story:

"We cannot even estimate the number of species of organisms on Earth to an order of magnitude, an appalling situation in terms of knowledge and our ability to affect the human prospect positively. There are clearly few areas of science about which so little is known, and none of such direct relevance to human beings."

- Peter H. Raven, Global Biodiversity Strategy

"The productivity of many sites in the Pictou Landing forest has declined due to abusive land use practices over the past 200 years....Forest harvesters invariably selected the tallest, largest, straightest, most valuable trees of the most valuable species. Inferior individuals of inferior species were left to dominate the site and regenerate. Today, productivity of the Pictou Landing forest is estimated to be approximately 50% of its capability."

\- Wade Prest, author of Pictou Landing Forest Management Plan

"If we, today, possessed the forest that covered this landscape 400 years ago, we would be wealthy indeed."

\- Jeremy Frith, woodlot owner, Cape Breton

"I spent all my working life basically unemploying people...installing equipment that would provide an economic return and displace some people. The thrust of our whole industry has been to do that."

-Ike Barber, President of Slocan Forest Products (Globe and Mail, July 18, l997)

"The fundamental problem [with the industrial forest model] is that it is costly and large scale. It is therefore beyond the reach of small rural communities and so will be run inevitably for the benefit not of the local people but of absentee investors. And because of its cost and size, a large wood products factory establishes in the local forest an enormous appetite for trees."

\- Wendell Berry

"Take three-quarter of a million and add interest and two men to run each piece plus yourself - you're going to ask yourself why is anyone in the logging business these days."

- Jim Buntain, Wilson Equipment

"There's no incentive not to do what I'm doing... I'm no better than anyone else. I smash and crash and I cut a bunch of wood and when we're done, it's history. We look behind us and it'll be a hundred years before anything will come back there and I know there's a better way to do it."

- Independent logger

"In the industry's cutting frenzy, another canoe carry (portage) has been mauled and slashed by those working for the Irving Company at Weymouth."

-Don Rice, Tobeatic Wilderness Committee

"Cutting a stand of desirable species and obtaining by regeneration a stand of less desirable or undesirable species in its place definitely degrades the stand for the next rotation. The implications for sustained yield and continuous economic development of the forest industry are obvious....There are ways to cut trees and to manage forests in order to gain satisfactory regeneration of desirable species, and we must follow these methods if we are to maintain a sound resource base for the forest industries. Indeed, the forest economy of Nova Scotia depends upon it. Harvesting practices must follow recognized regeneration methods to accomplish the task. The careful application of suitable regeneration methods is what separates forestry from exploitation."

- Department of Lands and Forests 1980 *Manual of good forest practices for NS*

"On a natural level the forest is itself a living organism made up of everything underground, above ground, and even in the air. I view each individual tree within that forest as a fruit which is formed and ripens in its time until ready for picking....If you take the tree as fruit analogy with the whole forest being the tree that produces the fruit, then harvesting by clearcutting is like cutting down your apple tree in order to get at the fruit. This might make picking the fruit a little easier but it sure is a wasteful and inefficient way to produce fruit. Every time you do it you have to plant a new sapling tree and wait years for it to mature sufficiently to produce another crop of fruit."

- Jeremy Frith, woodlot owner, Cape Breton

"Currently, the federal tax system operates as a powerful disincentive to sustainability....Ironically, it is sometimes possible to obtain a greater tax benefit by prematurely clear cutting a woodlot than by managing it sustainably."

- National Round Table on the Environment and the Economy (NRTEE)

"The increase in liquidation harvesting has been driven by the wood market and by some other factors. There is a concern that the Canadian income tax system inadvertently favours liquidation harvesting over more sustainable harvest methods such as selection harvesting approaches."

- Bruce Lunergan

"Private woodlots in Canada's Maritime provinces face serious management problems....Many argue the impacts could be swift and dramatic, challenging the very fabric of life in the region. A few liken the situation to that preceding the collapse of the Atlantic cod fishery."

- NRTEE, Private Woodlot Management in the Maritimes

"The stability of forestry and the stability of regions might be contradictory goals....When the industry can no longer grow by extracting huge quantities from a new forest region, the only way of increasing productivity is to reduce employment."

- Patricia Marchak, author of *Logging the Globe*

"The [Public Lands] Coalition has been critical of many aspects of [the Nova Scotia Department of Natural Resources'] Integrated Resource Management (IRM) planning and has lobbied for changes to the process to make it more transparent, progressive, and reflective of public aspirations. Central to our position is the belief that Nova Scotia will enjoy the most benefits from our limited public land base if many more Crown lands acquire legal protection.

"We believe, and hope, that the Department has recognized that the IRM strategic plan was very poorly received in many circles, including the tourism industry, environmental groups, hunting and fishing clubs, scientists, some Mi'kmaq interests, much of the general public, some government departments, and several community groups and municipalities. An underlying concern among these interests remains that the IRM strategic plan is not fairly balanced – it heavily favours industrial resource extraction and industrial users at the expense of non-consumptive values and nearly everybody else with an interest in public land."

- Kermit deGooyer, Coordinator of the Ecology Action Center's Wilderness Campaign

"This plan [NSDNR's Integrated Resource Management Plan] was supposed to bring different government policies together in a unified and balanced approach. Instead, one government department [the NSDNR] has decided that the lion's share of Crown lands is for industry, while the rest of us are sitting on the sidelines."

- Bob Bancroft, President of the Nova Scotia Anglers and Hunters Federation

"When we go by clearcuts on the way to our Upper Bay of Fundy Hiking Adventure, it is an embarrassment and I have to explain to our guests that most harvesting in Nova Scotia is by clearcutting. We have to tell the truth.

"Our guests have written letters to the Premier but it has done no good. We have written letters, made submissions, asked for a place at the decision making table in the IRM process but have been ignored. All of tourism, not just outdoor/nature tourism depends upon our natural beauty. We are a stakeholder in the forests of this province, however we have no say in what happens to it. NSDNR says we have a say but ignore all of our submissions to them about selection harvesting."

- Wendy Scott, Scott Walking Adventures

The new story:

"A forest makes things slowly; a good forest economy should therefore be a patient economy. It would also be an unselfish one, for good foresters must always look toward harvests that they will not live to reap."

- Wendell Berry

"In the Acadian Forest Region, less than 1% of the Ancient Forest remains. That means ecoforestry is 99% restoration forestry."

- Jim Drescher, Windhorse Farm

"If Nova Scotia were to move toward an ecoforestry paradigm, we could double the employment on half the harvest."

- Jim Drescher, Windhorse Farm

"I am so convinced that Maritime woodlots have, over the years, been increasingly degraded and discounted of their real value that I would like to help prove they could be much more productive".

- Jeremy Frith, woodlot owner, Cape Breton

"I am sure that a vital, healthy, all aged…forest has exponentially greater economic and ecological value than a softwood plantation on any day of the week and that such a forest, well managed, will increase further in value every year while it is being studied, tended and harvested."

- Jeremy Frith, woodlot owner, Cape Breton

"Forest management decisions taken today can have a dramatic impact on future log and wood quality attributes, and subsequently on end-use potential and end-product quality and value".

- Zhang and Gingras, 1999

"We spend more money to cut timber on our lands than they do off the reservation - because of the way it's being cut. But in the long run we'll have timber to cut and the other guys won't."

- Marshall Pecore, Forest Manager, Menominee Tribal Enterprises (MTE)

"We still have lots of things that there's a shortage of everywhere else. Hawks, songbirds, bears, butterflies - every time they come looking for them, they find them here. We're kind of proud of that."

- Marshall Pecore, Forest Manager, MTE

"Unfortunately, most purchasers of woodland do not understand that they have bought a severely overdrawn bank account. In most cases, the initial cash investment to purchase the land is just the tip of the iceberg. At some point the overdraft will have to be covered. Now or later are the only alternatives."

- Jim Drescher, Windhorse Farm

"Diversity minimizes the risks to the forest of an unpredictable future by retaining all the pieces of the forest and not putting all of your eggs in one basket."

- Menominee Tribal Enterprises (MTE)

"Cutting [in Algonquin Park] is done in carefully researched ways that seek to preserve the forest's diversity and ability to support the full range of native wildlife while at the same time maximizing the land's production of desired tree species and to continue that

production, cycle after cycle, on into the future....The management systems used in Algonquin Park almost always mean that trees remain standing on the land at all times....”

- Dan Strickland, Algonquin Park

“If the Menominee ignored ecological concerns, they could also make a great deal more money. They could just produce a monoculture of economically beneficial species like Red Pine, and cut and replant on a short rotation. They could push their forest in whatever direction they think the market will go. They could cut based on market demand. But that’s not what they have chosen to do.”

- Marshall Pecore, Forest Manager, MTE

“I keep my mind open and clear and I listen to the forest. I ask it what I can do. How can I leave it better than I found it? I look to see, do the berries still grow? Do the birds still sing? Some of what I look for is spiritual. I have no fear. What I have is concern. What I have is hope.”

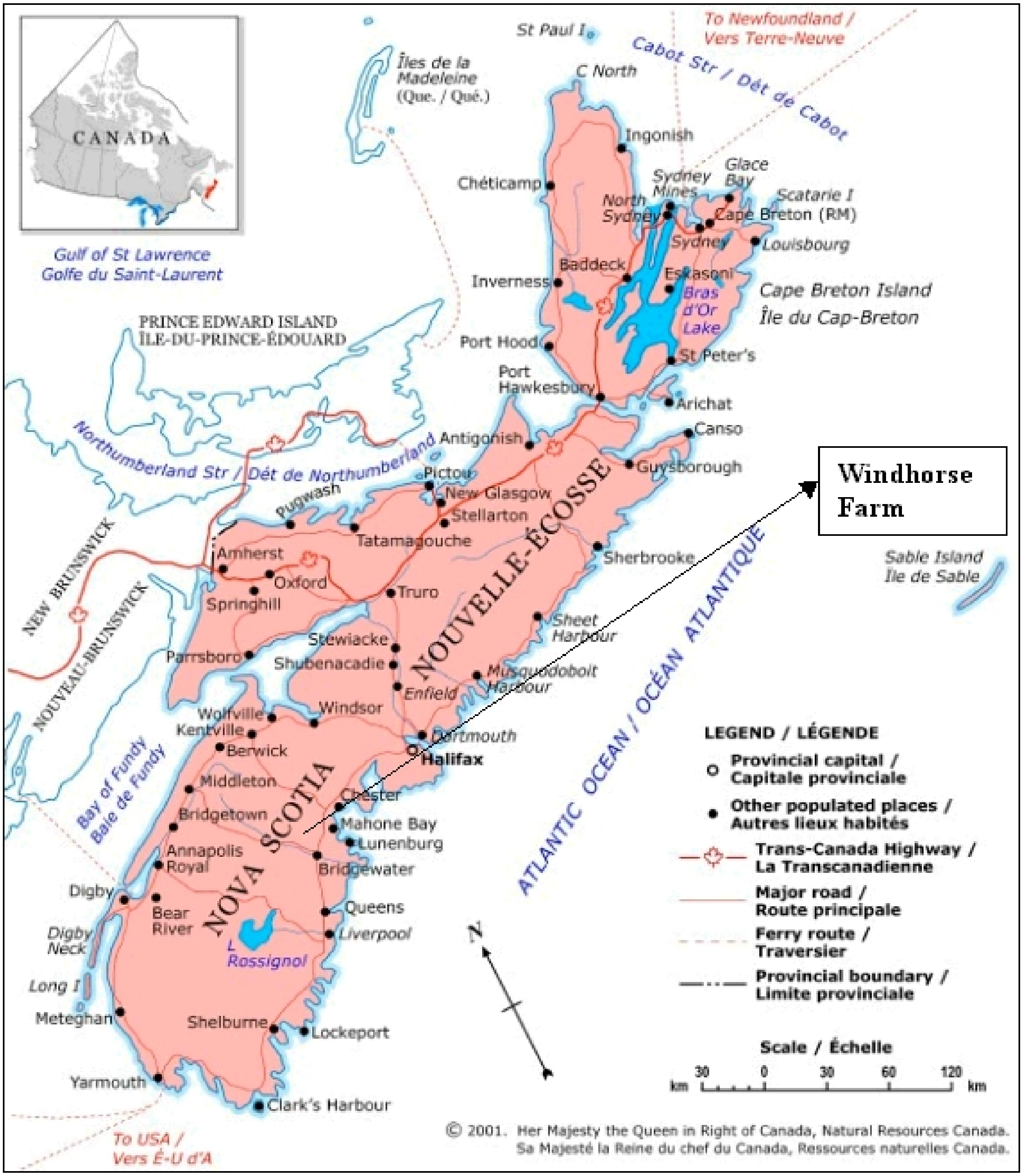
- Larry Waukau, president of MTE

PART I

CASE STUDIES

CHAPTER ONE: WINDHORSE FARM, NOVA SCOTIA

Figure 1. Windhorse Farm, Nova Scotia, Canada



The key to ecologically-based harvesting is to harvest wood without compromising the full range of vital ecological services provided by a forest and without undermining the natural systems that allow the forest to function effectively in all its aspects. This approach maintains the long-term ecological, social and economic values of a forest.

1. Introduction: The Place and the People

> *"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."*
>
> - Aldo Leopold (Leopold l987)

En route to New Germany in southwest Nova Scotia, just as the LaHave River widens into Wentzell Lake, a quick left turn takes the visitor down a picturesque secondary road, over a single-lane green iron bridge and then to Sarty Road and a place called Windhorse Farm. Upon arrival, the structural beauty of the place is immediately striking. Large timber-frame buildings dominate the roadside. A barn, woodshop, sawmill and greenhouse cluster the left side of the road and, to the right, is a rambling country house with one-hundred-year-old grapevines and gardens. But before long the visitor is struck by something else.

A short walk in the woods is enough to know one has come to a remarkable place. The forests here have been logged here every year for the last 161 years. In that time more than 8 million board feet have been cut. But from walking along one of the "logging roads," one would never know it. Horse manure and the occasional pile of bark slabs might offer a few clues. For the most part, walking through Windhorse Farm's 60-hectare woodlot is more like being in a park. The tree canopy, 30-35 metres high in some places, stretches across the road, and all the while one can hear the peaceful rushing of Sweetwater Brook that babbles past the woodshop and house and empties into Wentzell Lake.

Jim Drescher and his wife Margaret bought the 60 ha woodlot in l990 and have carried on the tradition and practices of the previous landowners, the Wentzell family. Four generations of Wentzells lived off the land and cut it using ecological principles. Drescher, with 40 years of forestry and ecology experience under his belt, learned how Carroll Wentzell sustainably managed the woodlot for so many years. "I've learned from several excellent teachers," says Drescher, who first studied forestry in Wisconsin with his father, who now manages a Forest Stewardship Council certified woodlot. Drescher then practiced forestry in the Okanagan, in Eastern Washington, and now in Nova Scotia.

When he and his wife moved to Windhorse Farm, they wanted to teach others about sustainable forestry, so they opened up The Maritime Ecoforestry School where students come from throughout North America to get a first-hand look at ecoforestry in action.

Despite the annual removal of trees, much of the forest at Windhorse Farm resembles its original sylvan magnificence. The Acadian forest, here dominated by eastern hemlocks, boasts trees as old as 450 years. Even though Windhorse Farm has been logged every year since l840 the volume, quality and value of wood remain undiminished. In fact, there have been improvements on all counts.

In the rest of the province, the picture is very different. Two hundred years of high-grading followed by an unprecedented amount of clearcutting in the last 50 years have transformed the province's forests. Today, less than 0.15% of Nova Scotia's forests are greater than 100 years old. Since the 1950s, there has been a sharp decline in forests older than 60 years old. At Windhorse Farm, by contrast, trees over 80 years old dominate 90% of the forest stands.

Of the 60 ha. Windhorse Farm property, 36 ha. has never been cleared. Tall, old trees dominate 100% of that parcel. The remaining 24 ha. had historically been cleared for pastureland. Of that, 5 ha. remains today in crops, vegetable gardens, farmland, living quarters, and space for a sawmill and other facilities. The remaining 19 ha. of woodland is in active forest restoration, with trees over 80 years already dominating 71% of that previously cleared parcel.

According to Drescher, restoration costs paid today are the costs incurred by exploitative harvesting practices in the past. As with any investment, costs go down when capital assets function at full capacity. At Windhorse Farm, all the lands are in various stages of restoration, and all profits are invested back into forest restoration.

So how is it decided that a tree is going to be cut down at Windhorse Farm? Drescher uses a technique called slow-grading. Essentially a tree is cut if it is slow growing relative to the nearby trees of the same species, but only if it has sufficient economic value. If it is one of a small group of slow-growing valuable trees the whole patch of 4 -5 trees might be cut, thus opening up a larger gap in the canopy for light penetration. Drescher says individual and group selection cutting mimics the natural disturbances (single and multiple tree fall) of the region. At Windhorse Farm the tallest trees are never cut to ensure structural diversity, and in order to maintain or increase canopy height within the stands.

If the previous owners had not had the foresight to cut sustainably, but had instead opted to clearcut the land, 2 million board feet would have been extracted in 1840. With repeated clearcuts every 50 years or so of an estimated 1.25 million board feet from the younger regenerated trees, a total of only 5.75 million board feet would have been harvested by 1990. By contrast, a total of more than 8 million board feet have been harvested at Windhorse Farm since 1840 through selection harvest methods – a far greater volume than would have been obtained from the woodlot had it been cleared every 50 years.

But the standing volume of the forest has never diminished, nor have the quality and value of the wood extracted over time. The woodlot currently has 2 million board feet of trees over 8 inches in diameter. If there had been successive clearcuts since 1840, the most recent in 1990, the Windhorse Farm property would currently be a wasteland, with successive regenerations producing wood of smaller diameter and lower value. The selection harvest method at Windhorse Farm has therefore yielded far more, and far better quality, timber than clearcutting over a 161-year period. Counting the still-standing timber today, selection harvest has yielded nearly twice the volume of wood that would have been obtained through clearcutting.

In short, harvesters at the Windhorse Farm woodlot have lived off the interest provided by the forest as a natural capital asset, without depleting or degrading the worth of the natural capital itself. Because renewable natural resources have the inherent capacity to regenerate (unlike manufactured capital, which depreciates over time by definition), there has been no depreciation of the Windhorse Farm forest. On the contrary, restoration forestry practices on previously degraded sections of the property outside the never-cleared 36 ha. parcel constitute a re-investment that has increased the value of the forested capital asset of the property as a whole.

Drescher says ecoforestry makes much more sense economically than clearcutting. In a clearcut, there are immediate profits, but the land and quality of the future forests are degraded. In ecoforestry these values are maintained. In addition, ecoforestry can provide more jobs. In total, Drescher harvests about 110,000 board feet of wood annually, some from his own woodlot and the rest from land belonging to neighbors. He purchases another 40,000 board feet and employs the equivalent of 7 full-time people at his sawmill and in the woods. According to Drescher, ecoforestry employs five times more people per unit of wood than do current industrial practices:

> *"If Nova Scotia were to move toward an ecoforestry paradigm, we could double the employment on half the harvest."*

The actual employment numbers confirm Drescher's argument. J.D Irving, for example, operating a sawmill in Weymouth, Nova Scotia, directly employs approximately one full-time person per 1000 cubic metres of wood harvested, including those at the sawmill and those contracted out for logging. Drescher employs 8 people per 1000 cubic metres of wood.

Drescher does not log the same way most industrial logging operations do either. He uses his horses, Dick and Ted. After logs are cut and browed in the woodlot, they are sawed into lumber with a portable sawmill so that all the sawdust and slabwood remain in the forest. Only lumber is hauled out. Drescher says when all the costs involved are taken into consideration, horse logging is much cheaper than mechanized logging – about half the cost, according to his calculations (J. Drescher pers. comm., 2001).

Getting into the logging business is currently a huge investment for conventional contractors. It is not unusual for someone in business as a logging contractor to be $1.5 - $2 million in debt after they have had to buy a feller-buncher or a single-grip harvester, tractor-trailer and forwarder. As logging becomes more capital intensive, pressure to cut 24 hours a day intensifies, in order to recoup the massive investment in machinery. Across Canada, more trees are being cut by fewer people, who are incurring higher and higher debt loads.

Drescher says ecoforestry is part of the answer. Costs are more manageable, and so the pressures to harvest intensively are not the same. Ecoforestry also makes sense from a long-term economic perspective because the protection of the forest soils and water, for instance, will benefit the forest of the future, increasing the quality, productivity and value of the forest. From a strictly ecological perspective, it is the only way, short of leaving the forest alone, to protect the full range of forest values.

But ecoforestry is not the whole answer. The enormous human demand for timber is likely to make it impossible to practice ecological forestry in all forests, especially if it is intended to set aside large areas of forests to serve as ecological reserves to protect the biodiversity on which life depends. A shift to sustainable forestry practices must therefore be accompanied by a reduction in demand. For this reason, a key indicator of genuine progress in the GPI is a reduction in ecological footprint, which explicitly measures the consumption side of the sustainability equation.

Drescher is convinced that our current practices are eating away at our natural capital to the point where we have a severely overdrawn account. “At some point the overdraft will have to be covered. Now or later are the only alternatives,” he says.

> “*In the Acadian Forest Region, less than 1% of the Ancient Forest remains. That means ecoforestry is 99% restoration forestry*” (Drescher l998a).

For the purposes of this report, unless otherwise stated, all charts, tables and discussion pertain to the sustainably logged 55 ha woodlot, which will be referred to as the “home” woodlot. Those 55 hectares, as noted above, include 36 hectares that have never been cleared, and 19 hectares previously cleared for pastureland and now being actively restored. The remaining 5 hectares, as noted, remain cleared and are largely used as a farm and gardens that supplies virtually all the household’s food needs.

2. Conservation and Biological Diversity

Age, structure, species, and genetic diversity are the major components of forest biological diversity. Protecting biological diversity – the variety of life in all its forms, levels and combinations including landscape diversity, ecosystem diversity, species diversity and genetic diversity – is important for the maintenance of ecosystem functions, which in turn provide life conditions essential for the survival of human and non-human organisms.

For example, the biological diversity of the world’s ecosystems provides the following essential functions and services (Wilson 2001, Chapter 7):

- provision of biomass;
- recycling of organic wastes;
- soil creation;
- fixing of vital nitrogen;
- bioremediation of chemical pollution;
- provision of genetic resources that increase crop and livestock yields;
- natural pest control;
- provision of the dominant perennial cereal grains;
- support for ecotourism;
- harvest of wild foods and pharmaceuticals; and
- sequestration of carbon dioxide.

In addition to these services, forest ecosystems also provide the following regulation functions (Wilson 2001, Chapter 7):

- regulation of local and global climate;
- regulation of runoff and flood-protection;
- prevention of soil erosion and sediment control;
- water catchment and groundwater recharge;
- formation of topsoil and maintenance of soil fertility;
- fixation of solar energy and biomass production;
- storage and recycling of organic matter;
- storage and recycling of nutrients;
- regulation of biological control mechanisms;
- maintenance of migration and nursery habitats; and
- maintenance of biological and genetic diversity.

A healthy or intact forest performs all these functions adequately, and provides all the services listed above for free. These services are analogous to interest in financial terms. In such a healthy forest, therefore, "capital" is preserved and we live off the "interest" without depleting the natural capital. It is the goal and practice at Windhorse Farm to maintain, or if necessary, restore the woodlands to a healthy natural forest – one that resembles the original forest that would have existed there prior to European settlement. Currently, the home woodlot is predominantly hemlock, red spruce and white pine, with some white ash, yellow birch, red oak, sugar maple, and others.

Balsam fir, at Windhorse Farm, is rare (Schneider l998, p.17). Drescher attributes this to the fact that balsam fir is not nearly as common in older forests. Balsam fir was always a component of the traditional Acadian Forest. But, because it is shade-tolerant (as well as being tolerant to full-sun), fast growing, and short-lived, it typically existed as an understory species. In contrast today, throughout Nova Scotia, balsam fir exists primarily as a canopy species – something Drescher attributes to clearcutting practices. In other words, balsam fir now occupies a different niche in the predominant, modern forest system than it did before colonization (J. Drescher pers. comm. 2001). In Nova Scotia, there are today 38.9 million cubic metres of balsam fir - a volume exceeded only by spruce (NSDNR l999).

In order to protect biodiversity, prohibitions are put on certain practices at Windhorse Farm including clearcutting, high-grading, low grading, and use of biocides, exotics, and genetically altered organisms. In addition, the further conversion of forested areas to any agricultural use, including Christmas tree plantations, is also prohibited (Drescher l997a).

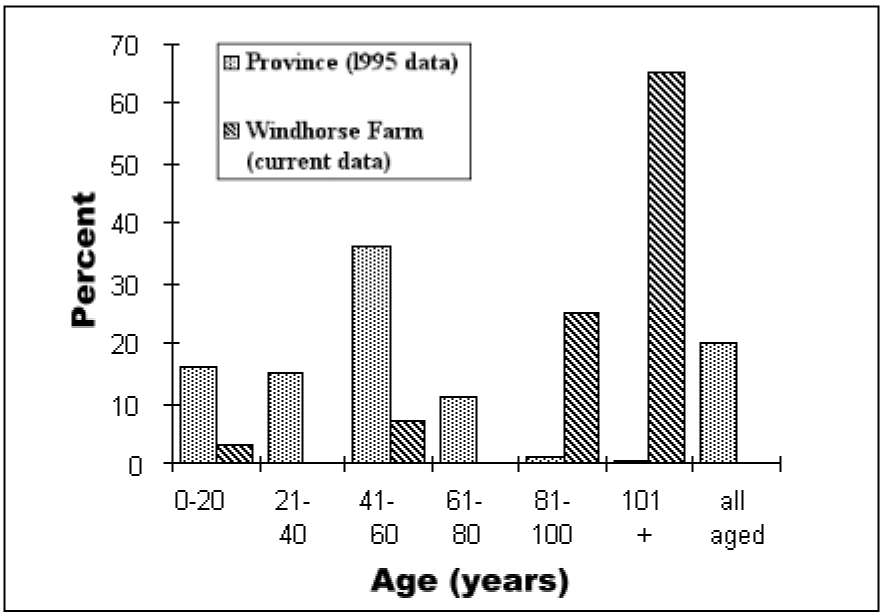
2.1 Age and Structural Diversity

According to the latest forest inventory (l999) only 0.15% of the province's forests are greater than 100 years of age. According to Lynds and Leduc (l995), while old-growth forests once dominated the landscape of Nova Scotia, by 1995, there were only 51 significant old forest sites still in existence, amounting to just 43,609 ha. in total. Regionally the situation is similar.

Within the Atlantic Maritime ecozone, only 3% of old forests (more than 120 years old) remain (CCFM, l997).

Windhorse Farm, however, is an extremely valuable representative remnant of the once extensive Acadian Forest landscape. While provincial numbers indicate declines in old as well as uneven-aged forests, Windhorse represents the reverse (Figure 2). Within the 60 ha "home" woodlot (of which 5 ha is gardens/pasture), the greatest proportion of the 55 ha woodlands (65% or 36 ha) is dominated by trees older than 101 years. As noted above, this 36 ha is the land that has never been cleared. Figure 2 includes both this 36 ha parcel that has never been cleared, and the 19 ha parcel previously cleared and now being restored.

Figure 2. Comparison of Total Forest Area by Age Class, Nova Scotia and Windhorse Farm



Sources: Wilson 2001; and Drescher, 2001.

In Figure 2 the percentages indicated for the province and for Windhorse Farm refer to the area of land on which that age class dominates. According to Ken Snow, the Manager of Forest Inventory at the Nova Scotia Department of Natural Resources, approximately 2 million stands of trees are assessed using aerial photo interpretation, and each stand is assigned an age category based on the dominant canopy layer. Similarly, at Windhorse Farm, within the most mature areas (the 36 ha never-cleared parcel), there are trees of all ages. However, trees over 101 years dominate those 36 hectares. For this reason the 36 ha parcel, representing 65% of the total wood lot area at Windhorse Farm, also accounts for the entire 65% of forest area represented in Figure 2 as being dominated by trees more than one hundred years old. All the areas have trees younger than those dominating the stand.

In the remaining 19 ha of woodlot at Windhorse Farm, 71% of the forest area is dominated by trees 81-100 years old; 20% is dominated by trees in the 41-60 age class; and 9% is dominated by trees 20 years and younger. In Figure 2, these age classes represent 25%, 7%, and 3% respectively of the total 55 ha wood lot. What this means is that when the Windhorse Farm wood lot is fully restored at some point in the future, the 101+ age class will dominate almost 100% of the wood lot.

Figure 2 also shows that 20% of Nova Scotia's forests in l995 fell under the "all-aged" category. According to Ken Snow, "all-aged" refers to those stands with more than two distinct canopy layers (K. Snow pers. comm. 2001). He says that there was an overestimate of those stands and that the real percentage should be between 17-18%. For the purposes of the Nova Scotia Wood Supply Forecast for l996-2070, the NSDNR averaged the height, and therefore the age, of each stand, and then applied these data to its forecast model. According to Wilson, NSDNR staff speculates that a large portion of these "all-aged" types of stand structure result from past high-grading practices. When this type of harvesting is conducted over several decades, what is left is a multi-layered canopy of poor quality trees. According to Wilson, the forest area in the province classified as "all-aged" has dramatically increased since l975 (Wilson 2001, Chapter 7). Overall, NSDNR seems to have great difficulty explaining the "all-aged" classification, despite its apparent increasing importance.

In Figure 2 no value is indicated for Windhorse Farm in the "all-aged" category. This is because Drescher disagrees with the current NSDNR definition of "all-aged." According to Drescher, an "all-aged" forest is a natural forest where there could be as many as seven canopy layers, whereas the NSDNR appears to be using the term to describe degraded stands.

Table 1 represents, according to Drescher, a more accurate account of the canopy and regeneration layers present within Windhorse Farm's "home" woodlot, and a more accurate use of the term "all-aged."

Table 1. Number of Canopy Layers Within Each Dominant Age Range (current data)

Age range (years)	Number of canopy layers/ age classes	Percentage (%) of "home" woodlot (55 ha)
up to 20	single –age	3
21-40	------	-----
41-60	two canopy layers	7
61-80	------	-----
81-100	two canopy layers	25
101 +	all-aged (more than 7 canopy layers)	65

Source: Drescher, 2001

Table 1 also indicates that there are no forests at Windhorse Farm categorized as between 21-40 years or 61-80 years old. This is because all wooded areas not dominated by trees more than 101 years old have previously been cleared for pasture, and because the age of each stand now reverting to forest depends on when the particular pasture was abandoned. In other words, in the 0-20 year age class stand, the pasture was abandoned in l988. In the 41-60 year age class, the pasture/field was abandoned 45 years ago. And in the 81-100 year age class, pasture was abandoned more than 80 years ago.

Provincially, there has also been a sharp decline in forests greater than 60 years old since the l950s (Wilson 2001, Chapter 7). In contrast, however, as Figure 2 indicates, trees greater than 80 years old dominate 90% of the Windhorse Farm forests. The stability of the age class distribution over time is an indication that natural capital value at Windhorse Farm is being maintained, with no diminution in valuable wide diameter and clear lumber over time. In fact, restoration is increasing the capital value of the standing timber.

While remnant old-growth forests are extremely rare in the province, they are also typically found in small, isolated stands that are often of questionable ecological integrity (Lynds and Leduc l995). It should be noted that Windhorse Farm's 36 ha (where 101 + year-old trees dominate) represents a very small area relative to the total area of the province. It cannot in any real way contribute to the overall biodiversity of the province, where biodiversity is defined as the variety of life in all its forms, levels, and combinations. It does, however, provide increasingly rare habitat for countless species of wildlife and it contributes on a local level to the biodiversity of the region. It also provides an example of what could take place provincially (and on a much larger scale) if more woodlots were treated in the same manner.

This caveat indicates that sustainable forest management is clearly not the whole answer to the maintenance of ecological integrity in Nova Scotia. No matter how admirable models like Windhorse Farm are, they do not constitute a substitute for protected areas. Nova Scotia still needs to complete a representative system of protected areas, that alone is capable of ensuring the protection of biodiversity at the landscape level.

In the last forty years, there has been a 12-fold decline in forests greater than 80 years old in Nova Scotia. Eighty to 100 year old forests have declined in distribution from approximately 16% in l958 to about 0.9% in l995. Forests over 101 years have declined from approximately 8% in l958 to 0.15% in l995 (Wilson 2001, Chapter 7). In contrast, it has been noted that 90% of the total forest land managed at Windhorse Farm is dominated by trees over 80 years old. That is, the vast majority of the Windhorse Farm forest area can be classified under the broad category of "old forest classes."

Despite this, Drescher says that only 5 ha of his woodlands resemble what he calls "true old-growth forest," (classed as "virgin old-growth forests" by Lynds (pers. comm. 2001)). Drescher defines this true old-growth as "having never seen an axe." True old-growth, according to Drescher, only exists in those areas that have been protected from harvesting and other anthropogenic disturbances for over 1,000 years. At Windhorse Farm, there are stands that exhibit the characteristics outlined in each of the following categories, as described by Lynds and Leduc (1995) in Table 2 – mature climax, immature old-growth and mature old-growth.

Although Drescher's own definition of "old-growth" is strict, significant portions of the Windhorse Farm woodland exhibit all the structural attributes of old-growth forests as discussed by Lynds and Leduc in Table 2, even though logging has taken place there. Table 3 shows the composition of these different old forest categories at Windhorse Farm by detailing the percentage distribution of different tree species within stands that correspond to those categories. Twenty-five percent of Windhorse Farm's woodlands fall under the "mature climax" category (the pasture land that was abandoned more than 80 years ago) and 65% under a combination of "immature" and "mature old-growth" (the 36 ha parcel that was never cleared.) It can be seen that hemlock, red spruce and white pine dominate both classes of forest, with the old-growth portion dominated far more extensively by hemlock, and the previously cleared portion dominated more extensively by red spruce.

As trees die, they fall down, creating gaps in the canopy. These gaps are rapidly filled by seedlings and smaller trees in the understory, as well as by adjacent trees. Over time, this leads to a diversity of tree sizes, canopy layering, accumulation of deadwood (snags and coarse woody debris) and the creation of multiple and diverse microhabitats. This progression results in a structurally diverse and biologically rich forest ecosystem (Lynds and Leduc l995).

Table 2. Structural Attributes of Old Forests in Nova Scotia

Structural Attributes	Mature Climax 80 - 125 yrs.	Immature Old-Growth 100-200 yrs.	Mature Old-Growth 150 + yrs.
Diameter Size	Dominated by larger diameter classes for appropriate species and site	Still dominated by many larger diameter stems but smaller diameter classes clearly evident	Composed of largest diameter class but in many instances occupying only small portion of area (20-50%)
Upper Canopy Density	High density with little light penetration for regeneration establishment and growth	Relatively high density with small canopy openings beginning to form	Mosaic of different densities
Layering	None, other than seedlings on ground	Beginning to show initial understory layering, mostly confined to small canopy openings. Seedling/sapling layer rather distinct.	Due to extreme variability in density of upper canopy, a mosaic of layering occurs - with a multi-layered forest.
Coarse Woody Debris (CWD)	Smaller diameter dead stems as a result of intense competition during stem exclusion phase, usually of earlier successional species and/or severely stressed climax species	With opening of canopy, stand beginning to accumulate CWD consisting of larger diameter snags and downed logs.	As even larger and older trees begin to die off, greater amounts of larger diameter CWD accumulate.
Micro-habitats	Very limited due to lack of structural diversity.	As a result of initiation of vegetation layering and CWD accumulation, different microhabitats begin to form.	With establishment of multi-layering, large old trees, and large amounts of CWD accumulation, many microhabitats are created within the tree canopy and on the ground. Results in increased general biodiversity.

Source: Lynds and Leduc, l995.

Table 3. Old Forest Classes - Windhorse Farm

Tree species	% distribution of tree species within stands that fall under "mature climax" category	% distribution of tree species within stands that fall under "immature" and "mature old-growth" categories
*eastern hemlock	10	35
*red spruce	35	20
white spruce	3	1
*white pine	15	15
*sugar maple	1	5
*yellow birch	4	6
*beech	3	5
white birch	5	1
red maple	4	2
red oak	3	2
white ash	3	2
balsam fir	2	2
large tooth aspen	2	1
tamarack	2	1
hop hornbeam	<1	<1
striped maple	<1	<1
black spruce	<1	<1
red pine	<1	<1
gray birch	<1	<1
black cherry	<1	<1

Note: * Long-lived shade-tolerant species

Source: Drescher, 2001

Nova Scotia Department of Natural Resources data indicate that the province has lost almost all of its old trees in the last 40 years alone, with old trees mostly being replaced by young smaller trees. This trend can be linked historically both to "high-grading" where the biggest and the best trees are taken, leaving behind smaller and poorer quality wood, and to clearcutting (Wilson 2001, Chapter 7).

In an attempt to "maintain old forests in the forested landscape" of Nova Scotia, the NSDNR has developed an "Interim Old Forest Policy," which is to "set aside the best remaining old forests and old forest restoration opportunities while a more comprehensive old forest policy is developed." According to the policy, old-growth is defined as any forest stand that has a minimum of 30% crown closure and 50% climax species[1], and in which at least 30% of the stand is 125 years of age or older. The policy states that NSDNR staff are to "set aside as old-growth 8% of Crown land in each landscape." However, the policy also recognizes that this goal may not be met entirely on Crown land and should include "an effective strategy for involving private landowners in the stewardship of forests" (NSDNR 2001a.)

[1] Climax species include hemlock, red spruce, white pine, sugar maple, yellow birch, and American beech.

However, while the "interim policy" might be a step in the right direction, it may not override the "previous commitments" of wood made to the forest industry. For instance, the Minister of Natural Resources, Ernest Fage, announced in August of this year that he would only consider conserving an old-growth wilderness region at Ship Harbor-Long Lake on the Eastern Shore, after the forest products company, Kimberly Clark, submitted its forest management plan for the crown land. Kimberly Clark will be allowed to put a road into the area and has stated that it would be ready to cut in about a year's time. The wood is required to feed the company's Pictou pulp mill. In sum, it is possible that the NSDNR's new policy to set aside old growth stands will be undermined by its commitments to the forest industry.

At Windhorse Farm, harvesting practices (to be discussed in detail in Section 3) on the "home" woodlot within the last 160 years have ensured that good quality trees with strong genetic properties are left standing. This again contrasts sharply with provincial trends.

The original Acadian forests of Nova Scotia comprised climax softwood, mixed, and hardwood forests. All climax forests dominated by long-lived, shade tolerant hardwoods and softwoods have declined dramatically in certain parts of the province since European settlement.

According to the NSDNR l999 Forest Inventory Data, the long-lived shade-tolerant eastern hemlock, for instance, currently comprises less than 2% of the total merchantable volume of softwoods on all forest lands in the province. By contrast, according to the forest inventory of thirty years ago it made up 5% of the total merchantable volume of softwoods in the province.

Similarly, the same 1999 inventory indicates that intermediate and tolerant hardwoods currently make up 32% of the total merchantable volume of hardwoods. This is in sharp contrast to thirty years ago, when mid-tolerant and tolerant hardwoods comprised just under 50% of the total merchantable volume of hardwoods (NSDNR l973).

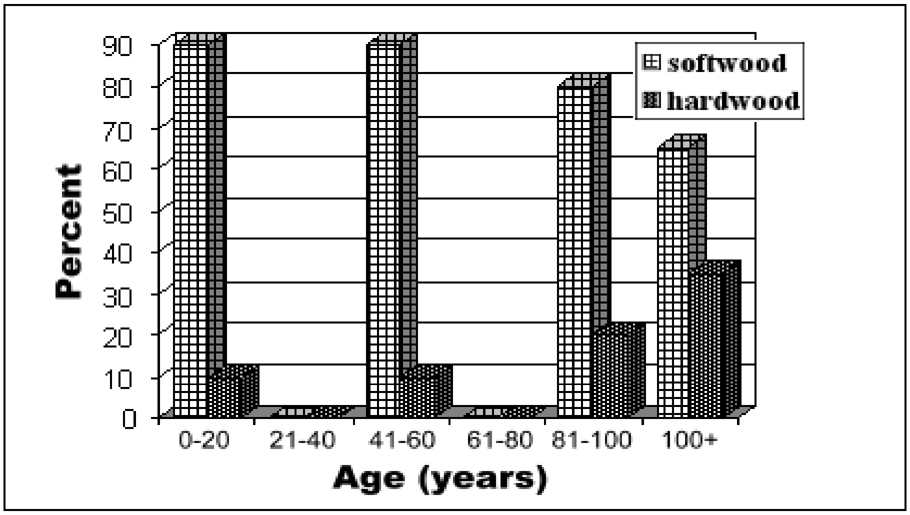
> "*This is a critical issue from an economic point of view, because early-successional deciduous species are less valuable economically. The province is converting land to spruce and fir plantations – not what the original Acadian forest looked like at all.*"

-Jim Drescher

At Windhorse Farm, 87% of the softwoods and 96% of the hardwoods are over 61 years old. This is in sharp contrast to the situation in the province where less than 13% of softwoods and hardwoods combined are over 61 years of age (Wilson 2001, Chapter 7). Both the hardwood and softwood components of the Windhorse Farm wood lot are dominated by high-value species such as hemlock, red spruce, white pine, white ash, red oak, sugar maple and others. Figure 3 shows the proportions of softwoods and hardwoods within each age class at Windhorse Farm.

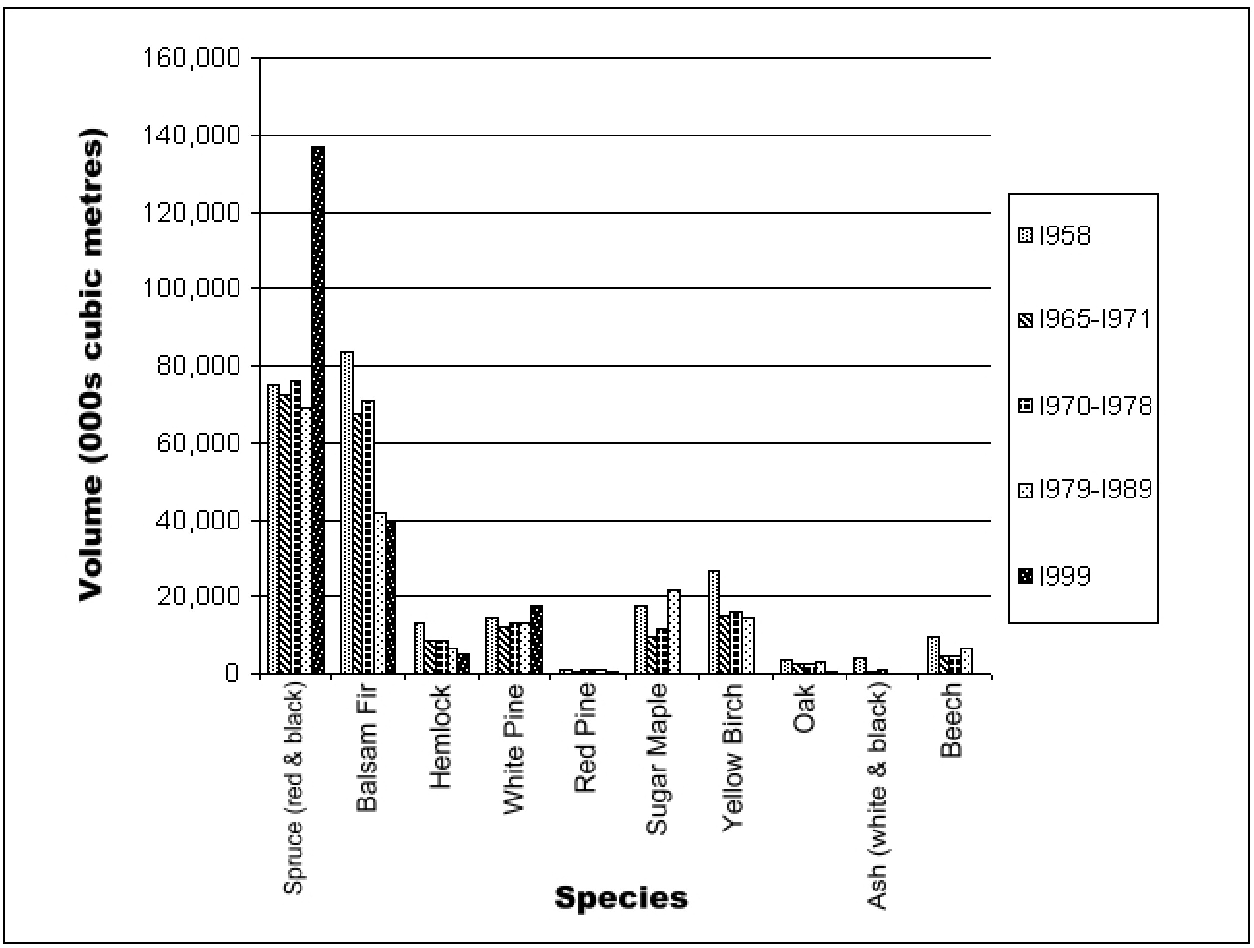
The tree species represented within the 101+ age category are mostly long-lived shade tolerant species such as eastern hemlock, red spruce, sugar maple, yellow birch and beech. By contrast, on a provincial level, some of these species (hemlock, yellow birch, beech) have declined significantly in the last 40 years. Figure 4 illustrates how the gross merchantable volume of a selection of tree species has changed over the last thirty years.

Figure 3. Windhorse Farm Forest Area by Age Class and Cover Type



Source: Drescher, 2001

Figure 4. Gross Merchantable Volume of Selected Species (000s m^3)



Source: NSDNR 1999, 1991, 1979, and 1973.

In Figure 4, no values are given for sugar maple or yellow birch for l999 because the forest inventory gave overall volume figures for hardwoods but did not give specific values for either of these species, as previous inventories had. In addition, in l999 there were 45,000 cubic metres of white and black ash. The value is so small it does not register on the chart for that year. No value was given for ash species in l989.

2.1.1 Level of Fragmentation

One characteristic of an intact forest ecosystem is continuous or relatively continuous crown closure. When there is a break in the canopy (for example, where a road is punched through the forest), "edge effects" are produced (discussed in detail in Chapter 2, Section 5.1.1) which impact on the surrounding fauna and flora. At Windhorse Farm, fragmentation of ecosystem components has been minimized with the use of various "organic" techniques in road building. The extensive "road" system essentially consists of 8-foot wide trails, which are covered with slabwood, shavings and sawdust from the logging and milling operations.

According to Drescher, no productive forest is lost to the roads, and the roads are so narrow that they do not fragment the forest or create edge effects. With the tallest trees at Windhorse Farm in the 30-35 metre range, the tree canopy closes over the roads, and the root masses and communities of soil organisms persist beneath the road surface (J. Drescher pers. comm. 2001).

This is in sharp contrast to the impact of typical logging roads in the province, which create openings large enough to cause significant edge effects. The Nova Scotia Department of Natural Resources does not have information regarding fragmentation and/or connectedness of forests (Wilson 2001, Chapter 7). We do know, however, that most forests in Nova Scotia are within a kilometre or two of a road. Thus, fragmentation of the province's forests can be assessed as high, and the ecological integrity correspondingly low (Wilson 2001, Chapter 7).

In Nova Scotia, species that are vulnerable to forest fragmentation include:

- songbirds, such as the northern parula warbler and black-throated green warbler;
- birds-of-prey, like the northern goshawk; and,
- mammals, including the pine marten, lynx, and fisher.

In addition, although provincial data on average heights for each of the two million stands in the province (crown and private land) are available based on aerial photography, no overall provincial average has been calculated. Ken Snow, NSDNR's Manager of Forest Inventory, estimates the average provincial canopy height to be between 13-15 metres (K. Snow pers. comm. 2001), substantially less than that at Windhorse Farm.

At Windhorse Farm, canopy height and canopy closure are two key indicators of ecosystem health that are amenable to effective management. Drescher recommends the maintenance, or if necessary, restoration of canopy closure to expected historical levels. The goal, he says, is to maintain at least 60% canopy closure within any stand, with no canopy gaps greater than onetenth of a hectare. Within the 36 ha that has never been cleared, the canopy is multi-layered with variable closure ranging from 70-95% (J. Drescher pers. comm. 2001).

In addition to the canopy closure and organic, non-intrusive nature of the road system, fragmentation at Windhorse Farm is minimized by the building of slab walls, which mimic coarse woody debris or brush walls called Benjes Hecken (named after Hermann Benjes of Germany whose name became synonymous with the technique). He popularized these brush walls as “fingers of the forest” that act as connectors between fragmented forests. Brush piles are not part of a natural forest, but are a human construct of long piles of treetops and branches arranged in such a way as to provide windbreaks, fences, islands, and most importantly, wildlife corridors (Drescher l998b, p. 5).

These hedges, constructed from natural materials, provide habitat for many wildlife species that could not otherwise live in a field. Amphibians, snakes, small mammals, insects, spiders, and birds take up residence in the brush walls almost immediately upon completion. This technique is especially conducive to a combined farm/woodlot operation, like Windhorse Farm, where forested areas may be fragmented by small fields used for pasture or gardens.

2.1.2 Protected Areas

Windhorse Farm operates in accordance with two basic principles and objectives: 1) to protect; and 2) to restore. Windhorse Farm has set aside protected areas next to riverbanks and other sensitive areas, including steep slopes, sensitive soils, rare plant locations, and wetlands. Corridors between watersheds are also protected. Sensitive areas amount to 10 ha (or 18%) of the 55 ha of operable forest land at Windhorse Farm. Logging is prohibited in these areas. These allocations contribute to maintaining and protecting all forest values in the wood lot as a whole.

In Nova Scotia, 80 natural landscape types have been identified, each characterized by distinctive local environmental and biotic factors. Currently, 30% of Nova Scotia’s natural landscapes are represented in the province’s network of protected areas. Provincially, only 8.4% of the total landbase (including federal and provincial lands) is under some form of protection.

2.2 Species Diversity

Red and black spruce currently dominate NS forests (137.1 million cubic metres or 35.3% in l995) (NSDNR l999). Many other species are in decline. For example, eastern hemlock, white and red pine, and black ash have all declined in range and/or volume since historical times, and inventories indicate a sharp decrease in the province’s merchantable beech and oak trees in the last 40 years alone.[2] Table 4 lists some of the tree species found at Windhorse Farm. As was noted earlier, eastern hemlock, red spruce, white pine, white ash, red oak, and sugar maple dominate.

[2] See Volume 1, Section 7.2.1 (Wilson 2001) on changes in inventory methods that may account for part of the measured decline in oak and beech, and Chapter 4, Section 3.4 in this volume on declines in merchantable beech due to beech bark disease.

Table 4. Tree Species Found at Windhorse Farm

Softwood	Shade -tolerant hardwood	Mid-tolerant hardwood	Shade-intolerant hardwood
red spruce white pine eastern hemlock balsam fir	sugar maple beech	yellow birch red oak white ash	red maple white birch willow gray birch

Source: Drescher 2001

Four major tree species that occur in Nova Scotia now occupy less than 50% of their original range: white pine, red pine, red spruce and eastern hemlock (Wilson 2001; Mosseler *et al.* 2000). All of these species are present at Windhorse Farm in varying degrees, and three of them are abundant. Of the four, only red pine is fairly rare.

According to Drescher, eastern hemlock is the most common tree species in the forest areas over 100 years old at Windhorse Farm. Red spruce is the second most common species in most older stands and the most common in stands dominated by trees 61-100 years old. White pine is common in all areas, and comprises about 15% of the Windhorse Farm tree species (J. Drescher pers. comm. 2001).

The primary reason for the abundance of valuable species, several of which are declining in other parts of the province, is adherence to certain fundamental principles that guide forest management with regard to forest species diversity at Windhorse Farm:

1) No cutting of tree species that are under-represented (by historical reference point) in the stand.
2) Maintain, or, if necessary, restore tree species diversity to a "natural forest" species composition appropriate to the site.
3) Maintain or restore indigenous tree species appropriate to the site in relative frequencies similar to those in the original Acadian forest.

Several species of forest-dependent flora and fauna are rare in Nova Scotia today, their decline possibly related to the loss of old-growth forests in the province. Not enough is currently known about the magnitude of this species loss in Nova Scotia. However the southern flying squirrel, wood turtle, and Bicknell's thrush - all forest-dependent species - are currently listed as "vulnerable" (at risk because they exist in low numbers or in restricted ranges, due to loss of habitat or other factors). In addition, the pine marten, black-backed woodpecker, and the barred owl have been reduced to occupy only a small portion of their former range (Wilson 2001, Chapter 7). All of these species require old-growth forests (150+ years old) to flourish.

As noted, in the last 40 years, forests over 100 years old have declined in distribution from 8% in 1958 to 0.15% in 1995, and forests over 80 years old declined from 16% to less than 1% (Wilson 2001). The remaining 80+ year old forests have continued to be heavily cut since 1995. As such it is not surprising that old-growth-dependent species are also in decline across the province.

Because of the extraordinary condition of the Windhorse forest, rare species such as the barred owl and pine marten can be found there. There are also northern goshawk (the largest North American true hawk), and peregrine falcon (listed as "threatened" in NS), a species that used to be widespread across North America, but was virtually eliminated by the widespread use of organochlorine pesticides (DDT) following the Second World War (Farrand l988, p. 231). As well, Drescher says several species of stubble lichens, an indicator of old-growth forests, can be found at Windhorse Farm.

The abundance of large diameter trees at Windhorse Farm ensure the provision of habitat for many of the cavity-using wildlife species listed below in Table 5.

Table 5. Minimum Tree Diameter for Cavity-Using Wildlife Species in the Maritimes

<8"	6-12"	12-18"	>18"	>24"
Black -capped chickadee* Downy woodpecker* Boreal chickadee* Red-breasted nuthatch Winter wren Deer mouse White-footed mouse Red-backed vole *** primary cavity excavators**	Black-backed woodpecker* Northern three-toed woodpecker* Hairy woodpecker* Yellow-bellied sapsucker* House wren White-breasted nuthatch Brown creeper Chimney swift Great crested flycatcher Tree swallow Eastern bluebird House sparrow Starling Southern flying squirrel Northern flying squirrel Ermine	Northern flicker* Boreal owl American kestrel Northern saw-whet owl Purple martin Northern long-eared bat	Pileated woodpecker* Wood duck Common goldeneye Hooded merganser Common merganser Barred owl Silver-haired bat Keen's myotis Eastern Pipistrelle Small-footed bat Red squirrel Grey squirrel Porcupine American pine Pine marten Fisher Long-tailed weasel	Little brown bat Big brown bat Red fox Raccoon Black bear

Source: O'Brien, 2000

Brian Starzomski, of NSDNR's Wildlife Division, acknowledges that a major shortcoming of the current system of deadwood measurement in the province is that large cavity trees (required by species such as the barred owl and pileated woodpeckers) are not currently identified and measured separately from the total deadwood component. The definition of "deadwood" encompasses snags and dead debris of all sizes, and so it is not currently possible to find data indicating the abundance of large-sized snags (B. Starzomski pers. comm. 2001).

Because of the importance of this indicator for preservation of species diversity, GPI Atlantic recommends that this distinction be made in future deadwood inventories in the province. (See Section 2.4 below for further discussion of the importance of deadwood to forest health.)

2.3 Genetic Diversity

> *"We cannot even estimate the number of species of organisms on Earth to an order of magnitude, an appalling situation in terms of knowledge and our ability to affect the human prospect positively. There are clearly few areas of science about which so little is known, and none of such direct relevance to human beings."*
>
> **-** Peter H. Raven, Global Biodiversity Strategy

According to the Canadian Biodiversity Strategy (l995) only 50% of Canada's species have been discovered, named and classified. On a global level, the number of species on the planet has been estimated at somewhere between 10 and 80 million different species, out of which only 1.5 million have been discovered, named and classified (McAllister l992 p. 29.) At the species level, there are many well-developed inventories especially for harvested species, but there are large gaps in our knowledge about organisms more difficult to observe and classify, such as insects, viruses, bacteria, fungi and protists.

When it comes to genetic diversity, even less is known. Sets of genes, called genomes, are what distinguish one species from another and allow variation within species. These genetic sets have been selected by evolution over thousands or millions of years and they enable a species to adapt to its natural environment. Genetic diversity is also vital in ensuring resilience – the capacity to recover from disturbances. Two hundred years of high-grading in Nova Scotia means there has been a long-term depletion of the genetic traits of the most desirable timber trees.

Data were not available for the genetic diversity at Windhorse Farm. However, it would be fair to assume that Drescher's efforts to maintain species diversity in age, structure and cover type would also contribute positively to enhancing genetic diversity and in turn creating a more resilient forest.

2.4 Deadwood - The Life of the Forest

According to Aaron Schneider, "deadwood is really the life of the forest and trees must die naturally to provide the snags and large dead-falls that make food and shelter for animals and contribute to water and nutrient cycles and the regeneration of vegetative richness" (Schneider l998, p. 18).

Deadwood is therefore a critical indicator of ecosystem health. It is very complex and difficult to measure accurately but at Windhorse Farm, Drescher has attempted to do just this. Standing dead trees and deadfalls are left alone at Windhorse Farm. Drescher's objective is for 20%[3] of the coarse wood in any given stand to be dead.

After studying the home woodlot over the last eleven years, Drescher believes the deadwood component in the woodlot is currently only 10% of the total coarse wood, and is therefore deficient. This deficiency tells him that the home woodlot is being over-harvested and, as of this year, harvesting will be cut in half. Harvesting will be reduced from 60,000 board feet/year to 30,000 board feet/year for at least the next 10 years. Drescher will do the same on all the lands he manages (190 ha in total).

Drescher says:

> *"I believe there are five critical indicators of ecological diversity that we can measure and for which we can manage. If these indicators (tree species diversity, canopy height, canopy closure, deadwood, and protected landscape corridors) are positive, it is likely that ecological diversity will be optimized. In the case of our woodlot, the first three are OK, the fourth is deficient, and the fifth, while inadequate at the landscape level, is beyond the control of current management.*
>
> (J. Drescher pers. comm. 2001)

No estimate is currently available for the percentage of deadwood in Nova Scotia's forests. In Nova Scotia, deadwood has been measured on permanent sample plots as part of the Forest Inventory Permanent Sample Plot Program (NSDNR 2000b). Data have been collected from a set of approximately 2,000 randomly located circular plots with a radius of 15 metres and 0.04 ha in size. In addition to an inventory on the number of trees and their age, species, and height, the amount of dead standing vegetation and coarse woody debris (CWD) on the forest floor has also been measured.

According to Brian Starzomski of NSDNR's Wildlife Division, a study conducted at the University of New Brunswick to analyze the deadwood data from the sample plots is not currently usable. Starzomski says the data collection did not include plots where there was no CWD, "thereby biasing the numbers up." Too few plots were measured overall to break down the data adequately by regions within the province, he adds. More data need to be collected over the next few years before a valid analysis can be released (B. Starzomski pers. comm. 2001). These data, says Starzomski, have never been analyzed before by the NSDNR. Because of the vital importance of this indicator for forest ecosystem health, GPI Atlantic recommends that adequate data collection and analysis of this information be given high priority.

Starzomski was able to collect information on the percentages of deadwood found in various "old-growth" stands in the province. He says the percentages vary because "forests are extremely

[3] Drescher's deadwood objective of 20% applies to a managed forest. Based on his own frequent forays into an old-growth stand owned by Bowater Mersey near Lake Rossignol, he estimates the natural deadwood component of an (unmanaged) old-growth forest to be 25-30%.

dynamic and complex assemblages of many species, and thus the characteristics of a forest in one part of the province can be very different from another stand somewhere else."

Table 6 lists twenty-two old-growth stands in the province and their corresponding deadwood component. The numbers in the last column represent the percentage of the total volume of the forest that is in downed coarse woody debris. In other words, if there are a total of 100 m^3/ha in the forest, with 75 m^3 standing and 25 m^3 dead, then the CWD proportion would be 25%.

Table 6. Percentage of Deadwood in Nova Scotia Old-Growth Stands

Old-growth stand	Dominant species: TH: tolerant hardwoods RS: red spruce WP: white pine HE: hemlock	Percentage of deadwood or Coarse Woody Debris (CWD)
Sixth Lake	He	25
Pollards	He	30
Big Pine	WP	10
Sporting	He/WP	39
Lamb Lake	TH	15
Blomidon	TH	51
Cambridge	WP	5
Lumsden	RS	9
Silvery Lake Island	He	38
Delaney	TH	17
Dunakin	TH	50
Inverness	TH	33
Inverness	TH	2
Inverness	TH	49
Inverness	TH	9
Inverness	TH	12
Pictou	TH	26
Pictou	TH	19
Londonderry	TH	27
Kings (post-cut)	TH	42
Colchester	TH	17
Colchester	TH	4

Source: Starzomski, 2001.

According to Starzomski, there are a number of reasons that could explain the very wide range in percentages from 2% to 50%:

> *"There is a large range in these numbers, and this can arise from a variety of factors such as time to last disturbance (i.e. fire, defoliator attack, hurricane), edaphic factors (depth of soil, type of soil), topographic (elevation, amount of regional variation in elevation), organisms present (porcupine, wood rotting fungi), and frequency of disturbance, to name just a few, can cause widely different forest structures over a short distance."*

(B. Starzomski pers. comm. 2001)

In addition, says Starzomski, softwood stands tend to contain a greater proportion of their total volume in downed wood because softwoods, such as spruce, fir and pine, take longer to decompose than would a similarly sized hardwood tree. While there are natural factors that account for the variance in numbers, Starzomski says anthropogenic disturbance may also play a role. In those stands where very little deadwood remains (i.e. Inverness, 2%), low-grading or the removal of CWD and snag trees may have been practiced, which would account for the very low percentage, says Starzomski. According to Starzomski, the stand referred to as Kings (post-cut) with 42% deadwood, was selectively logged.

Both Starzomski and Tony Duke, also a biologist with NSDNR's Wildlife Division, agree that the measurement of deadwood needs to be improved to take into account the different cavity sizes. In addition, while there is a general sentiment that not enough is known regarding the importance of deadwood in the health of a forest, there is also general agreement that deadwood is in short supply province-wide. The proposed Wildlife Habitat Management Regulations (NSDNR 2000a) recognize this shortage and require that:

- Where an owner clearcuts or permits the clearcut of more than three hectares of forest land, the owner shall ensure that ten trees for each hectare cut are left standing.
- Trees required to be left standing shall be clumped together at not less than thirty trees per clump.
- The owner shall leave distributed throughout the area 150 metres of freshly cut tree boles for each hectare cut.
- Tree boles left shall have an average diameter equal to or greater than the average diameter of the trees within the stand being harvested.

Duke says the proposed regulations are a "good start," but admits that it will be difficult to assess whether the regulations are being implemented and working (i.e. increasing deadwood) due to shortages in staff and funds.

The importance of deadwood should not be underestimated, he says. At least one-third of all vertebrate species in Nova Scotia require a dead tree in some part of their life cycle, says Duke. "That's just vertebrates. When we start looking at invertebrates, soil organisms, lichens, and mosses, the number is much higher" (T. Duke pers. comm. 2001).

3. Preserving and Improving Forest Ecosystem Health and Productivity

3.1 Incidence of Disturbance and Stress

In the following sections, this report will focus on the incidence of human-induced disturbance and stress to the forests of Windhorse Farm (as opposed to natural disturbances). In particular, the removal of wood will be discussed in detail.

3.1.1 Annual Removal of Wood Products

Past Removal of Wood Products

On the 60 ha home woodlot, 5 hectares consist primarily of a house and gardens/pasture, and another 5 ha of recently abandoned pasture (1988) are occupied by young stands with no merchantable timber. Therefore, in total there are approximately 50 ha of operable forestland. As well, Drescher manages and harvests wood from other nearby lands, including 40 ha belonging to one neighbour, and another 90 ha near Sherbrooke Lake. He is also the consulting forester on another 90 ha where he does not do the harvesting himself, but buys the logs that are cut from that property. In total, therefore, Drescher manages and harvests 190 ha of land, cuts approximately 110,000 board feet of wood annually, and purchases another 40,000 board feet – a total of 150,000 board feet.

The home woodlot has been managed using ecological principles for 161 years. In l840 it contained 2 million board feet of merchantable standing stock (> 8” diameter at breast height). Today, this volume remains the same and, indeed, has never substantially diminished (Wilson 2001, Chapter 12).

The current annual growth on the Windhorse Farm home wood lot is 100,000 board feet (or 5% of the merchantable standing stock). An average of about 50,000 board feet, which is 50% of the current annual growth, or 2.5% of the merchantable standing stock, have been harvested each year for the past 161 years. In recent years the harvest has been about 60,000 board feet. In total, more than 8 million board feet have been harvested over this same time period.

If the previous owners had not had the foresight to log sustainably and had opted instead to clearcut the home woodlot, 2 million board feet would have been extracted in l840. With repeated clearcuts every 50 years of an estimated 1.25 million board feet (calculations based on mean annual increments of natural regeneration) up to the year l990, a total of only 5.75 million board feet would have been harvested. In addition, the timber value of the current forest would now essentially be zero, given that there would be no merchantable wood present on the woodlot as a result of the latest l990 clearcut.

The approximate total volume of wood harvested through selection methods over 160 years (more than 8 million board feet) plus the current volume on the woodlot (2 million board feet) gives a total volume of more than 10 million board feet. This is nearly twice the volume that would have been obtained from the woodlot had it been clearcut every 50 years.

In other words even from a strictly commercial "timber only" point of view that accounts for no ecological or social benefits, substantially fewer board feet would have been extracted through clearcutting. In addition, four successive clearcuts would have substantially reduced all other forest values including water quality, soil quality and future forest productivity. Clearcut operations would also not have provided any long-term job security to members of the local community who have found steady work at Windhorse Farm.

Current and Future Removal of Wood Products

Based largely on the percentage of deadwood within the home woodlot, Drescher has decided to reduce his annual harvest by 50%. Starting this year (2001) he will be harvesting 30% of the annual growth increment (down from 60% in recent years), which translates to 30,000 board feet (down from 60,000 board feet). He will be applying this reduction to all his managed lands (l90 ha).

This reduction in harvest levels will remain in place for at least 10 years, or until the deadwood component in the woodlot more closely approximates old-growth conditions. As such he will be foregoing harvesting revenues in order to invest in the ecological sustainability and long-term economic viability of his woodlands.

> *"I have not seen any woodlot in the province that I think should be harvested above this rate. I used to believe Nova Scotia's forests were being harvested at twice the sustainable rate. I now believe harvesting should be reduced to one-third of the current cut."*
>
> -Drescher, January 21, 2001

3.1.2 Harvesting Practices

The key to ecologically-based harvesting is to harvest wood without compromising the full range of vital ecological services provided by a forest and without undermining the natural systems that allow the forest to function effectively in all its aspects. This approach maintains the long-term ecological, social and economic values of a forest.

Slow-Grading Selection Method

According to Drescher there are four things one can do to a tree: 1) leave it, 2) girdle it, 3) prune it, or 4) harvest it. A highly simplified explanation of the harvest selection method at Windhorse Farm follows (Drescher l997c, p. 5).

At Windhorse Farm it is appropriate to harvest a tree when:

1) It is slow-growing relative to the adjacent trees of the same species. In other words, if the green crown is small relative to the height of the tree, then it is slow growing and is showing reduced health and vigor in comparison to the surrounding trees.
2) It has sufficient economic value (i.e. a relatively high value-to-biomass ratio for the portion of the tree that will be removed from the stand).
3) The tree is poorly formed, but still has significant financial value, *and* the tree is competing for light with other more valuable trees that will remain in the stand.
4) If it is one of a small group of slow-growing valuable trees which, when all removed, would open up a light patch of the size resulting from a natural multiple tree fall.

Windhorse Farm has several provisos to these general harvest practices. Even if some of the above criteria are met, the tree cannot be cut if:

- It is the tallest tree in the group;
- It has relatively little economic value; and
- It is of a species under-represented in the stand.

Group selection mimics the natural process of an occasional large tree falling and taking out several others with it, thus opening a larger gap in the canopy and opening up areas for light penetration. This encourages the regeneration of less shade-tolerant species such as white pine. At Windhorse Farm the tallest trees are never cut, even if dead. These trees increase the canopy height and structural diversity of the stand.

Group selection (patch cutting) can also be used to restore diversity in a simplified woodlot where a species is under-represented. Four or five trees may be removed from around a tree that is unable to regenerate in the shade of the existing canopy. According to Drescher:

> *"These selection methods mimic the non-catastrophic natural disturbance regimes of this region and ensure that natural seeding, from the old trees that have been protected throughout the woodlot, will provide for the continued regeneration of the forest."*
>
> (cited in Schneider l998, p. 19)

The slow-grading technique, which was also practiced by the land's previous owners, the Wentzell family, has both economic and ecological benefits. The resulting forest is diverse in age, species, and structure, which in turn adds to the quality and value of the merchantable wood (see Chapter 8 - Forest Timber Values).

Sustainable harvest practices also take into account appropriate times and seasons. To protect forest ecosystem health and the wide range of forest functions, winter is the optimal time for harvest, because the ground is frozen and the snow cover affords the greatest protection to the soils and undergrowth. By contrast, in Nova Scotia, industrial logging takes place all year long, with little or no regard paid to the saturation or compaction of the soils.

At Windhorse Farm, two horses (Dick and Ted) pull the logs to log yards within the woods where they are sawn from spring to fall. Thus, only sawn boards are carted out of the forest, while the remains are used to build the narrow woods roads and trails, as well as slabwood walls that mimic CWD.

According to Drescher, “low grading,” or the practice of harvesting the least valuable trees or the cheapest biomass (the opposite of high-grading) is also problematic because it can lead to a lack of deadwood in the stand. One would also have to take a substantial amount of biomass out of the forest to make any money and this also depletes the biological material at the site.

Low impact forestry in New Brunswick

In January of this year the New Brunswick Federation of Woodlot Owners and the Conservation Council, in a joint press release, launched a campaign to promote the use of what they call “low impact forestry” on Crown and private lands in New Brunswick. David Coon of the Conservation Council stated that low impact forestry was a model for how to “better take care of the public forests while increasing their value and creating work for New Brunswickers” (NBFWO 2001).

“Low impact forestry leaves an intact functioning forest, while providing work and revenue from the same piece of land repeatedly over a single lifetime. High impact forestry eliminates this opportunity.”

The two groups urge that rather than trying to make the forests fit the mills, the forests should be managed for their health, vigor and naturally occurring species “widening our economic opportunities for the future.”

Peter deMarsh, president of the Canadian Federation of Woodlot Owners and General Manager for the NB Federation of Woodlot Owners says the average woodlot owner isn’t aware of the harvesting options available. According to de Marsh, low impact forestry or selection harvesting increases forest health, adds to long-term productivity, improves the quality of the trees and considers other non-timber forest values (P. deMarsh pers. comm. 2001b).

DeMarsh says, however, that low impact forestry costs the woodlot owner 30% more than high impact (clearcutting) - a cost gap he attributes to the productivity of the equipment.

“If you can produce 10 cords in a day clearcutting, you’d be able to produce 7 cords a day using selection harvesting.”

These New Brunswick estimates clearly demonstrate the need for short-term investment to maintain long-term value. Currently Maritime woodlots are experiencing a loss in value due to short-term profit maximization. There is an urgent need for an enlightened tax incentive policy to create a conducive environment for sustainable forestry, and to encourage practices that will maintain and enhance the value of forests for the benefit of future generations. Woodlot owners cannot do it alone. Chapter 10 of this report (Policy Options to Advance Sustainability) will look at what deMarsh and others are advocating with regard to changes in public policy that can create incentives for sustainable harvest practices.

4. Conservation of Soil and Water

4.1 Water

The environmental, human, social and economic costs of a degraded watershed are staggering. According to Wilson, "the price of water from a watershed catchment with undisturbed forest increases twofold after a forest is logged, and fourfold after uncontrolled logging." She demonstrates that there is direct economic value to the capacity of a standing forest to filter water – a "free" service that could cost literally cost billions of dollars to replace with human engineering works.[4]

With this in mind, protection of water quality and the nutrient and water cycles is at the root of many choices made at Windhorse Farm. For instance, forest practices must avoid degradation of water quality and act to "slow the water."

4.1.1 "Slow the Water"

Protection of the watershed at Windhorse Farm is paramount. In both the protected areas and the harvesting practices, the flow, quality, temperature, turbidity and other characteristics of water quality are key indicators of forest health and the sustainability of harvesting practices.

Forests play an essential and irreplaceable role in safeguarding against excessive runoff and in protecting water quality, because of the role trees play in what Drescher refers to as "slowing the water."

> *"In older forests with bigger trees the rain falls more slowly, in smaller drops. And it continues to drip from the tree canopy long after the rain from the sky has stopped. The thick, forest duff and rotting logs soak up the moisture as it falls, converting surface water to ground water. Over the ensuing hours, days, weeks and months, this water is slowly released from the soil into springs and streams."*
>
> (Drescher 2000, p. 13)

This is in sharp contrast to what typically happens in a stand of seedlings and smaller trees or in stands where few trees remain, such as in a clearcut. Here, water drops hit the soil directly, with little or no interception by the forest canopy, washing soil directly into nearby streams. In this way, clearcuts contribute to soil erosion, leaching of essential nutrients, and stream siltation (See Section 4.3 on Fish and Aquatic Fauna). Furthermore, soils and streams exposed to direct solar

[4] See the GPI Forest Accounts, volume 1, in which Wilson describes the value of a forested watershed to New York City. The city recently purchased a major forested watershed area specifically to protect and filter its water supply. In the absence of this forest, a filtration plant would have cost the city US $8 billion in capital costs and an additional US $300 million in operating costs annually. The purchase and restoration of the watershed cost less than US $2 billion – a savings of US $9 billion over ten years.

radiation experience higher peaks in temperature and greater fluctuations in temperature than streams with a continuous forest canopy.

These hotter temperatures and fluctuations in turn can seriously impact trout, salmon and other freshwater fish populations. The dramatic declines in trout, salmon and other recreational fish in Nova Scotia since the mid-1980s are undoubtedly caused by many factors, including acid rain, climate change, and overfishing. But it has been suggested that forest practices may have played a major role in the losses (see 4.3 below and Wilson 2001).

At Windhorse Farm, efforts are made to maintain a continuous canopy (see Section 2.1.1 on Fragmentation), and increase standing deadwood (Section 2.4) and woody debris, all of which contribute to "slowing the water."

Other efforts to protect water quality at Windhorse Farm include making the bridges over stream crossings out of hemlock stringers. Bridge construction is entirely hand made and hand installed. Horses, wagons, sleds, tractors, and portable sawmills cross streams only on these bridges (J. Drescher pers. comm. 2001).

4.1.2 "Think like Water"

Many of the students who visit Windhorse Farm to participate in the ecoforestry courses have been asked to "think like water" and to map the watersheds of the home woodlot so as to help with forest management decisions. Drescher says political boundaries and ownership boundaries do not mean anything in terms of water flow. "Forests should be managed in natural units where you know that all the water that falls on that land drains to the river and everyone downstream is affected by what happens upstream."

Sweetwater Brook drains the home woodlot and Willow Brook drains the watershed immediately to the north of Windhorse Farm. Both empty into the LaHave River.

4.2 Soil

Soil compaction and soil erosion are minimized at Windhorse Farm with the following practices:

- logging on frozen ground;
- motor vehicle travel is confined to established roads and trails;
- maintenance of tree canopy, which reduces the amount of water runoff, or flushing;
- slabwood and sawdust covers the roadways, preventing rutting and soil compaction, allowing soil organisms and roots to persist beneath the road, preventing fragmentation, and maintaining ecosystem integrity;
- no logging on steep slopes, thus avoiding erosion;
- deadwood (currently deficient) should be maintained at or above 20%, contributing to soil building and soil nutrients and slowing the water; and
- horse manure remains in the forest and fertilizes the soil.

4.2.1 Biomass and Nutrient Budget

According to Drescher, the wealth of a forest is in its biomass. Biomass is a forest's natural capital. With any capital asset the goal is not to deplete the capital stock. Any forestry practice that reduces the consumption and loss of biomass adds to the sustainability and profitability of a forest. One of Drescher's main economic and ecological principles is to maximize the dollar to biomass ratio – namely, to keep as much natural wealth on site as possible and to get the most dollars per unit of biomass in what is sold. From that perspective, ecology and economics are not at odds, as is so often imagined, but are literally two parts of the same equation.

Low-grading is therefore not practiced at Windhorse Farm. If the wealth of a forest is in its biomass, as Drescher maintains, one should trade as little of that biomass as possible for as much money as possible. Material removed in a low-grade has a very low dollar-to-biomass ratio, so it has greater value in enhancing the forest capital stock when left to decompose in the woodlot than in being sold at market.

At Windhorse Farm, all the by-products of the harvesting and sawmilling processes are kept in the forest in order to sustain the biological wealth of the forest. All biomass, except lumber with high economic value, is returned to the stand from which it was cut. Brush walls and slab walls are also built across steep slopes to prevent erosion and loss of biomass, and to mimic the functions of coarse woody debris in enhancing soil and forest quality.

4.3 Fish and Aquatic Fauna

According to Wilson (2001), Atlantic salmon populations are extinct in 22% of the Nova Scotia salmon rivers; 25% have depleted stocks; and 32% have only remnant populations. In l999, only 22 of Nova Scotia's 72 salmon rivers were open to recreational salmon angling.

Salmon returns in the LaHave River, which drains the watershed on which Windhorse Farm is located, have dropped by 45% since l994 alone. Some of this has been attributed to acid rain. But the effects of land use and forestry practices on water quality and flow cannot be ignored.

Brook trout populations, limited by the higher stream temperatures that result in the summer in clearcut areas, have also declined dramatically since l985. Within a ten-year period beginning in l985, the number of brook trout caught declined by 50%. This sharp decline may be the result of several changes in habitat, such as reduced canopy cover, sedimentation, overfishing and the acidification of rivers. As noted above, forestry practices are likely a contributing factor to the decline in salmon and trout populations.

At Windhorse Farm efforts to protect water and soil quality directly influence fish habitat and aquatic fauna. Unlike clearcutting, which can degrade spawning beds by causing stream siltation, higher peakflows, and wide temperature fluctuations, selection logging minimizes both soil erosion and the "flushing effect." The flushing effect results in rapid increases in streamflow immediately after rain events, with lower-than-normal flows during dry periods.

Carnation Creek

The twenty-year long Carnation Creek study (l998) looked at the impacts of forestry on fish populations in Carnation Creek, Vancouver Island. The Creek was home to Coho and Chum Salmon as well as Steelhead and Cutthroat Trout. The study began in the l970s because of serious conflicts in approaches to the management of fisheries and forest resources. The study found that forestry practices have significant impacts on fish habitat, including increased sedimentation, stream bed scouring, and channel scouring, as well as effects on temperature fluctuations and oxygen levels. In the study, half of the streams inspected were seriously adversely affected by forest harvesting practices (Hogan et al. 1998).

5. Forests Store Carbon

Forest ecosystems play a significant role in stabilizing global climate. One particular function that impacts climate is carbon sequestration, where carbon is stored in living biomass, soil and forest floor debris. As dead plant matter decays, some of it goes back into the atmosphere, but some is also incorporated into the soil. Globally, soils store about five times as much carbon as vegetation (Stephens 2000).

A 60-year old spruce plantation in New Brunswick was found to store only about 22% of the above-ground carbon of an older, natural forest. In particular, it has been found that the conversion of old-growth forests to younger even-aged plantations releases massive amounts of carbon to the atmosphere from forest soils (Walker *et. al*. 2001; Wilson 2001). According to Wilson, the conversion of Nova Scotia's old-growth and older mature forests to younger and predominantly even-aged softwood stands may have diminished the province's forest carbon storage capacity by up to 80% compared to the capacity of the historical Acadian forest, thereby contributing to global warming.

At a time when Canada has committed itself anew to the implementation of the Kyoto Accords and the reduction of its greenhouse gas emissions, this loss of carbon sequestration capacity has direct economic costs. This economic dimension was affirmed at the most recent climate change negotiations in Bonn, which agreed that credit would be given to forest carbon storage capacity in assessments and targets for greenhouse gas reductions.

In sum, the loss of old trees, the conversion to softwoods, and the increase in the younger age classes in the province have contributed to a significant decrease in carbon storage potential for Nova Scotia.

To illustrate this point, Wilson explains that 16% of Nova Scotia's forests are between 0-20 years of age. This relatively large portion of the forest stores roughly the same amount of carbon as the 80 –100 year age class that comprises only 1% of the province's forests (Wilson 2001, Chapter 10).

Because larger amounts of carbon are stored in older trees, age class distribution and forest type help determine the carbon storage potential of a forested area. On a per hectare basis, Windhorse Farm, with 90% of the total managed lands dominated by trees over 80 years of age, contributes far more positively to carbon sequestration on a per hectare basis than lands on which industrial forestry and clearcutting are practiced. On a global scale, Windhorse Farm is clearly insignificant in terms of size, but if the forest practices used at Windhorse Farm were practiced on a provincial scale, the benefits in terms of carbon sequestration would be substantial.

6. Forests Benefit Society

6.1 Tourism and Recreation

Tourists and residents clearly want to visit beautiful and interesting places. If we degrade our natural environment, we will also diminish those aesthetic values that attract tourism in the first place.

Windhorse Farm's Maritime Ecoforestry School attracts many visitors, but also contributes a range of spinoff benefits to provincial revenues by attracting people to the province who would otherwise not visit. Visitors to Windhorse Farm come from far and wide and for varying lengths of time. They may come to tour the woodlot or to attend one-week training courses in ecologically-based harvesting methods, including the use of horses in horse logging. Every year Windhorse Farm trains 12 interns as part of its internship program, and welcomes 72 students who attend 1-2 week courses that are offered six times a year. Another 300-400 people visit Windhorse Farm annually and stay for less than a day (J. Drescher pers. comm. 2001).

Students have come from every province in Canada, except Manitoba. Some have come from the US, Europe, and as far away as Brazil. Their backgrounds are diverse - woodlot owners and mill operators, graduate students, CIDA interns and "the just curious." Students stay in the local community and contribute to the local economy.

"Almost without exception they have been gentle and intelligent, keen and quick learners, motivated to make a difference in the world. In general they are well-informed about ecological, social justice, and trade issues before they come, and they are ready to jump into the turbulence and practicality," says Drescher.

In addition to The Maritime Ecoforestry School, Windhorse Farm offers visitors the opportunity to go on woodlot tours or on wagon and sleigh rides. It also offers organic farming workshops and other recreation activities such as bird watching, hiking, snow-shoeing, and cross country skiing. In short, timber extraction is not the only forest industry at Windhorse Farm, because a healthy forest provides a multititude of services and can support a wide range of other social, economic, recreational, and educational activities.

6.2 Windhorse Farm and the Broader Community

Windhorse Farm is one of a burgeoning number of “place-based” initiatives sprouting up all over North America, and led by people seeking an alternative to the increased dependence of many communities on global economic forces beyond their control. Firmly rooted in place, these individuals know that their futures depend on taking good care of the resources in and around their own neighborhoods.

Generally, ecoforestry woodlots are community-based by definition. They provide local employment and long-term viability for small, rural and often resource dependent, communities. At Windhorse Farm, 90-95% of the products are sold to customers within a 15-25 km radius, and its woodlot and woodshop provide year-round employment for a number of local community members.

Many resource dependent communities suffer from boom and bust cycles, which are an almost inevitable characteristic of clearcut harvesting methods. Jobs and prosperity when the forests are there and being cut, are replaced by unemployment and uncertainty when the forests are gone. In addition, as forests close to the community disappear, logging contractors must travel ever longer distances to available forestland.

6.3 Economic Value of Non-Timber Goods and Services

As noted above, forests perform essential functions and provide many services above and beyond the economic value of wood removed from them.

According to Wilson (2001), the essential services provided by forests include:

- climate regulation;
- soil formation;
- waste treatment;
- biological control;
- food production;
- recreation; and
- cultural services.

Costanza et. al. (1997) estimate that temperate and boreal forests contribute a minimum of CDN$430.10/ha/year (l997$) in essential services (Wilson 2001, Chapter 11). The estimates are based on replacement values – what it would cost for human engineered construction to replace a lost ecosystem service. For instance, what would it cost to construct a water filtration plant to perform functions once performed by a healthy forested watershed?

Not included in the estimate (due to lack of data and calculation difficulties) are water supply and regulation (watershed protection), soil erosion control and sedimentation retention, nutrient cycling, and the conservation of pools of biological diversity. If these and other ecosystem functions were included, it is likely that the economic value of forest ecosystem functions would be doubled (Wilson 2001, Chapter 11). This significant economic value, invisible in our conventional market-based accounting mechanisms, is preserved when a forest is logged sustainably and severely diminished when a forest is clearcut.

6.4 Jobs

Windhorse Farm's forest operations employ the equivalent of seven full-time people, not including Drescher. In total, these workers harvest (using the slow-grading method) and process a total of 150,000 board feet of wood per year from the total area of lands managed by Drescher (190 ha) (J. Drescher pers. comm. 2001). This means that **for every 1000m^3 of wood harvested, eight people are employed**.[5] This is in sharp contrast to industrial forest companies that may only employ one full-time person per 1000 m^3 of wood (see Chapter 8).

According to Drescher, ecoforestry employs at least five times more people per unit of wood than do current industrial practices. He predicts:

> *"If Nova Scotia were to move toward an ecoforestry paradigm, we could double the employment on half the harvest."*

6.5 Music

Old-growth suppressed red spruce and eastern hemlock produce a clear and tight grained wood that is coveted by makers of guitars, violins and other stringed instruments. The red spruce, which is suppressed due to either lack of light or to poor soil conditions, occurs at Windhorse Farm at the edges of wetlands. While these trees are slow-growing, they are exceptional in that they are still healthy and vigorous.

Instrument makers generally require that their wood be tight-grained and at least 20 inches in diameter (approximately 200-400 year-old trees). At Windhorse Farm there are approximately 300-400 trees of this quality, and annually one or two are harvested, fetching about $500 for an 8 foot log. Currently, Drescher sells wood to five instrument makers, who tell him that they cannot find the wood they need anywhere else in the province.

In short, healthy forests, responsibly managed through sustainable logging practices, maintain the highest quality valuable timber and provide economic value on a per board foot basis that is far in excess of the timber clearcut for the pulp and paper industry. There are clearly opportunities here for Nova Scotia woodlot owners to increase the value of their properties and the income they provide.

[5] The conversion factor used to convert board feet to cubic metres is 177. This conversion factor was taken from the Forestry Field Handbook, Department of Lands and Forests, l988.

7. Restoring the Acadian Forest

> *"Unfortunately, most purchasers of woodland do not understand that they have bought a severely overdrawn bank account. In most cases, the initial cash investment to purchase the land is just the tip of the iceberg. At some point the overdraft will have to be covered. Now or later are the only alternatives."*
>
> \- Jim Drescher

As noted, only 36 hectares of land at Windhorse Farm have never been cleared. The rest, therefore, is in various stages of restoration – the process of bringing a stand to fully restored maturity. Drescher says that at "fully restored maturity," the costs of forestry are minimized.

According to Drescher, any woodland that does not exhibit the composition and structure of old-growth forests is in need of restoration. Windhorse Farm's home woodlot, for instance, has the same volume of standing timber as an old-growth forest. However, with a deadwood content of only 10%, Drescher classifies the forest as deficient and in need of restoration. As noted in Section 2.4 above, deadwood is "the life of the forest and trees must die naturally to provide the snags and large dead-falls that make food and shelter for animals and contribute to water and nutrient cycles and the regeneration of vegetative richness" (Schneider 1998).

Restoration in this case, where an increase in deadwood is a primary concern, may include girdling (encircling the tree with cuts that sever bark and cambium, in order to kill the tree). Drescher currently girdles about 100 trees per year to create more snags, and also constructs slab walls throughout the woodlot to simulate coarse woody debris. Drescher is also cutting his annual harvest in half on all his managed lands for at least the next 10 years, or until the deadwood content of the woodlot increases to 20%.

He also recognizes that the volume of deadwood may be less important than the size of the pieces, their configuration, and their distribution. Large snags and CWD are more valuable for habitat than the same biomass in fine debris on the ground (J. Drescher pers. comm. 2001).

In Nova Scotia as a whole, there has been very little forest restoration, and current trends are the opposite of what is required to restore the province's natural forested wealth. The two-fold increase in clearcutting in the l990s has degraded Nova Scotia's forests substantially, and diminished the province's wealth further. Restoration forestry, accompanied by a moratorium on current practices can, in the long term, bring back the forest's natural capital value.

At Windhorse Farm, restoration could take the form of leaving the forest alone, or it could involve active intervention (in an attempt to accelerate the restoration process) in the forms of:

- patch cutting to open the canopy, thereby accelerating light incidence on the ground;
- planting (to increase age and species diversity);
- building of brush piles/walls (to increase structural diversity); and,
- girdling (to increase deadwood component).

No woodlot ever “needs” to be restored, says Drescher. A forest, if left alone, with the necessary species available nearby, will be restored in time of its own accord. But if one wanted to accelerate the restoration process, these interventions cost money. Drescher says he doesn’t know any woodlot owner that has enough money to restore a site fully. “It’s really expensive,” he says. “But only if you’re in a hurry.”

There are some aspects of restoration that cannot be accomplished through intervention alone. Deadwood, for example, can be increased by girdling trees, which increases the dead proportion of the forest. But essentially, says Drescher, one has to wait.

In many instances, some harvesting can take place as a “by-catch” of some of the above interventions, and could offset part or all of the costs, or even provide some return to the owner.

The kind of restoration work that takes place, however, depends on a variety of important parameters: time since disturbance, the extent of the past damage, tree species diversity present in natural regeneration, and proximity to protected areas or other viable “seed” sources (J. Drescher pers. comm. 2001).

In general, the costs of restoration are proportional to the extent of damage done by past practices. Many woodlot owners, says Drescher, do not realise that their land resembles a severely overdrawn bank account. Costs associated with the restoration of two similarly degraded woodlots could also vary depending on the following factors:

- Site characteristics (exposure, slope, soil depth, etc). Sites having richer soils, more moisture, and conditions less vulnerable to erosion will recover more quickly, thus costing less.
- Equipment used in the harvest and season of harvest. If heavy machinery had been used especially when ground was not frozen, it likely resulted in severe rutting of the soils which would affect the restoration period.
- Availability of local seed sources.

There is no magic number for how much it costs to restore a woodlot. However, it is possible to harvest, and at the same time not to interrupt the natural restoration process.

RESTORATION FORESTRY IS NOT INCOMPATIBLE WITH HARVESTING.

If harvesting is done badly (clearcutting, high-grading), it will set back the restoration process. However, harvesting can also be done in ways that accelerate restoration, or, at least do not negatively impact the restoration process.

For the purposes of this report, we will attempt to quantify some of the costs of restoration in terms of foregone revenue. Woodlot owners who are restoring their lands are incurring current costs for past damage. Because future generations will reap the benefits of these restoration efforts in the form of healthier, more valuable, and more productive forests, these restoration “costs” should properly be viewed as “investments” that will yield an increased flow of future goods and services.

For this reason, it is appropriate that there should be tax incentives or subsidies to offset the costs of restoration, and to encourage woodlot owners to undertake restoration efforts that will restore the province's natural wealth and benefit future generations of Nova Scotians (See Chapter 9). Without this understanding of restoration costs as investments, and without the necessary level of support for these efforts, few woodlot owners will be willing or able to forego current revenues for the sake of long-term gain.

7.1 Costs of Restoration: Foregone Revenue

The Annual Growth Increment of merchantable timber in Drescher's woodlot is approximately 2,000 board feet/ha. The stumpage value for that grade of timber averages $250 per thousand board feet. Therefore, if one were to cut a timber volume equivalent to half the annual growth of the forest, the stumpage revenue (the value of timber as it stands uncut in the forest) from one hectare would be approximately $250/ha/year.

After clearcutting a woodlot, it takes at least 200 years to restore the volume and quality of the original forest. During that period, however, some harvesting can be done, and one can estimate that about half the timber harvest value (starting at 0 and increasing to 1,000 board feet after 200 years) would be generated during the restoration period to offset the costs. Therefore, over a 200-year period, the total foregone net revenue (assuming the current $250 stumpage value) is $25,000/ha (J. Drescher pers. comm. 2001).

7.2 Costs of Restoration Interventions: Some Examples

The following are examples of the real costs that are associated with restoration work. They are taken from actual cases of woodlots that have been degraded to varying degrees and that are currently undergoing restoration work by Drescher, who does this work as a consultant. He says the costs reflect what the particular woodlot owners can actually afford, and that the possible costs of restoration work could be limitless.

The following examples go from best to worst cases, with costs increasing in direct proportion to past damage. In each case, the costs should therefore be understood *both* as proxies for past damage *and* as corresponding investments that repair the damage and increase the value of natural capital.

The costs described below are mis-reported in our current economic accounts. Past damage costs have been concealed by conventional accounting mechanisms (like GDP and economic growth statistics) that only report harvest revenues without accounting for depreciation of capital stocks, and that therefore mistakenly count the depletion of natural capital as economic gain. Similarly, to the extent that foregone revenues inhibit current GDP growth, the true value of current investments in restoration remain concealed and unrecognized in conventional accounting systems. It is the purpose of the Genuine Progress Index to account for such damage costs and investments accurately.

a) In the best circumstances, the only cost a woodlot owner would have is the cost of the land itself. If the woodlot owner chose not to intervene, and made no attempt to hasten the restoration process, but instead decided to wait for the restoration to occur naturally, then it would take 100 years before a very careful selection harvesting system (removing <20% of the Annual Growth Increment each year) could be started. Over the next 300-500 years the Annual Allowable Cut might rise to 40-50% of the Annual Growth Increment.

b) Drescher currently advises on restoration interventions on a 50-year-old, 25 hectare woodlot with relatively good species diversity. Here interventions include gap opening to increase light on the ground, and increasing structural diversity with brush piles, walls and girdling. In this case the landowner has decided to forego harvest income for the next 100 years. At $2,000 a year for the recommended interventions, the cost of the restoration investment in this instance is $80/ha/year.

c) Drescher is also assisting restoration on a 50 year-old, 20-hectare stand of mostly White Spruce and Balsam Fir,with little age or species diversity. Many of the trees in the woodlot are dying and falling out of the stand. Over the last five years interventions have included gap openings to accelerate light incidence on the ground, and developing age and species diversity by planting trees that have been lost from the site and that have no local seed source. Nothing is being taken out of the woodlot - all dead wood is left in the stand. The owners in this case have planned not to remove any wood from their woodlot for their lifetimes. The cost of restoration in this example is $3,000 a year or $150/ha/year.

d) Another 40-hectare woodlot was badly degraded up until the l940s. The owners have decided to accelerate the natural restoration process by doing some harvesting, thinning, pruning, building of structural diversity through brush and slab walls, and taking measures to "slow the water." These interventions directly cost approximately $2,000/year for materials and labour. In addition however, the value of approximately 30,000 board feet of stumpage (@ $150/thousand board feet) from thinning and harvesting is also paid by the woodlot owner. In this case the cost of restoration is $162/ha/year.

e) The worst case, or most expensive restoration option for badly damaged land, would require extensive intervention. This would include both site protection, such as water bars on abandoned trails, and planting species which were a part of the natural forest appropriate to that site but for which there is now no natural seed source. Soil and nutrient loss are damage costs that can never be repaid or repaired except through time. Soil may take thousands of years to replace.

Again it should be repeated here that these examples are not presented as models for restoration work, but are actual examples that simply reflect what these individual landowners can afford. In all these cases, however, the interventions should help accelerate the natural restoration process of the forests.

7.3 Hidden Foregone Revenues and Need for a Long-Term Vision

Imagine for a moment that Nova Scotia's forests were still in their natural state, or at least had been logged sustainably since European settlement. Now apply Windhorse Farm data to Nova Scotia's forests: Each of the 2.6 million hectares of operable forestland in the province would then have 40,000 board feet of merchantable wood, just like Windhorse Farm, and 3% of the standing stock is harvested annually.

If one-half of the harvest fetched a premium price of $1.70 per board foot, as Windhorse Farm timber does, it would be worth $2.7 billion. At the current knotty spruce price of $0.60 a board foot, reflecting the value of most timber harvested in Nova Scotia today, it would be worth only $936 million, representing a loss of value of $1.8 billion annually. In other words, a degraded forest is already foregoing significant potential revenues, but these foregone revenues remain hidden because our current economic growth statistics account for neither natural capital depreciation nor long-term benefits, costs or values.

The need for a long-term vision for Nova Scotia's forests was expressed by Dalhousie University professor, Bill Freedman (1998):

> *"My vision involves an appropriate system of protected areas in NS which might encompass at least 15% of the land as protected areas where we're not harvesting timber. And in addition, in respect to areas of working forest where we are harvesting trees, there would be much greater use of selection harvesting systems designed to develop forests with a multi-age structure and more heavily dominated by moderate-lived species of trees than we're typically favouring today. Fifty percent of the working forest would be comprised of selection harvesting system and the other 50% of more intensive management including the use of plantations restricted to native species of trees.*
>
> *Now under that kind of system I could see 50% less harvesting than we have today. The economic consequences would mean 50% less processing capacity, so we're talking about closing some sawmills and some pulp mills. But in the longer term, however, there would be potentially a higher value of product such as sawlogs that would be manufactured in a larger dimension, wood that has greater overall economic benefit. But in the medium term, and we're talking say 30 to 40 years, there would be a lot less in potential economic activity associated with forestry."*

It should be noted that the 50% reduction in harvesting proposed by Dr. Freedman does not mean a 50% reduction in employment. On the contrary, because selection harvesting is far more labour intensive, Drescher suggests that a 50% reduction in harvesting, along with the adoption of selection methods on the remaining 50%, could more than double forest industry employment.

In addition to Freedman's suggestions, there should also be active reinvestment in the restoration of natural capital values (see Chapter 10). Much of that restoration work is labour intensive and can provide further employment. In short, a reduction in output can be combined with a significant increase in employment if ecological harvesting methods are adopted.

8. Economic Viability/Resilience of Sustainable Forestry

Long-term economic viability is a key element of sustainability. According to Drescher, the foundation of sustainability, and therefore of long-term economic viability, is ecological diversity. Industrial forestry, as it is currently practiced in Nova Scotia and elsewhere, not only severely reduces ecological diversity but also “delays the possibility of long-term [economic] sustainability on that site by hundreds of years” (Drescher l997b, p. 3).

The economic and environmental benefits of maintaining the full array of native biodiversity are substantial. In the United States alone, these benefits are estimated to be worth $300 billion annually (Pimentel et al l997). The economic benefits of restoring native biodiversity to Nova Scotia’s forests include:

- Older trees provide knot-free lumber at varying diameters. Clear, wide diameter wood in turn fetches premium prices in the market economy.
- Old forests store more carbon than young ones, enhancing the carbon sink value of Nova Scotia forests.
- Loss of tree species diversity reduces the variety of wood products from forests. For example, there has been a significant decline in the abundance of white cedar and white pine in Nova Scotia due to 200 years of high-grading (CCFM l997).
- Species and age diversity can increase forest resilience and reduce susceptibility to spruce budworm and other insect and disease infestation, thus protecting timber values.
- Nova Scotia’s tourism industry depends on the visual appeal of pleasing landscapes.
- Diverse forests provide habitat for wildlife that single-aged single-species plantation forests cannot provide. Wildlife abundance in turn enhances the recreation value of forests.
- There is mounting evidence that age and species diversity enhance soil quality and therefore improve timber productivity.

While Windhorse Farm can be used as a model for sustainable forest practices, it should not necessarily be copied in all its details. All forests are different, and therefore appropriate harvest methods and management techniques will differ accordingly. However, one basic economic principle at Windhorse Farm will likely apply to other ecoforestry operations as well. Just as ecological diversity is vital to forest health and value, so economic diversity is a sound business principle for woodlot owners wishing to practice sustainable forestry.

A diversified business like Windhorse Farm will almost always work best for an ecoforestry woodlot. In addition to a variety of wood products, Windhorse Farm sells cut-flowers, native plants, reforestation services, dairy products, organic food, and a wide range of educational services including ecoforestry course. This economic diversity can improve resilience and help cushion the business against fluctuations in the market price of particular forest products.

As noted above, in addition to harvesting and selling wood and wood products, the ecoforestry business at Windhorse Farm includes a full-fledged training and internship program with an average of 12 students per year. Seventy-two students a year also participate in 1-2 week courses in ecoforestry (6 courses offered per year), and there are woodlot tours for tourists and visitors which cost $50 for a two-hour tour.

Drescher believes “diversity brings greater stability to a business, increases the probability of economic viability and reduces the probability of market catastrophe” (J. Drescher pers. comm. l998).

Table 7 presents a simplified expense statement for Windhorse Farm’s wood products business, with expenses expressed as a percentage of total revenues. Included in the compensation to employees is a salary for Jim Drescher. Any profits made are reinvested in the forest.

Table 7. Simplified Expense Statement, Expressed as Percentage of Total Revenues for Windhorse Farm Wood Products

Expenses	Percentage (%) of revenue
Raw materials	15
Compensation to employees	57
Payroll costs (CPP, EI, WCB)	8
Interest	12
Power	2
Supplies, maintenance, repairs, fuel	2
Other expenses	3
Profit	1

Source: Drescher, 2001

8.1 Wood Products and Their Value

As of January of this year, the main products at Windhorse Farm are flooring, lumber, molding, wainscoting, pine siding, flagpoles, linking logs, and arched bridge kits. These products are made from high quality hardwood (oak, ash, sugar maple, yellow birch, white birch, beech and aspen) and softwood (pine, hemlock and spruce). Windhorse Farm also carries figured aspen and maple, including birdseye, and “old-fashioned” wide plank flooring continues to be one of its specialties.

According to a notice sent out by Windhorse Farm in November 2000, about 75% of its log supply is harvested from its own managed woodlots where “the strictest set of ecoforestry standards” applies. In addition, as much as possible of the balance is obtained from other well-managed woodlots including the Pictou Landing First Nations lands (dealt with in detail in Chapter 2 of this report) which have received the first Forest Stewardship Council (FSC) certification in the province.

However, the November, 2000, Windhorse Farm notification explains that the “extreme shortage of supply of wood from certified well-managed lands” has forced Windhorse Farm to obtain approximately 12% of its wood from mills where the forestry practices could not be verified (J. Drescher pers. comm. 2001).

8.2 Large Dimension and Clear Wood

While the value of large diameter wood and clear wood in general will be addressed in greater detail in Chapter 8 of this report, it is dealt with here in relation to Windhorse Farm.

Large dimension red spruce, sugar maple, and pine, which are in high demand in Nova Scotia, New Brunswick and Maine (deMarsh l998) fetch higher prices than balsam fir, white birch, aspen, and red maple. All of the former, in large dimension, are sold at Windhorse Farm.

Wood grown continually under a forest canopy is also worth more than wood grown after a clearcut. Diameter, size, and clear wood are indicators of quality, and they help determine market prices. Selectively harvested wood yields a much higher proportion of clear (rather than knotty) lumber as well as wide-diameter wood, both of which fetch premium market prices and are simply not obtainable from a 50-year old clearcut stand. Therefore, maintaining a forest cover protects the woodlot's natural capital, which in turn yields more valuable economic services, with large diameter, clear wood providing a significantly higher financial return per board foot than the smaller, knotty wood characteristic of successive clearcuts.

Windhorse Farm practices uneven-aged management, with 20-25% of the annual 60,000 board foot harvest (from the home woodlot) consisting of large diameter logs (i.e. 15 to 30 inch diameter). Within the same annual harvest, between 15 -20% of the wood is clear. One half of the wood sold at Windhorse Farm fetches a premium price. Clear lumber is worth two to four times the value of knotty wood. For instance, clear board red spruce fetches $1.70 to $2.70/ board foot compared to knotty red spruce that fetches only $0.60/ board foot. Hemlock knotty lumber is even less desirable (Wilson 2001). In sum, even in strict market terms (not accounting for loss of ecological and social values) excessive clearcutting has resulted in a very significant loss of timber value in Nova Scotia.

In addition to the increased market value of large dimension wood, the woodlot owner realises an additional cost saving, since felling large diameter trees is cheaper per board foot than felling smaller diameter trees, because roughly the same amount of effort is required to fell large and small trees (J. Drescher pers. comm. 2000).

In sum, a multi-species, multi-aged woodlot is therefore more valuable in all its aspects than an even-aged single species plantation. There is a larger range of products, the wood has higher quality, and it is worth more at the market place.

8.3 Value-Added

Another way to practice sustainable forestry is to add as much value on-site and as close to the stump as possible. The further wood products must be shipped, the greater the costs, says Drescher, even though many of these costs are "externalized" or borne by society. If, for example, the full costs of greenhouse gas emissions, air pollution, fossil fuel depletion, road construction and maintenance are included, then society and future generations pay a much higher price for the long-distance transportation of wood products than market prices currently reflect.

Ninety to ninety-five percent of the products at Windhorse Farm are sold to customers within a 15-25 km radius, says Drescher, thus minimizing hidden transportation costs. As well, processing and value-added activities occur on-site, further reducing transportation costs, and in sharp contrast to current industrial forestry practices.

The following activities add value to wood at Windhorse Farm:

- felling, limbing, bucking (cutting tree into log lengths), yarding and browing (piling logs ready for mill);
- sawing, stacking and stick, air drying;
- kiln drying;
- jointing and planing;
- trimming and grading;
- manufacturing of flooring, wainscoting and moldings;
- marketing and retailing; and,
- delivering to site.

8.4 Value of Certification and Chain of Custody

Drescher is currently embarking on the process of having his woodlands certified by the Forest Stewardship Council (FSC). In addition, because some of his wood is purchased from Pictou Landing, which does have FSC certification, he is also involved in establishing a chain of custody certification (J. Drescher pers. comm. 2001).

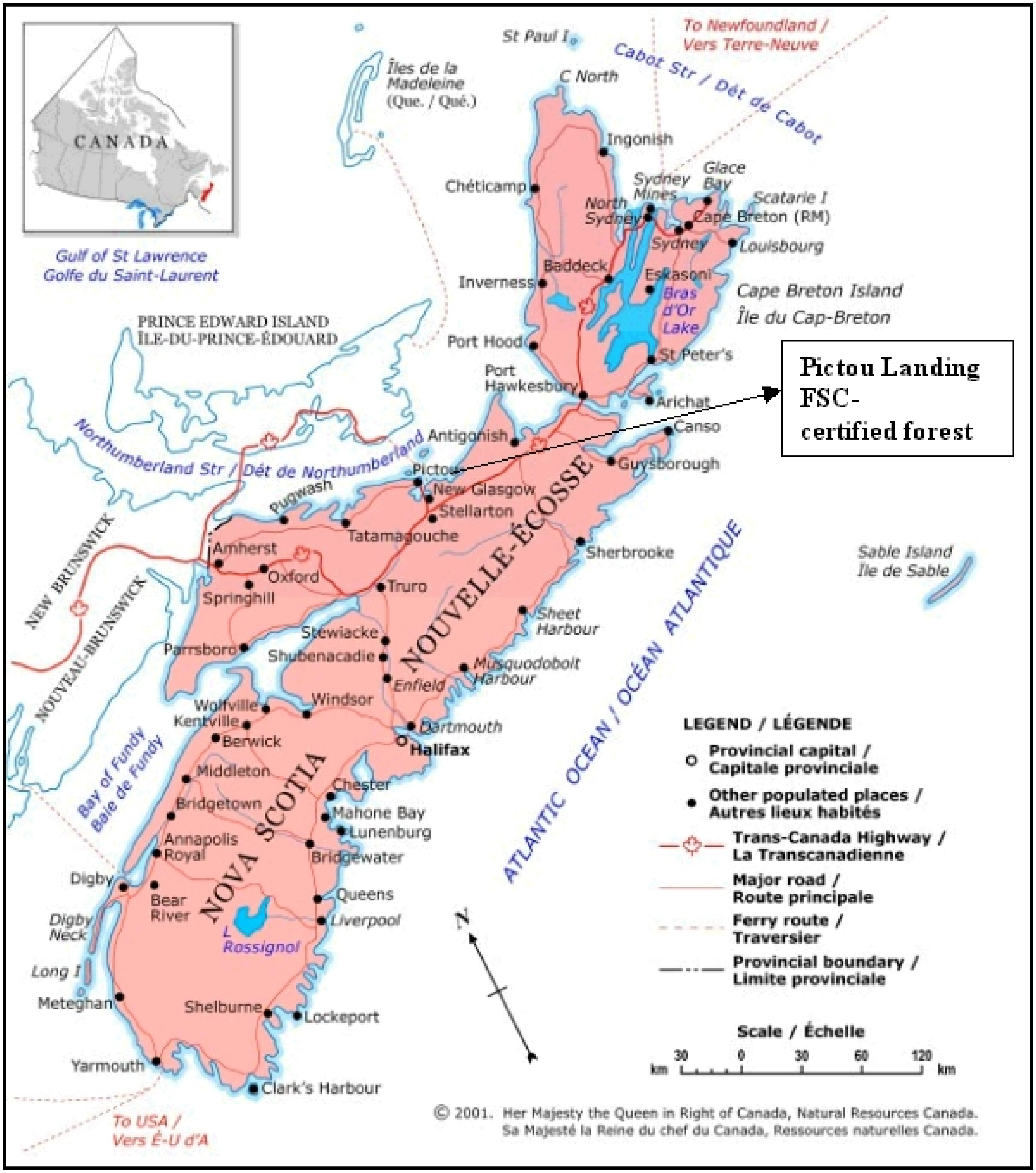
The growing demand for certified wood, particularly in Europe, is increasing its market value. A recent article in the *Vancouver Sun*, [6] reported on one British Columbia company, Shawood Lumber, that is reaping substantial financial benefits from eco-certified wood. Shawood owner, Andy Shaw, is the first B.C sawmiller to get a supply of FSC certified rainforest logs from Timfor Contractors (BC's only major logging operation to have the FSC seal of approval). One of Shaw's European clients offered to buy everything he had, giving him a 5% premium for certification - a $1.5 million deal for 300,000 board feet of prime B.C cedar. Certified clear western red cedar is worth 10 times more than construction lumber in B.C.

Drescher currently pays a 10% premium for FSC certified wood from Pictou Landing. The Menominee Tribal Enterprises (Chapter 4), which are also FSC certified, are also able to sell their wood for at least 10% more than normal market prices for the same grade of timber. In short, consumer demand for sustainably logged wood is increasingly reflected in higher market prices that are providing a growing return on investment in ecological harvesting practices.

[6] Gordon Hamilton, "Europeans open their wallets for eco-certified rainforest cedar," *Vancouver Sun*, December 5, 2000.

Chapter Two: Pictou Landing, Nova Scotia

Figure 5. Pictou Landing, Nova Scotia, Canada



1. Introduction

Until 1992, the forests of the Pictou Landing First Nation were treated like most forests in Nova Scotia. They were either being clearcut and turned into softwood plantations, or they were being cut over several years and allowed to regenerate naturally. The condition of the Pictou Landing forests was also similar to that of most forests in Nova Scotia. Centuries of high-grading (taking the best, leaving the rest), burning, and clearing had greatly degraded their quality, worth, structure and function.

By the 1990s, the Pictou Landing forests were dominated by short-lived, low value tree species, such as alders, white spruce, balsam fir, white and gray birch, red maple, and poplar. The large-sized, long-lived trees of the ‘Acadian’ forest, like white pine, red oak, and sugar maple, had all but disappeared. Unlike the unusual circumstances of Windhorse Farm, where most of the woodland has been harvested sustainably for 160 years, the forest operations of the Pictou Landing First Nation provide a particularly good model for the vast majority of existing Nova Scotia woodlots that are currently in a similarly degraded state.

The recent shift to “restoration” forestry at Pictou Landing, involving major changes in on-the-ground practices, resulted in the first Nova Scotia certification under the internationally recognized Forest Stewardship Council guidelines. Pictou Landing has demonstrated that there is always the potential, even in highly degraded woodlots, to reverse the legacy of degradation, and to embark upon the long, slow path towards restoring the health and worth of a forest.

The Pictou Landing forest manager, Bill McKay, and his technician, Alton Hudson, had been trained in conventional, even-aged, forestry practices: -- clearcut, replant, control competing vegetation with herbicides, thin the stand as it matures, then harvest again in 50 or 60 years. As they used these techniques on Mi’kmaq First Nations lands, however, they detected dissatisfaction in the Mi’kmaq community.

At Pictou Landing, in particular, many Mi’kmaq indicated that fiber removal was a low priority compared to other forest values, and that the foresters should not clearcut the forests, spray chemicals, or introduce exotic tree species. Instead, they should work with what was there, and ‘bring it around’ to provide healthy forests for the children. McKay and Hudson became familiar with the meaning of the Mi’kmaq concept ‘Netukulimk’-- that people do not dominate the forest; that all parts of the forest should be treated with respect; that no life form is more important than another; and that nothing is to be used without protecting the integrity of the whole.

In 1993, McKay also became familiar with the concept of forest restoration, whereby the forest is restored to conditions similar to that of the original ‘Acadian’ forests of this region. These forests were typified by:

- An uneven-aged, and eventually all-aged forest.
- A diversity of tree and other plant species, with red spruce, white pine, hemlock, yellow birch, sugar maple, ash, and beech the dominant tree species.

- A diverse stand structure, including standing and fallen snags, and adequate coarse woody debris.
- Stable populations of a diverse array of birds, mammals, reptiles, amphibians, invertebrates, and micro fauna (Prest, 1999).

The concept of restoration provided a good fit with the culture and the values of the Mi'kmaq community, and with the practice of Netukulimk.

The Mi'kmaq have occupied Nova Scotia for more than 11,400 years, and yet it has only been in the last 300-400 years, with the arrival of Europeans, that the abundant natural treasures of this province have been severely diminished and degraded. As resources diminished, so did the independence and vigor of the Mi'kmaq. Groups of Mi'kmaq were relocated, granted small parcels of land, and isolated from much of society.

These changes are reflected in current social conditions. Today, the life expectancy of First Nations peoples is seven years less than that of other Canadians; infant mortality rates are twice the national rate; Aboriginal people are more likely than other Canadians to have hearing, sight and speech disabilities; Aboriginal incarceration rates are 5-6 times higher than the national average, and many Aboriginal adults report family violence, sexual abuse and rape as significant problems in their communities.[7] Furthermore, First Nations communities are among the poorest in the country, with some of the highest rates of substance abuse, suicide, unemployment, and financial dependence on the state (Minister of Indian Affairs and Northern Development 1997).

The small First Nations community at Pictou Landing, with 516 people, is isolated from the town of Pictou, and suffers from many of the common problems that plague Canada's Aboriginal communities, including a high incidence of substance abuse and single parent families. Many youth have not completed their high school education, and leave the school system without the necessary skills for employment, and without the language and cultural knowledge of their own people.[8]

The Pictou Landing Band was subjected to an additional stress. In 1965, Boat Harbor, located adjacent to the Reserve, was converted to a pulp mill effluent treatment facility for the nearby Scott Pulp and Paper mill. The noxious fumes from this toxic effluent lagoon caused severe dizziness and nausea for people working, hunting or passing through the surrounding Pictou Landing forest.

The ongoing discrimination and isolation that have characterized the native experience has left a feeling of apathy in the community. Forest restoration at Pictou Landing is therefore intended to stimulate the interest, employment opportunities, and internal feelings of self-worth among local residents. Indeed, the *primary* goal of forest management at Pictou Landing is *to restore the*

[7] These statistics are from the Social Development backgrounder in *Gathering Strength – Canada's Aboriginal Action Plan,* by the Minister of Indian Affairs and Northern Development, 1997, published by the Minister of Public Works and Government Services Canada. Ottawa.

[8] In 1976, the jobless rate for Mi'kmaq youth under 25 years of age was estimated at 85%. In the same year, while the overall Maritime unemployment rate was 9%, between 55-70% of adult Mi'kmaq were without jobs. Statistics quoted in Sandra Smith "The story of the missing 's'", Shunpiking Magazine, Volume 5, Number 38; October/December 2000

confidence, skills and abilities of the Pictou Landing community. The social values of the forest are paramount, and Pictou Landing forest restoration may provide a model for First Nations communities throughout Canada.

Making the transition to restoration forestry has not been easy. In a province where forestry expertise is tailored almost entirely to even-aged management techniques, the technical skills and knowledge required to accomplish restoration forestry were essentially non-existent. McKay and Hudson had to learn a whole new approach to forest management, and they had to train or hire people who could also comprehend that approach and make it work on the ground.

Perhaps their greatest accomplishment, however, has been to gain the interest and support of the Pictou Landing Band as a whole. Despite the profound understanding and appreciation of traditional forest values of some band members, many others had typically viewed the Pictou Landing forest with either disinterest or as an opportunity for personal gain. Many used the wooded land to dump garbage, ride their all-terrain vehicles (ATVs), or harvest pulpwood for a quick profit. These band members showed little regard or concern for the impact of their activities, or for the future of the Pictou Landing forest.

Today, a Community Forest Management Board oversees operations in the woodlot, and has made enormous strides in gaining co-operation, support and buy-in from all band members, including those previously inclined to cut in the woodlot whenever they felt like it. Numerous projects involving band members have helped to inspire and rekindle interest in the land. For example, a recent school program brought young children to the forest. The children were given birdhouses made of wood from the forest. These birdhouses were hung up in the trees, with the purpose of giving each child a sense of ownership of the woodlot.

While the economic benefits of restoration will be realised well in the future, the social benefits have already begun to take effect. This is due in part to the recent certification of the Pictou Landing forest management practices by SmartWood, a Forest Stewardship Council accredited certifier. The Forest Stewardship Council (FSC) is an international body that puts a ‘green’ stamp on wood products derived from forest management practices that adhere to strict environmental and socio-economic standards, and that protect Indigenous People’s rights.

In 1999, McKay hired SmartWood to carry out an independent, third party assessment of the Pictou Landing forest operations, and in March, 2000, Pictou Landing became the first FSC-certified forest operation in Nova Scotia, and the first operation to meet the Maritime Regional FSC Standards. All wood products from Pictou Landing can now be labeled with an internationally recognized ‘green’ stamp of approval. According to the Mi’kmaq-Maliseet Nations News,

> “*This no small achievement. In fact it is huge. It is something that the Federal and Provincial Governments have yet to learn to do. It is a first in Nova Scotia. It is an accomplishment first among the First Nations of Canada. It puts Pictou Landing First Nation in the lead and as part of a group recognized the world over as the best*.”

Bill McKay, Mi’kmaq Maliseet Nations News, June 2000.

McKay now receives an average of one call a week from buyers interested in purchasing certified wood from the Pictou Landing forest. He cannot meet the demand, but he is delighted with the interest. Perhaps most importantly, Pictou Landing is now the envy of First Nations bands across the province, some of which have expressed their intent to emulate the Pictou Landing example.

As the first FSC certified operation in the province, the first First Nations certification in Canada, and only one of a handful of woodlots across the country holding this distinction, the Pictou Landing First Nation has good reason to be proud of its achievement. Members of the community experienced a sense of personal and community pride, showing friends the announcement in the paper. It is hoped that the positive reinforcement from this certification will help to overcome prior apathy in the community, and to provide new opportunities for employment, education and training for band members.

The following case study outlines many details of the restoration management system for the Pictou Landing forest, and how this impacts ecological values and social well being. The enormous benefits of restoration - to the forest, and to the people of Pictou Landing, are compared to the up-front financial costs of stand improvement, road building, training, and all other expenses associated with the new management regime. Had these forests never been degraded, little or no investment would be required today to restore these once productive, healthy, and diverse forest ecosystems. Thus, these current costs should be understood both as a proxy for past degradation as well as an investment in the future.

2. Physical Description of Land

The Pictou Landing First Nation reserve is located north of the town of Trenton in Pictou County, Nova Scotia, on the eastern side of Pictou Harbor, and on the southern shore of the Northumberland Strait. The reserve is approximately 465 hectares in size, of which 385 hectares have been designated as forest resource. The band plans to acquire more land as it becomes available, in order to build up its forest resource.

Pictou Landing is classified by Loucks (1962) as part of the Northumberland Shore District of the Maritime Lowland Ecoregion. This is part of the red spruce, hemlock, and pine zone. The area immediately around Pictou Landing and Boat Harbor has been modified by local landforms and climate, such that conditions are favourable for the growth of tolerant hardwoods.

> "*The forest composition and structure on the Pictou Landing forest today is substantially different than the conditions found by the first European settlers in the area. There is still some evidence as to the likely composition of the forest, but we are left to surmise the whole picture*." (Prest 1999).

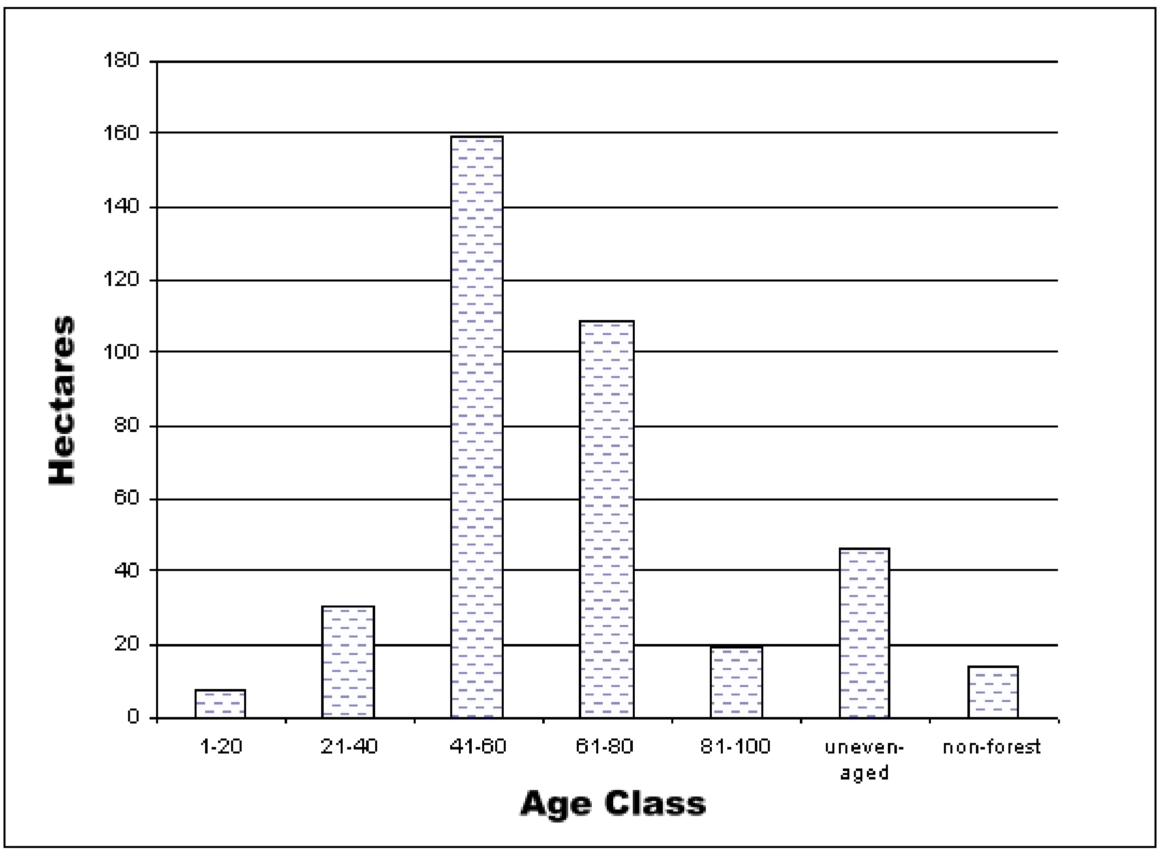
White pine and red oak, once common tree species throughout Nova Scotia, were favoured by the early shipbuilders. The abundance of these and other valuable, heavy seeded species has declined significantly. The presence of naturally regenerated oak, ash, yellow birch, and pine seedlings in the Pictou Landing forest suggests that these species, given the opportunity, could again attain representation on the landscape at levels found in the original Acadian forest.

By the early 1900s, the lands of the Pictou Landing Indian Reservation had been repeatedly burned, cleared, and high-graded. Much of the land was turned into homesteads and farmland, most of which were abandoned in the 1930s and 1940s. A letter written in 1900 by a land agent responsible for establishing Indian Reservations indicated there was not enough wood on the Pictou Landing Indian Reservation to fuel band members' homes for more than three years.

2.1 Age Class and Cover Type

Today, the Pictou Landing forest is dominated by early and mid-successional[9] forest types, with 73% of the forest 40-80 years of age (Figure 6). Ten percent of the forest is less than 40 years old, while 5% is 80-100 years of age. Most of the stands originated after harvesting or following abandonment of cultivated lands in the first half of this century.

Figure 6. Age Class Distribution of Pictou Landing Forest



Source: Prest, 1999.

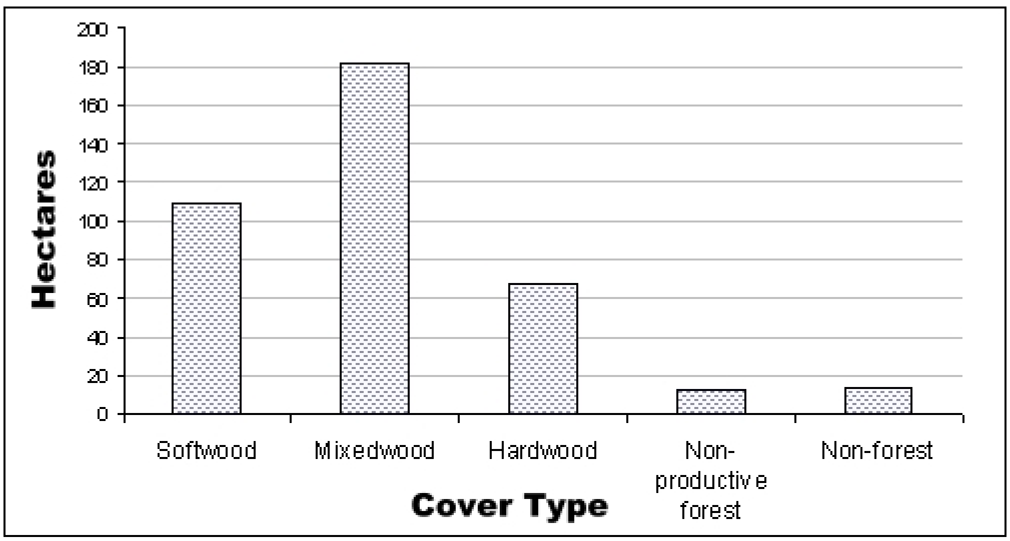
[9] Succession refers to the orderly and predictable replacement of one plant community by another over time in the absence of disturbance (New Hampshire Forest Sustainability Standards Work Team 1997)

Softwood stands, accounting for 30% of the forest, are comprised of commercially important species, such as red spruce, white spruce, balsam fir, hemlock, white pine, red pine, and larch (Figure 7). Roughly half the standing volume of softwood stands is saw material (sawlogs, studwood, poles), and half is cordwood (pulpwood). The hardwood component is dominated by early to mid-successional species, such as red maple, white birch and poplar.

Unlike Windhorse Farm, where the main wood products are high quality hardwoods and softwoods, 96% of the merchantable volume of hardwood species from Pictou Landing is considered low value cordwood. White ash, red oak, yellow birch, and sugar maple are present only in small quantities. Just under 3.5% of forest cover types are considered non-productive forestland. Less than 4% of the 'Pictou Landing Forest' is non-forest, including open fields and wetlands without tree cover.

A comprehensive exploration of the Pictou Landing forest resulted in the discovery of an old-growth hemlock stand. This site has been removed from the harvest plan, and is slated to become a spiritual focal point, as well as a symbol of what restoration forestry could accomplish in the remainder of the management unit.

Figure 7. Cover-Type Distribution of Pictou Landing Forest



Source: Prest, 1999.

3. Forest Operations

3.1 Objectives

Management objectives for the Pictou Landing Forest include:

- high quality recreational opportunities, such as hunting, gathering, and viewing of wildlife;

- maintenance and enhancement of high-order ecological functions, characterized by clean water, carbon sequestration, and high plant and animal diversity;
- educational opportunities, to enhance community understanding and learning about the forest environment; and
- economic benefits, including employment and training, income from stumpage, and raw materials for Native crafts.

3.2 Forest Restoration

In order to achieve the above objectives, McKay and Hudson, with the help and support of the Pictou Landing Band Council, have adopted low impact forest practices that favour the more valuable, long-lived species in the forest. The forest manager's long-term goal is to restore the forest to conditions similar to that of the original Acadian Forest, i.e. to a tree species mix, abundance, and age class distribution similar to that which existed in this part of Nova Scotia prior to European settlement.

Defining the 'Acadian Forest' is no simple task. A combination of historical inventories, historical accounts, forestry studies, and small remnants of old forests provide a fair amount of material which can be used to conceptualize the original Acadian forest. The forest managers have taken that available information as well as the site characteristics into account to formulate prescriptions for each stand in the management plan.

In addition, prior to harvesting, a detailed stand assessment is carried out to identify those trees whose retention will contribute most to the management objectives. The handling of the stand is partially determined by the needs of relatively few 'restoration' trees. Restoration trees are the remnant, long-lived, shade and semi-shade tolerant species that were once more dominant in the forests of Nova Scotia, such as sugar maple, red oak, beech, hemlock, red pine, yellow birch, white ash and red spruce (Wilson 2001; Mosseler *et al*. 2000). Centuries of high-grading and clearcutting have resulted in major declines in these tree species (with the exception of beech, which has been devastated by an exotic disease).

Restoration can also refer to the promotion of under-represented species that were never dominant in the forest canopy, but have important cultural or biological value. Black ash, for example, is now quite rare in Nova Scotia, and is very significant to the Mi'kmaq.

Unlike the typical industrial paradigm in Nova Scotia, in which forests are managed in short rotations for short-lived, coniferous tree species, the major goals of restoration forestry include:

- increasing the frequency of occurrence of Acadian forest species;
- creating a multi-aged, older forest; and,
- increasing the dead wood component in the forest.

In the mid-1990s, forest management objectives at Pictou Landing shifted to restoration, and Mr. McKay and Mr. Hudson embarked upon a management regime that entailed crop-tree release and crop-tree improvement, employing a combination of single tree selection, group selection, and shelterwood harvesting techniques. Management objectives include the following:

- With appropriate, low intensity harvests, preference is now given to retaining and promoting late successional tree species, like those mentioned above.
- Slow growing trees are removed, provided their removal does not compromise the residual stand, nor involve unnecessary expense.
- Vertical structure is maintained by retaining healthy individuals of as many species, age, diameter, and height classes as possible.
- The maximum height of individual stands is maintained by retaining the tallest trees in each stand.
- Deadwood, in the form of standing dead trees, as well as downed woody debris, is retained and recruited to improve soil fertility, structure, and water retention capacities, and to provide habitat for numerous species of wildlife.

3.3 Annual Removal of Wood Products

In 1999, the Pictou Landing First Nation contracted Wade Prest, a professional forester, to write a Forest Management Plan (1999). In calculating an annual allowable cut (AAC) for the Pictou Landing forest appropriate to the new management regime, Prest adopted a conservative approach characterized by the following considerations:

- Growth and yield predictions were made using the best available information for annual growth increments from the Nova Scotia Department of Natural Resources.
- Reductions for stocking levels, insect damage, disease, blow downs, buffers, stand health, and vigour were made in an effort to reflect the true productivity of the forest.
- Fields, fens, bogs, swamps, no-logging zones, permanent reserves, and Special Management Zones (where harvesting is significantly restricted) were deducted from the timberland base.
- The red pine plantations, growing vigorously at present, are particularly vulnerable to Scleroderris canker and Sirrococcus shoot blight. Prest adopted a cautious approach and allowed for a major reduction in returns from these plantations.

Based on these considersations, Prest's Annual Allowable Cut calculations are shown in Table 8. These calculations will be reviewed periodically, and growth estimates revisited, based on data from a series of Permanent Sample Plots. These plots are being established throughout the Pictou Landing forest in a variety of stands that are undergoing varying treatments.

The Pictou Landing AAC allows for the harvesting of 1.26-1.46 m^3/ha, depending on whether one includes Special Management Zones in the calculations. Excluding Special Management Zones, the AAC is 1.46 m^3/ha. For the province of Nova Scotia, the AAC, which is sometimes referred to as a "sustainable harvest level", is 2.6 m^3/ha, nearly double that of Pictou Landing. Therefore, the Nova Scotia government supports the harvesting of roughly two times more wood per hectare of operable forest than Pictou Landing – at a time when the forests of Nova Scotia have never been so degraded (Sandberg 1992), and the cutting so heavy (Wilson 2001).

Table 8. Calculations of Annual Allowable Cut for Pictou Landing Forest

	Softwood (m^3)	Hardwood (m^3)	Total (m^3)
Total Annual Available Growth	467	228	695
Reductions for:			
Insects 10%	47	23	70
Disease 10%	47	23	70
Blow down 15%	70	0	70
Buffer 10%	46	23	69
Annual Allowable Cut	257 m^3	159 m^3	416 m^3

Source: Prest, 1999

A record of harvest volumes from 1995-2001 is shown in Table 9. During this past fiscal year, April 2000-March 2001, 53.4 m^3 of sawlogs were harvested, along with 7.3 m^3 of studwood, and 3.6 m^3 of fish poles. In 1999, 47 m^3 of poplar were harvested, 10.9 m^3 of firewood, 86.9 m^3 of fir and spruce pulpwood, 50 pieces of 5-foot long small diameter red pine, and 40 spruce for fish weir poles. In 1998, 57.64 m^3 of red pine poles and 3.6 m^3 of spruce poles were harvested. From 1995-1997, softwood and hardwood were harvested, with the larger harvests reflecting mostly softwood pulp.

Table 9. Harvest Record for Pictou Landing

Year	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01
Total m^3 stacked	1475.9	479.52	337.95	61.24	144.8	64.37

Source: McKay, 2001; Prest, 1999

Harvest volumes have decreased since 1995, when shelterwood was the primary harvesting system at Pictou Landing. When shelterwood harvesting was adopted in the early 1990s, it was an improvement over ‘remnant removal,’ or conventional clearcutting practices. However, band members soon realised that shelterwood harvests, as practiced then, were essentially a clearcut in disguise. As generally practiced in Nova Scotia, shelterwood cutting is basically a two-stage clearcut that is essentially focused on fiber removal, and not on health of the living forest. Several band members expressed their discontent with such large removals of volume at any one time. As McKay learned more about Netukulimk, restoration forestry became the focus of management.

The Pictou Landing forest provides a variety of forest products used for both conventional and traditional purposes, including firewood, pulpwood, sawlogs, fish weir poles, and sweat lodge poles (Table 10). Firewood is made available to band members, while the pulpwood and sawlog material are sold to the best available markets. On occasion, poplar and hemlock are sold to Windhorse Farm, where they are processed into moldings, flooring and other products. Fish weir and sweat lodge poles are cut for band members on request.

McKay calculates that the current rate of employment per volume of wood harvested over the past 3 years has ranged between 1.6-2.2 person years per 1000 m^3 of wood. This is comparable to the employment/biomass ratio of the pulp and paper industry (See Chapter 8, Figure 17). McKay hopes that this ratio will increase for Pictou Landing with increased use of wood in basket making, crafts, and a portable sawmill. Also, as vigorous, late successional tree species are promoted and underplanted,[10] the proportion of valuable lumber per tree harvested will also increase.

Table 10. Forest Products from Pictou Landing

Common Name	Scientific Name	Product
Poplar	Populus	moulding, veneer
White Birch	Betula papyrifera	firewood
Red Spruce	Picea rubens	sawlogs, studwood, pulp
White Spruce	Picea glauca	sawlogs, studwood, pulp, fish weir poles
Red Pine	Pinus resinosa	sweat lodge poles
Balsam Fir	Abies balsamea	sawlogs, studwood, pulp

Source: McKay, 2001; Prest, 1999

3.4 Harvesting

Harvesting is carried out using the cut-to-length system, which involves felling, delimbing, and bucking at the stump. Harvesting crews have been trained in directional felling techniques – taking care to minimize all forms of logging damage within stands. The SmartWood assessment team noted there was almost no damage to residual trees. This is a good indication that the managers of Pictou Landing are investing in the long-term health and vigour of future stands.

Prior to 2001, the extraction of wood was carried out with porters and tractors. The porters had wide flotation tires to minimize soil compaction, and the tractors hauled wood to trailside with a winch. Harvest operations were conducted in the dry season of August and September. More recently, a small-sized forwarder has been used to extract wood, with the use of a winch and cable where machine entry is inappropriate. To minimize soil disturbance, harvesting and extraction are now being carried out in the winter months, from January-March (as at Windhorse Farm), or during the dry summer months.

Mr. McKay is currently testing the concept of a 'Silent Season' from April to July to minimize disturbance to wildlife and soils. During this time, no machines can operate in the woods. This is a time when animals are busy breeding and rearing young, and when soils are still saturated from snowmelt and spring rains, and thus most susceptible to damage. Repeated passes of heavy

[10] Underplanting is a technique used to supplement natural regeneration of desired tree species, by planting seedlings of the desired species in suitable locations. This is one of the mechanisms used to restore the dominance of under-represented, late successional Acadian tree species.

equipment over forest soils, especially during wet conditions, can disrupt topsoil, mix soil layers, create deep ruts, and compact soil air spaces. In turn, this affects the feeder roots in the top six inches of soil, and can lower the productivity of the site (Mou *et al.* 1993; Turcotte *et al*. 1991).

The Pictou Landing efforts to maintain healthy soils are in stark contrast to the activities of conventional operators, whose debt load and depreciation costs require that equipment be utilized as much as 24 hours a day, 7 days a week to cover loan payments, regardless of the season (See Chapter 9, Section 1).

The managers of the Pictou Landing forest tried to hire horse loggers to do skidding work, but soon found that local and regional teams were in such high demand that they were not readily available for such a small and seasonal operation. As a result, they have settled on the use of small-scale equipment, such as tractors and small-sized skidders, which allow frequent entries with low volume removal.

3.5 Protected Areas and Special Management Zones

The forest technician, Alton Hudson, has walked this management unit for approximately fifteen years, and has not yet located any areas with unusually high levels of native species or ecosystem diversity. This is confirmed both by Wade Prest, the forester who prepared the forest management plan, and by Marion Zinck, an authority on regional botany, who have both independently assessed the site and not located any such areas. Given that the Pictou Landing forest is only 385 hectares in size, it appears that unusually high native species abundance and ecosystem diversity no longer exist on this site.

As the band continues to acquire land, to increase the size of its ownership, and to restore elements of the Acadian forest, the ecological and biological value of the Pictou Landing forest will also increase. Similarly, Boat Harbor, which was once a tidal pond, and is currently a pulp and paper effluent treatment facility, may well have been a popular breeding area and layover for waterfowl. With restoration, Boat Harbor could once again become a destination for waterfowl.

To date, a small stand of old hemlocks has been set aside as a permanent reserve, as have riparian buffer strips along streams and ponds. In total, 54.5 hectares have been set aside because they are either unproductive, or non-forest, or protecting riparian areas (Table 11).

Table 11. Total Area in Distinct Land Use Categories

Management type	Area in hectares
Non-productive + non-forest + riparian area	54.5
Special Management Zone	45.0
Timber harvesting	285.0

Source: Prest, 1999

In addition to the no-logging zones, which comprise 14% of the Pictou Landing 'forest,' 16% of the total area has been allocated as Special Management Zones (SMZs), where timber extraction is significantly curtailed due to a higher priority placed on other values, such as water quality, wildlife, or aesthetics. Examples include stream corridors, forest swamps, and areas that sustain heavy use by wildlife. SMZs are not off limits to timber extraction. However any extraction activities must be conducted in a manner that does not disturb or degrade the significant values of the area.

4. Social Benefits

The benefits of the Pictou Landing forest operation, and from FSC certification, go far beyond the sale of wood products. The Pictou Landing Band shares many of the chronic problems reported in national publications on the demographics of indigenous peoples in Canada. These documents report that many First Nations communities in the country suffer from substance abuse, crime, and poverty, as well as feelings of helplessness, low self-esteem, and inadequacy, which are the historical legacy of conquest and cultural domination (Minister of Indian Affairs and Northern Development 1997). The forest has become an experimental 'healing ground' for the band, where band members can regain lost skills, renew their interest in their environment, improve their confidence in themselves and in their community, learn skills and knowledge of interest to others, and regain control over their own destiny.

Following is a description of these social benefits, which are a key goal of the restoration forestry plan. These benefits include:

- community control of forest management operations;
- optimizing hunting and wildlife-viewing opportunities for band members;
- improved relations with neighbours;
- a good rapport with trusted contractors;
- restoring a sense of pride and accomplishment among community members;
- re-introduction or promotion of culturally valuable species, like black ash;
- promotion and education regarding non-timber forest products;
- training and employment opportunities in the woods;
- partnerships with local universities; and
- provision of basic supplies important to the community, such as firewood and poles.

4.1 Community Control

The Pictou Landing forest is owned by all the members of the Pictou Landing Band. While all members have been encouraged to provide input into the management of the forest,[11] a Community Forest Management Board has been established to oversee forestry activities, and to

[11] For example, door-to-door invitations were extended to band members to participate in a land information meeting on the Reserve, where information was provided about the forestry operation, and input sought from community members.

set community objectives and goals for forest management. The board has five positions, two of which must be filled by band members, a third by an elder, a fourth by a representative of the Band Council, and a fifth by a representative of the band staff. All representatives are selected by the Band Council, with advice from the First Nations Forestry Association of Nova Scotia, on the basis of candidates' interest and understanding of the forestry operations, and their reputation in the community.

In sharp contrast to today's global economy, in which many people feel increasingly disenfranchised and lacking in control over their own destiny, the Pictou Landing community has regained a sense of control and ownership over its commonly held lands.

In 1993, the Pictou Landing Band successfully sued the Federal government for breach of fiduciary responsibilities, for allowing Scott Paper to locate its effluent treatment lagoon in Boat Harbor, producing adverse health and environmental impacts on the Pictou Landing community. The band received $35 million as a settlement. This has resulted in a $20 million fund being established and held in trust for the community to enable it to encourage social and economic development.

As part of the settlement, treatment of effluent from the pulp mill was changed to reduce gaseous emissions, and to reduce the quantity of toxic chemicals flowing into the lagoon. In addition, the pulp mill was ordered to find an alternate treatment facility by the year 2005.

4.2 Wildlife and Hunting

Band members are being encouraged to increase their understanding of ecology and the forest environment, and in particular how this relates to their woodland and to their own history, culture, and traditions. Biologist Bob Bancroft is carrying out a four-season survey of wildlife in the Pictou Landing forest. Bancroft will prepare two lists, one describing all the species he saw, heard, or found evidence of, and the second describing the species he did not find, but that he suspects are present. Both lists will be posted in the band office, and band members will be encouraged to find those suspected of being present, and to check them on the list if they find evidence of them.

Hunting, in particular, is a highly valued recreational pursuit of the Pictou Landing Band, as well as a source of meat for the winter. Considerable attention has been paid to optimizing game habitat in areas already frequented by deer, hare, and grouse. In particular, three Special Management Zones for wildlife have been identified, including a 50-acre field and surrounding forest where plans are under way to attract many different species of wildlife by making slight modifications in habitat. One of these modifications will be the construction of several ponds to encourage beaver activity.

Future plans also include the creation of an Interpretation Center, which will be used as an educational tool to teach visitors about the Mi'kmaq culture, restoration forestry, wildlife, and conservation. Visitors to the Center would generate tourism dollars in the region by buying native crafts, and by supporting local eating establishments, gas stations, hotels, and inns.

4.3 Neighborly Relations

Being the first and only FSC-certified forest operation in Nova Scotia has created a sense of accomplishment among band members. Another Mi'kmaq Band has expressed envy and interest in emulating the Pictou Landing example, and has become much more open to sharing management of an additional, co-owned property. Landowners abutting the Pictou Landing forest have also become more co-operative both in selling land to the band, and in establishing mutually agreed boundary lines.

Over the years, a good rapport has been established with a select group of reliable local contractors and individuals, including road-builders, harvesting crews, foresters, and others. Harvesting crews have been trained by Bill McKay and Alton Hudson, as well as by an independent silviculture contractor, Tom Miller. Many members of the harvesting crew are from the Pictou Landing Band, and are either hired directly by the Band Council, or indirectly through a local independent contractor.

4.4 Indirect social and Health Benefits

While some of the social benefits from this forest operation are more immediate, such as the improved forestry skills of some band members, and the sense of pride in being the only certified operation in the province, other benefits are more difficult to quantify, though no less important. These indirect benefits include reduced rates of alcohol and drug abuse, incarceration, and dependence on welfare, employment insurance, and health care.

A recent GPI Atlantic report (Dodds and Colman 1999) demonstrates that crime costs Nova Scotia $1.2 billion a year in direct and indirect costs. Reduced crime and incarceration rates provide both direct savings to the justice system, and indirect savings through avoided productivity losses. Similarly, the societal costs related to Fetal Alcohol Syndrome - a common illness among children on Canadian First Nations Reservations - were recently enumerated by Dr. Gideon Koren of the Toronto Hospital for Sick Children. Koren concluded: "The health cost of each case of FAS [Fetal Alcohol Syndrome] is several million dollars over a lifetime" (Wente 2001). Thus, reduced rates of alcohol and drug dependence will also save both the band and the province substantial costs.

Through forest restoration and other projects that instill a sense of pride and accomplishment, it is hoped that the Pictou Landing Band will become a healthier and more self-reliant community, in which individuals are better able to contribute to their own well being and to society as a whole. While accounts of forest restoration efforts frequently recognize their important ecological benefits, the social benefits of sustainable forest management are less often acknowledged. At Pictou Landing, social goals are primary, and this case study can therefore play an important role in elucidating the more subtle social functions performed by forests.

4.5 Black Ash Reintroduction

Black ash has long been prized by the Mi'kmaq for baskets, snowshoes, and canoe ribs. The First Nations Forestry Association of Nova Scotia has gone to great lengths to find a seed source for black ash in proximity to Pictou Landing. A "Wanted Alive" brochure was designed and distributed across the province to garner help from naturalists and others to locate healthy, seed-producing black ash trees. Several sources were located, and the seeds were subsequently collected and germinated, in an effort that received accolades in the provincial press. Appropriate areas of the Pictou Landing Forest, and other First Nations lands, will be under-planted with black ash seedlings.

4.6 Non-Timber Forest Products

The Pictou Landing forest is expected to provide high quality recreational opportunities, including hiking, viewing of wildlife, and gathering of natural food, medicinal plants and raw materials for use in crafts. Marion Zinck, a leading botanist in the province, was hired to carry out an inventory of the Pictou Landing Forest, as well as to identify all the plants that have been traditionally harvested by the Mi'kmaq for food, fiber, medicinal and other purposes.

Zinck spent several days in the field with band members and technical staff, and noted that some of the band members were already very familiar with the uses and values of different plants. For example, several band members have already been collecting white birch bark for wild-crafting purposes, and a pure stand of white birch is now being promoted for this purpose.

4.7 Employment and Training Opportunities

Most forest management activities involve band members, as well as local contractors and trainers. Band members are given the first opportunity for employment in the woods. However, if they do not possess the necessary skills or equipment, skilled local contractors are hired instead, while efforts are made to provide the requisite training to band members. In 1998, for example, six band members participated in a four-week training course that involved chainsaw instruction, and selection harvesting and felling techniques. Interestingly, the training course was offered to the six most vocal opponents of the restoration forestry operation. The trainees were paid for their time, and, as a result of this course, they became strong supporters of the forestry program.

Currently, many of the new trainees are still working in the lobster fishery, so Tom Miller, a local contractor, does the majority of the woods work. Logging crews are paid going rates, and are expected to work 8-hour days. In the winter, workdays are closer to 6-7 hours, given the tendency for operators to get wet and cold.

Several band members have been involved in building birdhouses from the forest's certified lumber. As noted above, these birdhouses have now been put up in the Pictou Landing forest as part of a school-based project designed to involve children in the forest restoration efforts.

Another band member, who owns a portable sawmill, was encouraged to get it working again, and to mill logs from the forest. He milled some wood from the forest in the fall of 2000, but has since been offered other work as a mechanic.

An elder in the community creates rustic furniture from wood harvested in the Pictou Landing forest. The demand for his products, through word of mouth alone, is more than he can fulfill. This gentleman is in his seventies, and the band is hoping he will train some of the young people in the community to make furniture. With proper marketing, emphasizing the use of certified wood from the Pictou Landing forest, this initiative may create several more jobs that will be available on a year-round basis.

This furniture-making initiative is a small example of the kind of value-added activity that can create more jobs and economic benefit per unit of biomass harvested than current practices that have massively increased harvest levels while leaving Nova Scotia with one of the lowest levels of value-added forest activity in the country. (See Chapter 6, Finewood Flooring and Lumber, for further discussion on the potential of value-added forest industries for job creation in the province.)

In order to further forest-related employment and training opportunities for band members, McKay arranges for interested band members to undertake training at Windhorse Farm's Maritime Ecoforestry School, where they learn the basics of restoration forestry, forest ecology, and sustainable forest management and harvesting techniques.

4.8 Ties with Local Universities

Pictou Landing First Nation is working with St. Francis Xavier University in Antigonish to develop mutual 'Teaching-Learning' opportunities. The university's biology and chemistry programs, in particular, can benefit by studying the impacts of a restoration forestry operation on flora and fauna, and on soil and water quality, just as the Pictou Landing community can benefit from its association with the university.

The opportunity for Pictou Landing youth to be involved with university research may kindle the interest of young minds and inspire youth to stay in school and move into areas of scientific study. Many young people at Pictou Landing fail to see their value to their families and communities, with low self-esteem a recurring issue. Exposure to professors and students from the university, and their own important role in introducing these visitors to the Pictou Landing Forest, may help reduce these feelings of inadequacy, and introduce new interests among band members.

The new relationship will provide opportunities for the Pictou Landing community and the university to exchange information and to learn from each other. Beyond their specific, specialized fields of study, university students will become familiar with aspects of Mi'kmaq culture, history, and tradition, and the challenges faced by Mi'kmaq communities.

The partnership between Pictou Landing and St. Francis Xavier University was recently cemented with the hiring of two university students for the summer of 2001 to carry out an inventory of reptiles, amphibians, and insects in the Pictou Landing forest. The students have also been directed to look for and identify fish in the streams. One of these students is a band member, the other a resident of nearby New Glasgow.

In Halifax, Dalhousie University's Community Development Plan was designed as a pilot project to assist selected First Nation communities in Atlantic Canada to maximize their income from the variety of resources available to them. Pictou Landing was chosen as one of the few successful candidates to participate in this program (partly due to its demonstrated commitment to improve its situation, as demonstrated through the certification of its forests). The university's Community Development Plan provides a community trainee to work with the Pictou Landing community to create a blueprint for a more stable and vibrant economic future.

4.9 Provision of Firewood and Other Wood products for the Community

Up to 20% of the wood cut in the Pictou Landing forest is hardwood, much of it low quality lumber that is made available as firewood to band members. On occasion, spruce and red pine poles have also been cut from the forest and used for ceremonial and fishing purposes by band members.

5. Conservation of Biological Diversity

5.1 Ecosystem Resilience

Ecosystem resilience refers to the ability of an ecosystem to withstand and recover from disturbance. Disturbances may be natural in origin, such as an insect infestation, fire, or hurricane, or they may be anthropogenic in origin, such as a clearcut, or a highway development. The ability of an ecosystem to resist a disturbance depends on many factors, including the severity, frequency of recurrence, and areal extent of the disturbance; the buffering capacity of the system; the nature and extent of existing stressors; the area's particular land use history; and other influences (Freedman 1995).

An intact forest ecosystem, characterized by continuous or relatively continuous canopy closure; a high degree of plant and animal diversity; a relative abudance of long-lived late successional tree species; stable water flows; continuous production of clean water; and large quantities of dead woody debris, has far more inherent stability, and thus resilience to anthropogenic and natural disturbances, than a system without these characteristics (Odum 1981; Bormann and Likens 1979).

Given the land use history of the Pictou Landing forest, it is useful to examine the current condition of the forest with respect to ecosystem resilience. Some of the key indicators of ecological integrity are:

- the level of fragmentation and connectedness of forested areas;
- the degree of forest canopy closure;
- soil productivity;
- presence of late-successional floral and faunal species; and
- structural, species, and genetic diversity.

5.1.1 Level of Fragmentation and Connectedness of Forest Ecosystem

Forest fragmentation and 'edge effects' are important considerations when planning for the conservation of native biodiversity. Edge effects occur where there is a break in the forest canopy, for example, when a road or power corridor is cut through an area of continuous forest cover. The impacts on the surrounding forest include increased light, temperature and wind speeds; decreased humidity; and greater contact with humans as well as with aggressive edge species. The net result of these edge effects is increased stress on interior forest species, forcing them to withdraw further into the stand, find residence elsewhere, or attempt to remain viable in the face of deteriorating conditions.

Those species that are most threatened by clearcuts, roads, and other openings in the forest canopy tend to fit into one or more of the following categories:

- They require large territories, and/or large uninterrupted tracts of forests;
- They are susceptible to predation and parasitism by edge-loving species;
- They are sensitive to human contact;
- They are frequently killed on roads, because they tend to seek out roads for heat or food; and
- They are unlikely or unable to traverse large openings (Schonewald-Cox and Buechner 1992).

In Nova Scotia, species that are vulnerable to this type of forest fragmentation and degradation include:

- songbirds, like the northern parula warbler and black-throated blue warbler;
- the black-backed and pileated woodpeckers;
- birds-of-prey, including the northern goshawk;
- mammals, like the pine marten, lynx, moose, and fisher;
- reptiles like the wood turtle; and
- amphibians like the blue-spotted salamander (Wilson 2001; NSDNR 2001; Freedman *et al*. 1994; Robbins *et al*. 1989).

The Pictou Landing forest is a relatively small, intensively used area with an established road network for forest operations, several old fields and plantations, and a history of forest management that, until 1993, included significant removal of the forest canopy. Given this level of use, the forest cover is relatively fragmented, and the area is unlikely to hold great potential for those species that require large tracts of continuous forest cover.

Nevertheless, the forest managers are attempting to minimize further fragmentation, through careful road design and through restoration of the forest canopy. The road system is currently being modified both to minimize road lengths and to avoid wet areas, with no further construction of forest access roads anticipated. Instead, additional extraction trails will be utilized. Road construction and maintenance procedures are carried out in accordance with the environmental standards outlined in the First Nations Forestry Association's *Road Construction Manual* (McKay and Hudson 1998).

5.1.2 Crown Transparency

Prior to 1993, the managers of the Pictou Landing forest prescribed three basic harvest and planting methods:

1) two-stage shelterwood harvesting systems (essentially an even-aged forest management technique staged over 5-8 years to encourage the natural regeneration of preferred tree species);
2) 'remnant removal' (one stage clearcut or bulldozing of existing cover); and
3) planting of red pine.

As a result, the canopy has been significantly opened in places.

More recent operations have involved selection and shelterwood harvesting techniques, in which the canopy is opened just enough to encourage the regeneration of moderately shade tolerant species like white pine, red oak, and yellow birch. The forest managers aim to be within 20% of the natural canopy closure for this forest, which is likely in the 80-90% range. This means that if one were to look down on this kind of forest in its natural state, the layer formed by the crowns of the taller trees in the forest would cover 80-90% of the ground. If, on the other hand, one were to look down on a recent clearcut in which all standing trees have been removed, there would be 0% canopy closure. Therefore, harvesting activities at Pictou Landing are conducted in such a way as to maintain as high a degree of natural canopy closure as possible.

5.1.3 Ecological Functions and Biological Components

According to the Pictou Landing Forest Management Plan (Prest 1999. p.36):

> *"The productivity of many sites in the Pictou Landing forest has declined due to abusive land use practices over the past 200 years....Forest harvesters invariably selected the tallest, largest, straightest, most valuable trees of the most valuable species. Inferior individuals of inferior species...were left to dominate the site and regenerate."*

The legacy of past land use abuses is demonstrated by large gaps in the forest canopy; domination by ecologically and economically inferior early successional species; poor quality growing stock; low canopy height; paucity of dead wood; and low productivity.

"While productivity of the first forest to reoccupy the site may be high in terms of fiber production, ecological functions have not been restored. It is unlikely that these sites will recover their original capability unless this ecological integrity is re-established....Today, productivity of the Pictou Landing forest is estimated to be approximately 50% of its capability." (Prest 1999)

At present, the degraded nature of the Pictou Landing forest creates limited opportunities for demonstration of high order ecology. According to Prest (1999):

"Many years of careful management will be needed to begin to restore ecological function to the forest."

Repairing centuries of abuse and degradation takes far more than a few decades: soil organic matter has to be built up again; under-represented species promoted or re-introduced; tree height and girth increased; canopy layers diversified; vigorous, healthy trees selected for; and standing and downed dead wood increased in abundance and size. Even fast-tracking restoration will take a very long time, so that present generations will not be able to realise the full benefits of restoration forestry. Because such restoration is literally an investment in the wellbeing of future generations, it makes long-term economic sense to encourage it actively through financial and taxation incentives.

5.1.4 Natural and Artificial Regeneration

The Pictou Landing forest managers understand that restoring stand diversity and maintaining natural ecological processes will naturally keep insect attacks and disease infestations in check. Insects are considered natural elements of the forest ecosystem: "We want bugs and bug eaters in our forest" (Bancroft et. al. 1999). This is one key reason that the managers have banned the use of biocides, and placed a moratorium on the establishment of any additional even-aged plantations in the Pictou Landing Forest.

The last time a plantation was established at Pictou Landing was in 1991, two years before the new management regime, when 5.7 hectares was cut, site prepared with a crusher, and planted to red pine. The long-term plans for this and the two other red pine plantations at Pictou Landing are to create openings in the plantations in order to encourage the natural regeneration of other desirable species and to increase diversity within the plantations. However, the managers will also ensure that red pine is maintained on the landscape and that it is a future component of the Pictou Landing forest. (These plantations are adjacent to naturally-occurring red pine stands). No further conversion of natural forest cover to plantation will take place. The overall forest management objectives are to create "an uneven-aged, eventually an all-aged forest".

The restoration plan for the Pictou Landing Forest will rely primarily on promoting the natural regeneration of desired tree species. In those areas where natural regeneration is insufficient, planting of desired species is being prescribed.

As noted above, a network of Permanent Sample Plots (PSPs) is being established in order to monitor and assess the success of these regeneration efforts. The data collected from these PSPs will be used to monitor changes in forest structure, growth, diversity, health, and effectiveness of silviculture treatments over time.

5.2 Species Diversity

5.2.1 Presence of Forest-Dependent Species-at-Risk Known to Occur in This Area

Expert advice is and has been sought from regional authorities by the Pictou Landing forest managers with regard to threatened and endangered species. Detailed plant information on the Pictou Landing forest has already been compiled by Marion Zinck of the Museum of Natural History, and commitments for wildlife assessments have been made with wildlife biologist Bob Bancroft. The management plan includes staff training for field identification of indicator species and threatened species. While there are a number of rare plant species known to occur in the region, only black ash, a rare but not threatened species, has been located within the forest management area.

5.2.2 Number of Known Forest-Dependent Species That Occupy Only a Small Portion of Their Former Range

Various tree species in Nova Scotia - generally the longer-lived, late successional species - are now greatly under-represented in today's younger, early successional forests. The converse is also true. Early successional species, like red maple, white birch, white spruce, and balsam fir, are highly over-represented on today's landscape. Eastern hemlock, red spruce, and red and white pine, are all species that were once more widespread across their range, but are still found - albeit in considerably lower abundance - in the Pictou Landing forest (Wilson 2001; Mosseler *et al*. 2000).

Similarly, all the various plant and animal species associated with these forest types have also changed in abundance in accordance with the change in forest cover. For example, there are many plant and animal species associated with old-growth forests, or with components of old-growth forests like large diameter trees, that are becoming increasingly rare on today's landscape. Examples include northern goshawks, American marten, fisher, southern flying squirrels, and Calypso orchids (NSDNR 2001; Singleton *et al*. 2000; Freedman *et al*. 1994).

5.3 Genetic Diversity

Restoration does not merely refer to the restoration of forest cover and species composition, but also to reversing the long-term depletion of genetic traits that make trees healthy, tall, straight, vigorous, and strong. The few black ash found in the Pictou Landing forest are unhealthy, poorly formed trees. This may be a consequence of where they grow, but it is also very likely a consequence of many centuries of black ash high-grading for cooperage (barrel making) and soap making.

Given the importance of black ash to First Nations, Bill McKay and the First Nations Forestry Association of Nova Scotia conducted a search for healthy, vigorous black ash seed trees throughout the province. Seeds were collected and germinated in greenhouses at the NS Agricultural College. These seedlings are now being used to restore black ash to the Pictou Landing forest and to other First Nations lands by underplanting in areas where they are currently found, and on similar sites nearby.

Planting of black ash, white pine, eastern white cedar, and late successional tree species is viewed as a means to hasten the return of a more site-suited, natural forest that corresponds more closely to the characteristics of the original Acadian forest. On-site or local seed sources are sought for these restoration programs in order to utilize the genetic material that is best adapted to the local conditions.

The current forest management system promotes only natural forest species. However, in 1991, before the switch to restoration forestry practices, approximately 1,000 Norway spruce were planted at Pictou Landing. The Pictou Landing forest management plan clearly states that exotic species will not be introduced in the future. In addition, as noted, three small-sized red pine plantations were established before 1992, the largest less than 5.7 hectares in size.

The performance of the red pine plantations has been exceptional to date, even though the seed source of the red pine seedlings originated in Alberta. This exotic seed source has been found to be far more vulnerable to the Scleroderris canker, while native red pine are much less vulnerable. Healthy, naturally occurring red pine trees near the plantations indicate that red pine may be an appropriate species for this site, but it is now understood that the seed source for the plantations should have been local in origin.

In sum, restoration forestry practices aim to ensure that the genetic stock of trees is both site-appropriate and of high quality, in order to ensure healthy growth and resistance to disease.

5.4 Maintenance and Enhancement of Significant Wildlife Habitat

The conversion of the Pictou Landing forests to early and mid-successional forest types has resulted in major changes in the wildlife species associated with different age classes and forest types. For example, those species that require large diameter cavity trees for all or part of their life cycle (See Chapter 1, Table 5) are more likely to be absent in the young Pictou Landing forests. Similarly, those species that have developed specific habitat requirements associated with older, multi-aged, structurally diverse forests are unlikely to be present in young, even-aged stands. Thus, in restoring the Pictou Landing forest, it will be necessary to pay special attention to the niche requirements of those species vulnerable to forest conversion, in order to gradually bring them back.

The managers of Pictou Landing forest are aware of these challenges, and have made the restoration of wildlife habitat - including dead standing trees - a key management objective. Stands are essentially being low-graded, with standing dead and dying wood left in treated areas. Low-grading is the opposite of high-grading, which is often summarized in the phrase "take the best, and leave the rest." In low-grading, by contrast, the manager is attempting to reverse a legacy of high-grading by removing poorly formed, unhealthy trees, and leaving the most vigorous, best formed trees as future growing stock.

The use of low-grading at Pictou Landing well illustrates the earlier argument that no one set of restoration forestry techniques should be blindly emulated, but that appropriate methods vary according to the particular conditions of a forest. While low-grading is not used at Windhorse Farm, where owner Jim Drescher regards it as inappropriate in a healthy forest that has been sustainbly logged for generations, it may be essential in a highly degraded forest that has been subjected to generations of high-grading.

At Pictou Landing, workers are also being trained to recognize trees with high biodiversity/habitat values, and to cut dead trees only when they pose a safety hazard. Innovative methods are used to recruit and recreate downed woody debris into stands. In this case, Pictou Landing has adopted some of the techniques utilized at Windhorse Farm for recruiting deadwood and emulating the habitat created by deadwood – including girdling to create snags, and creating slab walls and brush piles to simulate downed woody debris. In the words of forest scientist Charles Elton,

> *"Dying and dead wood provides one of the two or three greatest resources for animal species in a natural forest....If fallen timber and slightly decayed trees are removed the whole system is gravely impoverished of perhaps more than one fifth of its wildlife component"* (Maser and Trappe 1984).

The Pictou Landing Band has hired Bob Bancroft, a wildlife biologist, to carry out a four-season inventory of the birds and mammals in the Pictou Landing forest. He will also be making recommendations for a biodiversity project, and has supplied plans for more bird boxes to be placed in the forest. As part of an effort to improve habitat, birdhouses of various sizes and shapes have already been placed in the forest. These birdhouses will increase the availability of nesting sites and provide easier observation of breeding birds.

6. Conservation of Soil, Water and Carbon

6.1 Soils

6.1.1 Soil Conditions

Soil maps were consulted by Wade Prest, the author of the Pictou Landing forest management plan, and soil pits have been dug in sample plots to assess organic soil layers. Soils with severe operating limitations were identified in the forest management plan, and the prescribed silviculture treatments were modified accordingly. Several stands were identified as having severely degraded soils, reflected by poor performance in tree growth.

Thus, the historic uses of this land so degraded the ecological functions of the forest, including its inherent capacity to protect soil quality, that the long-term productivity of these sites has been significantly reduced. According to the forest managers, it is important that forest management activities at Pictou Landing not continue to degrade soils, but rather promote soil building.

6.1.2 Restoring Healthy Soils

The forest managers of Pictou Landing are cognizant of the importance of minimizing soil erosion, soil compaction, and nutrient depletion, in order to achieve their objectives for forest restoration. To this end, all harvesting and extraction is now carried out in the winter months when the ground is frozen, or during the dry summer months, using either a forwarder with wide floatation tires or a tractor and a winch. The forwarder trails have been heavily covered with branches from felled trees to minimize soil compaction and erosion.

Soils with severe operating limitations have been identified and delineated as Special Management Zones designed to protect water quality. In addition, buffer zones around watercourses prohibit the use of machinery in those areas. Site preparation techniques that could damage soil structure, fertility, or biological activity, or that cause erosion, are not employed.

A recent assessment of the Pictou Landing forest operations observed no adverse impacts on soils in any of the areas inspected. On the contrary, the assessment team noted that measures were being taken to protect forest soils. In one instance, a forwarder operator had piled unmerchantable stems and tops to form a corduroy surface on the main skid trail, in order to lessen the impact of the machinery on the site. Removal of soil nutrients and organic matter from the site is also minimized by felling, delimbing and bucking at the stump.

The concerns for soil health and long-term site productivity at Pictou Landing are in distinct contrast to the vast majority of forest operations in Nova Scotia. Harvesting generally takes place year-round, and comes to a halt only when deep snow or mud, and/or washouts prevent access. The adverse impacts of the use of heavy equipment on saturated soils are outlined in Section 3.4 above.

Furthermore, nearly all harvesting in Nova Scotia is done by clearcutting methods, with little if any concern for soils with severe operating limitations. Clearcut harvesting results in the leaching of nutrients from forest soils and in large exports of tree biomass, both of which can significantly degrade the productive capacity of forest soils (Maliondo 1988).

6.2 Conservation of Water Resources

The Pictou Landing forest management plan addresses the conservation of water resources and the provision of clean water by:

- establishing buffers along all watercourses and other wet areas,
- creating Special Management Zones (SMZs) that are managed for water quality, and
- careful road building practices.

Watercourses are protected by the *Watercourse Buffer Zone Guidelines,* adopted from the Maritime Regional Forest Stewardship Council Certification Standards. The intent of these guidelines is to ensure that aquatic habitat, water quality, and hydrological cycles are protected during road-building and forestry operations. The guidelines require a minimum, 30-metre-wide buffer zone on all sides of watercourses and water bodies that have an average width greater than 1 metre, and a 15-metre-wide buffer zone on watercourses that are less than 1 metre in width. Various conditions and factors can increase buffer width, such as slope or soil stability.

In addition to these buffers, riparian Special Management Zones have been established 30 metres on either side of brooks under 1 metre in width. Riparian SMZs are managed primarily for water quality. Other areas can also be designated as riparian SMZs due to special conditions, such as areas with perched water tables where soils are often soft and not conducive to the operation of machinery. This designation allows limited harvesting on frozen, snow-covered ground only. Furthermore, outside these buffer and special management zones, the forests are being cut using selection and shelterwood harvesting techniques, which further reduce the impacts of harvesting on water quantity and quality by comparison with clearcutting (O'Brien 1995).

Haul roads, landings, and main skid trails are designed, planned, and laid out prior to tree marking and logging activities. The road network has been laid out to avoid wet areas, and efforts have been made to minimize stream crossings and road length. The FSC certification team noted a water bar on one road as an indication that efforts are being made to divert surface water from flowing directly into the stream. Ditches and road crowns are well maintained in accordance with the high standards of the First Nations Forestry Association's *Road Construction Manual* (McKay and Hudson 1998). Ditches on recently constructed roads were hydro-seeded.

This combination of careful road-building, selection and shelterwood harvesting, buffer zones around watercourses and other wet areas, and the eventual decommissioning of Boat Harbor as an effluent treatment facility will also help to restore the original aquatic flora and fauna of this area.

These practices are in sharp contrast to the norm for the province. While Pictou Landing is working towards improving water quality, and protecting watersheds and forest hydrological cycles, forest practices in most of Nova Scotia are undermining the capacity of forests to moderate water flows and maintain high water quality (by moderating temperature fluctuations, providing inputs of large woody debris, and by minimizing sedimentation and nutrient losses) (O'Brien 1995). Almost all harvesting in the province is by clearcutting, and there are presently no regulations requiring no-logging zones along watercourses and water bodies on private land.

In addition, the increased rate of forest harvesting across the province (Wilson 2001, Section 8.1.1) has serious implications for many of the province's watersheds. Forest practices may also be implicated in the recent closures of shellfish beds due to poor water quality in the Bras D'or

Lakes (J. O'Brien pers comm. 2000), and in province-wide declines in salmon and trout populations (Wilson 2001, Section 9.2.4).

6.3 Carbon Storage

The loss of old-growth and older mature forests in Nova Scotia has produced a significant decline in the carbon storage value of provincial forests (Wilson 2001). Conversion of older forests to young naturally regenerated or planted stands results in a net loss of carbon to the atmosphere, largely because carbon stored in forest soils over hundreds or thousands of years is released when the forest is harvested (Wilson 2001).

In Nova Scotia, there are roughly 4.1 million hectares of forestland. According to calculations by Wilson (2001), the estimated total tree carbon storage in provincial forests is worth $2.2 billion. Thus, on average, each hectare of NS forests is worth $537 as a carbon sink. For the Pictou Landing forest, this translates into a current contribution of roughly $206,745 in carbon storage value, or potential damages avoided due to climate change. Because older trees store more carbon, restoration forestry practices that will gradually increase the proportion of older forests over time will gradually enhance the carbon sink value of the Pictou Landing forest.

7. Forest Economics

The following Section details the costs and the benefits of restoration forestry at Pictou Landing. As with any investment, costs are up front, while the benefits are realised gradually over time. Therefore, comparing current revenues with current expenditures, as in conventional accounting procedures and narrow cost-benefit analyses, is not accurate in the long-term, because this fails to account for the increased value of the standing forest. By refraining from harvesting more trees in the short-term (and thereby foregoing some revenue in the present), the band is investing in the future value of the forest, and building up its natural capital stock. That expansion of natural wealth will in turn result in an increased flow of forest services in the future.

While current revenue and expense statements cannot capture the future value of these current investments, they are nevertheless useful in indicating the degree and extent of social investment that is required to restore the province's forests. That is, restoration expenditures minus harvest revenues indicates the approximate magnitude of the social subsidy (tax/financial incentives) required to compensate for past damage, and to make necessary investments in the future. Public investment in restoring the province's natural wealth is justified both because current owners will not reap the full benefits of the investment, and because future generations of Nova Scotians will be the primary beneficiaries.

In addition to the investments needed to rebuild the natural capital of the forest, the managers of the Pictou Landing forest are attempting to rebuild the 'human capital' of the Pictou Landing Band. Thus, their investments in silviculture training, re-introducing black ash, creating a community forest management board, documenting wildlife, and attaining Forest Stewardship Council certification can also be viewed as investments in restoring the pride, self esteem, confidence, interest, and skills of band members. Like the forest, the benefits of these investments will be realised with time.

Both forest degradation and the history of First Nations' loss of independence have occurred over a long time span. Thus, current investments reflect ecological, human, and social damage costs accumulated over centuries. Similarly, the long life cycle of a forest, and the generations of commitment that it will take to restore Nova Scotia's forests to a semblance of their former value will see returns on current investments realised very gradually over many generations. As noted in the previous Chapter, "at some point the overdraft will have to be covered," and that overdraft is currently so great that responsibility for restoring the wealth can no longer be transferred to the next generation.

7.1 Expenditures

Total expenditures on forest management at Pictou Landing were estimated for the fiscal years April, 1994 to April, 2001 (Table 12). Until 1993, conventional even-aged management techniques were being practiced at Pictou Landing. Restoration forestry became the objective of management in 1994. Between 1994-2001, approximately $297,000 ($370,000 minus $73,000 in revenues and non-cash income) was spent on the management of Pictou Landing, with an average of $42,500 per year (Table 12 & 13). Some of these expenses are annual operating expenses, while others, like the black ash project, or the FSC scoping and assessment, are either one time capital investments or periodic costs.

With 385 hectares under active management, the annual cost per hectare for restoration of the Pictou Landing forest is roughly $110/hectare. Given the additional social investments in restoring the 'human capital' of the Pictou Landing Band, the per hectare cost of restoration is higher than that of Jeremy Frith ($35/ha/yr - see Chapter 3). The Pictou Landing restoration cost also falls between the second and third most expensive scenarios described by Jim Drescher in Chapter 1, Section 7, ($80/ha/yr - $150/ha/yr), but falls far short of the restoration cost estimates for the Menominee forests, at $750-$1,500/ha/yr (Chapter 4).

These varying estimates of restoration costs are further evidence of the wide range of available restoration options that depend both on the particular circumstances and conditions of different forests, including the extent of past damage, and on the capacity of landowners to afford active interventions. The $110/hectare restoration expenditure at Pictou Landing may nevertheless be a suitable proxy for costs in other First Nations communities, because of the considerable portion of these expenditures accounted for by social investments in the Pictou Landing Band through employment, training and community control.

A breakdown of some of the expenditures above may be useful to other woodlot owners and First Nations groups contemplating restoration expenditures, and to government officials with the understanding and vision to support these investments:

- Anywhere from $7,231 to $18,184 has been spent each year on the actual forest operation, including roads, underplanting, and forest improvement.
- Another $25,000 a year is the proportion of McKay's and Hudson's salaries and travel expenses devoted to Pictou Landing. (McKay and Hudson devote 10-15% of their time to

Pictou Landing; they also manage 15-18 other parcels of First Nations forestlands in the province).

- An additional $12,250 to $16,000 a year is invested in the forest by the Pictou Landing Band Council, including:
  - time spent organizing and participating in meetings with the Community Forest Management Board and public information meetings;
  - having a bylaw officer spend 5-20% of his time patrolling the forest to prevent unauthorized campfires, illegal harvesting, ATVs, and dumping;
  - attending to administrative issues (e.g. boundary maintenance, forest security, and trespass);
  - accounting and invoicing.

Table 12. Forest Management Expenditures for Pictou Landing Forest, 1994-2001

Operating and Capital Expenditures April, 1994 - March, 2001 (annual costs)	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	Total costs 1994-2001
First Nation's Forestry Program (salaries, mileage, other expenses)	25,000	25,000	25,000	25,000	25,000	25,000	25,000	175,000
Pictou Landing Band (salaries, council meetings, administration)	12,250	12,250	12,250	13,500	13,500	16,000	16,000	95,750
Forest Operations (roads, forest improvement, other)	11,050	18,184	7,997	11,386	10,474	8,510	7,231	74,833
Management Plan (worth $4,927)					246	246	246	739
Silviculture Training Course (worth $12,800)					2,560	2,560	2,560	7,680
Plant Survey (worth $1,200)						120	120	240
Black Ash Project				1,500	1,500	1,500	1,500	6,000
Certification and Scoping					2,000	2,000	2,000	6,000
Partnership with St. F.X. University ($3,800 of in-kind support)								3,800
Total costs: 1994-2001								**$370,042**

Source: McKay (2001)

Note: The table indicates that actual expenditures have not always reflected the full market value (or "worth") of the services provided. At full market value, actual costs would have been about $10,300 higher.

Table 13. Revenues and Savings for Pictou Landing Forest, 1994-2001

Annual Harvest	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	Total Volume Harvested (m^3)	$ Value
Hardwood and Softwood, Stacked* (m^3)	695.2	1476	479.52	337.95	61.24	144.8	64.3	3259.01	
Total Revenues from Harvest:									**$66,386**
Savings (non-cash income)									
Firewood	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	**Total Savings:**	**$7,000**
Total Revenues plus Savings:									**$73,386**
Net cost of forest restoration -- expenditures minus revenues: (Total Table 12 minus total Table 13):									**$296,656**

Note: *Values for pulp and studwood between 1994-1999 are based on conservative figures from MacQuarrie (2001b) and MacLeod (2001).

Source: McKay, 2001; Prest, 1999.

The $10,000 spent on FSC certification is a periodic cost. The pre-assessment scoping will not have to be repeated. However, FSC certification requires a full re-assessment of an operation every five years, as well as annual audits. Annual audits are a fraction of the cost of a full assessment. While certification appears costly, the investment has already paid for itself in many ways. The more tangible benefits of certification are:

- Wood from Pictou Landing is now being sold at a 10% premium.
- McKay receives calls every week requesting certified wood.
- Certification has resulted in greater interest and attention paid to Pictou Landing, with McKay being asked to lead field trips through the forest, answer questions, give presentations, write articles, etc.
- Certification has forced the band office to improve its administration and book-keeping records.
- Certification is encouraging co-operation, interest and funding from other agencies, for example, Environment Canada's Community Animation Program, the Forest Stewards Guild, and potentially, FSC International and the Canadian Wildlife Service. Pictou Landing has also received $3,800 of in-kind services from St. Francis Xavier University.

These benefits, including the potential economic benefits of a planned visitor and interpretation center, will accrue over time and far exceed the original certification cost.

The less tangible social benefits (outlined in Section 4) are not easily quantifiable, but can be very substantial. For example, as noted in Section 4, empowering and instilling confidence in one First Nations woman with a drinking problem may prevent a child being born with Fetal Alcohol Syndrome, thereby saving society millions of dollars over the child's lifetime. When such avoided social costs are considered, the investments outlined above appear modest indeed.

Another periodic cost of forest restoration at Pictou Landing is the Management Plan, in that another detailed plan will not have to be written for many years. The importance of documenting the condition and composition of the forest at this early stage in the restoration process cannot be underestimated, as future progress can be measured against and compared with the 1999 assessment and plan. These measures, in turn, will allow management methods to be adapted and changed, as the success of different treatments is known and understood.

Other expenses, like the silviculture training course, which cost $12,800, were direct investments in the skills of band members, as well as in the livelihood security and support of the community through the forest operation. The community realised some immediate benefits through revenues from wood sustainably harvested for sale by the new trainees (See Table 13). In addition, over time, such investments in intellectual capital will provide additional benefits to the community, as skills are passed on to other band members by the early trainees.

Wildlife surveys, like the plant survey carried out by Zinck, and the animal survey by Bancroft, are optional projects that are being carried out to heighten interest in and awareness of the forest, while at the same time, providing valuable information and input to operating plans.

The black ash project, which has cost in excess of $40,000 (including $10,000 of in-kind support from the Nova Scotia Agricultural College), is for the benefit of all First Nations groups in the Maritimes. As with other investments noted above, the benefits of the project are both short-term and long-term. The project has already piqued the interest of First Nations people throughout the province, who regard black ash as having particularly valuable cultural significance. In the longer term, the project aims to replant the forests of Nova Scotia with this now rare tree species in the hope that black ash will regain its place in the forest and that a sustainable harvest of black ash for crafts and other purposes will be realised in the future.

Given that the black ash project will benefit all the First Nations forestlands managed by McKay and Hudson, only 15% of the cost of this project has been attributed to Pictou Landing in the expenditure statement in Table 12.

7.2 Revenues

Revenues from the sale of pulpwood and sawlogs between April, 1994, and March, 2001, amounted to roughly $66,386 (Table 13). Pictou Landing Band members have also saved roughly $7,000 on oil bills and firewood by collecting the hardwood left from forest operations. Over the same period, total forest management, operation and restoration costs amounted to $370,000. The difference in value between revenues and expenditures between 1994 and 2001 has been the social, ecological and economic investment required to date to restore the Pictou Landing forests.

To date, the costs of this investment have been subsidized by:

- the supervisory role and technical support of the First Nations Forestry Association of Nova Scotia;

- the Pictou Landing Band's Trust Fund (created from the monies won from the lawsuit against the federal government regarding the use of Boat Harbor as an effluent treatment lagoon);
- the Federal Department of Indian Affairs;
- Environment Canada; and
- Other groups, including the Nova Forest Alliance, Forest Stewards Guild, etc.

As the on-the-ground management strategy is implemented, the forest operation should gradually become more self-sufficient. The band will have its own trained harvesting crews, and will take over some of the forest management responsibilities. The process of forest restoration will slowly improve the value and quality of the timber in the forest, so that, in the long-term, the higher value wood will be processed into more value-added products, creating additional economic spin-offs for the band.[12]

The managers of Pictou Landing are currently working on various means of adding value to their wood products. Over time, they hope to strengthen the local Pictou Landing economy and to provide jobs to band members by supplying wood for a range of diverse wood products. Currently, the managers are encouraging the use of a portable sawmill, and the construction of rustic furniture and birdhouses, all of which can be marketed as using FSC-certified wood, thus potentially fetching premium prices.

8. Conclusions

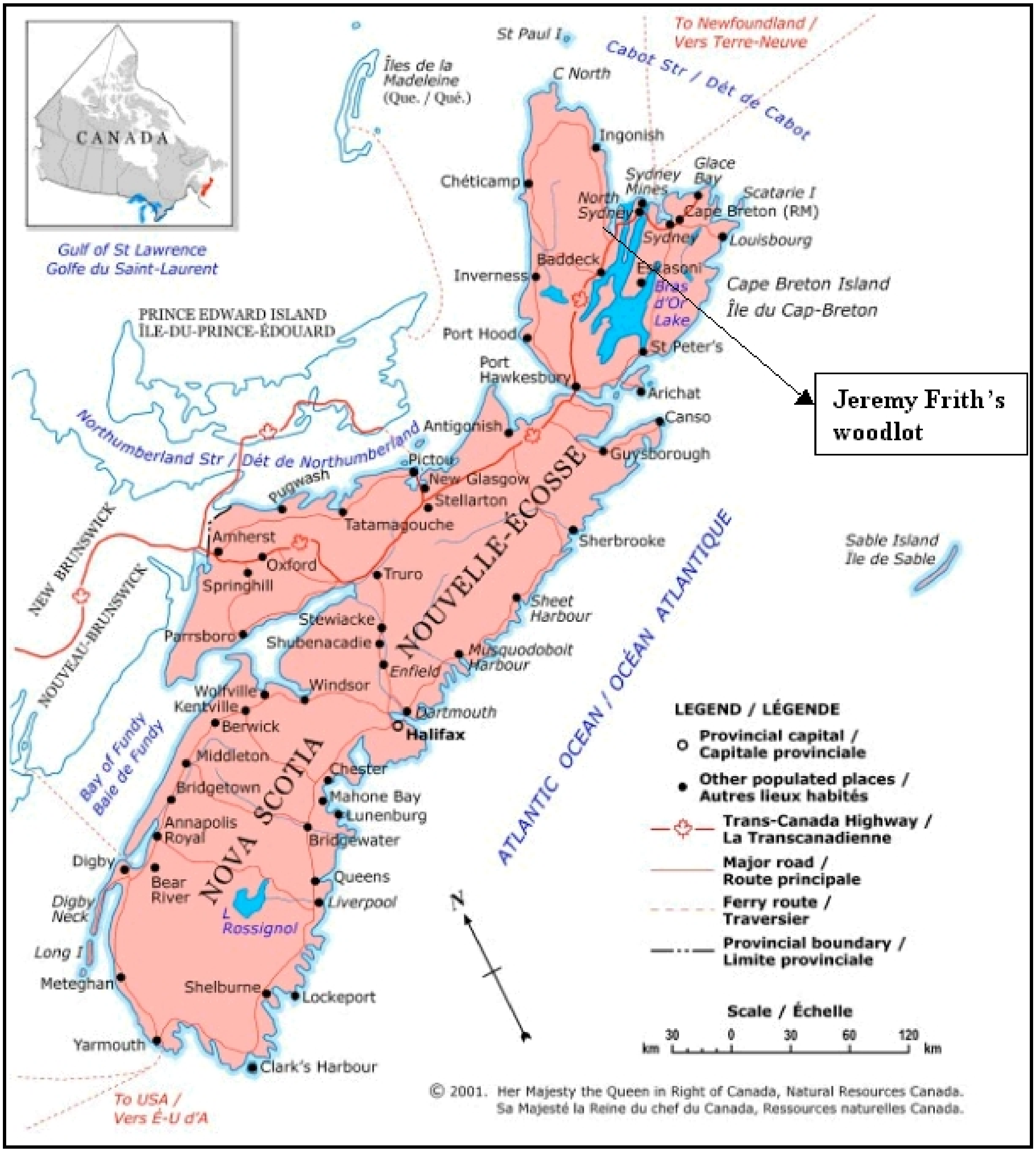
Pictou Landing provides an excellent model, both for landowners interested in restoring their woodlots, and for communities interested in gaining greater control over their forestlands. The Pictou Landing forests are similar to many other forests in Nova Scotia in that they have been subjected to more than 300 years of land clearing, cultivation, burning, and clearcutting. They are dissimilar in that, in the last decade, the managers of Pictou Landing have understood and adopted the Mi'kmaq concept of 'Netukulimk.' As a result, they are now focused on restoring the forests to a semblance of their original species mix, age class distribution, and ecological and economic value, and to restoring the strength, confidence, and self-reliance of a forest-dependent First Nations community.

Pictou Landing forests are also unusual in that they are owned and managed by the Pictou Landing Band, a community of more than 500 people, in the long-term economic, environmental and social interests of the band. Instead of managing the forest for low quality saw material and pulpwood, the forests are being managed to promote vigorous, higher-value tree species, and to provide a diversity of wood products. The evidence indicates that current investments in forest restoration will produce substantial long-term returns in higher value wood products, a wide range of vital ecological services, improved timber productivity, avoided social costs, and other social, economic and environmental benefits.

[12] 2001 Maritime sawmill prices for spruce and fir studwood range from $100-165/cord, compared to $65-$800/cord for hardwoods (Atlantic Forestry Review, 2001, Volume 7, Numbers 3 and 6), an indication of how greatly quality can affect price, especially for high-quality hardwoods suitable for value-added products.

CHAPTER THREE: JEREMY FRITH, CAPE BRETON

Figure 8. Jeremy Frith's woodlot, Nova Scotia, Canada



1. Introduction

> *"If we, today, possessed the forest that covered this landscape 400 years ago, we would be wealthy indeed"* (Frith 2001a).

After more than 200 years of high-grading, clearcutting, and land clearing by prior owners, Jeremy Frith has taken on the challenge of fast-tracking the restoration of his woodlot to conditions approaching those of the pre-settlement Acadian Forest. For Frith, this is not simply a labour of love. He believes his woodlot to be a better investment in time and effort than his RRSP, as his work will begin paying off in 10-20 years:

> *"My objective in managing this woodlot is not to degrade it as the MacDonalds did over 160 years, taking the best and leaving the worst.... My goal is added value and added volume."*

Frith's approach is by no means representative of most woodlot owners in Nova Scotia today. Shortly after Frith purchased his land in 1991, he reviewed the existing forest management plan, and noted that the plan recommended clearcutting or bulldozing much of his 89 hectares, and replanting it with monoculture spruce plantations.

Frith was well aware of the dangers inherent in monocultures, having witnessed the demise of most of the single-species forests in Bermuda, his native country, due to an introduced insect. He rejected the recommendations in the plan, and embarked upon a management regime that utilizes the existing degraded forest to hasten the restoration of a healthy mixed forest. Because of these explicit economic goals, Frith's example is of interest to woodlot owners assessing the practical economic payoffs of forest restoration.

Frith's long-term goals are straightforward and likely shared by every responsible forester and woodlot owner. These goals include:

- enhancing growth rates and standing timber volumes;
- increasing the health and insect/disease resistance of trees;
- creating product diversity to capitalize on timber markets when at their best; and
- leaving his land in much better condition than when he bought it – with more standing timber volume and value, and producing more oxygen, clean water, and abundant wildlife.

> *"I am so convinced that Maritime woodlots have, over the years, been increasingly degraded and discounted of their real value that I would like to help prove they could be much more productive"* (Frith 2001a).

Frith manages his land to exceed existing certification standards for ecosystem-based forest management. He also manages another property, and hopes to become a Forest Stewardship Council-certified resource manager in the future.

2. Description of Property and Land Use History

Frith's land is 89 hectares in size, and roughly 2 km long by 0.4-0.5 km wide. The property is situated on a fairly high point of land along the Meadow Rd. in St. Ann's Bay, Cape Breton. The terrain is gently rolling to moderately sloping, before rising sharply to the Cape Breton Highlands. The 12 hectares of cleared land around the house are on moderately rocky, clay-loam soils, while the remaining acreage is characterized by gravely to stony Thom soils. Thom soils are noted for their ability to produce excellent timber, but the position of the woodlot is such that it is exposed to the strong northwesterly winter winds blowing off the highlands, and it is thereby subject to considerable blow-down during the gale season.

Frith's land is in the white pine, hemlock, yellow birch biogeoclimatic zone. Prior to the commencement of shipbuilding and settlement in the St. Anne's Bay area, most of the forests would have been in a mature old-growth condition. (See Chapter 1, Table 2, for a description of the characteristics of old-growth forests in Nova Scotia). The height of the forest canopy would have been in the 25-45 metre range (Table 14), with the oldest trees in excess of 300 years old (Table 15). Eastern hemlock - the longest living tree in the Maritimes - can live to be as much as 800 years old.

Table 14. Maximum Height and Diameter of Native Tree Species

Tree species	Maximum Height	Maximum Diameter (or Width)
White Ash	25m*	1.5m**
American Beech	25m	1.0m
White Birch	25m	0.9m
Yellow Birch	25m	1.05m
Eastern Hemlock	30m	1.2m
Red Maple	25m	0.6m
Sugar Maple	30m	0.9m
Red Oak	30m	1.2m
Red Pine	25m	0.75m
White Pine	45m	1.2m
Black Spruce	30m	0.6m
Red Spruce	35m	0.6m
White Spruce	25m	0.65m

* For comparison, 3 metres in height = roughly one story of an apartment building.

** For comparison, 1 metre in width = roughly five times the width of this page.

Source: O'Brien 2000; Nichols 1918

In the 1700s and 1800s, Nova Scotia's forests were highly prized for the tall, straight white pine trees that were used for shipbuilding. Between 1846 and 1894, Englishtown, at the mouth of St. Anne's Bay, Cape Breton, was a vibrant shipbuilding community (Patterson 1978). Most of the best-growing white pine, red oak, and larch were logged off Frith's property for use in ship-building, as well as the best-grown spruce and hemlock.

These early incursions to 'take the best and leave the rest' had a significant effect on the forest composition of natural stands, depleting stocks of large seeded species and diminishing their chances of reoccurrence (Patterson 1978). Repeated cutting thinned out white pine to a greater extent than any other single species (Nichols 1918). As well, this high-grading likely degraded the genetic stock of the most desirable species.

Table 15. Natural Age Limits of Selected Tree Species in the Maritimes

Tree species	Life Span
White Ash	100-200
American Beech	300-400
White Birch	120-150
Yellow Birch	150-250
Eastern Hemlock	300-800
Red Maple	100-150
Sugar Maple	300-400
Red Oak	200-350
Red Pine	200-250
White Pine	200-450
Black Spruce	200-250
Red Spruce	250-400
White Spruce	150-200

Source: O'Brien, 2000.

In the 1830s, the Meadow Rd. area was settled by Scottish immigrants. Despite being 195 metres above sea level, Frith's property was better in aspect, terrain, and soil than much of the surrounding lands. Through the mid-1800s, well over 20 hectares were cleared and cultivated by the MacDonald family, and another 20-40 hectares were repeatedly high-graded to make buildings, tools, and equipment; to heat the home; and to feed a forge (the family were blacksmiths). The house on the property was built in the 1860s, and is finished almost entirely in knot-free pine.

The MacDonald family continued to harvest the prime logs, and to leave the poor quality trees standing. This undoubtedly diminished any remaining stocks of the most desirable species, which also tend to be heavy seeded and therefore dependent on the maintenance of viable seed sources for continued regeneration (Frith 2001a).

Today, there are only 2 sizeable oak trees left on the property, and 2 oak seedlings. The only remaining pines are on the sides of ravines, where removal would have been risky. There is one remnant large-sized yellow birch at least 200 years old, with a hollowed out center. No white ash or hemlock are left on the property, though they are found nearby. All these depleted species were once abundant on this property. The loss of most of the best growing, tallest, and long-lived tree species from this property has significantly devalued the worth of the woodlot.

This gradual degradation is invisible in the standard economic accounting measures conventionally used to assess prosperity and wellbeing, because those economic growth statistics count only the immediate present gain from cutting the forest. Thus, the steady devaluation of Frith's woodlot was actually counted as economic gain. By contrast, the Genuine Progress Index also registers gains and losses in the value of the capital stock, and thus provides a measure not only of what is extracted from the forest, but also what remains in the forest.

By the 1950s, the predominant species on the MacDonald property were white and yellow birch, red and sugar maple, white and black spruce, and balsam fir. Much of the back part of the property was dominated by coppiced red maple, indicating at least several generations of cutting. Old fields closer to the house had regenerated in large spruce and fir.

Ninety percent of the operational forest was again logged or cutover in the 1960s and 1970s. An older resident of the community estimated that 4,000 cords of wood were removed from the MacDonald land before and after the spruce budworm epidemic in the 1970s.

In the 1980s, several stands were 'cleaned,' and the hardwoods were removed to create pure stands of balsam fir. In 1986, the MacDonalds joined the Baddeck Valley Wood Producers, and a Management Plan was drawn up for the property. As part of this plan, a road was built, paid for primarily by taxpayers, to access the back portion of the property. Up to 1990, 12 cords of firewood were burned each year to heat the house. As noted, Frith bought the property in 1991.

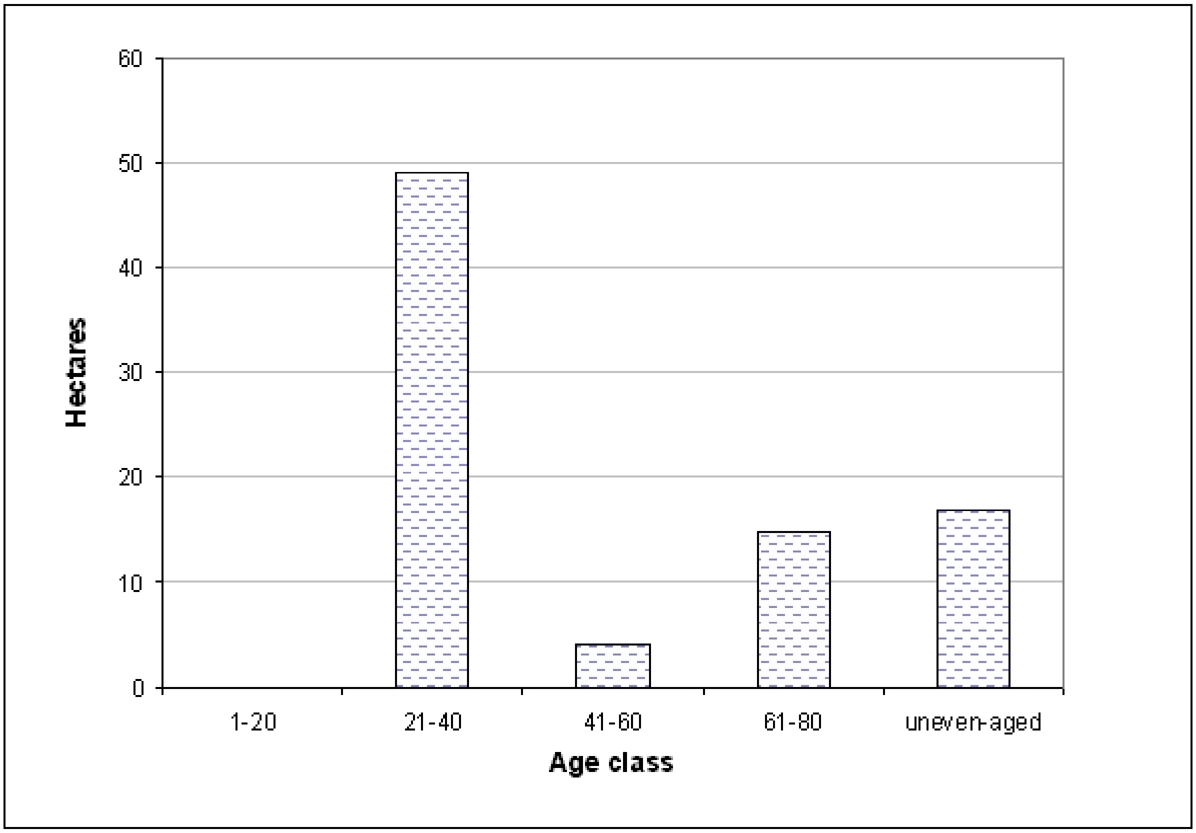
The current status of the Frith woodlot is as follows. There are:

- 24 hectares of intolerant hardwoods (white birch and red maple), 20-40 years old;
- 7.1 hectares of neglected pasture now grown in as white spruce;
- 19.9 hectares of young and immature mixedwood stands (primarily balsam fir, white spruce, red maple, and white birch);
- 14 hectares of 'overmature' mixed wood;
- 16.9 ha of 'overmature' hardwood (including tolerant and intolerant hardwoods of varying ages, such as red and sugar maple, yellow birch, beech, and white pine); and
- 3.5 hectares of immature mixedwoods that were cleaned in the 1980s (Figure 9).

In sum, Jeremy Frith has inherited a degraded, devalued woodlot of young, mostly even-aged trees with little diversity. The woodlot has been high-graded and cutover many times over 200 years with almost no awareness of ecological or long-term values. This is typical and largely representative of the condition of many Nova Scotia woodlots.

If restoration forestry can be successfully practiced here and the value of the woodlot gradually restored, then it can be practiced anywhere. Unlike the rich and highly atypical inheritance of Windhorse Farm, which shows what a healthy Nova Scotia forest can eventually look like, Jeremy Frith's woodlot might be a more practical model for most Nova Scotia woodlots. This is especially true since Frith's goals are highly practical, and geared to increasing the economic value of both his woodlot and the products it provides. He sees his restoration work as an investment that will provide measurable and valuable returns within his lifetime.

Figure 9. Age Class Distribution of Jeremy Frith's forest



Source: Frith, 2001b.

3. Management Regime

3.1 From Monoculture to All-Aged Stands

After buying his land in 1991, Frith moved to Cape Breton in 1993. By the time he arrived, government funding for forest management activities on private woodlots had almost dried up. In retrospect, Frith believes this to have been a blessing, due to the emphasis of these programs on clearcutting and planting to promote monoculture spruce for pulpwood. For Frith, the whole concept of clearcutting a forest - even a highly degraded forest - makes no sense:

> *"On a natural level the forest is itself a living organism made up of everything underground, above ground, and even in the air. I view each individual tree within that forest as a fruit which is formed and ripens in its time until ready for*

picking....If you take the tree as fruit analogy with the whole forest being the tree that produces the fruit, then harvesting by clearcutting is like cutting down your apple tree in order to get at the fruit. This might make picking the fruit a little easier but it sure is a wasteful and inefficient way to produce fruit. Every time you do it you have to plant a new sapling tree and wait years for it to mature sufficiently to produce another crop of fruit"[13] (Frith 2001a).

In lay language, Frith is articulating the precise approach of the GPI accounting methods, that distinguish stocks of capital assets (forests) from the functions and services (including timber) that they provide. "Sustainable" development in the Genuine Progress Index means living off the interest (picking the fruit) without depleting the capital stock (the standing forest).

In addition to being wasteful, clearcutting makes the forest more susceptible to extremes of temperature and moisture conditions, blow down, wind and ice damage, soil erosion, major losses of organic carbon, and a proliferation of low value weed tree species (Frith 2001; Fleming and Freedman 1998; O'Brien 1995; Freedman 1995). Furthermore, says Frith, planting clearcuts with even-aged monoculture softwoods in a region hit periodically by spruce budworm outbreaks is "*as good as hanging out a sign advertising budworm bait*". The continuing practice of converting mixed wood stands to softwood monocultures increases vulnerability to pests, disease, and other disturbances (Osawa 1989; Odum 1981).

A study by Su *et al*. (1996) indicates a clear inverse correlation between the hardwood content of forest stands and the predicted mortality of softwoods during spruce budworm infestations (Figure 10). This is thought to be because greater hardwood content increases the diversity and populations of natural enemies such as birds and parasitoids. In other words, maintenance of species diversity and sufficient hardwood content increases forest values, including timber values, by strengthening resistance and resilience to the budworm.

"I have to improve my current immature even-aged monoculture stands of both hardwood and softwood into uneven-aged…stands of prime quality mixed woods, and I need to improve my entire forest into an all-aged mixed wood forest which once again possesses its original Acadian Forest tree species,... wildlife, standing dead and downed trees, (and) undergrowth....

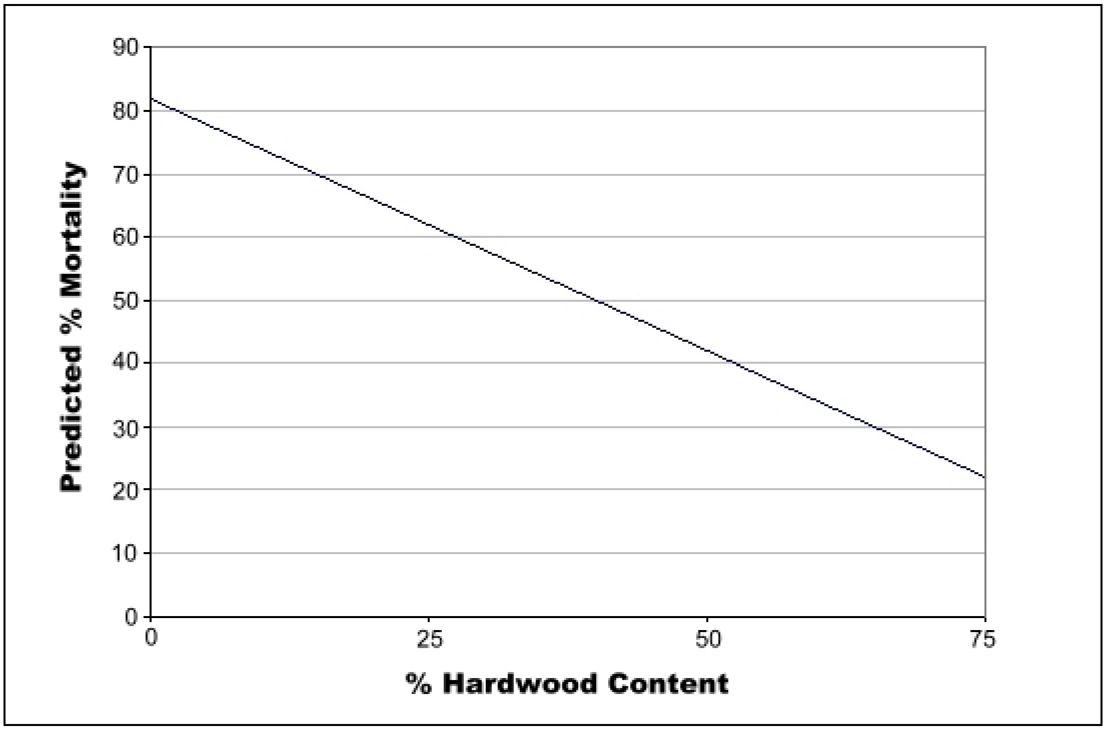
I am sure that a vital, healthy, all aged...forest has exponentially greater economic and ecological value than a softwood plantation on any day of the week and that such a forest, well managed, will increase further in value every year while it is being studied, tended and harvested" (Frith 2001a).

For Frith, selection harvesting is not only the least destructive method of tree harvesting. It also simply makes more sense. Only through the selection process will the volumes and quality of standing timber in the forest continually increase, allowing for greater future harvested volumes and a steadily increasing canopy height. By contrast to the trend initiated by Jeremy Frith on his own woodlot, the canopy height of Nova Scotia forests has gradually diminished over time.

[13] This philosophy is remarkably similar to that expressed in the Mi'kmaq concept 'Netukulimk' (see Chapter 2).

Restoration forestry is therefore a practical model for the province's future, because it increases forest value both directly by increasing canopy height, age and species diversity, and the proportion of wide diameter, clear lumber, and also indirectly by gradually improving soil quality and timber productivity.

Figure 10. Hardwood Content vs. Predicted Budworm Damage



Source: Su et al. 1996.

3.2 Restoration Treatment

One of the first things Frith did after moving to his land in 1993 was to review the Forest Management Plan, and walk through the stands described in the plan. He then consulted the government-funded forester who wrote the plan. One 8 hectare stand of 6m tall, 25-year old intolerants (white birch, red maple, and white spruce) was designated in the plan for "remnant removal", which means to cut or bulldoze everything, prepare the site, and replant with white spruce seedlings. He was told by the forester that the white birch currently on the site has little or no value for firewood or timber.

Frith did not clearcut the stand, and today the stand reaches 13.5m in height, with trees ranging up to 20cm in diameter. Over the last year, he has thinned up to half the stand by removing the poorly formed and suppressed trees. Limbs, branches and leaves were left on site to enrich soils, with the remainder cut to 1.2m lengths and carried to trailside. In this process, Frith produced over 20 cords of mostly white birch firewood, which he will sell as 'eco' wood for a 10% premium. It is worthy of note that Frith, the Pictou Landing First Nation, and the Menominee

Tribal Enterprises (Chapter 4), are all charging an additional 10% for harvesting timber in an ecologically sustainable manner.

In addition, Frith has used roughly 12 cords of firewood to heat his own house over the past few years. If he had bought this wood, he would have paid the going rate of $135/cord chopped and delivered (J. O'Brien pers. comm. 2001b). Frith therefore realised a savings of $1,620 as a byproduct of harvesting wood in such a way as to improve the value of his woodlot.

Two years after being advised to clearcut the 8-hectare stand, partly to clear white birch stands considered relatively valueless, Columbia Forest Products passed through Cape Breton looking specifically for white birch veneer logs. Today, the sale of spruce logs in Nova Scotia and New Brunswick fetches anywhere from $230-$425 per Mfbm (thousand board foot), while white birch fetches anywhere from $210 - $1,825 per Mfbm.[14] Prices vary with quality and grade, with the highest price reflecting top grade plus delivery to the mill gate. Evidently, contrary to advice provided by government foresters, the economic advantages of growing high quality white birch can significantly outweigh the advantages of growing high quality spruce.

In 10-15 years, Frith hopes to begin harvesting white birch veneer and sawlogs at prices that greatly exceed those for spruce logs. In recent years, reduced availability of hard maple has made white birch much more acceptable as saw timber and firewood. Had he followed the recommended management plan, he would now have 2.4-3.0m high spruce trees. Instead, he has natural sugar maple regenerating under the shade of the white birch, as well as a stand of vigorous, fast growing birch and red maple that will be harvested over time for firewood, sawtimber, and veneer.

3.2.1 Pruning and the Full Costs of Restoration

Another unique component of Frith's management strategy is to prune white and black spruce and balsam fir stands when the trees are sufficiently high to have dead branches. Initially, he prunes dead branches up to 2.1-2.4m in height. As the stand grows, he makes subsequent passes to remove branches up to 6m. He usually prunes in the winter to minimize damage to the tree.

Pruning is a time consuming and costly activity, but Frith finds it has various advantages:

- Delimbing when trees are upright is easier than when they have been cut and are lying on the ground (it takes 3-5 minutes to prune to a height of 2.4m).
- All wood that a tree lays on after it is pruned is clear wood, and clear sawlogs fetch a premium price. That premium is liable to increase considerably in the future as the availability of clear wood continues to diminish with the decline in older forests.
- Pruning lower branches provides easier access to the stand.
- Pruned branches fall to the ground, decompose, and add organic matter to the soil.

[14] Prices are from the January, 2001 and July, 2001 issues of the Atlantic Forestry Review, as well as from individual conversations with staff at JD Irving, Sussex, New Brunswick, and Miramichi Hardwoods Ltd., Boiestown, New Brunswick, July 9, 2001.

- Pruning appears to have a positive growth effect on some spruce that had stopped growing at a relatively immature stage.

For Frith, pruning is an investment in time and money that begins paying off immediately. "*If you don't prune…you are wasting time growing hardwood,*" he says. Other than Christmas tree growers, there are few other operators in the province that make use of this technique. Frith imports manual pruning saws from Sweden. He uses a few each year on his own woodlot, and has become the North American agent for the Swedish manufacturer. He sells saws to interested woodlot owners at $20 each, for a profit of $8/saw.

Since 1993, Frith has invested a total of 942 hours of manual labour in his woodlot. This includes 452 hours of his own time, and 490 hours of hired work, paid at $7.50/hr (worth $3,675), half of that covered by a government grant. Fifty-five percent of the total paid and unpaid hours worked were spent pruning.

To date, Frith has invested 280.5 hours of his own time plus $900 in paid labour (half of his own contribution to the paid labour hours) to prune the young softwood and hardwood stands on his land (Table 16). Because one half of total paid labour costs were covered by a government grant (Table 17), an additional $900 in government money went towards the pruning.

The following expense and revenue statements may again be useful to woodlot owners contemplating a shift to sustainable harvesting practices, and to government officials assessing the extent of financial incentives or tax breaks necessary to encourage woodlot owners to restore the province's natural forested wealth.

3.2.2 Harvesting and Extraction

Over time, Frith plans to remove suppressed and poorly formed trees on most of the accessible parts of his property. As the stands respond to his treatments, individual or groups of trees will be removed, creating openings into which other species can be naturally introduced or underplanted.

Harvesting on the woodlot is carried out with chainsaws. Frith owns two large-sized chainsaws that he has operated for more than 15 years. Both are still in good working condition. He also owns two small chainsaws (each worth less than $500) for pruning, spacing, and felling of small diameter trees. He expects these to last at least 10 more years.

Logs are either extracted by hand for the smaller-sized pieces, or by tractor and winch. Winching is used to bring larger logs to trailside. With a good network of extraction trails, the tractor is rarely taken into the woods. The use of machinery is avoided during seasons when sap is flowing, and when roots and bark are fragile, in order to prevent damage to the roots, bark, and trunks of residual trees. In Frith's view, the best time to do the least damage when harvesting and extracting is throughout the late fall and winter.

Table 16. Expenses for the Frith Woodlot Operation, 1993-2000

	Hired labour*	Frith's unpaid labour	Materials and maintenance	Annual depreciation cost	Depreciation costs 1993-2000	Proportion of capital expenditure used for woodswork	Total costs
Operating Expenditures 1993-2000							
Pruning	$1,792.50	$3,155.63					$4,948.13
Spacing, falling, bucking, treemarking, harvesting, forwarding	$1,882.50	$247.50					$2,130.00
Seedlings			$700.00				$700.00
Road clearing		$1,687.50	$1,000.00				$2,687.50
Pole saw			$400.00				$400.00
Manual pruning saws			$320.00				$320.00
Road improvements, firepond (funds provided by ECBC)							$7,200.00
Depreciation costs of capital expenditures							
Shindawa chainsaw (purchased for $340)			$170.00	$68.00	$340.00		$510.00
Stihl pruning saw (purchased for $420)			$210.00	$84.00	$420.00		$630.00
356 Husquvarna (purchased for $600)			$480.00	$40.00	$320.00		$800.00
388 Husquvarna (purchased for $600)			$240.00	$40.00	$320.00		$560.00
Portable sawmill (purchased for $3,500)			$2,800.00	$33.33	$266.67		$3,066.67
4-wheel drive tractor (purchased for $26,000)			$3,900.00	$1,733.33	$5,200.00	10%	$910.00
2-wheel drive tractor (purchased for $4,000)			$2,800.00	$400.00	$2,800.00	10%	$560.00
Road improvements, firepond ($12,000)				$800.00	$4,800.00	50%	$2,400.00
						Total Costs	**$27,822.29**

* Note that hired labour costs include the full costs of labour, of which 50% were covered by Jeremy Frith, and 50% were covered by a government grant.

Source: Frith, 2001b.

Table 17. Total Revenues for the Frith Woodlot Operation, 1993-2000

Revenues	
Firewood	$2,600.00
Sale of pulpwood	$3,600.00
Government grant to hire labourer	$1,837.00
ECBC grant for fire pond, road, and drainage work	$7,200.00
Total Revenues	**$15,237.00**
Savings (non-cash income)	
Firewood	$1,620.00
Total Savings	**$1,620.00**
Total revenues plus savings	**$16,857.00**
Net cost of forest restoration -- expenditures minus revenues: (Total Table 16 minus total Table 17)	**$10,965.29**

Note: Various assumptions were made in order to assign values in these tables:

1) While Jeremy Frith did not pay himself a salary, the Genuine Progress Index recognizes that unpaid work has economic value, and should therefore be factored into the economic analysis of a resource sector. For analyses of the agriculture sector, Agriculture Canada assigns a value to the unpaid work of farmers equivalent to a wage rate 50% higher than wages paid to farm labourers. Accordingly, we assigned Frith a wage of $11.25/hour, which is 50% higher than the wage paid to his hired labourers.

2) Frith estimated annual operating and maintenance charges to be 5-10% of the value of the equipment. All but the Husquvarna 388 chainsaw were assigned operating and maintenance expenses at 10% of the value of the chainsaw per year. Frith seldom uses the Husquvarna 388, and it was therefore assigned an operating expense of 5% of its value per year.

3) In addition to operating and maintenance expenses, each piece of equipment was depreciated at a rate that was somewhere between its expected lifetime and the depreciation rate for tax purposes. In addition, in depreciating equipment, the replacement value should be factored into the balance sheet to give a realistic picture of a person's assets in any given year. For example, Frith expects his new 4-wheel drive tractor to last 25 – 30 years (resulting in a depreciation rate of 3.3-4.0%). For tax purposes, the tractor can be discounted at no more than 15% in the first year, and 30% in the following years. If, after 25 years, Frith sells his woodlot and equipment to a new landowner, having not replaced his 25-year-old, 4-wheel drive tractor, the new landowner would soon have to replace the tractor. At that time, the old tractor would not be considered a sizable asset to the property. If Frith had added replacement cost to the depreciation rate, then he would have depreciated the tractor more rapidly, and may have begun saving for its replacement. In this exercise, we used a depreciation rate of 6.7%, which discounts the tractor over 15 years.

4) Government grants are shown both as revenues and expenses. Because the money had to be spent, the grant did not result in a net gain for Frith.

5) Firewood used in Frith's home was considered a non-cash savings, in that he would have had to expend money to purchase firewood had he not taken it from his own woodlot.

Source: Frith, 2001b.

Frith recently purchased a new 4-wheel drive, 48 horsepower tractor worth $26,000. The expected life span of the tractor is 30 years, and Frith expects to get 10,000 hours of work out of it. The tractor is also used for snow blowing, tilling fields, sowing crops, hauling, and powering the portable sawmill. Frith also plans to purchase a tractor winch, which will cost roughly $3,000.

In total, Frith will be spending roughly $30,000 on forestry equipment - including chainsaws, tractor, and winch. This modest investment contrasts sharply with the minimum $1.5 million investment (see Chapter 9, Table 33) required by modern forest contractors who own a feller-buncher, single grip harvester, and forwarder (all of which are essentially larger versions of Frith's chainsaw, winch, tractor, and trailer).

To date, Frith has invested 273 of the 942 labour hours invested in his woodlot in spacing, falling, bucking[15], treemarking, selection cuts, and forwarding[16] by hand. The paid labour for these tasks cost Frith $941.25, with a government grant contributing an addition $941.25 towards total paid labour costs. To date, more than 56 cords of wood have been cut by Frith. Twenty cords will be sold as firewood, and the remaining 36 have been sold to Stora as pulpwood for $3,600.

3.2.3 Planting

Another important component of Frith's restoration work is to promote and reintroduce tree species once common to the region. Where possible, he encourages natural regeneration of the long-lived Acadian species. As Frith says, "*nobody breeds, plants, and grows better timber than Mother Nature*."

However, the heavy seeded species, like red oak and white pine, have all but disappeared from Frith's woodlot, so he plans to replant the woodlot with seedlings of once common species. To date, he has bought 600 white pine, 600 larch, 400 red spruce, 200 black spruce, 200 yellow birch, 150 red oak, and 100 hemlock. The seedlings were purchased from the NSDNR for a cost of $700. While he is uncertain where the seed stock came from, he presumes they are of Maritime origin.

3.3 Value-Added

More than 15 years ago, Frith purchased a portable sawmill for $3,500. His investment in the mill paid off many years ago, having already milled in excess of 100 Mfbm. Despite this, he estimates its current value to be $3,000. As the woodlot responds to his various treatments, Frith hopes to generate an increasing proportion of high-value, clear lumber, which he will mill and kiln-dry himself, thereby adding significantly to the value of the wood before resale. This on-site processing also significantly reduces the hidden costs of additional transportation and fossil fuel combustion, which are regarded in conventional accounting systems as "externalities" borne by society.

3.4 Roads

The typical, modern-day logging road requires clearing 6-12 metre wide corridors through the woods, and importing truckloads of fill materials to raise the road above the surrounding terrain.

[15] Bucking is cutting a felled tree into segments.
[16] Forwarding is delivering a felled tree to roadside.

If the road is not designed to be circular, there is often a wide turnaround at the end of each road to allow large machinery to turn and exit. Such typical road corridors in areas of continuous forest canopy produce forest fragmentation, ‘edge effects,’ and ecosystem and habitat disruption. See Chapter 2, Section 5.1.1, for a discussion of edge effects.

In the late 1980s, a main access road into the rear portion of Frith’s property was built by the Baddeck Valley Wood Producers - 95% of it at taxpayers expense. It is 6-12 m wide, with a large turnaround at the end. Given that it is already there, Frith will make use of this road, but it is certainly not Frith’s own preferred method of construction. Indeed, it is interesting to compare Frith’s own forest access system to the more typical approach.

For selection harvesting, Frith recommends having a system of parallel forwarding trails every 45-75 metres that connect and form loops. Where possible, he recommends making use of any pre-existing rudimentary trails. Once old networks of trails are located, Frith clears and widens the trail to a width of 2.4-3 m, improves the drainage, and fills ruts with branches and logs. He currently has 5.6 kilometres of cleared trails, and plans to clear another one or two kilometres. The forest canopy above the trails remains relatively unbroken; fill material is not used; heavy equipment use on trails is restricted to either frozen or dry ground; and the tractor rarely leaves the trail.

By contrast, skidders and feller-bunchers are taken off main access roads to operate in the woods. The 80-100 hour week worked by many forest equipment operators leaves little or no time to take into account the vulnerability of forest soils at different times of the year, nor to restrict operations when the soil is most susceptible to rutting. It is not uncommon to see deep, 0.6-0.9m ruts in clearcuts.

Frith has spent upwards of 150 hours of his own time opening old trails and filling ruts. He estimates that this process has cost him $500-$1,000. Additional trail clearing expenses to access the back portions of the property will be slightly offset by the sale of trees from road clearing. In 1995, Frith received a grant from the government-funded Enterprise Cape Breton Corporation (ECBE) to build a firepond, make road improvements, improve drainage, and place culverts. ECBC provided $7,200, or 60% of the project cost, while Frith had to produce receipts indicating he had spent $4,800, or 40% of the total cost.

3.5 Summary: Cost of Restoration

Over the past eight years, the costs of restoration have exceeded revenues from the sale of wood (as well as non-cash savings from the use of firewood in the home) by $10,965 (Tables 3.3 and 3.4 above). On a per hectare basis, restoration forestry has cost Frith roughly $18/ha/yr between 1993 and 2000. When government grants for employment, roadwork, and the firepond are factored into this calculation, the total cost of restoration activities on Frith’s woodlot is $35/ha/yr.

Frith’s costs are small compared to the estimates for Pictou Landing, at $110/ha/yr (Chapter 2), and Menominee Tribal Enterprises, at $Cdn750-1,500/ha/yr (Chapter 4.) They are also at the lowest end of Jim Drescher's range of restoration cost estimates (Chapter 1, Section 7.) In the absence of a strong government commitment to support active restoration forestry in the form of tax and financial incentives, Frith's example provides real inspiration to woodlot owners of limited means who are nonetheless ready to take personal responsibility for improving the health and value of their forests.

4. Ecological Concerns

4.1 Water Quality

To date, Frith has operated on the front portion of his land, which has no permanent or seasonal streams. A few trails have spring activity, and in those places he uses a crib and/or branches to cover the wet ground. When he gains access to the back portion of his land, he will have to cross two streams, one seasonal, and the other permanent. At that time, he will install log bridges or culverts. Frith is abiding by the watercourse buffer zone guidelines of the Maritime Regional Standards of the Forest Stewardship Council in order to be FSC-certifiable, even though he is not fully in agreement with these guidelines. The no-cut zone within 15-30 metres of permanent streams prevents him from selectively harvesting within the riparian zone, an activity that he feels would have no impact on water quality if carried out carefully.

4.2 Significant Wildlife

Despite the degraded condition of Frith's land, the woodlot is located in a fairly remote area of Cape Breton Island, with a large wilderness protected area adjacent to the western boundary of his property. The protected area likely provides a sanctuary for a number of wildlife species that also make use of Frith's land. For example, barred and saw-whet owls, and black bears require large diameter cavity trees for nesting and hibernating (See Chapter 1, Table 5). While they are likely nesting or hibernating elsewhere, their range appears to include Frith's land.

Frith has observed quite a large selection of wildlife on his woodlot, including barred and saw-whet owls, red-tailed and sharp-shinned hawks, bald eagles, osprey, kestrels, downy and pileated woodpeckers, flickers, barn and cliff swallows, woodcocks, beaver, moose, coyote, fox, lynx, bobcat, and a 3-legged black bear.

4.3 Carbon Storage

Based on estimates outlined in Chapter 2 from Wilson (2001), the carbon sink value of each hectare of NS forests is worth an average of $537 in avoided climate change damages. Older forests have a much greater carbon storage capacity than young, 20-year-old immature forests. Therefore, the relatively young age of Frith's forests means that their value as carbon sinks is slightly below the provincial average. For Frith, this translates into a carbon storage contribution of roughly $40,812 in avoided climate change damages.

Furthermore, as the age structure of Frith's woodlot changes in response to his restoration practices, its carbon storage value will gradually increase. While this added social benefit is hidden and ignored in conventional accounting systems that recognize only timber extraction, it is explicitly acknowledged in the Genuine Progress Index, which also recognizes the economic value of standing forests as natural capital stocks.

5. Economics

5.1 Economic Value of Non-Timber Goods and Services

Aside from his intensive focus on forest management activities, Frith enjoys long walks on his land and in the surrounding areas. He has also taken note of the chanterelle mushrooms growing under spruce stands, and hopes to sell these in the future.

These recreational and other non-timber forest values, including indirect spin-off benefits, are also acknowledged in the Genuine Progress Index, though generally excluded from conventional forest economics, which define forest industries solely in terms of timber extraction. The GPI, for example, recognizes that eco-tourism is a forest-dependent industry just as logging is.

5.2 Investment in Forest Management to Ensure Sustainability

The recurring theme in Frith's approach to forest management is his investment in the future. From pruning, to thinning, underplanting, avoiding damage to residual trees, establishing a network of extraction trails, and purchasing a high quality tractor, -- all of these activities are carried out with an expectation of future returns. As mentioned in the introduction, Frith sees his woodlot as a better investment than his RRSPs. In addition, the skills, knowledge, and equipment that he has gained from or for his own woodlot will also be used to manage other people's woodlots.

Frith's approach is in line with the GPI's capital/investment-oriented accounting approach that sees forests as natural capital assets subject to depreciation and requiring re-investment in the same way as manufactured capital is currently measured. Conventional economic measures, by contrast, count only the present value of extracted resources.

The major difference between manufactured capital and natural capital is simply that the former depreciates by definition, while the latter has the capacity for inherent renewal and regeneration without depreciation, *provided that* it is used sustainably. Although Frith intends to see returns from his investment in his own lifetime, the real beneficiaries of his investment will be future generations of Nova Scotians and Cape Bretoners.

Over time, the closer Frith's woodlot resembles the original Acadian forest, the less active investment in restoration will be required, and the more human society will be able to enjoy the benefits of a healthy forest that renews itself indefinitely. At that time, it will literally be possible to 'live off the interest' provided by the natural capital stock without depleting the value of that stock, and without interfering with its natural regenerative capacity.

5.3 Highest and Best Use

Frith uses various techniques to optimize the economic returns from his woodlot:

1) The first is to improve every individual tree to its maximum value as veneer, sawlog, pulp and/or deadwood and debris.
2) The second is to grade timber and its products strictly. He grades and marks trees on the stump before harvest, then again at the landing for timber sales, and finally in his mill yard for sawing.
3) When he starts harvesting high-value sawlogs and veneer, he plans to call around and make sure he gets the best possible price. This might mean that he sells to American buyers like Columbia Forest Products, which used to purchase and sort high-value wood products in the yard of a local sawmill near Baddeck, Cape Breton.

There are some obstacles to this plan, however, due to current industrial forestry practices. In order to sell pulpwood to Stora, for example, a landowner or contractor has to have at least 18 cords. This did not used to be the case. Until fairly recently, a woodlot owner could drop off small loads at a local sorting yard and be reimbursed accordingly. Nowadays, in order to reach the 18 cord quota, there is a temptation to put higher quality logs in the load.

5.4 Employment

The vast amount of restoration work to be carried out on Frith's woodlot takes many hours of manual labour. Since 1993, Frith has put 452 hours of his own time into pruning, spacing, felling, bucking, thinning, marking, cutting, and clearing trails. Since 2000, he has also hired labourers for a total of 490 hours at $7.50/hr, under a federal employment program that covered half the labour costs.

Another potential employment funding source soon to be explored is the apprenticeship grant program at Mount St. Vincent University. Frith is hoping to train a local unemployed youth, who will then be capable of carrying out the same type of work elsewhere. He hopes to instill confidence in his apprentice - a quality he thinks is sadly lacking in many young Cape Bretoners. And he hopes to pass his knowledge on to younger generations, who will be the future stewards of the land.

6. Conclusion

If the full extent of Frith's contribution were fully acknowledged and appreciated by government, his work would be supported and used to train forest managers throughout the province and beyond. Because the degraded condition of Frith's woodlot is typical of Nova Scotia woodlots, his exemplary work is a particularly inspiring model for others, and demonstrates the economics of restoration very effectively. Frith is convinced from his experience that a financially modest, but thoroughly dedicated, investment in restoration forestry will pay off handsomely both in the direct returns that can be realised from higher quality, clear, and, eventually, FSC-certified wood, and indirectly in the even greater hidden values of a well-developed, biologically rich, and structurally diverse forest.

Frith's very careful detailing of all costs and expenditures is an extraordinary resource for woodlot owners and government officials. It also provides an excellent template for government to assess the precise *social* investment (in the form of tax breaks and financial incentives) that is required to make restoration forestry economically viable for Nova Scotia woodlot owners. Frith's accounts also allow one of the most detailed assessments to date of the cost effectiveness of investing in restoration forestry for future generations of Nova Scotians.

CHAPTER FOUR: MENOMINEE TRIBAL ENTERPRISES, WISCONSIN

Figure 11. Menominee County, Wisconsin, United States

1. Introduction: The Land and its History

It could be argued that the woodlots of Windhorse Farm, Pictou Landing, and Jeremy Frith, so far described in this report, are too small to be used as models for "industrial" forestry operations in Nova Scotia, and are thus irrelevant to the large companies that dominate the province's forest industry. Indeed, in Nova Scotia, the few models of sustainable forestry that do exist are small.

Approximately 69% of Nova Scotia's forests are privately owned. Of that, small private woodlots (less than 400 hectares) account for 52%, and large industry owns the rest (NRTEE l997, p. 28). Furthermore, industry relies heavily on the wood from small woodlots for its mills, processing, and export operations, making it imperative that we provide examples of small sustainable forest operations.

However, the question still remains – can good forestry be practiced on the vast tracts managed by J.D. Irving, Stora Enso, Bowater Mersey, Kimberly Clarke, and MacTara? The Algonquin Park and Menominee Tribal Enterprises case studies provide a clear answer.

It should be noted at the start that very little of the Menominee forest is actually maintained in a pristine state or strictly natural condition. This demonstrates that even good forest practices and sustainable management are not a substitute for an effective system of protected areas. While this study focuses on sustainable forest management, only an adequate system of fully protected areas, in which logging is actually prohibited, can ensure the protection of the biodiversity that is so vital to life on the planet.

Nevertheless, despite their very different methods and practices, the case for protected areas, and the basic principles of restoration forestry share the same fundamental understanding and philosophy, and a profound appreciation that their methods are complementary. This common understand has been given eloquent expression by Aldo Leopold:

> *"If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering*" (Leopold 1966).

Starting out as a small creek in Wisconsin's north, the Wolf River picks up speed and depth as it rushes past the rolling fields and painted silos of dairy country, and enters the forest of the Menominee Indian Reservation, where white pine and hemlock, sugar maple and yellow birch shade its banks. For more than 400 km, before finally emptying into Lake Michigan, the rugged river, known for its trout and white water, is protected by US law in its free-flowing state because of its remarkable beauty.

Fortunately, this remarkable river is also protected by the outstanding management practices employed in the Menominee forest, through which it flows. The Menominee Indian Tribe, a self-governing nation, was recognized by the United Nations in l995 for its expertise in forest management, and the tribe received the first ever U.S. Presidential award for Sustainable Development in l996. Today, it is the only Native American tribe to have its forests certified by two Forest Stewardship Council-approved certifiers, SmartWood and Scientific Certification Systems.

Driving through the 95,000 hectare Menominee reservation on Interstate 47 takes an hour-and-a-half from one end to the other. "As soon as you go off the reservation you know right away," says Terry Peters, a student at the Menominee-run Sustainable Development Institute. "There are no more trees." Even from space one can tell where the forest starts and stops. A satellite photo of the state of Wisconsin shows a clearly delineated area located about 60 km northwest of Green Bay. In the photo, a dark line surrounds a deep green oasis separating the Menominee lands from the surrounding snow covered farm fields.

Until the 19th century, the Menominee occupied more than half of what is now Wisconsin, as well as part of northern Michigan – about 4 million hectares of land in all. But after two hundred years of conquest by French, British, and American settlers, and a series of treaties and land cessions, less than 3% of the tribe's original land remains.

The forest that is left looks pristine. But it is in fact one of the most intensively managed forests in the U.S. The 89,000 ha of forest (equivalent to about 3.4% of Nova Scotia's operable forestland) have been logged for 147 years, and there is more wood there today than there was when the reservation was first established in l854. The Menominee, employing about 450 people, cut about 58 million board feet of timber last year and have harvested more than 2 billion board feet since cutting began in l865. Yet the most recent forest inventory indicates a higher volume and quality of saw timber now than when the land was first surveyed. This record is in sharp contrast to the forests of Nova Scotia, where two centuries of high-grading and clearcutting have depleted the quality and value of the standing timber (Wilson 2001).

Marshall Pecore manages the forests for Menominee Tribal Enterprises (MTE), the Menominee-governed corporation which oversees the forests and operates a sawmill on behalf of the tribe. On an annual basis, approximately 3,240 ha of forest (less than 4% of the total) is harvested using selection, shelterwood, or clearcutting methods. Pecore says that highly regulated clearcutting is used in about 25% of the forests, shelterwood systems in 25%, and the remaining 50% is managed using selection methods, where only single trees or small patches of trees are cut. This compares with an almost total reliance on clearcutting in Nova Scotia.

What gets cut, according to Pecore, depends on what he calls "vigor and risk." "If a tree is 30 inches in diameter and it's healthy and vigorous, we leave it alone. Those that are risky, that won't be alive in 15 years when we re-enter that forest, they're removed," says Pecore. This "slow-grading" method has improved the quality of the Menominee forest.

More than 30 species of trees can be found in the Menominee forest, some as old as 350 years, as well as countless species of wildlife. "We still have lots of things that there's a shortage of everywhere else. Hawks, songbirds, bears, butterflies – every time they come looking for them they find them here," says Pecore.

The Nicolet National Forest, [17] just north of the reservation, is similar to the Menominee forest in terms of soil, terrain, and tree species, but was cut over and burnt to sod in the last century. As a result, even though the Nicolet forest is three times the size of the Menominee forest, it produces only slightly more wood.[18] Between l986 and l999, an average volume of 70 million board feet was harvested from Nicolet. During that same 14-year period, the volume of sawtimber removed decreased by 68%, so that in l999 sawtimber volume accounted for only 10% of the total harvest, the remaining 90% going to pulp (T. Smith pers. comm. 2001).

In the Menominee forest, by contrast, data indicate that the volume of high-quality and high-value sawlogs has increased since l963, and sawlogs accounted for one-third of last year's harvest, with the remaining two-thirds going to pulp.

Of the 8,500 Menominee (on and off reservation), 450 have work in the sawmill, as loggers, or in the administration of the forestry center. Approximately 70% of those employed in the mill and other forest operations are Menominee tribal members, and approximately 25% of the work force on the reservation is employed directly in forest-based industries.

From the start, tribal leaders have known that if the Menominee were going to survive as a people they would have to preserve the forest. But this was easier said than done. By the late 1800s, the US government wanted to relocate the 2,000 or so remaining Menominee to a tract of poor land in Minnesota. However, the tribe's Chief at the time, Oshkosh, successfully pleaded that his people be allowed to stay on a piece of their homeland – land that was rich in the ancient white pines that were gold to timber barons.

According to Pecore, in the late 1800s, nearly 3.4 billion board feet of white pine timber were sent down Wisconsin rivers each year. When the old-growth pine dwindled, lumbermen used railroads to move the heavier hardwood logs to the mills. Due to ownership by the Menominee Tribe, the Menominee forest escaped this ravage.

White loggers, known as the "pine ring," pirated the majestic pines that grew along the forest edges, and the U.S. Bureau of Indian Affairs embarked on unsuccessful campaigns to convert the Menominee to farmers, encouraging them to clear their land. After a 30-year tug-of-war over the pines of the Menominee forest, the U.S. government in l890 passed an Act that established the annual allowable cut on the Menominee reservation at 20 million board feet per year. From l890 until l907, the Menominee continued to harvest timber under this legislation.

Then in l905 a windstorm blew down an estimated 40 million board feet of hardwood and hemlock. The Menominee wanted to salvage the downed wood but were limited by the Act of

[17] The Nicolet National Forest was first established in the United States in l933 and now comprises over 661,000 acres (268,000 hectares) in northeastern Wisconsin. Later that same year, the Chequamegon was established as a separate forest from the Nicolet's westernmost lands. The Chequamegon forest now comprises 857,000 acres (347,000 ha). Today the two forests have been combined as the Chequamegon-Nicolet National Forest, comprising more than 1.5 million acres, but data and land management continue to be developed separately for each of the two areas.

[18] Cited in Catherine Mater, Menominee Tribal Enterprises: Sustainable Forestry to Improve Forest Health and Create Jobs (Sustainable Forestry Working Group, l998) p. 4. The original comparison was made in an independent evaluation of the Menominee forest by FSC-certifier SmartWood in l994.

l890 so, in l908, Congress passed the LaFollette Act, which authorized the salvage operation. Robert LaFollette, the bill's sponsor, stated that "what the white man has in other places destroyed, [Indians] should be taught to preserve" (Landis l992).

Two years after the reservation was created, the Menominee established their own small sawmill in the town of Keshena in 1856, with the goal of retaining control of processing as well as production. In l908, with authorization again from the LaFollette Act, a bigger sawmill was built in the town of Neopit, where it stands today.

In the years that followed, the Menominee prospered. With the revenues from the sawmill they were able to build schools and a hospital, and to fund many of the needs of the community. Ironically, the relative affluence of the tribe nearly brought about its demise when, in l954, the US government passed the Menominee Termination Act removing the reservation from federal trust. The Act required the tribe to pay state taxes on its land for the first time, with nothing except the revenues from the sawmill to fund it.

So began a 10-year downward economic spiral that forced the closures of the Menominee hospital and schools, and even forced the tribe to develop some of its land as cottage country for non-Menominee. For years the Menominee organized and petitioned Washington, and, in l973, their tribal status was again recognized by the federal government and much of their land returned to federal trust.

Maintaining a sustainable harvest in the Menominee forest has been an economic and social challenge. On many occasions the impoverishment of the tribe could have been temporarily alleviated by the liquidation of the forests. If the Menominee were to clearcut their forests today, the timber alone would be worth more than $US700 million. However, the Menominee have resisted this temptation. Much like the Mi'kmaq of Pictou Landing in Nova Scotia, the culture of the Menominee has put constraints on the harvest of timber. For them, the liquidation of their forests is not a social or cultural option.

Pecore says that, despite efforts to maintain all the values of the forest, approximately 20,000 ha, or 22% of the total forest area, do not "fit the tribe's objective of right species and best quality and quantity." These lands, which once supported high-quality hardwoods and pine, are now growing less valuable aspen, white birch, red maple, and scrub oak.

Pecore says clearcutting for railroad logging in the nineteenth century degraded some of the land. In the late 1800s the Menominee were only allowed to harvest dead (standing and downed) timber. The non-native timber barons, who wanted the valuable pine trees, set fire to the forest, killing the trees, and thereby allowing for their subsequent harvest. This land, too, now requires restoration. Currently the Menominee are actively restoring 12,000 ha of land, and investing in bringing their forest back as far as possible to its original state. This generation will not reap the benefits of these restoration practices. Future generations will.

Unlike the smaller-scale case studies in this report, the Menominee forests are an example of a successful "industrial" model which has managed to keep certain forest and community values beyond the reach of the market economy, while being commercially successful at the same time.

2. Maintenance and Enhancement of Forest Ecosystem Health and Productivity

2.1 Forest Operations

"The mill cuts what the forest has to give us. And we never modify our cut for the market."

- Matt Ottravec, mill manager

"One of the enjoyable and interesting aspects of the Menominee forest is the diversity of forest type, composition and stand management. This is an attractive managed forest, offering mid-age stands planted neatly in rows; healthy looking, young stands of pine regenerated following clearcutting; dapple canopied hardwood stands selectively logged every 15 years and white pine stands where some older trees have been retained in a shelterwood pattern."

- The Forest Alliance of British Columbia

In the Menominee forest the impact of harvesting on tree species is monitored using two inventory systems: the Continuous Forest Inventory (CFI) and the Operations Inventory (OI).

2.1.1 Continuous Forest Inventory (CFI)

The job of the entire forest management team at MTE is to identify those areas of the forest that are best suited to each particular species (see Forest Habitat Classification System), and then to prescribe the most appropriate silviculture treatment for those species. Perhaps the most important tool used for determining this is the Continuous Forest Inventory (CFI), conducted every 10 years on approximately 1,000 permanent sample plots, each a circular area 0.08 ha in size, set in an even grid of 0.3 ha by 0.3 ha throughout the forest. Plots were originally established in l963.

MTE staff go into the field to make CFI measurements of area, timber volume, growth, tree condition, and quality. Each sample plot represents approximately 100 ha. This allows MTE to track changes or trends in the forest due to forest management practices or natural occurrences (Pecore l995, p. 5). The Continuous Forest Inventory provides a base of information against which MTE foresters can measure the long-term effects of forest harvesting and silviculture, as well as natural disturbances, on timber volume and quality, and species diversity.

2.1.2 Operations Inventory (OI)

The Operations Inventory (OI) was implemented between l987 and l989. MTE monitors all forestland to determine where the timber types described in the CFI occur. Data are collected by stands (areas of like species growing together in uniform fashion), which are then delineated from each other in the OI database. Data from the CFI and OI are then merged using a computer based mapping system -- the Geographical Information System (GIS).

Pecore says the CFI tells them how much volume is available for harvest. The OI tells them how much land is available for harvest.

2.1.3 Annual Allowable Cut

According to MTE, "the Annual Allowable Cut is the calculated volume of timber that can be harvested in a single year. The Menominee AAC is calculated based on the volume that can be removed, plus one-half of the projected annual growth on the removal volume" (MTE l997, p. 51).

The CFI is used to determine the AAC on both the uneven-aged and even-aged stands. The CFI incorporates a cut/leave determination for each of the 1,000 plots. This is based on "the excess stocking of fully stocked stands, not on the net growth of all stands," says Pecore, so as to prevent the inclusion of unavailable net growth on understocked stands into the annual cut calculation.

Stands managed using selection methods have their AAC calculated by how much "overstocking" there is within the stands, based on data collected in the CFI. A stand is classified as overstocked if it has at least 1,300 board feet (7.34 m^3) per 0.4 ha that can be removed. The overstocking on these plots is then added up, and the total volume and acreage are equally divided over the 15-year harvest cycle, because each stand is harvested once every 15 years (MTE l997, p. 18). In other words, the total volume available for harvest on the selection harvested stands is divided by 15 to determine the annual removal.

Volume control is used on the following cover types: northern hardwoods, mid-tolerant hardwoods, swamp hardwoods, hemlock-tolerant hardwoods, and hemlock-mid-tolerant hardwoods.

The AAC on even-aged stands is determined differently. When the CFI plots are measured, plots that are within five years of maturity are identified, and a time frame for harvesting these stands is then decided. Then the total number of hectares and volume slated to be cut is divided by the rotation length of the tree species (the planned time between cuts in a single forest stand), to determine the annual cut. Rotation length for white pine, for instance, is between 160-200 years, while for hemlock it is 250 years. Cover types managed using this method are white pine, jack pine, swamp conifer, aspen, red oak, and pin oak.

Pecore says the year 2000 harvest of 58 million board feet, or 328,000 m^3, represents 75-80% of the AAC for the Menominee forests. This means that since the Menominee harvest 3,240 ha per year overall, approximately 101 m^3 of wood is harvested per hectare. In Nova Scotia, 2.6 million ha of forestland are considered operable, but not all this land is harvested in any given year. In 1997, for instance, 68,718 ha were clearcut. The mean annual harvest in Nova Scotia between

1996 and 1998 was 5.4 million cubic metres (Wilson 2001), which means that aproximately 77 cubic metres are harvested per hectare.

In other words, the Menominee are able to extract more wood from each hectare they cut, even though they employ selection harvesting on 50% of their forestlands. In Nova Scotia we are removing 24% less wood volume per hectare, even though clearcutting is the predominant harvesting technique. This may be due to the greater standing biomass in the Menominee forests, and the higher proportion of older age classes yielding higher volumes of timber.

These results are in line with those presented for Windhorse Farm (Chapter 1), which has produced nearly twice as many board feet of timber since 1840 than would have been extracted through successive clearcuts. In short, a healthy and diverse forest with a higher proportion of older trees and sustainably logged over time, produces significantly higher timber yields than one clearcut without regard to the quality of the standing timber.

2.1.4 Forest Habitat Classification System

The Menominee lands contain eleven of a total of fifteen plant associations or habitat types found in the entire state of Wisconsin. More than 9,000 distinct timber stands make up the Menominee forest. These stands are defined by tree species composition, tree size, and volume, and they occur on a wide variety of soils and topographical and geologic features. These combinations of interdependent physical and biological elements comprise what we call ecosystems.

Certain forest cover types are better suited to a site than others. Recognizing these distinctions allows MTE foresters to assess each particular site (along with its history of past harvesting, disease etc.) to determine which high quality and high value forest type best suits it. For instance, lower value aspen currently growing on a site that is also suitable for higher value sugar maple might be regenerated with sugar maple and associated high quality hardwoods, rather than simply regenerated for aspen.

Understory plants re-establish in recognizable combinations (associations) according to site productivity, which in turn is determined by a combination of soil, moisture, and nutrients. In the Menominee forests, as noted, eleven plant associations have been identified, each related to particular site conditions, ranging from dry, nutrient poor sites dominated by pin oak and jack pine to moist, nutrient rich sites dominated by sugar maple and basswood. These habitat types are described in detail in Table 18.

This approach, linking timber productivity with soil quality and type, also exemplifies the GPI natural capital approach to accounting, which sees soil as an essential capital asset on which the future flow of timber and other forest services ultimately depends.

As Table 18 demonstrates, a single tree species will grow on a number of different sites or habitat types. However, it may achieve its best form and quality on only one or two sites. The Forest Habitat Classification System can identify which tree species are best suited to a given habitat type, and thus increase forest productivity by preserving and making the best use of soil type and quality.

Table 18. Menominee Habitat Type Descriptions

Habitat Type: Common names/Latin abbreviation	Soil Characteristics	Floral Characteristics
1. Pin oak/blueberry QV	Soil: deep, dry Nutrients: poor Moisture: very low	
2. White pine/wild lily-of-the-valley/blueberry PMV (Q)	Soil: loamy sands Nutrients: medium Moisture: low	Presence of pointed-leaved trick trefoil, early meadow rue, princess pine and pyrola
3. Sugar maple/red oak, maple leaf AQVib	Soil: sandy loams and loams Nutrients: medium Moisture: medium	Presence of witch hazel, American fly-honeysuckle, downy yellow violet, beech seedlings, white ash seedlings
4. Sugar maple/red oak/maple leaf (witch hazel phase) AQVib (Ha)	Soil: mostly loams and fine sandy loams of outwash, overlying reddish-brown till Nutrients: medium Moisture: medium (more than above)	Presence of wild geranium, sweet cicely, bristly greenbrier, spinulosa, shield fern and alternate-leaved dogwood. Has well-developed shrub layer.
5. Sugar maple/American beech/maple-leaf viburnum AFVib	Soil: loams and fine sandy loams over red till Nutrients: rich Moisture: medium	Presence of maidenhair fern, Indian cucumber root and spikenard. Does not have a well-developed shrub layer.
6. Hemlock/wild lily-of-the-valley/goldthread TMC	Soil: no specific soil type dominates this habitat type Nutrients: medium Moisture: high	Presence of wood sorrel, bunchberry and goldthread
7. Sugar maple/ hemlock/wild lily-of-the-valley ATM	Soil: fine sands Nutrients: medium Moisture: medium	Presence of round-lobed hepatica, chokecherry, trilliums, wood anemone, bristly greenbrier. Absence of wood sorrel, bunchberry and goldthread
8. Sugar maple/hemlock/beech/ shield fern ATFD	Soil: fine sandy loams Nutrients: medium to rich Moisture: medium	Presence of Indian cucumber root, red elderberry, sweet cicely, gooseberries and jack-in-the-pulpit
9. Sugar maple/hemlock/shield fern/Virginia waterleaf ATDH	Soils: fine sandy loams Nutrients: medium to rich Moisture: medium	Presence of maidenhair fern, bloodroot, sharp-lobed hepatica, leatherwood, blue cohosh and Virginia waterleaf

Table 18. Continued

Habitat Type: Common names/Latin abbreviation	Soil Characteristics	Floral Characteristics
10. Sugar maple/beech/ maidenhair fern AFAd	Soil: loams Nutrients: rich to very rich Moisture: rich	Presence of beech seedlings, bitternut hickory seedlings. The absence of clubmosses, star flower, yellow beadlily, oak fern, round-lobed hepatica and mountain maple
11. Sugar maple/virginia waterleaf AH	Soil: silt loams and loams Nutrients: rich to very rich Moisture: rich to very rich	Presence of early meadow rue, wild leek, Canadian white violet, wood nettle, and the absence of beech. Coverage of Virginia waterleaf, wood nettle and sweet cicely is 15% or greater.

Source: Menominee Tribal Enterprises, l997.

Table 19. Featured Forest Cover Type Identification

Habitat Type (Latin Abbrev.)	Featured Forest Cover Type	Objective Species	Associate Species
1.Pin oak/blueberry QV	red pine white pine	red pine white pine	jack pine red maple quaking aspen pin oak
2. White pine/lily-of-the-valley/blueberry PMV (Q)	red pine white pine	red pine white pine	red maple white birch quaking aspen pin oak
3. Sugar maple/red oak, maple leaf AQVib	white pine mid-tolerant hardwoods red oak	white pine red oak white ash basswood	red maple white birch quaking aspen pin oak white oak
4. Sugar maple/red oak/maple leaf (witch hazel phase) AQVib (Ha)	white pine mid-tolerant hardwoods red oak	white pine red oak white ash basswood	red maple sugar maple white birch big tooth aspen quaking aspen pin oak white oak

Table 19. Continued

Habitat Type (Latin Abbrev.)	Featured Forest Cover Type	Objective Species	Associate Species
5. Sugar maple/American beech/maple-leaf viburnum AFVib	white pine mid-tolerant hardwoods red oak	white pine red oak white ash basswood	red maple sugar maple white birch big tooth aspen quaking aspen
6. Hemlock/wild lily-of-the-valley/gold-thread TMC	hemlock hemlock-yellow birch swamp conifers swamp hardwoods	hemlock yellow birch cedar	spruce/fir red maple black ash
7. Sugar maple/hemlock/wild lily-of-the-valley ATM	white pine hemlock hemlock-sugar maple hemlock-yellow birch sugar maple mid-tolerant hardwoods red oak	white pine hemlock sugar maple yellow birch white ash red oak basswood	cedar red maple white birch quaking aspen
8. Sugar maple/hemlock/ beech/ shield fern ATFD	hemlock hemlock-sugar maple hemlock-yellow birch sugar maple	hemlock sugar maple yellow birch beech	white pine red maple basswood hard and soft elm
9. Sugar maple/ hemlock/shield fern/ Virginia waterleaf ATDH	hemlock hemlock-sugar maple hemlock-yellow birch sugar maple	hemlock sugar maple yellow birch hard and soft elm	basswood
10. Sugar maple/beech/ maidenhair fern AFAd	sugar maple mid-tolerant hardwoods red oak	sugar maple beech red oak white ash basswood hard and soft elm	hemlock yellow birch hickory quaking aspen
11. Sugar maple/Virginia waterleaf AH	sugar maple	sugar maple	yellow birch hickory white ash red oak basswood hard and soft elm

Source: MTE, l997.

The tree species that are the focus of these management efforts are called "objective" species – those high quality and high-value species that MTE would like to promote. These include red pine, white pine, red oak, basswood, white ash, hemlock, yellow birch, cedar, sugar maple, and hard/soft elm. Table 19 presents the featured cover types (those forest covers that best suit a particular habitat type), and the objective species (those individual species that are nurtured and managed on each habitat type.) Note that the habitat types in Table 19 correspond to the 11 categories in Table 18 above.

The managers of MTE apply the Forest Habitat Classification system to decide which harvesting method best suits each forest stand. The three steps to determine the best method are:

1) If the stand consists primarily of the featured forest cover type, then the objective is to maintain the present cover type.
2) If the current stand includes a minor component of one or more objective species that could become a major component of the stand through management, then the harvesting method will be tailored to increase the presence of the objective species.
3) If the current dominant species are not appropriate to the soil characteristics of a particular site, then the appropriate "featured" and "objective" cover type and species are established by seeding or planting (MTE l997, p. 30).

The goal is not to manage for one individual species, but to manage a single species as the primary component of "an assemblage of species" in the stand. The Menominee recognize that the health and resilience of the forest depends on its richness and diversity. (See also the Windhorse Farm case study in this report, Chapter 1.)

Once featured species within a stand are determined, the harvesting method follows suit. For instance, a hemlock/sugar maple cover type is shade-tolerant and is managed using an uneven-aged system or selection method. By contrast, in Nova Scotia, little attention is currently paid to assemblages of species that grow well together. Clearcutting followed by monoculture tree plantations or by natural regeneration, and the aggressive removal of competitive species, are the norm. In Nova Scotia, 98.9% of forest harvesting is with even-aged management techniques, including clearcutting and shelterwood.

2.1.5 Harvesting Methods

> *"We spend more money to cut timber on our lands than they do off the reservation because of the way it's being cut. But in the long run we'll have timber to cut and the other guys won't."*
>
> \- Marshall Pecore

The Menominee forest is divided into 109 compartments, or cutting units, ranging from 200-800 ha each depending on growing stock volume. The compartment is the smallest management unit in the cutting schedule. Cutting is done on a 15-year cycle for the forests managed under an uneven-aged system (see *Selection Method* below).

Approximately 56,000 ha of forestland out of a possible 89,000 ha of forest on the reservation are currently considered "fully stocked" and available for harvest. The remaining 33,000 ha are being left to grow and develop for future harvests. MTE recognizes that leaving part of the forest alone is a critical investment in the future.

On an annual basis, the Menominee partially harvest 3,240 ha,[19] or 3.7% of their total forest area, at a rate of 8.9 ha per day. By comparison, in Nova Scotia, 68,718 ha were cut in 1997, equal to 2.6% of the total operable forest area, at a rate of 186.4 ha/day. A 50% reliance on selection harvest methods does not, therefore, yield lower volume or per hectare timber extraction for the Menominee than Nova Scotia's reliance on conventional, industrial forestry practices. In fact, the contrary appears to be the case.

The difference is in *what* is being cut, *how* it is cut, and *what* is being maintained. The Menominee, for the most part, employ silviculture systems that maintain a continuous forest cover, and that are tailored to the regeneration requirements of the existing stand. By contrast, clearcutting (including shelterwood) is employed on 98.9% of forestlands in Nova Scotia, regardless of forest cover type. The more diverse Menominee harvest methods are described below.

2.1.6 Selection Method – Risk and Vigor

Approximately half of the total forestland area, 44,500 ha, is allocated to the selection method, where trees are marked, and individual trees or small groups of trees are cut. Between 2,400 - 3,200 ha of forest are marked for harvest each year. Five or six of the forest's 109 compartments are cut each year, and foresters return every 15 years to select trees for cutting.

Loggers remove trees based on the principle of "risk and vigour," also known as slow-grading. Vigour is defined as the measure of growth potential of an individual tree. Marshall Pecore says:

> *"If a stand is healthy and vigorous, it remains. If a tree is 30 inches (75 cm) in diameter and it's healthy and vigorous, we leave it alone. Those that are risky, that won't be there in 15 years when we re-enter that forest, they're removed."*

Two four-man Menominee marking crews spend all year in the bush, measuring and marking timber stands in advance of the cuts. First they look for high-risk trees – those with damaged tops, for example, that are unlikely to make it to the next harvest. Next the markers target slow-growing trees that are stunted by disease or competition. Finally, the markers identify those trees whose removal will improve the spacing within a stand.

Underlying this policy is the understanding that economic survival is directly related to the speed at which the forest can regenerate, and to the quality and characteristics of that regeneration process.

[19] Between 2,400-3,200 ha each year are partially harvested using selection systems. The total harvested area is arrived at using the average between these two figures (2,800 ha), added to the areas harvested annually using clearcutting (200 ha) and shelterwood (240 ha) methods.

Uneven-aged management could mean the removal of a single tree, or it could mean the removal of a group of trees (called “patch selection”.) Patches are usually about 0.2 ha (about half an acre) and allow improvement of tree species diversity, and planting of mid-tolerant hardwoods such as white ash and yellow birch.

As noted, old trees that are healthy and still growing are left alone. As a result, approximately 65% of the Menominee forest is an old forest, and the average age of harvested maples, for instance, is 140 to 180 years. In Nova Scotia, sugar maples are typically harvested when greater than 24 cm in diameter. They usually reach that size when they are greater than 75 years old, at which point they are harvested (K. Snow pers. comm. 2001). The average age of harvested sugar maples in Nova Scotia is about half that in the Menominee forests, testimony to the sharp differences between the two systems, in overall age structure, volume yields, and harvest methods.

Pecore adds that many of the trees in the Menominee forest are greater than 18 inches in diameter and are too large to cut with heavy machinery. By volume, he estimates that 50-60% of the total Menominee harvest is cut by hand, using either chainsaws or handsaws (M. Pecore pers. comm. 2001). In Nova Scotia, as noted, 99% of the harvesting that takes place is clearcutting, in which mechanized machinery, not hand cutting, is always used.

The selection method works best for species that can regenerate in full shade, such as sugar maple, beech, hemlock, and basswood. The result of selection harvesting on such a large scale (50%) is a forest diverse in age, species, and structure. By contrast, less than 1% of Nova Scotia forests are harvested using selection systems, and less than 1.2% of the province’s forest area is still dominated by trees more than 80 years old.

2.1.7 Shelterwood

A two-stage shelterwood harvest system is currently used on approximately 25% of the Menominee land, or 22,250 ha, to regenerate white pine, red oak, hemlock, and yellow birch. On an annual basis, about 240 ha are harvested using a shelterwood system. In a white pine shelterwood, the first cut leaves no more than 50% crown closure. The site is allowed to develop for 2-3 years in order to let the seed bank germinate. Three years after the seedlings germinate, the overstory is reduced to no more than 20%, leaving only the best trees to continue to grow. For hemlock shelterwoods, the first cut removes 25% of the crown, and after the second cut, crown closure is reduced to 20% after regeneration is 3-5 feet tall.

2.1.8 Clearcutting

Clearcuts are no less controversial on the Menominee reservation than elsewhere. Many tribal members are opposed to clearcutting, and, since tribal members make up MTE’s elected 12-member board of directors, these voices of dissent have to be addressed. Of the 89,000 hectares of forest belonging to the Menominee, roughly 25%, or 22,250 ha, are managed for aspen, red pine, and jack pine, with approximately 200 ha being clearcut each year for this purpose.

Clearcuts are never larger than 12 ha, are not contiguous, and are permitted only on high ground and well away from streams or lakes.

In Nova Scotia, guidelines exist regarding cutting on crown lands, but there are currently no restrictions in place to regulate cutting on private lands, which constitute the majority (69%) of the province's forested lands.

Less than 5% of the Menominee forest, or 4,450 ha, is held in plantations, where nursery-grown red and white pine seedlings are planted in clearcuts (M. Pecore pers. comm. 2001). In Nova Scotia, between l975 and l999, approximately 157,360 ha were held in plantations, amounting to approximately 6% of the province's operable forestland.

Herbicides, fire, and methods of mechanical soil disturbance are occasionally used in conjunction with the clearcuts, in an effort to maintain some of the "disturbance-dependent" community types, says MTE. As many tribal members are not comfortable with the use of these methods, foresters have proceeded very cautiously in their use. Like clearcutting, the use of herbicides has been a highly contentious issue in the Menominee community and, as such, they are used "prudently" (Landis l992).

In addition to manual removal of competing growth, herbicides are sometimes sprayed "to protect white pine seedlings from competition after a shelterwood cut," and they are also used in the clearcuts. In total, roughly 500 ha may be sprayed with herbicides annually.

It should also be noted here that the SmartWood assessment team was concerned about the use of chemical pesticides for silviculture purposes, "regardless of its justified application." The assessors raised concerns about "the long-term sustainability of the forest management operation." As such, one of the conditions for Forest Stewardship Council certification was that MTE revise its chemical-use policy, reduce the use of chemicals, and increase the use of alternative treatments. In SmartWood's l997 audit it states that this condition was met, and that the MTE pesticide policy "indicates a strong desire to move away from chemical treatments and toward alternatives such as prescribed burns and mechanical treatments" (SmartWood l997, p. 10).

The Menominee spend an average of US $600 per hectare/year on silviculture (M. Pecore pers. comm. 2001). This seems considerable, but in the Menominee view is a small price to pay for what they consider a significant investment in their future, which they see as dependent on the long-term health of their forests and the maintenance of the full range of forest values.

2.1.9 Logging Performance Penalties

In order to ensure sustainable management practices in the field, the tribe uses financial incentives and penalties for performing or not performing to required standards. These financial incentives are in part responsible for the higher costs associated with harvesting in the Menominee forest. These incentive/penalty stipulations in the logging contracts, some of which are listed in Table 20, have helped to reduce logging damage to the forest.

The Menominee incentive/penalty system could be a model for Nova Scotia. Because the Genuine Progress Index links natural resource health to economic prosperity, and recognizes that forest sustainability protects the *economic* value of forests, a primary purpose of this study is to point to the financial instruments needed to ensure the maintenance and enhancement of the full range of forest values. Through such incentives and penalties, economic and environmental sustainability can be encouraged.

All loggers involved in harvesting wood from Menominee lands must attend training sessions and learn the rules and restrictions they have to abide by when working on Menominee lands. Once in the field, they are rewarded or penalized according to their performance, with special emphasis on the care they exercise in preventing damage to the standing stock.

Table 20. Examples of MTE Logging Performance Penalties

Action	Penalty Imposed
Cut or girdled unmarked sawlog size tree	$250.00 per tree
Excessive damage to sawlog size tree	$125.00 per tree

Source: Mater, l998.

In addition to the above penalties, incentives are also offered. A $2.50 bonus for every thousand board feet is given as a performance guarantee to the logger who successfully cuts and delivers his contracted harvest in accordance with contract specifications. According to Mater, this is a critical incentive because the harvest includes all grades of material – lower quality as well as higher quality. In conventional systems, loggers would want to harvest the higher quality, large diameter wood only, because of the higher price it would fetch at the mill. As well, loggers would prefer to harvest straight pulpwood, because it can be cut quickly with little regard for damage to the log (Mater l998, p.7).

The incentive and penalty system works. A report to the Menominee Tribal legislature in l984 conducted by the Wisconsin Department of Natural Resources found that the Menominee forests experience only 1.9 trees/acre of logging damage compared to 13 trees/acre on national forest systems in the region (Mater l998, p. 7).

In Nova Scotia there are no provincial studies that look at tree damage from logging. According to Ken Snow, the Manager of Forest Inventory for the Nova Scotia Department of Natural Resources, "it's not really an issue here [in Nova Scotia] since most trees are clearcut." He says there may be some damage to the trees left at the edges, but these data have not been collected. If Nova Scotia were to incorporate more selection cutting into industrial forestry operations, then the Menominee incentive/penalty system could be used as a model.

2.2 Annual Removal of Wood Products

In l884, about 1.2 billion board feet of standing timber was documented in the Menominee Forest. Since then, the amount of board feet of standing timber has increased by 40% (Mater l998, p. 2). Even though over 2 billion board feet of timber has been harvested from the Menominee forest since the reservation was first established in l854, the proportion of high quality and large diameter logs has significantly increased.

This enhancement of forest value is partially due to restoration efforts on land that at one time supported high-quality and high-value species, but that had been degraded due to clearcutting for railroad logging between 1880 and the early 1900s. In addition, because only dead (standing or downed) trees could be harvested in the Menominee forest in the late 1800s, non-Menominee loggers, known as the "pine ring," who wanted the massive pines, set fire to the forests in order to kill the white pine and allow for their subsequent harvest.

These degraded lands are being restored today, increasing both the quality and quantity of standing timber in the Menominee forests. The long-term success of these restoration efforts in increasing the market value of the Menominee forests, supports the arguments of Jeremy Frith (Chapter 3) that restoration forestry is good business, and a sound, cost-effective investment that will yield a high rate of return.

Between l963 and l988, using the Forest Habitat Classification System, MTE converted some stands to higher quality native species to match the appropriate habitat type. For instance, between l963 and l988, of the more than 7,000 ha of land dominated by aspen, 59% (or 4,120 ha) were converted to tolerant hardwoods, 20% to red and white pine, and the rest to a mixture of jack pine, swamp conifer, hemlock, and scrub oak. Forestry data also document that the forest area covered by lower quality, lower value species such as aspen decreased, while the acreage covered by the native higher value species, such as northern hardwoods, increased (Mater l998, p. 4).

Forest inventories conducted in l963, l970, l979 and l989 indicate the Menominee forest had higher timber volumes in successive inventories, even though 600 million board feet of timber were harvested over the same period. This is testimony to the sustainable forest management (SFM) practices used by the Menominee over the last 25 years. In sharp contrast to the loss of wide diameter trees in Nova Scotia, the average diameter of the trees in the Menominee forest has been reduced by only half an inch over the entire 147-year harvesting period (Mater l998, p. 4).

In Nova Scotia, successive forest inventories over a thirty-year period also indicate an increase in merchantable forest volume.[20] In fact, successive inventories indicate that between l971 and l999, the total merchantable forest volume increased by 133 million m^3, from 260 million in the l965-71 inventory, to 393 million in the l999 inventory. Even more dramatic was the 60%

[20] Merchantable volume is defined by the NSDNR as the wood fibre in trees that are 9.1 cm and larger in diameter at breast height outside bark, and that is contained between a 15 cm stump and an inside bark top diameter of 7.6 cm.

recorded increase between l989 and l999, at the same time that the volume clearcut increased by 50%, and the area clearcut by 100%.

However, according to Peter MacQuarrie (2001a), director of the Renewable Resources Branch of the NSDNR, it is likely that little, if any, of the apparent increase reflects an actual increase in volume. He says the recorded increase may be more an artifact of measurement or methodology, that is due to changes in both techniques and definitions.

After the early forest inventories, strip cruises gave way to use of temporary sample plots. Then in l980 the methodology changed once again with the introduction of point sampling with varying probabilities. The current system uses photo interpretation for determining variables for every forest stand in the province. [21,22]

In addition, says MacQuarrie (2001a), trees that were not considered merchantable thirty years ago, and were not counted in the earlier inventories, are being counted now. "As the inventories progressed, people tended to measure more trees. In the l950s people may have only considered 10 inch trees merchantable," he says. Today, anything bigger than roughly 3.6 inches (9.1 cm) is considered merchantable. As the province has lost its larger, older trees, ever smaller trees have become the merchantable norm. Because this loss has occurred gradually, particularly over the last 40 years, it has not, until now, been associated with an overall decline in value of the province's standing forests, and the new conditions are simply accepted as the norm.

Therefore, despite the appearance of a volume increase in the recorded inventories, there is no evidence that such a trend actually exists in Nova Scotia. It may only be possible to tell if there was a true volume increase after the next inventory, assuming that the methodology and definitions remain the same.

Indeed, the evidence in these forest accounts does not support reports of an increase in actual merchantable forest volume in Nova Scotia, in light of the substantial shift to much younger forests noted in Volume 1 of these accounts. Since l958, there has been a 12-fold decline in older forests in the province and a 57-fold decrease in forests over 100 years old, while at the same time, the percentage of young forest (0-40 years old) has increased by more than two and a half times. The province has lost almost all of its remaining old trees in the last forty years alone (Wilson 2001, Chapter 7), indicating a likely decrease in forest volume rather than the reverse.

Currently, the Menominee are harvesting 58 million board feet (328,000 m^3) of wood from their woodlands per year (M. Pecore pers. comm. 2001). Of this, approximately 34% (113,000 m^3) goes to the Menominee sawmill in Neopit. The rest, approximately 66% (215,000 m^3) is sold as pulpwood. Generally, low quality, small diameter, crooked trees are sold for pulp, fetching between US $45-85/cord (M. Pecore pers. comm. 2001).

[21] Using air photos, forest stands that are generally one hectare in size or greater are delineated. Variables assessed include crown closure, average stand height (height of average co-dominant trees) to the nearest metre, land capability, and species in 10% classes. If a second story for the stand is detected, a forest type, average height, and crown closure are also estimated for that story.

[22] In the current system, merchantable volume is calculated using an algorithm developed for converting total basal area to merchantable volume. First the maximum total basal area for every stand with a height of 5 metres or more is calculated. Then this total for softwood and hardwood is multiplied by the merchantable volume conversion factor.

The Annual Allowable Cut (AAC), as noted, is developed in 15-year cycles, with the overall planning horizon being 150 years. As noted above, Pecore records the current annual harvest of 58 million board feet as representing 75-80% of the AAC.

Tribal members are also allowed to cut firewood on the reservation. To do so they need a permit that is free and issued by the Menominee Forestry Department. The permit allows for the harvest of 25 cords of firewood, 100 cedar posts, and any number of evergreen boughs. About 350 people apply for this permit annually, and it is estimated that this amounts to 8,500 m^3 of harvested firewood per year. This is in addition to the 328,000 m^3 harvested commercially.

2.3 Ecosystem Resilience

Currently the best indicators available to assess ecosystem resilience and the capacity of the forest to recover from disturbance, are distribution of forest types, age class distribution, and successful regeneration.

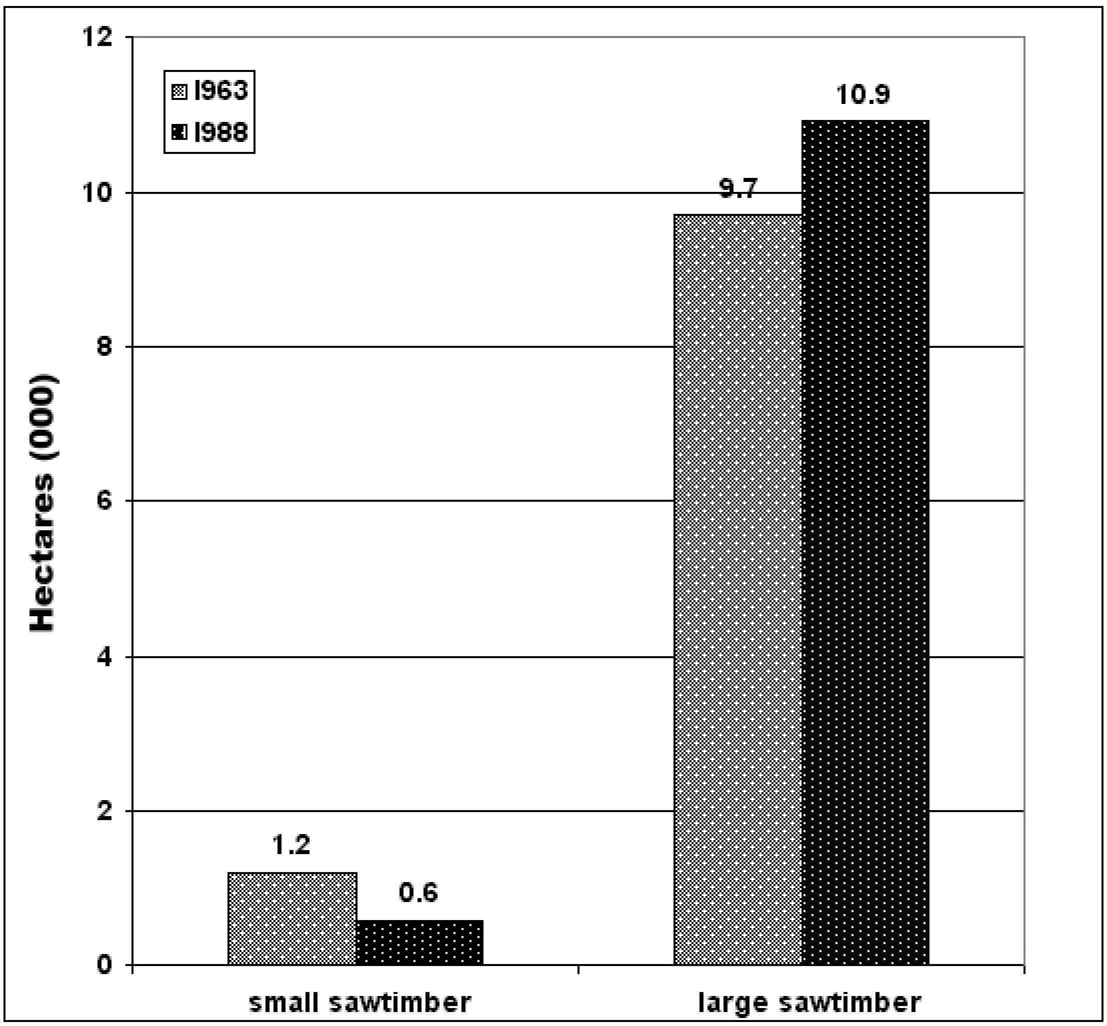
Due to the fact that the Menominee do not manage by age class but by vigour and risk, Pecore was unable to provide data on age class diversity within the Menominee forests. However, the following trends, most already noted above, indicate that age class diversity and forest type diversity have been maintained and enhanced:

- Since l854 the amount of high quality and large diameter timber has significantly increased (see Figures 4.1 and 4.2 below).
- The average age of harvested maples is between 140 and 180 years of age.
- The Menominee lands contain eleven of a total of fifteen plant associations found in the entire state of Wisconsin.
- More than 9,000 distinct timber stands make up the Menominee Forest.
- Complete forest inventories conducted for l963 to l989 indicate the Menominee forest contained a greater volume of timber in each successive inventory period, even though 600 million board feet were harvested over that same time period.
- Between l963 and l989, the Menominee continuous forest inventory (CFI) shows that the area covered by native higher quality and higher value species such as northern hardwoods (sugar maple, basswood, red oak, yellow birch) has increased, and currently occupies nearly 40% of the Menominee forest (Forest Alliance l995). This is in sharp contrast to Nova Scotia where there have been significant losses in the province's higher quality maple, oak, ash, and other tolerant hardwoods in the last 40 years (Wilson 2001, Chapter 7).
- The area containing valuable, large northern hardwood sawtimber increased by 30% on the Menominee land between l963 and l988 (Mater l998 p. 5).
- Over that same time period, the Menominee increased their Grade 1 sawlog (at least 14 inches in diameter) volume from 25% of their total growing stock to over 30%, and they decreased their Grade 3 sawlog volume by an almost equal amount.

Between l963 and l988 there was also a corresponding conversion from lower quality, lower value species such as aspen, to higher value northern hardwoods. During that same period, the quality of almost all the species represented in the forest improved. Increased diameter size indicates both an improvement in the quality and grade of sawlogs, and the presence of a significant portion of older age classes.

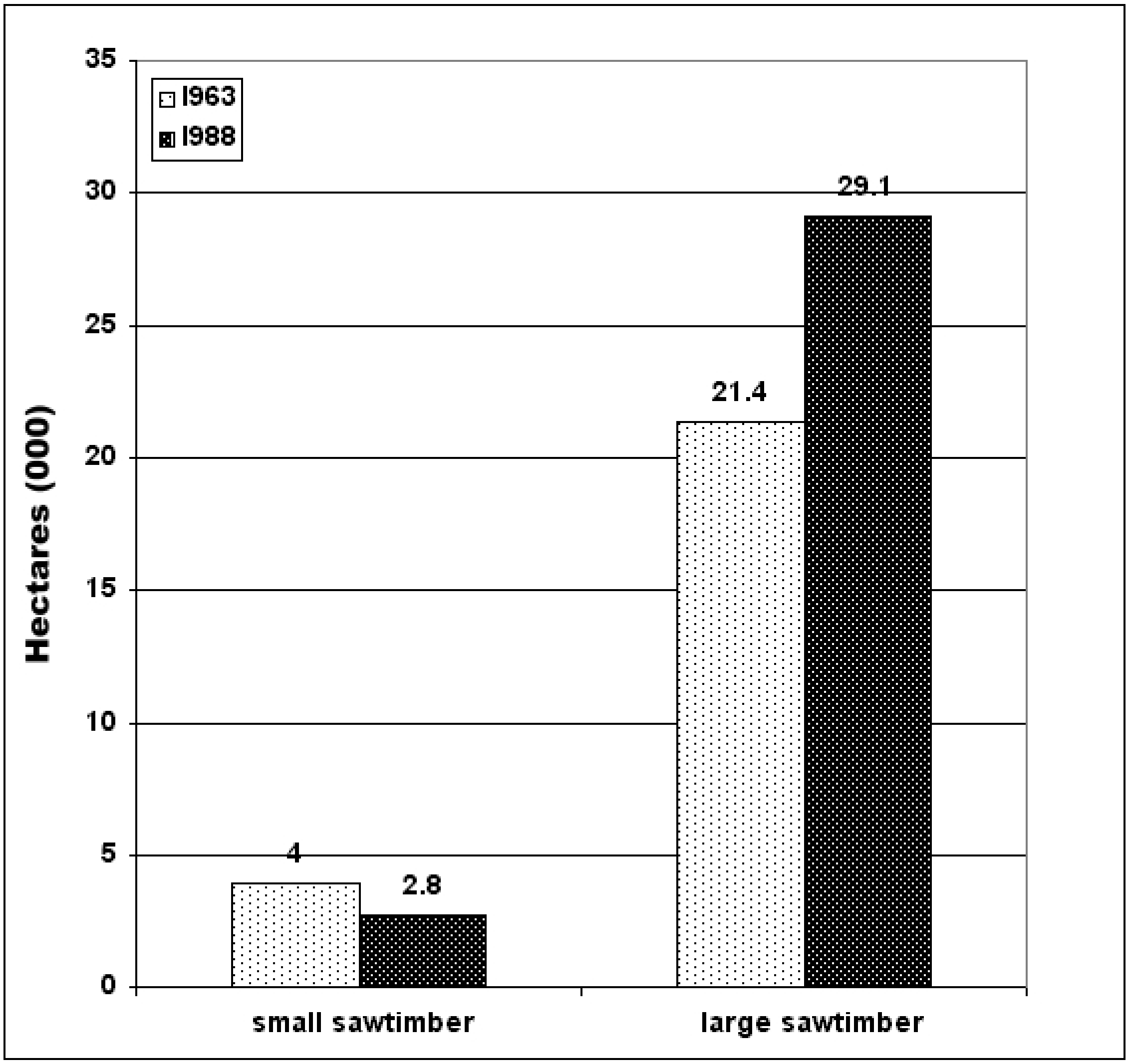
In sum, all existing indicators of forest type, age class distribution, and successful regeneration indicate the maintenance and enhancement of ecosystem resilience and recovery in the Menominee forest. By contrast to these positive trends, there has been a significant increase in younger age classes in Nova Scotia, and a concomitant decrease in large-dimension, clear lumber.

Figure 12. Area (ha) of Standing White Pine in the Menominee Forest, by Size Class



Source: Mater, l998.

Figure 13. Area (ha) of Standing Northern Hardwoods in the Menominee Forest by Size Class



Source: Mater, 1998.

3. Conservation and Biological Diversity

There are three core principles that underpin the sustainable forest management system of the Menominee forest:

1) The forest must be sustainable for future generations.
2) The forest must be cared for properly to provide for the many varying needs of people over time.
3) All parts of the forest must be maintained for diversity

3.1 Ecosystem Diversity

> *"Diversity minimizes the risks to the forest of an unpredictable future by retaining 'all the pieces' of the forest and not 'putting all of your eggs in one basket.'"* (MTE l997 p. 15)
>
> -Menominee Tribal Enterprises, l997

In addition to the 89,000 ha of forested land, more than 240 km of rivers and streams flow through the Menominee reservation, and 123 lakes cover approximately 1,600 ha. These features, together with the surrounding forest, provide a wide range of ecological, social, recreational, and spiritual opportunities for the Menominee and their visitors. The Menominee forest has been described as a "fully structured forest," and "arguably the most unique biological resource in the region" (SmartWood 2000, p. 6).

Maintaining the diversity of native species similar to what would exist in a natural forest ecosystem is paramount for the Menominee. To realise this objective, they employ the Forest Habitat Classification System described above (see Table 18), which helps them identify the best forest cover for each habitat, regardless of the tree species or quality currently growing on the site.

Even though the Menominee intensively manage their forest, it is more diverse than any other forest in the region. The Menominee attribute this to the fact that their forest contains eleven out of a total of fifteen plant associations or forest habitat types found in the entire state of Wisconsin. The major soil types range from dry, nutrient poor sites to moist nutrient rich sites. Each habitat type supports and is suitable for different tree species (cover types), and there are currently more than 9,000 distinct stands making up the Menominee forest.

The matching of a tree species or cover type to a particular habitat type is based on:

1) Sawtimber growth potential in quality and quantity;
2) Biological/ecological suitability to the site; and
3) Competitiveness with other tree species commonly associated with it (Mater l998, p.3).

According to Marshall Pecore, certain forest cover types do best on certain soil types in combination with other species. "It all depends on the site capabilities," he says, with forests differing from site to site because of variations in sunlight, moisture, soil type and climate.

The dominant forest cover types within the Menominee forest include northern hardwoods (maple, red oak and basswood), hemlock hardwoods, mid-tolerant hardwoods, pine stands (jack, white and red), aspen, scrub oak, and swamp forest.

This classification system also accounts for the fact that past disturbances and less appropriate harvesting practices have degraded many sites and, in some cases, allowed lower-value scrub species to take over prime forestland. For instance, using this system, MTE has identified over 26,000 ha of land that are suitable for pine and quality hardwoods but that have been taken over by aspen, white birch, red maple, and scrub oak. According to Mater's case study on MTE, these lands once supported high-quality hardwoods, but were altered by past management practices that included clearcutting for railroad logging and uncontrolled slash fires caused by poor logging practices (Mater l998, p.3)

While many species grow on multiple sites, they generally achieve their best form and quality in only one or two habitat types. White pine, however, is one species that can thrive on five habitat types, says Pecore.

Despite efforts to maintain high levels of natural biodiversity, there are no "true" old-growth forests on the Menominee reservation. There are individual trees older than 250 years. But, since the entire forest has been modified to some extent, there are no areas that exhibit all the characteristics of true old-growth, such as the presence of large diameter coarse woody debris and the creation of many micro-habitats (see Windhorse Farm study, Chapter 1). Since the rotation lengths are so long – 160-200 years for white pine and 250 years for hemlock – some of the selection harvested Menominee forests nevertheless do attain *some* of the attributes of an "untouched forest" (Pecore pers. comm. 2001).

3.1.1 Protected Areas

There are currently no designated protected areas within the Menominee forest.

One of the conditions of forest certification stipulated by SmartWood was that MTE further evaluate the need for a system of representative ecological reserves where no logging could take place. The SmartWood report stated that MTE would have to substantiate their rationale if they did not designate ecological reserves. SmartWood's l997 audit report states that MTE did supply such a rationale for not designating ecosystem reserves, based on "land-use history, conservation biology, and cultural traditions of the Menominee."

3.1.2 Deadwood

According to the Forest Alliance of British Columbia, the Menominee forests have few snags (standing dead trees), and have limited structural diversity. This may be the result, says Pecore, of rules that were put in place in the late 1800s by the US government. At the time when the Menominee sawmill began manufacturing pine for sale outside the reservation, harvesters were only allowed to harvest dead or downed timber. In a 15-year period, the Menominee cut or pulled out about 565,000 m^3 of deadwood. In the years that followed, they were granted permission to cut "green" trees as well as dead trees (Pecore l995, p.2).

The shortage of deadwood is very likely a product of this historical legacy. However, the Menominee are aware of the deficiency, and have taken measures to increase the deadwood component in their stands. Dead trees are now left to rot.

According to Pecore, deadwood is now seen as an "investment," and efforts are being made to determine just how much coarse woody debris (CWD) is on the ground and how many cavity trees are available for cavity-dependent species. This is part of an effort to increase the composition (in size, not just volume) of deadwood in forest stands. This initiative is similar to that taken by Jim Drescher, who has recently halved the annual allowable harvest for Windhorse Farm in response to a shortage of deadwood (Chapter 1).

Despite the recognized deficiency, MTE staff report that results from an ongoing survey indicate the snag component in their forest is greater than the average found in the rest of Wisconsin (Forest Alliance l995).

3.2 Species Diversity

> *"We still have lots of the things that there's a shortage of everywhere else. Hawks, songbirds, bears, butterflies – every time they come looking for them they find them here. These are the things we're kind of proud of.*"
>
> Marshall Pecore, MTE forest manager (Bernard and Young l997, p. 94)

The Menominee forest is located at the northern cusp of the divide between Wisconsin's central hardwood forest and the northern hardwood forest, and it contains a higher diversity of tree species than forests found to the north or south. This diversity is demonstrated by the fact that eleven forest habitat types have been identified out of a total of fifteen in the state as a whole. The dominant forest cover types include northern hardwoods (maple, red oak and basswood), hemlock hardwoods, mid-tolerant hardwoods, pine stands (jack, white, red) aspen, scrub oak and swamp forest (Mater l998 p. 2). Table 21 lists the tree species found in the Menominee forest.

Table 21. Tree Species found in the Menominee Forest

Hard maple, eastern hemlock, eastern white pine, red oak, basswood, yellow birch, big tooth aspen, quaking aspen, cedar, soft maple, pin oak, white birch, beech, black ash, white ash, red pine, white spruce, black cherry, balsam poplar, white oak, hickory, jack pine, tamarack, balsam fir, black spruce, butternut.

Over thirty species of trees can be found in the Menominee forest, including eastern hemlock and Canada yew, two species that are widely accepted as indicators of ecosystem health. The Menominee forest also has a high proportion of old trees. It is not unusual to come across 350 year-old cedar and hemlock. As well, the understory composition (tree species, mix, age and size class structure) closely resembles that of the original forest (Bernard and Young l997, p. 94).

In order to monitor biodiversity in their forests, the Menominee have set up more than 900 permanently marked monitoring plots which are used to keep track not only of the tree species but also of the shrubs and ground layer component. They also have a wildlife management program that is carried out by the Menominee Tribal Conservation Department.

Biological inventories on the reserve have been limited. The only inventory of mammals was done in l929 and preliminary inventories of vascular plants and birds were done more than 30 years ago. Pecore reports that an on-site MTE biologist and other MTE staff are currently collecting baseline data on birds, large game, and reptiles, with the goal of developing a long-term analysis on the effects of forest practices on wildlife. The data will be used to determine how management practices can be improved to protect wildlife habitats.

Rare invertebrate species that have disappeared from most of Wisconsin's rivers are found in the rivers of the reservation, and fish fauna is diverse and representative of the historic mix of species. Pecore attributes the statewide decline in these species to a wide range of factors: from acid rain, to poor land management, to higher water temperatures caused by clearcutting. A deep-woods nesting bird, the hooded warbler, is also found in the Menominee forest. As well, the forest provides habitat for endangered species, such as the bald eagle and the karner blue butterfly.

When designing the prescription and boundary of a harvest, the Menominee consider how wildlife populations will be affected. Some of the factors considered are travel corridors, forest edges, and grassy openings (MTE l997, p. 21). According to MTE, if a proposed forestry operation cannot be modified or timed to minimize or eliminate adverse effects on wildlife, then an environmental assessment is conducted. "It is MTE's desire to manage the forest on a sound ecological basis, and wildlife populations are an integral part of the ecosystem" (M. Pecore pers. comm. 2001). While insufficient information is currently available to assess the success of existing strategies, MTE's new wildlife data collection initiative will allow more accurate assessments in the future.

3.3 Genetic Diversity

Genetic variation due to forestry practices in the Menominee forest was assessed in a Purdue University study that tested and compared the genetic variation of tree seedlings in stands of eastern white pine that had undergone clearcuts and shelterwood cuts with that of seedlings in unmanaged virgin stands. Their results showed that no loss of genetic variation had occurred (M. Pecore pers. comm. 2001).

However, as was noted, clearcutting is an extremely controversial subject on the Menominee reservation, with many tribal members vigorously opposed to it. Since MTE's board of directors is comprised of Menominee tribal members, these concerns are regularly aired and addressed. Any clearcutting that does take place is carried out under the strictest of guidelines, and only on 25% of the forestland. Clearly, the Menominee could have realised substantial returns by clearcutting a much larger portion of their forests, but they have quite deliberately chosen not to do so.

> *"If the Menominee ignored ecological concerns, they could also make a great deal more money. They could just produce a monoculture of economically beneficial species like red pine, and cut and replant on a short rotation. They could push their forest in whatever direction they think the market will go. They could cut based on market demand. But that's not what they have chosen to do"* (Pecore l995, p. 8).

4. Conservation of Soil and Water Resources

4.1 Water

Very little of the Menominee forest is actually maintained in a pristine state or strictly natural condition. It has already been noted that even good forest practices and sustainable management are not a substitute for an effective system of protected areas. However, the Wolf River, which runs through the reservation and is culturally significant to the Menominee, *is* protected throughout its length, and is a federally designated Wild and Scenic River. Watersheds in the region drain into the Wolf River system and ultimately into Green Bay.

Streamside management of the Menominee forest is carried out according to the State of Wisconsin's guideline document *Wisconsin's Forests: Best Management Practices for Water Quality, l995.* Under these guidelines, fish bearing streams have a 20-30 metre wide buffer strip.

There are at least two additional practices employed by the Menominee that help protect water and stream quality (Hogan *et al.* 1998):

- Strict rules are in place that restrict the placement of skid trails.
- In areas where selection harvesting is used, canopy cover is maintained both to minimize the flushing effect after rains and snowmelt, and to maintain shade cover and cool water temperatures for cold water fish species such as trout.

Since the Menominee currently use herbicides in combination with manual competition removal on a very limited number of their white pine shelterwood cuts and plantations, there could be an impact on local streams and rivers from these practices. However, these data are not currently available.

4.2 Soil

Very little information is also available on soil erosion or soil compaction in the Menominee forest. Rutting by heavy machinery does occur on skid trails (Forest Alliance l995), but the Menominee endeavor to minimize this in the following ways:

- They specify incentives and penalties in their logging contracts that include fines if unauthorized equipment is used on undesignated trails.
- Much of the cutting still involves chainsaws, says Pecore, which reduces the presence of heavy machinery within forest stands. Pecore says many of the trees cut within the selectively logged areas are greater than 18 inches in diameter, – a size many machines cannot handle. Of the total volume of timber harvested in the entire Menominee forest, Pecore estimates that between 50-60% is cut by hand using chainsaws and hand saws.
- Active logging operations are shut down regularly for weather reasons, – for example, when soils are wet and easily rutted. By contrast, in Nova Scotia, harvesting takes place

during all times of the year, regardless of soil saturation, as is evidenced by the many 2-3 foot deep ruts visible in many Nova Scotia clearcuts.

The limits of even the best industrial forest practices in protecting soil quality demonstrate the need for strict ecoforestry operations coupled with an extensive system of protected areas. Seasonal horse logging coupled with careful road design and construction (as is practiced at Windhorse Farm, for instance) ensures no rutting or compaction.

4.3 Fish and Aquatic Fauna

The Menominee consider the Wolf River and its tributaries as a "cultural resource". "The disturbances to significant cultural resources are minimized or avoided and all treatments must be evaluated for potential cultural resource impacts" (MTE l997, p. 22).

Apart from anecdotal evidence on the presence of an historic representation of fish fauna within streams and rivers on the Menominee reservation, there is little information available on this subject. However, fishing and hunting are part of the cultural heritage of the Menominee people, and particular efforts are made to ensure the protection of aquatic and forest dependent species such as trout. Pecore says surveys currently under way to determine baseline data for various forest and aquatic fauna should help to determine whether the existing forest operations are adversely affecting the wildlife populations, and whether they need to be modified accordingly.

5. Multiple Benefits of Forests to Society

There are immense social benefits that arise from long-term stable employment. Indeed, the provision of jobs is frequently cited as the primary objective of economic growth strategies. But while some kinds of growth *may* produce more long-term stable employment, other kinds may actually threaten jobs, particularly when growth is highly capital intensive or when it depletes the resource on which those jobs depend. In Nova Scotia, that distinction is one of the key differences between selection harvesting and clearcutting.

Aside from the indirect services provided by forests to human society through their ecological functions, they also provide direct social services through the provision of employment. When a forest is sustainably harvested through selection methods, a relatively fixed quantity of timber can be extracted annually in direct proportion to the forest's annual growth increment. Using these methods, the Windhorse Farm woodlot and MTE have been able to provide long-term stable employment for local communities for generations. (See Section 9 below.)

Clearcutting, by its very nature, cannot generally provide local communities with this kind of livelihood security. It is highly capital intensive, usually undertaken by contractors with feller-bunchers and other expensive equipment, and it immediately dries up a resource-based source of employment for at least 50 years when the timber has been removed. The drive to maximize profits in the short-term has left many communities devastated once the resource has disappeared. This kind of boom and bust economy is the antithesis of economic sustainability just as resource depletion is the antithesis of environmental sustainability (also see the discussion of boom and bust commodity industries in Chapter 5, Section 9.5).

Resource management practices therefore directly impact all resource-dependent communities, and have the capacity either to sustain or to undermine their livelihood security. One of the Menominee's primary goals is to integrate community values and needs with effective resource management. These two objectives are inextricably linked for the Menominee and are highly dependent on each other.

The difference between the Menominee approach and that currently prevalent in Nova Scotia is that the Menominee make a conscious effort to sustain the forest for future generations, rather than to make an immediate short-term profit. Indeed, that basic approach differentiates MTE's forest management practices from the vast majority of conventional industrial practices. The explicit goal of the Menominee is to preserve the ongoing identification of the human community with the forest, while at the same time giving an absolute priority to the forest's ecological integrity. Above all, the "growing heart of the forest" must remain intact (Bernard and Young l997, p.103).

Beyond jobs, the forest provides other social services to the Menominee people that cannot be as easily quantified. The forest means much more to the Menominee than timber sales. If the entire forest were clearcut today, the Menominee could earn US $700 million (M. Pecore pers. comm. 2001). However, they have made a conscious choice not to go this route because the forest is a direct expression of Menominee culture, spirituality, and values. In addition to providing stable and long-term employment for members of the tribe, the forest provides the community with a profound cultural identity.

The Menominee refer to their forests as the "backbone" of their people. The community members have a say in what happens to their forest, and this meaningful participation sets the Menominee community apart from almost all other resource-dependent communities. The sustainability of the Menominee forest means the sustainability of the Menominee people.

Traditionally, at a time when the Menominee lived by hunting, fishing and gathering, the forest providing them with everything they needed. Today this has changed. Even though the Menominee remain close to the land, their lifestyles have been influenced by the dominant North American culture. Many families do not utilize the woods as they did in the past, and many have illnesses such as diabetes, cancer, and heart disease, as a result of the changes in their diet (T. Peters pers. comm. 2001). According to the Menominee-run Sustainable Development Institute, these diseases occur at epidemic levels on the reservation, where the incidence rates are three times higher than that of the general population.

The Sustainable Development Institute, in partnership with the Woodlands Confederation (which includes six Tribal Colleges located in the Great Lakes region), and the University of Minnesota have recently undertaken an initiative to tackle the growing rates of diabetes, cancer and heart disease. The Institute and Confederation are now offering a course entitled *Woodland Wisdom,* which looks at the history of traditional food production and preparation among the Woodlands tribes. Through this educational initiative and other actions, it is hoped that a return to some traditional dietary habits may help stem the current high incidence of serious chronic illness.

6. Economic Contribution of Other Non-timber Goods and Services

In Nova Scotia and elsewhere, the “forest industry” is generally narrowly defined by timber extraction. But forests also provide a wide range of other goods and services that have direct economic benefit to human society. The Menominee people (approximately 8,500, on and off reserve) currently use the land and water for a variety of recreational, cultural, and subsistence activities, including harvesting medicinal plants, berry picking, fishing, and hunting. The Menominee people are allowed to hunt and fish for personal use but are not allowed to sell the food taken from the forest.[23] Use of the reservation land by non-Menominee is not allowed.

Picking berries (blackberries, raspberries, cranberries) is a fall activity for many tribal members, but it is not regulated, and so there are no data on rates of participation in these activities. As well, tribal members collect plants for medicinal uses. Wild rice, a traditional staple of the Menominee, still grows in the waters on the reservation. Since the late 1800’s the Menominee have been involved in maple syrup production, and today many still collect sap for this purpose.

In addition, moss and cedar boughs are sold to local floral product companies. The biggest market, however, is for ginseng, commonly called shang. Several Menominee gather shang and sell it to dealers in Wausau, who export it to China. Ginseng gatherers are very protective of their sites and always bury the seeds to ensure they do not deplete the supply of ginseng (Pecore l995, p.4).

The Menominee reservation also attracts thousands of visitors year-round for guided tours of the forest. This activity, however, only brings in a nominal income, says Pecore. The reservation also has a Menominee Logging Camp Museum that boasts the largest collection of logging artifacts in the Midwest.

Tourism, in general, is a controversial subject on the reservation. Pecore says tourism in the form of recreational development, RV parks, and walking trails can result in “a loss of acreage” for the forest operations. Many Menominee regard the events that took place during “termination” (between l954 and l973) as proof that tourism can carry a high price.

The Termination Act removed the reservation from federal trust, and required the tribe to pay state taxes on its land. In response, and to raise revenues, a number of small lakes and a marshland were dammed in the early l960s, creating a large lake and hundreds of vacation lots totaling more than 1,600 ha of land. These lots were sold to non-Menominee at premium prices in an attempt to raise the revenue necessary to pay the land taxes for the reservation, a requirement of “termination” that soon led to the tribe’s impoverishment.

[23] From The Constitution and Bylaws of the Memoninee Indian Tribe of Wisconsin. Cited in Pecore l995, p.4.

Pecore reports that even after the federal government reinstated the tribe's status in l973, the loss of tribal ownership of the land was irreversible and has since remained a "stigma" for the Menominee. Pecore says many members still equate tourism with a loss of land (M. Pecore pers. comm. 2001).

In the mid-1990s the Menominee also set up a college on the reserve called the College of the Menominee. Five Menominee are currently enrolled in a new degree program offered through the Sustainable Development Institute. The program will see its first graduate this year (2001).

Terry Peters, one of those enrolled at the Institute, says the ancestors of the Menominee took care of the forests for thousands of years. But despite this long-standing relationship, Peters worries about the forest's future. "So many people are just so used to seeing the forest that they take it for granted," she says. "Many children never even go into the forest and their parents aren't teaching them about it either." She says the children need to go back to the forest to "pick some berries and hear the birds sing."

In addition to the cultural value of the forest, there are also other indirect, intangible values that have a significant economic value but are even more difficult to quantify. As at Pictou Landing (Chapter 2), a key objective in Menominee forest management is to encourage direct, full and meaningful community participation, which in turn can positively affect members' sense of self-worth, esteem and, as a result, their health.

At the same time, it must be acknowledged that, despite the forest's significant contribution to employment, cultural identity, and social wellbeing, it has by no means provided a panacea for all the challenges facing the Menominee, most of which are shared by First Nations communities throughout North America. According to the l990 Census, more than half (52.1%) of the people on the reservation were living below the poverty line. Household incomes and per capita income on the reservation were considerably lower than the Wisconsin average (Pecore l995, p. 10). In l994, the poverty rate on the reservation was 48.7%, compared to 10.7% statewide.[24] Poverty, in turn, is highly correlated with poor health.

According to Pecore, there has been some improvement in the last decade. In the early l990s unemployment on the reserve was between 30-40%. Today, he says, it is 4-8%. Pecore attributes the significant increase in employment to the expansion of the sawmill in l995, the building of a casino on the reserve, and the spin-off businesses associated with both. Even though the casino has brought employment and cash flow to the reserve, tribal members realise the forest is still the "backbone" of the community, says Pecore.

The challenges that face the Menominee and most other aboriginal communities in North America – high poverty rates, poor health, high incarceration rates, and relatively low student achievement – are undoubtedly related to the historial colonization of their land and culture. Despite these serious challenges, however, the Menominee have managed to stand firm on their commitment to the forest, to conserve their forest wealth, and to ensure that "the growing heart of the forest remains intact." As at Pictou Landing (Chapter 2), many Menominee now see the

[24] Figures taken from the Wisconsin Legislative Audit Bureau Web site: http://www.legis.statewi.us/lab/reports/98-3summary.htm

forest and its inherent natural wealth as a potential source of healing for the community, and as a means to regain their pride and overcome some aspects of the historical legacy of colonization.

7. Restoration Forestry

> *"I keep my mind open and clear and I listen to the forest. I ask it what I can do. How can I leave it better than I found it? I look to see, do the berries still grow? Do the birds still sing? Some of what I look for is spiritual. I have no fear. What I have is concern. What I have is hope."*
>
> Larry Waukau, president of MTE (Bernard and Young l997, p. 110)

According to Pecore, the forest values of the Menominee forest have been maintained overall. However, due to past "errors," he estimates that just over 20,000 ha or 22% of the total forest area, do not "fit the tribe's objective of right species and best quality and quantity." It was noted above that these lands, which once supported high-quality hardwoods and pine, are now growing less valuable aspen, white birch, red maple, and scrub oak.

Pecore says the clearcutting for railroad logging that took place between 1880 and the early 1900s was responsible for degrading some of the land. In addition, it was noted above that, because the Menominee were originally only allowed to harvest dead (standing or downed) trees, non-Menominee loggers, known as the "pine ring," who wanted the massive pines, set fire to the forests in order to kill the pines and allow for their subsequent harvest. These poor logging practices of the past require that the land be restored today (M. Pecore pers. comm. 2001).

The restoration of these lands to the forest cover types that best suit the particular forest habitats (see Section 2) will do more to increase the productivity of the Menominee forests than any other single forestry practice (MTE l997, p. 33).

The economic reasons the Menominee give to restore this land include:

- Low-value material growing on the site usually goes to pulpwood, which is processed off reservation and therefore supports very few on-reservation jobs.
- Higher-value pines and hardwoods are all processed in the Menominee sawmill in Neopit, Wisconsin, a mill that is owned and operated by the tribal members, and therefore provides more jobs to tribal members.
- There is a general desire to restore the tribal forestlands to their natural state with large diameter, larger volume, and more valuable material constituting the forest landscape.
- Higher value species and clear, large diameter wood can be better directed not only toward higher profit-per-unit secondary wood product markets, but also toward markets that prefer certified wood and will pay a premium price for it (Mater l998, p. 3).

In addition to these economic reasons, there are also substantial ecological and social reasons for restoring the land, including the desire to provide future generations with a healthy forest, and to provide habitat for countless forest-dependent species.

According to Pecore, the Menominee are currently actively restoring approximately 12,000 of these 20,000 previously degraded hectares, at a cost ranging from $500-1,000 US/ha/year. Restoration costs in the Genuine Progress Index are seen as a) a proxy for past damage over a long period of time (depreciation costs), and b) an investment in the future from which the current generation may reap little benefit, but which will directly and substantially benefit future generations.

Because it increases a region's stock of natural capital, these restoration costs should be encouraged and supported through financial and taxation incentives. The Menominee Tribe's unique relationship with the U.S. federal government allows investments in active forest restoration on a scale and intensity far beyond that described in the first three case studies, and at a per hectare cost that is several times greater. That relationship is seen below as a key element in supporting current forest management practices among the Menominee.

8. Economic Viability

> *"A forest makes things slowly; a good forest economy should therefore be a patient economy. It would also be an unselfish one, for good foresters must always look toward harvests that they will not live to reap."*
>
> Wendell Berry[25]

Menominee Tribal Enterprises (MTE) is the engine of the Menominee economy, and is set up as a corporation to manage the Menominee forests, operate the sawmill, and market wood products. It is governed by an elected board of directors made up of tribal members, and a large proportion of its employees are also tribal members.

The federal government provides financial support for the Menominee forestry operation, including salaries, operations, and support services, and the U.S. Secretary of the Interior officially gives final approval to all management plans. Two foresters from the Bureau of Indian Affairs, as representatives of the Secretary of the Interior, are stationed at the Menominee Forestry Center. Also at the center, at the request of the tribe, are staff from the Department of Natural Resources, who are also paid with federal funds (Pecore l995, p. 3).

In total, the tribe is provided a US $1.3 million annual subsidy from the Bureau of Indian Affairs to manage its lands, with the provision that the tribe cannot sell or trade its forestland without congressional approval. The land cannot, therefore, be used as a financial asset, which limits MTE's business financing options (Mater l998, p. 6).

---

[25] Wendell Berry, "Conserving Forest Communities," available at www.tipiglen.dircon.co.uk/berryfc.html

Pecore says this "trust" relationship between the Menominee and the government goes back to a series of Treaties signed between l828 and 1856. He reports that the Menominee have actually paid for the services now being provided by the government many times over in the land lost (totaling more than 3 million hectares) as a result of the Treaties (M. Pecore pers. comm. 2001). Lest the Menominee model should be dismissed as inapplicable to other cases, it should be noted that taxpayers also subsidize logging in the national forests of the United States. Sales-generated revenues from Wisconsin's national forests were US$6.4 million in l997 but the cost to taxpayers was US$7.9 million.[26]

In Nova Scotia the situation is similar. According to the Canadian Council of Forest Ministers, taxpayers paid $87.3 million between l990 and l997 to subsidize forestry on Nova Scotia's crown lands. Over that same time period, stumpage paid to the province amounted to just $25.6 million, a net loss of $61.7 million (Ecology Action Centre 2000.) Thus, adequate support for restoration forestry may have more to do with re-directing existing funds to sustainable practices than with finding new money.

The sawmill in Neopit receives no federal subsidies. Its success depends solely on the steady flow of timber from the forest to the market. It relies only on the wood from the Menominee forest, and does not buy any outside lumber. Unlike other sawmills that do not own the land from which they harvest, the Neopit mill does not pay stumpage costs for the logs harvested from the Menominee forest. All forestry costs, including sawmill equipment and upgrades, are paid by the mill through lumber sales.

The sawmill is owned by the tribe collectively. When the mill makes a profit, MTE board members first determine whether any of the money is required to make mill improvements. Decisions regarding the money left over are made by the Menominee Tribal Legislature. Often profits have been put toward community infrastructure such as hospitals and schools. But the profits are occasionally distributed on a per capita basis to all tribal members living on reserve (M. Pecore pers. comm. 2001).

Despite the Menominee's success in maintaining a sustainable forest management system, cutting sustainably has not always been profitable. Until the last decade, MTE did not make a profit in most years. The primary cause can be attributed to the tremendous burden placed on MTE as a result of nearly two decades of "termination." In the l990s, however, MTE has shown a profit in every year since l991 except for one (l996). As Table 22 indicates, the l993-94 profit amounted to nearly US $1.9 million. MTE attributes the recent turnaround to better planning, and to the creation of niche markets through certification.

Several factors account for the 1996 losses. Between fiscal years l995 and l996, the MTE sawmill received 17% less high value hard maple harvest and a 47% increase in much lower value aspen, a direct result of the practice of converting acreage to mixed native species. Since the market price for hard maple was US $1,100 greater per thousand board feet than for aspen, the short-term profit loss due to this conversion process was significant. This choice is a testimony both to the self-discipline required to forego immediate gain for the sake of long-term investment in the forest resource, and to the need for financial incentives specifically geared to restoration objectives.

[26] The Wilderness Society, "An Economic Boon" available at: www.wilderness.org/newsroom/pdf/roadless

The Menominee faced additional financial challenges in 1995-1996 due to weather conditions and unfulfilled logging contracts that left over 5,600 cubic metres of timber standing in the forest that had originally been slated for harvest that year (Mater l998, p. 15).

Table 22. MTE Financials (constant dollars US year 2000)

	1991-92	1992-93	1993-94	1994-95	1995-96
Total Sales ($ US)	11,497,213	12,791,517	13,373,525	14,249,842	12,223,289
%increase/decrease in total sales from previous year		+15%	+6%	+9%	-12%
Net Profit/ (Loss)	880,443	916,682	1,948,545	1,439,713	(438,733)
Net profit as percent of total sales	8%	7%	14.5%	10%	0
Volume (bf) produced at sawmill	10,909,368	12,081,244	10,065,446	10,460,992	10,798,482
Sales price/ Board ft of production	$1.05/bf	$1.06/bf	$1.33/bf	$1.37/bf	$1.13/bf

Source: Mater, 1998.

In the last fiscal year (1999-2000), the profits totaled approximately US $500,000 (M. Pecore pers. comm. 2001).

Calculating profits is a complicated issue because the Menominee do not pay for the management of the forest resource. As was noted earlier, this money comes from federal subsidies. However, the sawmill is not subsidized and it directly generates salaries for its employees, in turn providing stable work for logging contractors and their employees. Mill profits are generally reinvested for mill upkeep and improvements.

By all accounts, there needs to be a greater diversification of the Menominee forestry operations. At present, forest products include sawed lumber, logs, veneer logs, pulpwood, and some "specialty woods," such as paneling and moldings. More value-added industries are needed, and the Menominee are currently working to introduce these. To this end, they are investing in new planing mills and dry kilns, and they are looking into selling flooring and cutstock for furniture components.

The Menominee sell about two-thirds of their wood as pulpwood. Most of the remainder is destined for their sawmill in Neopit. The approximate percentage split for resource distribution and product production is as follows:

- 75% logs for lumber production;
- 16% logs for direct sales to lumber customers;
- 7% veneer log sales; and,
- 2% log inventory carry-over.

Although new dry kilns, installed in the mill operations in l996, provide much needed and valuable increased drying capacity and quality, the Menominee still sell most of their lumber as green wood to their customer base. Green wood fetches a lower price.

In l995, domestic buyers purchased 90% of the lumber processed at the mill. Since then, MTE has been trying to market its certified wood internationally, selling hemlock studs to Japan and hard maple to the U.K., as well as developing value-added production on site (Mater l998, p. 13). The Menominee are aware of untapped opportunities to increase economic viability and profit margins, and they are moving gradually in these directions without compromising the ecological integrity of the forest.

8.1 Value and Challenges to Certification

The Menominee Indian Tribe, a self-governing nation, was recognized by the United Nations in l995 for its expertise in forest management. The Menominee also received the first ever Presidential Award for Sustainable Development in l996. Today, they are the only Native American tribe to have its forests certified as sustainably managed by two Forest Stewardship Council approved certifiers, Scientific Certification Systems in l992 and the SmartWood Program of the Rainforest Alliance in l994.

FSC certification means that the Menominee could charge a premium on the wood they sell - generally 10% above normal market prices. But the Menominee have little experience in sales and marketing, and only rarely get the premium prices that are potentially available to them. “It’s been a struggle,” Pecore admits frankly. The challenges are three-fold:

1) Limited sales and marketing capacity;
2) Limited capacity by local wholesale buyers to handle certified wood;
3) Inability to meet large direct orders for certified wood.

1) Currently MTE employs only one salesperson and, apart from what it sells informally to tribal members, it does not operate a retail outlet. This would require new buildings to house a large inventory, and the hiring of at least 20 more people (M. Pecore pers. comm. 2001).

2) Currently, MTE wood is sold wholesale, mostly to local businesses. Selling it as “certified” to these businesses, which would command the higher premium, has been challenging because these businesses would then have to go through the “chain of custody” (unbroken chain of accountability) process in order to re-sell it as certified, says Pecore. Many businesses do not want to invest in doing this, he says, so MTE cannot command the higher price. For this reason, certified lumber sales made up only 5% of MTE’s total annual lumber sales in l998.

3) Hard maple veneer quality sawlogs, sold by the Menominee as certified, command a 10% clear premium (above cost plus standard mark up). This premium is also currently realised by the FSC-certified Pictou Landing First Nations forest operations in Nova Scotia. Despite this potential economic advantage, the Menominee, like the Pictou Landing First Nations, have found it challenging to meet the demand for certified wood.

For instance, in l997 a large US veneer operation approached MTE to negotiate the purchase of 22,600 cubic metres (4 million board feet) of certified veneer logs from MTE on an annual basis.

Based on its sustainable forest management (SFM) practices, the total projected volume for all veneer logs to be harvested that year was just over 4,600 cubic metres. This one order exceeded MTE's annual supply capacity by almost 400% (Mater l998, p. 10).

According to Mater (l998), MTE's sustainable practices mean that it is harvesting set volumes of high-to-low grade material from its forest on an annual basis, and this prevents substantial sales of certified wood that could get the 10% premium. **The volume harvested is tied to what is sustainable, *not* to demand.**

The Menominee sawmill located in the town of Neopit cuts "what the forest provides, not what the market necessarily wants," says Pecore. This, combined with the fact that the Menominee sell most of their wood "green" (not dried), means they are not making as much as they could if they manufactured the wood into finished products, thereby adding value to the wood and using less of it.

In addition, "cutting sustainably costs more," says Pecore. Incentives paid to loggers as well as the limited use of clearcutting reduces short-term profits. "We spend more money to cut timber on our lands than they do off reservation because of the way its being cut. But in the long run we'll have forests to cut and the other guys won't."

9. Employment

Stable logging work combined with the mill operations in Neopit contribute substantially to stable, long-term employment in the area. Approximately 70% of those employed in the mill and in the logging operations are Menominee tribal members. Approximately 25% of the work force on the reserve is employed directly in mill work, logging operations, or administration (Bernard and Young l997, p. 110). In total, the Menominee forest operations directly employ 450 people (M. Pecore pers. comm. 2001).

Except for l996, MTE has operated at a profit through the l990s, while employing more than double the number of personnel traditionally used to produce the same annual volume of production (Mater l998, p. 14). By contrast, in Nova Scotia, an increasing volume of timber is harvested every year, while employment has remained steady (see employment in Part II, Chapter 8). This indicates that a major shift to selection harvesting and sustainable forest management in Nova Scotia would increase employment at the same time as it reduces the quantity of timber harvested. As noted in Chapter 1, Jim Drescher of Windhorse Farm estimates that a switch to ecoforestry practices in the province could double forest industry employment on half the current harvest.

Of MTE's total 58 million board feet harvest (year 2000 figure), 20 million board feet[27] is utilized by the sawmill in Neopit, and the rest (38 million board feet) is sold as pulp. In total,

[27] Twenty million board feet per year is currently what the mill in Neopit can process. This number is up from 10 million board feet in l995-l996. In l996 the sawmill was upgraded to include new dry kilns, and expanded to increase capacity.

MTE directly employs 450 people, not including the jobs created in the nearby pulp mills which purchase roundwood from MTE. Based on the total wood harvested (327,683 m^3 in 2000) and

the total employed, the Menominee directly employ 1.4 people/1000m^3 wood, a ratio that would be higher if nearby pulp mill employment were included. But even this conservative ratio is 40% higher than that of J.D Irving, a large forest company operating in Nova Scotia, which employs just 1 person per 1000 cubic metres of wood harvested.

This employment to biomass ratio is still far below the Windhorse Farm model, where 8 jobs are created with 1000 cubic metres of wood. It is not currently possible to compare the Menominee job per unit biomass ratio with that of the nearby Nicolet National Forest, because employment figures for forestry in the Nicolet Forest include indirect as well as direct employment.[28]

The Menominee recognize that their total employment per unit of biomass can be improved further with the addition of value-added industries, which would increase employment while utilizing less wood. To this end, as noted, the Menominee are investing in new planing mills and more dry kilns, and they are exploring the sale of flooring and cutstock for furniture components (M. Pecore pers. comm. 2001).

According to Mater, the Menominee goal is to achieve as many consistent, full-time, family-wage jobs for tribal members as possible. Currently there are approximately 26 logging contract operations on the reservation, of which 15 are Menominee-owned. Entry level workers at the Neopit mill make about US $16,000 a year, and a logger might make approximately US $26,000. These figures are consistent with rates in the U.S. (Forest Alliance 1995). As was noted earlier, the unemployment rate on the reserve has fallen dramatically to 4-8% in recent years, which is very low compared to most reservations and First Nation communities in both the US and Canada.

10. Conclusion: Applying the Menominee Model

In sum, an application of the Menominee model to industrial forestry operations in Nova Scotia appears to have three fundamental requirements:

1) The multiple benefits of the Menominee forest operations require a long-term perspective and the self-discipline to forego quick short-term economic gain.
2) The restoration of degraded forests and the enhancement of natural capital values require a current investment that will benefit future generations.
3) Incentives for restoration forestry require vision among government leaders and natural resource officials, and cooperation among industry, government, and consumers.

[28] According to the USDA Forest Service data, in l998 there were 828 timber-related jobs (both direct and indirect) created from the Nicolet National Forest.

CHAPTER FIVE: ALGONQUIN PARK, ONTARIO

Figure 14. Algonquin Park, Ontario, Canada

1. Introduction

Algonquin Park is a 7,633 km^2 provincial park located in Southeast Ontario. It is a destination for cottagers, hikers, cross-country skiers, canoe-trippers, nature lovers, researchers, fishing enthusiasts, and others. It is also a destination for forestry professionals from around the world, who come to see the innovative, precedent-setting forestry operations that have made Algonquin Park a leader in forest management, science, and research.

Algonquin Park is not a classic example of forest restoration like the other case studies in this report. In those examples, the emphasis of management is to restore the forest to *pre-settlement* conditions, as well as to improve stand quality. The forest managers in Algonquin Park are primarily focused on restoring the quality of *managed* stands by practicing selection and uniform shelterwood harvesting, and by investing in silviculture activities like tree marking, stand improvement, planting, and manual cleaning.

By making these investments, the forest managers are ensuring that future generations will inherit a greatly improved forest, instead of a forest that has been degraded by repeated high-grading and clearcutting. They are also working to ensure that timber harvesting is compatible with the considerable tourism and recreational values of the Algonquin Park forests, a concern that has particular relevance to Nova Scotia.

By contrast, and as noted in Volume 1, the rate of clearcutting in Nova Scotia has doubled in the last decade; older forests have been logged to near non-existence in the past 40 years; and silviculture investments have plummeted.

Algonquin Park is a potential model for Nova Scotia resource managers. By following the Algonquin example, Nova Scotians would see their timber resources managed more effectively and profitably, the health of the province's forests improved, tourism industry interests protected, and a wide range of forest services and functions maintained. The Algonquin example demonstrates that it is possible to increase the timber value of forests in a way that is compatible with the importance of forests for the province's burgeoning eco-tourism industry. Algonquin Park is also a model of citizen input into forest management, that would give Nova Scotians a direct say into the use of forests and into the condition of the natural wealth they will leave their children.

Maintaining and improving the quality of forest stands has not always been a primary objective of forest management for Algonquin Park. Algonquin Provincial Park was established in 1893 with the proviso that logging was to be allowed to continue within park boundaries. By the 1960s, the population of southern Ontario had increased substantially, as had conflicts between users of the park.

In 1968, the first provisional master plan for the park was completed and publicly released. The master plan sparked considerable controversy and public debate, and as a result, an Algonquin Park Advisory Committee was formed to represent the many interest groups associated with the park. After nearly four years of deliberations, the Advisory Committee submitted 36 recommendations to the provincial government. In 1973, the Minister of Natural Resources, acting on many of these recommendations, cancelled all existing licenses held by logging companies within the park, and announced the creation of the Algonquin Forest Authority.

The Algonquin Forest Authority is a Crown agency responsible for all forest management activities, including silviculture and harvesting, within Algonquin Park. The mission of the Algonquin Forest Authority is:

> *"to ensure the long-term health of Algonquin's forests while producing a sustainable supply of forest products for the forest industry of the region through environmentally-sound forest management practices"* (AFA 1998).

The informal mantra of the Algonquin Forest Authority is to 'do what's best for the bush' – in short, not to make the forest succumb to market demands, but instead, to allow markets to adapt to what the forest can produce.

Algonquin Park is an interesting example of how public pressure resulted in improved harvesting practices on publicly owned land. Notwithstanding these improvements in forest management, Algonquin Park is still subject to public controversy. There are some members of the public who oppose all logging in the park, regardless of how it is done. Algonquin Park remains the only Ontario provincial park where logging is still allowed. This analysis does not take sides in that dispute. From the GPI perspective, there is indeed an inherent value in a representative system of protected areas that protects the full complement of native biodiversity.[29] Even the best logging practices cannot substitute for an adequate network of fully protected areas for reasons previously explained.

For the purposes of this case study, however, we are merely focusing on the cutting practices of a Crown-owned and Crown-managed forest operation, on a scale comparable to many forest operations in Nova Scotia, but with a management approach that embodies ecologically, socially, and economically sustainable forestry practices. The practices adopted by the Algonquin Forest Authority in the mid-1970s established a precedent for southern Ontario, and have in fact served as a model of silviculturally and ecologically appropriate harvesting practices for the whole region. Without entering into the debate on whether logging is appropriate in Algonquin Park, the following evidence can, therefore, still serve as an outstanding model for forest management in Nova Scotia.

While several other case studies presented in this Volume are appropriate models for small woodlots, the Algonquin case is presented as an appropriate model for many of Nova Scotia's larger-scale operations. The size of Algonquin Park makes it large enough to plan on a landscape scale, with specific zones designated for nature reserves, wilderness areas, riparian corridors, recreation, timber utilization, and development. Public pressure has ensured that forest, water, and recreational values are maintained for all park users, and that timber extraction is limited to specific areas within the park, at certain times of year, and using only low impact harvesting methods.

[29] See the GPI Ecological Footprint analysis and the full GPI forest accounts for discussions of protected area values. As noted there, international agreements specify a minimum protected area set-aside of 12% while conservation biologists suggest that at least a 30-50% set-side is required to protect biodiversity effectively (Soule and Sanjayan 1998).

An ecosystem-based approach, utilizing current scientific knowledge, is taken in all planning and management activities.

> *"Cutting is done in carefully researched ways that seek to preserve the forest's diversity and ability to support the full range of native wildlife while at the same time maximizing the land's production of desired tree species and to continue that production, cycle after cycle, on into the future.…(T)he management systems used in Algonquin Park almost always mean that trees remain standing on the land at all times..."* (Strickland 2000).

Flying over the park today, an observer has difficulty distinguishing cut areas from uncut areas. This is in stark contrast to Nova Scotia, where aerial views reveal a landscape carved up by forest roads and clearcuts (Ecology Action Center 2001).

2. Physical Description of Land

Algonquin Park is 7,633 km^2 in size, with water making up 12% of the total area. Situated on some of the highest land in Southeast Ontario, the park has a total of 2,456 lakes, and serves as the headwaters for 18 principal watersheds (AFA 1998).

The park is located in a transition zone between the northern boreal forest and southern deciduous hardwood forests, resulting in a rich diversity of northern and southern life forms. To the south is the most densely populated area in the whole country, and to the north, Quebec and the boreal forest. Given its location, Algonquin Park is considered southern Ontario's principal wildlife reserve. More than 1,000 vascular plant species and 200 vertebrates species breed in the park, including 134 breeding species of birds (with a total of 258 bird species recorded in the park), 45 species of mammals, 14 species of reptiles, and 16 species of amphibians (AFA 1998).

3. History of Management

3.1 Logging Activities Before the Creation of Algonquin Park

By the time Algonquin Park was established in 1893, areas of the Park had been logged for 60 years. In the early decades, giant white pines were felled and squared, driven down streams and rivers to Ottawa and Quebec City, then exported to England. In 1866-67 alone, 30,000 pieces of squared timber were cut from the forests that would become Algonquin Park (Strickland 2000). The process of squaring timbers left much of the felled wood in the forest - wood that, today, would be much coveted. The upper 60-80 feet of cut trees were typically discarded because they showed knots at the surface, and the timber buyers of the day would not buy them (Strickland

2000). Only the part of the tree below the first branch was considered suitable for making into square timber.

> *"In retrospect, the squaring process must be seen as extraordinarily wasteful. A quarter or more of the main tree trunk's beautiful wood was left lying in the bush as useless chips - not to mention all the other wood in the upper, branched part of the tree that wasn't even considered for squaring in the first place. Even worse, the discarded wood often ended up being fuel for particularly devastating forest fires. These probably did far more damage to the primeval forests than the removal of the rather scarce individual trees (perhaps less than 5% of all White and Red Pines) that were big enough to be selected for squaring*" (Strickland 2000).

3.2 Establishment of Algonquin Provincial Park

Algonquin Provincial Park was established in 1893 following the recommendations of the Royal Commission on Forest Reservation and National Parks. The commissioners of the Park envisioned that it would have many benefits, including:

> *"maintenance of water supply in a half dozen major water systems, preservation of a primeval forest, protection of birds and animals, a field for experiments in forestry, a place of health resort, and beneficial effects on climate"* (Townsend 1995).

At the time, the establishment of Algonquin Park was welcomed by logging companies, as it would preserve valuable forest lands from clearing by settlers, and prevent the associated increase in the incidence of fire.

The square timber era came to an end in 1912, and by then the forests of Algonquin Park were supplying pine and spruce to the early sawmills located inside and outside the Park. By the 1930s, yellow birch was sought after for veneer and furniture. And by the early 1950s, diameter limits were established to control the amount of timber harvested from specific areas: no cutting of yellow birch, sugar maple, and hemlock less than 38 cm in diameter was allowed, and no cutting of pine less than 46 cm in diameter. Marking of individual trees to be removed or to be retained began in the early 1950s, and by the 1970s, tree marking became the rule for all forest operations. Since 1893, the Park has expanded to twice its original size, from 3797 km^2 to 7,633 km^2.

3.3 The Algonquin Forest Authority and Public Input

The Algonquin Forest Authority was officially established in 1975 as a Crown Agency responsible for harvesting timber in the Park and supplying it to manufacturing facilities outside the Park. One of the Authority's most distinguishing features is its openness to public input and participation, both in structure and in its actual processes. The Algonquin Forest Authority has

21 staff, and is directed by a general manager who reports to a Board of Directors. The Board of Directors includes individuals from local communities surrounding the park, whose main interest is the maintenance of Algonquin Park's unique values for future generations.

Twenty and five-year Forest Management Plans are prepared to guide forestry activities within the Park.[30] A local citizens committee has been established to assist the planning team in the preparation of Forest Management Plans. Plans are also available for public review, and the Algonquin Forest Authority hosts two open house sessions to invite public input into Plan preparation.

At any time during the forest management planning process, interested persons can have issues addressed by contacting the plan author. If the issues are not resolved, individuals may express their concerns to the Algonquin Park Superintendent, the Ontario Ministry of Natural Resources District Manager or Regional Director, and/or the Local Citizen's Committee. Interested persons may also request that the Ontario Minister of Environment require an environmental assessment of specific forest management activities under the Environmental Assessment Act.

3.3.1 Algonquin Public Input an Important Model for Nova Scotia

The involvement of the public, and the provisions for public input into forest management planning, are an important model for Nova Scotia. Approximately 50% of the available Crown land in Nova Scotia is licensed under long term agreements to two pulp and paper mills, Stora Enso and Kimberly Clark, while the remaining 50% is open to logging under short term Forest Utilization Agreements (D. Eidt pers. comm. 2001).

Both Stora and Kimberly Clark are required to prepare long-range forest management plans. Neither company is required to consult the public during the management planning process (D. Eidt pers. comm. 2001). Of its own volition, Stora Enso has created a public advisory committee, which is providing input to the company's management plan. Neither the advisory committee nor the public at large has any say in the approval of the forest management plan (P. MacQuarrie pers. comm. 2001a). Public access to Stora's and Kimberly Clark's forest management plans are restricted to requests under the Freedom of Information Act.

The volume-based Forest Utilization Agreements are 10-year licenses issued to sawmill owners. The license owners do not have to prepare long range management plans. Instead, they prepare 5-year operating plans that are reviewed and approved by the regional office of the Nova Scotia Department of Natural Resources (D. Eidt pers. comm. 2001). Currently, there are no region or province-wide management plans that guide or limit these volume-based agreements.[31]

[30] Planning for Forest Management Operations in Algonquin Park is conducted under the *Crown Forest Sustainability Act (1995)* and the Ministry of Natural Resources' *Forest Management Planning Manual for Ontario's Crown Forests (1996)*. Source: www.algonquinforestry.on.ca/management.html

[31] In lieu of management plans, there are databases and master maps, and calculations of a 'Potential Wood Supply' for the whole province. (From conversations with Dan Eidt and Peter MacQuarrie, NSDNR, June, 2001.)

Furthermore, no public input is required in the preparation of the 5-year operating plans, and access to these plans by the public is restricted to requests under the Freedom of Information Act or to written applications, either to the NSDNR or to the sawmill company (D. Eidt pers. comm. 2001). Companies have been known to refuse access to plans. By contrast, the openness of the Algonquin Park planning and management process invites and encourages public access, input, and participation, and citizens are directly involved in decision-making through the Algonquin Forest Authority's board of directors.

In September, 2000, a land use plan (*not* a forest management plan) for provincial Crown lands in Nova Scotia, dubbed the Integrated Resource Management Plan, was unveiled by the NSDNR after several years of preparation, and a series of public consultations. The plan was poorly received by members of the province's Public Lands Coalition, a consortium of 37 hunting, fishing, recreation, naturalist, and environmental groups that collectively represent over 15,000 Nova Scotians. Bob Bancroft, President of the Nova Scotia Federation of Anglers and Hunters, a member group of the Coalition, maintained that:

> *"This plan was supposed to bring different government policies together in a unified and balanced approach. Instead, one government department [the NSDNR] has decided that the lion's share of Crown lands is for industry, while the rest of us are sitting on the sidelines"* (Bancroft 2000).

According to Kermit deGooyer, Co-ordinator of the Ecology Action Center's Wilderness Campaign:

> *"The Coalition has been critical of many aspects of Integrated Resource Management (IRM) planning and has lobbied for changes to the process to make it more transparent, progressive, and reflective of public aspirations. Central to our position is the belief that Nova Scotia will enjoy the most benefits from our limited public land base if many more Crown lands acquire legal protection.*
>
> *We believe, and hope, that the Department has recognized that the IRM strategic plan was very poorly received in many circles, including the tourism industry, environmental groups, hunting and fishing clubs, scientists, some Mi'kmaq interests, much of the general public, some government departments, and several community groups and municipalities.*
>
> *An underlying concern among these interests remains that the IRM strategic plan is not fairly balanced – it heavily favours industrial resource extraction and industrial users at the expense of non-consumptive values and nearly everybody else with an interest in public land"* (deGooyer 2001).

Again, by contrast, the Algonquin Park planning, management, and decision-making structures are designed precisely to achieve the balance of interests desired by these groups, and to ensure that none are left "sitting on the sidelines." The Algonquin Park process explicitly recognizes the multiple uses of forests, and ensures that timber extraction remains compatible with all of them. Given the vital and growing importance of tourism to the Nova Scotia economy, the Algonquin model may have particular applicability to the use of crown lands in this province.

3.4 Current Forest Conditions

Current forest conditions in Algonquin Park have been greatly influenced by 170 years of logging and fires. As mentioned earlier, the wood left over from squaring timber often ended up as fuel for devastating forest fires. Furthermore, the selection of the largest and straightest trees for square timber, lumber, and veneer left a forest much degraded in quality, with reductions in the abundance of targeted species, as well as declines in the older age classes.

Today, for the purposes of management planning, Algonquin Park has been divided into 14 forest units. Each unit is a conglomeration of stands dispersed throughout the management unit with similar silvicultural characteristics and cover types. For instance, shade tolerant tree species like sugar maple and American beech are treated as one forest unit. The largest unit is the tolerant hardwood selection forest unit, with 200,000 ha. This unit is uneven-aged, and contains older age classes as well as middle and young age classes. The remaining units are considered "even-aged", with the assigned age determined by the dominant species in the stand. These even-aged forests comprise more than 65% of total forestland in the Park.

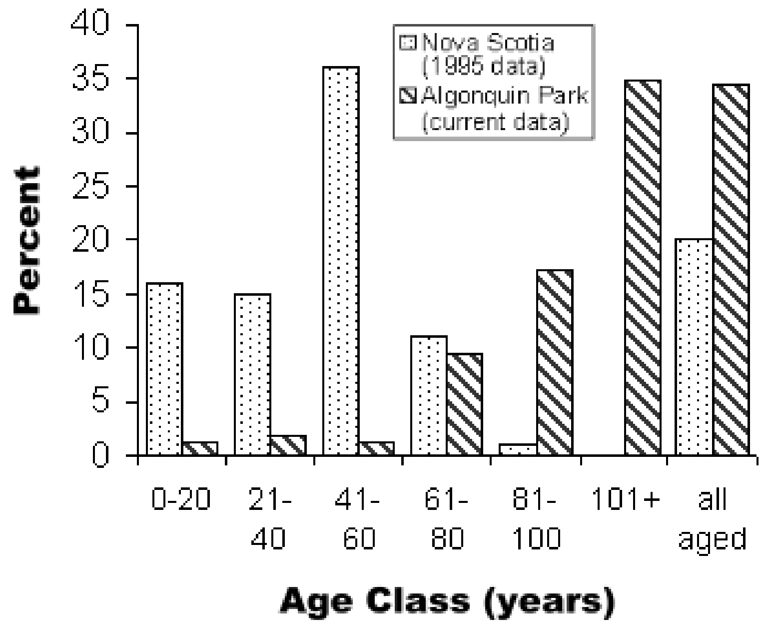
Most of Algonquin Park's forests average 80-100 years of age, with the age class distribution skewed towards the older age classes (Figure 15). In 1995, more than 50% of the even-aged forests in Algonquin Park were over 100 years old. Just over 3% of Algonquin Park forests are greater than 200 years old. In contrast, there are very few forest stands greater than 80 years old left standing in Nova Scotia, with much of this older age class decline occurring in the past 40 years. In 1958, nearly 25% of Nova Scotia's forests were more than 80 years old. By 1999, less than 1.2% of forest area in the province still had stands greater than 80 years old, and only 0.15% of forests were over 100 years old (Wilson 2001).

The Algonquin Forest Authority (AFA) strives to regenerate stands based on site capability and the species appropriate to the site. Over the past 30 years, the AFA has not only maintained the proportion of shade tolerant hardwoods and softwoods in the park, but also invested in their long-term health and improvement. Tree species that were once more widespread are carefully managed to ensure that no further decline occurs.

By contrast, over the past 40 years, shade-tolerant hardwood species have decreased in abundance in Nova Scotia. According to Nova Scotia forest inventory statistics, oak volume has declined by 89%, with almost the entire loss occurring in the past 10 years; beech by 98%;[32] and sugar maple and yellow birch volumes by 34% (Wilson 2001). White pine, red pine, red spruce, and eastern hemlock have been reduced to less than 50% of their historical range (Wilson 2001; Mosseler *et al*. 2000). In the absence of any policy initiative to restore and protect species and age diversity, these declines will likely continue unabated.

[32] Beech bark disease, caused by the introduced Beech scale insect and *Nectria coccinea* fungus, is responsible for much of the recent decline in beech volume throughout North America (Farrar, 1995; and Ontario Ministry of Natural Resources. 1998).

Figure 15. Comparison of total forest area by age class, Nova Scotia and Algonquin Park



Source: Wilson 2001; Cumming, 2001

4. Forest Operations

4.1 Goals and Objectives

The broad goal of the AFA for Algonquin Park is to:

> *"provide protection of natural and cultural features, continuing opportunities for a diversity of low-intensity recreational, wilderness, and natural environmental experiences; and within this provision continue and enhance the Park's contribution to the economic, social, and cultural life of the region"* (AFA 1998).

Park management has identified five objectives to meet these goals. The first is to provide protection for:

- significant or representative earth and life science features;
- natural and cultural features;
- areas providing wilderness recreational experiences; and,
- historic and archaeological sites for educational and research purposes.

This objective is being achieved with the establishment of nature reserve, wilderness, and historic zones.

The second objective is to encourage recreational activities, including canoe tripping, backpacking, horseback riding, mountain biking, snow shoeing, dog sledding, camping, cross-country skiing, nature interpretation, swimming, picnicking, hunting, fishing, and wildlife viewing. The third objective is to enhance Heritage Appreciation by means of a Natural Heritage Education program, Visitor Center, logging museum, and interpretative trails. The fourth objective is to encourage and meet the needs of tourism, and the fifth is to manage the renewable resources of Algonquin Park on a sustainable basis.

In sum, as in the Genuine Progress Index, the forest is explicitly valued for all its manifold functions, of which timber production is just one.

4.2 Land Use Zones

The key to accommodating all the various users of Algonquin Park, including loggers, hikers, researchers, canoe trippers, car campers, and others, is a well-designed land use plan that separates activities both spatially and temporally. The entire park is zoned for different land-use activities (Table 23). Many of the areas frequented by back-country recreationalists are zoned as nature reserves and wilderness areas. Forest management activities are only permitted within the recreation/utilization zone. Each zone serves various functions, and has different restrictions on the activities permitted within that zone.

Table 23. Land Use Zones of Algonquin Park; Area of Zone in Hectares, and as a Percent of the Total.

Zone Type	Area (ha)	% of Park Area
Nature Reserve	39,250	5.1
Wilderness	90,475	11.9
Natural Environment	13,765	1.8
Historical	1,680	0.2
Development	22,545	3.0
Access	735	0.1
Recreation/Utilization	594,860	77.9
Total	763,310	100.0

Source: Algonquin Forest Authority 1998.

Out of the total 763,310 hectares that comprise Algonquin Park, 594,860 hectares, or 77.9%, is zoned as recreation/utilization. This zone accommodates both recreational and forestry activities. Forest management occurs in 73% of the recreation/utilization zone, or 57% of the park as a whole (AFA 1998; p.23). Since 1975, there has been a steady reduction in the productive forest area available for forestry activities: in 1980, the productive forest base was 517, 348 hectares; in 1995, it was 479,927 ha (Townsend 1995).

Areas within the recreational/utilization zone that are excluded from forestry activities include:

- no-cut reserves for shorelines, earth/life science, and cultural values;
- islands;
- water;
- non-productive forest land; and
- non-forested areas.

No-cut reserves, where there is no tree marking or harvesting, include 30m buffers around all bodies of water, public roads, and rail corridors; 60m buffers around portages and ski trails; and 15m buffers around the boundary of Algonquin Park (AFA 1998).

In addition to the above restrictions, 'areas of concern' (AOCs) are areas identified on operating maps, and flagged by people working in the woods, where either no cutting or modified cutting occurs. AOCs provide for the protection of natural, cultural, and recreational values, such as:

- fish habitat and water quality;
- habitats of vulnerable, threatened, and endangered species;
- wildlife habitats; and
- significant or representative natural environments.

In these areas, cutting may be restricted to certain times of year when there is the lowest potential for conflict with recreational users.

"Special Management Areas" are areas within forest management zones where individual management prescriptions are developed to provide protection of a special feature or area of interest. In short, even within the recreation/utilization zone, where forest management activities are permitted, great care is taken to protect the integrity and multiple values of the forest, and to conserve special or vulnerable features.

Wilderness zones are meant to protect entire landscapes within the park. There are a total of four wilderness zones, the largest 48,870 hectares in size, and the smallest 5,280 hectares. These are the least disturbed areas within the park, with no logging, railways, power corridors, or buildings. The four wilderness zones comprise nearly 12% of the park.

Nature reserve zones serve a similar function as wilderness zones, but on a smaller scale. Nature reserves protect representative and significant earth and life science features, including:

- relatively undisturbed examples of typical habitat types (e.g. old-growth forests);
- landform features, complexes or phenomena; and,
- rare and/or exceptional populations of floral and faunal species.

There are 88 nature reserve zones in the park, totaling 39,250 ha, or 5.1% of the park, and varying in size from a few hectares to more than 5,200 ha.

Natural environment zones include aesthetic landscapes that permit low-intensity recreational activities and interpretative trails. Natural environment zones remain, for the most part, undeveloped, but do not necessarily protect significant natural areas or features.

4.3 Silviculture Activities

Silviculture refers to the theory and practice of controlling forest establishment, composition, growth, and quality of forests to achieve the objectives of management. This includes such activities as:

- planting;
- site preparation (light disturbance of the upper soil layers to create a seedbed for regeneration);
- manual cleaning (releasing target species from competition with less merchantable species by removing the latter);
- stand improvement (thinning and pruning); and,
- tree marking.

The focus of silviculture activities in Algonquin Park is to remove the unacceptable growing stock, i.e. the trees that will not significantly improve in quality over the next 20 years. Examples of unacceptable growing stock include trees with disease, damage, dieback and poor form (OMNR 1998). Given the legacy of 140 years of high-grading in Algonquin Park, by the mid-1970s, forests had a high proportion of undesirable growing stock. Since the mid-1970s, acceptable growing stock has been promoted, while undesirable growing stock has been removed.

One of the guiding principles of management in Algonquin Park is to "*regenerate the forest to the appropriate species for a site,"* using "*the most current scientific forest management techniques*" (AFA 2001). Great attention is therefore paid to the silvics (conditions for growth and reproduction) of individual tree species in order to promote the vigorous regeneration of preferred species. These preferred species include the more valuable shade and semi-shade tolerant species like sugar maple, yellow birch, white pine and red oak, as well as species best adapted to a particular site.

The key to meeting the needs of all Park users, and to protecting all forest values, is the practice of tree marking. Tree marking is the art and science of individually marking trees to be cut or retained. In Algonquin Park, tree marking is carried out by trained tree markers, who cover 6,000-11,000 hectares of forest each year, ahead of planned logging operations. The tree markers work independently of the tree harvesting operations, according to the following principle:

> *"What is marked is the product of environmentally-sound forest management practices, the blending of silvics, species diversity, fish and wildlife habitat and recreational values rather than the economics of the harvest"* (Townsend 1995).

From the GPI perspective, this enhancement of the full range of forest values is not antithetical to forest economics. On the contrary, tree marking can promote timber productivity and high market values per unit of biomass harvested.

Tree marking began in Algonquin Park in the early 1950s. Over time, tree marking guidelines have been modified and improved to accommodate new scientific research. Early marking prescriptions resulted in the removal of cull (badly formed) trees. By the late 1980s, wildlife values were incorporated into tree marking prescriptions to ensure that habitat for red-shouldered hawks and blue herons was protected, and to retain some trees for cavity-nesting birds and mammals.

Today, tree markers are expected to consider some or all of the following during the course of any given day (Townsend 1995):

- tree species diversity;
- moose calving sites;
- feeding and nesting cavities;
- stick nests;
- fruit and nut trees for birds and mammals;
- heron rookeries;
- winter requirements for deer and moose;
- fish habitat;
- slope;
- erosion potential; as well as
- canoe routes and campsite locations.

In addition, tree markers have to consider the requirements of every individual tree: shade tolerance, seed establishment, soil type, water regime, topography, site class, stocking levels, growth, and recruitment (Townsend 1995).

Between 1995 and 1998, all silviculture work, including tree marking, planting, tending, site preparation, manual cleaning, and stand improvement in Algonquin Park was carried out on approximately 48,000 hectares (on average 12,000 ha per year) (AFA 1999). Over that same time period, 27,580 ha were harvested,[33] mostly by selection and shelterwood harvesting systems (Table 24). The AFA's investments in silviculture are designed to improve the quality of stands over time, and will help guarantee a continuous supply of high quality timber into the future.

By contrast, in Nova Scotia, between 1995-1998, 232,705 hectares were harvested (an average of 58,176 ha per year), while silviculture activities lagged behind, with site preparation, seeding, planting, and stand tending carried out on 99,016 hectares (24,754 ha per year) (Canadian Council of Forest Ministers 2001) (Table 24). This means that, on a per hectare basis, the silviculture:harvest ratio is four times greater in Algonquin Park than in Nova Scotia (Table 24)

[33] From 1990-1996, 7,500 ha were harvested annually (AFA 1998; p.23); in 1997-98, 6,371 ha were harvested on an annual basis; in 1998-99, 6,209 ha were harvested; and in 1998-99, 4,859 ha were harvested (Cumming, 2001) .

Not only have silviculture investments been disproportionate to the volumes of wood being harvested in Nova Scotia, but a large proportion of the silviculture work in this province has involved creating, protecting (often with herbicides), and maintaining monoculture softwood plantations and softwood stands at the expense of the typically mixed species, natural forest stands that they so often replace.

Table 24. Extent of Silviculture and Harvesting (hectares per year) in Algonquin Park and in Nova Scotia, 1995-1998

	Extent of silviculture activities, 1995-1998 (ha/yr)	Area harvested 1995-1998 (ha/yr)	Silviculture activities per hectare harvested, 1995-1998 (ha)
Algonquin Park	12,000	6,895	1.73
Nova Scotia	24,754	58,176	0.43

Source: Canadian Council of Forest Ministers 2001; AFA 1999.

For Algonquin Park, silviculture expenditures averaged $370,000 per annum between 1984-94 (Townsend 1995), and had increased to $1,098,931 by 1998 (AFA 1999). In Nova Scotia, silviculture expenditures dropped from $23,525,000 in 1990, to $2,493,000 in 1998 (Canadian Council of Forest Ministers 2001), largely due to cuts in public funding support. The recently introduced Forest Sustainability Regulations are designed to increase silviculture activities in Nova Scotia with the goal of doubling the current annual cut by 2070.

4.4 Harvesting Activities

For Algonquin Park "*the level of harvesting is based on what is sustainable over the long term. The wood supply available to industry is a function of sustainable forestry practices and is not influenced by industrial demand*" (AFA 2001). The calculations for annual available harvest for Algonquin Park are based strictly on what the woods can provide on a long-term sustainable basis.

To calculate the annual allowable cut, the AFA first determines the total amount of land available for forest management. Wilderness, nature reserve, and natural environment zones, no-cut reserves, areas of concern (described in Section 4.2), unproductive forestlands, and islands are all deducted from the total forest landbase. Conservative growth rates are then employed to estimate annual growth yields under the different harvesting regimes.

The total forestland base in Algonquin Park is 738,350 ha. After subtracting the various categories of protected areas, the operable forestland base for Algonquin Park is assessed at 479,927 ha. The annual available harvest has been in the order of 400,000 m^3 for the last 25 years (Townsend 1995). This annual harvest allocation calculated by the Algonquin Forest Authority for Algonquin Park has never been exceeded.

In Nova Scotia, 2.6 million ha of forestland are considered operable, and the current "sustainable harvest level" (i.e. Annual Allowable Cut) has been calculated as 6.7 million cubic metres/year (Wilson 2001). This means that for Nova Scotia, the NSDNR considers the harvesting of 2.6 m^3 of wood per hectare per year as "sustainable," whereas the Algonquin Forest Authority only allows the harvesting of 0.83 m^3 of wood per hectare per year (Table 25).

Table 25. Total Operable Forest and Annual Allowable Cut/Sustainable Harvest Level for Algonquin Park and for Nova Scotia.

	Total area of operable forest (ha)	Annual Allowable Cut (cubic metres)	Annual Allowable Cut per ha of operable forest (cubic metres)
Algonquin Park	479,927	400,000	0.83
Nova Scotia	2,600,000	6,700,000	2.6

Source: Wilson 2001; Townsend 1995

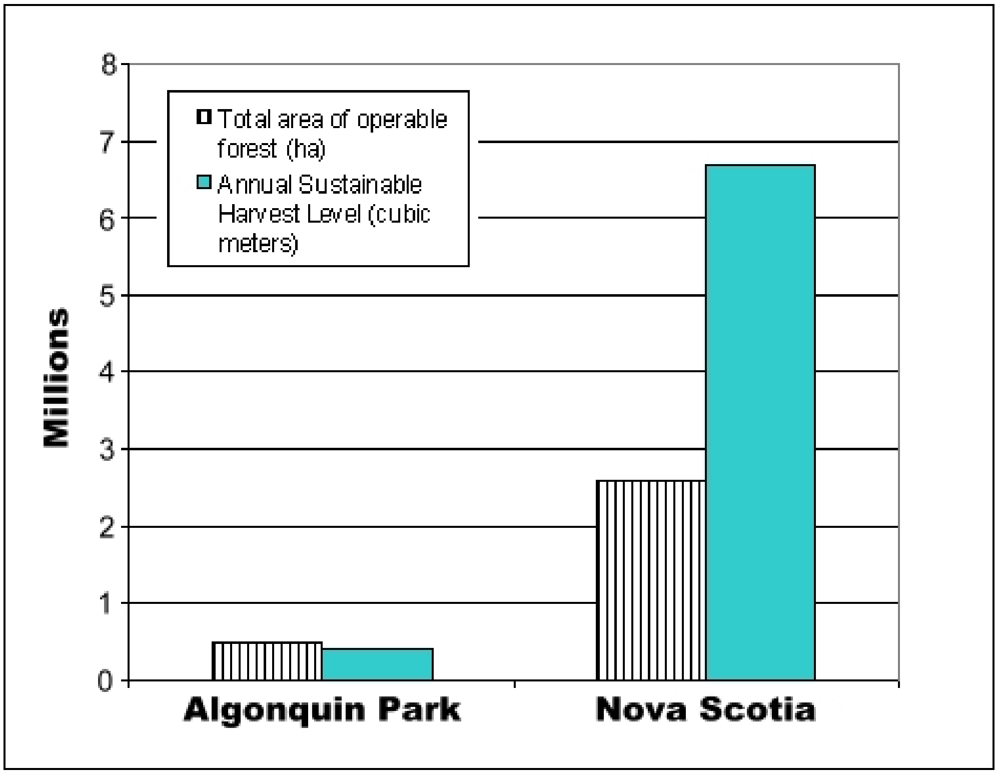
Therefore, the Nova Scotia government supports the harvesting of three times more wood per hectare of operable forest than the Algonquin Forest Authority (Figure 16).[34] This is despite the fact that in every year from 1988 to 1997, the volume of softwoods harvested (which is roughly 90% of the total volume of timber harvested) exceeded the official "sustainable harvest level" based on actual reported silviculture. In 1997 harvest levels were 60% higher than the calculated "sustainable harvest level" with actual reported silviculture (Wilson 2001, Section 8.1.1).

Healthy multi-aged forests like Windhorse Farm, with a high proportion of old trees and sustainably harvested over long periods, can potentially yield higher volumes of wood per hectare than are currently extracted from Nova Scotia's forests, without degrading or undermining the full range of forest values. For degraded forests that have been repeatedly high-graded and/or clearcut, and that are in need of restoration, a reduction in harvest levels, particularly of desirable growing stock, is an inevitable part of the restoration process.

[34] It could be argued that since the majority of the harvest in NS is softwood while a large proportion of the harvest in AP is tolerant hardwoods, it makes sense that the allowable harvest for AP is lower per ha, since hardwoods have lower net growth rates than softwoods. However, this is only part of the story. As noted in Wilson (2001), many of the tolerant and semi-tolerant hardwood tree species in Nova Scotia have declined significantly in the last 40 years due to clearcutting practices. Furthermore, many mixedwood natural forests have been clearcut and converted to softwood plantations, or to naturally regenerated stands of early successional, intolerant tree species. Thus, in NS, many stands that are now dominated by softwoods and early successional, intolerant hardwoods were once tolerant hardwood and mixedwood stands. The conversion of multi-species, multi-aged forests to young, even-aged, early successional stands, intensively managed to promote rapid growth of softwoods, may appear to allow for a higher AAC, but it is questionable whether such conversions are compatible with accepted definitions of sustainability. The use of the AAC to signify "sustainable harvest levels" is therefore also questionable without reference to historical conversions or restoration forestry requirements.
It could also be argued that the AFA's calculations for AAC are not based strictly on yield, whereas those for NS are. However, one of the intentions of this case study, and of the GPI Forest Accounts as a whole, is to demonstrate the need to accommodate all forest values in calculations of sustainable harvest levels. From that perspective, the comparison is justified.

Determination of sustainable harvest levels, must therefore account for the condition of the forest and its needs. Therefore, the following contrast between the Nova Scotia and Algonquin Park annual allowable cuts, which argues for a lowering of the Nova Scotia AAC, is not comparable to earlier comparisons with Windhorse Farm and the Menominee forests, which demonstrate the higher potential timber yield that can accrue from a healthy forest.

Figure 16. Total operable forest, in hectares, and Annual Allowable Cut, in cubic metres, Algonquin Park and Nova Scotia



Source: Wilson 2001; Townsend 1995

In addition, in Nova Scotia, it has been very difficult to monitor and assess either the annual volume of timber cut or the extent of silvicultural treatments applied, due to the large proportion of privately-owned lands in the province. Trends indicate that cutting on private woodlots has increased dramatically in the past 10 years, while silviculture inputs have declined (Wilson 2001). A 1997 report by the National Roundtable on Environment and Economy noted that poor and uncoordinated record-keeping rendered current harvesting statistics highly inaccurate, and that actual harvesting levels likely exceeded official estimates (Wilson 2001).

The recently introduced Registry of Buyers (1998) was created to improve record keeping by sawmill owners and other purchasers of unprocessed wood. Buyers now have to maintain more accurate records with respect to harvesting amounts, exports, imports, fuelwood, and processing of roundwood into secondary products (Cameron 2001). This should allow more accurate estimates of actual harvest levels in the future.

In its calculations of the potential wood supply for the province (based on the SAWS model), the Nova Scotia government excludes many forest values other than timber on operable forestland. These excluded values include tourism, and ecosystem services like watershed protection, soil fertility, carbon sequestration, and maintaining the full array of native biodiversity.

Current forecast models and AAC estimates also do not take into account the lower value of wood grown in plantations or naturally regenerated after clearcutting, compared to wood grown under a forest canopy (See Part II, Chapter 8, Section 1). Despite these omissions, the NSDNR has forecast a twofold increase in wood supply for the province, from 1996 to 2070, due to projected increased silvicultural treatments based on the recently introduced Registry of Buyers and Sustainable Forestry Fund.

Between 1995 and 1998, as noted, the forests of Nova Scotia were harvested at a rate of 58,176 ha/year, compared to 6,895 ha/year for Algonquin Park (Table 26). In Nova Scotia, the forests were *clearcut* at a rate of 57,594 ha/yr, compared to just 137 ha/yr for Algonquin Park (Table 26).

With respect to available forestland, an average of 2.24% of the total operable forestland in Nova Scotia was harvested each year between 1995-1998, 99% by clearcutting, regardless of forest cover type (Canadian Council of Forest Ministers 2001). For Algonquin Park, 1.44% of the operable forestland was harvested each year between 1995-1998, 98% by selection and shelterwood harvesting methods that are tailored to the regeneration requirements of the existing stand, and that maintain a continuous forest cover (AFA 2001).

Table 26. Average Area Harvested per Year, Percent of Harvesting by Clearcutting, Average Area Clearcut per Year, and Percent of Operable Forest Harvested per Year, for Algonquin Park and for Nova Scotia, 1995-1998.

	Average area harvested per year, 1995-1998 (ha)	% of harvesting by clearcutting	Average area clearcut Per year, 1995-1998 (ha)	% operable forest harvested each year
Algonquin Park	6,895	2	137	1.44
Nova Scotia	58,176	99	57,594	2.24

Source: Canadian Council of Forest Ministers 2001; Algonquin Forest Authority 2001

4.4.1 Harvest Methods

In order to prepare the first Forest Management Plan for Algonquin Park, predicated on selection and uniform shelterwood management systems, the Algonquin Forest Authority collected additional data to make growth and yield projections, and to estimate logging costs. In 1977, a methodology was devised to collect information on tree species, quality of trees, number of trees, and basal area information. This information was not available from standard inventories, but it indicates the type of data that would also be required to support a movement towards sustainable harvest methods in Nova Scotia.

Ninety-eight percent of the areas harvested in Algonquin Park are managed using selection (56%) and uniform shelterwood (42%) systems that maintain forest cover on the land base at all times. Selection harvesting refers to the removal of trees individually or in small groups, thereby creating and/or maintaining an uneven-aged, multi-species forest. Regeneration is natural, and the aim is to achieve a diversity of age classes. In Algonquin Park, this technique is used to regenerate sugar maple, beech, red maple, basswood, white ash, and yellow birch.

In the uniform shelterwood harvesting system used in Algonquin Park, trees are harvested in a series of two to four cuts for the purpose of obtaining natural regeneration under the shelter of residual trees, thereby maintaining the original genetic stock. This is an even-aged system that is used in conifer stands and some poorer quality tolerant hardwood stands in order to regenerate white pine, hemlock, white and black spruce, balsam fir, red oak, and some sugar maple.

The ideal application of the shelterwood system, in a well-stocked immature pine stand, is a 4-step removal process, each step roughly 20 years apart. After the fourth and final overstory removal, a minimum of 16 veteran dominant and co-dominant trees are left per hectare, to maintain wildlife habitat, as required by the Ontario provincial silviculture guidelines for final removal cuts.

Problems with weevil damage of young pine are also reduced significantly in the 3-4 cut system by opening up the canopy in small increments. Weevils are small insects that eat the terminal bud of young white pine trees, resulting in deformed growth, and greatly reducing the market value of the future pine crop. By contrast, shelterwood harvesting to regenerate white pine in Nova Scotia is usually done in a two step system, and weevil damage to young white pine is very common.

In Algonquin Park, two cut shelterwood treatments are sometimes carried out in poorer quality hardwood stands, provided there is good tolerant hardwood regeneration in the understory. For this treatment, a portion of the overstory is removed to release the understory. Care is taken not to remove too much of the overstory too quickly, as overexposure to sunlight may result in significant dieback of the understory. Typically, no less than 15 square metres in basal area per hectare are left standing to protect the understory regeneration.

By contrast, in Nova Scotia, most if not all tolerant hardwood stands are clearcut, regardless of the quality of the stand or the presence of understory regeneration. As outlined in Section 3.4, clearcutting has resulted in significant declines in many of the tolerant hardwood and softwood species in Nova Scotia.

Partial cutting systems have been in use for more than 25 years in Algonquin Park. With 20-25 year cutting cycles, stands managed under the shelterwood and selection systems are now being entered for a second time. Already, higher grades of lumber are being harvested during second entries. The Algonquin Forest Authority has shown that careful, silviculturally appropriate harvesting practices can produce a future crop of high quality and high value timber within 20-25 years. **In short, protecting the full range of forest values through appropriate and sensitive harvest methods *also* enhances the timber value of a forest.**

This evidence also supports the assumptions of Jeremy Frith (Chapter 3) that a current investment in sustainable harvest practices and forest restoration will yield higher quality and higher value timber outputs within a reasonably short time span.

The Algonquin Forest Authority employs clearcutting systems on the remaining 2% of the area harvested in Algonquin Park. Clearcutting is selectively used to create openings for the maintenance and establishment of shade intolerants, i.e. tree species that need abundant sunlight, like jack pine, white birch, red pine, and poplar. In the absence of fire (due to strict fire suppression policies), white pine has been succeeding jack pine, and so clearcutting has been used as a deliberate technique to maintain the small component of jack pine on the landscape. The average size of clearcuts in Algonquin Park - 25 hectares - is only a small fraction of the maximum size permitted by the Ontario government (260 ha).

The dominant logging system in Algonquin Park in the 1970s and 1980s was to fell with a chain saw, skid the tree length to central landings, then cut, sort and pile the different products for hauling on trucks. Today, a similar system is used except that logs are skidded to smaller landings, where they are loaded onto trucks, and the whole treelength is then hauled to central landings outside the park. The latter practice reduces the size of landings in the park, reduces machinery and noise inside the park, and allows for better sorting and recovery of the more valuable forest products.

4.5 Roads

Logging roads are a major cause of forest fragmentation, edge effects, and sedimentation in watercourses. As discussed in Chapter 2, Section 5.1.1, fragmentation and edge effects can significantly degrade habitat for area-sensitive forest interior species. Similarly, sediments can cause significant changes in stream insect and fish habitat by disrupting feeding mechanisms, abrading respiratory organs, inhibiting visibility, smothering larvae, and clogging spawning gravels (O'Brien 1995). In order to minimize the ecological impacts of logging roads, it is essential to minimize their length and width, and to prevent erosion when building bridges and culverts across watercourses.

Prior to the establishment of the Algonquin Forest Authority, the 18 different timber license holders in Algonquin Park each maintained their own road system within the Park. This resulted in a network of roads that was inefficient from the perspective of minimizing the total length of roads within the park. Furthermore, road-building techniques varied from one company to another, and were sometimes quite poor.

Road inspections in 1975 clarified the need to improve road-building techniques. The first forest management plan, completed in 1980, required that the road system be rationalized to improve the efficient movement of forest products, and to minimize impacts on recreational values. This meant the use of existing roads had to be maximized, and new construction minimized. Within nature reserves or wilderness zones, no new roads were allowed and existing roads had to be phased out.

In addition, the 1980 forest management plan specified that timber landings could not be larger than 0.2 hectares. Maximum road rights-of-way were established for all types of logging and access roads, and new roads had to be built in accordance with the Ontario Ministry of Natural Resource's (OMNR) Environmental Guidelines for Access Roads and Water Crossings.

5. Conservation of Biological Diversity

5.1 Wildlife - Flora and Fauna

Given the size of Algonquin Park, and its proximity to the most densely populated region in Canada, a particularly important function of the park is to provide habitat for a wide variety of fauna and flora, and significant habitat for a number of rare, vulnerable, threatened, and endangered species. There are at least 7 nationally rare plants, 5 provincially rare plants, and 3 locally rare plants in Algonquin Park. Algonquin Park is also home to the nationally rare spotted turtle, provincially vulnerable wood turtle and eastern hognose snake, provincially rare red-shouldered hawk, and locally significant long-eared bat and rock vole. In addition, Algonquin Park has one of the most southerly populations of wolves in North America.

The objective of wildlife management for Algonquin Park is to foster the continued existence of the *full array* of native wildlife and its natural habitats, and to ensure that no vulnerable, threatened and endangered species is further threatened by anything other than natural processes. Traditionally, wildlife management has focused on promoting 'game' species favoured by hunters and fishermen. Game species tend to do well in the early successional habitats created by clearcutting. However, many of the species in decline across North America tend to be those that require large contiguous tracts of forest, or that require well-developed, old-growth forests (See discussion in Chapter 1, Section 2.2; and Chapter 2, Section 5.1.1).

The Algonquin Forest Authority has modeled the habitat requirements of 17 selected wildlife species, including those that require continuous forest cover, to examine whether their habitat requirements are met under the current management regime. Meanwhile, the Ontario Ministry of Natural Resources has undertaken habitat supply analyses to examine whether specific species, like the red-shouldered hawk, have sufficient habitat to survive in the long-term. Modifications to proposed forest operations have been made in Algonquin Park to accommodate the needs of various species of concern.

The Algonquin Forest Authority will continue to modify forestry practices to account for the habitat needs of native fauna as new scientific information becomes available. Over the past 20 years alone, tree marking prescriptions have been modified numerous times to accommodate the needs of wildlife. For example, mast producing beech trees are maintained for bears and other species that favour beechnuts. In addition, snags and fallen trunks are no longer perceived as useless deadwood, but are recognized for their vital role in providing habitat for numerous wildlife species. Forest operations in Algonquin Park are now required to retain at least six cavity-nesting trees per hectare, and woods workers are encouraged to leave cull ends of logs and cull trees in the forest as downed woody debris.

In Nova Scotia, the wildlife management programs of the Nova Scotia Department of Natural Resources (NSDNR) have recently expanded to include non-game species, including species that are listed by COSEWIC or by the province as vulnerable, threatened, or endangered. More recently, the NSDNR Wildlife Division has developed status ranks of wild species in Nova Scotia. The purpose of this ranking exercise is to:

> *"help identify those species most in need of immediate conservation and recovery action. The approach also helps to identify gaps in our knowledge and serves as a "first alert," early warning system that better aligns our priorities for species conservation recognizing the need for a heightened focus on prevention in our decision making"* (NSDNR 2001).

The NSDNR's online web-site ranks the status of wild species in Nova Scotia into a series of categories. It is interesting to note that, of the 31 bird species listed as extinct/extirpated/at risk or considered sensitive to human activities, only two are noted to be vulnerable to forest harvesting.

A considerable body of scientific literature has documented the vulnerability of particular bird species to forest conversion, forest fragmentation, and edge effects. These include species whose range encompasses Nova Scotia, such as the northern parula warbler, black-throated blue warbler, black-backed woodpecker, pileated woodpecker, northern goshawk, and others (Betts 1999; Freedman *et al.* 1994; Hunter 1990; Robinson 1990).

Considering the profound ecological impacts of forest harvesting on Nova Scotia, and the limited Nova Scotia-specific information available on the impacts of forestry on potentially sensitive bird species, NSDNR's general status ranking system would better serve as an 'early warning system' if it identified a larger number of such potentially sensitive species as 'vulnerable' or 'indeterminate.' This could draw attention to potential long-term threats and the need for better information, and might encourage forestry practices better suited to preserve the habitat of these species.

5.2 Protected Areas

Almost 19% (18.8%) of Algonquin Park is protected from logging activities in wilderness, nature reserve, and natural environment zones. However, when areas excluded from operations in the recreation/utilization zone, such as reserves for watercourses, and natural and cultural values, as well as non-productive forest land, non-forested areas, water and islands are included in the calculation, the total area protected from logging increases to 39.8% of the Park.

In light of the fact that it is a provincial park, this degree of protection falls short of some people's expectations. Nevertheless, for the purposes of this particular case study, Algonquin Park provides an excellent example of a model forest management operation with particular applicability to Nova Scotia, where the demands of the tourism industry create a special imperative to preserve habitat for wildlife. A higher level of protection, particularly for Crown lands, has been demanded, for example, by the 37 organizational members of the province's Public Lands Coalition.

In a 1998 article published in *Science*, conservation biologists Michael Soule and M. Sanjayan suggest that the "typical estimate of the land area needed to represent and protect most elements of biodiversity, including wide-ranging animal species, is about 50%". In Nova Scotia, only 8.3% of the land area is currently under some form of protection. While significant additions of protected lands have been made in the past ten years, the 8.3% set-aside still falls far short of national targets (12%), with many landscapes in the province still unrepresented by protected areas.[35]

During the recent development of a land use plan for the province, the Nova Scotia Department of Natural Resources received proposals from hunting, fishing, wildlife, and environmental groups for the protection of twenty new areas in the province (K. deGooyer pers. comm. 2001). However, none of these were adopted in the land use plan unveiled by the NSDNR in the fall of 2000.

5.3 Habitat Fragmentation

From a conservation perspective, the impacts of forestry practices on habitat fragmentation are of major concern, even when most of the harvesting is carried out by methods that maintain a relatively continuous forest cover. This is because forestry operations require roads that allow machines and trucks to access stands and remove logs. Roads create breaks in the forest canopy, resulting in edge effects (see discussion in Chapter 2, Section 5.1.1). Roads also create an avenue for the introduction of exotic species, alter surface and ground water flows, and can become a major source of silt in watercourses.

All of the following actions adopted by the Algonquin Forest Authority have helped to minimize habitat fragmentation in Algonquin Park:

- Almost 19% of the Park is in protected zones;
- An additional 21% is in no-cut reserves and AOC's;
- More than 98% of harvesting is done by selection and shelterwood methods;
- Road networks have been rationalized and in some cases decommissioned; and
- Trail and canoe route crossings, gravel pits, camp sites, and mill sites are being rehabilitated.

[35] The target of a 12% protected areas strategy is found in the Nova Scotia Round Table on the Environment and the Economy's report, "A Sustainable Development Strategy for Nova Scotia" (1992). Canada also endorsed 12% as a protected areas target at the Rio Summit, although conservation biologists generally consider a 30%-50% set-aside to be the minimum required for the preservation of biodiversity.

5.4 Old-Growth Forests

There are 81,000 hectares of even-aged old-growth forests in Algonquin Park according to the Algonquin Forest Authority's definition of old-growth, which includes all forests greater than 120 years old. This is not as strict a definition of old-growth as that employed by Jim Drescher (Chapter 1.) There are also an additional 200,000 ha of uneven-aged forests, some of which could also be considered old-growth.

Of the 81,000 ha of even-aged old forests, there are 2,511 ha of old-growth red and white pine forests. Of this, 45%, or 1130 ha, is protected in the wilderness, nature reserve and natural environment zones, and in no-cut reserves. The remaining old-growth red and white pine forests are in the recreation/utilization zone, and are potentially eligible for harvest, provided it can be shown that overall old-growth diversity values are not adversely affected. One of the management objectives in the 2000-2020 Management Plan is to achieve 25% of red and white pine forest units in old-growth (120+ years old).

In Nova Scotia, almost all old-growth and older forests have been cut. According to Lynds and LeDuc, "very few true old-growth forests (+150 years old) are left in Nova Scotia and what remains is typically found in small isolated stands often of questionable ecological integrity" (Lynds and LeDuc 1995). In the last 40 years, forests over 100 years old declined in distribution from 8% in 1958 to 0.15% in 1995, and forests over 80 years old declined from 16% to less than 1% (Wilson 2001). The remaining 80+ year old forests have continued to be heavily cut since 1995.

The Protected Areas Division of the Department of Environment and Labor (DEL) has identified the remaining, large, roadless tracts of 80+ year old forest in the province. However recent flyovers by the Nova Scotia Nature Trust in search of these forests identified by DEL revealed that most sites had been clearcut, cleared for subdivisions, or were soon to be cut, as evidenced by recent road construction (Sutherland pers. comm. 2000).

5.5 Genetic Diversity

Losses in genetic diversity may be associated with several factors: reduced range and/or population levels of particular species, and/or removal of the strongest, tallest, most vigorous individuals in a stand (known as 'high-grading'). The implications of such losses of genetic diversity are serious and potentially irreversible. They include a decrease in a species' ability to adapt to environmental change, a decrease in a species' overall viability, and the loss of the most valuable and potentially valuable timber in a stand.

In Algonquin Park, various measures are being taken to reverse, to the extent possible, the effects of 150 years of high-grading, and to protect the remaining native genetic diversity of the park. Tree marking guidelines ensure that the dominant and co-dominant trees in good health are retained as a seed source, and that many of the poor quality and poorly formed trees are removed. Already, mills are seeing higher percentages of higher quality wood from Algonquin Park coming through their gates. In addition, selection and shelterwood harvesting systems rely heavily on natural regeneration by maintaining the most vigorous seed trees on site. For planting, seed is collected from stands in the park to assist in the maintenance of genetic diversity.

The decline in volume, abundance and distribution of most of the long-lived, shade-tolerant hardwood and shade-tolerant softwood species in Nova Scotia - largely due to high-grading and clearcutting practices - represents a significant loss in the genetic diversity of our native tree species.

6. Conservation of Soil and Water Resources

6.1 Water Quality and Quantity

As mentioned earlier, Algonquin Park serves as the headwaters for 18 principal watersheds, with 5 major rivers draining the park, and a total of 2,456 lakes. Algonquin Park is considered one of the great natural fisheries in Ontario, and has the only relatively intact native trout fisheries remaining in the southern part of the province (AFA 1998). Recreational fishing is second only to canoeing as a major recreational pursuit in the Park. Algonquin Park is home to two threatened fish species, the short-jaw cisco and the deepwater sculpin.

Forest harvesting and the construction of logging roads can have very significant impacts on water flows, and hence, on fish habitat. Forest canopies help break the impact of rain on soil, and they slow runoff. Conifer forests intercept as much as 50% of precipitation, and maple-beech forests as much as 43% (Brady 1990, cited in Wilson 2001). Precipitation is also absorbed by decomposing trees and limbs, and by soils rich in organic matter. Organic matter acts as a sponge, delaying and decreasing storm flows. These processes, in turn, help protect fish habitat by reducing soil erosion and stream sedimentation, and by minimizing fluctuations in stream water temperatures.

Numerous studies have found that the removal of the forest canopy by clearcutting results in substantial increases in water flows due to reductions in transpiration and canopy interception (Hornbeck *et al.* 1993). These impacts are most severe during the first years after cutting. Furthermore, clearcutting reduces the organic matter content of soils, through the removal of biomass and the loss of long-term recruitment of dead wood to the forest floor (Freedman *et al.* 1996). This in turn reduces the long-term water retention capacity of forest soils (Maser and Trappe 1994)

With 98% of the forest harvesting in Algonquin Park conducted by selection and shelterwood techniques (both methods that maintain a relatively continuous forest canopy), the potential impacts of harvesting on water runoff are very significantly reduced. In Nova Scotia, on the other hand, 99% of harvesting is by clearcutting. Recent clearcuts leave little or no forest cover to intercept precipitation, nor large volumes of live and dead trees to provide long-term inputs of soil organic matter. Year-round logging by heavy machinery also causes soil compaction and rutting, further reducing the soil's capacity to absorb precipitation.

The hydrological cycles of five major rivers in Nova Scotia were measured consistently between 1922-1990. The results indicate that these rivers now have significantly higher flows in the winter months, and significantly lower flows in the summer months. These changes are likely a product of forest cutting, as well as other influences like warmer atmospheric temperatures, urbanization, and agriculture (Wilson 2001).

Quality of fish habitat, especially for cold water species, is significantly influenced by water flows, water temperatures, availability of food, and, as mentioned in Section 4.5, sedimentation. Riparian trees that shade streams, rivers, and lakes play a key role in maintaining low water temperatures, minimizing fluctuations in daily and seasonal water temperatures, and providing food to stream insects in the form of leaves and other organic matter. These insects in turn become prey for salmon and trout.

Maintenance of forested buffer strips along watercourses therefore greatly reduces changes in water fluctuations. However research has shown that higher than normal fluctuations in stream water temperature occur following clearcutting even with buffer strips maintained, due to the warming of ground and surface water in the exposed, clearcut portions of watersheds (O'Brien 1995).

All forestry operations in Algonquin Park maintain slope dependent (minimum 30-meter wide) no-cut zones along all watercourses and water bodies to protect water quality and water flows. Water quality and quantity are further protected by the Ontario Environmental Assessment Act, the Ontario Environmental Protection Act, the Lakes and Rivers Improvement Act, and the work permit process. Contractors must also abide by the Code of Practice for Operations in Riparian Areas.

The Nova Scotia Wildlife Habitat Management Regulations require a minimum 20m-wide 'Special Management Zone' on each side of watercourses greater than 50 cm wide. This is *not* a no-cut zone. These regulations permit the removal of 40% of the volume of trees within the zone every 20 years. There are no restrictions as to which trees can be removed. Given the importance of the long-term recruitment of large dimension woody debris into streams (O'Brien 1995), it is unfortunate that these regulations do not specify that a minimum number of larger-sized trees be left standing.

Currently, Nova Scotia Wildlife Habitat Management Regulations only apply to Crown land. They are expected to apply to all lands in Nova Scotia pending approval by Cabinet. The lack of stringent, mandatory regulations for the protection of water quality and quantity on *all* lands in NS has resulted in numerous incidents in which cutting has occurred right up to the edges of streams, rivers and lakes. One south shore canoe enthusiast has documented JD Irving clearcuts within several metres of the banks of the Upper Silver River and the East Branch Tusket (A. Smith pers. comm. 2001). Both of these rivers are part of the Tusket River watershed, which is well known for its many relict populations of rare coastal plain flora, some of which are considered nationally endangered.

Although a simple cause-effect relationship has not been proved, it is likely that the high rate of clearcutting in Nova Scotia and the lack of effective regulations to protect water quality have contributed to major declines in freshwater fish populations in many Nova Scotia rivers. The total number of recreational fish retained has dropped by 70% since 1975. Salmon populations have fallen to an all-time low, with only 22 of Nova Scotia's 72 salmon rivers open to recreational salmon angling in 1999. Brook trout catches have fallen by 50% since 1985.[36]

Acid rain, habitat degradation, and over-fishing have almost certainly contributed to the demise of Atlantic salmon in many Nova Scotia rivers, and to the dramatic decline in Nova Scotia brook trout. But it is also highly likely that clearcutting and road construction have contributed to the declines of both these fish species by causing low summer flows, warmer water temperatures, sedimentation, and the reduced availability of good cover and spawning habitat (O'Brien 1995). According to one Maritime ecologist, brook trout should be considered a forest dwelling species, because forest shade is considered an essential habitat requirement for this species (Clay 1988, cited in Wilson 2001).

These population declines have had a direct economic impact. Between 1990 and 1995 alone, there was a 33% decline in total recreational fishing expenditures in Nova Scotia (Wilson 2001), a trend clearly related to the increasing difficulty that anglers have in catching fish.

6.2 Soils

Soil organic matter and soil nutrient and mineral content are key elements of the productive capital of forests and of the timber industry, and directly impact future forest and timber productivity. Organic matter stores water, nutrients, and carbon, and acts as a slow release fertilizer (Hammond 1991). Loss of soil organic matter results from the removal of harvested biomass, erosion, leaching, burning, scarification, and volatilization of soil carbon and nitrogen. Soil organic matter content is strongly correlated with site fertility, and is therefore an excellent indicator of soil health and the productive potential of forests.

One of the guiding principles of management for the Algonquin Forest Authority is to "*maintain the productive capacity of the soil*" (AFA 2001). To that end, a significant amount of harvesting is carried out during the winter, when the ground is frozen and/or snow covered, or during the summer, when the ground is dry, and therefore much less susceptible to mechanical disturbance.

In addition, 98% of harvesting systems in Algonquin Park leave a fairly continuous forest canopy, resulting in little if any increase in runoff and leaching of nutrients from the watershed. As well, all harvesting is by tree length, in which branches, foliage, and roots are left on site, which greatly reduces the loss of nutrients from the site (Freedman *et al.* 1986). The Algonquin Forest Authority has also developed Site Impact Guidelines to minimize rutting of the forest floor.

In Nova Scotia, nutrient leaching, soil compaction and rutting, and large exports of tree biomass have significantly degraded the productive capacity of forest soils (Maliondo 1988). Furthermore, harvesting takes place at all times of the year, regardless of soil saturation, as is evidenced by the deep ruts visible in many Nova Scotia clearcuts.

[36] For more information on these trends, see Wilson, S. J. (2000), The GPI Water Quality Accounts, GPI Atlantic, Halifax, NS.

7. Economic Value of Non-Market Goods and Services

7.1 Carbon Cycle

Based on estimates described in Chapter 2, Section 6.3, each hectare of Nova Scotia forests is worth, on average, $537 as a carbon sink. The economic estimates are derived from assessments of avoided climate change damages. If this same per hectare value were applied to Algonquin Park, its forests would be worth $360.7 million as a carbon sink.

However, with more than 50% of the even-aged forests in Algonquin Park greater than 100 years old, and another 200,000 ha in uneven-aged stands, a much greater portion of Algonquin Park's forests are in older age classes, and are therefore much more effective as carbon sinks. This increased carbon storage capacity would in fact yield a considerably higher per hectare carbon sink value than Nova Scotian forests.

Furthermore, the primary harvesting methods employed by Algonquin Park remove less forest cover and biomass during any one rotation, and thus retain considerably more carbon storage capacity both in the soils and in the retained biomass than is currently the case for Nova Scotia. Higher per hectare harvest rates in Nova Scotia also release more carbon to the atmosphere from the province's forests on an annual basis than is the case in Algonquin Park, thereby contributing to global warming and adversely affecting the overall carbon budget of the province's forests

The conversion of many of Nova Scotia's old-growth forests to predominantly even-aged softwood stands and plantations has likely diminished the province's forest carbon storage capacity by up to 80% (Wilson 2001). In sum, the change in age and species composition, and particularly the loss of older age classes, render Nova Scotian forests far less effective carbon sinks than they once were. Second growth forests only begin to approach the levels of carbon storage of original old-growth forests after 200 years or more (Schulze *et al.* 2000).

7.2 Ecosystem Services

Costanza et al. (1997, cited in Wilson 2001) estimate that temperate and boreal forests contribute a minimum of $430.10/ha/yr in ecosystem services to human society, including climate regulation, soil formation, waste treatment, biological control, food production, recreation, and cultural goods and services. This estimate is based on replacement value and contingent valuation estimates. Replacement values include the costs of human engineering construction to replace lost equivalent ecosystem services, such as the cost of a water filtration plant to emulate the functions performed by a healthy forested watershed. This estimate does not include many other essential ecosystem services, like disturbance regulation, water supply, soil erosion control, nutrient cycling, pollination, habitat, and genetic resources.

Based on Costanza's estimates, the contribution of Algonquin Park's forests to the above-mentioned ecosystem services is approximately $317.6 million per year. When compared to the annual economic contribution of forest operations in Algonquin Park - nearly $66 million - the standing forest provides nearly 5 times more value in ecosystem services than the forest's annual contribution of timber. This provides further economic justification for the high priority assigned by the Algonquin Forest Authority to the maintenance and enhancement of the Park's ecosystem functions, and to the health of its standing forests as a whole.

8. Multiple Benefits

8.1 Employment

The Algonquin Forest Authority, which oversees the management of forest operations for Algonquin Park, employs 21 full-time staff, including a general manager, 5 foresters, 9 forest technicians, and a chartered accountant (AFA 2001). The Algonquin Forest Authority also has up to 15 seasonal staff, working about 10 months a year, including timber cruisers and scalers. But AFA's direct employees are only a small proportion of the total employed in forestry operations in the park.

In all, over 280 people are employed directly in woodlands operations in Algonquin Park, and at least 1,800 more are employed in the 7 sawmills, 2 veneer plants, one pole plant, one pulp mill, and one oriented strand board mill that receive wood from Algonquin Park (AFA 2001). These 12 plants are either wholly or partly dependent on Algonquin Park as a source of wood. Algonquin Park also provides periodic supplies to another 5-10 mills, for which there are no employment-related statistics (AFA 2001).

Forest management and operations in Algonquin Park together employ about 316 people. Of the 1,800 mill jobs noted above, it is difficult to estimate what proportion of these jobs are attributable to the wood supply from Algonquin Park. In the first edition of this report, we estimated that 80% of these mill jobs may be generated from the Algonquin Park wood supply, and we noted that the actual proportion was not known at the time. Since that time, however, an Ontario Ministry of Natural Resources (OMNR) report, released in late 2001, has provided more detailed information on employment for Algonquin Park and the surrounding sub-regions. This more detailed and recent source is used here to estimate employment per unit of biomass harvested for Algonquin Park.

The study of central and eastern Ontario by the OMNR identified direct employment by the forest industry for the region. This region includes five sub-regions, one of these being Algonquin Park. Given that there are no towns in Algonquin Park, the jobs produced by the Algonquin Forest Authority and by the forest operations in the park are included in the employment statistics of the surrounding regions.

Direct employment by the forest industry in the region as a whole is 4,965 (OMNR 2001). For every direct job created by the forest industry in central and eastern Ontario, the OMNR estimates that an additional 0.48 indirect jobs are created within the region – 2,373 indirect jobs in all. The OMNR estimates that an additional 3,209 indirect jobs are created elsewhere in the province as a result of forest industry operations in central and eastern Ontario. For example, the two veneer plants and seven sawmills supplied by Algonquin Park sell their wood products to manufacturing facilities outside this region for use in furniture, flooring, cabinets, and other products (OMNR 2001). At the same time, a portion of the jobs produced in this region may be attributable to wood supplies from outside the region. In all the forest industry in central and eastern Ontario creates a total of 10,547 jobs in the province.

In addition to identifying direct employment in the region, the OMNR report cites the volumes of timber harvested in each sub-region. Algonquin Park produces the greatest amount of wood of all the sub-regions, with as much as 39% of the total volumes for the region as a whole. For the whole area (including all five sub-regions), the annual harvest can be as much as 1,212,000 m^3 (OMNR 2001). Based on these proportions, it is estimated that direct employment within the region as a whole is roughly 4.1 jobs per 1000 m^3 (4,965/1,212).

This estimate does not capture (1) the 2,373 indirect jobs sustained by the forest industry in central and eastern Ontario, and (2) the 3,209 indirect jobs created elsewhere in the province as a result of the forest industry in this region. However, this estimate *does* include employment created in this region as a result of the forest industry elsewhere. However, we could not find any data to indicate whether there is a net import or export of wood products from this region.

Since Algonquin Park accounts for 39% of all wood harvested in central and eastern Ontario, we have taken the ratio of direct jobs to biomass harvested in the region as a whole as representative of the Algonquin Park sub-region. In actual fact, the more labour-intensive selection harvest operations in Algonquin Park are likely to produce a higher ratio of jobs to biomass harvested than other conventional clearcut operations in the region. So the estimate of 4.1 jobs per 1,000 m^3 for Algonquin Park can be considered conservative. In any case, it is the most accurate estimate currently available from official and reliable sources.

Direct employment by the forest industry in Nova Scotia was estimated to be 13,000 in 1996 (see discussion of this estimate in Chapter 8, Section 3.1). Nova Scotia thus generated 2.15 jobs per 1000 cubic metres of wood harvested in 1996. This number may be low compared to Algonquin Park due to the dominance of the pulp and paper industry in the Nova Scotia forest economy. Pulp and paper production involves large amounts of wood for a relatively low value product. In Nova Scotia, this industry produces only 1.4 jobs per 1000 cubic metres of wood (See Figure 17 in Chapter 8, Section 3).

Given the high value-added estimates for Ontario (this chapter, Section 9.5), it is likely that derivative secondary and tertiary manufacturing are responsible for a significant difference in forest sector value-added between Nova Scotia and Ontario. Certainly, the quality and diversity of wood from Algonquin Park lends itself more readily to furniture, flooring, cabinet making, and other value-added manufacturing than the lower quality wood harvested in Nova Scotia.

Woods work has long been physically demanding and required long hours of work. Even today, some of the logging contractors are known to work 7 days a week during the busy logging seasons. Timber cruising and tree marking are also physically demanding jobs that involve long, arduous days in all kinds of weather conditions. In general, though, most employees who work for the Algonquin Forest Authority and the logging contractors in the park work weekdays with weekends off, a vast improvement over the working conditions of early days. This is also an improvement over the work schedules of conventional operators in Nova Scotia, whose debt loads often require equipment operation 80-100 hours a week, 12 months a year, to cover loan payments (W. Prest pers. comm. 2001c; S. Hankynson pers. comm. 1998).

The employment opportunities created by the forest industry in Algonquin Park have occurred primarily within the communities immediately adjacent to the park. Decisions have been made over the years by the Algonquin Forest Authority to favour the same, dependable, local contractors. The men employed by these contractors usually come from the contractors' home communities. Four family-owned logging companies have been operating in the park for two to four generations. In 1995, one of the tree markers was from the McRae family, which has been operating in Algonquin Park for five generations. All the mills and plants that process wood from Algonquin Park are located within 50 km of the perimeter of the park.

The Algonquin Park harvest methods and employment patterns contribute significantly to local community stability and resilience, providing steady and reliable employment opportunities for local residents year after year. By contrast, clearcutting patterns in Nova Scotia provide no steady logging employment for local communities, and require independent contractors to travel considerable distances to the next clearcut.

Algonquin Park owes much of its success as a forest operation to the high quality of expertise and technical skills of Algonquin Forest Authority staff and of the people working in the woods. Over the years, all staff and field personnel have participated in numerous training seminars and skills upgrading events. The Algonquin Forest Authority has organized courses in log marking and veneer grading to better capture the highest potential value of all logs coming out of the woods. Tree markers have to attend a training course every year before marking begins. Loggers, contractors and supervisors now require skills training, by order of the Government of Ontario.

The Algonquin Forest Authority has also taken extra measures to ensure safety and maintain high standards by printing and disseminating standards for cutting, skidding, trucking, logging, and safety procedures; and by producing sets of Site Impact Guidelines for contractors. AFA is also establishing an Environmental Management System to be registered to the ISO 14001 International Environmental Standard.

8.2 Tourism

Given its location in heavily populated southern Ontario, Algonquin Park attracts over half a million visitors annually. In the 1996/97 fiscal year, tourism expenditures in the Park were approximately $29.8 million, with an estimated provincial impact of $75.9 million. Tourism generated by Algonquin Park created 843 person years of provincial employment. Of this total, 446 person years occurred in the region, mostly within the park.

Unlike the situation in Nova Scotia, where the tourism and logging industries are increasingly at odds with each other over land use practices, Algonquin Park has managed to sustain both a vibrant tourism industry and a healthy forest industry. This can be attributed in part to the forest management systems adopted by the Algonquin Forest Authority, which

> *"almost always mean that trees remain standing on the land at all times, and many people would be hard pressed to realise that logging had even taken place in most areas just a few years later"* (Strickland 2000).

Furthermore, the managers of Algonquin Park have recognized that tourism opportunities, including high quality recreational and wilderness experiences, are highly valued by the Ontario public, contributing to the province's economy, attractiveness, and quality of life. As such, they have avoided potential clashes between logging operations and recreational park users through careful planning. Roads that infringed unnecessarily on recreational values, like canoe route crossings, have been eliminated. Two removable dry-land bridges have been built to accommodate the summer canoeing period. Portages, hiking trails, and canoe routes through the recreation/utilization zone are treated as 'Areas of Concern,' and cutting is either not allowed or restricted, in order to reduce potential conflicts with recreational users.

By contrast, in Nova Scotia, canoeists, eco-tourism operators, hikers, and other outdoor enthusiasts have been finding increasing numbers of their favourite canoe routes, trails, and portages eliminated or degraded by clearcutting. In many cases, pleas were made to the landowners, such as J.D. Irving or the Crown, to preserve a right-of-way, or a scenic view, and to shift to other methods of timber harvesting. Following are some of the experiences of Wendy Scott, an eco-tourism operator in NS (Scott Walking Adventures):

> *"I had an experience a few years ago bringing birders to NS. We stopped at the Liscomb Wildlife Sanctuary, which had just been clear-cut. The year before, a birding tour company (the largest in the world – they used to do tours here all the time) had scouted and found spruce grouse in this area. The birders were horrified at the sight of the destruction and disappointed that they wouldn't see spruce grouse. I think this company never came back to Nova Scotia. These are high-end tourists and are a big loss to the tourism industry as they drop a lot of money here.*
>
> *I also heard that a media person from Germany visiting Liscomb Lodge went home immediately, did not finish the tour, and wrote negative stories about the province when he saw the devastation in the 'Wildlife Sanctuary'.*

As for our own tours, we do three different 6 and 7 day walking adventures in Cape Breton, South Shore and the Bay of Fundy. We would also like to do a 6-day walking adventure along the Eastern Shore coming back in a loop by the Sunrise Coast (Pictou area). However whenever we scout that out, there is so much clearcutting that, so far, we haven't done it.

Since we cannot grow our business here, we have expanded to Newfoundland and Gaspé, where there are still forests left.

When we go by clearcuts on the way to our Upper Bay of Fundy Hiking Adventure, it is an embarrassment and I have to explain to our guests that most harvesting in Nova Scotia is by clearcutting. We have to tell the truth.

Our guests have written letters to the Premier but it has done no good. We have written letters, made submissions, asked for a place at the decision making table in the IRM process but have been ignored. All of tourism, not just outdoor/nature tourism depends upon our natural beauty. We are a stakeholder in the forests of this province. However we have no say in what happens to them. DNR says we have a say but ignore all of our submissions to them about selection harvesting"

(W. Scott pers. comm. 2001).

Canoe enthusiasts in southwestern Nova Scotia have witnessed many of their favourite canoe carries ruined by clearcutting. The following quotes are from a letter published in the Chronicle Herald by Don Rice of the Tobeatic Wilderness Committee:

"In the industry's cutting frenzy, another canoe carry (portage) has been mauled and slashed by those working for the Irving Company at Weymouth….This route has been documented in many personal journals and travel publications….The carries from Lake Joli…to Eighth Lake…are hardly recognizable any longer, having been stripped of trees, fragmented by roads and cut within a few feet of the streams." (Rice 2000)

Irving staff had been asked to keep these carries intact, but the requests were ignored, and many of the carries in the area "trashed". Publication of this letter and the embarrassment it caused the company resulted in JD Irving taking more time to consult with people like Rice as to the whereabouts of canoe carries on its properties (D. Rice pers. comm. 2001). However, according to Andy Smith, of the Southwest Paddling Club and Canoe Nova Scotia, even if carries are protected, the many clearcuts on private land, often within feet of the water's edge, "*diminish and degrade the paddling experience*" (A. Smith pers. comm. 2001).

Tourists traveling by car, boat and train enjoy and appreciate aesthetically pleasing landscapes and scenic vistas. In Algonquin Park, Highway 60 traverses the southern portion of the park and provides many scenic views and opportunities for short walks and guided tours. No harvesting is allowed within 30 metres of public roads, although in reality, no harvesting occurs within one kilometre of this highway. By contrast, in Nova Scotia, many "scenic" drives that are promoted to tourists, like the "Marine Drive" along Route 7, have views of extensive and recent clearcuts, including many that border the road.

A representative from a local car rental company took the inaugural VIA Rail summer train to Cape Breton. This is targeted at tourists, and billed as a romantic summer excursion through scenic rural landscapes, hardwood hills, and the Bras D'or Lakes. According to this representative, many of the people on the train were surprised and dismayed by the extent of the clearcutting along the route, and by the barren post-cutting landscape (Anon. 2001).

8.3 Model of Good Timber Management

The Algonquin Forest Authority has created many excellent precedents and set new standards for forest management in Ontario. The Park is believed by many, including the Algonquin Wildlands League, to be a model of good timber management. The Algonquin Forest Authority was the first Crown institution in Ontario to embark upon large-scale selection and shelterwood management systems.

The Algonquin park management systems have been the subject of many research studies that have contributed to the establishment of guidelines and production of manuals setting new standards for management practices across the Great Lakes-St. Lawrence region of southern Ontario. Some of the Algonquin Park research has also contributed to the establishment of provincial legislation for the protection of all forest values. The technical skills and knowledge generated by the use of selection and shelterwood management systems in Algonquin Park have also been shared across the province and, to a lesser extent, across the country.

As one observer commented, given the high profile of Algonquin Park and its popularity with recreationalists in Ontario, the Algonquin Forest Authority may not have survived had it not been on the leading edge of ecologically-based forest practices. Over the years,

> *"the Algonquin Forest Authority earned the respect of industry, government and the forestry profession. Requests for tours and speaking engagements increased …to 30-35/year. Tours have been conducted for groups from around the world, …all interested in forestry practices as carried out in Algonquin Provincial Park"* (Townsend 1995).

9. Forest Economics

9.1 Mechanization

The first mechanical skidders appeared in Algonquin Park in the 1950s, replacing horses and small trucks. Today, skidders are the standard machine in use in Algonquin Park. Similarly, log drives were once a common mode of transporting logs to mills, but they had been discontinued by 1959.

In contrast to the 80-100 hour per week use of forestry equipment in Nova Scotia, work crews in the Consolidated Bathurst Radiant Lake Camp (located in Algonquin Park, but closed in 1980), worked their machines 35-50 hours per week. Today, typical hours of operation in the park are 7 hours a day, 5 days a week. Between 1975 and 1995, greater efficiency, improved machinery, and better equipment utilization (more refined logging techniques) in the Algonquin Park forest resource sector increased production from 8 m^3 per man day to 15 m^3 per man day without compromising the high harvesting standards.

9.2 Transportation

When the Algonquin Forest Authority was established, there were 16 lumber camps in Algonquin Park, and two sawmills. Lumber camps were phased out, as a system of permanent well-maintained roads permitted year-round access to work sites in the park. Today, there is only one lumber camp still in use. As mentioned in Section 8.1, most of the logging contractors and their employees come from communities near the Park.

The last sawmill in Algonquin Park was relocated to a nearby town in 1979. In 1980, the average log haul from Algonquin Park logging sites to nearby mills was 75 miles, including hauling distances within park boundaries. Comparative log haul mileage data are not available for Nova Scotia. However, a full cost accounting comparison would definitely include transportation costs in the equation and analysis.

9.3 Changes in Quality of Products

In order to reverse the legacy of more than a century and a half of high-grading, the Algonquin Forest Authority has had to focus on removing the unacceptable growing stock (UGS), and leaving the acceptable growing stock (AGS). From the beginning, the consensus among the Algonquin Forest Authority foresters was that the first 20 years would be the toughest.

One of the Algonquin Forest Authority’s big challenges in improving growing stock in this early stage was to find markets for low quality material extracted from the forest. The Authority has since devised various strategies for dealing with this challenge – including actively seeking new markets for low-end products such as boltwood, pulp, and firewood; and encouraging local industries to utilize the low quality materials in new product lines. Tembec’s hardwood flooring mill in Huntsville has modified its facilities to handle low-grade hardwood that is common in the early stages of selection management.

After the introduction of the new Algonquin Park management regime in 1975, the hardwood sawmills lobbied for changes to the new marking prescriptions. However,

> *"both the Ontario Ministry of Natural Resources and the Algonquin Forest Authority remained dedicated to the new approach, realizing that by accepting short-term pain, the long-term benefits would eventually be realised"* (Townsend 1995).

The investment is already beginning to pay off as predicted. One sawmill owner, who is now starting to receive logs from areas first cut under the new management system 20 years ago, has reported that mills are now sawing as high as 47% number one common and better grades from the managed hardwood stands (Townsend 1995, p.42). Ten years ago, the same mills were experiencing number one common and better yields of only 25%.

Also, the proportion of sawlogs to total hardwoods harvested has increased to 50% from the traditional 35-40% range in these managed areas (Townsend 1995). In short, the discipline of foregoing short-term gains in the interests of improving growing stock is already producing an increasingly handsome return on investment. In contrast to the decline in wood quality noted in the GPI Forest Accounts for Nova Scotia, the Algonquin Park forest is literally "worth more" than it was 25 years ago, and is producing ever higher grades of lumber.

While the Algonquin Forest Authority embarked upon a path that was initially quite difficult, it is, therefore, already beginning to see the benefits. Future rotations will yield higher quality wood, and will provide even greater returns.

By contrast, between 1984 and 1997, the contribution of forest industries to the Nova Scotia Gross Domestic Product increased only marginally from $327 million to $329 million (Stats Canada CANSIM GDP data). This is a very minor increase in light of the fact that the area clearcut more than doubled from 30,000 to 70,000 hectares per year over that same period. Furthermore, the contribution of the forest sector to the total provincial GDP decreased from 3.1% in 1984 to 1.9% in 1997. Mechanization, automation, and declines in the more valuable older age classes and tolerant tree species are likely contributing factors to these lower returns.

9.4 Optimizing Returns in Times of Prosperity and Recession

Since its inception, the Algonquin Forest Authority has experienced periods of economic prosperity and two national recessions. The Authority has adjusted to fluctuating demands for wood by maintaining a lean operation, and by taking various steps to reduce costs in times of recession. These measures include:

- the use of back-hauls and cross-hauls to cheapen delivery costs;
- contracting out the skills and expertise of Algonquin Forest Authority employees;
- adopting computer technology;
- removing all but one permanent logging camp;
- reducing capital expenditures for road projects; and
- developing large processing yards outside Algonquin Park.

Additional advantages to trucking tree-lengths directly to processing and mill yards outside Algonquin Park include reducing the physical presence of machinery in the Park, creating fewer roadside landings, and improving product recovery, tree utilization, and operator safety on large industrial sites.

9.5 Value-Added

The timber from Algonquin Park supports 12 mills, including two veneer mills, one pole plant, one pulp mill, one oriented strand board plant, and seven sawmills. These industries are either wholly or partly dependent on Algonquin Park as a source of wood. Another 5-10 mills receive wood from the park on a periodic basis. Algonquin Park forest operations also provide bark for canoes, wood for charcoal plants, boltwood, railway ties, and poker poles for the Sudbury smelting plant. Additional secondary and tertiary products are manufactured from the wood processed by the primary mills.

Based on a harvest level of 400,000 m^3, the *direct* contribution of Algonquin Park logging and *primary* manufacturing to the Ontario economy was estimated as $65.9 million in terms of value-added in the year 2000 (AFA 2001). This figure does not include indirect contributions to the provincial economy, or additional secondary and tertiary value-added contributions in the manufacturing sector.

From the GPI perspective, every extra dollar in value-added production increases the “interest” on natural capital assets, and the timber value per unit of biomass harvested. Higher ratios are a sign of “genuine progress” in the GPI because they signal enhanced economic viability in living off the interest or services provided by natural capital stocks, without depleting the stocks or capital assets themselves.

Ontario has the best record among forest industries in Canada for ‘living off the interest,’ with the highest rate of value-added product per cubic metre of wood harvested. In 1997/98, Ontario’s value-added was $273/$m^3$, compared with Quebec at $204/$m^3$, Manitoba at $187/$m^3$, New Brunswick at $123/$m^3$, British Columbia at $110/$m^3$, and Nova Scotia at only $82/$m^3$ (Table 27).[37] In 1997, Nova Scotia’s rate of value-added production was 30% that of Ontario’s, and 67% that of New Brunswick’s (Table 27).

[37] Calculations of value-added production in the forest industry by province are based on statistics available in the National Forestry Database (http://nfdp.ccfm.org), and Statistics Canada Catalogues 31-203-XPB and 25-201-XIB. Value-added figures for each province come from the logging, wood product, paper and allied industries, and furniture and related product manufacturing sectors. The latter sector only includes those products made from wood, including wood kitchen cabinet and counter tops (NAICS 33711), other wood household furniture (NAICS 337123), and wood office furniture (NAICS 337213). Logging and paper industry figures were available up to 1997, with wood and furniture manufacturing figures up to 1998. The 1998 wood and furniture manufacturing statistics were used here rather than the 1997 figures, as there was a change in recording systems between 1997 and 1998, from SIC to NAICS codes, with the latter system providing much more detailed information about wood products. The use of both 1997 and 1998 figures in summing these four industry sectors should not affect the inter-provincial comparisons markedly, since the same methods were used for all provinces. The total of these four sectors was divided by the total volume of roundwood harvested in 1997 to assess the rate of value-added. This method of calculating value-added has been utilized by the Ontario Ministry of Natural Resources. (pers. comm. via telephone with Laurie Gravlines, economist, Ontario Ministry of Natural Resources, July 11 and 30, 2001).

Table 27. Value-Added in the Forest Sector by Province, as well as Value-Added per Cubic Metre of Wood Harvested

	1997 Logging Industry Value-Added	1997 Paper & Allied Products MFG Value-Added	1998 Wood Product MFG Value-Added	1998 Wood Furniture & Related Product MFG Value-Added	Total Roundwood Harvested (1997)	Value-Added (Per Volume Wood Harvested 1997)
NFLD	81,900,000	265,000,000	18,900,000	2,300,000	2,558,000	$143.90
PEI	3,800,000	2,400,000	12,100,000		514,000	$35.60
NS	84,200,000	294,000,000	159,900,000	1,400,000	6,568,223	$82.14
NB	216,400,000	706,900,000	456,400,000		11,253,000	$122.61
QC	705,400,000	4,600,800,000	2,702,100,000	669,100,000	42,546,000	$203.95
ON	594,000,000	3,985,000,000	1,860,500,000	821,700,000	26,595,000	$273.03
MAN	41,300,000	153,000,000	206,900,000	6,500,000	2,183,000	$186.76
SASK	66,500,000	0	149,200,000	1,200,000	4,205,000	$51.58
ALTA	208,800,000	795,700,000	948,600,000		22,217,000	$87.91
BC	2,144,400,000	2,093,400,000	3,202,200,000	171,800,000	69,298,000	$109.84

Sources: Minister of Industry 2001, (Statistics Canada 31-203); Canadian Council of Forest Ministers 2001; Minister of Industry 2000a, (Statistics Canada 31-203); Minister of Industry 2000b, (Statistics Canada 25-201).

According to Sandberg (1992), the low level of value added in Nova Scotia can be attributed to the dominance of the pulp and paper industry in the Nova Scotia forest economy. In the 1980s, he reports, "pulpwood exceeded sawlog production by a ratio of more than three to one."

In Nova Scotia, the wood market is dominated by three transnational corporations: the American Bowater Mersey in Liverpool, the American Kimberley Clark in Abercrombie (purchased from Scott Maritimes in 1999), and the Swedish Stora Enso in Port Hawkesbury (Sandberg 1992). In 1992, these three major pulp and paper companies held Crown leases or agreements on the majority of Crown lands, which amounted to 21% of the total forest area in the province (Sandberg 1992). Large private landowners, including these three pulp and paper companies, held an additional 24% of all forestlands. These three companies

> *"hold incredible power in communities such as …Abercrombie, Liverpool, and Port Hawkesbury.…(G)iven the lack of alternatives and local high unemployment …the large, mostly foreign, pulp and paper mills are political capital instrumental in the electoral process and survival of the provincial governments"* (Sandberg 1992).

With the dominance of the pulp and paper companies in the provincial forest sector, and the highly degraded condition of most of the region's forests, the opportunities for improving the quality of forest stands, and producing higher value forest products, are further diminished with every new clearcut (Sandberg 1992). As such, it is no surprise that the forest industry in Nova Scotia has poorly developed value-added sectors in wood and furniture products.

Indeed, Nova Scotia still exports in excess of 50,000 m^3 of unprocessed hardwood chips to Japan each year. Much of this wood is bought as roundwood and chipped on site in Sheet Harbor prior to export (P. MacQuarrie pers. comm. 2001a). In Ontario, the export of unprocessed wood (including chips) is prohibited by law under the Crown Forest Sustainability Act.

The reliance on commodity-based industries in the Nova Scotia forest sector renders the forest economy vulnerable to boom and bust cycles in the global economy. Commodity industries are subject to fierce competition across the globe, and prices are highly cyclical. In contrast, secondary and tertiary value-added businesses tend to be far more stable: products are differentiated, prices are less cyclical over time, and their ongoing presence and demand for materials adds stability to otherwise unstable commodity industries (L. Gravlines pers comm. 2001).

9.6 Revenues and Expenses

Ten years ago, the Ontario government withdrew from the business of managing Crown land. This responsibility was turned over to new management companies that took over sustainable forest licenses (SFLs) across Ontario. These management companies prepare forest management plans, conduct silviculture, and administer a stumpage-funded Forest Renewal Fund. SFL companies are generally co-operative ventures of the primary timber companies operating within a license.

The SFL companies do not tend to make a profit. Instead, they generate profits through the production of forest products harvested from the license. The costs of running the SFL management companies are considered overhead expenses, and guarantee the timber companies greater control and tenure over Crown land licenses.

Each company operating on Crown land has to pay stumpage fees to the government. A portion of these fees goes towards the Forest Renewal Fund, which funds silviculture activities on the management unit. Another portion goes towards the provincial Forestry Futures Trust, which is a fund available for all management units for special purposes, such as regenerating burned and blow down areas.

In many ways, the Algonquin Forest Authority is very much like an SFL company. It manages Crown land, abides by many of the same laws and regulations, including the Crown Forest Sustainability Act, administers a Forest Renewal Account, prepares management plans, and conducts silviculture. Similarly, the Algonquin Forest Authority's income statement does not show a huge profit. In the 1998/99 operating year, net income was $297,889, on sales revenues of $16,910,605. Expenses included logging and distribution costs, Crown timber stumpage charges, road maintenance, operations planning, Algonquin Forest Authority staff salaries, and administration.

The Algonquin Forest Authority has been self-sufficient since 1978, recovering expenses through the sale of products to client mills. The Algonquin Forest Authority has continued to be profitable, while providing employment and forest products at market rates. However, what really makes the AFA distinct from the other case studies in this report is the fact that it has pursued a form of restoration forestry and *still* turned a profit.

It could be argued that Algonquin Park is not being managed by the AFA as an 'active' restoration operation. For example, the AFA does not have a program for promoting or re-introducing under-represented tree species, or, like Windhorse Farm, of emulating pre-logging levels of woody debris. Nevertheless, the AFA has been passively restoring the Algonquin Park forest by, for example,:

- reversing trends of past high-grading,
- increasing the proportion of high-value timber,
- promoting long-lived, more valuable species over others, and
- taking active steps to recruit deadwood.

The fact that these positive steps can be taken to increase the forest's timber value, to protect and enhance other forest values, and to provide a high level of stable, local employment, while still turning a profit, is highly encouraging for the large forest industries operating in Nova Scotia. In particular, the AFA's capacity to support both tourism and forest industry operations compatibly, profitably, and without major conflicts over land use, makes it an especially useful model for a province highly dependent on its burgeoning resource-based tourism industry.

10. Conclusion

In sum, the Algonquin Park forest operations provide an outstanding model of sustainable and economically viable forestry practices on a large scale. These practices maintain and enhance the full range of forest values, including soil and watershed protection, carbon sequestration, recreation, and the provision of wildlife habitat and other forest ecosystem services. While most case studies in this report provide excellent models for small, private woodlots and small businesses, the Algonquin experience is particularly relevant for large forest operations in Nova Scotia.

Both the large industrial operations (Stora, J.D. Irving, MacTara, Bowater, Kimberly Clark, Ledwidge Lumber, Harry Freeman & Son, and BMPC Oakhill Sawmill), and the Nova Scotia Department of Natural Resources have much to learn from the experience of the Algonquin Forest Authority – in land use management, harvest methods, community involvement in decision-making, and enhancement of forest values in Nova Scotia. Just as the Algonquin authorities faced the challenge of reversing 150 years of destructive high-grading, so the challenge in Nova Scotia will be to restore age and species diversity and the value of a growing stock that has been badly depleted and degraded by a long history of high-grading, clearcutting, and overharvesting.

After only 25 years of careful and responsible management, Algonquin Park is already producing higher-grade lumber, while continuing to enhance the value of the park's standing timber. Even more significant is the example of the park in providing stable and sustainable logging and timber employment for local communities, while at the same time strengthening the forest's tourism and recreational values.

The Algonquin model, above all, demonstrates the power of an active partnership between environmental, community, and forestry interests that can work for the benefit of present *and* future generations. The active citizen and community input into the AFA management processes is itself an outstanding model of governance whose relevance extends beyond the forestry sector.

Nova Scotia does not have to "reinvent the wheel". The viable working models both of Algonquin Park and of the other case studies in this report provide tried and tested paths for Nova Scotia. The pioneers at Algonquin Park and elsewhere have learned from their own mistakes, so that Nova Scotia and other jurisdictions do not have to repeat them, but can benefit from the challenges already met and overcome. The AFA and other pioneers can now pass on their experience to provide a smoother path for Nova Scotians and others. GPI Atlantic strongly recommends the Algonquin model for the consideration both of the Nova Scotia Department of Natural Resources and of large industry in the province.

CHAPTER SIX: FINEWOOD FLOORING AND LUMBER LTD., CAPE BRETON.

A CASE STUDY IN VALUE-ADDED

1. Introduction

In l978 on Cape Breton Island, the hearts of yellow birch and sugar maple were being used to make mine chucks for the local coal industry. The heart or center of the tree is the strongest and therefore most stable part of the tree – a significant factor, since it was used to hold up the roofs of mine shafts. This was done by piling the 4" to 8" square pieces from floor to ceiling to hold up the roof as the mineshaft was extended. The removal of the heartwood from the cut timber left crescent shaped slabs which were then flat sawn into 1" to 2" boards.

These sideboards were stored in local lumberyards, exposed to weather. Flat stacking degrades hardwood board immediately, so the boards, no matter how good they were, ended up being sold to make pallets or lobster traps. Both are low-grade products (C. Christiano pers. comm. 2001).

Peter Christiano, a Cape Breton woodworker employed at a local hardwood mill at the time, recognized these hardwood sideboards as an under-appreciated, yet valuable, by-product of the mine chuck markets. He began taking them home to use on his renovation projects.

Christiano soon realised that the fresh green sideboards had to be dried before one could add value to then. Encouraged by the interest of other local woodworkers in his discovery, he and his wife, Candace, decided to build a lumber drying kiln, to produce 300,000 board feet of dried graded lumber per year. Because government at the time had no interest in supporting fledgling hardwood industries, Finewood Flooring and Lumber Ltd. was built with private financing in l982.

To make the enterprise economically viable, the Christianos realised they had to make a finished product. By l984 they were manufacturing hardwood flooring, and by l985 they had entered into the trim and molding markets.

In l997 Finewood Flooring incorporated and sold 15% of its business to its agent in Europe. The Christianos retained ownership of the remaining 85% (C. Christiano pers. comm. 2001). Finewood Flooring and Lumber Ltd. is currently the highest value-added wood product business on Cape Breton Island, Nova Scotia.

2. Profile and Products

B.A. Fraser Lumber Ltd., a 40-year-old business in the Margaree Valley of Cape Breton Island, is Finewood Flooring's primary (95%) source of raw wood (C. Christiano pers. comm. 2001).

In addition to the flooring, Finewood has expanded its line of products to include dimension stock and plank flooring for export markets, wainscoting, baseboards, window and door casings, and stair treads and risers.

Finewood now operates two molders and two dehumidification kilns (with the capacity to dry one million board feet of lumber/year). It also has climate-controlled storage with a total capacity of 140,000 board feet. Another kiln will be added in 2001.

Currently 60% of Finewood sales are exported and 40% are domestic (C. Christiano pers. comm. 2001). Of this 40%, half is sold out of Finewood's Cape Breton plant and showroom, and the other half is sold through its distributor, Highland Forest Products in Halifax/Dartmouth. The 60% overseas portion is sold through its agent in Europe with the product going to Italy, Germany, Austria, and France.

Finewood Flooring is a private company with overseas shareholders and so, information about its revenues remains confidential. However, according to Candace, it has experienced 20 –30% growth over the last three years (C. Christiano pers. comm. 2001).

3. Value-Added Production

In forests that are in need of restoration, one of the principle goals of sustainable forest use is to reduce the quantity of timber harvested without reducing value and employment. The goal should be to add value per unit of biomass harvested so that we get the maximum value from each cubic metre of wood harvested.

Since l984, the focus at Finewood Flooring has been to get the most value from every piece of wood that comes into the plant. Through manufacturing, Finewood Flooring adds 10 times more value per unit of wood than the local pulp mill owned by Stora Enso. For example, pulp and paper revenues are approximately $118/m^3 of wood, compared to Finewood's finished products, which fetch an average of CDN $1,200/m^3 on the domestic market and CDN $1,600/ m^3 on the foreign market (C. Christiano pers. comm. 2001).

In addition, 40% of Finewood's finished products are sold in Nova Scotia, doubling their value in local spin-off employment for the labour-intensive work of laying and finishing floors. Local sales produce far greater spin-off value and more jobs in the provincial economy per unit of biomass harvested than exports of raw product, lumber, and pulp and paper. And more jobs and higher skilled jobs, are created per unit of wood in value-added processing than in less intensive-

intensive areas such as logging and chip mills. (See Part II, Chapter 8 for more discussion of employment in the forest industry).

As noted in Table 27 in the previous Chapter, Nova Scotia has one of the lowest rates of forest sector value-added production in the country. The Finewood model is, therefore, particularly relevant to Nova Scotia, as a potential path to restoring the value of the province's forests without reducing the contribution of the forest sector both to employment and to GDP.

As noted in Chapter 1, Dr. Bill Freedman of Dalhousie University, has recommended a 50% reduction in Nova Scotia harvest levels, and Jim Drescher argues that a reduction of this dimension can double forest sector employment through a shift to ecoforestry methods. As a reduction in harvest levels will be an essential component of any restoration effort in Nova Scotia, the promotion and support of value-added wood products industries can play a vital role in protecting employment and economic opportunity in the forest sector.

The fact that Finewood Flooring could achieve solid and steady growth, export expansion, profitability, and investment in new equipment on a base of private rather than government financing, is particularly encouraging to business and government, and makes the model worthy of study.

4. Employment

> "*How much fiber you need to employ one person full-time should be the question we ask, not how many people you employ*."
>
> Peter Christiano

For every 1000 cubic metres of wood processed, Finewood Flooring directly employs approximately 10 people full-time, whereas the pulp and paper industry supports only 1.4 jobs for every 1000 m^3 of wood processed. The employment/volume ratio for Finewood was calculated using the firm's year 2000 production and employment numbers, which show that15 people were employed and 1,519 m^3 of wood were used.

U.S. statistics further confirm that support for value-added industry can reduce harvest levels while increasing employment and contributing to the economy through more direct employment per cubic metre of wood. Table 28 demonstrates that more jobs, and higher skilled jobs, are created per unit of wood when value-added processing is developed in the economy (Abramowitz and Mattoon 1999).[38]

This "volume to value shift" has been recognized by some companies as a key to higher profits through producing higher value products rather than through increasing the volume of wood cut or processed.

[38] This table appears in volume 1 of these GPI Forest Accounts for Nova Scotia as Table 12.1 (Wilson 2001).

In the long run, forest workers and forest-dependent communities also gain from this shift, because jobs are more secure when the forest is sustained through lower harvests, and when value-added industries produce a steady local demand for wood. As noted in Chapter 5, a higher proportion of value-added industries, which experience less price fluctuations than commodity markets, can add stability and security of employment to the logging industry on which value-added products ultimately depend.

Table 28. U.S. Employment Created by Various Timber Products

Process	Additional Jobs Created
Logs to lumber	3 jobs per million board feet
Lumber to components (e.g., furniture parts)	Another 20 jobs per million board feet
Components to high-end consumer goods (e.g., furniture)	Another 80 jobs per million board feet

Source: State of the World 1999, Worldwatch Institute

5. Challenges

In 19 years of operation, Finewood has been faced with a number of recurring challenges that demonstrate the need for a fundamental reorientation of provincial forest policy.

While Part II of this report will deal with general challenges to sustainable forestry in Nova Scotia, this Section addresses some specific, key challenges faced by Finewood Flooring in its 20-year history.

1) Green wood supply and Nova Scotia's "addiction to softwood"

Fifty-five percent of the crown land in Nova Scotia is leased to Stora Enso, a Swedish-owned multinational corporation.[39] Most of this land is located in eastern Nova Scotia, where Stora Enso also operates a pulp mill. Because of this pre-existing and renewable 50-year license agreement between the province and Stora Enso, Finewood Flooring has not been able to lease a sufficiently large tract of land to manage on a sustainable basis for hardwood sawlogs.

Recently, however, there has been positive movement toward gaining access to hardwood on Crown land in the seven eastern counties. Stora Enso and the NSDNR are now expressing an interest in seeing hardwoods used more effectively, and Stora Enso is also currently in the process of gaining certification for its woodlands. At this point, all of the company's decisions are confidential and sensitive, but there appears to be a greater propensity towards accommodation of Finewood's needs than previously (P. Christiano pers. comm. 2001).

[39] Percentage derived from information provided by Dan Eidt, Crown Lands Forester with the NSDNR, May l998 and May 2000.

However, there are also troubling signs for future hardwood supply. Finewood anticipates that current harvest practices in the area, driven by the requirements of the local pulp mill, will further diminish the available forest area that could potentially be suitable for its own products (Wilson 2001). According to Candace Christiano, subsidies for silvicultural treatments conducive to pulp wood production have encouraged small woodlot owners to convert healthy mixed forests to softwood pulp stands. She notes that "where the [silviculture] money goes is at the whim of the softwood producers."

There is, therefore, a pressing need for equitable silviculture incentives that will allow woodlot owners to manage forests selectively for shade-tolerant hardwoods. Such supports would help cover initial stand improvement cuts that often require leaving low quality wood on the ground (See Part II, Chapter 10 for a discussion of the new forest sustainability regulations and their schedule of silviculture credits).

Candace Christiano says that silviculture subsidies over the last 20 years have supported the conversion of mixed and hardwood woodlands to softwood, because money was available to harvest these mixed stands and to replant the land with softwood trees. Paradoxically, the slashing of federal silvicultural subsidies has renewed interest in hardwood.

There has been no improvement, however, in cutting practices on private lands, says Candace. Contractors have little experience or expertise in carrying out selection harvests, she says, and they routinely continue to apply the "take the best, leave the rest," philosophy.

> "*This province is addicted to softwood. It even acts like a softwood junkie. It takes hardwood land, clearcuts it, and then replants to softwood, and pays incentives to landowners to plant softwood …. The province is so narrowly focused on softwood it's hard and excruciatingly painful to even get an audience regarding hardwood.*"
>
> Candace Christiano

According to the NSDNR Registry of Buyers for l999, approximately 88% (approx. 5.4 million m^3) of wood harvested in the province was softwood species.

2) Small value-added production excluded from many forms of support

Getting the most value from every piece of wood that comes into the Finewood plant has been the focus of its value-added business since l984. In contrast to the conventional focus on increasing harvest volumes and mechanizing processing to increase output, Finewood has shifted the focus to getting the most value and employment from the least amount of wood fiber.

As a result, the Christianos say they do not qualify for many government supported programs that favour larger scale operations. Many existing policies, they say, favour large operations that export unfinished or semi-finished products (C. Christiano pers. comm. 2001). Instead, the Christianos point to New Brunswick as a model for what Nova Scotia could be doing to encourage value-added production. In that province, Crown land allocations are based on usage/employment provided within the province.

According to Candace Christiano, how something is defined, can determine the structure of government incentives and supports:

> *"Value-added is a loaded term. The GPI must address the social, aesthetic and environmental value of a tree standing in the forest before anyone can calculate a value-added economic factor*."
>
> Candace Christiano

3) The need for high yield and high quality production

In value-added production, attention must be paid to the most efficient use of the available resource. For example, the wood coming from the Fraser hardwood mill to Finewood is of varying widths and species. In order to get the highest quality wood at a reasonable cost, Finewood has to purchase what the mill produces, which means developing products from boards of varying grades, qualities and species. The Christianos had to meet this challenge from the start, as the yield ratio in a manufacturing facility is a 'make or break' factor.

To this end, Finewood has managed to develop markets for low to high grades of wood, thus utilizing as much wood as possible and minimizing waste. Continual grading of colour specifications throughout the plant allows Finewood to cull out the high-value specifications, thus gaining the most value from the wood.

4) Accessing Financing

The challenge of accessing financing and venture capital is not unique to Finewood. It is shared by many small business ventures. However the following factors contribute to the hesitation of many bankers to back small, high-value, sustainable forestry ventures:

- Adherence to the "bigger is better" model, which biases investments in favour of large corporate ventures with high production numbers and revenues.
- Short-term profits are given more weight than long-term investment in the forests, which ultimately increase the value of the forests but do not yield quick returns.
- Lending institutions have little concern over adding to the forest's inventory, improving the long-term productive capacity of the forests, or enhancing the forest's ability to provide ecological services.
- These institutions generally lack familiarity with the multiple uses and multiple values of a forest ecosystem.

Because conventional market mechanisms function inefficiently when they exclude environmental and social values, full cost accounting mechanisms like the GPI are essential to ensure that value-added operations like Finewood Flooring have the means to survive and flourish.

CHAPTER SEVEN: OTHER NOTABLE CASE STUDIES

The aforementioned case studies were selected to represent a wide range of forest sizes, locations and forest types. Four of the six case studies also focus on sustainable forestry practices currently taking place within Nova Scotia itself, that can serve as working models for other Nova Scotian woodlot owners and for a viable and strong forest products industry far into the future.

During the course of this research, the authors stumbled upon many other remarkable cases where a new and inspiring vision of forestry is being adopted and practiced. Time constraints made it impossible to look at these cases in depth. However, they are touched on briefly below and can all be used as shining examples of sustainable forest practices in action. All of them show a path forward for forestry in Nova Scotia.

[The Wildwood and Wreck Cove examples below are from Aaron Schneider's report, *Selection Management of Private Woodlands in Nova Scotia: A Steward's Guide, l998*].

Wildwood, Vancouver Island: 45 years of selection management

In 1936, Merv Wilkinson bought 55 ha of forestland near Ladysmith, British Columbia. After being tutored by a Danish professor of forestry, he decided that forestry should never produce destruction. In l938, Wilkinson's timber cruise showed a volume of 1,500,000 board feet (8,475 m^3). By l990, Wilkinson had made nine cuts at roughly five-year intervals, totaling a volume of 1,670,000 board feet.

But in harvesting his forest, Wilkinson had not depleted the forest; - its original volume remained. In addition, he had preserved the forest's age class, distribution, and species mix. The forest never stopped functioning (or looking like) a forest. The forest continued to perform its full range of functions and to protect the full range of forest values, including soil and watershed protection, climate regulation, and protection of wildlife habitat, even while it supplied ample quantities of wood for human use.

Wreck Cove, Cape Breton Island

In l996 Danny Robinson, of St. Ann's Silviculture, secured an agreement to do a selection harvest in three uneven-aged stands of shade-tolerant hardwoods owned by the Nova Scotia Power Corporation. He wanted to demonstrate that a selection harvest was practical and economically viable both in the short and long-term, and that the selection harvest would produce high quality timber while maintaining the forest's health and improving its potential for future quality and growth.

Standing Forest Horselogging, Annapolis Valley, Nova Scotia

[Taken from "Can Horse Logging Pay?" by K.M. Redcliffe (Rural Delivery, Jan/Feb 2001)]

In l998, Lance Bishop, with a Master's degree in forest biology to his credit, returned to Long Beach on the North Mountain in the Annapolis Valley. He bought his first horse in February l999, built her a barn out of logs he pulled himself, and now operates Standing Forest Horselogging, which employs two people. He has managed to stay in the black. Bishop does not practice any clearcutting, but restricts his logging to selection harvesting, which he calls both an art and a science.

[The following two examples are from *The Business of Sustainable Forestry: Case Studies,* Sustainable Forestry Working Group, John D. and Catherine T. MacArthur Foundation, Chicago, Illinois, l998.]

The Brent Tract: A Perpetual Forest of Douglas Fir, Oregon

The Brent Tract, l71 acres of farm and forestland located in Oregon's Williamette Valley, is covered with 40-80 year old stands of high quality Douglas Fir. The owners favour selective thinning and natural regenerations over clearcutting. Since l985 the conservative forest management methods at the Brent Tract have generated over $47,000 of net stumpage income. Although there have been no recent appraisals of timber or land value, the total current property value is estimated to be more than $1.5 million (standing timber $1,085,000; bare land $171,000; location value $250,000).

The Freeman Farm: Stewardship in Action

Since l971, George Freeman and his wife Joan have managed 639 acres of highly productive Pennsylvania forest comprised of mixed hardwoods, and white and red pine. Although some clearcutting had been used in the past, new selection cutting techniques such as crop tree harvests, which retain the better growing stock on the site, are now implemented to regenerate oaks and black cherry, while also maintaining the property's beauty.

During harvests, care is taken to minimize erosion and sedimentation, and to protect water resources and trees that provide habitat for wildlife. The farm's non-timber and uses include recreation and education for the public, which comes to see sustainable forestry in action.

In sum, there is clearly no shortage of additional case studies that demonstrate a sustainable and viable way forward for Nova Scotia forests and for the province's forest products industries. All the cases clearly demonstrate the urgent need for enlightened government leadership, and for public policy initiatives that provide the necessary incentives for social investments that will restore the value of the province's degraded forests for the benefit of future generations of Nova Scotians. It is equally essential that such public policy initiatives penalize practices that currently degrade forest values further, and thereby deplete the province's natural wealth at the expense of future generations.

PART II

IMPLICATIONS OF CASE STUDIES FOR FOREST POLICY

CHAPTER EIGHT: FOREST TIMBER VALUES

1. Canopy-Grown vs. Open-Grown Wood

> *"Forest management decisions taken today can have a dramatic impact on future log and wood quality attributes, and subsequently on end-use potential and end-product quality and value"* (Zhang and Gingras 1999).

Research indicates that there is a significant difference in quality between wood from open-grown conditions and wood from closed canopy conditions. Open-grown conditions are characteristic of the regeneration that follows clearcutting, while closed canopy conditions are characteristic of uneven-aged management using selection harvesting. Market prices indicate that these differences in quality affect economic value.

According to a paper published by Zhang and Gingras (1999) in *Canadian Forest Industries,* logs obtained from intensively managed stands differ from those of the natural forest in many ways: taper, knottiness, annual ring characteristics, wood density, wood defects, juvenile wood content, fiber morphology, mechanical properties, and chemical composition.

The relative importance of these wood characteristics depends greatly upon the specific end use that is intended. For example, log diameter, log straightness, taper, knottiness, dimensional stability, mechanical properties, and aesthetic characteristics are of primary importance to solid wood products. On the other hand, fiber morphology and chemical composition are of critical importance to pulp and paper products.

For lumber manufacturers, log diameter is an important characteristic, with yield increasing significantly with increasing log size (Zhang and Gingras 1999). Larger diameter logs, also mitigate the negative effects of knots, which are one of the most common causes of visual downgrade. Knots can also have a detrimental effect on lumber's mechanical properties. Knottiness is directly related to 'branchiness,' which is a common characteristic of trees grown in open conditions after clearcuts. Due to the light they receive in the more open environment, the lower branches do not die, and they therefore tend to have larger, looser knots.

Furthermore, it has been shown that thinning results in stems with higher proportions of knots (Zhang and Gingras 1999). According to Zhang and Gingras, it would be logical to favour pruning over thinning to maintain log quality standards. As noted in Chapter 3, Jeremy Frith devotes 55% of labour hours on his woodlot just to pruning.

Lumber with a high percentage of juvenile wood is often associated with decreased strength and poor dimensional stability. One of the most oft-cited criticisms of lumber quality by building contractors today is warping:

> "*With increasing proportions of juvenile wood in sawlogs, warping caused by the higher microfibril angle becomes a quality concern. More frequent occurrence of warping in*

studwood is one of the major reasons some builders are switching to steel studs" (Zhang and Gingras 1999).

As primary (old-growth) and secondary forests are being harvested, many areas are being converted to a managed resource, which calls for shorter rotations. Thus, increasingly, logs contain a significantly higher percentage of juvenile wood, with its attendant problems for the construction industry, and for the strength of homes and buildings.

In addition to lumber manufacturers, both the plywood and oriented strand board industries prefer large and straight logs with little taper. As rotation age increases, as is characteristic of selection-harvested uneven-aged stands, the grade and strength of lumber also increases.

Plywood made from higher density wood is stronger and stiffer. According to Zhang and Gingras (1999), the faster growth associated with intensive forest management usually leads to a reduction in wood density, that means poorer mechanical properties for plywood and lumber, and lower pulping yields.

In very practical terms, this analysis demonstrates the flaws of an accounting system that establishes value by quantitative criteria alone, and that implies that 'more' is always 'better.' That flawed assumption is fundamental to all attempts to equate wellbeing, prosperity, and progress with economic growth. Indeed, the decline in forest value and in the quality of timber harvested is masked in these accounts by sending ever greater *quantities* of timber to market, and by counting the depletion of the standing forest resource wealth as economic gain.

By contrast, the Genuine Progress Index recognizes that value is also determined by *quality*, that forests must be valued as natural capital assets, and that the health of those assets determines the value of the products and services they provide. This is in accord with the findings of Zhang and Gingras that the management of the standing resource directly affects end-product wood quality and the market value of forest products.

As the following Section shows, our forests, and the value of the timber they produce, are literally worth more when they are managed and harvested sustainably, *even* when the full range of ecological and social functions performed by forests is not explicitly valued.

2. Wood Quality and Market Value

For some building contractors in Nova Scotia, finding good quality construction lumber has become a source of great frustration. Bruce Pelton and John O'Brien of Peltons Construction report that 20 years ago, they could trust a local building supply company to deliver wood directly to their construction site. Today, however, they never do that, as most of the lumber delivered is of such poor quality – too knotty, warped, improperly dried, or with too much bark (Pelton and O'Brien pers. comm. 2001).

Nowadays, they go to the building supply store themselves, and individually select each piece of lumber. According to Pelton, the extra time it takes to do this is passed on as an extra cost to the customer, and can account for 10% of the total cost of a project. Ironically, conventional accounting mechanisms like the GDP count those higher costs and higher levels of consumer spending as contributions to economic growth, even though the supposed growth is actually fuelled by declining quality.

As their own costs increase, the contractors report that they are losing customers, some of whom are more inclined to do the work themselves than pay a builder. O'Brien says that since he has been in the business (starting in 1988), he estimates the quality of wood has declined by approximately 30%. O'Brien and Pelton say that they will sometimes pay 50-100% more for good quality spruce and pine.

The quality of wood is generally reflected in the market price of different types of lumber. Large dimension white pine and spruce lumber are worth considerably more per cubic metre than narrow gauge and thin lumber (Tables 29 and 30). Among the retailers interviewed, large dimension white pine fetched 18-41% more per volume than small dimension white pine. Large dimension spruce fetched 67-186% more per volume than small dimension spruce.

According to one sawmill employee, clear spruce is hard to access in large quantities because less than 5% of a spruce tree is generally clear. Therefore, in order to accumulate enough clear board to sell, a sawmill has to be able to access large diameter trees over a long period of time.[40]

Clearly the observations of Zhang and Gingras (Section 1 above) on the impact of forest management decisions on wood quality are also reflected in today's market prices.

Interestingly, there appears to be little concern either in the forest industry or in the policy arena for the quality considerations of end users like builders, for the decline in large dimension wood, or for the loss of value that this decline signifies. According to Ken Snow, of the Nova Scotia Department of Natural Resources:

> *"[The forest inventories for Nova Scotia] indicate that the abundance of saw log material has declined. It should be realised that modern technology has developed to improve the utilization of smaller diameter saw logs. So, while there has been a decline in larger diameter logs the sawmill industry has been able to adapt."*[41]

Wood in the 11.5 to 13 inch range can regularly be found in older stands, and in woodlots like Windhorse Farm, that have been logged on a selection basis over several rotations.

Clear wood is currently worth two to three times the value of knotty wood. Table 31 illustrates the price advantage wood retailers have in being able to sell clear white pine. It should be noted that clear spruce was often unavailable or "hard to come by" and so is not included in the table. Where prices were available from merchants, clear board red spruce commanded three to 4.5 times the price of knotty red spruce -- $1.70 to $2.70/board foot for clear red spruce compared to $0.60/board foot for knotty red spruce.

[40] Information obtained from a conversation with an employee of Hefler Forest Products in Lower Sackville, January 2001.
[41] Review comment on the GPI Forest Accounts received 23 October, 2001.

The price contrasts in Tables 29 to 31 demonstrate that a move from short rotation clearcuts towards selection harvesting and canopy-grown wood can substantially increase the unit value of Nova Scotia timber, and thereby increase the market value of the province's timber resources. The price differences also provide an indication of the potential dollar value of returns on investments in restoration forestry, and they help to explain the rationale of woodlot owners like Jeremy Frith (Chapter 3), who regards his investment as more valuable than an RRSP.

Table 29. Examples of Retail Prices for Varying Dimension White Pine (Jan. 2001 prices)

Wood retailers	2x4 pine (linear foot)	2x6 pine (linear foot)	2x8 pine (linear foot)	2x12 pine (linear foot)	Percentage price advantage 2x12 vs. 2x4*
Barrett Lumber	.79	1.19	1.59	2.80	18%
Beaver Lumber	.94	1.35	1.77	3.99	41%
Piercey's	.99	1.39	1.69	3.99	34%
Millet	.47	.70	.94	1.70	21%
Collicuts	.56	.90	1.13	------	-----

Note: *Price advantages were calculated after adjusting prices for volume, so that identical volumes are the basis for comparison. The price advantage is the margin between the larger and smaller dimension wood after adjusting for volume, expressed as a percentage of the smaller dimension price.

Source: Information (during telephone conversations) from sales employees of Barrett Lumber Co., Pierceys, Beaver Lumber, Millet, Collicuts, January, 2001

Table 30. Examples of Retail Prices for Varying Dimension Spruce (Jan. 2001 prices)

Wood Retailers	2x4 spruce (linear foot)	2x6 spruce (linear foot)	2x8 spruce (linear foot)	2x12 spruce (linear foot)	Percentage price advantage 2x12 vs. 2x4*
Barrett Lumber	.31	.50	.70	1.90	104%
Beaver Lumber	.37	.60	.86	2.14	93%
Pierceys	.28	.47	.84	2.40	186%
Millet	.30	.48	.67	1.50	67%
Collicuts	.38	.61	.82	-----	-----

Note: *Price advantages were calculated after adjusting price for volume, so that identical volumes are being compared. The price advantage is the margin between the larger and smaller dimension wood after adjusting for volume, expressed as a percentage of the smaller dimension price.

Source: Information (during a telephone conversation) from sales employees of Barrett Lumber, Beaver Lumber, Pierceys, Millet, and Collicuts, January, 2001

Table 31. Examples of Retail Prices for Clear vs. Knotty White Pine (Jan. 2001 prices)

Wood retailers	White pine KNOTTY per board foot ($)	White pine CLEAR per board foot ($)	Increased value of clear per board foot ($)	Percentage price advantage clear vs. knotty
Barrett Lumber Co.	1.04	3.43	+2.39	230%
Hefler Forest Products	1.42	3.73	+2.31	163%
Payzant Building Products	1.55	3.70	+2.15	139%
Pierceys	1.79	4.79	+3.00	168%
Beaver Lumber	2.10	4.99	+2.89	138%
Millet	.85	1.10	+0.25	29%
Collicuts	.85	2.00	+1.15	135%

Note: The price advantage is the margin between the clear and knotty wood price (the increased value) expressed as a percentage of the knotty wood price.

Source: Information (during telephone conversations) from sales employees of Barrett Lumber Co., Hefler Forest Products, Payzant Building Products, Pierceys, Beaver Lumber, Millet, and Collicuts, January, 2001

Viewed from another angle, the market price difference between what most small dimension, knotty wood fetches today, compared to what the same volume of higher quality timber would be worth if it had been harvested sustainably over several generations, is a proxy measure for the depreciation in value of Nova Scotia's forested assets. An admittedly crude estimate in Volume 1 of these accounts assesses that lost value at $1.8 billion annually. Further analysis is required to arrive at a more accurate estimate.

At this early stage in the development of natural resource accounts, it is enough to note that the price differences in Tables 8.1-8.3 above demonstrate that the Nova Scotia economy today is paying a significant price in lost revenues due to the long-term degradation of the province's forests. Sadly, the conventional economic accounts have masked this substantial economic loss by mistakenly counting the continued liquidation of the province's natural wealth and capital as economic gain.

In addition to the increased value of clear and large dimension lumber, those selling wood that has been FSC certified (i.e. Pictou Landing and Menominee Tribal Enterprises) are in many cases able to sell their wood at a premium. Buyers are increasingly concerned about supporting sustainable forest practices, and several major retailers have announced their intention to buy FSC-certified wood. This trend will further increase the value of sustainably harvested timber, and encourage enlightened public policy initiatives that protect and restore the province's natural wealth more effectively than in the past.

Beyond simple price advantages, the variety of timber products from a well-managed multi-aged, multi-species forest provides a measure of stability and protection against the commodity price fluctuations to which an even-aged single-species forest is far more vulnerable.

This analysis does not imply that timber values should be the only or even primary consideration in forest management. The GPI Forest Accounts as a whole clearly demonstrate that forest values are determined by a wide range of non-market considerations as well as timber supply. However, the evidence also shows that forest practices that protect the full range of ecological and social values of the forest, and which allow the forest to perform all its natural functions, in turn enhance timber values.

In short, there is no conflict between ecology and economy. Managing and harvesting our forested resources ecologically, so that they can effectively provide vital ecosystem services, also promotes high quality timber productivity and enhances the economic value of the resource.

3. Employment

> *"I spent all my working life basically unemploying people...installing equipment that would provide an economic return and displace some people. The thrust of our whole industry has been to do that."*
>
> Ike Barber, President of Slocan Forest Products (Globe and Mail, July 18, l997)

In Canada, 1,600 communities depend on forest industry jobs. In 337 of them, forest industries account for more than 50% of the employment (World Resources Institute 2000, p. 72). Clearly, the sustainability of forests and forest-dependent regions are intertwined, and forest policy and practices have social implications that directly impact the well-being and sustainability of communities.

It has already been noted that selection harvest techniques, that extract a steady supply of wood on a periodic basis in perpetuity, can provide stable local employment and contribute to the resilience of forest-dependent communities. By contrast, clearcutting rarely provides steady logging employment for local communities, and may create serious unemployment where the resource has been harvested and will not return for 50 years or more. Highly mechanized harvesting relies largely on contractors who frequently travel long distances to the next clearcut.

In Nova Scotia the total number employed in the logging industry has remained relatively unchanged over the past 40 years at the same time that there have been massive increases in clearcutting. The provincial forest area clearcut has doubled since the early l980s, with the most dramatic increases in both area and volume harvested occurring between l992 and l997. In just six years, the forest area clearcut doubled from approximately 35,000 ha in l992 to almost 70,000 ha in l997 (Wilson 2001, Chapter 8). Actual volumes harvested have also increased dramatically from 3.3 million m^3 in the early l980s to 6.5 million m^3 in 2000.

These trends appear to be due to several factors, including:

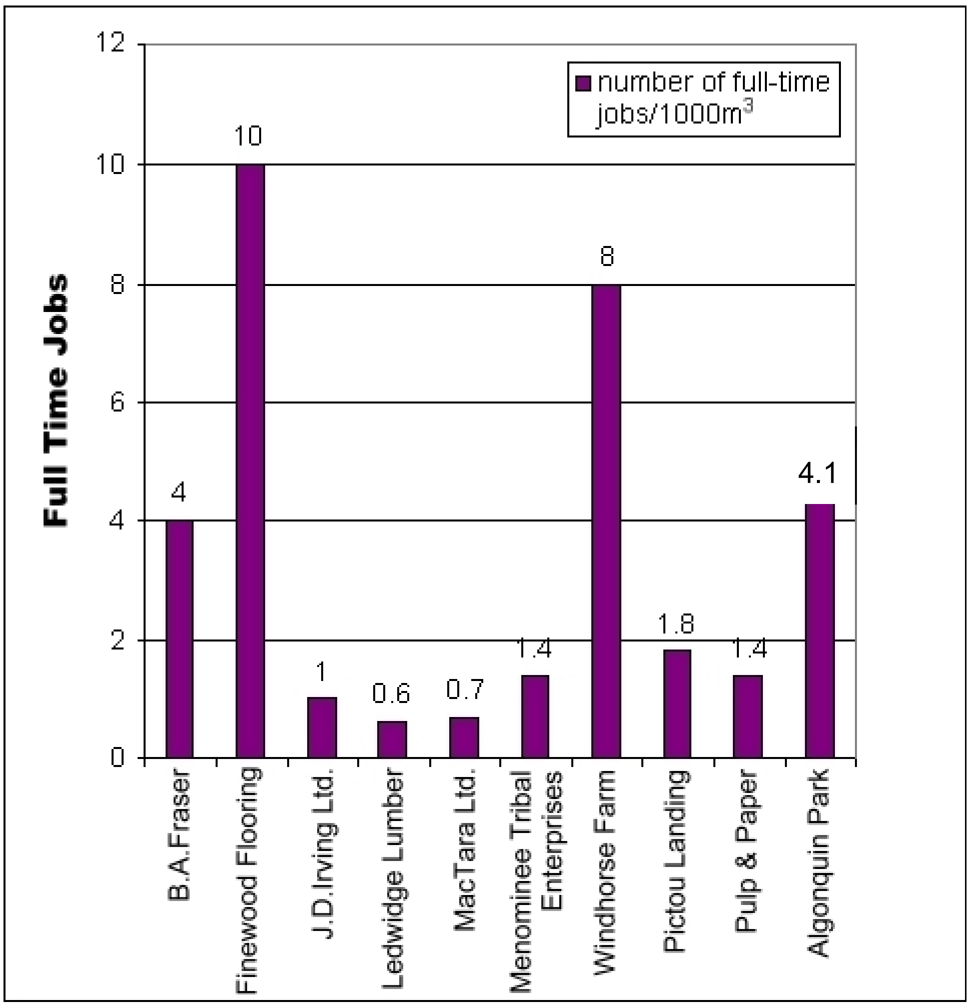
- An increase in mechanization (see Chapter 9) and automation in both harvesting and processing;
- Investment in modern, state-of-the-art, sawmill technology;
- A decline in high-value sawlog species;

- Global market and trading patterns, including the exemption of the Atlantic provinces from restrictive trade agreements between Canada and the U.S.

The shift to highly mechanized industrial forestry has not only increased production while decreasing employment, but has also lead to the massive liquidation of many of the province's natural capital assets. By contrast, the mark of sustainability in the GPI natural resource accounts, is the capacity to live off the interest generated by these assets, while retaining and protecting the value of the capital stocks for future generations.

As Figure 17 demonstrates, the rate of employment per unit of biomass harvested is considerably higher where selection harvesting and value-added industry are the norms than in the highly mechanized industrial forestry operations that currently dominate the industry. The ratios demonstrate that it is possible to reduce harvest volumes substantially in order to protect a declining resource, while increasing forest industry employment.

Figure 17. Estimates of full-time jobs for 1000 m^3 wood



Sources: Christiano, 2000, 2001; Drescher, 2001; Keith, l998; MacLellan, l998; Pecore, 2001; Hitz, 2001; NSDNR, 2000c.

In calculating the estimated jobs/m^3 ratios in Figure 17, it was at times difficult to obtain values for employment and annual production or acquisition. Some of the challenges are discussed below, along with an explanation of how the values were derived. As employment per unit of biomass harvested is a key social indicator of sustainability, GPI Atlantic strongly recommends that the province collect and produce these data in the future. For the present, these are the best estimates that GPI Atlantic is able to derive, given the severe data limitations described below:

J.D Irving Ltd.: Mary Keith, J.D Irving's communications director, declined to answer any questions pertaining to this report. Therefore the authors were unable to obtain either current employment figures for the Weymouth sawmill, or estimates of the proportion of wood harvested by J.D. Irving that is destined solely for its Weymouth mill (JDI also owns Sproule Lumber near Truro). However in a faxed letter to Linda Pannozzo dated February 3, l998, Keith stated that the Weymouth sawmill directly employed 326 people.

The estimated volume of cubic metres of wood cut by J.D Irving in Nova Scotia is, therefore, based on an average derived from the NSDNR Registry of Buyers for l999 (NSDNR 2000c). In the Registry, J.D Irving is listed among a total of six sawmill businesses that each acquired over 150,000 m^3 of wood per year. This category is the highest category in the Registry, but neither production numbers specific to each sawmill business nor the highest wood acquisition amounts per mill are included.

Peter MacQuarrie is the Director of the Renewable Resources Branch of the NSDNR. When asked what the highest acquisition was, he replied, "could be infinity, I guess." According to MacQuarrie (2001c), the reason for the category being open-ended is "so as not to inadvertently reveal the top producer." He suggested using the total production in that category (1,955,594 m^3) and then dividing by six to estimate an average production for each of the six mills (325,932 m^3). That average is used here as a proxy for J.D. Irving's total production. GPI Atlantic would welcome a public disclosure by J.D Irving that can improve the accuracy of the estimate in Figure 17.

MacTara Ltd.: MacTara's Vice President of Operations, Allan Reese, also declined to answer any questions. MacTara is also among the top six sawmills in NS acquiring more than 150,001m^3 of wood annually. As such, the averaged value (stated above) from the NSDNR Registry was used. In an interview conducted in l998 with Linda Pannozzo, MacTara's Timber Manager, John MacLellan, stated that MacTara employs 220 people full-time. GPI Atlantic would welcome a public disclosure by MacTara Ltd that can improve the accuracy of the estimate in Figure 17.

Based on these averages, MacTara and Ledwidge Lumber each create less than one full-time job for every 1000 cubic metres of wood acquired, while J.D Irving creates one full-time employee.

Figure 17 shows the Menominee creating 1.4 jobs per 1000m^3 of wood harvested, but this is an underestimate because MTE total employment numbers do not take include those employed off-reserve in the pulp industry. Nevertheless, the Menominee recognize their low job creation ratio as a major deficiency, which they are trying to remedy by adding more value-added manufacturing to their wood product enterprises (see Chapter 4). The particularly high proportion of jobs per unit of wood harvested at Finewood Flooring and Lumber Ltd. indicates the significant job creation potential of value-added enterprises.

The Menominee recognize that further processing, involving human effort, tools, and machines, not only creates more jobs, but also increases the market value of raw logs. Processing fine-furniture, for example, which requires many steps, adds more value to each unit of wood harvested, creating a greater potential for jobs and other economic spin-offs.

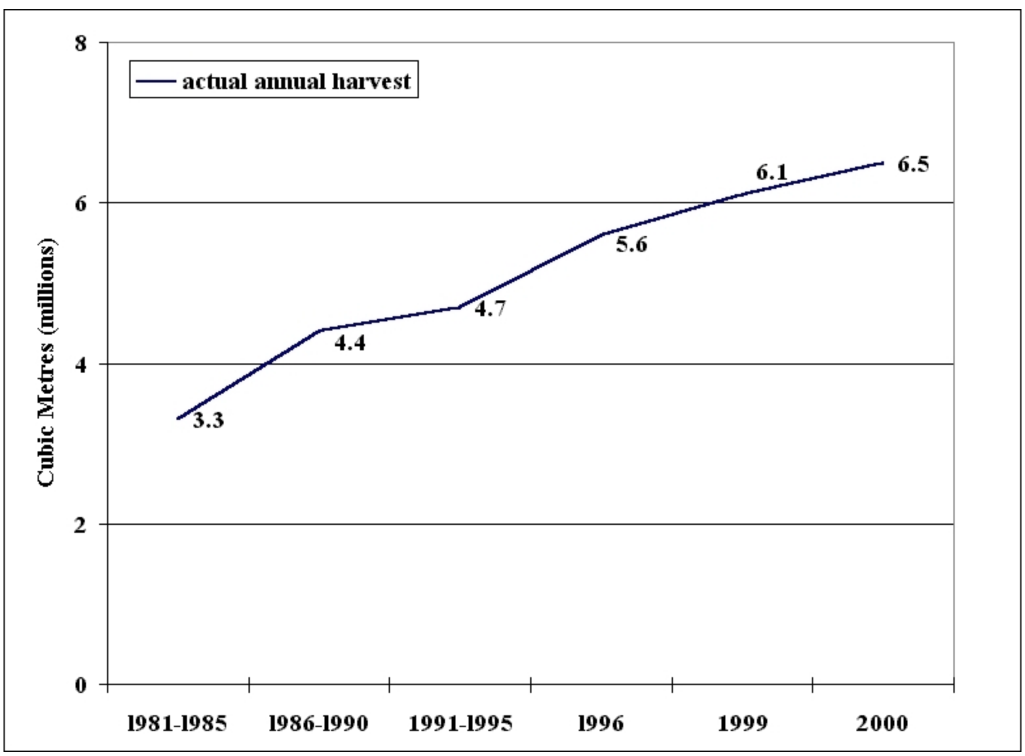
GPI Atlantic encourages Nova Scotia's large industrial processors to acknowledge and correct the current deficiency in job creation per unit of biomass harvested, as the Menominee are now doing, and thereby to enhance the social sustainability of the industry.

> *"The value-added industry is small relative to the Canadian lumber and panel products industries but it generates substantially more employment per unit of wood and per dollar of sales than does primary production (i.e. logging)"*
>
> (Ministry of Northern Development and Mines l992).

Over the last two decades, as noted, the volume of wood harvested from Nova Scotia's forests has doubled from an average of 3.3 million cubic metres to 6.5 million cubic metres (Figure 18). At the same time, the total number of people employed directly by the forest industries in the province has remained relatively unchanged. This indicates that the ratio of the number of jobs per unit of biomass harvested has declined by 50% in the last 20 years.

Given the degraded state of the province's forests and the urgent need for forest restoration, a reversal of this trend would be a sign of genuine progress in the GPI.

Figure 18. Trends in actual annual harvest in Nova Scotia (crown and private land)



Source: NSDNR 2000c; NSDNR l997; NSDNR 2001b.

3.1 Challenges in Assessing Accurate Forest Industry Employment Statistics

Assessing accurate overall employment numbers for the forest sector in Nova Scotia has been a major challenge. Figures vary substantially depending on what is included under the category of the forest sector.

One l997 study conducted by St. Francis Xavier University professor Ian Spencer for the Wood Products Association of Nova Scotia estimated that as many as 13,000 people may have been directly employed by the forest industry in l996, although he acknowledges that this is an upper range estimate. In the report, Spencer writes "conventional wisdom puts forest sector employment at 7,500 to 8,500 jobs. My draft estimates suggest the figure could be as high as 13,000."
Spencer's higher estimate could be partially due to the fact that in almost every instance he added 10% to the numbers, in order to account for "under-reporting." Under the category of forest sector, Spencer includes Christmas trees, maple syrup, logging, forestry services, paper and allied products, trucking, government and industry association employees, and construction jobs from capital expansion expenditures (Spencer l997).

A study conducted by the Atlantic Provinces Economic Council (APEC 2000), and funded by the Nova Scotia Forest Products Association, also estimated 13,000 direct jobs in l998 – 4,200 in logging and forest support services, 4,100 in the wood products industry (which includes sawmills), and 4,600 in paper and allied products. [42]

In addition APEC estimated 9,000 indirect or spin-off jobs. However, upon further analysis of the APEC report, and after conversations with report co-author Patrick Brannon, GPI Atlantic researchers discovered that 3,363 of those jobs had been counted twice,[43] once in the direct employment statistics and again in the indirect employment numbers (acknowledged in P. Brannon pers. comm. 2001). The remaining spin-off jobs are mainly in retail/wholesale, transportation, business, financial services, and personal services.

While APEC numbers for direct employment are based on Statistics Canada's Labour Force Survey, other Statistics Canada data provide conflicting information. Statistics Canada's *Survey of Employment, Payroll and Hours,* cited in Volume 1 of this report, shows forest industry employment fluctuating between 7,500 and 9,000 in the late 1990s (Wilson 2001). This source shows average employment in the 1980s as 7,401 persons, and in the 1990s as 7,618. In this source, the year of highest total forestry employment is 2000, in which 8,956 are shown as employed.

---

[42] APEC direct employment numbers were based on the Statistics Canada Labour Force Survey (P. Brannon, pers. community. 2001).

[43] APEC's double counting of the indirect employment numbers would have spin-off effects in other calculations made in the report. For instance, indirect employment numbers were used to make calculations for the wages and salaries attributable (directly and indirectly) to forest products in l998. Also, indirect employment numbers were used to calculate amounts paid out in income tax and sales taxes. Prior to publication, GPI Atlantic was awaiting confirmation from APEC on which calculations would have been affected by the double-counting, but a response was not received in time for publication.

According to Statistics Canada's *Manufacturers Survey* (1960-1997), direct forest industry employment has remained fairly steady over the past four decades, but is less now than the number employed in the 1970s and the mid to late 1980s. The latest year in this time series indicates that 6,075 were directly employed in 1997.

The provincial government also supplies employment data to the National Forestry Database. In 2000, these numbers changed without explanation, without any of the trend lines that had appeared before 2000, and without providing any reason for the differences between the much lower earlier numbers and the much higher later numbers.

The 2000 Nova Scotia Statistical Review cites forestry and logging employment as 3,600, but this does not include related manufacturing employment, which is not broken down by industry in this source.[44]

This wide range of conflicting numbers may be an artifact of recent changes in the industrial classification system used by Statistics Canada. However, GPI Atlantic has not succeeded in determining which categories of forest industry employment are included in the new North American Industry Classification System (NAICS) that are not included in the earlier Standard Industrial Classification System (SIC).

The conflicting evidence may also be due to differences in the definition of forest industry employment, and to the inclusiveness of those definitions. For example, Christmas tree plantations are sometimes regarded as part of the agriculture sector and sometimes as part of the forestry sector. Since 1996, Christmas tree income has been included by Statistics Canada in its *Agriculture Economic Statistics*,[45] but employment in this sector is counted by Spencer as part of the forestry sector. Similarly government employees dealing with forestry issues may be listed as "public administration" employees, as in the Nova Scotia Statistical Review, or as part of the forest industry sector, as Spencer (above) does.

Another significant source of confusion in the forestry employment statistics is the apparent over-reporting of forestry employment as a full time occupation. The average number of weeks worked in a year by many silviculture workers, tree planters and others may be very low. At the same time, contractors with heavy machinery may be putting in extremely long hours. In order to make forestry employment figures comparable to other industries, it would be more helpful to express employment as actual person years of employment within the sector.

Based on the frequency with which the 13,000 estimate is now being used in Nova Scotia, that figure is also used in this Section for the number directly employed in the forest industry. At the same time, it must be acknowledged that the accuracy of this figure is difficult to verify, and that it is about 60-70% higher than some other estimates, including those that appeared until recently in the National Forestry Database.

[44] This source is available at: http://www.gov.ns.ca/finance/publish/statsrev/sr2000.pdf
[45] Statistics Canada, catalogue no. 21-603-UPE.

3.2 Employment Per Unit of Biomass Harvested

From the GPI perspective, the most important consideration is to relate total employment numbers to the health of the resource. Given the need to restore the health of Nova Scotia's degraded forests, to reduce the overharvesting of the 1990s, and to recognize both social and environmental realities, a key indicator of genuine progress and sustainability in the GPI is to increase employment per unit of biomass harvested. Unfortunately, the data indicate the tendency of increased mechanization, such as use of feller bunchers, to reduce employment per unit of biomass harvested

Based on a direct employment estimate of 13,000 and the amount of wood harvested in l999 (6.1 million m^3), two jobs are being created for every 1000m^3 of wood harvested. In the l980s, when less wood was being harvested, this estimate would have been closer to four jobs. Using the lower employment estimates from Statistics Canada's *Survey of Employment, Payroll and Hours,* cited in Volume 1 of these accounts, the number of jobs per 1,000m^3 was an average of 1.9 jobs in the 1980s and 1.4 jobs in the 1990s.[46] Whichever figures or time frame are used, the ratio of jobs per unit of biomass harvested in this province is clearly decreasing.

It should be noted here that the ratios of jobs per unit of biomass for Nova Scotia and for the Menominee Tribal Enterprises cannot be accurately compared, because the MTE total employment numbers do not take into account those employed off-reserve in the pulp industry.

The potential to sustain or even increase current employment levels through a switch to sustainable harvesting systems can be demonstrated by comparing the Nova Scotia figures given above to the employment per unit of biomass ratio for Windhorse Farm. Figure 17 shows that Windhorse Farm employs 8 people for every 1000 m^3 of wood harvested.

According to Dr. Bill Freedman of Dalhousie University, sustainable management of Nova Scotia's forests would require a 50% reduction in harvest levels (Chapter 1, Section 7.) If the total wood harvested in l999 were reduced by 50%, then 3,200,000 m^3 of timber would be harvested annually. Using the Windhorse Farm model, and assuming active restoration programs aimed at bringing the forests back to their original condition, this amount of harvested wood could employ 25,600 people at a ratio of 8 persons per 1000m^3 of wood harvested. This means, as Jim Drescher estimates (Chapter 1), that a shift to sustainable forest management could nearly double the number of people currently employed, on half the volume of wood.

Table 32 illustrates that a substantial increase in employment is possible when raw wood is processed for use in value-added industry rather than used primarily for pulp and paper manufacturing, as is currently the case in Nova Scotia (see Chapter 5, Section 9.5).

Through shifts both to sustainable forest management and to greater value-added manufacturing, it is quite clear that a reduction in harvesting need not threaten jobs. On the contrary, enlightened investment in forest restoration, selection harvesting, and value-added wood industries will

[46] Calculations are based on the average employment figures cited by Statistics Canada Survey of Employment Payroll and Hours of 7,401 jobs in the 1980s and 7,618 jobs in the l990s. Harvest levels used in the calculations were also based on averages of 3.8 million cubic metres in the l980s and 5.5 million cubic metres in the l990s.

produce considerably more jobs than current industrial forestry practices, while better protecting and enhancing the value of the forest resource and the province's natural wealth.

Finally, it must be repeated that integrated, well-developed, secondary and tertiary manufacturing sectors create far more stable economies than one based on the production of commodities alone, which faces global competition and cyclical fluctuations in prices.

Table 32. The Job Creation Potential of Value-Added Wood Industries: Full-Time Jobs Theoretically Created with Set Volume of Wood.

Industry/Activity	Theoretical number of jobs per $1000m^3$ wood
New oriented strand board mills	1.8
Pulp/paper mills	2.4
Older particle/wafer board mills	7.2
Logging operations **	37
Quality doors	233
House kits/log homes	256
Cedar canoes	3,874
Fine guitars	95,238

Note: ** Employment figures for logging operations are taken from Statistics Canada, Selected Forestry Statistics, l992, and include everything from feller-buncher operators to truck drivers, chainsaw operators and tree planters.

Source: Wildlands League, 1997.

CHAPTER NINE: MECHANIZATION & THE HIDDEN COSTS OF LARGE-SCALE HARVESTING

1. Mechanization

> *"The fundamental problem [with the industrial model] is that it is costly and large scale. It is therefore beyond the reach of small rural communities and so will be run inevitably for the benefit not of the local people but of absentee investors. And because of its cost and size, a large wood products factory establishes in the local forest an enormous appetite for trees."*
>
> -Wendell Berry

The mandate of a corporation is to provide maximum profit to its owners or shareholders. It can be argued that this is not deleterious in and of itself, so long as accurate accounting also reflects the value and state of the capital assets on which those profits and future service flows depend, and so long as real social and environmental costs are internalized.

However, when the owners and shareholders are not members of the local community where the business resides, and when they do not carry the full costs of the operation, then, as Berry explains,

> *"labour and materials must be procured as cheaply as possible, and real human and ecological costs must be externalized and charged to taxpayers or to the future [generations]"* (Berry 2000).

This contrast points to another key advantage in social sustainability demonstrated by the case studies in this report. All of them– Windhorse Farm, Jeremy Frith, Finewood Flooring, Pictou Landing, Algonquin Park, and the Menominee Tribal Enterprises – are locally or publicly owned or controlled by members of the community.

This enhances accountability, and it ensures that costs and benefits are accounted for locally, and thus internalized to a greater degree. For example if harvest practices cause sedimentation in local streams and destroy fish habitat, or if they eliminate jobs, local owners may suffer the consequences personally, and can more easily be held accountable for costs incurred within their own community.

In Nova Scotia, the volume of timber cut per employee has doubled since the early l980s. This is in large part due to an increase in mechanization, which has enabled the maximum extraction of wood products, and hence profits, in the shortest period of time. This may be desirable for a lumber company whose eye is on short-term profit margins.

However, from the viewpoint of a resource-dependent community, this increased efficiency and extraction rate is not an improvement, especially if it fails to translate into more jobs, depletes the resource on which those jobs depend, and thereby undermines the prospects of future generations. Sustainability from a community perspective depends primarily on long-term employment prospects that depend in turn on the health of the natural capital on which those jobs rely.

The forest industry has come a long way from the two-man cross-cut saw and oxen of the l870s, and this analysis does not suggest turning back the clock on technological advances. However, it *is* worth reflecting on the state of the resource in an earlier era, and on how we may apply our technological ingenuity intelligently so that it does not destroy the resource, but allows it to provide services to human society in perpetuity.

In the 1800s, John Muir counted the rings of a grizzly sequoia and found that the tree had "swayed in the Sierra winds when Christ walked the earth." The trees were so mammoth that the process of felling one of them would take five men three weeks. The stump of one felled sequoia was said to be so gargantuan that it could be made into a dance floor, easily accommodating some 32 persons (Schama l995, p. 189).

While Nova Scotia's Acadian forest did not grow to the age and size of the California sequoias, its eastern hemlocks could grow to 800 years, its white pines to 450, and its sugar maples and red spruce to 400. Few trees of this age and dimension remain in the Nova Scotia forests, and the rapid 22-fold (95.5%) decline in the over-80 age class in the last 40 years alone is partly attributable to the mechanization of harvest methods.

Today, one tree harvester can do the job of six or seven men (I. Spencer pers. comm. l998), even according to some of the most conservative estimates. Others have said the mechanical harvester replaces as many as 13-15 men (J. Drescher pers. comm. 2001). Whatever the number, mechanization in the forest industry has come with considerable costs, not only to the health and sustainability of the forests themselves, but to the health and sustainability of communities, and to the jobs of individual members of those communities.

As logging has become more capital intensive, and as trees are becoming smaller in size, pressure has increased to log more trees faster. In Eastern Canada, the average size of trees is so small today that high production levels cannot be easily sustained unless most other considerations, especially ecological and long-term ones, are compromised (W. Prest pers. comm. 2001a).

The reliance on heavy machinery to fell large numbers of trees with greater rapidity has proved a mixed blessing for its owners, and has often undermined their livelihood security in a different way from that of the workers displaced by the mechanical harvesters. For an operator in the logging business today, machinery costs extend well into the million-dollar range (Table 33).

As fewer people are cutting more trees, the remaining operators have incurred higher and higher debt loads to pay for their machines, travel long distances to successive clearcuts, and work longer hours to make payments on their debt. As Table 33 shows, costs are so high that mechanization is not necessarily a lucrative enterprise for those who have retained their jobs by investing in the standard machinery.

Table 33. Machinery Costs for Large-Scale Harvesting

Logging/Hauling Machinery	Estimated Cost ($) Range
Tractor-trailer	220,000
Feller buncher (small, medium and large)	430,000, 475,000, 500,000
Single grip harvester	400,000-600,000
Forwarder (off-highway truck)	240,000-500,000
Welder	4,500
spare parts	30,000
Cumulative costs	**964,500 – 1,854,500**

Source: Buntain, 2001; Matheson, 2001; Wade Prest, 2001.

In addition to the high capital costs for machinery, ranging from $1 to $1.8 million, there are other operating costs, including fuel, commuting costs, and ongoing maintenance and repair of the machinery.

In fuel expenses alone, it costs approximately $2,700/week to run a harvester and a forwarder for 100 hours.[47] Maintenance of the tractor could cost at least $10,000 /year and the trailer would need about $5,000 of maintenance every three years (G. Matheson pers. comm. 2001).

> *"Take three-quarter of a million and add interest and two men to run each piece plus yourself - you're going to ask yourself why is anyone in the logging business these days."*
>
> -Jim Buntain, Wilson Equipment

Sandy Hankynson is in the logging business near Weymouth, in southwestern Nova Scotia. He and his father and brother own two single-grip harvesters and one forwarder, and they cut wood for the J.D. Irving sawmill in Weymouth. They have invested $1.5 million in the equipment, and the pressure to cut night and day is real. In one week, Hankynson works more than 80 hours. "We cut at night to pay for the machines," he says. "It takes 100 operating hours [a week] to pay for these. We only stop for breakdown" (S. Hankynson pers. comm. l998). At that rate, Hankynson says, one single - grip harvester can cut 500 cords of wood in a week. And at that rate, he says, he's "surviving."

In other words, the economics of large-scale, highly mechanized industrial forestry creates its own pressures both on the resource and on those who try to make a living within ever tighter financial constraints, let alone on those whose jobs the machinery has displaced.

Buntain, at Wilson Equipment, meets many in the logging business. He says getting into the logging business these days is just "buying yourself a seven day a week job." He says someone who can put 20% down on a harvester and forwarder is looking at monthly payments of $16,000

[47] Information obtained from Jim Buntain, Sales Manager of the Forestry Division at Wilson Equipment, Truro, Jan. 2001. Fuel figure is based on running only harvester and forwarder 100 hours per week using diesel fuel at a rate of 36 liters per hour at a cost of $0.75/litre.

not including the payments on other equipment (J. Buntain pers. comm. 2001). Financing for a tractor/trailer combination, for instance, could cost an additional $3,500/month (G. Matheson pers. comm. 2001).

> *"You can't make a living on one harvester and one forwarder. You have to have more than that, but that comes with extra bills and more employees… The fellas are telling me they're making a wage. They may have $1.5-2 million tied up but they're not getting much return on their investment*"
>
> (J. Buntain pers. comm. 2001).

Woods machinery depreciates in value very quickly. After ten years a trailer is generally worth only $3,000-4,000 (approximately 6% of its original market value). Tractors are only worth about 10% of their original value after 10 years.

According to Wade Prest (2001c), a forester and woodlot owner, it is very difficult for a logger in the industry today to maintain his independence and be relatively free of debt, unless he owns or manages a fair acreage himself. Otherwise, the large mills will dictate price and equipment. This is partly because most operators find it very hard to access the woodland necessary to make their investment in logging equipment worthwhile.

As a result, most operators enter into arrangements with large mills, which dictate which equipment to purchase, provide the operators with land to cut, and then pay them a rate for wood that is as close as possible to the contractor's break even point. Rates are based on 80-100 hours of equipment operation per week. These arrangements, of course, reduce the cost of wood for the mills.

Again, none of this is an argument against the appropriate use of technology in forest management and harvesting. But, according to Jeremy Frith, woodlot owners in the Maritimes are very restricted by the limited availability of appropriate and affordable machinery for intensive management. He says that machinery commonly available in Europe for spacing, thinning, merchantable thinning, and selection harvesting is simply not found here.

Furthermore, integrated and accessible sort-yards would allow woodlot owners to sell smaller quantities of pulpwood (Stora only purchases loads in multiples of 18 cords), as well as to optimize their returns on more valuable logs. In short, the current market structure is geared to the needs of industrial forestry and its dependence on heavy machinery, rather than to selection harvest techniques on smaller woodlots.

Market infrastructure supports for appropriate technology diffusion, and for sales and distribution, are therefore vital tools for government officials interested in promoting a shift to sustainable forest practices. As other woodlot owners follow the example of Pictou Landing and attain Forest Stewardship Council certification, marketing assistance will be important to ensure that premium prices are obtained. The difficulties faced by the Menominee in this regard (Chapter 4) point to an important role that the business advisory services of ACOA might play to ensure that maximum value is obtained from certified and sustainably harvested wood.

With clearcutting and mechanization, the age class structure of Nova Scotia's forests has shifted to younger and younger trees. Furthermore, increasingly younger stands are being cut. Effective from 1946-1965, the Small Tree Act in Nova Scotia prohibited the cutting of spruce, pine, and hemlock trees less than 10" in diameter (Johnson 1986)[48]. Today, mills have modified their equipment to accept trees as small as 5-7.5 cm (2-3") in diameter (Whynot pers. comm. 2001).

As trees get smaller and smaller, they become increasingly inefficient to handle with a chainsaw. Thus mechanization of forest work promotes further mechanization.

Woodlot owners interested in exploring less capital-intensive harvesting methods find it increasingly difficult to hire skilled and willing chain saw operators (Prest 2001c). Woods work has a poor image in society, and chainsaw work has never been particularly well paid, says Wade Prest. Chainsaw operators also have to deal with a host of poor working conditions, including flies, rain, snow, and extreme temperatures. Given the right conditions, however, Prest argues that a highly skilled chainsaw operator could potentially make a better living than a machine operator, and incur little or no debt, but a good quality forest is a prerequisite (Prest 2001c.)

Aside from the monetary stresses outlined above, there are also hidden costs to the chronic indebtedness and extremely long work hours experienced by many logging contractors today. These conditions impact on workers' quality of life, mental stress levels, and ultimately their health and the health of those near them. Livelihood security, health, debt reduction, and free time are key socio-economic components of the Genuine Progress Index. The available evidence does not indicate that current industrial forest practices are contributing to genuine progress in any of these dimensions.

In sum, the impact of current forest practices and mechanization is felt beyond their more obvious negative effects on basic forest resource values and employment. The adverse impact of these trends for a number of other key socio-economic dimensions of the Genuine Progress Index is testimony to the interconnectedness of social, economic and environmental realities. The good news is that a shift to the ecologically-based forestry practices outlined in this report has the potential not only to enhance the value of Nova Scotia's natural wealth, but also to make a positive contribution to the quality of life of Nova Scotians across a number of socio-economic dimensions.

2. Transportation Costs

There are additional costs to large-scale harvesting which should be explored in greater detail in future work, but which could not be included here due to time constraints. These include:

- Costs of commuting to distant work sites, compared with working within a local community that harvests sustainably over the long-term;

[48] In the beginning, the Small Tree Act applied only to Crown land and private properties of 1,000 acres or more. An amendment in 1946 applied the act to any operation of 100,000 board feet or more on all lands in any year. A later amendment applied the act to any operation of 50,000 board feet or 100 cords or more in any year (Johnson 1986, p.245).

- Costs of transporting logs long distances from forests to mills, compared to on-site processing.
- Costs of road damage and soil compaction from logging trucks and heavy equipment, compared to the careful road construction and management described in these case studies.

While much work still needs to be done to assess the full costs of transportation associated with current forest practices, GPI Atlantic has done some preliminary work towards a full-cost accounting of the passenger transportation costs associated with one vehicle kilometre in Nova Scotia (Table 34).[49] Some of the externalized (social) costs of transportation add up to roughly 5.7 cents per vehicle kilometre travelled, or nearly $1.4 billion when all driving in the province is counted. This amounts to $57,000 for every kilometre of public roadway in Nova Scotia.[50] Needless to say, this estimate does not include internal (user paid) costs like car payments, repairs, and fuel costs.

Table 34. Some Externalized Transportation Costs in Nova Scotia (l997 $millions)

GHG emissions	$178.9
Toxic emissions	$63.0
Accidents	$481.0
Well contamination	$0.5
Land Use	$41.0
Congestion	$228.0
Public services	$386.0
Total cost	$1,378.4
Length of roads	24,000 km
Cost per vehicle km travelled	$0.057/v.km

Source: Vanessa Hussain 2001.

It is not possible at this stage to draw conclusions regarding the full costs of transportation incurred as a result of heavy equipment use of Nova Scotia roads by forest industry vehicles. However, taxpayers do pay the costs of road damage caused by heavy trucks through repair and maintenance expenditures of the NS Department of Transportation and Public Works. These costs are well documented:

1) An exhaustive four-volume Royal Commission study on transportation in Canada used load equivalency ratios to calculate that one 10,000 kg truck axle does 160,000 times as much damage to a flexible pavement as a car axle load of 500 kg (Royal Commission 1991).

[49] The cost per "vehicle kilometre" refers to the cost of driving one kilometre
[50] The total length of roads refers to all paved and dirt roads maintained by the Department of Transportation and Public Works. This does not include all private roads in the province, including logging roads owned by private lumber companies.

2) Litman's comprehensive *Transportation Cost Analysis* concludes that heavy loads are the most significant single factor in producing road wear and damage, with a heavy truck imposing maintenance costs hundreds of times greater than a car (Litman 1997).

3) The Brookings Institute's *Road Works* analysis reports that the equivalence factor for an axle rises very steeply with its load, roughly as its third power. Thus, for example, the rear axle of a typical 13-ton van causes over 1,000 times as much structural damage as that of a car. If illegally loaded to 19 tons, it would cause at least 3,000 times as much damage. Earlier tests by the American Association of State Highway Officials determined that road wear increases by approximately the fourth power of vehicle axle weight (Small et. al. 1989).

4) A Norwegian study for the European Federation for Transport and Environment assembled calculations from several countries and concluded that trucks and other heavy traffic account for 60% of wear on roads, and 30-40% of total maintenance costs (Oftedal 1993).

5) Both Sweden and the United Kingdom have a "user pay" road tax that attributes a portion of road maintenance expenditures directly to heavy trucks. In addition, the U.K. puts 15% of the cost of new road investments directly on heavy vehicles, with the remaining 85% allocated according to road space used, so that trucks and other heavy vehicles bear about 27% of total capital costs (Kageson 1993).

In sum, the long-distance transportation of logs by heavy trucks to distant mills that are a feature of current industrial forestry practices, carry a considerable hidden social cost. In addition, logging contractors move heavy equipment to distant clearcut sites, and processed forest products are again moved long distances from mills to distant export markets, usually in the U.S. Like the other external costs detailed in Table 34, and like the costs of soil compaction due to heavy machinery, these road damage costs are invisible in conventional accounting mechanisms that assess forestry sector contributions to the economy. GPI full-cost accounting analyses do consider these costs.

By contrast to the dependence of industrial forestry on heavy vehicle, long-distance transportation, several sustainable forest operations described in this report consciously minimize transportation costs by processing on-site or as close to the harvest site as possible. Windhorse Farm and the Menominee have their own mill; Pictou Landing has experimented with a portable mill; Algonquin Park sends its timber to mills within 50 km of the park perimeter; and Finewood Flooring buys 95% of its raw wood locally from B.A. Fraser in the Margaree Valley. At Windhorse Farm, 90-95% of wood products are sold to customers within a 15-25 km radius.

In the absence of data on actual vehicle kilometres travelled annually in Nova Scotia by heavy trucks transporting forest products, it is not possible at this stage to give a dollar estimate of the hidden costs of transportation attributable to the forestry sector. GPI Atlantic urges that these data be collected and publicly released, so that this estimate can be given in future updates of this report.

However, one recent investigation into the costs of upgrading a rural road to allow access for logging equipment sheds some light on the extent to which taxpayers are footing the bill for some of the hidden transportation costs in the forest sector. This small case study also highlights the need for further investigation of this topic.

In order to create access to a parcel of privately owned forestland five kilometres down a disused but publicly owned dirt road near Seal Island Bridge, Cape Breton, the NS Department of Transportation and Public Works repaired two bridges, and widened several kilometres of road. Reconstruction of these bridges involved the use of 14 main beams, worth $2,500 each, as well as an additional $17,000 in materials and equipment (O'Brien 2001a). Road widening was estimated at an additional $10,000, bringing the total cost of repairing the bridges and road to roughly $62,000 (O'Brien 2001a).

After road access was secured, the property was clearcut in the spring and summer of 2001, yielding a total of 400 cords harvested from the site (O'Brien 2001b). At most, Stora would have paid $120 per cord, bringing the value of the wood to $48,000. In fact, had Stora had to pay the full cost of the wood, including the cost of road and bridge repairs to provide road access to the property, the company would have had to pay $275/cord. In effect, taxpayers subsidized the cost of the wood for Stora at $155/cord. This does not include the other ecological, social and economic costs of clearcutting described in these forest accounts.

In conclusion, it is recommended that future updates of this report investigate the hidden costs of logging roads and damage to public roads, in order to assess more accurately the extent to which taxpayers subsidize the extraction and processing of wood from Nova Scotia forests. The extent to which they do so, reduces operating costs and increases profits for the forest industry in Nova Scotia.

The costs and benefits of forest restoration in the case studies described in this report need to be evaluated against an accurate accounting of the full ecological, social and economic costs and benefits of current industrial forest practices. Conventional accounting practices tend to detail only the gross revenues of extracted timber and total employment in the timber industry, while concealing substantial ecological, social and economic costs, and without accounting for the full range of forest values.

The full-cost accounting mechanisms of the Genuine Progress Index can provide a much more accurate and comprehensive means of assessing forest restoration benefits and costs against the true economics of current forest practices. As this Chapter demonstrates, those economics must include an assessment of social impacts, as well as the impact of forest management and harvesting practices on the value of forests as natural capital assets.

CHAPTER TEN: POLICY OPTIONS TO ADVANCE SUSTAINABILITY

1. Tax Reform: Incentives for Sustainability

"There's no incentive not to do what I'm doing... I'm no better than anyone else. I smash and crash and I cut a bunch of wood and when we're done' it's history. We look behind us and it'll be a hundred years before anything will come back there and I know there's a better way to do it."

Independent logger (Moffat l999, p. 23)

There are approximately 425,500 woodlot owners in Canada who, collectively, own 6% of the nation's land base. In Nova Scotia, private landowners hold approximately 70% of the land base. Of that, individuals with small land holdings (less than 400 ha) own 52% and industry owns the rest.

According to the Nova Scotia Department of Natural Resources, private woodlots are being over-harvested. Between l981-85 and l991-95, the amount of timber harvested in Nova Scotia increased from an average of 3,444,000 m^3 between 1981-1985, to 4,754,000 m^3 between 1991-1995 (Canadian Council of Forest Ministers 2001). Most of this occurred on small private woodlots (NSDNR l997 p. 1-7).

In a 1997 position paper, the NSDNR stated:

"Overharvesting is a potentially serious problem demanding immediate attention…softwood harvests have exceeded the sustainable supply… [I]ncreasing demand for forest products is leading to the harvesting of immature stands that should form part of the future wood supply."

While half the land base is owned by the Crown and by large industrial operators, the wood from small private woodlots accounts for the majority of what ends up at sawmills and pulp mills (Table 35). There are likely many reasons for this, but one of the commonly cited problems is:

"*that the Canadian income tax system inadvertently favours liquidation harvesting over more sustainable harvest methods such as selection harvesting approaches*"
(Lunergan l997, p. 693).

According to a report issued by the National Round Table on the Environment and the Economy, government has contributed to overharvesting by creating a federal tax system that operates as a powerful disincentive to sustainability:

"*Ironically, it is sometimes possible to obtain a greater tax benefit by prematurely clearcutting a woodlot than by managing it sustainably"* (NRTEE l997, p. 28).

Table 35. Industry's Reliance on Wood from Private Woodlots

Company	Percent of wood from private woodlot owners
Bowater Mersey	75
Kimberly Clark	Undisclosed
J.D Irving	60
Stora Enso	70
MacTara	50

Sources: Keith, l998; Porter, l997; Waycott, l997; McGregor, l997; MacLellan, l997.

According to Peter de Marsh, president of the Canadian Federation of Woodlot Owners, the Canadian government should be endeavoring to encourage sustainability wherever possible, and it can begin to do so by restructuring the current tax system. When a woodlot is passed from one generation to another it is currently subject to estate taxes. This can be a major financial burden to those inheriting the property, often leading either to liquidation of the woodlot or to sale of the land in order to pay the taxes (deMarsh 2001b).

In the current income tax system, when people die, they are deemed to have 'disposed' of their property. Capital gains taxes are calculated based on the fair market value of the property at the time of death minus the fair market value of the property at the time of acquisition (Lunergan 2000). Given that many landowners have owned their properties for many decades, the increase in value of the property (or the capital gain) can be very significant. The taxable capital gain is based on 3/4 of this total difference in value, and is added as income in the deceased owner's final tax return (Lunergan 2000).

If the property is sold, there is cash from the sale to pay these taxes. However, if the property is passed on to children or grandchildren, and the only source of cash is the woodlot, then the heirs to the property have to come up with the money to pay the taxes. This often leads to these heirs clearcutting the property, because "the need for cash overrides good forestry practices" (Lunergan 2000).

In some cases, knowledge that the estate taxes will pose a burden on the inheritors of their estate causes people to clearcut their property in anticipation of their death, thus reducing the land value and hence the taxes. "A lot of bad harvesting has taken place by old people who don't want their kids to inherit a big tax bill," says deMarsh. This tax liability discourages long term management objectives (P. deMarsh pers. comm. 2001b). De Marsh says we cannot downplay how often this happens in the Maritimes.

> *"Government has given woodland owners few choices when it comes to passing land to their heirs. The inheritance tax rate is so prohibitive that a son or daughter often cannot afford to inherit land"* (Harlow 2000).

In agriculture, land is passed from one generation to the next more easily. When a farmer dies, there is a capital gains exemption of up to $500,000 on the farm (MacLaughlin 2001). Young farmers can usually take over the family farm without paying capital gains on its assessed value.

By contrast, the treatment of woodlots is very different. Managed forests are not recognized as continually productive land, but rather, as a standing crop to be cashed in at any time (Lindsay 2000). People who have invested time, energy, and expense in their woodlot are actually penalized, because their land is worth more at the time of disposition than had they clearcut it.

If the woodlot is actively "farmed", with silviculture activity happening at a steady pace (for example, a Christmas tree farm), and where trees are being 'grown' as opposed to merely harvested, it may qualify as a farm and thus be eligible for the $500,000 capital gains exemption (Lunergan 2000). In order to fit into this category, the woodlot has to be classified as a 'commercial farm woodlot,' as well as meet various other Revenue Canada requirements.

The Canadian Federation of Woodlot Owners has been lobbying the federal government to alleviate the tax burden on intergenerational transfers of woodlots. The Federation recently received a commitment from Revenue Canada to allow the deferral of capital gains taxes for commercial woodlots if the woodlot stays within the family (P. deMarsh pers. comm. 2001a). If the property is sold, the deferred capital gains taxes would come into effect. The major caveat is that, in order to qualify for the deferral, the woodlot would have to be deemed 'commercial' by Revenue Canada, and would therefore have to demonstrate a 'reasonable expectation of profit.'

The recent Revenue Canada Interpretation Bulletin IT-373R2 describes 'commercial' woodlots and what is meant by a 'reasonable expectation of profit.' A woodlot owner who has a credible Management Plan, who has received technical advice (or who personally has the technical expertise), and who has every intention of turning a profit over the long-term, would likely be considered a commercial woodlot (P. deMarsh pers. comm. 2001a).

This could apply to a woodlot owner who carries out no harvesting in his/her woodlot for ten years because that is what has been prescribed in the management plan (P. deMarsh pers. comm. 2001a). This would also include small woodlot owners like Jeremy Frith, who invests in the long-term value of his woodlot every year through trail-widening, pruning, thinning, underplanting, and crop tree release; who has a management plan; and who applies technical skills and knowledge to his management practices.

For more than a decade, the Canadian Federation of Woodlot Owners has also been lobbying Revenue Canada to allow woodlot owners to deduct expenses from other income. This would allow woodlot owners to deduct silviculture expenses as they are incurred, and, in the view of the Federation, to act as an incentive for woodlot owners to invest in good woodlot management.

The recent Tax Bulletin clarified that 'commercial' woodlot owners can deduct "recurring" expenses as incurred, such as planting, pruning, thinning, and property taxes. This follows earlier recommendations by Curtis (l992) and a joint task force report (PriceWaterhouseCoopers l998). It is also in line with the decision of the Federal Court of Appeal (Northwood Pulp and Timber Ltd. v. Her Majesty the Queen, l998) which found that silviculture costs are period costs and should not be added to the cost of inventory (P. deMarsh pers. comm. 2001b).

Thus, woodlot owners who are restoring a badly degraded forest, and who meet the criteria for a reasonable expectation of profit in Section 7 of the Revenue Canada Interpretation Bulletin IT 373R2, could potentially deduct expenses in the year they are incurred, and, in the near future, bequeath their woodlot to family members without serious financial repercussions.

At present, only 20-30% of woodlot owners in New Brunswick qualify as having commercial woodlots (deMarsh 2001a). This number is likely lower for Nova Scotia. So, for the vast majority of woodlot owners, silviculture expenses still cannot be deducted, either at the time they are incurred or when wood is sold, and capital gains taxes are still paid upon intergenerational transfer of the woodlot. Thus, for most woodlot owners in Nova Scotia, there is still no financial incentive – in income tax terms – to invest in their own woodlots, and still a strong incentive to clearcut in order to avoid the capital gains tax.

According to Wade Prest, President of the Nova Scotia Woodlot Owners and Operators Association, a woodlot owner can establish a corporation in order to claim expenses in the year they are incurred. To be considered a business, the owner must be active every year, harvesting or carrying out silviculture work. This might be feasible for larger woodlot owners, but for small-scale woodlot owners, the costs are likely a disincentive. To become incorporated, the woodlot owner would have to incur $4,000-$5,000 in legal fees, and would have to prepare annual financial statements and tax returns for an additional cost of $500-$1,000 (MacLaughlin 2001). Furthermore, incorporating does not reduce capital gains taxes, though it can make payment of the taxes more manageable for heirs (A. MacLaughlin pers. comm. 2001).

These conditions also disqualify woodlot owners who do not have the financial means for active, interventionist restoration forestry, but who intend to restore their land by leaving it alone. Just as the moratorium on cod fishing constitutes an actual investment in rebuilding the fish stocks, so Jim Drescher (Chapter 1) notes that a viable restoration forestry option is simply to wait. But that investment is not currently recognized under current regulations.

Tax reform has been a focus of concern by woodlot owner associations for many years, and government has also recognized the need for such reform for some time. The ‘Curtis Study’ (Curtis l992), published and funded by the Canadian Forest Service, and initiated by the Canadian Federation of Woodlot Owners (CFWO), made eight recommendations for tax reform to improve sustainable land use practices. They were:

- Create a specific category or status for woodlot owners, to accommodate the special needs and characteristics of those woodlot owners who are not also farmers or otherwise in a position to obtain equitable tax treatment with regard to woodlot operations.
- Allow deductions against any income for all admissible expenses incurred for the purposes of forest management, without any restriction on the amount of losses, and with provision for loss carry-forward.
- Provide that the cash-basis accounting currently available for farming and fishing be extended to woodlot management.
- Enable woodlot managers to claim a deduction for the cost of standing timber in the year of acquisition of a woodlot.
- Permit woodlot owners to elect to treat their woodlots as either income or capital properties.
- All capital gains realised upon the disposition of a managed woodlot by a woodlot owner to be eligible for the $500,000 lifetime capital gains deduction, and the mechanism of deferral of capital gains tax available for intergenerational transfers of farm property.

- Establish tax credits to make it more attractive for woodlot owners to purchase woodlots and to invest in woodlot management and related machinery and equipment.
- Create a mechanism to enable woodlot owners to shelter current income, provided that the funds are invested in forest management within a reasonable period of time.

A task force was subsequently assembled that included the Canadian Federation of Woodlot Owners, the Canadian Forest Service and Revenue Canada. The task force commissioned two reports by PriceWaterhouseCoopers in l998 and l999, which deal with the effect of tax legislation on the sustainability of the private woodlot sector. The first report, titled the *Effect of Tax Legislation in Canada on the Sustainability of the Private Woodlot Sector*, makes the following recommendations:

- Production of various crops, including timber, from woodlots should be included in the definition of farming, with the consequent tax results. Production of forest crops is not a separate business from farming.
- Woodlot owners should be included in the definition of farmer for the purposes of intergenerational transfers and capital gains deductions.
- The interpretive issues associated with *inter vivos* transfers of woodlots and transfers on death could be resolved by clarifying the legislation as follows:
  - Include a description of how the principal use of a property is determined, i.e., by physical area or otherwise.
  - Clarify that the intergenerational transfer rules and applicable property use definition can be applied to partial interest in property, as opposed to legal parcels.
  - Clarify that standing timber will be considered inventory for the purposes of the Act, and that a rollover for standing timber inventory will be provided for both types of intergenerational transfers.
- Woodlot owners should be able to deduct silviculture costs, as incurred, from other than woodlot income.
- The reasonable expectation of profit test should be clarified so as not to deny deductions for legitimate business expenses to woodlot owners.
- Some form of income averaging should be reintroduced if the optional inventory adjustment is not made available to woodlot owners.
- Woodlot owners should either be exempted from the restricted farm loss provisions or be entitled to increased loss carry forward periods, assuming that woodlot management is included in the definition of farming.

The National Roundtable on the Environment and the Economy also discusses the importance of tax reform in its l997 report on *Private Woodlot Management in the Maritimes.* Its recommendations include the following:

- Reform the federal tax system to treat private woodlot owners as small business owners. The tax should enable forest management investments such as silviculture to be an eligible expense against income. For example, if a woodlot owner has a four-hectare patch of small young trees, so thick that growth is very slow, he will be able to double the growth of those trees over the next 25 years if he invests $2,500 in thinning today. Immediate employment is also created in silviculture, which could reduce harvest

pressure. This investment would double and perhaps triple the value of the patch over a 25-year period. This expense for thinning should be an eligible expense against income.
- Permit intergenerational transfers of woodlot property and promote sustainable forest harvest practices through deferral of the capital gains tax.
- Modify the property tax regimes to reward woodlot owners for good forest management and to impose penalties on owners who allow poor forest operating practices on their land.

In l999, prior to the release of the Revenue Canada Interpretation Bulletin, PriceWaterhouse Coopers prepared another report on the draft Bulletin titled: *Comparison of "Effect of Tax Legislation in Canada on the Sustainability of the Private Woodlot Sector" and Draft Interpretation Bulletin IT-373R2, Woodlots."* The report recommended that the following changes be incorporated into the final Bulletin:

- Provide examples illustrating that woodlots will be considered as being used in a farming business during periods in which no harvesting takes place. The examples could be qualified to provide that the woodlot owner must follow the long term management plan during periods where no harvesting takes place in order for the property to be considered "used" on a regular and continuous basis.
- Maintain the original recommendation contained in the Report, that the determination of the use of a property should be applicable to a partial interest (as compared with legal parcels).
- State that the standing timber will be eligible for the capital gains deduction (when sold with the land) and for intergenerational rollovers. These rules should apply regardless of whether the timber is purchased with the land or is second growth, either planted by the woodlot owner or regenerated naturally.
- State that timber limits will be considered depreciable property of a prescribed class for the purposes of the capital gains deduction and intergenerational rollover rules.
- Remove the references in IT-373R2 to the reasonable expectation of profit test, except as they relate to the determination of personal living expenses. Woodlots should either be "commercial" woodlots, for which the general limitations on deductions described above do not apply, or personal-use property.
- Standing timber should be considered as inventory for the purpose of the optional inventory adjustment rules.

Based on the evidence in these Forest Accounts, GPI recommends the following additional changes to Revenue Canada's tax laws:

- Bulletin IT-373R2 should explicitly recognize and address restoration forestry and ways to encourage the maintenance of biodiversity in forest ecosystems (i.e. age class, species and structural diversity) to approximate the original diversity of the native forests. Restoration forestry that includes abstaining from harvests should be recognized as a legitimate management practice.
- Inheritance tax should be applicable where people have destroyed their woodlot, and should be exempt for well-managed, productive forestlands. This would reverse the previous system and create an incentive rather than disincentive for sustainable practices.

- The goal of tax reform should be to protect the *full* range of forest ecosystem values - commercial and non-commercial – for future generations, and for the benefit of the province as a whole. Protecting the collective natural wealth of the forest is a social investment that also improves timber productivity in the long-term.

  This requires a broader view and definition of investment and management than the current narrow definitions of 'commercial' woodlots, that are confined to timber production alone, and that also exclude most woodlot owners. One possibility is to replace the word 'commercial' by the term 'productive,' since a woodlot can still be highly productive if it is managed to perform a wide range of ecosystem and social functions other than timber production. In other words, a *standing* forest is productive and provides a wide range of vital services to human society. These services have an *economic* value that may exceed the current value of harvested timber.

1.1 Property Tax

In Nova Scotia, forestland that is used, or intended to be used, for "forestry purposes" is subject to a tax of $0.62/ha, provided the area does not exceed 20,243 ha.

A report on Maritime woodlots produced by the National Roundtable on the Environment and the Economy (NRTEE) recommends that tax regimes be reformed to reward woodlot owners for good forest management. Conversely, penalties should be imposed on those who allow poor operating practices.

The evidence in these forest accounts supports that finding, and GPI Atlantic therefore recommends that property taxes be adjusted to give preferential treatment to those who are sustainably managing their woodlots (including doing nothing to them). Conversely, forestlands that are liquidated should be treated as developed lands (commercial or industrial) and be taxed at a higher rate.

> "*Private woodlots in Canada's Maritime provinces face serious management problems…. [M]any argue the impacts could be swift and dramatic, challenging the very fabric of life in the region. A few liken the situation to that preceding the collapse of the Atlantic cod fishery.*"
>
> (NRTEE l997, p. 3)

1.2 Tax Credits and Dedicated Taxes

Currently, there is a 10% federal tax credit on new forestry equipment. This means that someone buying a $100,000 forwarder would be eligible for a $10,000 tax credit, 40% of which ($4,000) is refundable, and the rest of which can be put toward reducing federal tax payable. While these credits have encouraged the practice of large-scale industrial harvesting, at least the same tax benefits should be available to encourage sustainable practices. For instance, workhorses from horse logging teams do not currently qualify as forestry equipment, though they perform the same function.

Peter deMarsh, president of the Canadian Federation of Woodlot Owners, and General Manager of the New Brunswick Federation of Woodlot Owners, argues that the benefits of selection harvesting are in the domain of non-market public goods, because benefits accrue to society at large and to future generations:

"When the public is the main beneficiary of the practice, they should contribute to the costs," says deMarsh (2001b). Woodlot owners cannot be expected to bear all the costs associated with harvesting sustainably, because the depletion of the province's natural wealth will cause losses to the economy for generations. Restoration forestry, on the other hand, enhances the province's natural wealth and will produce long-term economic benefits. Healthy forests also produce immediate economic benefits to the public in the form of recreation and tourism values.

According to Wade Prest, President of the NS Woodlot Owners and Operators Association, it can cost 30% less in the short-term to clearcut a woodlot than to harvest sustainably, so that additional selection harvesting costs are borne by woodlot owners. If society wants healthy forests (which in turn provide numerous services to society, and substantial *long-term* benefits), then society should be prepared to help pay for them. Dedicated taxes (which would go back to the woodlot owners) could be one way of doing this, says deMarsh.

It is necessary to assess which tax credits or dedicated taxes might best be used as incentives to sustainability. The restoration costs described in this study, including the gap between expenditures and revenues, can provide a very useful guideline for determining the magnitude of the tax incentives required.

2. Silviculture Incentives

According to the Nova Scotia Minister of Natural Resources, "*clearcutting is a legitimate harvest technique along with selection harvest, shelterwood harvests, etc*", and "*the choice of harvest lies clearly with the landowner or manager*" (Fage 2000, cited in Wilson 2001, Section 8.1.1a).

However this statement implies that clearcutting is co-equal with other harvest methods, and does not acknowledge that 99% of harvesting in Nova Scotia is by clearcutting. The statement also does not account for the structure of the forest industry in Nova Scotia, the nature of existing forestry expertise in the province, and the bias of management practices towards clearcutting. Although there are many possible types of silviculture suited to different forest management and harvest systems, these have not been equally favoured by existing structures and tax regimes.

For 25 years, from the early 1970s to 1995, there were formal financial agreements between the federal and provincial governments to fund silviculture work on private forestland (Cameron 2001). The provincial NSDNR looked after implementation, administration, budgeting, and inspections on behalf of woodlot owners. Silviculture treatments were carried out either by silviculture contractors or by landowners themselves (Cameron 2001). Interested landowners would contact their local NSDNR office to partake in the program. The local NSDNR office would arrange for management plans and roads, and would take care of paperwork.

Silviculture treatments and harvesting techniques prescribed under the federal-provincial agreements were, almost without exception, even-aged management techniques geared towards producing, replanting, and converting forests to conifers. They included cleaning,[51] planting, herbiciding, remnant removal, merchantable thinning, weeding, site preparation, conifer release, strip cutting, clearcutting, and shelterwood cutting (Frith 2001).[52]

Landowners interested in uneven-aged management systems would have been advised to carry out even-aged management, and would have had few people to turn to for an expert opinion that recommended otherwise. The silviculture programs, as administered by the NSDNR, were not conducive to selection harvesting, and especially not to efforts to restore the forest to a semblance of its former structure, function, species assemblage, or site capability.

As noted in Chapter 3, Jeremy Frith ignored the government-funded management plan for his own woodlot in the interests of what he considered sounder and more sustainable practices that would produce greater long-term value. It is true that the ultimate "choice of harvest lies clearly with the landowner or manager," as the Minister states. But it is also true that the structures, incentives, advice, and knowledge base offered by government strongly favoured one particular management, harvest, and silviculture system. That in turn, has a powerful influence on landowner "choices."

The new Forest Sustainability Regulations that came into law in April, 2000, have shifted the responsibility of silviculture work from the NSDNR to the pulp mills and sawmills. Forest product companies now have most of the responsibilities for planning, funding, locating, and implementing most of the silviculture work on private forest lands (Cameron 2001). They have to reinvest money and resources back into private woodlands in proportion to the volume of wood taken from those lands (Cameron 2001).

Under these new regulations, companies are required to carry out a silviculture program themselves, or they can hire a private silviculture contractor to do the work for them. If they opt to do neither, they have to pay into a sustainable forestry fund administered by an independent body to see that the work gets done (Cameron 2001).

This system does not require that silviculture work be carried out on the same lands from which the volumes of wood were acquired. It does allow landowners to do silviculture work themselves and to get reimbursed by one of the 'registered buyers' (i.e. one of the sawmills or pulp mills buying wood from private woodlots) (Atlantic Forestry Review 2001).
The registered buyer has to acquire silviculture 'credits' in lieu of paying into the sustainable forestry fund. The number of credits acquired is proportional to the volume of wood taken off private land. A schedule of silviculture treatments and the credits earned is published in the Forest Sustainability Regulations (Table 36). While most of the treatments that earn credits under this system are even-aged management scenarios, for the first time in Nova Scotia's history, there are also opportunities for the funding of selection and crop tree management techniques.

[51] Cleaning involves removing non-commercial species, which, in Frith's case, meant removing intolerant hardwoods to create pure stands of even-aged balsam fir. This was prescribed despite the fact that, as this stand matured, it would very predictably become an excellent food source for spruce budworm.
[52] Shelterwood harvesting, as it is prescribed in Nova Scotia, is essentially a staged clearcut over 5-8 years.

Table 36. Schedule of Silviculture Treatments and Credits

Category	Description	Silviculture Credits/ha
1	Natural Regeneration Establishment	100
2	Established Plantation (site preparation, stock acquisition, planting)	650
3	Early Competition Control: Plantation & Natural (chemical/manual weeding)	300
4	Plantation: Density Control & Release (pre-commercial thinning in plantation)	350
5	Natural: Density Control & Release (pre-commercial thinning in natural stand)	750
6	Commercially thinned	400
7	Quality Improvement: a. Crop Trees Released b. Crop Trees Pruned c. Selection Managed	 250 250 250

Note: All silviculture categories can only be claimed once during the life of the forest stand except for 7a and 7c where reclaim periods apply.

Source: Section 6(2) of the Forest Sustainability Regulations (Government of Nova Scotia 2001)

The credits in each category vary significantly, but over a 60-year time-span, the total credits for different treatments add up to about the same number. For example, a landowner who carries out selection harvesting can claim 250 credits per hectare per site every ten years under Category 7. A landowner replanting a cutover, on the other hand, could claim 650 credits/ha for the plantation, an additional 350 credits for a pre-commercial thinning, and 400 credits for a commercial thinning. Thus, for a plantation, the landowner receives a large payment up front because most of the costs are incurred at that stage. But over a 60-year period, the plantation owner can claim about the same number of credits as a landowner carrying out crop tree release or selection management.

This credit system will be reviewed every five years to assess whether or not wood supply targets are being met (Beyeler 2001a). Modifications to the system could, potentially, include options like doubling the credits for selection harvesting (MacQuarrie pers. comm. 2001a). In short, the new system has the *potential* to encourage a shift to selection harvesting systems, uneven-aged management, and restoration forestry practices by increasing the credits for those regimes. Conversely, it could discourage excessive clearcutting and the loss of old forests by reducing credits for plantations.

Forester and landowner, Wade Prest, carried out the first selection harvest under the new silviculture credit system on 20 acres of his own land. He was reimbursed for his work by selling the credits to J.D. Irving after his selection cut met the technical standards in the new regulations. Because his was the first selection cut under this system, NSDNR staff came and looked at the stand 4 times, and it took 6 months to gain approval (W. Prest pers. comm. 2001b). According to Prest, selection management covers so many potential situations that it is difficult to reduce it to a few criteria in a set of technical standards.

Prest was the only applicant to earn credits for a selection cut in the year 2000. According to Jorg Beyeler of the NSDNR (2001a), some of the registered buyers have expressed interest in the treatments under Category 7, but he does not know yet if anyone other than Prest has tried it. Selection management is not as simple or as straight-forward as clearcutting, and the expertise and equipment to carry it out successfully are limited in supply. Few forest technicians and foresters in the province are familiar with uneven-aged management techniques.

At present, there is still a strong reliance on clearcutting, plantations, and even-aged management. Conversations with several forest technicians indicated little interest in making use of the Category 7 silviculture credits. For the time being, NSDNR technicians remain unfamiliar with these techniques, and may thus have difficulty carrying out inspections and approving credits (W. Prest pers. comm. 2001b). Ultimately, landowners will have to insist that they want uneven-aged management if the selection harvest credits are to be effectively utilized and implemented.

Overall, Prest is pleased with the regulations, because companies have to bear more of the cost of their harvesting activities. In his opinion, as costs become absorbed to a greater extent by industry and less by taxpayers, companies will be forced to make better decisions as to where they spend money, and they will realise that the clearcutting-plantation-spraying paradigm is very expensive. The extent of public subsidy in the past is illustrated by the fact that taxpayers paid $61.7 million to subsidize forestry on Nova Scotia’s crown lands between l990 and l997 (Canadian Council of Forest Ministers 2001). Stumpage over that same time period amounted to just $25.6 million.

However, the most positive and important step in the new silviculture regulations is the fact that, for the first time, selection harvesting and uneven-aged management are actually recognized, acknowledged, and eligible for credits similar to those available for conventional methods. Most importantly, the actual size of credits for different treatments can change over time. The five-year review system therefore has excellent potential to turn the new credit system into a set of strong incentives for sustainable forest management and restoration, and a set of disincentives for those methods that have degraded the province’s forests in the past.

Now that there are equitable silviculture incentives that will allow woodlot owners to manage forests selectively for shade-tolerant hardwoods and softwoods, there is also a pressing need to educate landowners on the availability of these incentives. And there is an equally important need to educate technicians, contractors, and foresters on the utility and worth of these methods, and on how they can be applied, assessed and monitored.

In sum, we have seen the beginnings of some genuine progress both in tax reform and silviculture credits in creating incentives, for the first time, for restoration forestry and sustainable forest management. More modestly, these first steps have perhaps begun to remove previous disincentives to sustainable forest management. The challenge is take these modest steps much further so that they can become real and practical tools to restore value to Nova Scotia’s natural forest wealth.

CHAPTER ELEVEN: ECOLOGICAL FOOTPRINT

> *"The stability of forestry and the stability of regions might be contradictory goals…. (W)hen the industry can no longer grow by extracting huge quantities from a new forest region, the only way of increasing productivity is to reduce employment."*
>
> Patricia Marchak, Logging the Globe (Griffin l996)

Natural resource accounts put the onus for sustainability implicitly on the producer. The implication of these forest accounts, and of the GPI fisheries and agriculture accounts, is that our renewable resources must be *harvested* more sustainably and with reference to the health of capital stocks. It is therefore the forester, the fisherman, and the farmer who implicitly bear responsibility for harvesting the resource in such a way that the stocks of trees, fish, and soils that constitute our natural wealth are not depleted.

But examining the equation solely from the supply side, as we have done in the last 400 and more pages, does not tell the whole story. Consumers, for a start, get off scot-free, bearing no responsibility for the impact of their voracious appetites on the health of the resource. After all, the driving force for natural capital depletion in our forests is the human demand for timber.

Industrial forestry can argue, justifiably, that it is simply meeting human demands, and that its highly mechanized harvest methods are the only way to meet those demands. In her book, *Logging the Globe*, Patricia Marchak documents the magnitude of logging taking place world-wide and argues that current forestry practices are incompatible with the stability of forest-dependent regions.

Currently 20% of the world's population is consuming 80% of the world's resources at an unprecedented rate. Indeed the richest one-fifth consumes 84% of all paper in the world; the poorest fifth just 1.1%. The disparities in resource consumption are therefore vast, and it is clear that the wealthiest countries bear significant responsibility for the depletion of forests worldwide.

Exploring the degradation of the world's forests from the consumption side rather than production side, from the demand side rather than the supply side, therefore brings a very different perspective to sustainable resource use than that presented in these Nova Scotia forest accounts. Because of these inherent limitations in natural resource accounting, GPI Atlantic includes an Ecological Footprint analysis as a core component in the Genuine Progress Index.[53] That component provides the necessary balance to the GPI natural resource accounts by placing responsibility for sustainability squarely on the shoulders of consumers as well as producers.

In sum, any shift to sustainable forestry cannot occur only through the methods suggested in this report. Restoration forestry and protection of the full range of forest values can only occur if they are accompanied by a reduction in the demand that has put such relentless pressure on the world's forests. Among the policies outlined in the State of Forests in Agenda 21 is one that calls

[53] Jeff Wilson 2001, *The Nova Scotia Ecological Footprint,* GPI Atlantic, Halifax, NS.

for the use of products that provide an alternative to wood. That policy also calls for the management, conservation, and addition of areas representing ecological systems, landscapes, and primary forests.

The models of sustainable forest practices described in this report provide outstanding examples of responsible resource management. They show that it is possible to reinvest in natural capital for the sake of future generations. The costs of that investment are a proxy for the damage and overconsumption of the past. But foresters and woodlot owners cannot do it alone, nor should they be expected to pay the price for past degradation or to carry the cost of investments that will benefit all society.

If future generations are not to pay an even higher price for our actions today, some restraint, self-discipline, responsibility, and willingness to share the burden is necessary from the larger society. This is particularly true in the wealthy countries, which consume the vast majority of the world's timber resources.

Only by curbing our appetite and consumption of wood and paper products, and investing in restorative forestry, can society properly support the pioneers described in this report and ensure that their still rare examples become the norm. It is difficult to imagine a shift of this magnitude in our consumption habits without real political will and genuinely enlightened leadership. This combination of consumption restraint, political will, genuine vision, and willingness to share the investment in forest restoration, are especially necessary for the larger society if we want to set aside larger areas of forests to serve as ecological reserves (Hunter l992).

Currently, the excessive human demand for timber, coupled with weak political leadership and lack of vision, is preventing the application of ecological forestry on a landscape scale in all forests. The significance of the Algonquin Park case study is that it does apply the principles of ecological forestry on a large scale, that it does involve the wider community in forest management decisions, and that it demonstrates the compatibility of effective and profitable timber management with other forest values.

To conclude, these Nova Scotia forest accounts must be read in conjunction with the GPI Ecological Footprint analysis. Only an active and educated partnership between producer and consumer can ensure that responsible management of timber supplies is matched by responsible demand on the part of consumers. The growing interest in forest certification signifies that such a partnership may be emerging. Such active social interest and the political will to invest in forest restoration are essential to support the pioneers profiled in this report more fully and to ensure that their example spreads more widely.

BIBLIOGRAPHY

Abramowitz, J.N., and Mattoon, A.T. 1999, "Reorienting the Forest Products Economy," in *State of the World 1999,* (ed.) L. Starke, Worldwatch Institute, W.W. Norton and Company, Inc., New York.

Algonquin Forest Authority 2001 Available from www.algonquinforestry.on.ca. Internet. Accessed March 2001.

Algonquin Forest Authority. 1999. *Twenty-fourth Annual Report 1998-1999.*

Algonquin Forest Authority. 1998. *Algonquin Provincial Park Management Plan*. Queen's Printer for Ontario.

Anonymous. 2001. Personal communication from representative of car rental company. June, 2001.

Atlantic Forestry Review. 2001. Small sawmillers getting hammered? *Atl. For. Rev.* 7(3)

Atlantic Provinces Economic Council (APEC). 2000. *The Economic Impact of the Forest Industry on the Nova Scotia Economy*. APEC. Nova Scotia.

Bancroft, Bob. 2000. Press release by the Nova Scotia Public Lands Coalition.. Available from. www.supercity.ns.ca/~land/coalition Internet. Posted September, 2000.

Bancroft, B., M. O'Brien, and K. Wright. 1999. *SmartWood Certification Assessment Report for Pictou Landing First Nation*. SmartWood Program of the Rainforest Alliance, New York

Bernard, T. and Young, J. 1997. *Ecology of Hope: Communities Collaborate for Sustainability*. New Society Publishers, Gabriola Island, BC.

Berry, T. 1988. *The Dream of the Earth*. Sierra Club Books, San Fransisco, CA.

Berry, W. *Conserving Forest Communities*. Available from www.tipiglen.dircon.co.uk/berryfc.html. Internet. Accessed December 11, 2000.

Betts, Matthew. 1999. *Landscape Ecology Mapping Project: A Landscape Approach to Conserving the Appalachian Hardwood Forest*. The Nature Trust of New Brunswick.

Beyeler, J. 2001a. Information (during telephone conversation) from Jorg Beyeler, Nova Scotia Department of Natural Resources. July, 2001.

Beyeler, Jorg. 2001b. Information (during a telephone conversation) from J. Beyeler, NSDNR, Truro, June, 2001.

Boates, Sherman. 2001. Information (during telephone conversation) from Dr. Sherman Boates, Endangered Species Biologist, NSDNR. July 3, 2001.

Bormann, F.H. and Likens, G.E. 1979. *Pattern and Process in a Forested Ecosystem*. New York: Spring-Verlag.

Brannon, Patrick. 2001. Information (during a telephone conversation) from P. Brannon, co-author of APEC Report on forestry, May, 2001.

Buntain, Jim. 2001. Information (during a telephone conversation) from J. Buntain, Sales Manager of the Forestry Division at Wilson Equipment, Jan. 2001.

Cameron, Don. 2001. Who's managing the woodlot? *Atl. For. Rev.* 7(3).

Canadian Council of Forest Ministers. 2001. National Forestry Database. Available from http: nfdp.ccfm.org. Internet. Accessed April and June, 2001.

Canadian Council of Forest Ministers (CCFM). l997. *Criteria and Indicators of Sustainable Forest Management in Canada.* Technical report. Natural Resources Canada.

Christiano, Candace. 2001. Information (in letters via email) from C. Christiano, co-owner of Finewood Flooring and Lumber Ltd., March, April, 2001.

Christiano, Peter. 2001. Information (in a letter via email) from P. Christiano, co-owner of Finewood Flooring and Lumber Ltd., April, 2001.

Clancy, Peter. 1992. The Politics of Pulpwood Marketing in Nova Scotia, 1960-1985. *In* Sandberg, A. (ed.) 1992. *Trouble in the Woods: Forest Policy and Social Conflict in Nova Scotia and New Brunswick*. Gorsebrook Research Institute for Atlantic Canada Studies. Acadiensis Press, New Brunswick.

Costanza, R., d'Argue, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naemme, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., and van den Belt, M. l997. The value of the world's ecosystem services and natural capital. *Nature*. 387: 253-259.

Cumming, Gord. 2001. Information (via email) from Gord Cumming, chief forester of the AFA, July 11, 2001.

Curtis, D.S. (ed.) l992. *Tax Reform for Private Woodlot Owners in Canada*. Canadian Forestry Association, Ottawa.

DeGooyer, K. 2001. Information (via email) from Kermit deGooyer, Wilderness Coordinator, Ecology Action Centre, June 25, 2001.

DeGooyer, Kermit. 2001. Excerpt from a letter to Laurel Russell, Chair, Interdepartmental IRM Advisory Committee, June, 2001.

DeMarsh, Peter. 2001a. Information (during telephone conversation) from P. deMarsh, President of the Canadian Federation of Woodlot Owners. July 27, 2001.

DeMarsh, Peter. 2001b. Information (during telephone interview) from P. deMarsh, President of the Canadian Federation of Woodlot Owners, Feb. 2, 2001.

DeMarsh, P. l998. Maritime marketing guide. *The Maritime Woodlot Owner*. 1: 6-12.

Dodds, Colin and Colman, Ronald. 1999. *The Cost of Crime in Nova Scotia.* GPI Atlantic, Halifax.

Drescher, Jim. 2001. Information (during telephone conversations, letters via email, and from the Windhorse Farm web site: www.windhorsefarm.org/wood.htm) from Jim Drescher, owner of Windhorse Farm, New Germany, 2001.

Drescher, Jim. 2000. Clearcut Death for Atlantic Salmon. *Clearcutting in Perspective*. Nova Scotia Public Interest Research Group, Halifax, May, 2000, p. 13.

Drescher, Jim. l998a. *The practicalities of restoration forestry*. (Unpublished.)

Drescher, Jim. l998b. *Mimicking natural patchiness*. (Unpublished.)

Drescher, Jim. l997a. *The Windhorse standard for restoration and maintenance of the natural forests of Nova Scotia*. (Unpublished.)

Drescher, Jim. l997b. The Economics of Ecoforestry. *In* Drengson, A. and Taylor, D., (eds.). *Ecoforestry: The Art and Science of Sustainable Forest Use*. New Society Publishers, Gabriola Island, BC.

Drescher, Jim. l997c. *Long-term Selection Harvesting: Four things to do with a Tree*. (Unpublished.)

Duke, Tony. 2001. Information (during telephone conversation) from T. Duke, wildlife biologist, NSDNR Wildlife Division, Kentville, 2001.

Ecology Action Centre. 2000. Last Call for Public Lands: Special supplement on Nova Scotia's Public Lands. *Shunpiking.* Volume 5, no. 33. Halifax.

Ecology Action Centre. 2001. Aerial photos of Nova Scotia clearcuts. Available from website: www.clearcutnovascotia.com. Internet. Accessed March 2001.

Eidt, D. 2001. Information (during telephone conversation) from Dan Eidt, Director of Crown lands, NSDNR. June 29, 2001.

Ellul, Jacques. l980. *The Technological System*. The Continuum Publishing Corporation, New York.

Environment Canada. l995. *Canadian Biodiversity Strategy: Canada's Response to the convention on Biological Diversity.* Ottawa.

Farrand, John Jr. l988. *An Audubon Handbook Eastern Birds*. McGraw -Hill Book Company, New York.

Farrar, John Laird. 1995. *Trees in Canada.* Canadian Forest Service, Fitzhenry & Whiteside Ltd., Markham, Ontario.

Fleming, T. and Freedman, B. 1998. Conversion of natural, mixed-species forests to conifer plantations: Implications for dead organic matter and carbon storage. *Ecoscience* 5(2), 213-221.

Franklin, Ursula. l990. *The Real World of Technology*. l989 CBC Massey lectures, Toronto.

Freedman, Bill. 1998. Information during a panel discussion at Dalhousie University, entitled "Sustainability or Liquidation: The State of Nova Scotia's Forests." September, l998.

Freedman, B., Zelazny, V., Beaudette, D., Fleming, T., Flemming, S., Forbes, G., Gerrow, J.S., Johnson, G., and Woodley, S. 1996. Biodiversity implications of changes in the quantity of dead organic matter in managed forests. *Environ. Rev.* 4, 238-265.

Freedman, B. 1995. *Environmental Ecology: the Impacts of Pollution and other Stressors on Ecosystem Structure and Function*. Academic Press: San Diego, California.

Freedman, B., Woodley, S. and Loo, J. 1994. Forestry practices and biodiversity , with particular reference to the Maritime provinces of eastern Canada. *Environ. Rev*., 2, 33-77.

Freedman, B., Duinker, P.N, and Morash, R. 1986. Biomass and nutrients in Nova Scotia forests and implications of intensive harvesting for future site productivity. *For. Ecol. Manag.* 15, 103-127.

Frith, Jeremy. 2001a. Notes from slide presentation at Nova Forest Alliance Woodlot Owners Workshop, by J. Frith, woodlot owner, Cape Breton Island, 27 January 2001.

Frith, Jeremy. 2001b. Personal communication with Jeremy Frith, woodlot owner, St. Ann's Bay, Cape Breton, January and February, 2001.

GPI Atlantic. 2001. Information available from www.gpiatlantic.org Internet.

Government of Nova Scotia. 2001. *Forest Sustainability Regulations, Section 40, Forests Act, R.S.N.S. 1989, c.179.* Available from http://www.gov.ns.ca/just/regulations/ regs/fosust.htm. Internet. Accessed February 6, 2001.

Gravlines, Laurie. 2001. Information (during telephone conversations) from Laurie Gravlines, forest economist, Ontario Ministry of Natural Resources. July 11 and 30, 2001.

Griffin, B. 1996. Book Review of 'Logging the Globe'. *HighGrader Magazine* 2(4). Cobalt, Ontario.

Hamilton, G. 2000. Europeans open their wallets for eco-certified rainforest cedar. *Vancouver Sun*. December 5, 2000. Vancouver.

Hammond, H. 1991. *Seeing the forest among the trees: the case for wholistic forest use.* Polestar Press. Vancouver, BC.

Harlow, L. 2000. Taxes, Death and More Taxes. *Atl. For. Rev.* 6 (3): 8.

Hitz, Larry. 2001. Information (during a telephone conversation) from L. Hitz, purchasing department with Ledwidge Lumber, February, 2001.

Hogan, D.L,. Tschaplinski, P.J. and Chatwin, S. (eds.). 1998. *Carnation Creek and Queen Charlotte Islands Fish/Forestry Workshop: Applying 20 years of coastal research to management*. Ministry of Forests Research Program, Vancouver.

Hornbeck, J.W., Adams, M.B., Corbett, E.S., Verry, E.S., and Lynch, J.A. 1993. Long-term impacts of forest treatments on water yield: a summary for northeastern USA. *Journal of Hydrology*. 150, 323-344.

Hunter, M.L. (ed.) 1992. *Maintaining biodiversity in forest ecosystems*. Cambridge University Press. New York.

Hunter, M.L. Jr. 1990. *Wildlife, Forests, and Forestry: Principles of Managing Forests for Biological Diversity*. Prentice Hall, Inc., Englewood Cliffs, New Jersey, 07632.

Hussain, V. 2001. Information (via email) with Vanessa Hussain, author of GPIAtlantic Transportation study.

Johnson, R. S. 1986. *Forests of Nova Scotia*. Nova Scotia Department of Lands and Forests, Halifax.

Kageson, Per. 1993. *Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs,* European Federation for Transport and Environment.

Keith, Mary. 1998. Information (in a letter via fax) from M. Keith, Director of communications for J.D Irving Ltd., Feb. 3, 1998.

Landis, Scott. 1992. Seventh-Generation Forestry: Wisconsin's Menominee Indians set the standard for sustainable forest management. Harrowsmith Country Life. Available from http://www.menominee.edu/mte/7gen.html Internet. Accessed March 22, 2001.

Leopold, Aldo. 1987. *A Sand County Almanac*. Oxford Press, New York.

Lindsay, David. 2000. The man who planted trees. *Atl. For. Rev.* 6 (3).

Litman, Todd. 1997. *Transportation Cost Analysis: Techniques, Estimates and Implications.* Victoria Transport Policy Institute, Victoria, B.C.

Loucks, O.L. 1962. *A Forest Classification for the Maritime Provinces*. Forest Research Branch, Nova Scotia Institute of Science, Nova Scotia.

Lunergan, Bruce. 2000. Estate planning for the woodlot owner. *Atl. For. Rev.* 6 (3).

Lunergan, B. l997. Tax Incentives/disincentives to sustainable forest management: A review of the Curtis Study recommendations. *The Forestry Chronicle*. 73(6): 693-696.

Lynds, A and LeDuc, J. l995. *Old Forests of Nova Scotia*. Natural Resources Occasional Papers No.1. Parks and Recreation Division, Nova Scotia Department of Natural Resources. Belmont, Nova Scotia.

MacAskill, G. l999. *Sustainable Forest Management in Nova Scotia.* Toronto, Ontario: York University. MES Thesis.

MacLaughlin, Andrew. 2001. Personal communication with Andrew MacLaughlin, Financial Advisor with Grant Thornton, Feb. 9, 2001.

MacLellan, John. l998. Information (during a telephone conversation) from J. MacLellan, forester for MacTara Lumber Ltd. l998.

MacLeod, Bruce. 2001. Information (during a telephone conversation) from Bruce MacLeod, Future Forestry Ltd., Pictou County. Feb. 27, 2001.

MacQuarrie, Peter. 2001a. Personal communication with Peter MacQuarrie, Director of Renewable Resources, NSDNR Halifax, June 25 & 29, 2001.

MacQuarrie, Peter. 2001b. Information (during a telephone conversation) from P. MacQuarrie, Director, Renewable Resources Branch, Nova Scotia Department of Natural Resources, Halifax, Feb. 23, 2001.

MacQuarrie, Peter. 2001c. Information (during a telephone conversation) from P. MacQuarrie, Director, Renewable Resources Branch, NSDNR, Halifax, Feb. 12, 2001.

Maliondo, S.M. 1988. *Possible effects of intensive harvesting on continuous productivity of forest lands.* Forestry Canada Information Report M-X-171. Fredericton, NB.

Maser, C. and Trappe, J. (eds.) 1984. *The Seen and Unseen World of the Fallen Tree*. General Technical Report PNW-164. Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, Portland, Oregon.

Mater, C. 1998. *Menominee Tribal Enterprises: Sustainable forestry to improve forest health and create jobs - case study*. The Sustainable Forestry Working Group. Island Press, Washington, D.C.

Matheson, Glen. 2001. Information (during a telephone conversation) from G. Matheson, controller of finance, Mackay's Truck and Trailer Centre. February, 2001.

May, Elizabeth. 1998. *At the Cutting Edge: The Crisis in Canada's Forests*. Key Porter Books, Toronto.

McAllister, Don. 1992. A Glimpse of Earth's Richness. *Earthkeeper: Canada's Environmental Magazine* 2(6) Guelph, Ontario.

McCormick, Jack. 1959. *The Living Forest*. Harper and Brothers, New York.

McGregor, Sandy. 1997. Information (during a telephone conversation) from S. McGregor, chief forester, Kimberly Clarke, 1997.

McKay, Bill. 2001. Personal communication with Bill McKay, forester, Confederacy of Mainland Mi'kmaq. February 2, July 24 & 25, 2001.

McKay, Bill. 2000. Mi'kmawey Forestry…An Old Idea with a New Beginning. *Mi'kmaq Maliseet Nations News*. June, 2000.

McKay, B. and Hudson, A. 1998. *First Nations Forestry Association's Road Construction Manual.* Eastern Woodlands Publishing.

Menominee Tribal Enterprises. 1997. *The Menominee Forest-based Sustainable Development Tradition*. Available from www.epa.gov/glnpo/menominee/forestkeepers/pdf Internet. Accessed February, 2001.

Menominee Tribal Enterprises. 1997. *The Menominee Forest Management Tradition: History Principles and Practices.* MTE, Keshena, Wisconsin.

Minister of Indian Affairs and Northern Development. 1997. *Gathering Strength – Canada's Aboriginal Action Plan*. Minister of Public Works and Government Services Canada. Ottawa, Canada.

Minister of Industry. 2001. *Manufacturing Industries of Canada: National and Provincial Areas, 1998*. Statistics Canada – Catalogue no. 31-203-XPB. Ottawa.

Minister of Industry. 2000a. *Manufacturing Industries of Canada: National and Provincial Areas, 1997.* Statistics Canada – Catalogue no. 31-203-XPB. Ottawa.

Minister of Industry. 2000b. *Logging Industries, 1997*. Statistics Canada – Catalogue no. 25-201-XIB. Ottawa.

Moffat, L. 1999. *Not a "Clear-Cut" Issue: The Role of the Independent Logger in Nova Scotia's Forest Industry*. Halifax, Nova Scotia: Dalhousie University. MES Thesis.

Mosseler, A., Major, J.E., Simpson, J.D., Daigle, B., Lange K., Park, Y.-S., Johnsen, K.H. and Rajora, O.P. 2000. Indicators of population viability in red spruce. Picea rubens. I. Reproductive traits and fecundity. *Cdn J. Bot.* 78, 928-940.

Mou, P., Fahey, T., and Hughes, J. 1993. Effects of soils disturbance on vegetation recovery and nutrient accumulation following whole-tree harvest of northern hardwood ecosystem. *North. J. Appl. Sci.*. 30, 661-675.

National Roundtable on the Environment and the Economy. 1997. *State of the Debate on the Environment and the Economy: Private Woodlot management in the Maritimes*. Ottawa.

New Brunswick Federation of Woodlot Owners and Conservation Council. 2001. *Low Impact Forestry in New Brunswick*. Press Release, January 24, 2001.

New Hampshire Forest Sustainability Standards Work Team. 1997. *Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire*. The Society for the Protection of New Hampshire Forests. Concord, NH.

Nichols, G. 1918. The vegetation of Northern Cape Breton Island. *Trans. Connect. Acad. Arts & Sci*. 22, 249-467.

Nova Scotia Department of Lands and Forests. 1989. *The Forest Industry in Nova Scotia 1988 Statistical Review.*

Nova Scotia Department of Lands and Forests. 1988. *Forestry Field Handbook.*

Nova Scotia Department of Lands and Forests. 1980. *The Trees Around Us: A manual of good forest practice for Nova Scotia*. Canada Department of Regional Economic Expansion and the Nova Scotia Department of Lands and Forests.

Nova Scotia Department of Natural Resources. 2001. *General Status Ranks of Wild Species in Nova Scotia*. Available from http://www.gov.ns.ca/natr/wildlife/genstatus Internet. Accessed June, 2001.

Nova Scotia Department of Natural Resources 2001a. *Nova Scotia's Old Growth Forests: Interim Old Forest Policy.* Available from: http://www.gov.ns.ca/natr/forestry/plan&resch/oldgrowth/policy.htm. Internet. Accessed March, 2001.

Nova Scotia Department of Natural Resources. 2001b. *Registry of Buyers, 2000 Calendar Year: Report on Primary Forest Products Acquired and Business Summaries.* Nova Scotia.

Nova Scotia Department of Natural Resources. 2000a. *Draft Wildlife Habitat Management Regulations*. Available from www.http://www.gov.ns.ca/natr/forestry/strategy/habitat.htm Internet. Accessed March 20, 2001.

Nova Scotia Department of Natural Resources. 2000b. *Forest Inventory Permanent Sample Plot Field Measurement Methods and Specifications*. Nova Scotia.

Nova Scotia Department of Natural Resources. 2000c. *Registry of Buyers, l999 Calendar Year: Report on Primary Forest Products Acquired and Business Summaries Plus Secondary Forest Products l998, l999*. Nova Scotia.

Nova Scotia Department of Natural Resources. 1999. *Forest Inventory*. Available from www.gov.ns.ca/natr/ Internet. Accessed April 2, 2001.

Nova Scotia Department of Natural Resources. l997. *Toward Sustainable Forestry, A Position Paper*. Nova Scotia.

Nova Scotia Department of Natural Resources. l991. *Information Report: Forest Inventory Provincial Summary 1979-1989*. Forest Planning Division. Truro, Nova Scotia.

Nova Scotia Department of Natural Resources. l979. *Information Report: Forest Inventory Provincial Summary l970-1978.* Forest Planning Division. Truro, Nova Scotia.

Nova Scotia Department of Natural Resources. 1973. *Information Report: Forest Inventory Provincial Summary l965-l971*. Forest Planning Division. Truro, Nova Scotia.

O'Brien, J. 2001a. Road upgrade for logging at taxpayers' expense. Letter to the editor, *Victoria Standard*. August 6-19, 2001, p. 4.

O'Brien, J. 2001b. Personal communication with J.O'Brien, resident, Cape Breton, August, 2001 and February 22, 2001.

O'Brien, J. 2000. Personal communication with Dr. Jim O'Brien, board member and past secretary of the Bras D'Or Stewardship Society, January 2000.

O'Brien, M. 2000. *Old growth forests of Nova Scotia*. Nova Scotia Nature Trust.

O'Brien, M. 1995. *Various effects of forest harvesting and management on stream ecosystems in the vicinity of Fundy National Park, New Brunswick*. MSc. Thesis. Dalhousie University

Odum. E. P. 1981. The effects of stress on the trajectory of ecological succession. *In*. Barrett, G.W. and Rosenburg, R. (eds.) *Stress Effects on Natural Ecosystems*. pp.43-47. Wiley, NY.

Oftedal, S. 1993. *Taxation and Infrastructural Costs of Heavy Goods Transport,* European Federation for Transport and Environment.

Ontario Ministry of Natural Resources. 1998. *A silviculture guide for the tolerant hardwood forest in Ontario*. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto.

Ontario Ministry of Natural Resources. 2001. Central and Eastern Ontario: Healthy Forests, Healthy Business. ISBN 0-7794-1481-0

Osawa, A. 1989. Causality in mortality patterns of spruce trees during a spruce budworm outbreak. *Can. J. For. Res.* 19, 632.

Patterson, G. 1978. *Patterson's History of Victoria County*. College of Cape Breton Press. Sydney, Nova Scotia.

Pecore, Marshall. l995. *Case Study: Menominee Tribal Enterprises.* Available from http://www.menominee.edu/sdi/csstdy.htm Internet. Accessed March 14, 2001.

Pecore, Marshall. 2001. Information (during telephone conversations and in letters via email) from M. Pecore, Forest Manager, MTE, Keshena, 2001.

Pelton, B. and O'Brien, J. 2001. Information (during telephone conversation) from Bruce Pelton and John O'Brien, Peltons Construction. June 22, 2001.

Peters, Terry, 2001. Information (during telephone conversations) from T. Peters, student at the Institute of Sustainable Development, Keshena, 2001.

Pimentel, D., Wilson, C., McCullum, C., Huang, R., Dwen, P., Flack, J., Saltman, T., and Cliff, B. l997. Economic and Environmental Benefits of Biodiversity. *Bioscience*. 47: 747-757.

Porter, Jonathan. 1997. Information (during a telephone conversation) from J. Porter, chief forester, Bowater Mersey, l997.

Prest, W. 2001a. Information via email from Wade Prest, forester and woodlot owner, July 15, 2001.

Prest, W. 2001b. Information (during telephone conversation) from Wade Prest, forester and woodlot owner, February 22, 2001.

Prest, W. 2001c. Information (during telephone conversation) from Wade Prest, forester and woodlot owner, January 26, 2001.

Prest, Wade. 1999. *Pictou Landing First Nation Forest Management Plan*. January 19, 1999.

PriceWaterhouseCoopers. l998. *Effect of Tax Legislation in Canada on the Sustainability of the Private Woodlot sector*. Natural Resources Canada. Ottawa.

PriceWaterhouseCoopers. l999. *Comparison of "Effect of Tax Legislation in Canada on the Sustainability of the Private Woodlot Sector" and Draft Interpretation Bulletin IT-373R2, Woodlots*. Natural Resources Canada, Canadian Forest Service. Ottawa.

Rice, Don. 2001. Information via email from Don Rice of the Tobeatic Wilderness Committee.
Rice, Don. 2000. First impressions – cut and slash. *Chronicle Herald – Voice of the People*. May 22, 2000.

Robbins, C., Dawson, D. and Dowell, B. 1989. Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States. *Wildl. Monogr.* 103, 1-34.

Robinson, S. 1990. *Effects of forest fragmentation on nesting songbirds*. Report No. 296. Illinois Natural History Survey. Champaign, USA.

Royal Commission on Passenger Transportation 1991, *Directions: The Final Report of the Royal Commission on National Passenger Transportation.* Ottawa: Supply and Services Canada. 4 volumes.

Sandberg, A. 1992. Introduction: Dependent Development and Client States: Forest Policy and Social Conflict in Nova Scotia and New Brunswick. *In: Trouble in the Woods: Forest Policy and Social Conflict in Nova Scotia and New Brunswick*. Sandberg, L.A. (ed). Gorsebrook Research Institute for Atlantic Canada Studies, Federicton, NB.

Sandberg, A. (ed.) 1992. *Trouble in the Woods: Forest Policy and Social Conflict in Nova Scotia and New Brunswick.* Gorsebrook Research Institute for Atlantic Canada Studies. Acadiensis Press, New Brunswick.

Schama, Simon. l995. *Landscape and Memory*. Random House of Canada, Toronto.

Schneider, A. l998. *Selection Management of Private Woodlands in Nova Scotia: A Steward's Guide*. Centre for International Studies, University College of Cape Breton. Sydney, Nova Scotia.

Schonewald-Cox, C. and Buechner, M. 1992. Park protection and public roads. *In* Pl. Fiedler and S.K. Jain (eds.), *Conservation Biology: The Theory and Practice of Nature Conservation, Preservation and Management*. Chapman and Hall, NY.

Schulze, E., Wirth, C., and Heimann, M. 2000. Managing forests after Kyoto. *Science*. 5487, 2058-2059.

Scott, W. 2001. Information via email from Wendy Scott of Scott Walking Adventures.

Singleton, J., Loo, J. and Foley, J. 1999. *Conservation guidelines for ecologically sensitive forested sites on private woodlots within the Fundy Model Forest*. Canadian Forest Service, Fredericton, NB.

Small, Kenneth, Winston, Clifford, and Evans, Carol. 1989. *Road Works: A New Highway Pricing and Investment Policy.* Washington, D.C., The Brookings Institute.

SmartWood Program. 1997. *Public Certification Summary Report for Natural Forest Assessment of Menominee Tribal Enterprises, Ltd*. New York.
SmartWood Program. 2000. *Forest Management Public Summary for Stockbridge Munsee Community*. New York.

Smith, A. 2001. Personal communication via email with Andy Smith, a member of the Southwest Paddling Club, the Canadian Recreational Canoeing Association, and Canoe Nova Scotia. June, 2001.

Snow, Ken. 2001. Information (during telephone conversations) from K. Snow, Manager Forest Inventory, NSDNR, Truro, 2001.

Soule, M., and Sanjayan, M. A. 1998. Conservation targets: do they help? *Science* 279(5359), 2060-2061.

Spencer, I. 1997. *Estimating the Size and Importance of the Forest Sector in Nova Scotia: The Conventional Wisdom with Adjustments*. Wood Products Manufacturer's Association, Nova Scotia.

Starzomski, Brian. 2001. Information (during telephone conversations and letters via email) from B. Starzomski, wildlife biologist NSDNR Wildlife Division, Kentville, 2001.

Stephens, W.K 2000. Controversy over Carbon. *Halifax Chronicle Herald*. May 20, 2000. Halifax.

Strickland., Dan. 2000. *Algonquin Logging Museum: Logging History in Algonquin Provincial Park*.

Su, Q., MacLean, D.A., and Needham, T.D. 1996. The influence of hardwood content on balsam fir defoliation by spruce budworm. *Cdn. J. Forest Research*. 26, 1620-1628.

Sutherland, B. 2000. Personal communication with Bonnie Sutherland, Executive Director, Nova Scotia Nature Trust.

The Coalition of Nova Scotia Forest Interests. 1996. *A new forest strategy for Nova Scotia: Discussion Paper*. Nova Scotia.

The Forest Alliance of British Columbia. 1995. *The Menominee Forest*. Available from www.forest.org/resources/studies/studd.html . Internet. Accessed December 11, 2000.

Townsend, E. Ray. 1995. *Algonquin Forest Authority - A 20 Year History 1975-1995*. Algonquin Forest Authority, Huntsville, Ontario.

Turcotte, D., Smith, S. and Federer, C. 1991. Soils disturbance following whole-tree harvesting in north-central Maine. *North. J. Appl. For.* 8, 68-72.

Walker, Sally, Monette, Anne, and Colman, Ronald, 2001. *The GPI Greenhouse Gas Accounts for Nova Scotia,* GPI Atlantic, Halifax, N.S.
Wente, Margaret. 2001. Finally, we're talking about FAS. *The Globe & Mail*, Feb.1, 2001.

Whynot, Tim. 2001. Information (during a telephone conversation) from T. Whynot, Extension Forester, NSDNR, August 31, 2001.

Wildlands League. l997. *New Directions in Ontario's Forests: Crafting More jobs with less wood.* Fact Sheet 7. Toronto.

Wilson, Jeff. 2001. *The Nova Scotia Ecological Footprint*. GPI Atlantic, Halifax.

Wilson, S.J., Pannozzo Linda, O'Brien, Minga, and Colman, Ronald 2001. *The Nova Scotia Genuine Progress Index Forest Accounts: Indicators of ecological, economic and social values of forests in Nova Scotia.* GPI Atlantic, Halifax. (Volume 1 of these GPI Forest Accounts.).

Wilson, S.J. 2000. *The GPI Water Quality Accounts: Nova Scotia's Water Resource Values and the damage cost of declining water resources and water quality.* GPI Atlantic. Halifax.

World Resources Institute. 2000. *Canada's forests at a crossroads: An assessment in the year 2000.* A Global Forest Watch Canada report. Washington, D.C.

Wycott, Russ. l997. Information (during a telephone conversation) from R. Wycott, chief forester, Stora Enso, l997.

Zhang, T. and J.-F. Gingras. 1999. Twig tweaking – timber management for wood quality and end-product value. *Cdn. For. Ind*. Nov/Dec. 1999.