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MEASURING SUSTAINABLE DEVELOPMENT

APPLICATION OF THE GENUINE PROGRESS INDEX TO NOVA SCOTIA

GPI FOREST HEADLINE INDICATORS FOR NOVA SCOTIA

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May 2008

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The lesson I read in the past is this: that the health of land and water—and of woods, which are the keeper of water—can be the only lasting basis for any civilization's survival and success.

– Ronald Wright (A Short History of Progress)[1]

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[2]

Our forest industries are in danger…. We're overcutting, seriously overcutting. We're clearcutting on steep hillsides that cause erosion…. You get a heavy rain in the spring, it's like flushing a toilet, and then in the summer there's not enough water, the salmon get sunburned…. In the past ten years, the crown lands have been raped and the crown land should show other people how the forests should be managed.

– Dr. Wilfrid Creighton (1998), former Deputy Minister, Nova Scotia Department of Lands and Forests[3]

ACKNOWLEDGEMENT

GPI*Atlantic* gratefully acknowledges funding for this study from the Province of Nova Scotia, the Alerce Trust, Bill and Susan van Iterson, and members of GPI*Atlantic*. This funding assistance is making possible the completion this year of the Nova Scotia Genuine Progress Index, of which this update of key forest indicators is one key component.

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

Inspiration for the Nova Scotia Genuine Progress Index came from the groundbreaking 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 aspiration 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 and environmental accounts build.

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Introduction: Counting the true value of our forests

> *Economic estimates ignore the fact that many ecosystem services are literally irreplaceable. (Costanza et al. 1997)*

How do we put a price tag on clean air and water, biodiversity, and healthy forests and societies? We often call these "priceless," because we recognize their enormous inherent value and the reality of our complete dependence on their effective functioning. By that logic, when a forest ecosystem is degraded and no longer able to provide essential goods and services, our economy should count that loss as a cost, not a gain. In our current national accounting system and GDP-based measures of progress, however, the intrinsic value of the natural environment is ignored, and forests are only given a monetary value when they are cut down and the timber sent to market. Forests are not valued for the essential services they provide when left standing.

Our natural world provides and performs a wide range of ecological, social, and economic functions, providing people with both direct goods and services like wood, food, and recreational opportunities, and indirect goods and services that enable human society and the economy to function. For example, an intact, optimally functioning forest ecosystem provides, at no cost, a long list of vital services, including climate regulation, habitat and watershed protection, flood and natural pest control, prevention of soil erosion, formation of topsoil, nutrient recycling, and long-term storage of carbon. It also provides us with high quality wood, wild foods, and a place to relax and rest our minds.

Preservation of the capacity of nature to yield a full range of economic, ecological, social, and cultural benefits is sometimes called 'holistic' forest use because this approach seeks to optimize the full range of forest functions. It also recognizes that long-term timber productivity is itself dependent on the preservation of healthy forest soils, age and species diversity, and other vital non-timber functions. This approach contrasts markedly with the current and historical 'industrial' approach to forestry in Nova Scotia, in which the primary focus of forest management is to harvest enough wood fibre to meet all available and desired markets. 'Sustainability', in an industrial model, is largely measured in terms of how much forest land is regenerated to commercial species. Water resources, wildlife, biodiversity, and ecosystem services receive only token consideration, if at all.

When a forest is degraded, its ability to provide vital 'free' services is compromised. Such services may be lost irreplaceably or diminished in effectiveness, or efforts may be made to replace them through often expensive feats of human engineering (as when a water filtration plant is built to replace the lost natural filtration function that healthy forests perform for free). An accurate accounting system would recognize and count such

losses as depreciation of natural capital, just as a factory owner currently counts a depletion or degradation in plant and equipment as depreciation of produced capital.

In 1997, an international team of scientists headed by Robert Costanza of the Maryland Institute of Ecological Economics conservatively estimated the average annual value of many of the world's key ecosystem services to be $33 trillion—almost twice the total annual GDP of all the countries on earth. It should be noted, however, that putting a price tag on the value of forests is highly problematic, in large part because there are many forest values that simply cannot be quantified. How, for example, can a dollar value be put on a forest species, or on the habitat provided to that species by the forest? Money was not designed to assess such non-market values and simply cannot adequately capture the intrinsic value of the natural world.

And yet, GPI*Atlantic* does often use monetary values for strategic purposes and as a tool to communicate with the world of conventional economics, while recognizing fully that profound human, social, and environmental values cannot properly be reduced to monetary terms. Monetization is thus seen as a temporary but necessary step in order to overcome the conventional tendency to attribute no value to natural capital like standing natural forests. Despite the limitations of monetization, therefore, GPI*Atlantic* does use the technique to make the intrinsic values of natural forests more clearly visible, and to ensure that these values are duly and properly considered and taken into account in the policy arena. In other words, monetization can be seen as necessary as long as the values of standing natural forests are ignored by policy makers and these forests continue to be assigned a value of zero in conventional accounting mechanisms.

For the sake of convenience, the evidence that follows is presented in the form of six indicators that, at first sight may appear to be separate from one another. However the value—and indeed the power—of the Genuine Progress Index lies in its capacity not just to present a wide range of social, economic, and environmental indicators but to show the linkages and interdependence between social, economic, and environmental factors, and thereby to demonstrate the interrelated nature of reality. In fact, the six key indicators presented here were chosen from among a very large set of indicators in the 2001 GPI Forest Accounts precisely because they clearly reflect these intricate and intimate relationships.

In order to restore the health of Nova Scotia's forests and their capacity to perform their functions optimally, it is essential to restore their age diversity (indicator 1). Those forest functions include protection of soils, watersheds, biodiversity, and aesthetic quality, climate regulation and carbon sequestration, and provision of high quality timber and habitat for species (indicator 2).

Restoration of forest health and age diversity in turn require both an expansion of protected areas (indicator 3) and shifts in forestry policy and harvest practices (indicators 4-6). The latter include a greater reliance on selection harvesting rather than clearcutting (indicator 4) and a greater emphasis on value added production (indicator 5) rather than

export of raw timber and the current over-reliance on production for pulp and paper manufacturing. These changes will produce more jobs and more value per unit of biomass harvested (indicators 6 and 5), thus ensuring both the resilience of forest industries and enabling a reduction in current rates of over-harvesting.

In sum, the recommendations that flow directly from the key indicators and evidence presented here are inter-related aspects of a single reality. They represent win-win solutions that can restore forest health and provide adequate habitat for forest-dependent species, while ensuring a vibrant forest industry that provides longer-term, sustainable jobs in forest-dependent communities.

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Indicator 1: Forest age class distribution: A measure of ecosystem diversity and health

Data sources: Nova Scotia Department of Lands and Forests. 1958. The Forest Resources of Nova Scotia. Prepared by L.S. Hawboldt and R.M. Bulmer; Nova Scotia Forest Inventory Provincial Summaries 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); NSDNR GIS Unpublished Inventory Data (1997-2003); Nova Scotia Department of Natural Resources (NSDNR). 2000. Nova Scotia Forest Inventory Based on Forest Inventory Permanent Sample Plots Measured Between 1994 and 1998. Report FOR 2000-1. Table 3; Nova Scotia Department of Natural Resources. 2004. Nova Scotia Forest Inventory Based on Permanent Sample Plots Measured Between 1999 and 2003. Report FOR 2004-3. Table 3.

Result: There has been a sharp and significant loss of old forests in Nova Scotia since the Province's first major forest inventory in 1958, with no significant improvements in age class distribution in recent times, and a continuing shift to ever younger forests.

Old forests with wide age diversity perform many vital functions that younger even-aged forests are less able to perform. To provide just a few examples, old forests provide habitat to many species that are dependent on old growth; they provide a canopy that more effectively intercepts precipitation and thus protects against soil erosion; they store more carbon—vital in an era of climate change; and they increase resilience against certain diseases and pest infestations. These and other functions, in turn, improve timber productivity and increase the timber value of forests. Trees grown in open-grown conditions (i.e. following a clearcut) tend to be smaller in diameter, knotty and of poorer quality, while trees grown in closed canopy conditions (i.e. old forests) tend to be wider in diameter, of higher quality and clear (not knotty)—characteristics that fetch higher market prices.

In 2001, GPI*Atlantic* reported that—based on the NSDNR forest inventory data dating back to 1958—there had been a sharp decline in the percentage of forests aged 61 and over, a significant loss in age diversity, and a sharp shift from older to younger age classes during the roughly 40-year period. For example, the GPI report found that in 1958, one-quarter of Nova Scotia's forests were over 80 years of age, with this percentage declining dramatically to just 1% four decades later. By contrast, young forests (up to 40 years old) more than doubled in this time period from just 12% of the total in 1958 to 32% at the end of the 1990s. In a single generation, therefore, the age composition of Nova Scotia's forests changed dramatically, and the Province lost almost all its remaining old forests—with true old growth (forests more than 100 years old) now virtually non-existent.[4]

However, the recent 40-year decline in forest age diversity should not be overstated, simply because Nova Scotia's forests in 1958 were by no means pristine or unspoiled, and were already far removed from the natural Acadian forest that prevailed prior to European settlement. In fact, the Nova Scotia Government's 1958 report on its own first ever forest inventory stated bluntly that "the forests standing in 1958 [were] the end result of the building up and tearing down of trees over the centuries."[5] Even as far back as 1910, observations of the liquidation of the Province's forests were being recorded:

> [The forest] is now largely in poor condition, and is being annually further deteriorated by abuse and injudicious use, because those owning it are mostly not concerned in its future, or do not realize its potentialities. To arrest further deterioration and to begin restoration is the present duty of those who have the continued prosperity of the Province at heart.[6]

In the early 1900s, forests were regularly cut before they were mature. By 1958, the year the first provincial forest inventory was published by the Department of Lands and Forests, it was reported that decades of "high-grading" the larger trees to meet the demand for sawlogs had not only changed the forest structure but had "nearly exhausted" the supply of larger trees, making it "necessary to accept smaller and smaller stock." In other words, nearly 50 years ago, government documents were already warning that forest conditions had "deteriorated considerably…making the conservative and recuperative measures even more imperative now."[7]

These warnings and recommendations—even from government agencies—went unheeded by the forest industry, and clear-cutting, over-harvesting, and the loss of old forests and age diversity continued unabated, and even accelerated with the advent of highly mechanized logging equipment. Thus, a 1997 NSDNR position paper made observations similar to those four decades earlier, particularly with regard to cutting on private lands, acknowledging that: "[F]orest stands are being harvested while they are still immature"; "softwood harvests have exceeded the sustainable supply level"; and "overharvesting is a potentially serious problem demanding immediate attention."[8]

While the 1997 warnings are similar in some ways to those of earlier years, there is a significant difference in the way in which the warnings were framed. In the early 1900s, and even in 1958, the observations centred on the ecology and condition of the Province's forests and on the ways in which forest structure and health were being affected by harvesting methods and levels. Today, discussions about Nova Scotia's forests focus on how to ensure that the forests can sustain harvest levels—which have increased by nearly 60% since the early 1980s alone.[9] The goal of having 'sustainable' harvests has replaced the goal of ensuring sustainable forests and ecosystems.

In order to update the data and trends in age class distribution since its 2001 report for this present headline indicator summary, GPI*Atlantic* obtained the most recent unpublished GIS inventory data based on aerial photography from the NSDNR, as well as

the most recent Permanent Sample Plot (PSP) data, of which only two sets of age class data are publicly available. A summary of the trends in age class are presented below in Figures 1-7. Figures 1-6 are based on the GIS inventory data (reported publicly for the first time here), and Figure 7 is based on the PSP data.[10]

As previously noted, the figures below demonstrate a sharp decline since the 1950s in the percentage of provincial forest aged 61 and older, and a simultaneous sharp increase in younger forest stands.

According to the most recent GIS inventory data provided by the NSDNR, the youngest age class (0 to 20 years), which includes those stands that have been clearcut, has increased considerably as a proportion of total forest cover since GPI*Atlantic*'s 2001 report—from 16.3% of the province's forests in 1999 to 23.9% in the 1997-2003 inventory. In the early 1970s, such very young forest stands constituted only 3.8% of the Province's forests, and this proportion has been increasing ever since—with the largest percentage point increase in the most recent period (Figures 1 and 3 below).[11]

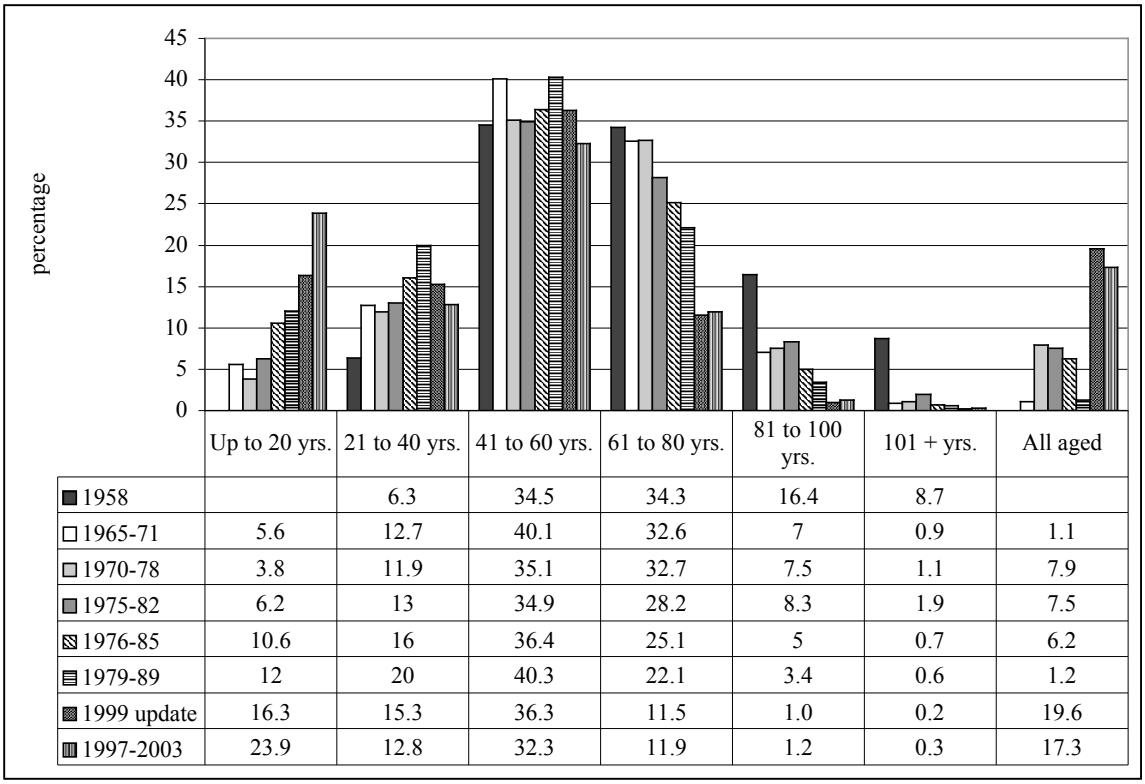
The forest area represented in the 61 to 80 year-old age class has not changed much in recent years, representing 11.5% of total forest area in 1999 and 11.9% in the 1997-2003 inventory. However, when viewed from a longer historical perspective, this age class has shrunk by two-thirds since 1958, when it comprised 34.3% of the province's forests. The forest area represented in the older age classes (80 years plus) decreased dramatically between 1958 and 1999, from 25% in 1958 to 1.2% in 1999 and 1.5% in the 1997-2003 GIS inventory. The oldest forests (101+) have virtually disappeared—declining from 8.7% of all forests in 1958 to 0.3% in the latest 1997-2003 inventory (Figure 2 below).

Expressed as percentage declines, the 61 to 80 year-old age class dropped by 65% between 1958 and 2003; the 81 to 100 year-old age class by 93%; and the 101+ year-old age class by 97%. Considering the Province's older forests as a whole, those over 60 years constituted 59.4% of all provincial forests in 1958, and only 13.4% in the latest 1997-2003 GIS inventory—a decline of 77.5% (Figure 4 below). At the same time, the percentage of young forest up to age 20 increased by a remarkable 327% over roughly the same time period,[12] and the 21 to 40 year-old age class increased by 103%.

Despite increasing talk of 'sustainability' in both industry and government circles, the available data show no evidence of effective forest restoration or increased age diversity. On the contrary, they indicate that Nova Scotia's forests continue to become ever younger, thus forfeiting the substantial benefits, services, and values of older forests and compromising forest sustainability. For GPI*Atlantic,* these results are of particular concern, since they indicate that the warnings and recommendations of the 2001 GPI report—which for the first time documented the decline in old forests and age diversity quantitatively—have not been heeded by the forest industry any more than have the consistent warnings from government agencies.

The results should be of even greater concern to the Provincial Government, since the lack of substantial positive change undermines the Government's new commitment to "sustainable prosperity" and its stated intention to "demonstrate international leadership by having one of the cleanest and most sustainable environments in the world by the year 2020" (Bill 146: Environmental Goals and Sustainable Prosperity Act, 2007). The latest available statistics indicate that the "recuperative measures" called for half a century ago are even more urgently required today if the Government is to meet its stated goals.

Figure 1. Provincial Forest Area by Age Class, Percentage of Total Forest Area, 1958–2003



	Up to 20 yrs.	21 to 40 yrs.	41 to 60 yrs.	61 to 80 yrs.	81 to 100 yrs.	101 + yrs.	All aged
1958		6.3	34.5	34.3	16.4	8.7	
1965-71	5.6	12.7	40.1	32.6	7	0.9	1.1
1970-78	3.8	11.9	35.1	32.7	7.5	1.1	7.9
1975-82	6.2	13	34.9	28.2	8.3	1.9	7.5
1976-85	10.6	16	36.4	25.1	5	0.7	6.2
1979-89	12	20	40.3	22.1	3.4	0.6	1.2
1999 update	16.3	15.3	36.3	11.5	1.0	0.2	19.6
1997-2003	23.9	12.8	32.3	11.9	1.2	0.3	17.3

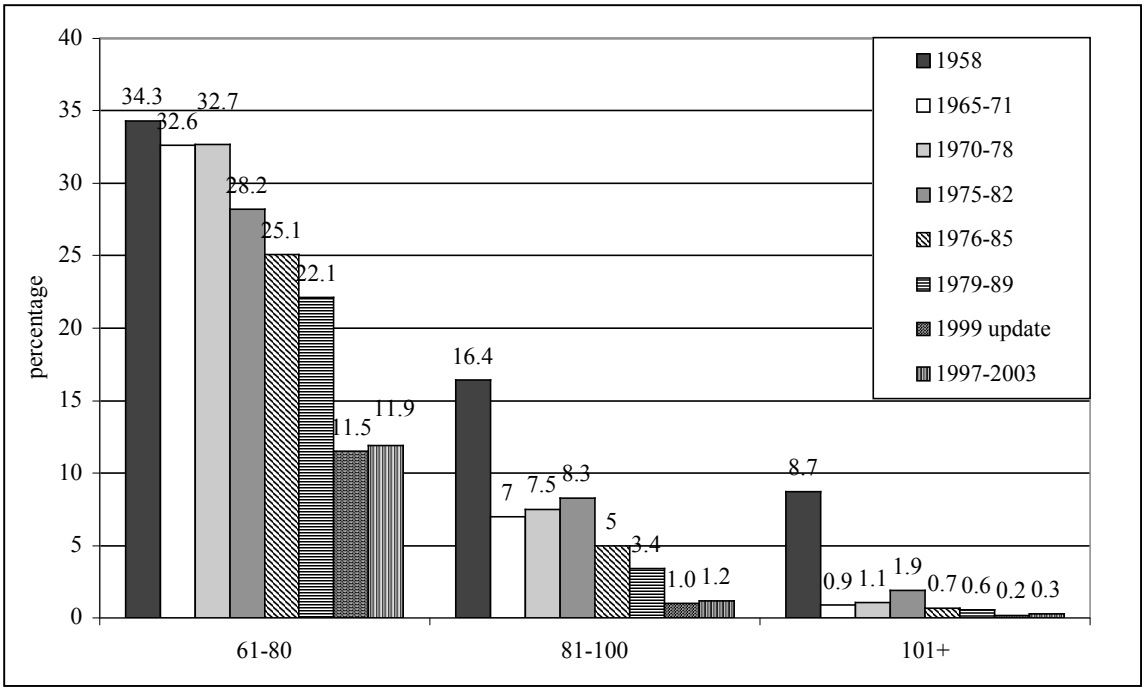
Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003).

Notes:

- Figures may not add up to 100 due to rounding.
- The age classes cited in the 1958 inventory were reported differently than in the subsequent inventories. Instead of 20-year intervals, such as 21-40, 41-60 etc, they were classified in 10-year intervals—30, 40, 50, etc. In 1958, age class 30 (26-35 years) roughly corresponds with the 21-40 age class category used in subsequent inventories; age classes 40 and 50 (36-55 years) roughly correspond with the 41-60 age class; age classes 60 and 70 (56-75 years) roughly correspond with the 61-80 age class; age classes 80 and 90 (76-95 years) roughly correspond with the 81-100 age class; age classes 100, 110, 120, and 126+ (96 + years) roughly correspond to the 101 + age class. In addition, it should be noted that in 1958, there was no mention of an age class between 0-20 years or of an all aged category, and these cells have therefore been left blank in the Figure above.

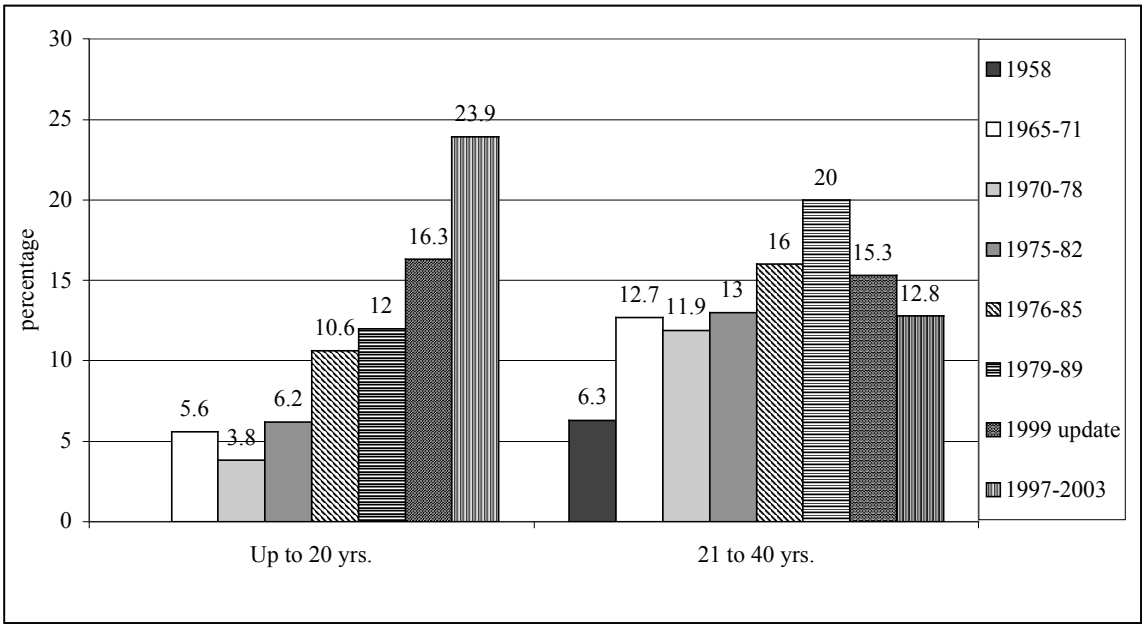
- The "all-aged" category is defined by the NSDNR as those stands with three or more distinct canopy layers visible on a photograph. For inventory purposes, the "all height" stands, which here are called "all-aged" are given an average height in order to calculate volume. According to Ken Snow, Manager of Forest Inventory at the NSDNR, "the average height of the All-height (All-Age) softwood stands are comparable to the average height of the softwood forest (11 metres) indicating that all height stands are not just young stands. In fact a stand must have a layer at least 9 metres tall (based on merchantable stems) to be classed as an All-height stand. A softwood stand at an average height of 9 metres on an average site (LC 5), would have an age of approx 35 years, 11 metres--43 years."[13] The reasons for the sharp increase in this category in recent years are unclear. Ken Snow says that "all aged" stands could result from high-grading, partial blow-down, or insect and disease kill of certain species. (Personal communication, November 26, 2007).

Figure 2. Provincial Forest Area by Age Classes over 61 yrs., Percentage of Total Forest Area, 1958–2003



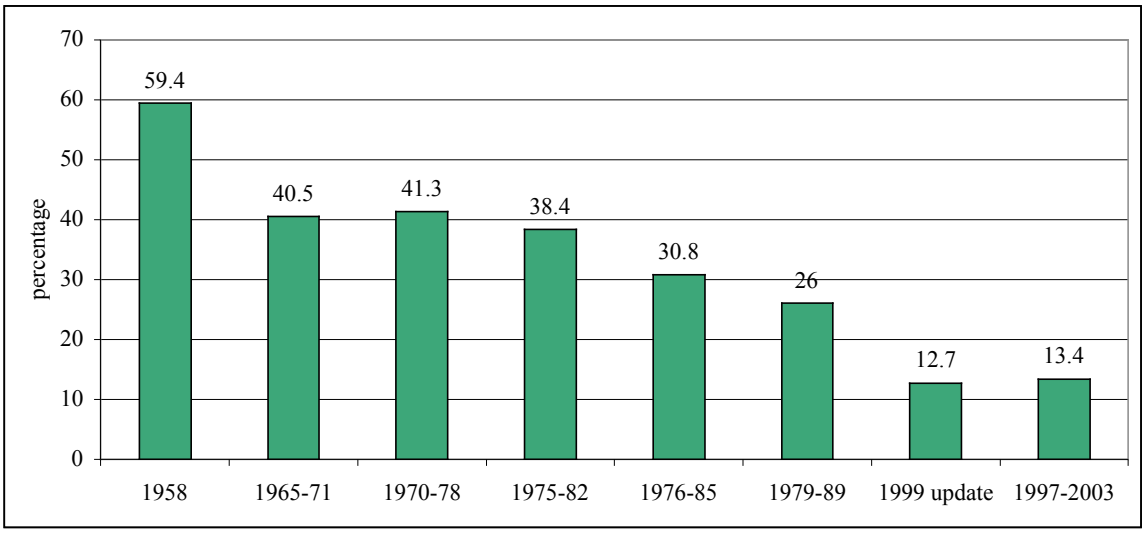
Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Figure 3. Provincial Forest Area by Age Classes up to 40 years of age, Percentage of Total Forest Area, 1958–2003



Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Figure 4. Provincial Forest Area more than 60 years old, Percentage of Total Forest Area, 1958–2003

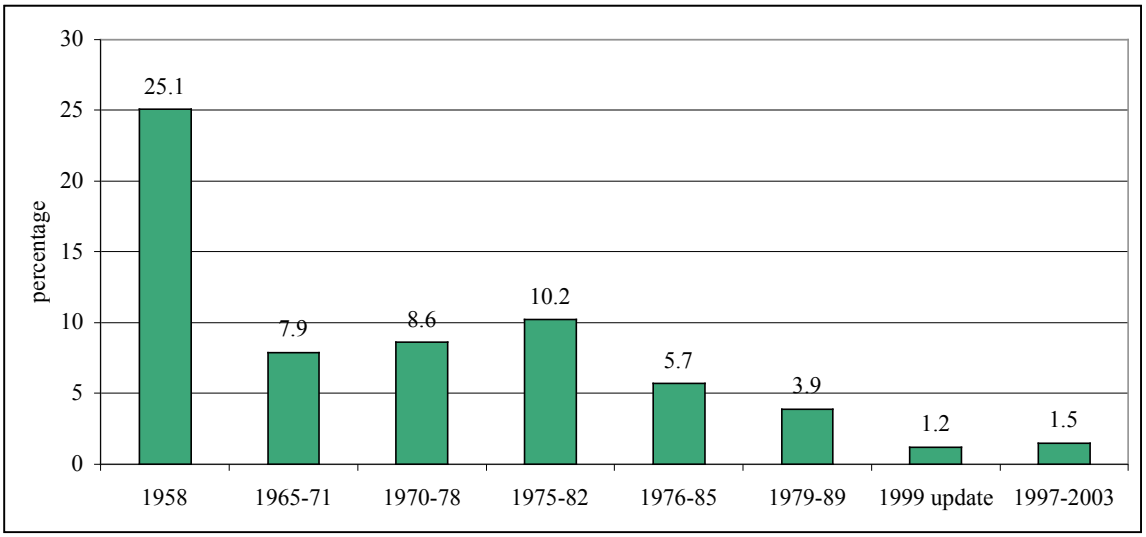


Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Remnant old-growth forests are extremely rare in the province and are typically found in small, isolated stands often of questionable ecological integrity. These are far too small and scattered to contribute in any real way to the overall biodiversity of the province, which is defined as the variety of life in all of its forms, levels, and combinations. Remarkably, however, even these tiny, isolated stands do still provide increasingly rare habitat for many species of old-growth dependent wildlife and plants, and they contribute—at least on a local level—to the biodiversity of the regions in which they remain. GPI*Atlantic*'s 2001 Forest Accounts describe some of the species that depend on old growth for their survival.

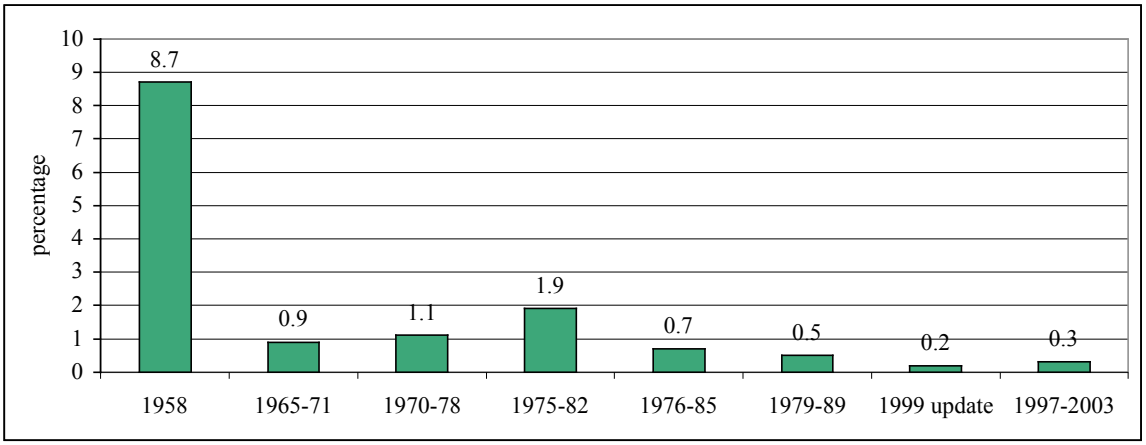
Figures 5 and 6 demonstrate the sharp decline in the percentage of forests over 80 years of age in Nova Scotia. As noted above, in 1958, roughly one-quarter of the province's forests were more than 80 years of age. Forty-five years later, only 1.5% of provinces forests now fall into these older age categories (Figure 5 below). While the dominant forest type that would have existed in Nova Scotia prior to European settlement would have been classified as "old growth" with an average age of well over 100 years, centuries of logging and high-grading had reduced those old forests to just 8.7% of the total by 1958, with even these virtually eliminated in the last 45 years—constituting just 0.3% of all the province's forests in the latest 1997-2003 inventory (Figure 6 below). Please see GPI*Atlantic*'s 2001 Forest Accounts for details on the average natural life span of Nova Scotia's forest species.

Figure 5. Provincial Forest Area over 80 years old, Percentage of Total Forest Area, Nova Scotia, 1958–2003



Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Figure 6. Provincial Forest Area more than 100 years old, Percentage of Total Forest Area, 1958–2003



Sources: The Forest Resources of Nova Scotia (1958); Nova Scotia Forest Inventory Provincial Summary 1965-1971, 1970-1978, 1975-1982, 1976-1985, 1979-1989; DNR GIS 1995 Inventory Data (September 1999 update); DNR GIS Unpublished Inventory Data (1997-2003). Note: Figures have been rounded.

Despite NSDNR's 1999 policy to set aside 8% of crown land in each of the province's 38 EcoDistricts as old growth and old forest, the Province is still clearly far from those targets.[14]

Forest inventory data for age class distribution are also collected from permanent sample plots randomly placed throughout the province. Despite the fact that Permanent Sample Plot (PSP) data have been collected since 1965, the NSDNR has only published forest age class data from these plots twice: in 2000, based on measurements of 1,923 plots between 1994 and 1998, and in 2004, based on measurements of 3,250 plots between 1999 and 2003.[15] Despite requests made by GPI*Atlantic* for the earlier PSP data, they have not been provided. In addition, while the NSDNR has stated that it may undertake the task of analyzing the full range of PSP data for age class trends at some time in the future, to date it has not done so.[16]

Therefore, with only two sets of PSP age class data available, it is not currently possible to develop a long-term historical trend for this indicator using the PSP data. Furthermore, as stated, the NSDNR does not have any current plans to analyze or publish these historical data, although it does acknowledge that: "It would be a very interesting research project to calculate provincial age class distributions in five year periods from 1965-70 to 2003-08 when the 2008 field season is completed."[17]

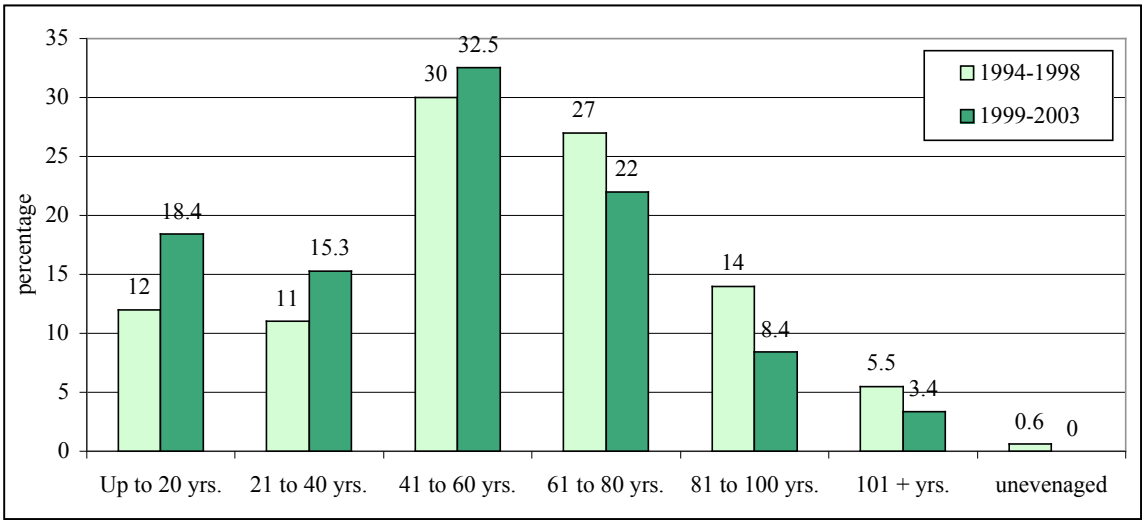
The age class data that are currently available from the 1994-98 and 1999-2003 PSP measurements are presented below in Figure 7. Between 1994-98 and 1999-2003, the

PSP data indicate a "shift to a younger forest,"[18] thus confirming the trends based on the GIS data outlined above. Indeed, in a relatively short time period, the PSP data show the percentage of total forest area more than 60 years of age decreasing from 46.5% in 1994-98 to 33.8% in 1999-2003, while the percentage of younger forests—less than 60 years of age—increased from 53% to 66.2% in the same time period.[19] The percentage of forests between 0 and 40 years of age increased from 23% of all forests to nearly 34%.

Thus, the PSP data also indicate and confirm that older age classes are in decline and have continued to decline, despite repeated warnings and admonitions about the loss of benefits and value that accompany the destruction of old forests. According to the limited PSP data available, stands more than 80 years of age decreased from 19.5% of the total provincial forest area in 1994-98 to 11.8% in 1999-2003.

According to Ken Snow of the NSDNR, increases in harvesting account for a "significant portion of the decline in the number of stands older than 81 year."[20] Despite this apparent understanding of the direct link between increased harvests and loss of old forests, the NSDNR has continued to support forest industry objectives to increase forest harvest levels in Nova Scotia. Thus, in 1999, the Department projected that by 2070, the softwood net merchantable volume of timber in Nova Scotia forests would double to more than 11 million cubic metres—up from about 5.5 million cubic metres in 1996.[21] Increased harvests were expected to be possible as a result of increased silviculture efforts, even though silviculture cannot replace old forests.

Figure 7. Provincial Forest Area by Age Class Based on Permanent Sample Plots, %, Nova Scotia, 1998 and 2003



Sources: Nova Scotia Department of Natural Resources. 2000. Nova Scotia Forest Inventory Based on Forest Inventory Permanent Sample Plots Measured Between 1994 and 1998. Report FOR 2000-1. NSDNR. Truro. Table 3.; Nova Scotia Department of Natural Resources. 2004. Nova Scotia Forest Inventory Based on Permanent Sample Plots Measured Between 1999 and 2003. Report FOR 2004-3. NSDNR. Truro. Table 3. Note: Figures have been rounded.

While the trends in Figure 7 above—including the decline in old forests and the shift to younger forests—mirror the longer-term trends from the GIS data described above, the absolute numbers and percentages are clearly very different. For a more in-depth analysis of the conflict between the GIS age class data and the PSP age class data please refer to Section 6.3.1 of the GPI Forest Accounts, Volume 1, 2001. There it was noted that any tendency to preserve permanent sample plots or exclude them from clearcuts may well lead to the PSP data reflecting a more optimistic and less dire picture than the GIS data. It is recommended that the DNR undertake the task of calculating provincial age class distributions in five-year periods from 1965-70 to 2003-08 when the 2008 field season is completed.

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Indicator 2: Number of known forest-dependent species at risk

Data Sources: Legally listed species: Nova Scotia Department of Natural Resources. 2006. NS Endangered Species Act: Legally Listed Species as of 2006. Available from http://www.gov.ns.ca/natr/wildlife/biodiv/specieslist.htm. Accessed October 12, 2007; COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2007. Schedule 1. List of Wildlife Species at Risk. Available from COSEWIC web site: http://www.sararegistry.gc.ca/species/default_e.cfm Accessed October 12, 2007.

Forest-dependence of yellow-, red-, and blue-listed species of flora and fauna was provided by the following experts: *Vascular plants*: Sean Blaney, Botantist and Assistant Director, Atlantic Canada Conservation Data Centre; *Lichens*: Stephen Clayden, Research Curator, Botany and Mycology Section, New Brunswick Museum. *Dragonflies*: Paul Brunelle, Research Associate, New Brunswick Museum and Regional Coordinator for Atlantic Dragonfly Inventory Program. *Fish:* John Gilhen, Curator Emeritus, Nova Scotia Museum of Natural History. *Birds, butterflies and mammals*: Mark Elderkin, Provincial Species at Risk Biologist, Nova Scotia Department of Natural Resources.

Result: There has been an increase in the number of known forest-dependent species at risk in Nova Scotia since 2001.

Biodiversity cannot be assessed simply by the counting of species. Biodiversity is the variety of life and all its processes, and includes the range of living organisms within an ecosystem, their genetic differences, and the communities in which they naturally occur. The diversity that makes up a natural forest, for instance, includes not only trees, but also soil bacteria, earthworms, flowers, ferns, lichens, shrubs, insects, fish, stream invertebrates, resident and migratory birds, mammals, amphibians, moulds and fungi, and humans. Within a forest system, thousands of different species interact, and all of them are interconnected in dynamic ways.

A 1994 study in the journal *Nature* found that ecosystems with losses in plant and animal biological diversity showed significant losses in ecosystem performance in a number of ecosystem functions and in the provision of essential ecosystem services. Thus, a highly diverse forest system is a key marker of its health and resilience, and a vital indicator of its capacity to perform its manifold functions effectively and optimally.[22]

There is also growing evidence that conserving the natural biological diversity of ecosystems provides stability for these ecosystems by buffering against natural and artificial stresses, and that this diversity also maintains productivity.[23] For example, forests with greater tree species diversity have been shown to be more resilient to disease

and insect infestation. Su et. al. studied 25 mixed balsam fir-hardwood stands in New Brunswick between 1989 and 1993 in areas with moderate to severe defoliations by spruce budworm. They found that defoliation by spruce budworm was significantly related to the hardwood content of a forest. As the hardwood content increased, the defoliation of the balsam fir within the stands decreased.[24] In that way, a healthy, diverse forest also has a direct impact on timber productivity and value.

Old growth forests, in particular, are rich in biodiversity, and are home to many different plants and animals that have specialized needs.[25] On the other hand, young softwood plantations are low in biodiversity—simple places with only a few tree and animal species. Studies have indicated that natural species diversity is a vital indicator of forest health, and of the capacity of a forest to perform a variety of ecosystem functions and to provide essential ecosystem services.

Nova Scotia has already lost much of its original biodiversity. Since European colonization, almost every stand of old growth forest in the province has been cut and/or burned. As a result, the habitat of plants and animals that depend on old-growth forests, including large cavities in large standing or fallen dead trees, has almost disappeared, causing declines in many species. Protection of forest-dependent species clearly depends on protection of their habitats.

In this province, many forest-dependent species are vulnerable to "edge effects," which in turn result from the fragmentation of forests caused by clearcutting and roads. Fragmentation can have severe impacts on species that require large territories, and/or large uninterrupted tracts of forest; that are susceptible to predation or parasitism by edge-loving species; that are sensitive to human contact; that are frequently killed on roads; or that are unlikely or unable to traverse large openings. Such "edge effects" have already taken their toll on the province's forest-dependent flora and fauna. At current harvesting rates, and given current harvesting practices, almost all provincial forests outside protected areas will continue to be degraded in this manner.

As noted, biodiversity cannot be assessed through counting species. And yet, listing species at risk is presently one of the only ways we have of even approaching this complex dimension of forest health from an indicator and assessment perspective. To that end, Tables 1 and 2 below list plant and animal species in Nova Scotia that are dependent on forests but are currently at risk.

Since 2001—the first time GPI*Atlantic* reported the number of known forest-dependent species at risk—the situation has worsened, and the list of endangered species has grown longer.[26] The Nova Scotia population of Blandings Turtle, listed as "threatened" in 2001, is now currently listed as "endangered." In addition, eight more forest-dependent species of flora and fauna have since been listed as endangered: Ram's Head Lady Slipper, Moose (mainland population), Boreal Felt Lichen, Canada Lynx, American Marten (Cape Breton population), Atlantic Salmon (Inner Bay of Fundy population), Atlantic Whitefish, and Chimney Swift.

Recently listed as "vulnerable," the Eastern White Cedar and Rusty Blackbird now join the ranks of the Wood Turtle and Bicknell's Thrush—whose status has not improved since the last GPI report. Extirpated species include the Grey Wolf and the Woodland Caribou. In addition, COSEWIC (Committee on the Status of Endangered Wildlife in Canada) lists "candidate species," which are species not yet assessed by COSEWIC, but which have been identified by COSEWIC as potentially being at risk. Known forest-dependent species in Nova Scotia listed by COSEWIC as candidates for detailed status assessment are the Eastern Cougar and Lake Trout.[27] Species listed in Table 1 are legally protected.

Table 1. Known forest-dependent species (flora and fauna) in Nova Scotia classified, federally and/or provincially, as vulnerable, threatened, endangered, or extirpated. 2007

VULNERABLE/ SPECIAL CONCERN	THREATENED	ENDANGERED	EXTIRPATED
Eastern White Cedar (2006) Bicknell's Thrush (2002) Rusty Blackbird (2006) Wood Turtle (2000) Gaspe shrew (2002)	Common nighthawk (2007)	Ram's Head Lady Slipper (2007) Moose (Mainland population) (2003) Boreal Felt Lichen (2007) Canada Lynx (2002) American Marten (Cape Breton population) (2001) Blandings Turtle (NS population) (2000) Atlantic Salmon (Inner Bay of Fundy population) (2001) Atlantic Whitefish (2002) Chimney Swift (2007) Eastern Cougar**	Grey Wolf Woodland Caribou Eastern Cougar**

Sources: Nova Scotia Department of Natural Resources. 2006. NS Endangered Species Act: Legally Listed Species as of 2006. Available from http://www.gov.ns.ca/natr/wildlife/biodiv/specieslist.htm. Accessed October 12, 2007; COSEWIC. 2007. Schedule 1. List of Wildlife Species at Risk. Available from COSEWIC web site: http://www.sararegistry.gc.ca/species/default_e.cfm Accessed October 12, 2007.

Notes:

- Only those Species at Risk categories with listed Nova Scotia species are included in the Table above. Under the Nova Scotia Endangered Species Act there are 5 categories of risk: Vulnerable, Threatened, Endangered, Extirpated, and Extinct.[28]

- The criteria for forest dependence include whether particular species require forests for food, shelter, breeding, or other critical aspects of their life cycles.

- Atlantic Salmon populations are affected by acid rain, climate change, over-fishing, sedimentation, and loss of forest canopy cover. Sandy stream bottoms are also essential for salmon spawning to be successful. Water temperature is another critical factor that influences the growth rate of salmon. When stream temperatures increase, salmon are adversely affected. Salmon like cool, well-oxygenated shaded streams that are relatively free of sediment. When a nearby forest is cut down or a steam-side forest canopy is removed, the salmon habitat changes dramatically: The water gets warmer during the day, the oxygen concentration decreases, and the stream beds become plugged with sediment. For these reasons, Atlantic Salmon are considered a forest-dependent species. Atlantic Whitefish are also threatened by acid rain, pollution, over-fishing, and deforestation.

- ** Eastern Cougar are not listed at all in the Nova Scotia Species at Risk, and therefore are not legally protected in the province. As noted above, however, they are listed by COSEWIC as candidates for detailed status assessment in the future. As is apparent in Table 2 below, Eastern Cougar are also not listed as being either red, yellow, or blue in the Nova Scotia General Status of Wild Species classifications. However, according to biologist Bob Bancroft, Eastern Cougar are a contentious subject, with some scientists maintaining that they do still inhabit parts of Nova Scotia, while others argue that they do not. Bancroft himself believes that Eastern Cougar still roam the province, and should be listed as endangered as their numbers would be very small indeed. If they are no longer found here, then they should be listed as extirpated. In either case, based on the precautionary principle—which would certainly make a case for their protection if they still exist in Nova Scotia, it seems that they should certainly be listed. Therefore, Eastern Cougar have been included in both the "endangered" and "extirpated" columns of Table 1 above, pending agreement on which of those two categories is most appropriate.

- In 2003, the Southern Flying Squirrel was designated by COSEWIC as a species of "special concern." However, in 2006, COSEWIC re-assessed the Southern Flying Squirrel as "not at risk." However, Amanda Lavers, whose 2004 thesis was about the Southern Flying Squirrel, concluded that we currently do not know enough about this species to determine that it is not at risk.[29]

The species at risk listed in Table 1 above are classified at the federal level through COSEWIC and the Species at Risk Act (SARA). At the provincial level, species of concern are protected by the Nova Scotia Endangered Species Act, and—in the absence of listing under law—they are assessed using the Nova Scotia General Status of Wild Species classifications. Thus, the species listed in Table 1 above, are supposed to receive legal protection. However, there are additional species of Nova Scotia flora and fauna that are considered rare or potentially at risk and that are therefore classified as either "yellow-listed"—sensitive to human activities or natural events or "red-listed"—known or believed to be at risk. These species are not legally protected, but are sometimes taken into consideration particularly when environmental assessments are required for projects or developments to go ahead.[30] Table 2 below therefore presents those forest-dependent species that are listed as either yellow, red, or blue (extirpated) in Nova Scotia. Table 2

does not include those species that are legally protected, which can be found in Table 1 above.

Table 2. Yellow, red, and blue-listed forest-dependent species not protected under legislation, Nova Scotia, 2007

YELLOW-LISTED	RED-LISTED	BLUE-LISTED
FLORA: **Vascular plants:** ***Highly forest-dependent*** Smoother Sweet-Cicely Common Alexanders Lindley's Aster White Snakeroot Boreal American-Aster Pale Jewel-Weed Squashberry Black Ash Halberd-Leaf Tearthumb Lesser Wintergreen Wood Anemone Alderleaf Buckthorn Boreal Bedstraw Northern Comandra Heart-Leaved Foam Flower Wood Nettle Pubescent Sedge Yellow Canada Lily Giant Rattlesnake-Plantain Dwarf Rattlesnake-Plantain Large Round-Leaved Orchid Northern Holly-Fern Meadow Horsetail Lance-Leaf Grape Fern Least Grape-Fern False Mermaid-Weed Large Yellow Lady's-Slipper Small Yellow Lady's-Slipper	**FLORA:** **Vascular plants:** ***Highly forest-dependent*** Northern White Cedar Blunt-Fruited Sweet Cicely Black Snake-Root Pussytoes Blue Cohosh Northern Wild Comfrey Large Toothwort Coffee Tinker's-Weed Large Tick-Trefoil Green Ash Squaw-Root Purple Clematis Round-Leaved Liverleaf Bristly Crowfoot Nantucket Shadbush Eastern Leatherwood Foxtail Sedge Chestnut-Coloured Sedge Slender Wood-Sedge Loose-Flowered Sedge Necklace Spike Sedge Plantain-Leaved Sedge Tuckerman Sedge Wiegand's Sedge Narrow-Leaved Wild Leek Small White Leek Long-Bract Green Orchis Showy Lady's Slipper	**FLORA:** **Vascular plants:** ***Highly forest-dependent*** Great Laurel Canada Violet ***Moderately forest-dependent*** Swamp Beggar-Ticks Northern Dewberry

Moderately forest-dependent	Downy Rattlesnake-Plantain	
	Southern Twayblade	
Hemlock Parsely	White Adder's-Mouth	
Philadelphia Fleabane	Broad-Glumed Brome	
Hairy Wild Lettuce	Stout Wood Reed-Grass	
Cut-Leaved Coneflower	Wiegand's Wild Rye	
Coast Pepper-Bush	Bottlebrush Grass	
Dwarf Huckleberry	Nodding Fescue	
Spurred Gentian	Northern Maidenhair-Fern	
Canada Anemone		
River Anemone	***Moderately forest-dependent***	
Marsh Marigold		
A Hawthorn	Nuttall's Small-Reedgrass	
Common Buttonbush	Northern Bedstraw	
Bog Bedstraw	Large Marsh Bestraw	
Thyme-Leaved Speedwell	Umbellate Bastard Toad-Flax	
Hair-Like Sedge	Cloud Sedge	
Ebony Sedge	Porcupine Sedge	
Swan Sedge	Greenish-White Sedge	
Slender Sedge	Sparse-Flowered Sedge	
Southern Rein Orchid	Tinged Sedge	
Canada Mountain-Ricegrass	Slender Dichanthelium	
Slender Wedge Grass	Fragile Rockbrake	
Maidenhair Spleenwort	Northern Woodsia	
Green Spleenwort	Bebb's Sedge	
Netted Chainfern		
Fragrant Fern		
Smooth Woodsia	**Lichens:**	
Adder's Tongue		
Short-Awn Foxtail	Erioderma pedicellatum	
Wavy-leaf American-Aster	Fuscopannaria ahlneri	
Purple-Stem Swamp Beggar-Ticks	Leptogium milligranum	
	Leptogium subtile	
Purple-Leaf Willow-Herb	Leptogium tenuissimum	
	Meolleropsis nebulosa ssp. frullaniae	
Lichens:	Pannaria lurida	
	Sticta limbata	
Degelia plumbea	Erioderma mollissimum	
Collema nigrescens		
Sticta fuliginosa	**FAUNA:**	
Fuscopannaria leucosticta		
Leptogium corticola		

Leptogium laceroides Leptogium saturninum Pannaria conoplea Pannaria rubiginosa Peltigera leucophlebia Coccocarpia palmicola **FAUNA:** **Butterflies: none** **Dragonflies:** Little Bluet Seaside Dragonlet Clamptipped Emerald (3) Muskeg Emerald Prince Baskettail (2) Harlequin Darner (1) Zorro Clubtail (3) Harpoon Clubtail (3) **Fish:** Brook Trout Lake Trout Gaspereau **Birds:** Olive-Sided Flycatcher Grey Jay Boreal Chickadee Northern Goshawk Canada Warbler Rusty Blackbird Common Loon **Mammals:** Fisher Eastern Pipistrelle Northern Long-Eared Bat Little Brown Bat Southern Flying Squirrel	**Butterflies:** Early Hairstreak Bog Elfin Jutta Arctic **Dragonflies:** Taiga Bluet Ebony Boghaunter (1) Williamson's Emerald (3) Ringed Emerald Rusty Snaketail (2) Twinhorned Snaketail (3) Brook Snaketail (3) Skillet Clubtail (2) **Fish:** Striped Bass Atlantic Sturgeon	

Sources: Forest-dependence of all yellow-listed, red-listed, and blue-listed flora and fauna was provided by the following experts. **Vascular plants:** Sean Blaney, Botantist and Assistant Director, Atlantic Canada Conservation Data Centre; **Lichens:** Stephen Clayden, Research Curator, Botany and Mycology Section, New Brunswick Museum. **Dragonflies:** Paul Brunelle, Research Associate, New Brunswick Museum and Regional Coordinator for Atlantic Dragonfly Inventory Program. **Fish:** John Gilhen, Curator Emeritus, NS Museum of Natural History. **Birds, butterflies and mammals:** Mark Elderkin, Provincial Species at Risk Biologist, Nova Scotia Department of Natural Resources.

Notes:
Not included in the above Table are those species protected under legislation. Please refer to Table 1 for these.
Vascular plants: The vascular plant species listed above are either highly forest-dependent or moderately forest-dependent, with the former including those most often found under a forest canopy in Nova Scotia and the latter including those that are fairly frequently found under a forest canopy, including forest edge species.
Lichens: These mostly occur on the bark of trees, and all are highly forest-dependent. Some lichens occur mainly on rock and soil, often in the shade of overhanging trees, or along shady brooks and rivers.
Dragonflies: In addition to the list of red- and yellow-listed species provided above, there are also 19 species of dragonflies that are listed as "undetermined," whose status cannot currently be assessed due to a lack of data. Among this group, the Zebra Clubtail is considered highly dependent on riparian forest cover. As well, an additional six species are listed as "undetermined" as a result of taxonomic (classification) issues. All dragonfly species are dependent on forest cover to some degree. In its absence they are vulnerable to predators, and some species rely on breaks in forest canopy to find sun-lit patches that are preferred mating territory. In addition, where timber cutting has been extensive, the aquatic habitat of dragonflies can be negatively impacted. This tends to be more significant to the running waters (lotic) species. In Table 2 above, the numbers beside the dragonfly species indicate the significance of forest cover where (1) indicates a species which requires forests for mating territory; (2) indicates a lotic species whose aquatic habitat characteristics are somewhat dependent on riparian forest cover; and (3) indicates a lotic species whose aquatic habitat characteristics are highly dependent on riparian forest cover. Absence of a number indicates that the species is vulnerable only in the sense that all Odonata (dragonflies) are vulnerable without cover.[31]
Fish: Forests "dictate" water temperature and water levels, and are overall "very important for most fish species to thrive," says John Gilhen, Curator Emeritus at the Museum of Natural History. Pearl Dace and Brook Stickleback are also "yellow-listed" species, but are not included in the Table above because, according to Gilhen, they are "not necessarily" forest-dependent, thrive in boggy areas, and can withstand much higher temperatures than most fish.[32]
Mammals: Despite the fact that the Southern Flying Squirrel was deemed "not at risk" by COSEWIC in 2006, it remains in the General Status of Wild Species in Nova Scotia classification as "yellow-listed," or sensitive to human activities or natural events.

In a 2007 report analyzing U.S. bird count data over a 40-year period, the Audubon Society found that many common birds are in decline. According to the Audubon report: "Since 1967 the average population of the common birds in steepest decline has fallen by 68%; some individual species nose-dived by as much as 80%. All 20 birds of the national Common Birds in Decline list lost at least half their populations in just four decades."[33] The Audubon Society attributes some bird decline to a loss of forest habitat from "inappropriate logging." In particular, the Audubon Society reports that the boreal forest of the northern U.S. and Canada provides essential breeding territory for evening grosbeaks and boreal chickadees, which have declined by 78% and 73% respectively since 1967.

Indicator 3: Protected areas as percentage of total provincial landmass

Data Sources: Provincial parks and park reserves: Brian Kinsman, Planner, NSDNR, personal communication, December 21, 2007. All other data: David Hopper, Private Land Conservation Coordinator, Nova Scotia Department of Environment and Labour, Protected Areas Branch, personal communication, November 29, 2007.

Result: There has been an increase in the percentage of Nova Scotia's total landmass under protection from 8.1% in 2001 to 8.5% in 2007.

The very best forestry practices are no substitute for a network of protected areas in which no logging at all occurs. For reasons described in detail in GPI*Atlantic*'s 2001 Forest Accounts for Nova Scotia, such a network is the only guarantee for adequate protection of vital natural assets at the landscape level.[34]

In Nova Scotia, the Department of Environment and Labour's protected areas program is based on a framework of 80 natural landscapes that have been identified based on the province's 9 climatic regions, 47 geologic formations, and 84 major soil types.[35] The term *landscape ecosystem* is defined as follows:

> A landscape ecosystem is a group of biotic communities, together with their environment, occurring over a particular portion over the landscape and held together by some common physical or biotic feature. Ecosystems contain climax and related successional communities within them and, as an assemblage, form distinct broad landscapes.[36]

In other words, each of the natural landscapes describes a full range of large-scale variations in landforms, vegetation, natural disturbance regimes, local climate, and biodiversity across the province. The province has committed to protect representative examples of each natural landscape in a network of protected areas. This is a challenging task, given that nearly 70% of the land in the province is privately owned.

In 2001, GPI *Atlantic* reported that 8.1% of provincial land was under some form of protection. This was still well below the minimum of 12% recommended by the World Wildlife Fund (WWF) in its global protected areas campaign. The goal of the WWF campaign, which began in the late 1980s and was agreed to by the federal and all provincial and territorial governments, was to ensure that none of Canada's designated

landscape and habitat types disappear.[37] In 2001, GPI*Atlantic* reported—based on the available data—that in 1998, 26 of the 80 landscape types, or 32.5% of all landscape types in Nova Scotia, had satisfactory representation in protected areas. This was an improvement from 1994, when only 7 landscape types, or 8.7%, had satisfactory representation in protected areas.

Since 1998, the only significant change in terms of representation was the protected areas designation in 2005 of the Eigg Mountain-James River Wilderness Area and the Gully Lake Wilderness Area. According to Department of Environment and Labour staff, Eigg Mountain is located in the Pictou-Antigonish Hills landscape, and the new wilderness area gave that particular landscape a "near satisfactory" representation, increasing the number of landscapes with satisfactory representation to 27, or 34.6% of all landscape types in the province. Gully Lake is mainly in the Cobequid Hills landscape, which was already well represented. All other designations that have occurred since 1998 (except the most recent, discussed below) "haven't been enough to move any other landscape into the "satisfactory" category.[38]

Table 3 below provides the most recent data on the percentage of Nova Scotia that is currently protected—8.5% of the total landmass, up from 8.1%, reported in 2001.

Table 3. Protected areas, Nova Scotia, 2007

TYPE OF PROTECTED AREA	TOTAL (HA)
34 Wilderness Areas	294,951
16 Nature Reserves	4,123
2 National Parks and 5 National Wildlife Areas	137,379
Provincial Parks and Park Reserves	33,000
National Heritage Rivers	N/A
Total Area Protected	469,453
Percentage of Total Provincial land (5.5 million ha)	8.5%

Sources: **Provincial parks and park reserves:** Brian Kinsman, Planner, NSDNR, personal communication, December 21, 2007. **All other data:** David Hopper, Private Land Conservation Coordinator, Nova Scotia Department of Environment and Labour, Protected Areas Branch, personal communication, November 29, 2007.

Notes:

- Shelburne River and Margaree River-Lake Ainslie are National Heritage Rivers, but they are only protected where they flow through a wilderness area.
- These numbers were accurate at time of writing. More recent wilderness area designations (see below) are not included.

- The NSDNR did not have current information on the proportion of protected forested and non-forested property. Therefore, a calculation of protected forest area as a percentage of total forested land (4.27 million ha) was not possible.
- These figures only include lands protected by the province, and not lands protected by private land owners or Municipalities. For example, the Nova Scotia Nature Trust currently protects roughly 1,200 ha of private land in Nova Scotia.[39] In addition, there may be individual land owners who are committed to protecting their land. In addition, Municipalities have land holdings used as parks. Due to time constraints, these figures have not been included in Table 3.
- Numbers have been rounded.

In 2001, GPI*Atlantic* reported that Nova Scotia had 31 wilderness areas. Today it has 34 designated wilderness areas, as seen in Table 3 above. However, this does not include the recently announced wilderness areas and acquired land, yet to be designated, such as the Bowater Mersey Paper Company Ltd. land acquisition (10,050 ha) announced in July of 2007,[40] the Blue Mountain-Birch Cove Lakes (1,350 ha) wilderness area in Halifax Regional Municipality announced in October, 2007, or the Ship Harbour-Long Lake wilderness area (14,000 ha) announced in December, 2007.

Once these areas are officially designated and added to the network of protected areas in Nova Scotia, they will extend the proportion of provincial land that is protected from 8.5% at present to 9%. Further analysis will be required to assess the impact of these new designations on the percentage of landscape types then protected and "satisfactorily" represented.

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Indicator 4: Harvest methods, % of total harvested, annual

Data Sources: National Forestry Database. Table 6.1. Silvicultural Statistics by Province/Territory, 1975-2006. Available from http://nfdp.ccfm.org/compendium/silviculture/tables_index_e.php

Result: There has been a marginal increase in the use of selection harvesting in the province. However, clearcutting remains by far the predominant harvest method in use.

A forest may depreciate in value as a result of either depletion (over-cutting) or degradation (harvesting in such a way as to undermine forest health.) We have already referenced the 1997 NSDNR position paper, which acknowledged that "softwood harvests have exceeded the sustainable supply level" on private lands, and that "overharvesting is a potentially serious problem demanding immediate attention."[41] The total area harvested has fallen since peaking in 1997 at roughly 70,000 ha, but remains about 50% higher than levels 20-30 years ago (Figure 8).

However, the 2001 GPI*Atlantic* Forest Accounts also noted that clearcutting, as a harvest method, has generally adverse impacts on forest health—exacerbating soil erosion, for example, by removing the entire tree canopy that normally intercepts precipitation. By contrast to uneven-aged selection harvest methods, clearcutting also undermines forest age and species diversity, destroys wildlife habitat, and compromises the capacity of forests to protect watersheds, sequester carbon, and regulate the climate. Again in contrast to selection harvesting, clearcutting also reduces actual timber value by removing wide-diameter and clear lumber from the forest, and it undermines community resilience by failing to provide steady forestry jobs over extended periods of time.

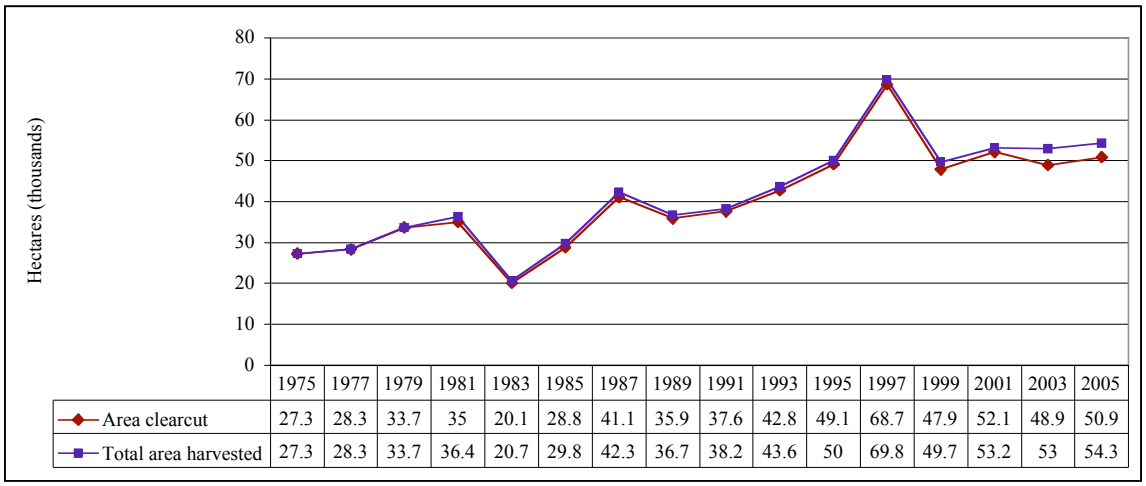
In 2001, the GPI Forest Accounts reported that roughly 98% of harvesting in Nova Scotia in the late 1990s was by clearcutting (including shelterwood).[42] By 2005, this proportion was closer to 94%—the lowest percentage on record in the 30 years for which data are available (see Figures 8 and 9 below). Between 2000 and 2005, therefore, there appears to have been some improvement in this area, with an increased use of selection harvesting—in which single trees or groups of trees are selectively removed from a stand in such a way as to maintain the integrity, diversity, health, and value of the stand as a whole.

Thus, in 2005, 838 ha of forest in Nova Scotia were harvested through selection cutting, up from 509 ha five years earlier—a quite dramatic relative increase of 65%, while the amount of forest clearcut fell by 4% during the same time period. In absolute terms, however, the selection harvest total remains very small. Thus, the few hundred hectares

selectively harvested is still in sharp contrast to the 52,874 ha clearcut in 2000 and the 50,864 ha clearcut in 2005. In other words, of the total forest area harvested in 2005, only 1.5% was cut using selection harvesting.[43]

Since 2000, there has also been a marked increase in the use of commercial thinning—from 1,050 ha in 2000 to 2,624 ha in 2005 (see Figure 10).

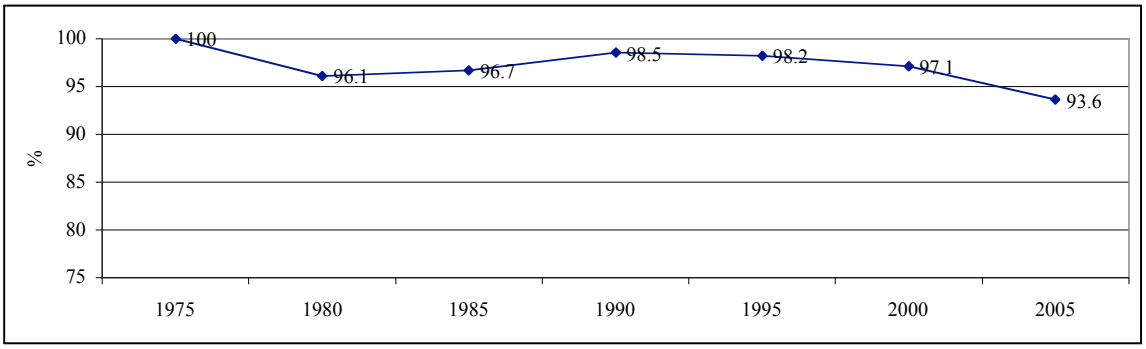
Figure 8. Total area harvested and area clearcut, Nova Scotia, 1975-2005, (hectares)



	1975	1977	1979	1981	1983	1985	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005
Area clearcut	27.3	28.3	33.7	35	20.1	28.8	41.1	35.9	37.6	42.8	49.1	68.7	47.9	52.1	48.9	50.9
Total area harvested	27.3	28.3	33.7	36.4	20.7	29.8	42.3	36.7	38.2	43.6	50	69.8	49.7	53.2	53	54.3

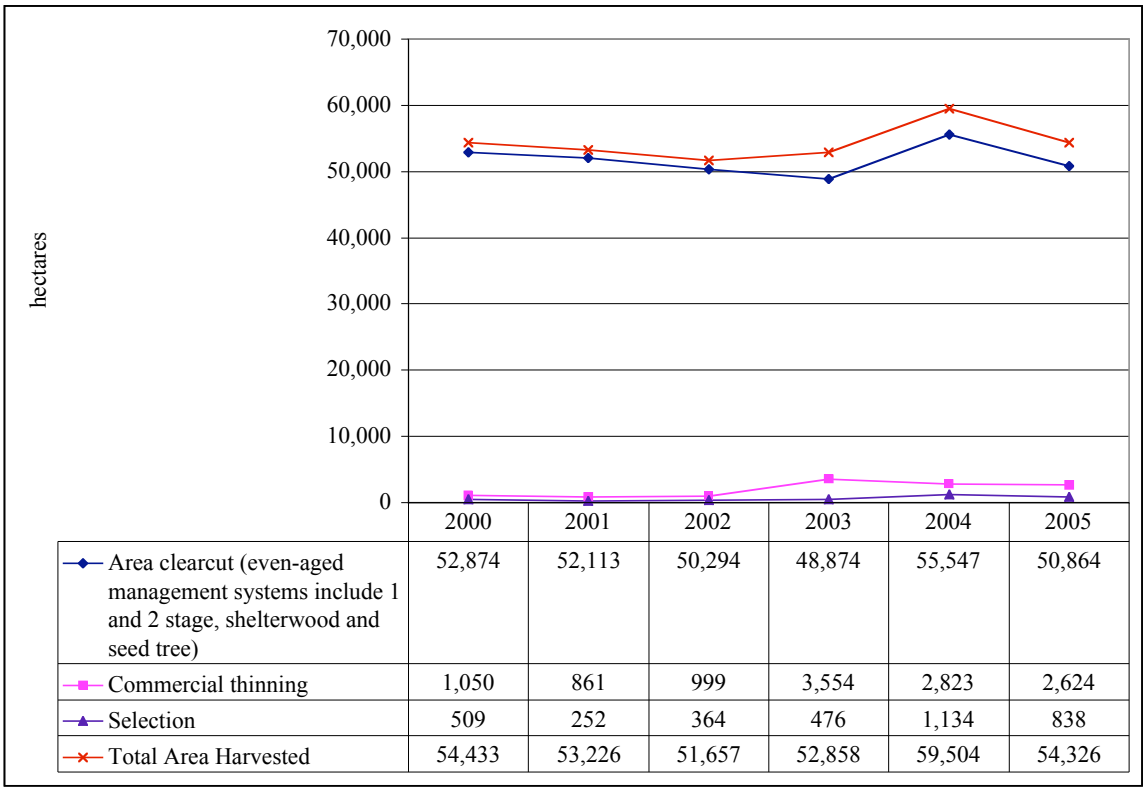
Source: National Forestry Database. Table 6.1. Silvicultural Statistics by Province/Territory, 1975-2006. Available from http://nfdp.ccfm.org/compendium/silviculture/tables_index_e.php.
Note: Data provided from this source for 2006 were identical to those for 2005, and were not included in this Figure because they were based on an estimate. Numbers have been rounded.

Figure 9. Percentage of area harvested by clearcutting, 1975-2005



Source: National Forestry Database. Table 6.1. Silvicultural Statistics by Province/Territory, 1975-2006. Available from http://nfdp.ccfm.org/compendium/silviculture/tables_index_e.php.
Note: Data for 2006 were identical to those for 2005, and were not included in this Figure because they were based on an estimate.

Figure 10. Harvest methods by area, Nova Scotia, 2000-2005



	2000	2001	2002	2003	2004	2005
Area clearcut (even-aged management systems include 1 and 2 stage, shelterwood and seed tree)	52,874	52,113	50,294	48,874	55,547	50,864
Commercial thinning	1,050	861	999	3,554	2,823	2,624
Selection	509	252	364	476	1,134	838
Total Area Harvested	54,433	53,226	51,657	52,858	59,504	54,326

Source: National Forestry Database. Table 6.1. Silvicultural Statistics by Province/Territory, 1975-2006. Available from http://nfdp.ccfm.org/compendium/silviculture/tables_index_e.php. Note: Data for 2006 were identical to 2005 and were not included in the Figure because they were based on an estimate.

In 2001, GPI*Atlantic* noted that the industrial model of forestry in use in Nova Scotia—with clearcutting as the predominant harvest method—impacts heavily on soil and water quality, degrades intrinsically valuable ecosystems that provide habitat for forest-dependent wildlife and aquatic species, and threatens forest-dependent communities in Nova Scotia. When used to the extent that it is in this province, clearcutting results in an overall loss of age diversity and tree species composition. In addition, the short-term removal of all commercial stands in an area for the sake of short-term economic expediency impacts negatively on communities that rely on stable long-term employment. In short, forest use based on clearcutting as the dominant harvesting method of choice, cannot sustain natural forest ecosystems nor contribute to stable employment or long-term community vitality.

For this reason, the GPI Forest Accounts count any movement away from clearcutting and even-aged management and towards uneven-aged selection harvest methods as genuine progress. This is in accord with public perception in the province. Thus, in 1999, 98% of those surveyed in Central Nova Scotia said that sustainable forest management was an important goal to achieve and 91% said that the present rate of timber harvest was too high to sustain the forest for other values or uses. Furthermore, "the majority felt that clearcutting should not be used as a harvest method because it harms wildlife, ruins forests, causes erosion, looks bad and wastes wood."[44] Any move by the Nova Scotia government that encourages movement in this direction by the forest industry and woodlot owners (either by regulating harvest practices or through a system of incentives and penalties like enhancing silviculture credits for selection harvesting and diminishing them for clearcutting) will likely have wide public support.

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Indicator 5: Value-added per cubic metre of wood harvested

Data Sources: Value-added for logging industry from 1990-2002 from Statistics Canada, CANSIM Table 301-0004 (Annual Survey of Forestry); Value-added for logging industry from 2003-2005 from Statistics Canada, CANSIM Table 301-0007 (Annual Survey of Manufactures and Logging); Value-added for paper, wood products, and wood furniture from 1990-2002 from Statistics Canada, CANSIM Table 301-0003 (Annual Survey of Manufactures); Value-added for paper, wood products, and wood furniture from 2003-2005 from Statistics Canada, CANSIM Table 301-0006 (Annual survey of Manufactures and Logging); Total Roundwood Harvested values from the National Forestry Database Program's Compendium of Canadian Forestry Statistics 2005, Table 5.1.

Result: Between 1998 and 2004, the rate of value-added forest product per cubic metre of wood harvested declined in Nova Scotia—giving it the second-lowest ranking among the provinces in 2004.

Genuinely sustainable development effectively integrates social, economic, and environmental objectives. In the forest sector, then, the challenge is to extract the greatest economic and social value from the resource with the least damage to the forest. From this perspective, the more value that can be added to each unit of biomass harvested, the less timber needs to be cut in order to maximize the value of the wood, provide jobs, and ensure a viable forestry sector. Higher ratios of timber value per unit of biomass harvested are therefore a sign of "genuine progress" in the GPI, because they signal improved economic viability in living off the interest or services provided by natural capital stocks, without depleting the stocks or capital assets themselves.

In 1998, Ontario had the highest rate of value-added product per cubic metre of wood harvested—\$374/m^3, compared with Quebec at \$260/m^3, New Brunswick at \$156/m^3, British Columbia at \$133/m^3, and Nova Scotia at 127/m^3 (\$2007).[45] The national average was \$205/m^3. In 1998, Nova Scotia's rate of value-added production was 34% that of Ontario, 49% that of Quebec, and 81% that of New Brunswick.

In 2004, the most recent year for which comparable data were available,[46] the highest rate of value-added product per cubic metre of wood harvested was in Manitoba (\$425), followed by Ontario (\$367), Quebec (\$241), and New Brunswick (\$176). The lowest rate was found in PEI (\$54). Nova Scotia ranked second-lowest among the provinces (\$107), and well below the Canadian average (\$183), with a rate of value-added production that was 25% that of Manitoba, 29% that of Ontario, 44% that of Quebec, and 61% that of New Brunswick (Table 4 below).

Table 4. Value-added per cubic metre of wood harvested, by province, 1998 and 2004, ($2007)

PROVINCE	VALUE-ADDED (PER M^3 OF WOOD HARVESTED)1998	VALUE –ADDED (PER M^3 OF WOOD HARVESTED)2004
NFLD	$50	$121
PEI	$39	$54
NS	$127	$107
NB*	$156	$176
QC	$260	$241
ON	$374	$367
MAN	$123	$425
SASK	$79	$142
ALTA*	$113	$137
BC	$133	$117
CANADA	$205	$183

Sources: Value-added for logging industry from 1990-2002 from Statistics Canada, CANSIM Table 301-0004 (Annual Survey of Forestry); Value-added for logging industry from 2003-2005 from Statistics Canada, CANSIM Table 301-0007 (Annual Survey of Manufactures and Logging); Value-added for paper, wood products, and wood furniture from 1990-2002 from Statistics Canada, CANSIM Table 301-0003 (Annual Survey of Manufactures); Value-added for paper, wood products, and wood furniture from 2003-2005 from Statistics Canada, CANSIM Table 301-0006 (Annual survey of Manufactures and Logging); Total Roundwood Harvested values from the National Forestry Database Program's Compendium of Canadian Forestry Statistics 2005, Table 5.1.

Notes:

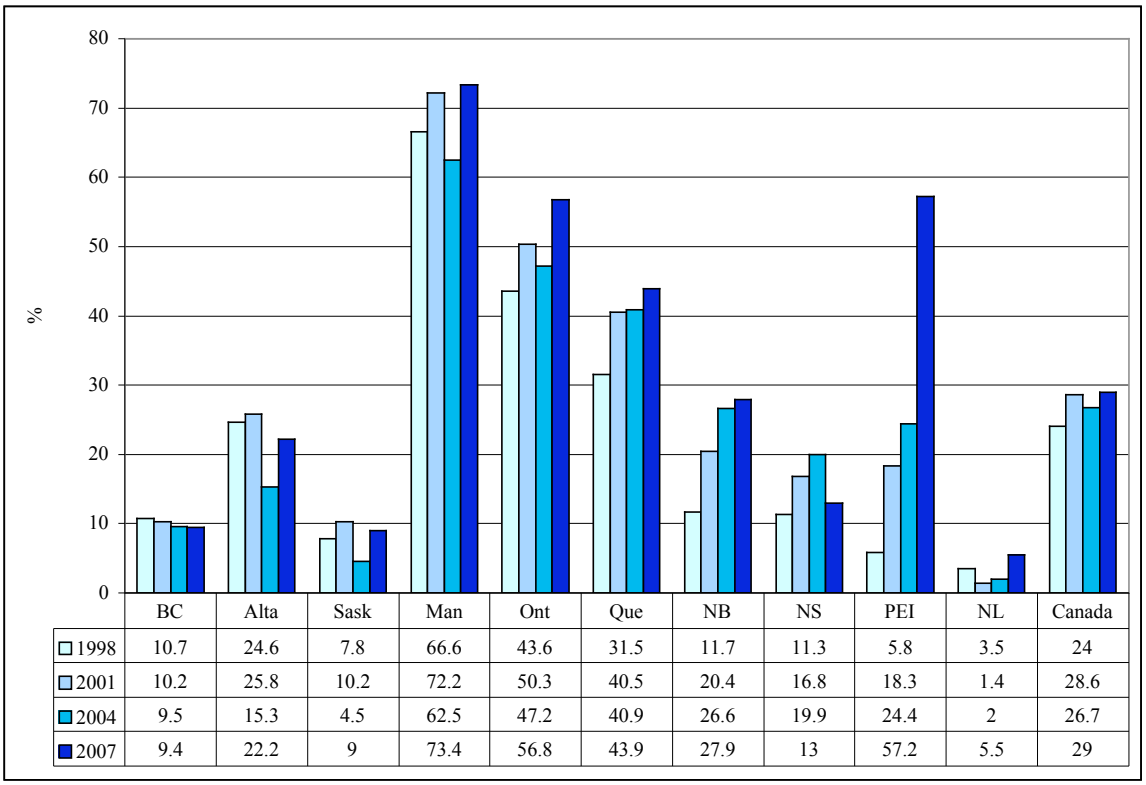
- *For comparability reasons, value-added data for New Brunswick and Alberta are for 1997.
- Value-added figures for each province come from logging, paper and allied products, wood product manufacturing, and wood furniture and related products. The latter sector includes value-added for products made from wood, including wood kitchen cabinet and countertop manufacturing, other wood household furniture, and wood office furniture. The rate of value-added by province was calculated by dividing the total value-added for each of these four sectors by the total volume of roundwood harvested in that province in the years under consideration.
- The most recent data available are for year 2005. However, due to the following reasons, 2004 data are reported here: 1) Total Roundwood Harvested data for New Brunswick and Manitoba are incomplete for the year 2005; and 2) in 2005, the value-added data for a number of forestry sectors were suppressed to protect confidentiality. Therefore, pan-Canadian comparisons were not possible using 2005 data.
- In 1998, the value-added from paper and allied products is not included in the Newfoundland, Manitoba, or Saskatchewan totals for that year because the data were suppressed by Statistics Canada to protect confidentiality. For the same reason, data for value-added in the paper and allied products and the wood furniture sectors are not included in the totals for PEI in 1998. In 2004, data for wood furniture and related products were suppressed for BC.
- In 2004, the Annual Survey of Manufactures and Logging replaced the Annual Survey of Forestry and the Annual Survey of Manufactures. While the survey still covers the same target industries, there are a few conceptual and methodological changes. There are some changes to the definition of financial variables in the new survey. However these were only found to affect the comparison of the costs of energy and water utilities and the costs of materials and supplies. Prior to 2004, businesses with revenues below $30,000 per year were excluded from the survey. In the new

survey, values are published for businesses above certain revenue thresholds that vary by province, industry and by year.

- Conversion to 2004 constant dollars was made using the Bank of Canada's Inflation Calculator, January 18, 2008. Numbers have been rounded.

As Table 4 above indicates, value-added per cubic metre of wood harvested in Manitoba increased from $123 in 1998 to $425 in 2004. While more investigation is required to ascertain why some provinces seem to be doing better than others with regard to this indicator, there is some evidence to suggest that the Manitoba government's explicit commitment to promoting value-added business operations has helped make Manitoba a leader in Canada in this field.[47] In March 2002, Manitoba Conservation published a Five Year *Report on the Status of Forestry* that referenced the government's policy to actively promote value-added processing in the province.[48] In the last several years, in fulfillment of that objective, programs have been implemented in Manitoba to link urban buyers with a chain of loggers, kiln operators, and furniture and cabinet makers. In 2007, nearly three quarters of all the wood exports from Manitoba were characterized as "value-added." In the same year 57% of Ontario's wood shipments, 44% of Quebec's, and 13% of Nova Scotia's, were value-added. The Canadian average was 29% (see Figure 11 below).[49]

Figure 11. Value added as a percent of total wood exports, by province, 1998–2007



	BC	Alta	Sask	Man	Ont	Que	NB	NS	PEI	NL	Canada
1998	10.7	24.6	7.8	66.6	43.6	31.5	11.7	11.3	5.8	3.5	24
2001	10.2	25.8	10.2	72.2	50.3	40.5	20.4	16.8	18.3	1.4	28.6
2004	9.5	15.3	4.5	62.5	47.2	40.9	26.6	19.9	24.4	2	26.7
2007	9.4	22.2	9	73.4	56.8	43.9	27.9	13	57.2	5.5	29

Source: Data provided to GPI*Atlantic* by Dan Schrier, Manager, Trade and Business Statistics, B.C. Stats, Ministry of Labour and Citizens' Services, Government of British Columbia. Original data are from Statistics Canada.

Note: Value-added exports are defined by B.C. Stats as a product made from lumber such as mouldings, siding, engineered wood and completed articles primarily of wood. Engineered wood products include glued laminated timber and laminated veneer lumber. Articles made from wood could include doors, windows, prefabricated houses and furniture. Excluded from the definition are shakes and shingles, and panel products such as plywood, oriented strand board and medium density fibreboard.[50]

According to Candace Christiano, co-owner of a value-added wood products business in Cape Breton, there are still many obstacles facing value-added industries in Nova Scotia. They include:

- Continued lack of interest in value-added potential and current uses by the NSDNR and Nova Scotia Economic Development
- Lack of policy relating to resource allotments for value-added end uses or end users
- Global market pressure to reduce prices.[51]

In 2001, GPI*Atlantic* reported that two key factors contribute to the fact that Nova Scotia has a poorly developed value-added forest sector. In 2007, the situation has not changed.

1) The dominance of the pulp and paper industry. In Nova Scotia, the wood market continues to be dominated by three transnational companies: U.S-based Bowater, Inc., in Liverpool; U.S.-based Neenah Paper, Inc., in Abercrombie (formerly Kimberly-Clark); and U.S-based NewPage in Port Hawkesbury (formerly Swedish Stora Enso).[52] These three companies hold Crown leases or agreements on the majority of Crown lands in the province, and rely heavily on private landowners for the majority of their wood supply. According to one analyst: "Given 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."[53]
2) The highly degraded condition of most of the region's forests further diminishes the opportunities for improving the quality of forest stands and thus producing higher value forest products.

A 2003 study, prepared for the Nova Scotia Community College and funded by Enterprise Cape Breton Corporation (ECBC) and Atlantic Canada Opportunities Agency (ACOA), about the value-added wood products industry in Nova Scotia, and citing the 2001 GPI Forest Accounts, had the aim to "develop a comprehensive plan that will promote its sustainable growth and viability as a vital contributor to the provincial economy."[54] The report cited a number of "threats" to the viability of the Nova Scotia Secondary Wood Products Industry (NSSWPI), including:

- Provincial focus on primary manufacturing: "The growth of the NSSWPI has been hindered by the past policies of the province with regard to the use of Crown Land and this policy now threatens any significant growth in the sector. It has been pointed out in earlier studies that the NSSWPI generates higher revenues and provides more jobs per unit of wood fibre than the primary sector but this has failed to drive any change in initiatives to promote higher value-added conversion of wood resources."

- Inadequate education and training in the field: Opportunities for training and technical assistance in the province are currently lacking. Despite the fact that the Atlantic region has more postsecondary institutions per capita than anywhere else in Canada, there is inadequate education in the field of manufacturing or industrial engineering. "Left as is, this issue will be the greatest threat to a viable exporting NSSWPI that can contribute to increased employment and GDP in the province."

- Limited natural resources: "We believe the forests have reached their limit in sustainable harvest levels for both softwoods and hardwoods. Our conclusion is based on lengthy discussions with the Natural Resources department of Nova Scotia and other stakeholders in the primary and secondary sectors of the industry and a review of available data."[55]

Some of the report's key recommendations are combined and summarized below. For more detail, please refer to the original report.[56]

- Create organizational and educational infrastructure for a NSSWPI by creating a NSSWPI Strategy Implementation Commission, which would be responsible for the overall implementation of the recommendations.

- Create a new Advanced Woodworking Technology Centre at the Nova Scotia Community College, and form a Nova Scotia chapter of the Wood Products Group. These structural initiatives could draw people into the value-added sector through career recruitment and retention initiatives.

- Develop a value-added forest resource strategy. In other words, "more roundwood *currently being harvested* needs to make its way into the supply chain of the value-added wood products industry in NS. Currently, very little is finding its way" there. "Instead, much of the hardwood and softwood roundwood is leaving the province to be processed elsewhere or is being converted into very low value-added products…higher-grade hardwood material is being exported to veneer mills in the U.S. and elsewhere."

- Develop a Technical Assistance Program for existing companies and new start-ups.

- Promote the development of higher-tier secondary wood products such as furniture or veneer.

- Develop a Nova Scotia Forest Certification Plan: "Two of the most important markets to Nova Scotia—Europe and the United States—will both continue to move toward value-added wood products from 'certified forests.'"[57]

Since 2003, some of these recommendations have been implemented and some have not. Thus, there has not been much progress on the first two recommendations above—creating a NSSWPI Strategy Implementation Commission and a New Advanced Woodworking Technology Centre. The Marconi Campus of the NSCC, where the current Wood Products Manufacturing Technology Program is found, has benefited from some new equipment, but the training and career recruitment vision laid out in the 2003 report has not been even remotely realized. While more forest land is being FSC-certified in Nova Scotia, a forest certification plan in the value-added sector does not yet exist in the province.

On the positive side, a Nova Scotia Secondary Wood Products Association (NSSWPA) has been formed since 2003 and is designed to do what the Wood Products Group (WPG) does in New Brunswick. Thus, the NSSWPA's mandate includes the promotion of the value-added sector in Nova Scotia, and the Association currently runs a web site and has published some brochures dedicated to this objective.

However, the NSSWPA is not a chapter of the Atlantic-wide WPG, as recommended in the 2003 NSCC study. The WPG's mandate is "to represent, promote, and advance the

interests of specialty and value-added wood-products companies in Atlantic Canada,"[58] and could thus provide a suitable framework and supporting structure for the new NSSWPA. One limiting factor is that the NSSWPA is currently run by volunteers and therefore requires an infusion of multi-year core funding in order to function as the marketing and policy research body that is envisioned.

Substantial progress has been made in developing a Technical Assistance Program, with the NSSWPA forging links with the Nova Scotia Community College (Marconi Campus), Wood Products Quality Council, and Forintek, a division of FPInnovations, a not-for-profit research organization involved in the wood products sector.

On balance and despite progress on some of the 2003 recommendations described above, Nova Scotia still lags behind other provinces in terms of developing an integrated and dedicated value-added forest resource strategy. Currently no formal policy with regard to the value-added sector exists in this province.[59]

Indicator 6: Jobs per unit of biomass: How much wood fibre do we need to employ one person?

Data Sources: 1981-1996 harvest volume data are from the NSDNR, 1997, Toward Sustainable Forestry: A Position Paper. 1999-2006 data are from NSDNR Registry of Buyers Annual Reports. Provincial employment data 1990-2006: Original data from Statistics Canada, Labour Force Survey, provided to GPI*Atlantic* by Patrick Brannon, Research Analyst, Atlantic Provinces Economic Council, October 16, 2007. Employment data for Windhorse Farm provided by Jim Drescher. Employment data for Finewood Flooring and Lumber Limited provided by Candace Christiano.

Result: Jobs per unit of biomass in the forest industry in Nova Scotia have not increased since 2001.

From a GPI perspective, the mark of sustainability is the capacity to live off the interest generated by natural capital—in this case the province's forests—while retaining and protecting the value of the capital stocks for future generations. Therefore, given the need to restore the health of Nova Scotia's degraded forests, to reduce over-harvesting and clearcutting, and to integrate social, economic, and environmental objectives in use of the province's forest resource, a key indicator of genuine progress in the GPI is to increase employment per unit of biomass harvested. Unfortunately, and despite the evidence and recommendations presented in GPI*Atlantic*'s 2001 Forest Accounts, data indicate that there has been no improvement in this area in the last six years, and that the opposite may in fact be happening.

In Nova Scotia, over the past 45 years, there have been a number of trends that have resulted in unsustainable harvesting of the province's forests. These include:

1) an increase in mechanization and automation in both harvesting and processing;
2) investment in modern, state-of-the-art sawmill technology;
3) a decline in high-value sawlog species; and
4) globalized market and trading patterns.

All of these together have led not only to the virtual liquidation of the province's remaining natural and old-growth forests as noted earlier, but also to a decrease in employment when measured in terms of jobs per unit of biomass harvested.

As Figure 12 below illustrates, over a 25-year period, the annual harvest volume of hardwood and softwood species from both public and private land has increased by nearly 60%—from an average of 3.3 million cubic metres annually in the early 1980s to 5.2 million cubic metres in 2006. Wood harvest volume peaked in 2004 at nearly 7

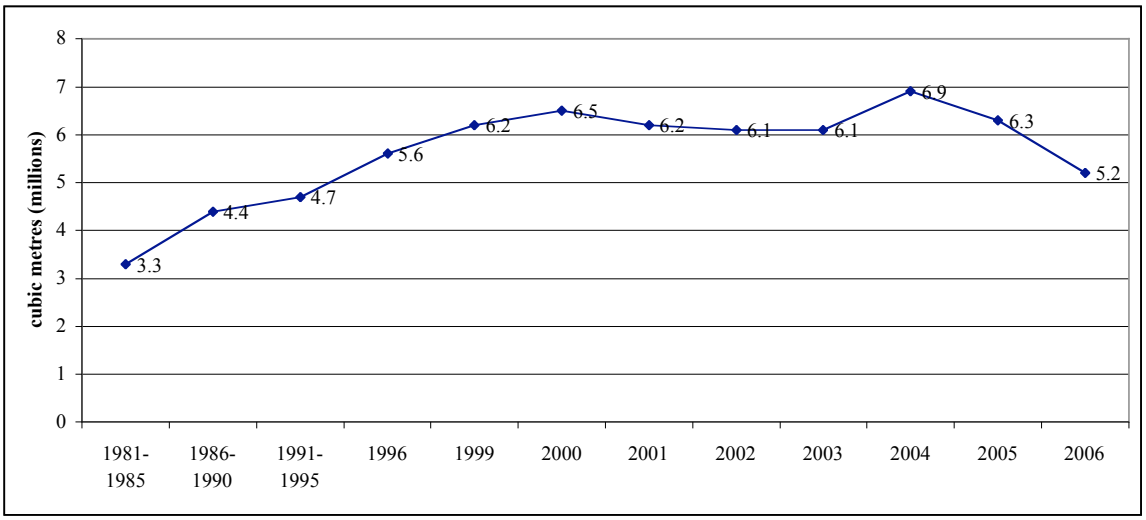
million cubic metres of wood—more than double the levels of the early 1980s. According to the NSDNR's Registry of Buyers, the "ten month shut down at Nova Scotia's largest pulp mill, Stora Enso, precipitated a significant decrease in the amount of pulpwood harvested in 2006." In that year, 5.2 million cubic metres of wood was cut—down 17.5% from the 6.3 million cubic metres cut the year before.[60]

In 1997, as noted earlier, the NSDNR published a report called "Toward Sustainable Forestry," which at the time raised alarm bells regarding the increase in harvest volumes, particularly on private lands, where silviculture activities were declining. The report noted that "softwood harvests have exceeded the sustainable supply level" on private lands, and stated that "…it seems reasonable to conclude that overharvesting is a potentially serious problem demanding immediate attention."

It is unclear whether this situation has improved in the intervening period, especially since harvest volumes continued to climb following publication of that report. Indeed—with the exception of the anomalous 2006 results attributable to the shut-down of the Stora Enso plant—harvest volumes have remained consistently higher than they were prior to that report's publication.

The 1997 NSDNR report also recommended that a Registry of Buyers report be published annually, providing data on the amount of wood being taken out of Nova Scotia's forests. This has occurred, and these annual reports have been used by GPI*Atlantic* both in 2001 and here to determine annual harvest volumes. However, in addition, the NSDNR stated in its 1997 report that it would "regularly" publish and distribute a "state of the forest" report. Such reports would indeed be helpful in assessing whether the current levels of harvest coupled with silvicultural practices are in fact sustainable. To our knowledge, however, these reports have never been published.

Figure 12. Actual annual harvest volumes in Nova Scotia (crown and private land), 1981-2006



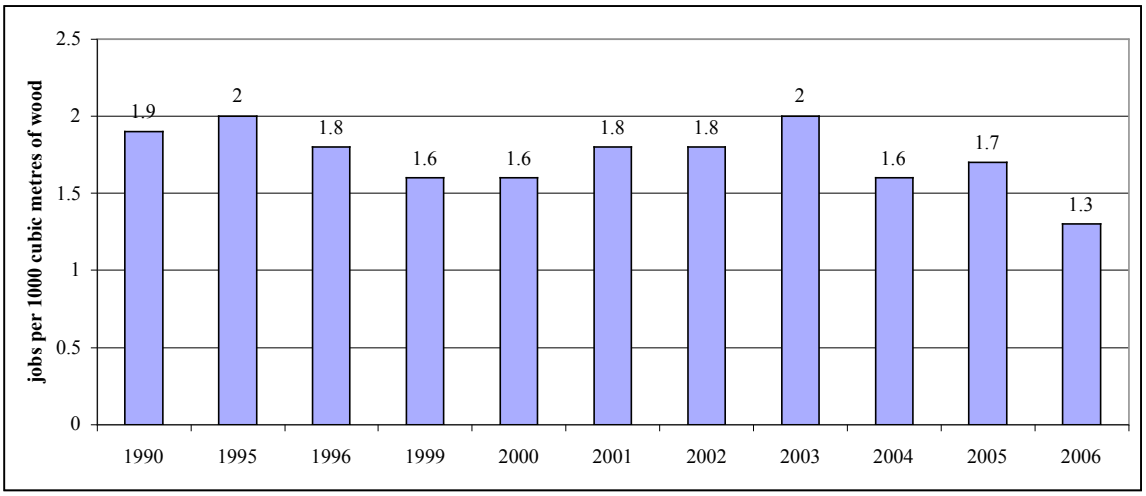
Sources: 1981-1996 data are from the NSDNR, 1997, Toward Sustainable Forestry: A Position Paper. 1999-2006 data are from NSDNR Registry of Buyers Annual Reports. The Registry of Buyers was established in 1998.

When it comes to employment in the forest industry, the question that is typically asked is: "How many people does your company employ?" Instead, from a sustainable forestry perspective, the question should be: "How much wood fibre do you need to employ one person?" In its 2001 Forest Accounts for Nova Scotia, GPI*Atlantic* found that companies that employed a combination of selection harvesting with value-added wood production had the highest jobs per unit of biomass ratio. By contrast, companies that rely on clearcutting and pulp and paper manufacturing produce far fewer jobs per unit of biomass harvested.

Figure 13 below illustrates that since this indicator was last reported on in the 2001 GPI Forest Accounts, results have not improved. Though no clear trend is discernible, jobs per unit of biomass in the forest industry apparently decreased between 2001 and 2006—from 1.8 to 1.3 jobs per 1,000 cubic metres of wood harvested, peaking in 2003 at 2.

However, the apparently anomalous 2006 results are likely related to the Stora Enso Port Hawkesbury mill shut-down. According to Statistics Canada's Labour Force Survey, total direct employment in the forest industry in 2006 was 6,900. This figure includes primary, wood, and pulp and paper jobs.[61] Without the 2006 results, Figure 13 shows no clear trend, though it is also apparent that there has been no overall increase in jobs per unit of biomass harvested in the period under consideration.

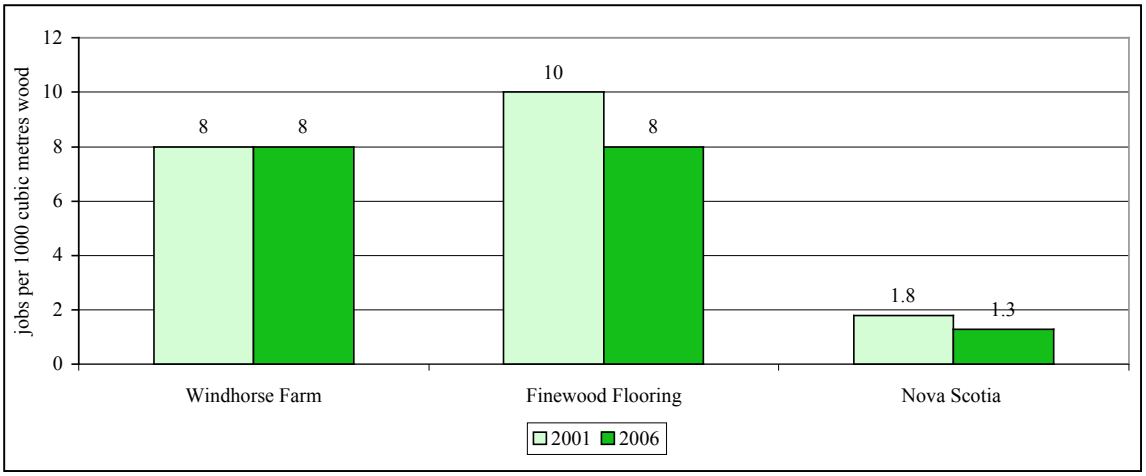
Figure 13. Number of full-time jobs per 1,000 cubic metres of wood harvested, Nova Scotia, 1990-2006



Source: Harvest volume data from NSDNR, 1997, Toward Sustainable Forestry: A Position Paper and NSDNR Registry of Buyers Annual Reports. Employment data from Statistics Canada's Labour Force Survey for 1990 to 2006 were provided to GPI*Atlantic* by Patrick Brannon, Research Analyst, Atlantic Provinces Economic Council, October 16, 2007.

In 2001, GPI*Atlantic* reported on six case studies, which all demonstrated and confirmed that getting the most value from every piece of wood cut can reduce harvest levels while increasing employment. Two of the case studies explored in 2001 were Windhorse Farm, a sustainably logged forest near New Germany where selection harvest methods and uneven-aged forest management have historically been used, and Finewood Flooring and Lumber Ltd., a value-added wood products business on Cape Breton Island. In 2001, Windhorse Farm directly employed 8 people full-time for every 1,000 cubic metres of wood harvested, and Finewood Flooring directly employed 10. In 2006, Windhorse Farm still employed 8, and in 2007 Finewood Flooring employed 8—down from 2001, due to more efficient processing of the products, according to the company owner.[62] These direct employment figures remain well above the 1.3 jobs per 1,000 cubic metres created by the Nova Scotia forestry industry in 2006 (see Figure 14 below).

Figure 14. Estimates of full-time jobs per 1,000 cubic metres of wood harvested, Nova Scotia, 2001 and 2006



Sources: NSDNR Registry of Buyers; Statistics Canada's Labour Force Survey (employment data provided by Patrick Brannon, Research Analyst, Atlantic Provinces Economic Council, October 16, 2007); Drescher, 2007; Christiano, 2007

Note: Figures for Finewood Flooring are for 2007.

GPI*Atlantic*

Recommendations

The GPI analysis demonstrates clearly that—according to a wide range of criteria and indicators of forest health—Nova Scotia's forests have been severely degraded over time, and their capacity to perform a wide range of forest functions has been seriously compromised. These functions include protection of soils, watersheds, biodiversity, habitat for species, aesthetic quality and recreational opportunities, climate regulation and sequestration of carbon from the atmosphere, and provision of the high quality, wide diameter, clear timber that characterizes older forests.

To begin to restore and protect the value of Nova Scotia's forest wealth so that it can once again provide a full range of forest functions and services, GPI*Atlantic* recommends:

- Greater incentives (tax and silvicultural) to woodlot owners for investment in forest restoration and uneven-aged management, including selection harvesting and restoration forestry methods, in order to restore the natural age distribution and species diversity of the province's forests, and to provide more sustainable jobs;

- A sharp reduction in the rate of unsustainable clearcutting methods, and in the volume of wood harvested annually;

- Development of a value-added forest strategy in Nova Scotia with a shift from volume-based to value-added forest products, in order to produce high-value wood products, and thus to increase the number of jobs per unit of wood harvested;

- Immediate protection of all remaining old-growth forest, and of older forests that have the greatest potential to return to their old-growth state over time;

- Monitoring the full range of forest values and services, and the full cost and benefits of associated harvest methods, to be counted and tracked in annual forest accounts and in ongoing forest management planning;

- An adequate network of represented protected areas in Nova Scotia;

- The Nova Scotia Department of Natural Resources undertake the task of calculating provincial age class distributions using Permanent Sample Plot data in five year periods from 1965-70 to 2003-08 when the 2008 field season is completed and provide this information to the public. (The historical PSP data have never been made public.)

- All Crown land in the province allocated for harvest should be Forest Stewardship Council (FSC) certified.

Given the high rate of private ownership of forest land in Nova Scotia (69%), government policy will have to focus as much on incentives encouraging good stewardship as on policy and regulation. Incentives should include encouraging the development of small-scale wood product industries and local Nova Scotian manufacturing and value-added enterprises. This can create a win-win situation with less wood needed to provide more jobs, and with more public and private revenues remaining in local communities within the province. Forest policy and practice would thus benefit forest-dependent communities, providing long-term sustainable employment, and contributing to their overall wellbeing.

While results have been presented here in the form of six key indicators, the evidence—and the GPI as a whole—clearly indicate the social, economic, and environmental aspects of forest health and indeed their interrelated nature. Thus, to restore the health of Nova Scotia's severely degraded forests, including their capacity to perform a wide range of vital functions that are now seriously compromised, requires the restoration of their age diversity. That in turn requires a sharp expansion of protected areas and a change in forest harvest practices and policies. A shift from clearcutting to selection harvest methods, and from over-reliance on pulp and paper production to greater value-added production can increase jobs and value per unit of biomass harvested, and would reduce current rates of over-harvesting and improve the viability and resilience of the forestry industry.

Endnotes

[1] Wright, Ronald. 2004. A Short History of Progress. Anansi Press. Toronto. p. 105.
[2] Wendell Berry cited in GPI Forest Accounts, Volume 2, 2001. Available from http://www.gpiatlantic.org.
[3] Dr. Wilfrid Creighton was the Deputy Minister of the Nova Scotia Department of Lands and Forests and retired in 1969. This quote was taken from a transcript of his comments given at a public forum on forest issues held at Dalhousie University in 1998. The transcript first appeared in *Clearcutting in Perspective,* 2000. Nova Scotia Public Interest Research Group. Dalhousie University, Halifax.
[4] 1958 is taken as a benchmark year in these estimates, only because it provides the earliest comparable inventory data set. The 1958 figures in no way represent a pristine, unspoiled, or natural forest. As outlined in GPI*Atlantic*'s 2001 Forest Accounts (Volume 1), the 1958 forest survey conducted by the provincial Department of Lands and Forests observed that NS had already lost most of its primary forest by that year. Even the first provincial forest survey in 1912 found the province's forest already depleted. Therefore, when these most recent inventory data are presented here, it must be kept in mind that if these were compared to the naturally existing Acadian forest of the province prior to European settlement and logging, the loss in age diversity would be far more dramatic than what is presented here.
[5] Nova Scotia Department of Lands and Forests. 1958. The Forest Resources of Nova Scotia. Prepared by L.S. Hawboldt and R.M. Bulmer, p. 30.
[6] Dr. Fernow made observations about the Nova Scotia forest in 1910. His remarks are cited in Nova Scotia Department of Lands and Forests. 1958. The Forest Resources of Nova Scotia. Prepared by L.S. Hawboldt and R.M. Bulmer, p. 62.
[7] Ibid.
[8] Nova Scotia Department of Natural Resources. l997. Toward Sustainable Forestry, A Position Paper. Nova Scotia, pp. 1-8.
[9] 1981-1996 data are from the NSDNR, 1997, Toward Sustainable Forestry: A Position Paper. 1999-2006 data are from NSDNR Registry of Buyers Annual Reports. The Registry of Buyers was established in 1998.
[10] According to the 1997 NSDNR publication "Toward Sustainable Forestry," the provincial forest inventory maintained since the late 1950s is the basis for "making estimates of the volumes of major tree species groups growing in the forest. Coupled with other data, it is possible to make harvest level projections that the forest can support. This inventory produces quantitative measures for broad policy planning purposes. It compares favourably to similar programs in other jurisdictions." p. 4
[11] The 1958 inventory provided no data for the 0-20 age category.
[12] No 0 to 20 age class data were provided in 1958. The earliest data for this age class were reported in the 1965-1971forest inventory. These 1965-71 data were therefore used in the calculation for percentage increase.
[13] Personal communication with Ken Snow, Manager Forest Inventory, NSDNR. January 3, 2008.
[14] The NSDNR's Interim 1999 Old Forest Policy defines "old growth" as forests over 125 years of age.
[15] According to Ken Snow, Manager of Forest Inventory with the NSDNR, PSP data for age classes do exist going back to 1965, but have not been published. Mr Snow writes: "It would be a very interesting research project to calculate provincial age class distributions in five year periods from 1965-70 to 2003-08 when the 2008 field season is completed." Personal communication with Linda Pannozzo, November 21, 2007.
[16] Personal communications with Ken Snow, Manager, Forest Inventory, NSDNR. November 21 and December 13, 2007. Historical PSP age class data were not made available to GPI*Atlantic* for the purposes of such an analysis.
[17] For a more in-depth analysis of the conflict between the GIS age class data and the PSP age class data please refer to Section 6.3.1 of the GPI Forest Accounts, Volume 1, 2001.
[18] Nova Scotia Department of Natural Resources. 2004. Nova Scotia Forest Inventory Based on Permanent Sample Plots Measured Between 1999 and 2003. Report FOR 2004-3. NSDNR. Truro, p. 4.
[19] These do not add up to 100 because in 1998, 0.6% of the plots were categorized as "unevenaged." The 2003 PSP report did not estimate whether plots were "unevenaged."

[20] Ken Snow, Manager of Forest Inventory, NSDNR. Personal communication, November 26, 2007.
[21] NSDNR. 1999. Nova Scotia Wood Supply: Forecast for Nova Scotia, 1996-2070. Powerpoint Presentation. Cited in GPI Atlantic. Forest Accounts for Nova Scotia. Volume 1, p. 61. Available at http://www.gpiatlantic.org/pdf/forest/forest1.pdf. Accessed February 20, 2008.
[22] Naeem, S., L.J. Thompson, S.P. Lawler, J.H. Lawton, and R.M. Woodfin. 1994. Declining Biodiversity can Alter the Performance of Ecosystems. Nature. 368:734-737. Cited in GPI*Atlantic* Forest Accounts, 2001, Volume 1, Section 7.2, p. 38.
[23] Smith, F. 1996. Biological diversity, ecosystem stability and economic development. *Ecological Economics*. 16: 191-203. Cited in GPI Forest Accounts, 2001, Vol. 1, Section 7.2, p. 38.
[24] Su, Q., D.A. MacLean, and T.D. Needham. 1996. The influence of hardwood content on balsam fir defoliation by spruce budworm. *Canadian Journal of Forest Research*. 26: 1620-1628. Cited in GPI Forest Accounts, 2001, Vol. 1, p. 70.
[25] NSDNR defines an "old growth" forest as any forest stand with a minimum of 30% crown closure, 50% or more of the basal area in climax species, and 30% or more of the stand's basal area 125 years old or older. NSDNR policy is to set aside 8% of crown land in each of the province's 38 EcoDistricts as old growth and old forest. Interim Old Forest Policy. Available at http://www.gov.ns.ca/natr/forestry/planresch/oldgrowth/policy.htm. Accessed November 29, 2007.
[26] While further investigation is required into the causes of the increase in number of known forest-dependent species at risk, it is possible that at least part of the explanation lies in factors such as increased research effort, new information arising from recent studies/surveys, and policy or definitional changes with regard to Species at Risk.
[27] Trout prefer cool water in summer months. Because studies indicate that high water temperatures caused by loss of forest canopy cover or shade (caused by clearcutting) can cause physiological stress and mortality to trout, it has been suggested that they are a forest-dwelling species. Please refer to the GPI Forest Accounts (Volume 1) for details.
[28] Species at Risk category definitions: Endangered: a species facing imminent extirpation or extinction; Threatened: a species likely to become endangered if limiting factors are not reversed; Vulnerable: a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events; Extirpated: a species that no longer exists in the wild in the province but exists in the wild outside the province; Extinct: a species that no longer exists.
[29] Amanda Lavers writes: "In Nova Scotia, 69% of land is owned privately (NSDNR 2004). This provides a unique challenge for the conservation of rare species, particularly for those (such as nocturnal flying squirrels) that are not well-known among the public. The public must be engaged if forest harvest practices are to be modified for long-term wildlife conservation. The information campaign to solicit records of *G. volans* was a preliminary step in both public engagement and research about this species. Communication of research results and natural history details to the public should continue and a strategy to conserve flying squirrels should be developed in Nova Scotia." Personal communication, December 4, 2007.
[30] According to Mark Elderkin, the Species at Risk biologist with the NSDNR, all private landowners are also expected to "exercise some degree of due diligence to ensure their actions" do not negatively impact a species at risk including red- and yellow-listed species. Personal communication, December 20, 2007.
[31] Information about the forest-dependence of Odonata (dragonflies) was provided by Paul Brunelle, Research Associate of the New Brunswick Museum and Regional Coordinator of the Atlantic Dragonfly Inventory Program. Personal Communication, November 2, 2007.
[32] Personal communications with John Gilhen, December 7, 2007, and January 3, 2008.
[33] Audubon Society. 2007. State of the Birds. Common Birds in Decline. Available from http://stateofthebirds.audubon.org/cbid/ Accessed October 12, 2007.
[34] Sustainable forest management is not the whole answer. Even with the most careful harvesting techniques, there will be some level of impact on forest ecosystems. While there is a great difference between clearcutting and selection harvesting systems, they both involve the construction of roads and removal of biomass. Even the highest standards applied on a particular woodlot cannot guarantee the needed protection of critical forest values at the landscape level. Therefore, no matter how excellent forest operations may be, they are not a substitute for an adequate network of representative protected areas in Nova Scotia.

[35] The NSDNR also has a system of land classification called Ecological Land Classification (ELC), comprised of 8 ecoregions, 39 ecodistricts and 637 ecosections, further broken down into ecosites—all within the Acadian Forest Ecozone. This program is used as part of its Integrated Resource Management planning process, which is a multiple-use planning process for Provincial Crown lands. The Department of Environment's 80 "natural landscapes" are used for provincial protected area planning and management processes and for assessing the level of landscape representation with protected areas. According to Peter Neily, Forest Ecologist with the NSDNR, the landscape unit used by the Department of Environment and Labour is based on the "Natural History of Nova Scotia," while the NSDNR's ELC system is based on the biophysical land classification for Nova Scotia. Neily says the Natural Landscape system does not capture the variability and detail that the NSDNR's ELC system does. Personal communication, December 5, 2007.
[36] Nova Scotia Department of Environment and Labour. 2002. Natural Landscapes of Nova Scotia. Summary Descriptions. Protected Areas Branch. Available from http://www.gov.ns.ca/enla/protectedareas/docs/landscapes_report.pdf. Accessed November 30, 2007. p. 3.
[37] In 1989, the WWF started the Endangered Spaces Campaign in an effort to protect a network of all of Canada's terrestrial regions by the year 2000. While the WWF recommended 12% protection, it has been suggested by Department of Environment and Labour staff that this number is not scientifically defensible and should probably be much higher. (Dave MacKinnon, personal communication, 2001). In any case, in 2007-08, Nova Scotia still has a long way to go to reach the 12% minimum recommended by the WWF. Nova Scotia's 2007 Environmental Goals and Sustainable Prosperity Act commits the province to protect 12% of its land mass by the year 2015—more than 25 years after the original WWF campaign began.
[38] The recently announced designation of new areas (i.e. Ship Harbour Long Lake) will be significant enough to change the representation level of some landscapes, but they are not counted until the designations are actually in place. Personal communication with Dave MacKinnon, Ecologist and Systems Planner with the Protected Areas Division, Department of Environment and Labour. December 19, 2007.
[39] Kaitlin Fahey, Office coordinator, Nova Scotia Nature Trust. Personal communication, October 17, 2007.
[40] Of the roughly 10,000 ha of land acquired from Bowater Mersey by the NSDNR and the Department of Environment and Labour, 11 areas will become nature reserves, 12 will be provincial park reserves, and 7 will become wilderness areas.
[41] Nova Scotia Department of Natural Resources. l997. Toward Sustainable Forestry, A Position Paper. Nova Scotia, pp. 1-8.
[42] Shelterwood cutting is defined as the removal of mature trees from a stand in two or more stages instead of all at once, as with a clearcut. In essence, however, shelterwood is a form of clearcutting, since it also generally results in the entire removal of a forest stand.
[43] Selection harvest methods mimic the non-catastrophic natural disturbance regimes of this region. Group selection, or patch cutting, for instance, mimics the natural process of an occasional large tree falling and taking out several others with it, thus opening up 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. In 2001, the GPI Forest Accounts (volume 2) reported on Windhorse Farm's use of selection cutting. In that case study, it was reported that the tallest trees in the canopy were never removed from a stand, even if dead. These trees increase canopy height and the structural diversity of a stand. Group selection can also be used to restore the diversity of a simplified woodlot in which a particular species is under-represented. For example, four or five trees may be removed from around a tree that is unable to regenerate in the shade of the existing canopy.
[44] Preliminary results from the first of a three phase public opinion survey conducted for the Nova Forest Alliance in 1999. According to NFA staff Kelly Dalling, "industry was not happy" with the results of the first telephone survey and as a result questions for the second and third phases of the survey would be vetted by industry representatives prior to use. Cited in *Clearcutting in Perspective.*2000. Nova Scotia Public Interest Research Group. Volume 8, p. 30. The final NFA report on survey results can be found at http://www.novaforestalliance.com/media/documents/publicperceptions.pdf. Accessed February 26, 2008.
[45] All dollar figures have been converted to 2007 constant dollars using the Bank of Canada Inflation Calculator, January 18, 2008.
[46] It is not possible to provide a time series for value-added wood products per volume of wood harvested by province because some value-added data have been suppressed "to protect confidentiality," according to

Statistics Canada. It is GPI*Atlantic*'s position, as a public interest research institute, that data suppression to protect confidentiality must be balanced against the importance of making publicly available those data that reflect vital public interests—as these do—since the health of our renewable natural resources is essential for sustainability and the wellbeing of future generations.

[47] There is some anecdotal evidence that the success and size of the value-added wood sector in Manitoba is due to the presence of nearly 40 Hutterite Colonies, where craftsmanship in woodworking is a traditional and highly regarded skill and many colonies engage in the manufacturing of cabinets and furniture to support themselves. In addition, Winnipeg has successfully attracted highly skilled immigrants who are working in the value-added sector. Success of the value-added industry in Manitoba is likely also related to the provincial government support of the industry. Personal communication with Adrian Wilson, Marconi Campus, Nova Scotia Community College, March 3 and 19, 2008. Wilson referred to Manitoba as a "leader in Canada" in regards to value-added and recently travelled to Winnipeg to take a look at 4-5 value-added wood industries in operation.

[48] Manitoba Department of Conservation. 2006. Five Year Report on the Status of Forestry, April 2001 to March 2006. Available from http://www.gov.mb.ca/conservation/forestry/pdf/5year.pdf. Accessed February 26, 2008.

[49] British Columbia Ministry of Labour and Citizens' Services. 2003. *BC Stats: Value added wood production lagging behind in BC.* Available from http://www.bcstats.gov.bc.ca/releases/info2003/in0334.pdf. Accessed February 26, 2008.

[50] Ibid.

[51] Candace Christiano, Finewood Flooring and Lumber Limited. Personal communication, November 30, 2007.

[52] Bowater Inc. is headquartered in South Carolina and makes bleached market pulp and lumber products. It has 12 pulp and paper mills in the United States, Canada, and South Korea. In North America, it also operates one converting facility and owns 10 sawmills. Available from http://www.bowater.com/en/. Accessed January 18, 2008. Neenah Paper was part of Kimberly-Clark until late 2004, when it became a stand-alone company. It manufactures and distributes a wide range of premium and specialty paper grades, and produces and sells bleached pulp, primarily for use in the manufacture of tissue and writing papers. Neenah Paper is based in Alpharetta, Georgia, and has manufacturing operations in Wisconsin, Michigan, Ontario, and Nova Scotia. Kimberly-Clark now focuses its operations on "health and hygiene" products. Neenah Paper, press release, March 23, 2005. Available from http://www.neenahpaperinc.com/pr/PR222304.aspx. Accessed January 18, 2008. According to a recent Securities and Exchange Commission filing by Neenah Paper Inc., the company plans to sell the Pictou mill and all its remaining woodland assets in Nova Scotia. According to the filing, the company committed to this plan in February 2008 and foresees the sale of the mill and woodlands to be complete within the next 12 months. To see Neenah's SEC filing please go to http://www.secinfo.com/d11MXs.tGSs.htm#1stPage. In December 2007, Swedish-owned Stora Enso divested its North American paper operations to U.S. company NewPage, a coated paper producer. Available from http://www.storaenso.com/CDAvgn/main/0,,1_EN-8861-18547-,00.html. Accessed January 4, 2008. The long-term future of the Port Hawkesbury operation in Nova Scotia and the impact this will have on employees is unclear. But for the time being, the plant remains in operation and NewPage announced on January 16, 2008, that the Port Hawkesbury newsprint and fine coated paper mills will not be among the facilities that will close as part of its U.S. $265-million "synergies" plan. That cost-saving, restructuring plan closed several of its U.S. facilities. ("N.S. paper mills dodge bullet as NewPage announces U.S. closures," *The Canadian Press,* 16 January, 2008. Available at: http://www.topix.com/ca/port-hawkesbury-ns/2008/01/n-s-paper-mills-dodge-bullet-as-newpage-announces-u-s-closures. Accessed February 24, 2008.)

[53] Sandberg, A. 1992. Introduction: Dependent Development and Client States. In: Trouble in the Woods: Forest Policy and Social Conflict in Nova Scotia and New Brunswick. Sandberg, A. (ed). Gorsebrook Research Institute for Atlantic Canada Studies, Fredericton.

[54] Aktrin-Dossenbach Associates. 2003. Nova Scotia Value-Added Wood Products Industry. Sector Export Strategy Final Report. Prepared for ACOA, Enterprise Cape Breton Corporation, and Nova Scotia Community College, p. 4.

[55] Ibid., p. 26.
[56] Ibid., pp. 44-57.
[57] Ibid.
[58] "About WPG." Reference is from the Wood Products Group website at http://www.woodproductsgroup.com/wpg/about_wpg/about_default.aspx. Accessed March 22, 2008.
[59] Personal communication with Adrian Wilson, Wood Products Manufacturing Technology Program, Marconi Campus, NSCC. March 4, 2008. Wilson wrote the Request for Proposals that resulted in the 2003 Aktrin–Dossenbach Report on Nova Scotia Value-Added Wood Products Industry.
[60] NSDNR Registry of Buyers. 2007. Report on Primary Forest Products Acquired, Secondary Forest Products Produced and Wood Acquisition Plan Program. Available from http://www.gov.ns.ca/natr/forestry/registry/ann_report.htm. Accessed October 15, 2007.
[61] Labour Force Survey data provided to GPI*Atlantic* by Patrick Brannon, Research Analyst, Atlantic Provinces Economic Council, October 16, 2007.
[62] Candace Christiano, Finewood Flooring and Lumber Limited. Personal communication, November 30, 2007.

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