

Forest sustainability in the province of Nova Scotia, Canada

Client:

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1. Introduction

The combustion of wood for energy purpose is not considered to contribute to the augmentation of greenhouse gases concentration in the atmosphere, as long as the CO₂ emissions released during the combustion of wood are balanced by the growth of new trees. It is therefore essential to investigate if the forests in the region where the wood used for energy purpose are managed in a sustainable way, avoiding resources associated with overexploitation of forests, land use change, depletion of carbon stocks, etc...

In this framework, literature research was carried out to produce a summary of forest management in Nova Scotia, including general condition, management and sustainability assessment.

2. Nova Scotia forests overview

2.1. Location and distribution

Nova Scotia (Latin for "New Scotland") is the second-smallest province in Canada with an area of 55 500 km². The mainland of the province is a peninsula surrounded by the Atlantic Ocean. The Cape Breton Island, a large island north-east of the mainland, is also part of the province, as well as the small Sable Island. Nova Scotia has three regional municipalities (Cape Breton, Halifax, and Queens) and 18 counties.

Figure 1 : General maps of Nova Scotia



Source: <http://geology.com>

As you can see on the Table 1, nearly 75% of Nova Scotia is forested. Most of the non-forested areas are water bodies, barrens, agricultural lands, urban areas and linear disturbances¹.

Table 1 : Land Cover types of Nova Scotia

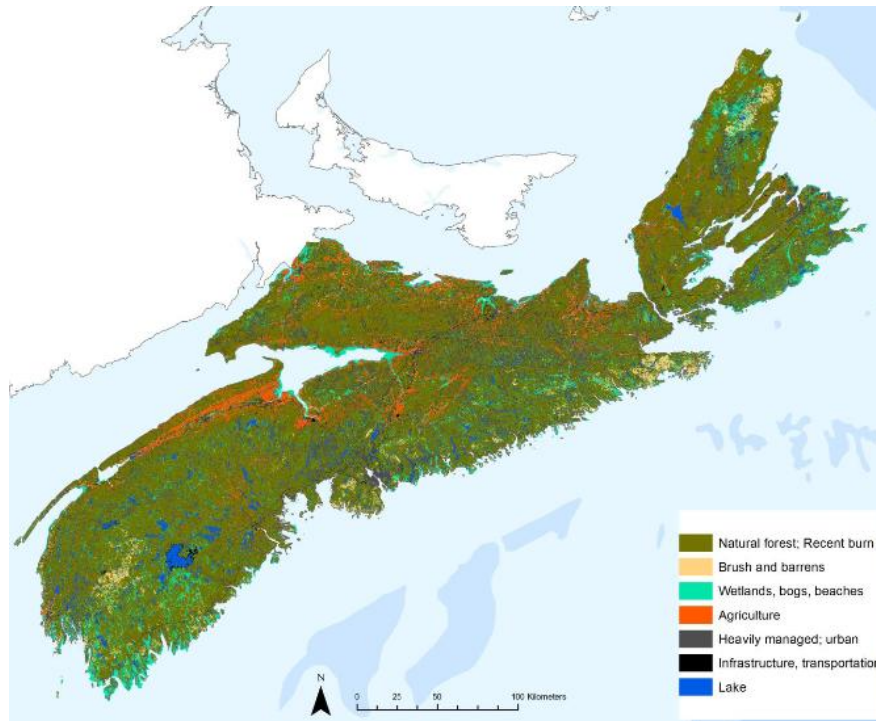
Land Cover Category	Nova Scotia	
	Area (sq km)	% of Province
Major Land Cover Categories		
Offshore Coastal Habitat	1,951	3.4
Lake islands	61	0.1
Off-shore islands	308	0.5
Mainland non-forested	12,394	21.7
Mainland forested	42,728	74.7
Total	57,442	100.0

Source: The Inclusive Wealth of Nova Scotia's Protected Areas, A Preliminary Estimate of Nature's Benefits.
Peter Lee, Ryan Cheng, Matt Hanneman. 2013

The Figure 2 presents the generalized land cover of Nova Scotia and the Figure 3 presents only the natural forest distribution in Nova Scotia.

¹ Lee P., Cheng R., Hanneman M. 2013. The Inclusive Wealth of Nova Scotia's Protected Areas, A Preliminary Estimate of Nature's Benefits. Global Forest Watch Canada Report #3, International Year of Sustainable Energy for All. 94pp.

http://www.globalforestwatch.ca/files/publications/20130628A_NS_PA_Natural_Capital_report_June2013.pdf

Figure 2 : Generalized land cover in Nova Scotia

Source: The Inclusive Wealth of Nova Scotia's Protected Areas, A Preliminary Estimate of Nature's Benefits. Peter Lee, Ryan Cheng, Matt Hanneman. 2013

Figure 3 : Natural forest distribution in Nova Scotia

Source: The Inclusive Wealth of Nova Scotia's Protected Areas, A Preliminary Estimate of Nature's Benefits. Peter Lee, Ryan Cheng, Matt Hanneman. 2013

2.2. Ecological zones

This province has about 40.000 kilometers of coastline. The highest point in Nova Scotia is at White Hill Lake in Victoria County with 532 meters above sea level. Nova Scotia receives an average of more than 1400 mm of rain annually². Most of the province receives about 230 cm of snow, and considerable winter precipitation comes in the form of rain or ice storms. Many storms can occur and there are in average more storms in this place than in other parts of Canada. The average temperature in January, the coldest month, is generally about -4°C near the coast and somewhat colder toward the interior. The average temperature in July, the hottest month, is about 18°C in the interior and about 16°C near the shore³.

Table 2 : Average variation of temperature during seasons

<i>Season</i>	<i>Month</i>	<i>Temperature (°C)</i>
Spring	Mid-March to late April	0 - 10
	Late April to mid-June	10 - 20
Summer	Mid June to mid-September	20 - 25
Autumn	Mid-September to mid-November	10 - 20
	Mid November to mid-December	0 - 10
Winter	Mid December to mid-March	-15 - 0

Source : <http://www.novascotia.com/about-nova-scotia/weather>

Nova Scotia has generally cool winters and hot summers and persistent falls. Several factors influence the climate. Three lakes surround the province: the Atlantic Ocean, the Gulf of St. Lawrence / Northumberland Strait and the Bay of Fundy. These three areas have their own properties (hot and cold water) and their reactions with the seasons (the amplitude variations of the water temperature). Due to the ocean's moderating effect, this is the warmest province in Canada. Nova Scotia is also the place where ocean currents converge i.e. the cold Labrador Current and the warm Gulf Stream. Furthermore, climate is also influenced by the movement of the air and topography. With distance from the sea, we have local weather conditions that create many micro-climates⁴. However, the weather conditions can be categorized into four physiographic regions (Figure 4).

From an ecological point of view, the province of Nova Scotia is in the Atlantic Maritime Ecozone. A high proportion of forests cover this ecozone (approximately 75%) which is divided into three distinct regions: Boreal, Great Lakes-St. Lawrence, and Acadian. All three regions are interlaced with

² <http://www.currentresults.com/Weather/Canada/Nova-Scotia>

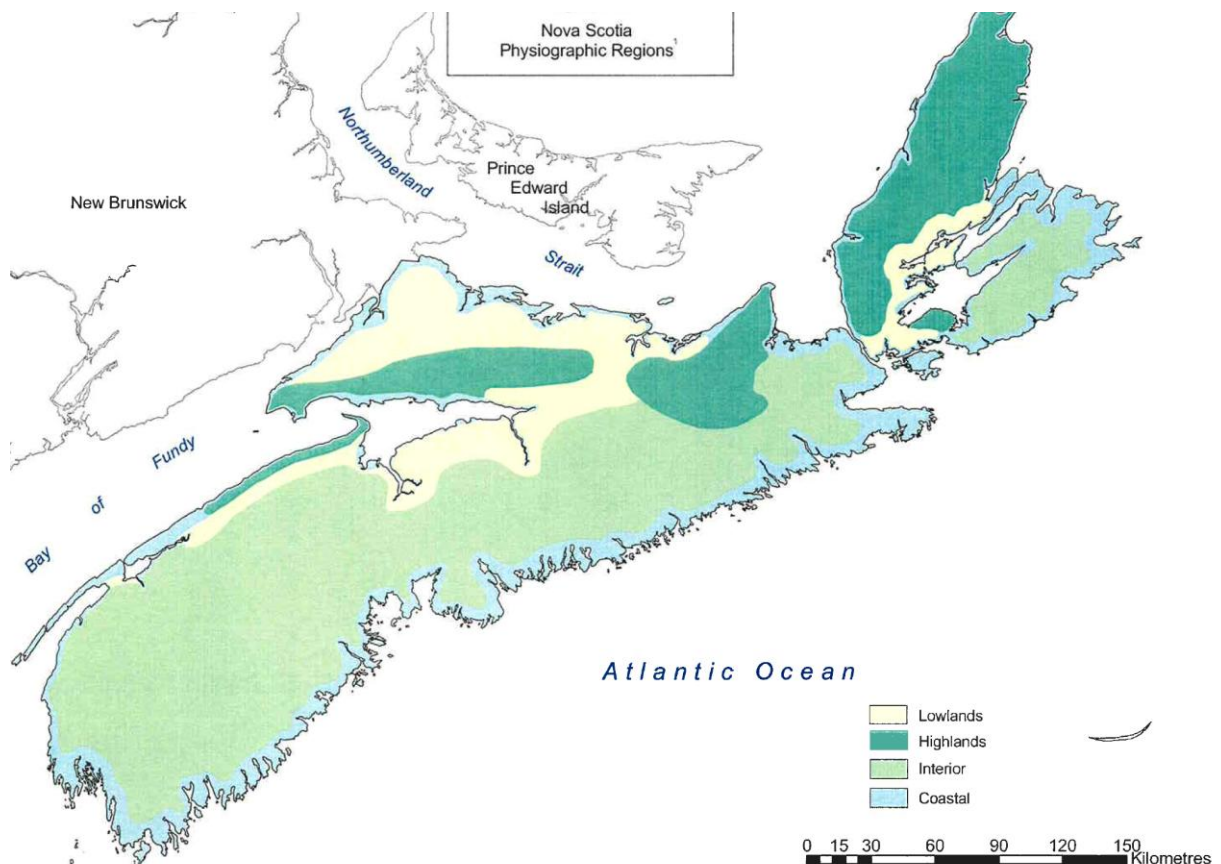
³ *Natural History of Nova Scotia, Vol. 1: Topics and Habitats*. Nova Scotia's Climate, page 97 to 103

⁴ Gouvernement of Nova Scotia. 2005. Adapting to a changing climate in Nova Scotia: vulnerability assessment and adaptation options.

numerous lakes and wetlands⁵. All of Nova Scotia is within the Acadian Forest. This region is characterized by a mixture of coniferous and deciduous species.

Nova Scotia can be also divided into several ecoregions (Figure 5) which have their own characteristics⁶. These characteristics are summarized in the Table 3. The ecoregions are also subdivided into 39 ecodistricts along the province which are areas with similar physiographic pattern (upland, lowland, local climate etc.).

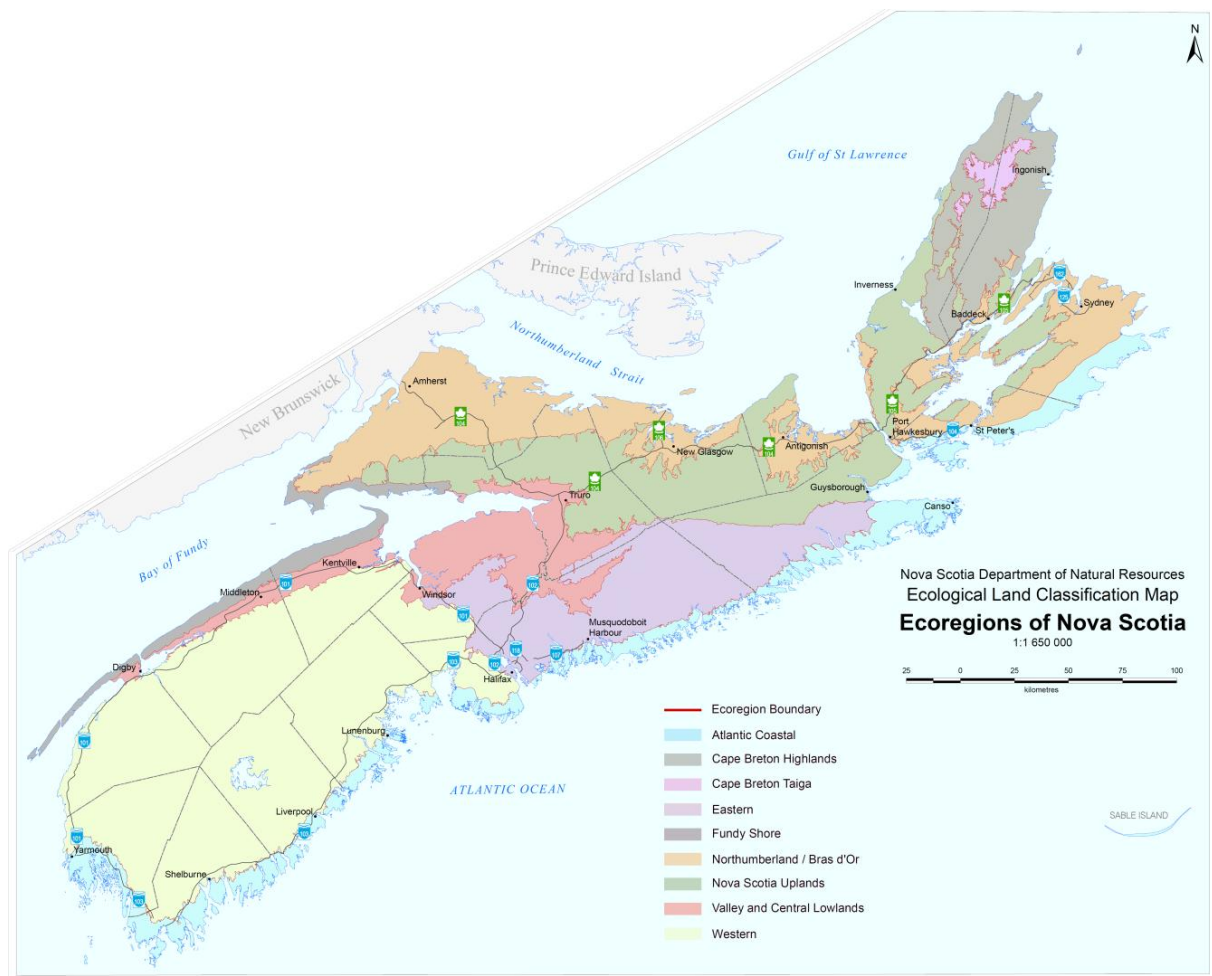
Figure 4 : Physiographic regions of Nova Scotia



Source: Government of Nova Scotia. 2005. Adapting to a changing climate in Nova Scotia: vulnerability assessment and adaptation options

⁵ <http://ecozones.ca/english/zone/AtlanticMaritime/plants.html>

⁶ Source : Neily, Peter D., E. Quigley, L. Benjamin, B. Stewart, T. Duke. 2003. Ecological land classification for Nova Scotia: Volume 1 - Mapping Nova Scotia's terrestrial ecosystems. Nova Scotia Department of Natural Resources, Renewable Resources Branch, April 2003, Report

Figure 5 : Ecoregions of Nova Scotia

Source : http://www.novascotia.ca/natr/forestry/ecological/pdf/ELC_Map.pdf

Table 3 : Main characteristics of each ecoregion

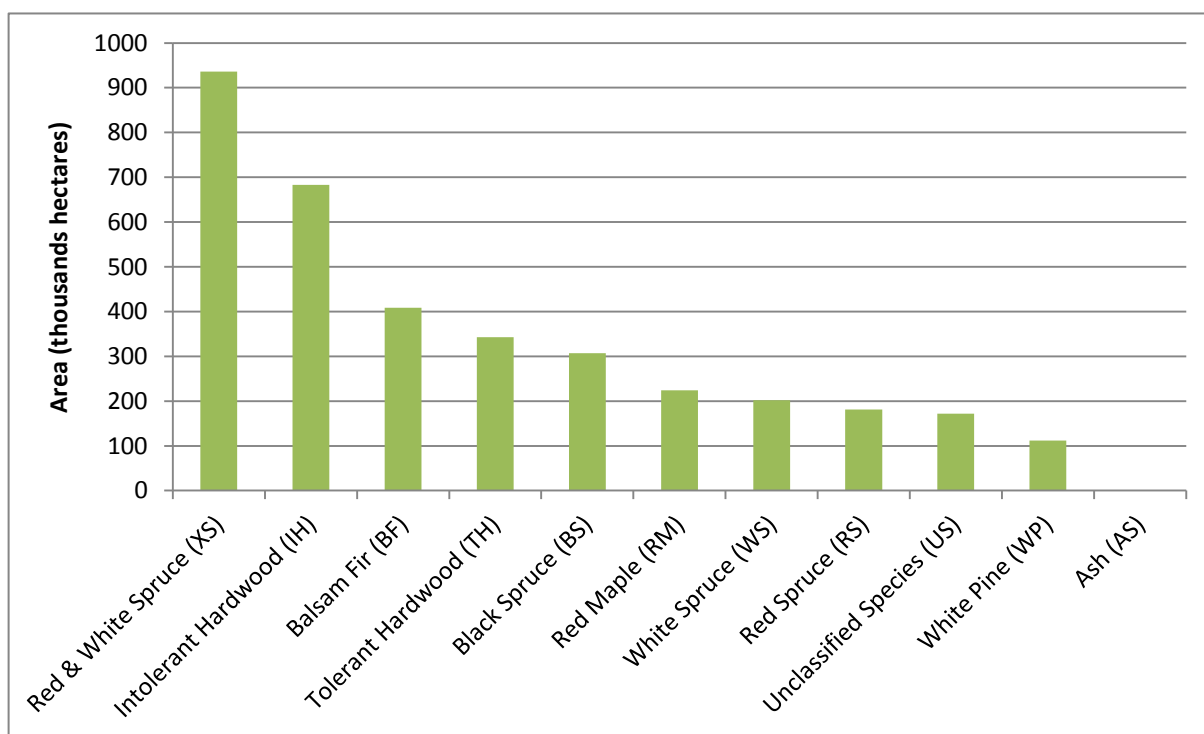
Ecoregions	Topography	Land area	Climate	Vegetation	Land use
Cape Breton Taiga	- Highest elevation in NS, most of region exceeds 425 m (max. 532m)	- Bogs are moss bogs with low plants and sedges - High annual precipitation climate as well as natural disturbances (e.g., windstorms and insects) shape the forest ecosystem in the region	- One of the coldest and wettest areas in NS - Short growing season and constant wind	- Expanses of ombrotrophic (cloud - fed) bogs, stunted conifers and exposed bedrock - Wet areas are dominated by black spruce and larch, balsam fir dominates upper slopes - Krummholz stands difficult to pass through	- No history of logging (stunted trees are of little economic importance)
Cape Breton Highlands	- Average elevation 300 to 450m but extends to sea level -Mountain terrain	- Ecoregion includes varied topography of lowlands, steep slopes and plateaus	- Similar to the taiga region (cooler temperatures, fog and precipitation) but less "harsh"	- On the plateau, the forest is boreal, dominated by balsam fir followed by white spruce - Wetter areas dominated by birch and black spruce - Tolerant hardwoods as well as mixed woods on slopes	
Nova Scotia Uplands	- Elevations of 100-300m (with exception of Inverness Lowlands ecodistrict which is comprised of valley floors of rivers flowing from the uplands to the lowlands)	-Complex region with uplands and lowland with mixed conifer and deciduous forests	- Warm summers Hilly topography – creates microclimatic conditions (sheltered vs. exposed)	- Wind and ice damage are limiting factors affecting tree growth on the Cobequid and Cape Breton hills (stunted forests of beech and sugar maple) - Complex region with uplands and lowlands with mixed conifer and deciduous forests : <ul style="list-style-type: none"> • Sugar maple, beech, red maple and yellow birch dominate hardwood hills • White spruce, red spruce, and balsam fir form mixed woods with the above listed hardwoods on some valleys and slopes • Hemlock commonly in ravines • Red spruce, balsam fir, white pine and hemlock are common in areas with a hummocky terrain (Mulgrave Plateau, St. Mary's River and Central Uplands) • Black spruce and eastern larch occur on poorly drained soils • Also large areas of barrens caused by repeated burning 	
Eastern	- Highest elevation is 220m	- South sloping upland interior in eastern NS - Consists of rolling till plains, drumlin fields, extensive rockland, wetlands and several freshwater lakes (eastern interior ecodistrict)	- Removed from the immediate climatic influence of the Atlantic and thus characterized by relatively warmer summers	- Predominantly coniferous forests with red and black spruce occupying most sites - Also scattered stands of hemlock, white pine and black spruce, and tolerant hardwood dominated by yellow birch and sugar maple are found in areas where conditions are appropriate	

Northumberland Bras d'Or Lowlands	<ul style="list-style-type: none"> - Most of ecoregion is low - lying; elevations 25 -50m 	Sheltered lowland in northern NS	<ul style="list-style-type: none"> - Variable climate (warmer along Northumberland strait than Bras d'Or) - Climate moderated by proximity to warm bodies of salt water 	<ul style="list-style-type: none"> - Coniferous, deciduous and mixed forests - Black spruce forests throughout the region (large areas of poorly drained soils) - Also tolerant hardwoods and mixed stands of red spruce, hemlock, sugar maple, yellow birch and beech (particularly on slopes vs. black spruce in the lowland areas) - Soil moisture deficits in some parts result in fire tolerant species like Jack Pine (e.g., Cumberland County) 	
Valley and Central Lowlands	<ul style="list-style-type: none"> - Elevation seldom more than 50m - Gently rolling topography 	<ul style="list-style-type: none"> - Includes Annapolis Valley and watersheds of the Minas Basin and Musquodoboit Valley - Extensive bogs (exceeding 400 ha) in Hants County - Wildfires = dominant natural disturbance (but reduced since European settlement) 	Ecoregion Lowlands sheltered from coastal climatic influences with warmer summer temperatures and milder winters than elsewhere in the province	<ul style="list-style-type: none"> - Wide range of forest species associations occur throughout the region - Overall (mainly because of poorly drained soils) black spruce and red maple predominate - Tolerant hardwood on ridges and upper slopes (sugar maple, yellow birch and beech) but these stands also include trees typical of wetter sites creating mixed woods - Lowland fire sites red oak, red maple, red pine, jack pine, grey birch and black spruce 	- Much is farmed and land reclamation along shores with the use of dykes
Western	<ul style="list-style-type: none"> - Elevations from 289 to 25 m (along Atlantic coast) 	<ul style="list-style-type: none"> - Old growth "Maritime" forest prominent; also barrens, wetlands and extensive river system - Has some of the longest rivers in Nova Scotia - Significant portions in the southwest are covered by wetlands 	Mild winters and warm summers are most typical but proximity to the coast makes climatic conditions variable	<ul style="list-style-type: none"> - Red spruce, hemlock and white pine (distinctive "Maritime forest") are more prominent here than anywhere else in NS; old growth forests - Stunted black spruce on bogs - Large tracts of red maple on wetlands associated with rivers - Conspicuous feature is extensive barrens with sparse forests of black spruce and white pine with a shrub and herb layer (fire suppression has led to more young forests in once barren areas) 	- Much of the area has been extensively logged
Atlantic Coastal		<ul style="list-style-type: none"> - Extends along the Atlantic Coast; seldom exceeds 5km in width except along the Cape Breton shoreline where the coastal influence can extend almost 20km inland - Eastern portion contains fens, bogs and salt marshes - Also large barren outcrops with scattered conifers and heath vegetation (east) 	<ul style="list-style-type: none"> - Slow spring warm - up and the lowest number of growing days in NS - Subject to high winds, high humidity, salt spray and fog 	<ul style="list-style-type: none"> - Absence of red spruce delineates the region from the Western and Eastern Ecoregions - White spruce is the most common on exposed sites (coastal islands and headlands) - Black spruce and balsam fir forests with red maple and white birch common components of the understory - Along eastern shore balsam fir forms dense stands with small diameters - Wet mineral soils (black spruce is the dominant tree) 	
Fundy Shore	<ul style="list-style-type: none"> - Variable topography and up to 225m above sea level (North Mountain) 	<ul style="list-style-type: none"> - Narrow strip that wraps around the Bay of Fundy 	<ul style="list-style-type: none"> - Cold waters delay spring arrival and fog frequent along the shore 	<ul style="list-style-type: none"> - Narrow band of forest, most notable on exposed cliffs, dominated by white spruce - Mixed wood forests of balsam fir, red spruce, red maple, white birch and yellow birch - Beech and maple at higher elevations. White pine and hemlock also present 	

Figure 6 shows the abundance of the different tree species in Nova Scotia. Northern temperate forests dominate a large portion of Nova Scotia province, and the most predominant forest types include spruce-fir conifer, northern hardwood, mixed deciduous-coniferous forests, regenerating forests and natural shrublands. Nova Scotia also encompasses considerable amounts of wetland habitats, including 5 934 km of mainland coastline, freshwater emergent marshes, freshwater forested wetlands, and a large number of open freshwater lakes, streams and rivers⁷.

In Figure 7 we can see the distribution of the different types of habitat.

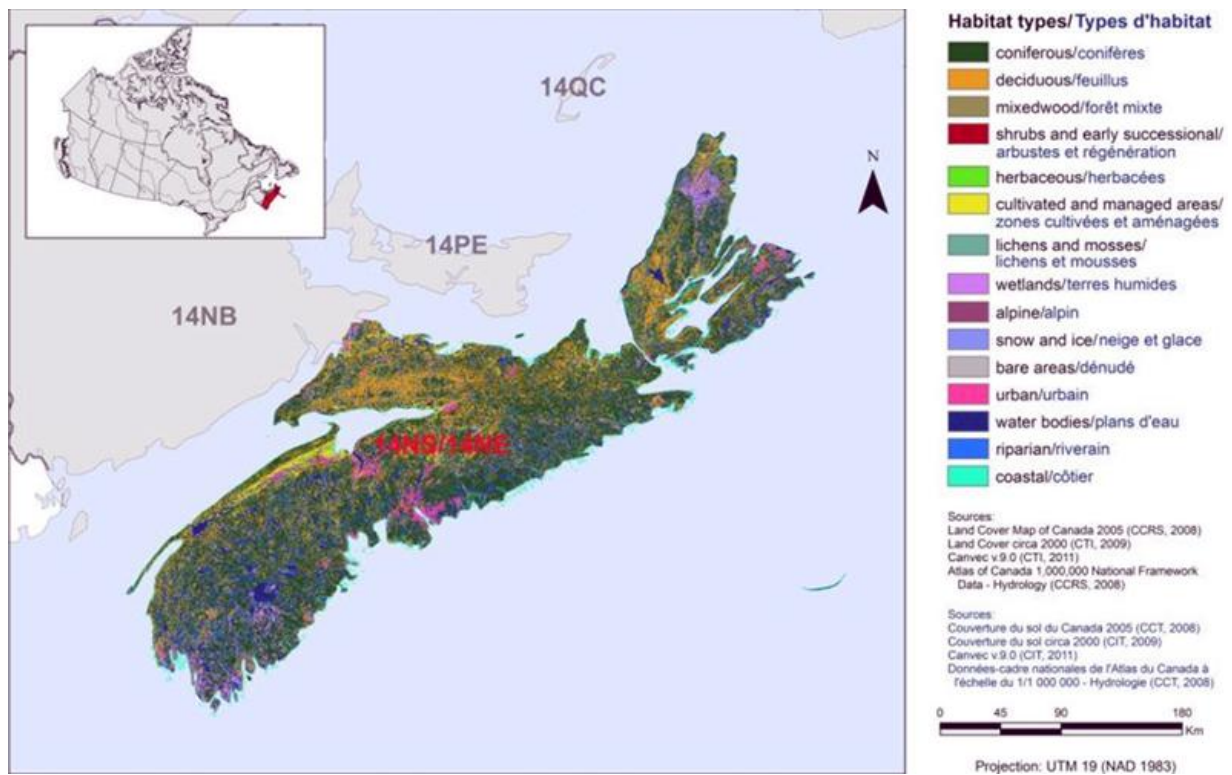
Figure 6 : Area of forest by predominant species (thousands of hectares)



Source: The Inclusive Wealth of Nova Scotia's Protected Areas, A Preliminary Estimate of Nature's Benefits. Peter Lee, Ryan Cheng, Matt Hanneman. 2013

⁷ <http://ec.gc.ca/>

Figure 7 : Repartition of habitats types in Nova Scotia

Source : <http://ec.gc.ca>

2.3. Forest ownership

The

Table 4 shows the area of forest land in function of the owner categories⁸.

This table indicates that the private areas represent 66% of the total forest landbase in the province and the public areas 34%. If we focus on forest land available for harvesting (working forest landbase) the proportion of public ownership is even lower : only 27%. Indeed, the majority of the federal spaces are national parks and a large part of the Crown land is included in the Interim Old Forest Policy that identifies and increases the representation and protection of old forests and to support the long-term restoration of old growth forest in the province. Because of that a large proportion of public forest is not available for harvesting.

⁸ Non-industrial Private Non-participation Scenarios: Crown Lands Forest Model Online Reporting & Statistics for Potential Wood Supply (v2010.6). Nova Scotia. Department of Natural Resources, Department of Natural Resources, 2011.

Table 4 : Area of forest land by ownership groups

Forest Ownership	Forested landbase area		Working forest landbase⁹	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Small private	2 102 800	50,3	1 865 000	55,6
Industrial private	650 000	15,5	597 500	17,8
Crown (provincial)	1 317 100	31,5	881 900	26,3
Federal	112 000	2,7	12 300	0,4
Total	4 181 900	100,0	3 356 700	100,0

Source: see⁸

Since the Forest Sustainability Regulations came into force in 2000, Registered Buyers who acquire round wood from private land have to contribute to silviculture activities, either through their own silviculture programme, or through cash contribution to the Sustainable Forestry Fund.

2.4. Competent authorities

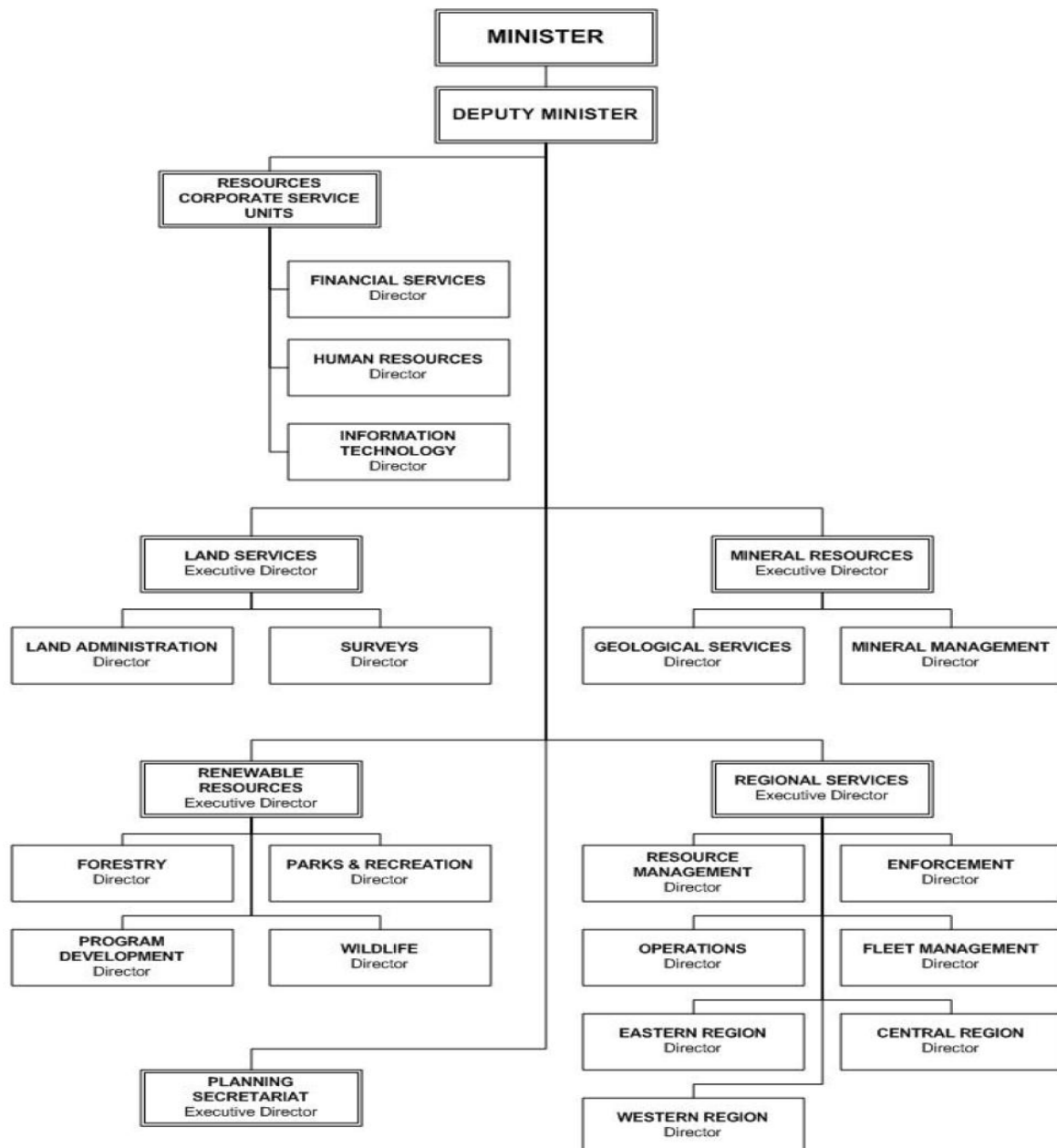
Forest management in Canada is essentially at the level of the provinces. At the federal level, the authorities in charge in each province cooperate in the Canadian Council of Forest Ministers, which is more a discussion platform than a decision making entity. The decision power is at the level of the provinces.

In Nova Scotia, the Department of Natural Resources (DNR) has broad responsibilities relative to the development, management, conservation and protection of forest, mineral, parks and wildlife resources and the administration of the province's Crown land. The resources of the department are organized into five branches (Figure 8). The main forestry competences are shared between the two following branches: "Renewable resources branch" and "Regional services branch" (Table 5).

On private forest land, the DNR is also in charge to enforce the Forest Sustainability Regulations, including managing the Sustainable Forestry Fund.

⁹ Working forest landbase is the proportion of the forested landbase considered available for conventional forest management planning after policy and operational restrictions are applied (i.e. protected areas, water coarsebuffers, steep slopes, land protection program, oldgrowth, etc.).

Figure 8 : Organization chart of the Department of Natural Resources



Source : Government of Nova Scotia, Management guide, Chapter 2: Organization and Responsibilities
<https://novascotia.ca/treasuryboard/manuals/PDF/100/NatRes.pdf>

Table 5 : Main functions of the different branches in the DNR

Branch	Main roles	Complementary responsibilities	Divisions
Renewable Resources	<ul style="list-style-type: none"> Integrated development management Conservation of the province's forests, parks, and wildlife resources 	<ul style="list-style-type: none"> Coordination and leadership on policy planning Program development including industry development and resource promotion, marketing, resource inventories and research The preparation of strategies and plans 	<ul style="list-style-type: none"> Forestry Forest Protection Parks and Recreation Program Development Wildlife
Geoscience & Mines Branch	<ul style="list-style-type: none"> Implementing policies and programs dealing with the exploration, development, management, and efficient use of mineral resources 	<ul style="list-style-type: none"> Promotes scientific understanding of the geology of Nova 	<ul style="list-style-type: none"> Geological Services Division Mineral Management Division
Regional Services	<ul style="list-style-type: none"> Delivers department programs and services through an extensive network of field offices Provides general field services for the Department of Environment and Labour's protected areas program 	<ul style="list-style-type: none"> Forest management programs Crown land surveys Regional geological services extension and education, Hunter safety Forest fire Prevention, detection, and suppression, monitoring of forest insects and diseases, Operation and maintenance of Provincial Parks Resource conservation enforcement 	<ul style="list-style-type: none"> Resource Management Division Enforcement Division Operations Division Fleet Management Division Eastern Region Central Region Western Region
Land Services	<ul style="list-style-type: none"> Administers statutes Provides service, advice, and leadership on all land-related matters concerning the department 	<ul style="list-style-type: none"> Providing advice and service to other departments 	<ul style="list-style-type: none"> Land Administration Division Surveys Division
Policy, Planning and Support Services Branch	<ul style="list-style-type: none"> Planning and policy coordination support to the Deputy Minister and the department (coordination of policies and plans developed within and across the department) Support the integrated management of our natural resources and are compatible with and support the strategic direction of government. 	<ul style="list-style-type: none"> Administrative, planning, research, information management, information distribution, graphics, cartographic and communication related services 	<ul style="list-style-type: none"> Strategic Policy and Planning Information Management and Support Services

Source : Nova Scotia, Department of Natural resources <http://novascotia.ca/natr/>

The Nova Scotia's forestry is guided by a several acts, regulations, and policies. The most important acts are the following¹⁰:

Crown Lands Act, amended in 1989, provides for the utilization of Crown lands, by governing forest management and harvesting, leasing and licensing, integration of wildlife and recreation in forest management planning, and administration and management of all Crown lands.

Forests Act, was amended in 1998 to allow for new regulations supporting the 1997 Forest Strategy. A significant component of the Strategy was the provision of a Forest Code of Practice, which is to specify requirements for management of Crown lands. The Code consists of 3 parts:

Code Principles provide guidance for strategic planning in the areas of forest ecosystems, forest products, wildlife habitat, and integrated forest use. These principles were released in 2004.

Code Guidelines specify management requirements for ecosystems, forest products, wildlife, and integrated use. The code guidebooks are scheduled to be released in draft for public comment in 2008 through the Voluntary Planning strategy consultation process.

Technical References developed through research and practice provide tools and options for management applicable to Nova Scotia forest conditions. This includes a broad suite of existing and developing management and decision support tools.

Environmental Goals and Sustainable Prosperity Act 2007, recently established a number of specific initiatives and objectives affecting management of the provincial lands. The IRM process will need to reflect these objectives:

- commitment to legally protect 12 percent of the provincial land mass by year 2015
- develop a policy preventing loss of wetlands by 2009
- adopt a natural resources strategy for forests, mines, parks and biodiversity by 2010

Interim Old Forest Policy 1999, established an objective to identify and protect the best remaining old forests and old forest restoration opportunities on a minimum 8 percent of Crown land in each of the 39 Ecodistricts. Most of this objective has now been met.

Environmental Certification Programs, particularly Forest Stewardship Council (FSC), Canadian Standards Association (CSA), and Sustainable Forestry Initiative (SFI), have a growing influence on forest management direction on private land, which makes up over 70 percent of the provincial landbase. Many of the tools and planning processes developed for Crown IRM support these certification programs which is encouraging better landscape level coordination across tenures. Large areas of Nova Scotia Crown land have already been certified under one or more of these systems.

¹⁰ Implementing ecosystem-based management approaches in Canada's forests. A science-policy dialogue. 2008. McAfee, B.J.; Malouin, C. Natural Resources Canada, Canadian Forest Service, Headquarters, Science and Programs Branch, Ottawa. 111 p.

2.5. Overview of wood-related industry

In 2012, forestry contributed about 283 million CAD to Nova Scotia's gross domestic product and exported more than 384 million CAD worth of products internationally¹¹.

The direct employment in forest industry in 2012 was estimated to be 5400 jobs. The direct employment includes wood products (2100 jobs), forestry and logging (1200 jobs), pulp and paper (800 jobs) and other support activities (1100 jobs). Compared to 2004, the employment in forestry has been cut by half.

In fact the sector has been under pressure in the last five years. The reason of this situation comes from falling demand for home building materials since the economic downturn between 2005 and 2010, and especially the Subprime Mortgage Crisis in the USA. The paper market also experienced difficulties, due to the stagnation of the prices on the international markets and difficult competition. Over the past decade, paper mills in the province have downsized or closed¹⁰.

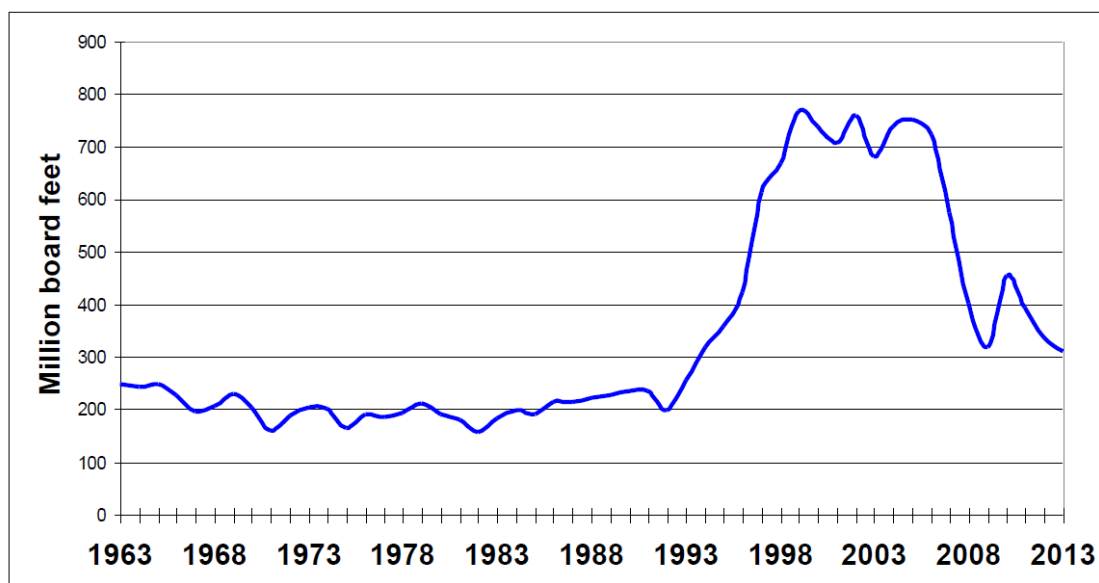
Table 6 : Employment evolution in forestry

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Forestry and logging industry	2700	2600	1500	1800	2000	1200	1500	1200	1200
Pulp and paper product manufacturing industry	3100	2400	2100	2800	2900	2100	2300	1800	800
Support activities for forestry industry	1000	1500	700	800	1300	1000	1100	1300	1100
Wood product manufacturing industry	4400	4000	2500	3100	3500	3000	1400	2100	2100
Direct jobs (number)	11100	10500	6900	8400	9600	7300	6300	6400	5400

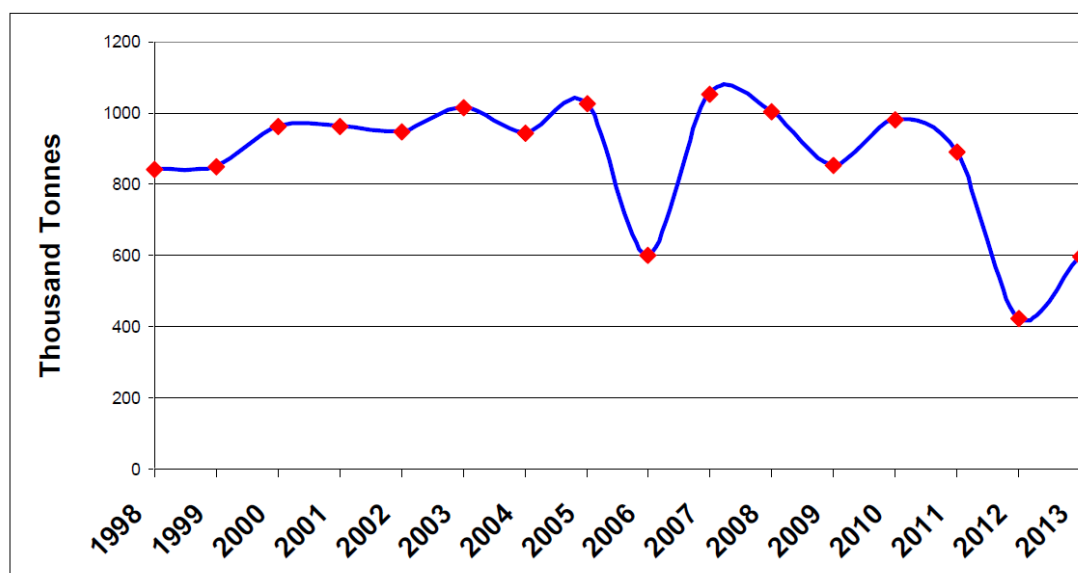
Source : <http://scf.rncan.gc.ca/profilstats>

This trend is confirmed by the evolution of the production of two important sectors (Figure 9 and Figure 10).

¹¹ Province Supports Innovation in Forestry Sector. *Department of Natural Resources* January 2014. <http://novascotia.ca/news/release/?id=20140131001>

Figure 9 : Sawmill production (1963-2013)

<http://novascotia.ca/natr/forestry/registry/>

Figure 10 : Pulp and paper production (1998-2013)

<http://novascotia.ca/natr/forestry/registry/>

The total exportation of forest resources in 2012 was approximately 385 million CAD compared with 45 million of importation¹². Nova Scotia has in 2012 a positive trade balance of 340 million CAD in terms of forest products.

¹² <https://cfs.nrcan.gc.ca>

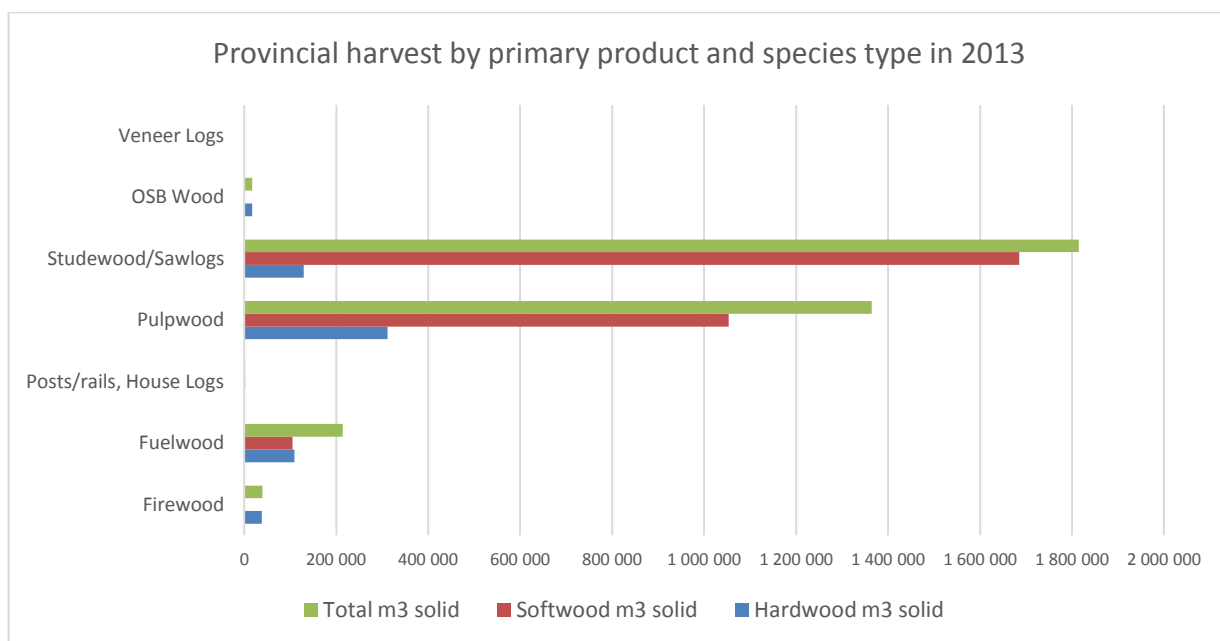
Table 7 : Importation and exportation of forest resources (CAD dollars)

	<i>Export</i>	<i>Import</i>
Primary wood products	21 742 550	No value
Pulp and paper products	290 380 134	15 982 762
Wood-fabricated materials	72 192 940	29 584 472
Total (excludes maple products)	384 315 624	45 567 234

Source : <http://scf.rncan.gc.ca/profilstats>

In 2012 export destinations are mainly the United States (207 million CAD) but also Europe (62 million CAD), and Middle East (32 million CAD)¹¹. As can be seen in Table 7, forest products exportations are largely dominated by Pulp and paper products.

As can be seen on Figure 11, in terms of volume, forest products are largely dominated by sawlog and pulpwood. Only 7,5% of the primary products is exported (primary product forest = any of the commercially valuable raw materials cut or harvested from a forest). The harvest of softwood is almost 5 times larger than hardwood.

Figure 11 : Primary forest products harvest by species

Source: Data calculated from <http://novascotia.ca/natr/forestry/registry/>

3. Sustainability of Nova Scotia forest

3.1. Evolution of forest area an risk of conversion

According to the Canadian Forest Service¹³, in 2005, an estimated 56 000 ha were deforested in Canada. At the same time, an estimated 9400 ha of new forests were set up in Canada (afforestation). As a result, the loss of forest land accounts for less than 0.02 % of Canada's forest area in 2005.

Even though deforestation is monitored in Canada, yearly statistics are not easily available. Nevertheless, for the purpose of the National GHG Inventory, there is a yearly quantification of the cumulative surfaces concerned by different kind of land use changes during the last 20 years¹⁴. This is because those data are used to compute the GHG emissions associated with land use change, which does not occur instantly, but progressively during a couple of decades.

The land use change data of the National GHG Inventory are available per reporting zones. Nova Scotia is part of Reporting Zone 6 "Atlantic Maritime" (which roughly includes Nova Scotia and New Brunswick). Based on the 2012 CRF tables (Common Reporting Format), the following figures can be put together:

Table 8 : Land use change to and from forest land in the Atlantic Maritime reporting zone between 2002 and 2012

Forest Land remaining Forest Land between 2002 and 2012	15 409 327 ha
Cropland converted to Forest Land between 2002 and 2012	+ 33 437 ha
Forest Land converted to Cropland between 2002 and 2012	- 33 352 ha
Forest Land converted to Wetlands between 2002 and 2012	- 149 ha
Forest Land converted to Settlements between 2002 and 2012	- 47 043 ha
Total loss of forest land between 2002 and 2012 (ha)	- 47 108 ha
Total loss of forest land between 2002 and 2012 (%)	- 0.31%

Source : calculated from the Common Reporting Format tables in Canada's National GHG Inventory latest version (2014 submission)¹⁵

Based on Table 8, we can compute that the average yearly loss of forest land in the Atlantic Maritime reporting zone was about 0.015% per year. This figure is comparable to the above cited loss of forest land in 2005 in Canada as a whole.

¹³ Deforestation in Canada—What Are the Facts?, Natural Resources Canada, May 2008
<http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/28159.pdf>

¹⁴ except for creation of reservoirs, for which the reference period for cumulative data is 10 years.

¹⁵ http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/8108.php

The land use changes from forestland to cropland and from cropland to forestland tend to compensate each other in the Atlantic Maritime zone between 2002 and 2012. As a result the net loss of forestland is mainly due to settlements (including urbanization, quarrying/mining, roads, recreational zones, etc...).

The FSC risk assessment platform www.globalforestregistry.org considers that Canada (as a whole) is at unspecified risk in terms of conversion of forest to other land uses, because the following criterion is verified at the country level:

- There is no net loss AND no significant rate of loss (> 0.5% per year) of natural forests and other naturally wooded ecosystems such as savannahs taking place in the eco-region in question.

3.2. *Standing trees volumes and removals*

No systematic assessment of the standing trees volumes seems to be published on a yearly basis for the forests in Nova Scotia. However, a report of the Forest Inventory Section of the DNR published in 2008 provides an assessment of the tonnage of living biomass in the Nova Scotia forest¹⁶. It includes figures in odt (oven dry tonnes) as well as additional conversion factors that makes possible to get figures in m³ wood. It is based on forest inventory data dated back 2005.

The total biomass of standing trees in Nova Scotia was estimated to be 309.2 million oven dried tons (odt). Private land contains a large proportion of biomass: 69% of the total biomass is on private forest land and 31% is on public land (federal or crown land).

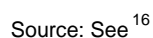
Table 9 : Estimated above ground biomass in oven dry tons in Nova Scotia, as per 2005 inventory

		softwood	hardwood	total
average biomass per ha forest	odt/ha	39.94	33.22	73.16
average wood boles per ha forest	odt/ha	24.2	21.3	45.5
	m ³ /ha	66.7	39.7	106.4
total biomass in Nova Scotia forests	million odt	168.8	140.4	309.2
total wood boles in Nova Scotia forests	million odt	102.3	90.0	192.3
	million m ³	281.9	167.8	449.7

Source: Townsend, P. 2008-07. Forest Biomass of Living, Merchantable Trees in Nova Scotia.

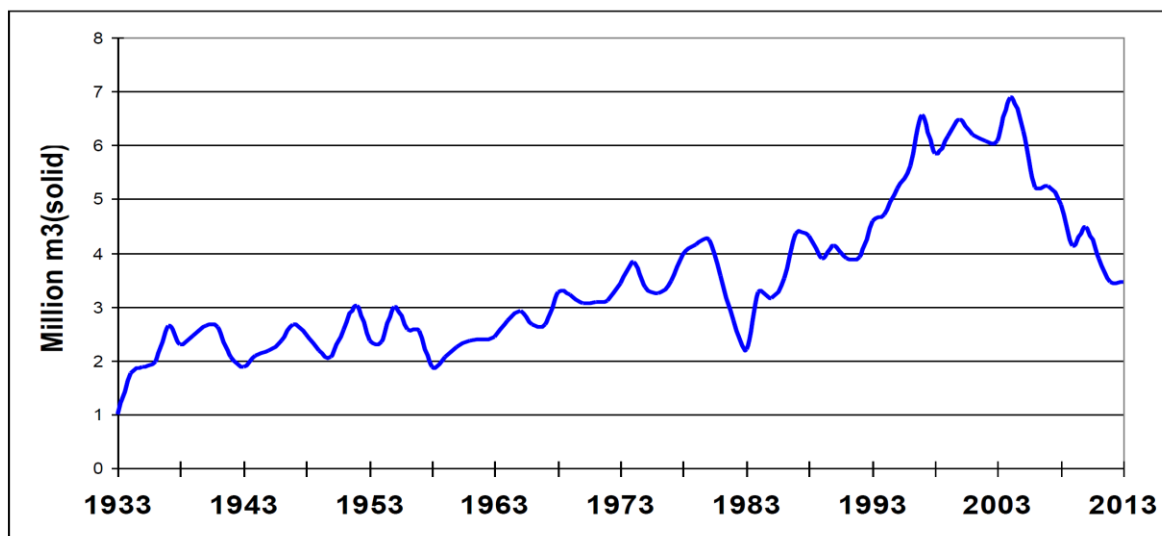
¹⁶ Townsend, P. 2008-07. Forest Biomass of Living, Merchantable Trees in Nova Scotia.

Figure 12 : Biomass of living, merchantable sized trees by Nova Scotia districts



On the other side, harvested area increased by 7 times in the 1933-2004 period (Figure 13). The decrease of this volume began in 2005 to reach 3.45 million m³ in 2013, twice less than 2005.

¹⁸ <http://www.gpiatlantic.org/publications/abstracts/forest-ab1.htm>

Figure 13 : Evolution of harvested volumes from 1933 to 2013

Source : <http://novascotia.ca/natr/forestry/registry/>

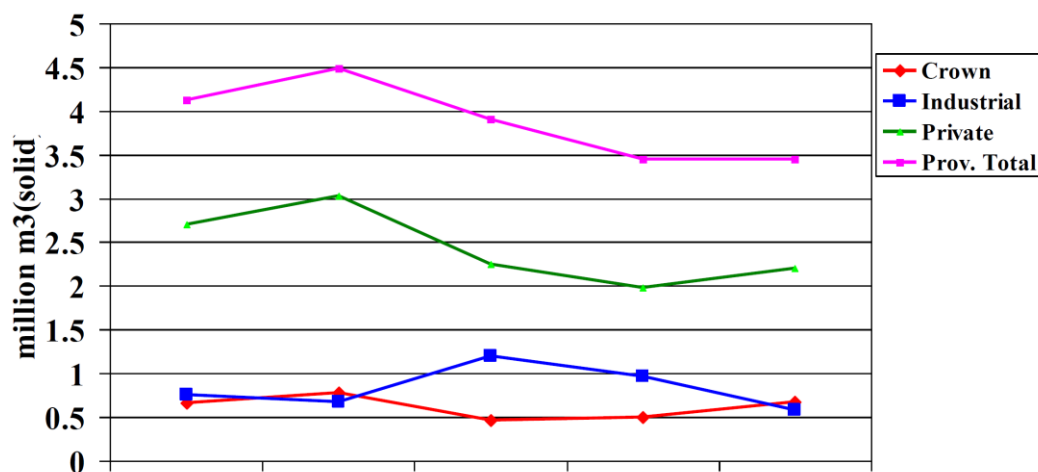
The detail of volumes harvested in the last 15 years is presented in the Table 10.

Table 10 : Harvested volume in the 2000-2013 period

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Harvest (volume) (1000 cubic meters)	6 500	6 183	6 067	6 085	6 889	6 249	5 209	5 260	4 899	4 127	4 482	3 903	3 447	3 454

Source : <http://scf.rncan.gc.ca/profilstats>

Figure 14 shows the difference between the owners in terms of primary forest products. Small private production represent more than twice of the total production.

Figure 14. Total primary forest products volume comparison by owners from 2009 to 2013

Source : <http://novascotia.ca/natr/forestry/registry/>

In DNR's State of the Forest report (report 1995-2005¹⁹), an estimation of the annual gains and losses in volume of standing trees is estimated (Table 11) as annual average figures for the period 1995-2005. We can see that during this period the total growth slightly exceeded the total removals. As a result, the volume of standing trees slightly increased (by 0.19% per year on average, i.e. by 1.9% between 1995 and 2005).

Table 11: Change of volume merchantable wood in Nova Scotia (average figures per year for the period 1995-2005)

	Accretion	Ingrowth	Mortality	Harvest	Total growth	Total removals	Net change
Softwood	+ 1.84	+ 0.19	- 0.86	- 1.24	+ 2.03	- 2.1	-0.08
Hardwood	+ 0.78	+ 0.06	- 0.25	- 0.31	+ 0.84	- 0.56	+0.27
total (m ³ /ha)	+ 2.62	+ 0.25	- 1.11	- 1.56	+ 2.87	- 2.67	+0.2
total (%)	+ 2.46%	+ 0.23%	- 1.04%	- 1.47%	+ 2.70%	- 2.51%	+0.19%

Source : DNR State of the Forest report (report 1995-2005), published in 2008

3.3. Protection of ecosystems and biodiversity

As shown on Table 12 in 2012, the conservation land in Nova Scotia covers 514 980ha. An estimated 9.32% of the land areas in Nova Scotia has a protection status. The future status of areas under protection is outlined by the Nova Scotia Environment Department in the *Environmental Goals and Sustainable Prosperity Act* (EGSPA). This plan aims to reach a threshold of 12% of the total land mass of the Province of Nova Scotia under legal protection in 2015²⁰.

An area of 206.020 hectares has been identified to meet this goal (13.06% of the landmass). Another 47.406ha of protected area would be added after 2015.

¹⁹ <https://www.novascotia.ca/natr/forestry/reports/State-Of-Forest-Report-April-2008.pdf>

²⁰ Our Parks and Protected Areas. A plan for Nova Scotia. 2013.

Table 12: Land under protection status and parks in Nova Scotia

Type of Land	Area (ha)	Portion of NS Land Base (%)
Administered by Government of Nova Scotia		
Wilderness Area	354,540	6.41%
Nature Reserve	5,000	0.09%
Provincial Park	6,380	0.12%
Other contributing properties		
National Park	137,740	2.49%
National Wildlife Area	2,400	0.04%
Land trust lands	7,260	0.13%
Protected by conservation easements	2,130	0.04%
Adjustment: nature reserves also in wilderness/land trust	-470	-0.01%
TOTAL (2012)	514,980	9.32%
Intended for designation by 2015	206,020	3.73%
TOTAL (existing and intended by 2015)	721,000	13.04%
Intended for designation after 2015	10,610	0.19%
Potential for designation if certain conditions are met	36,800	0.67%
Potential TOTAL	768,410	13.90%

Source: See²¹

The different types of conservation status are described hereunder²¹:

Private land conservation

Land Trust

Lands owned by charitable organizations. Usually small pieces of land, they are selected to protect plants, animals, or other important natural features. Light recreation, education, and research are usually allowed.

Conservation easement lands

The private land owners agree to leave the land in its natural state. The rules for conservation easement lands are set out in Nova Scotia's Conservation Easements Act.

Provincial government Protection

Wilderness areas

Large areas selected to protect nature while supporting wilderness recreation, hunting, sport fishing, trapping, and other uses. Some off highway vehicle (OHV) use can be permitted on certain routes.

²¹ Our wild spaces: identifying new protected areas for Nova Scotia: 12 percent by 2015. Nova Scotia. Department of the Environment.

Wilderness areas usually do not have facilities or organized campgrounds. The rules for wilderness areas are set out in Nova Scotia's Wilderness Areas Protection Act.

Provincial parks and reserves

Areas selected for natural or cultural reasons. Many have developed areas for camping, hiking, picnicking, or other recreational activities. Some parks do not count towards the 12 per cent goal because of size or use. The rules for provincial parks and reserves are set out in Nova Scotia's Provincial Parks Act.

Nature reserves

Small areas selected to protect unique or rare species or features. They provide our highest level of protection and are used mainly for education and research. The rules for nature reserves are set out in Nova Scotia's Special Places Protection Act.

Federal government Protection**National parks**

Large areas of national importance.

National parks have three goals:

- *to protect a particular kind of natural environment*
- *to teach us about that environment*
- *to offer us places to enjoy nature*

They often have large areas of wild spaces as well as developed areas for camping, hiking, and other recreational uses. The rules for national parks are set out in Canada's National Parks Act.

National wildlife areas

Land selected for the protection of particular animals, often migratory birds.

The rules for national wildlife areas are set out in the Canada Wildlife Act.

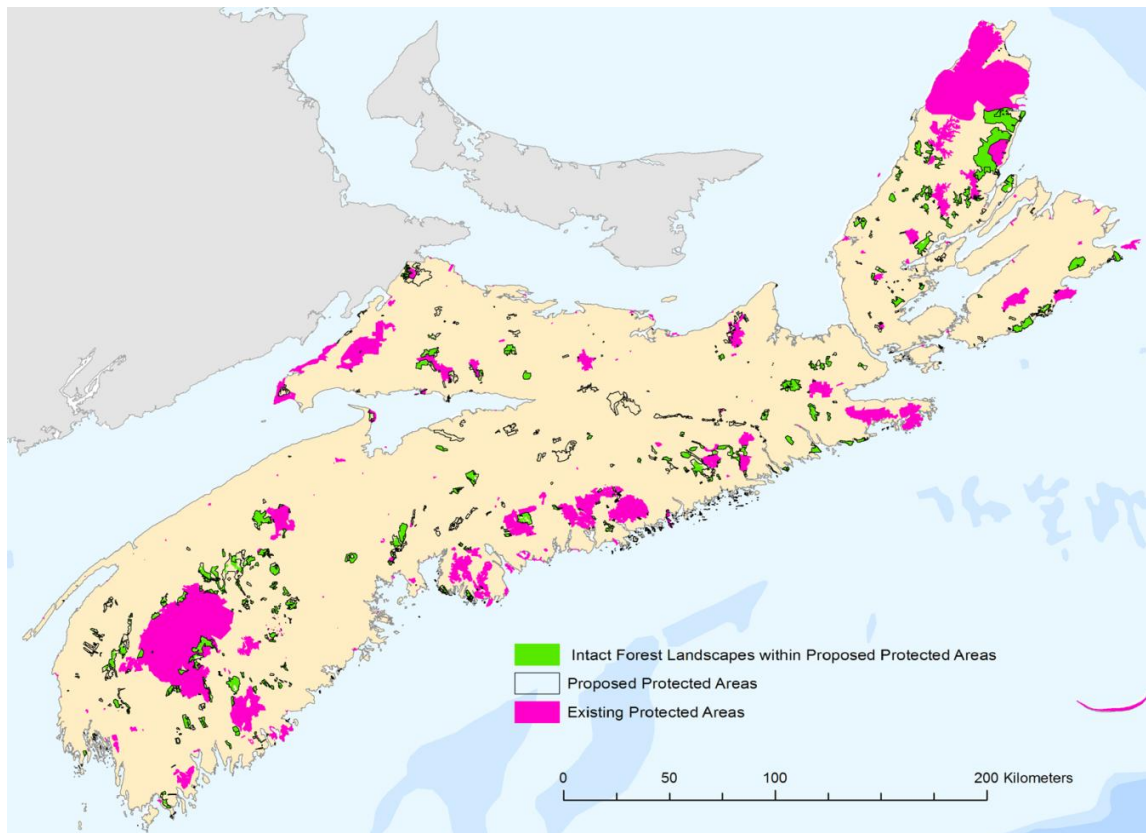
The location of the protected areas is available on the website

<http://www.novascotia.ca/parksandprotectedareas/plan/interactive-map/>

The EGSPA plan also recommends adopting strategies to ensure the sustainability of the Province's natural capital in the areas of forestry, mining, parks and biodiversity by the year 2010. In the document "The Path We Share, A Natural Resources Strategy for Nova Scotia 2011–2020", several strategies have been developed (23 goals and more than 90 actions). The companion document, "From Strategy to Action," lays out 32 specific time-bound actions to be implemented in the first 24 months.

If all land proposed by the plan gets a protection status, a total of 45.9% of all remaining intact forests²² would be legally protected²³.

²² An intact forest landscape is a contiguous mosaic of naturally occurring ecosystems in a forest ecozone, essentially undisturbed by significant human influence visible on Landsat satellite images.

Figure 15 : Intact forest landscapes within proposed protected areasSource: see²³

3.4. Protection of water

In Nova Scotia, several legal provisions aim to ensure that the quality of surface water and groundwater is appropriately protected, the provincial *Environmental Goals and Sustainable Prosperity Act* and the *Water Resources Protection Act*. The main objectives of the first act are the following²⁴ :

Restoring, preserving, and managing our precious water resources:

- 1) Develop a comprehensive water-resource management strategy by 2010
- 2) Provide at least primary treatment to all wastewater treatment facility discharges by 2017
- 3) Meet operating guidelines for all septage treatment facilities by 2011
- 4) All municipal public drinking water supplies will meet the province's treatment standards by 2008
- 5) A policy of preventing net loss of wetlands will be established by the year 2009

²³ PG Lee. 2013. Nova Scotia's Proposed Protected Areas: How well do they capture large intact forest landscapes?

Edmonton, Alberta: Global Forest Watch Canada. Global Forest Watch Canada. 11 pp. Available at: www.globalforestwatch.ca

²⁴ <http://novascotia.ca/nse/pollutionprevention/docs/2020FactSheet.pdf>

These targets are reviewed regularly and are subject to an annual report (with the progress status of in function of the initial objectives)²⁵.

The second act specifies the special protection given to the Atlantic Drainage Basin, which includes the entire province, and covers all surface water or groundwater and such water in the form of ice.

In the forestry context, a section in the Code of Forest Practice is devoted to air, water and soil. See “Air, water and soil under the Code Principle 1.6: *Forest management practices will be designed and conducted in a manner that maintains and enhances the quality of air, water and soil in Nova Scotia.* Those guidelines are applicable to Crown land.

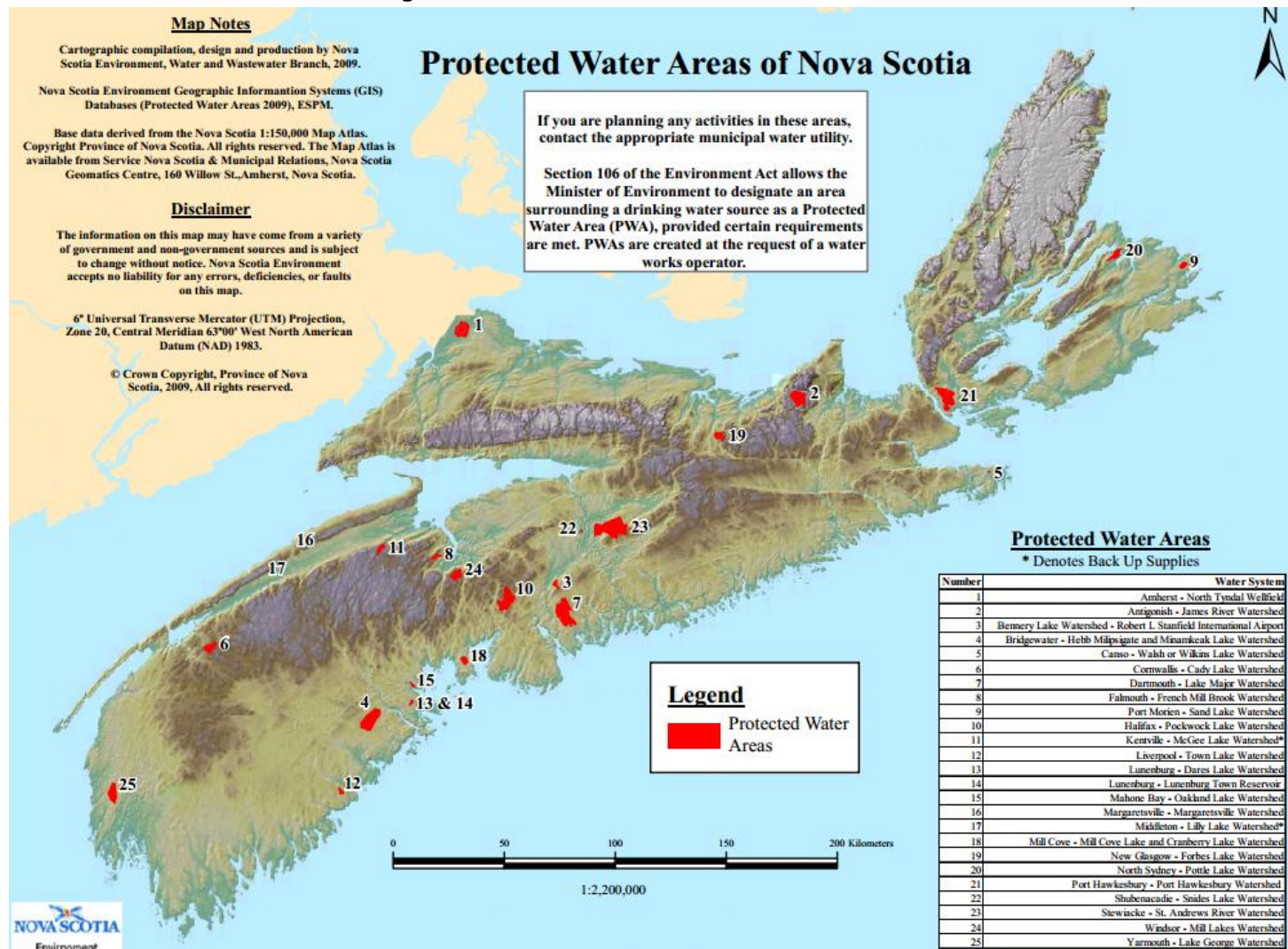
The *Wildlife Habitat and Watercourses Protection Regulations* is also designed to protect water quality and to maintain various elements of wildlife habitat on all forest harvest sites (private, industrial and Crown land)²⁶. This regulation consists of 10 sections deals with the following aspects: definitions, application, legacy trees and habitat structure, determining average width of watercourse, special management zones, protection of watercourse less than 50 cm wide, provisions applying to all watercourses and offence.

As a large amount of forests in Nova Scotia is certified under a forestry standard (see section 3.10 hereunder), additional requirements for the protection of water are also applicable to most forest land, in accordance with the relevant forest standards.

²⁵ <http://novascotia.ca/nse/egspa/>

²⁶ <http://www.novascotia.ca/just/regulations/regs/fowhwp.htm>

Figure 16 : Protected water areas of Nova Scotia

Source : <http://www.novascotia.ca/nse/water/docs/Protected.Water.Areas.Map.pdf>

3.5. Protection of soils

In a similar way as for the protection of water, the protection of soil in Nova Scotia relies on the *Code of Forest Practice*.

Soil conduction at a landscape level in forest can be managed in function of the ecosystem classification and the soil type²⁷. Furthermore a guide has been made by the Nova Scotia Department of Natural Resources. This guide describes all currently recognized Forest Ecosystem Classification Soil Types in the province along with related management interpretations²⁸.

A total of 19 soil types and 6 soil type phases have been identified. These soil types have been differentiated based on general features of ecological and/or management related significance, namely:

- thickness and type of surface organic horizons
- mineral soil depth
- presence of organically enriched Ah or Ap mineral horizons
- dominant particle size and soil texture classes within the soil profile
- soil drainage condition
- soil coarse fragment content
- surface stoniness

A soil type key and soil texture class key have been developed to aid soil type classification. When the soil is determined, some management interpretations related to soil compaction hazard, rutting hazard, erosion hazard, frost heave hazard, and sensitivity to forest floor loss have been made.

3.6. Protection of carbon stocks

In forest land the carbon stocks mainly includes:

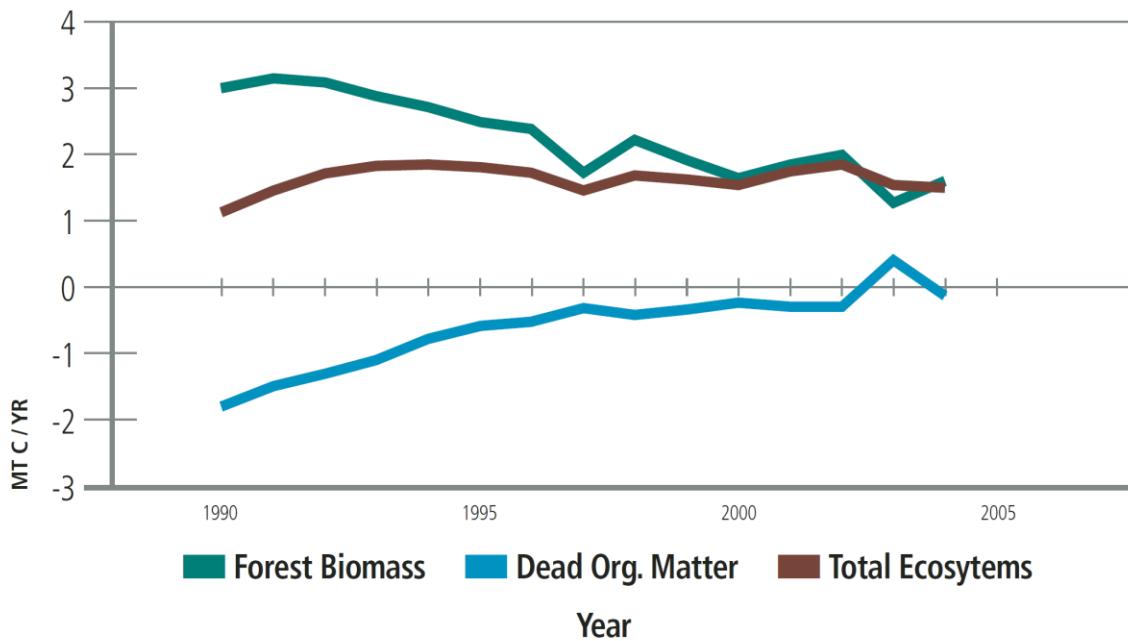
- living above ground and below ground woody biomass,
- soil organic carbon,
- carbon in litter.

The Figure 17 shows the evolution of the carbon biomass in the ecosystem of Nova Scotia forest during the period 1990-2004. The situation in 2004 is a positive balance of 1.6 million tonnes stored into the forest²⁹.

²⁷ Soil Types are soils differentiated based on texture, drainage, fertility, and depth; all of which influence site productivity and other management interpretations.

²⁸ Forest Ecosystem Classification for Nova Scotia Part II: Soil Types (2010). Nova Scotia Department of Natural Resources.

²⁹ State of the Forest Report 1995-2005. Nova Scotia Forests in Transition. Nova Scotia Department of Natural Resource.

Figure 17 : Net annual change in forest ecosystem carbon in Nova Scotia, 1990-2004

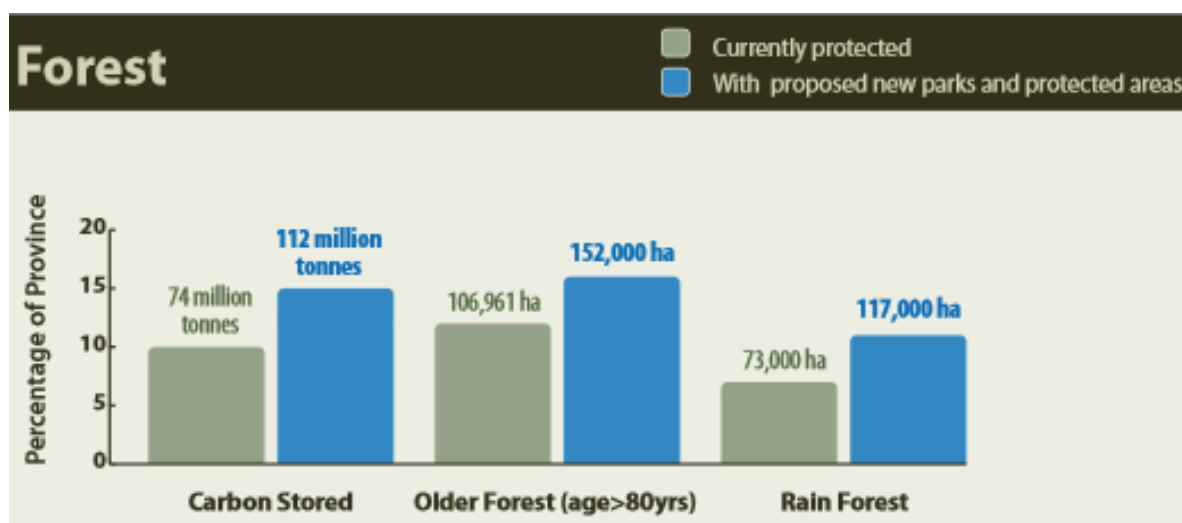
Source: State of the Forest Report 1995-2005.

Despite a positive balance of carbon storage recorded each year, the additional amounts of carbon sequestered yearly in the forest ecosystem tend to decrease slightly, as a result of several factors. First are natural like forest fires, hurricanes (Hurricane Juan in September 2003) and areas defoliated by insects. The use of clearcutting has also contributed locally to carbon depletion. In the last couple of years, efforts have been made by the Nova Scotia's government to reduce this effect and indirectly increase the amount of carbon sinks.

- reducing the amount of clearcutting
- shifted some silviculture funding toward more sustainable forestry practices
- conservation of biodiversity
- increasing the area of protected area
- etc.

As far as the legal protection of areas is concerned, it is estimated that an additional 38 million tonnes of carbon will be stored in the forests of Nova Scotia if the target of 13% of protected area is reached (objective for 2015, as explained in section 3.3).

Figure 18 : Carbon stored and forest area in current situation and in case of increase of protection of forest areas



Source: Our wild spaces: identifying new protected areas for Nova Scotia: 12 percent by 2015. Nova Scotia.

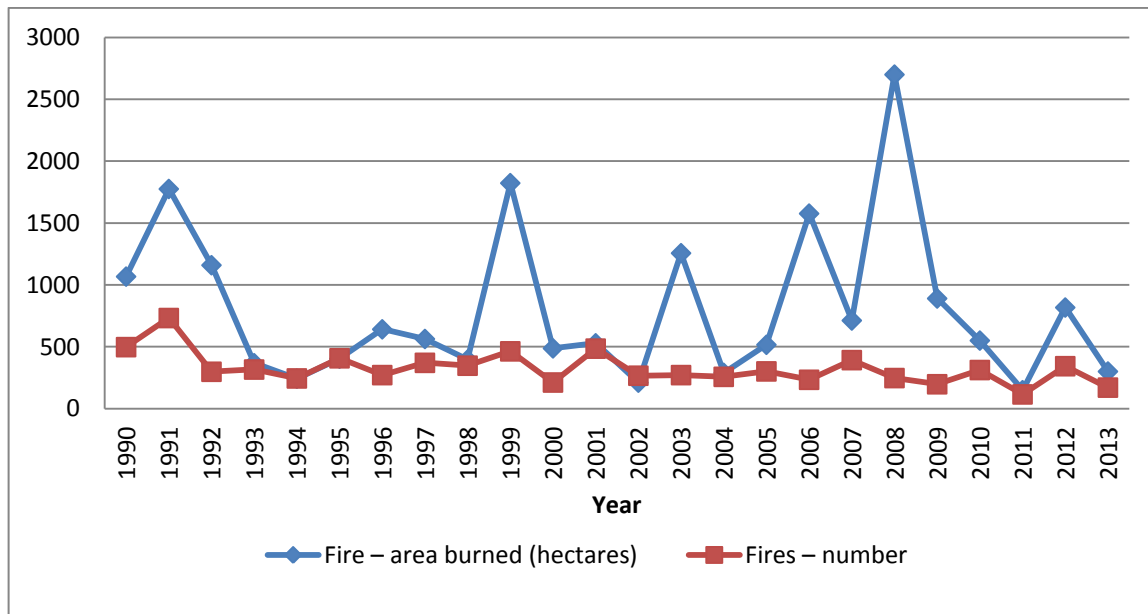
3.7. Protection of air quality

The main impact of forestry on air quality relates to fire. It includes wild fire (which are unintended) and prescribed fire (which is used as part of forest management under controlled conditions).

Prescribed fire does not seem to be a very usual and widespread practice in Nova Scotia, even though it is used in some cases, including habitat management in some natural parks. Nova Scotia has a relatively wet climate, thus the number of wildfires that typically occurs in an average season is low compared to drier provinces³⁰.

The surfaces affected by wildfire and the number of fires are relatively constant during the 1990-2013 period with an annual average of 800ha burned and 320 fires.

³⁰ <http://novascotia.ca/natr/forestprotection/wildfire/>

Figure 19 : Number of wildfire and areas affected (1990-2013)

Source: calculated from <http://scf.mcan.gc.ca/profilstats> and <http://novascotia.ca/natr/forestprotection/wildfire/stats/2013gen.asp>

We also note that a special act is consecrated to *Forest Fire Protection Regulations*³¹.

3.8. *Illegal logging*

The FSC risk assessment platform www.globalforestregistry.org considers that Canada is at low risk in terms of illegal logging, because the following criteria are all verified:

- Evidence of enforcement of logging related laws in the district³²
- There is evidence in the district demonstrating the legality of harvests and wood purchases that includes robust and effective system for granting licenses and harvest permits³³
- There is little or no evidence or reporting of illegal harvesting in the district of origin³⁴
- There is a low perception of corruption related to the granting or issuing of harvesting permits and other areas of law enforcement related to harvesting and wood trade³⁵

³¹ <http://www.novascotia.ca/just/regulations/regs/fofire.htm>

³² www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

³³ www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

³⁴ www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

³⁵ <http://www.transparency.org/cpi2012/results>

3.9. Civil rights and traditional rights

The FSC risk assessment platform www.globalforestregistry.org considers that Canada is at low risk in terms of violation of civil and traditional rights, because the following criteria are all verified:

- There is no UN Security Council ban on timber exports from the country concerned
- The country or district is not designated a source of conflict timber (e.g. USAID Type 1 conflict)
- There is no evidence of child labor or violation of ILO Fundamental Principles and Rights at work taking place in forest areas in the district concerned
- There are recognized and equitable processes in place to resolve conflicts of substantial magnitude pertaining to traditional rights including use rights, cultural interests or traditional cultural identity in the district concerned
- There is no evidence of violation of the ILO Convention 169 on Indigenous and Tribal Peoples taking place in the forest areas in the district concerned

3.10. Forest certification

The main forest certification schemes used in Nova Scotia are:

- CSA (Canadian Standards Association - Group Sustainable Forest Management System³⁶) which is endorsed by PEFC (Programme for the Endorsement of Forest Certification)
- SFI (Sustainable Forestry Initiative³⁷), which is endorsed by PEFC (Programme for the Endorsement of Forest Certification)
- FSC (Forest Stewardship Council³⁸), which is specifically suitable for small private owners

The certified forest area under each of those schemes as for 2013 is presented in the table hereunder:

Table 13: Certified forest land in Nova Scotia (2013)

	CSA	SFI	FSC	Total certified
Area certified (thousand ha)	10,927	663,253	767,128	1441,308
Percentage forests	0,26%	18,86%	18,35%	34,47%

Source: calculated <http://www.certificationcanada.org>

The percentages have been calculated in comparison with the total forested reported above in

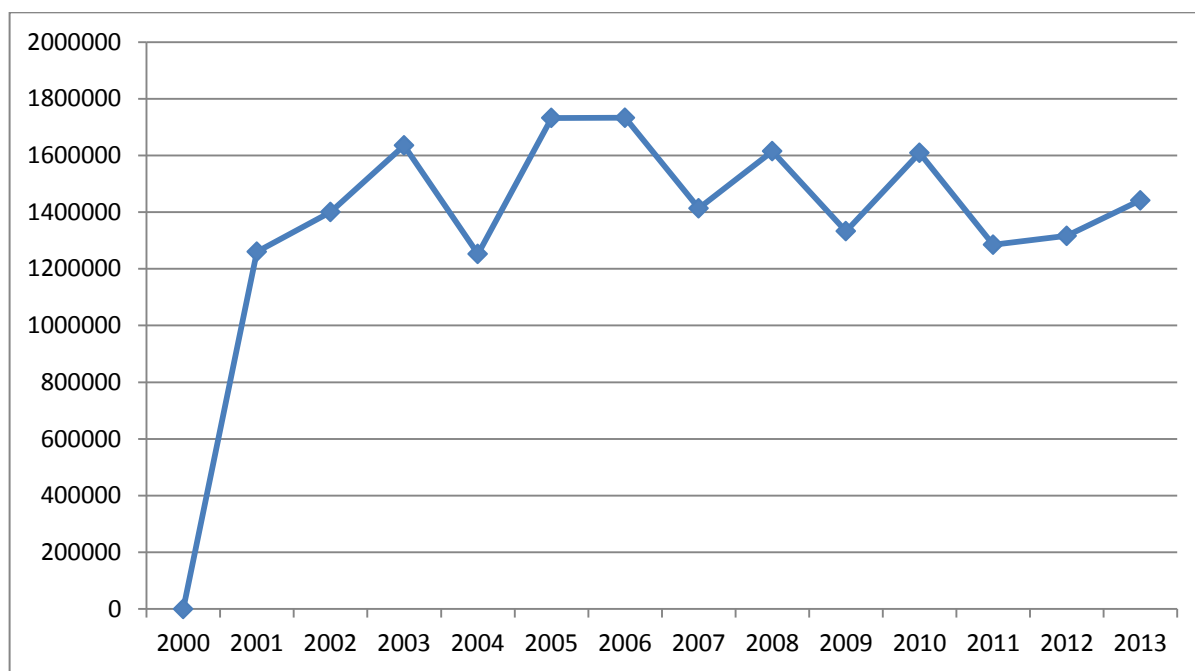
³⁶ <http://www.csasfmforests.ca/>

³⁷ <http://www.sfiprogram.org>

³⁸ www.fsc.org

Table 4

The areas of certified forests have quickly increased since 2000 and remain stable after, as can be seen on Figure 20

Figure 20 : Evolution of certified forest area in hectares

Source: calculated from <http://scf.mcan.gc.ca/profilstats>

4. Conclusions

Nova Scotia has approximately 4.2 million ha of forests, which is about 75% of the province's land area. About 80% of the forest land is considered potentially available to timber harvesting. The province is very diverse in terms of ecological conditions, and the forest is present in most of them (coast, hill and interior plains).

Approximately 34% of Nova Scotia's forest land area is publicly-owned (mostly Crown land). Private ownerships accounts for the remaining 66%.

Conifers predominate largely in Nova Scotia and account for the great majority of all forest species. Spruce, hardwood and fir largely dominate the growing stock.

The forest area of Nova Scotia is not systematically monitored in terms of surface on a yearly basis. However, land use change is monitored in the framework of the national GHG inventory report (submitted to UNFCCC). According to this report, in the Atlantic Maritime reporting region (i.e. Nova Scotia and New Brunswick put together), the net deforestation was below 0.015% per year on average during the period 1992-2012. The FSC risk assessment platform considers that Canada (as a whole) is at low risk in terms of conversion of forest to other land uses (www.globalforestregistry.org).

The volume of harvested wood used to fluctuate between 3.5 and 6.9 million cubic feet per year in the period 2000 to 2013.

The volume standing trees is not regularly assessed at the provincial level. Total merchantable hardwood for commercial species in the province is estimated to be over 132 million m³ in 2007 with red maple (57.6 million), yellow birch (19.4 million), sugar maple (18.0 million), and white birch (13.3 million). Between 1995 and 2005, the living volume of merchantable wood in Nova Scotia is estimated to have increased by 0.2% yearly.

Nova Scotia's forests are estimated to be a sink of 1,6 million tonnes of carbons in 2004, which is consistent with the increase in terms of volume of standing wood and very little deforestation. Even though the forests in Nova Scotia remain a carbon sink, the additional amounts of carbon sequestrated yearly tend to slightly decrease after 2000, because of various factors (including a major storm and some wildfires). Some action have been taken by the Nova Scotia's government (e.g. reducing the occurrence of clear cutting and increasing the surfaces of conserved forest) which should help the carbon sequestration to stay positive in the future.

Protected forest areas, mostly wilderness areas and national parks, cover 515 thousand hectares, which is about 9.3% of the province forests. Significant efforts have been taken for the next years to increase Nova Scotia's protected forest areas to 13%.

The *Environmental Goals and Sustainable Prosperity Act* has priorities like restoring, preserving, and managing water resources. The *Wildlife Habitat and Watercourses Protection Regulations* is also designed to protect water quality and to maintain various elements of wildlife habitat on all forest harvest sites.

The protection of water, the protection of soil and air in Nova Scotia rely on the *Code of Forest Practice*. Determination of ecosystem soil type can help to advice management interpretations.

related to soil compaction hazard, rutting hazard, erosion hazard, frost heave hazard, and sensitivity to forest floor loss have been made. The main impact of forestry on air quality relates to fire. However Nova Scotia has a relatively wet climate, thus the number of fires that typically occurs in an average season is low compared to drier provinces.

The FSC risk assessment platform www.globalforestregistry.org considers Canada is at low risk in terms of violation of illegal logging and in terms of violation of traditional and civil rights.

The forest certification systems have strongly developed in Nova Scotia since 2000, with nearly 35 % of forest certified under 3 systems CSA, SFI and FSC. FSC and SFI are the major ones. CSA is the less important system, with 0.3% forest certified.

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