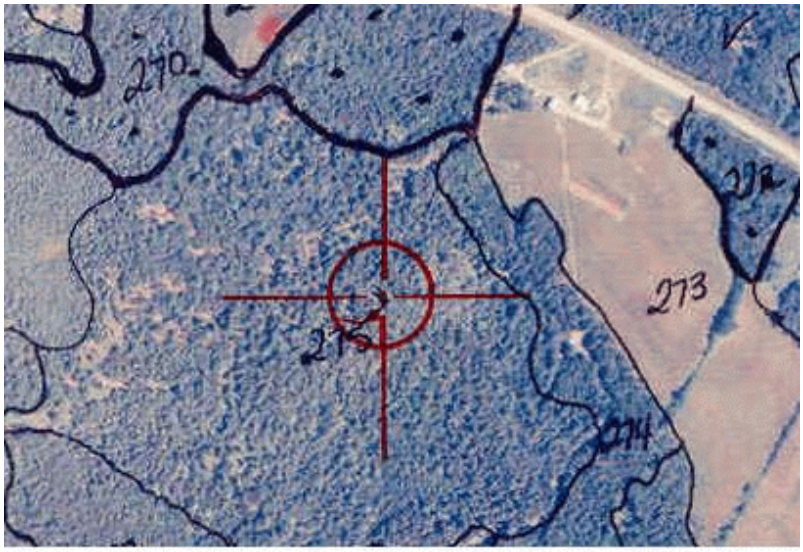
NOVA SCOTIA

Natural Resources

Forestry Division



Nova Scotia Forest Inventory Based on Permanent Sample Plots Measured between 1999 and 2003

Report FOR 2004 - 3

Peter Townsend

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Cover Photo: Approximate location of a Permanent Sample plot in Nova Scotia. Plots are re-located by cruisers using global positioning satellite technology.

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1.0 INTRODUCTION

Nova Scotia has a system of 3250 randomly located Forest Inventory Permanent Sample Plots which provide information on our forest resources. The information on forest volumes provided is compiled to estimate the merchantable volume for the Province. This report uses data from all 3250 inventory plots measured over the 5 year period from 1999 to 2003. The results are presented in tabular form similar to the previous report (NSDNR, FOR 2000-1) as well as the Forest Resources Inventory (FRI) Report (NSDNR, FOR 1999-1) which publishes the photo interpretation inventory.

1.1 Background

Nova Scotia has an inventory program that requires two data collection systems. The Forest Resources Inventory Report (NSDNR FOR 1999-1) (FRI) provides volumes based primarily on photo interpretation, but augmented with satellite data and field data. The Permanent Sample Plot (PSP) system is a continuous forest inventory system which uses field measurements to determine the growth and mortality of Nova Scotia forests over time. Combining aspects of both systems is one way to provide more meaningful information for management and planning. This report combines the Photo Interpretation ability to give area, ownership, and forest cover, with the Permanent Sample Plot ability to provide species (especially for those that are minor components in many stands) and age.

A description of current and previous forest inventories can be found at the department web site http://www.gov.ns.ca/natr/forestry/For-inventory.htm . Approximately 1760 PSP plots were established between 1965 and 1970, with the remainder established from 1998 to 2002. A previous report in 2000 (NSDNR, FOR 2000-1) compiled information from all 1923 plots for which data was collected to the end of the 1998 field season. Five years later, all plots have been remeasured/established. This report captures the latest moving 5 year average. When referring to these two reports, the one using data from 1994 to 1998 will be called the 1998 report, while the one using data from 1999 to 2003 will be called the 2003 report.

2.0 METHODS

Individual tree values of Basal Area (BA) and Merchantable Volume (MV) are aggregated to plot level values. At the plot level, they are combined with the plot age and Land Capability (LC). This information allows the plots to be stratified by Age, or LC or BA class or MV class or other combinations as required. To expand these values to provincial estimates, the Forest Resources Inventory (FRI) area is used. Table 1. (Appendix I) gives the provincial forest areas by forest cover and ownership. The values of the plots are then applied to these areas to provide the tables in Appendix I.

One of the photo interpretation forest cover categories is "Other". The "Other" Forest Cover category is for unclassified stands which do not have a species assigned and are primarily recent harvest areas. The Photo Interpreters were unable to confidently say what was growing on these sites. In the photo interpretation inventory, this area comprised 13.5% of the total forest land, so 13.5% of the lowest volume PSP's were removed[1]. The remaining 2816 plots were used to get Age class, BA class, MV class, Land Capability, etc. and the compiled information is distributed by the area of Forest Cover Type as determined by Photo Interpretation. For example, to determine area by age class in softwood stands on Crown land: the number of crown land plots in each age class is divided by the total number of plots in softwood plots on Crown land. The resultant representative fraction (rf) was applied to the total Crown Softwood (SW) area to give area by age class for Crown softwood land. A more explicit example:

Example: 81-100 year old SW stands on Crown Land.
Number of PSP's located in SW plots on Crown Land: 521
Number of these PSP's that are 81-100 years old: 70
Percent (rf): 70/521 = 13.44%
Area of SW stands on Crown Land from FRI: 708,325 ha
Resultant area of 81-100 yr SW on Crown Lands; 708,325 *0.1344 = 95,168 ha

3.0 RESULTS

The results of the compilations appear in Tables 1 to 7 in Appendix I. Highlights of some of the more interesting results are briefly described in the following sections.

[1]This comprises an area of 573 M hectares, or 13.5% of the forest land. A GIS based forest area of 86.5% currently provides the volume for Nova Scotia forest inventory. Therefore, 86.5% of the PSP's or 2816 plots were then used to populate 86.5% of the forested area provided by GIS.

3.1 Merchantable Volume

Merchantable volume[2] for the province, using PSP data, is estimated at 404.4 million cubic metres (Table 2). This is 1.8 % less than the previous inventory based on PSP's 5 years ago and 2.7 % more than the figure generated by the FRI database in 1999. As a check to this volume, the average volume on all 3250 plots was computed and applied to the total forest area of the Province. The result is 94.93 m^3/ha x 4,256,846 ha = 404,102,391 m^3, virtually the same as the estimated figure in Table 2 which uses FRI areas by forest Cover Type and Ownership. Figure 1. illustrates the slight shift in volume by ownership between 1998 and 2003. Federal and Crown land has experienced a slight growth in volume while small and large private land has experienced a slight drop.

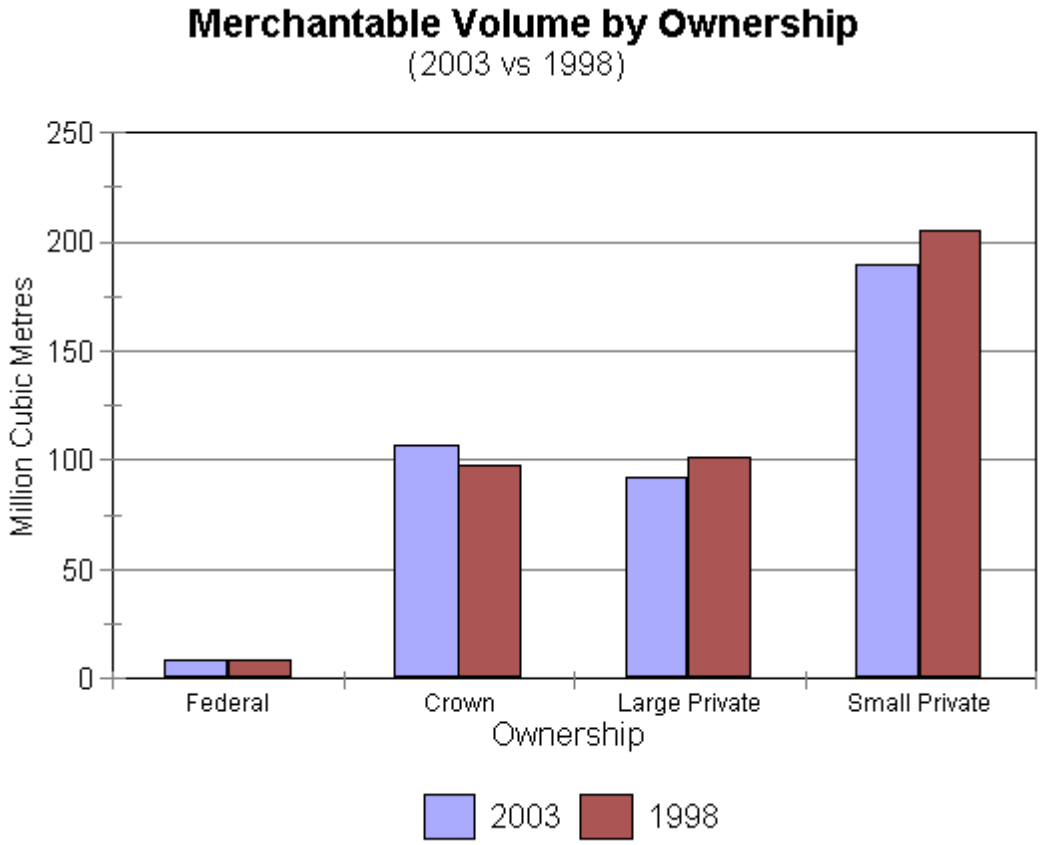


Figure 1. Merchantable volume by ownership using FRI based area for ownership and covertype combined with PSP based average volume by these same strata.

[2]Merchantable Volume is the wood fibre in trees, exclusive of branches, 9.1 cm DBH outside bark and larger that is contained between a 15 cm high stump and an inside bark top diameter of 7.6 cm.

3.2 Age Class

Plot age is calculated for PSP's using the 3 trees closest in diameter to the tree of average basal area for the plot. These three trees are bored and their age at breast height is counted and recorded. The Land Capability for the plot is used to determine the years from stump height to breast height. These years are added to each tree, and then the 3 tree ages are averaged to get the age of the plot. For some plots, the age data was not available. In each of these cases, the age was assumed to be in the "0 to 20 years" category[3].

Figure 2 illustrates the change in age structure between the 2003 and 1998 report. Plot ages show the forest has a multi-age structure which has a distinct peak in the "41-60 age class". One aspect of the present inventory plots is that we do not try to estimate whether a plot is unevenaged. The 1998 unevenaged plots that appear in the following figure were assigned this category before 1998. A comparison with the age classes recorded in 1998 show a shift to a younger forest.

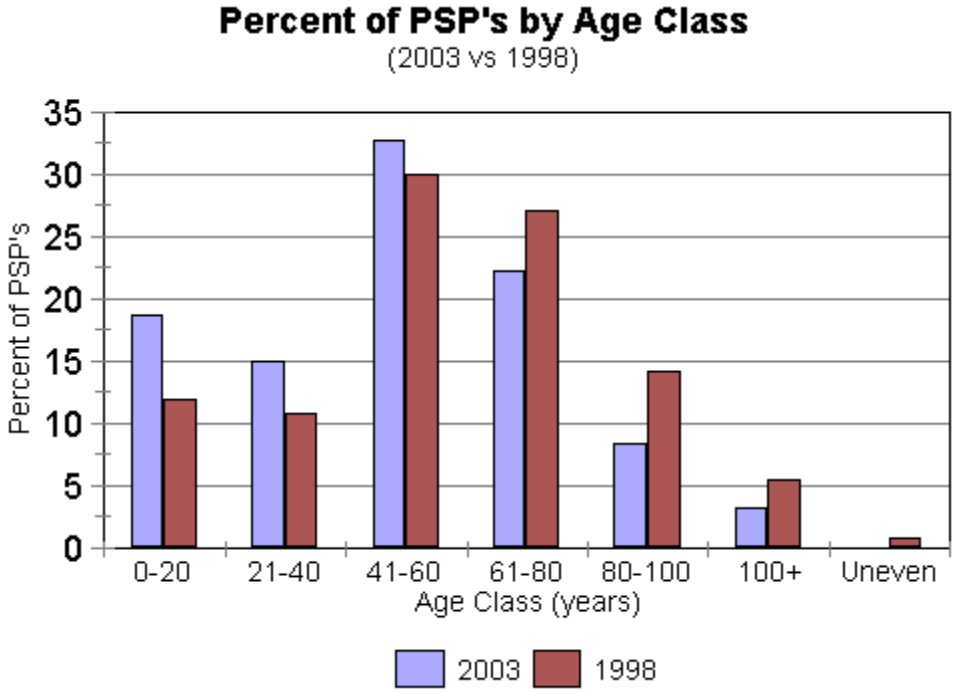


Figure 2. A comparison of the age class distribution of the 1923 PSP's used in the 1998 report versus the 3250 PSP's used in this 2003 report.

[3]While this may not always be true, it is seen as a consistent resolution to an unresolvable problem. The majority of these plots are harvested areas in which regeneration has not yet reached breast height.

3.3 Basal Area

The plot basal[4] area was used to distribute Provincial area by Forest Cover Type in Table 4 (Appendix I). As expected, as the Basal Area Class increases, there is a slight increase in average age category. As a general rule, fully stocked hardwood stands could contain around 30 m^2/ha while softwood stands could contain around 50 m^2/ha. Figure 3 illustrates the PSP's by Basal Area Class for the Province. There is no large change between 1998 and 2003.

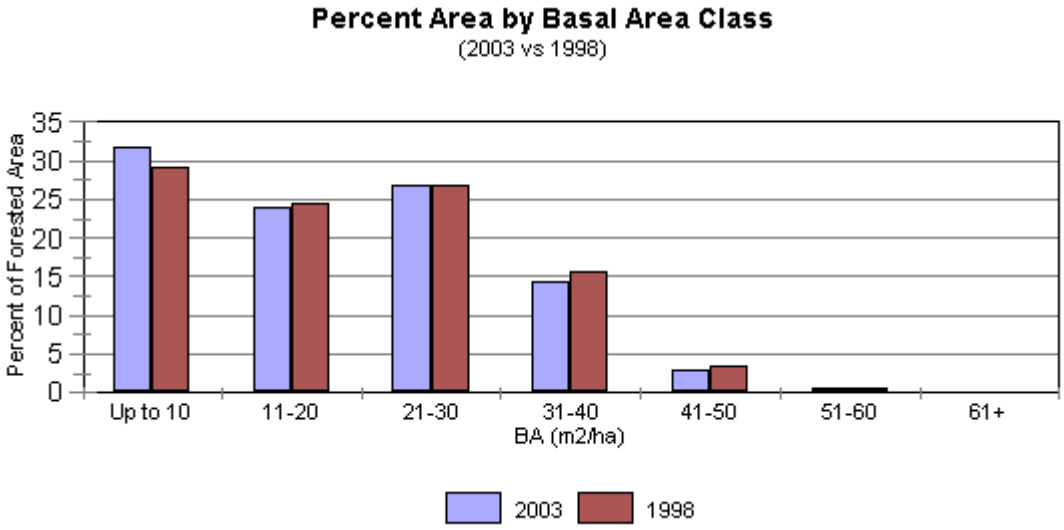


Figure 3. A comparison of the basal area classes of the 1923 PSP's used in the 1998 report with the 3250 PSP's used int this 2003 report.

[4]Merchantable Basal Area is the cross-sectional area of all trees 9.1 cm DBH outside bark and greater and is reported in m^2/ha. It is an important variable in computing merchantable volume.

3.4 Merchantable Volume by Species

The total volume of all 3250 plots were compiled by species. The total volume of each species on all plots, when divided by the total volume of all species on the plots and multiplied by 100, gives the percent volume by species. Percent by species was then applied to the total volume for Nova Scotia presented in Table 2. Figure 4 compares the volume of the major species with those in 1998. Sorted in descending order by volume, red/black spruce is the leading softwood while red maple is the leading hardwood. The graph also illustrates that the percent of spruce[5] (red+black, (xs)), white spruce, balsam fir and eastern hemlock have all decreased since 1998, while white pine, tamarack (tl) and most all hardwoods have increased.

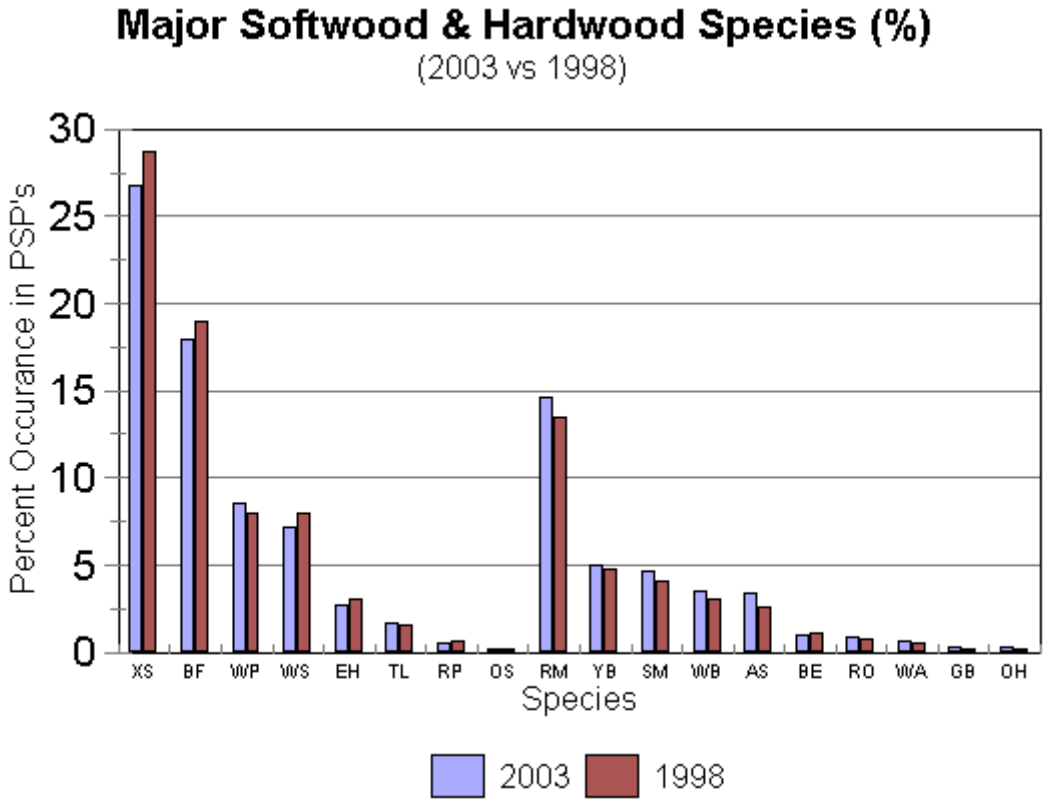


Figure 4. A comparison of the major softwood and hardwood species based on species merchantable volume and expressed as percent for 1923 PSP's from the 1998 report versus the 3250 PSP's used in this 2003 report.

[5]Prior to 1998, red and black spruce were not differentiated, so for the 1998 report, only one year of data splitting these two species existed. Due to this low number, a comparison of the relative numbers of red and black spruce are not presented.

3.5 Land Capability

Land Capability is an indication of the maximum growth potential of forest volume on an area and is expressed in m^3/ha/yr. On the Forest Inventory Plots, the three best trees are selected by experienced cruisers to determine Land Capability. All three trees should be of the same species and should be dominant, of the majority species, and appear to be and have been free growing with no indication of top damage. The Height and Age of these trees are recorded and analyzed to determine Land Capability. From these results, the best is chosen and used to categorize the plot. This method will under-estimate the Land Capability in plots where the trees have reached a climatic maximum height[6]. The results of this categorization appear in Table 7 and the province wide picture in Figure 5. Additional plots established since 1998 have resulted in a more normal distribution in 2003. However, the provincial average is still estimated to be 5 m^3/ha/yr.

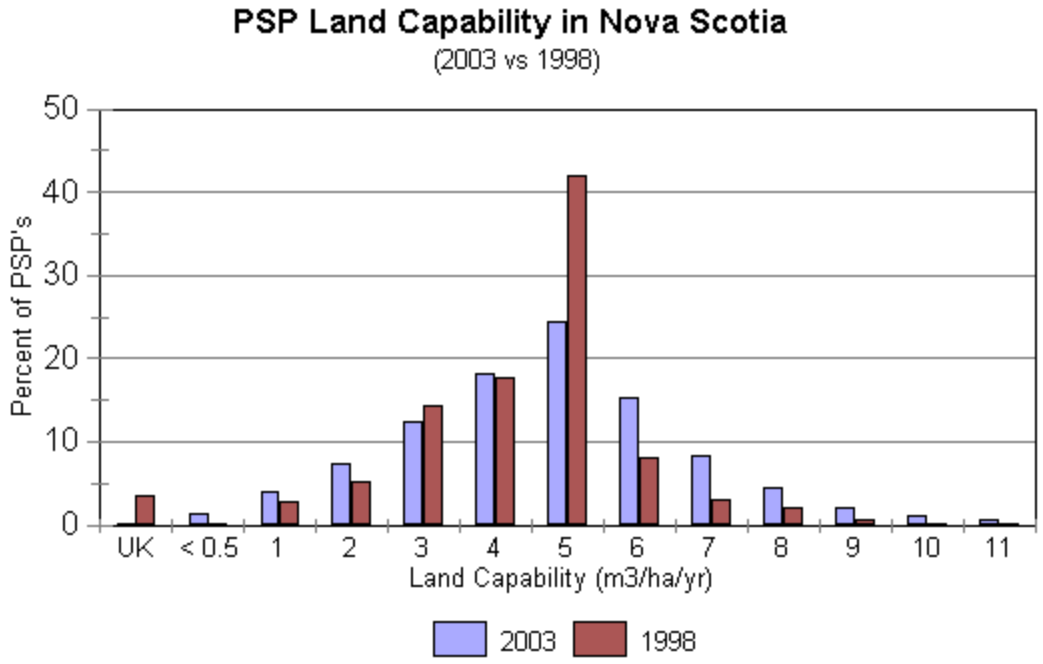


Figure 5. A comparison of Land Capability based on percent of 3250 PSP's in this 2003 report versus the 1923 PSP's in the 1998 report.

[6]When a tree hits its climatic maximum height, the tree will continue to grow in diameter, but will show a very large reduction or perhaps even stop its height growth, therefore, analyses using present models will underestimate the actual Land Capability of the plot. This situation will occur more frequently, the older the plot becomes and may affect a significant proportion of stands 61years and older.

3.6 Harvest Activity

A description of total harvest area for Nova Scotia is best captured by the Spatially Related Forest Resources Inventory (FRI) database (resident on the NSDNR Forestry Division Geographic Information System (GIS)) which incorporates several updates including satellite coverage. However, the PSP's can also provide recent information on harvests at the plot level. Data has been collected up the end of 2003, however, use of all 3253 plots should be used to report on this treatment. Because of this, a complete picture exists only for 1999 and previous years. For plots experiencing harvests, approximately 67% were clearcut[7] while 33% were partial cut. On average, 1.3% of all plots are either clear or partially cut each year. As a check on this number, one may consider the recent volumes reported in the NS Registry of Buyers. It reports a harvest level of around 6 million m^3/yr. Dividing this by an average[8] harvest volume of 110 m^3/ha equals an area of ~54,545 ha or 1.3% of the forested area. Similar values.

Table A. PSP reported harvest type by plot for plots measured between 1999 and 2003. The total area of Nova Scotia's forest is 4, 256,846 ha.

Year	Clearcut	Partial	Total Harvest	Plots Reporting	Percent	Representative Area
1995	32	12	44	3253	1.35	57,578
1996	33	18	51	3253	1.57	66,738
1997	36	18	54	3253	1.66	70,664
1998	28	14	42	3253	1.29	54,961
1999	26	16	42	3253	1.29	54,961
Average	29	14	43	3253	1.32	56,270

[7]Clearcut is defined as less than 25% of the original Merchantable Basal Area remaining following the harvest.

[8]The 110 m^3/ha (20 cds/acre) is a suggested average harvest for a combination of clear and partial cuts. The actual harvest volumes in the PSP's will require further analysis.

3.7 Woody Vegetation

On each PSP there is a 10 m^2 subplot established to collect information on woody vegetation. The woody vegetation on the plots gives a description of one component of habitat. The following tables show the most commonly encountered woody vegetation from 1998 to 2002. During this time, stem density of all woody vegetation was collected[9]. Woody vegetation can be divided into two categories: those that will grow into merchantable size trees (e.g. balsam fir) and those that will remain as woody shrubs or smaller (e.g. Lambkill). For trees, Table B shows that balsam fir was recorded in 1872 of the 3250 plots measured. It had an average density of 25 stems/10 m^2 and an average height of 43 cm in the plots where it was found. For woody shrubs, Table C shows that the most commonly encountered is lambkill, found on 967 plots with an average density of 84 stems/10 m^2 and an average height of 28 cm. The entire list for both trees and woody shrubs appears in Appendix I, Tables 8 and 9 respectively.

Table B. Tree species on the woody vegetation plot by average density and height. (Only includes plots where the vegetation occurred.)

Species	Plots	Average Density (per 10 m^2)	Average Height (cm)
Balsam Fir	1872	25	43
Red Maple	1192	14	44
Red Spruce	957	12	44
White Birch	402	8	90

Table C. Woody Species by average density and height. (Only includes plots where the vegetation occurred.)

Species	Plots	Average Density (per 10 $m^{2)}$	Average Height (cm)
Lambkill	967	84	28
Blueberry	819	41	17
Witherod (Wild Raisin)	385	11	89
Raspberry	325	45	36

[9]In 2003, density was still collected on all tree species but not for the woody vegetation. It was decided to assess woody vegetation in terms of percent cover in the subplot.

3.8 Coarse Woody Debris

Within each PSP a coarse woody debris line transect plot is located. Along this transect, the cruiser measures all coarse woody debris larger than 9.1 cm at the point where the woody debris crosses the transect. The woody debris is recorded by species, diameter and decay class[10]. Figure 6 shows the provincial average volumes by plot age class for the plots measured between 1999 and 2003. Initially, coarse woody debris volume is high following harvest/stand initiation, thereafter it drops, then increases again as the forest matures. Decay class 3 always contains the highest volume. For the province, the average coarse woody debris for each decay class 1, 2, and 3 is 1.92, 5.70 and 12.81 m^3/ha respectively, for an overall average of 20.43 m^3/ha.

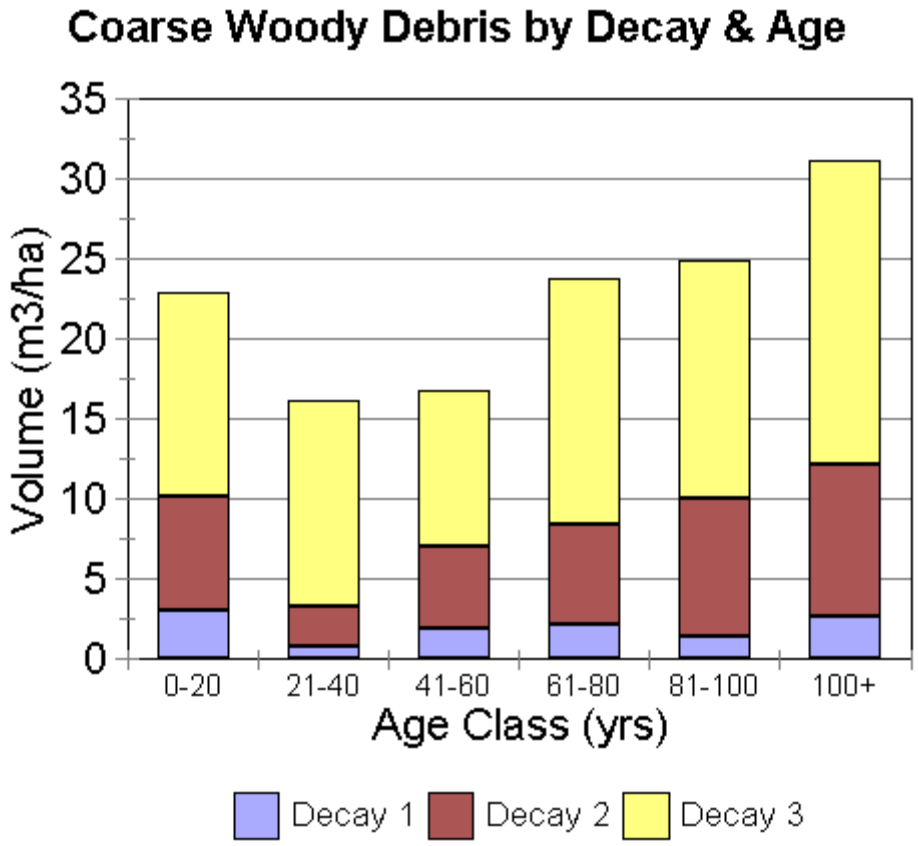


Figure 8. Coarse woody debris by decay class and age for Nova Scotia, recorded between 1999 and 2003.

[10]Decay Classes:

1 bark on, hard bole, round, twigs and branches present and supporting log partially off ground,
2 bark flaking, mostly hard bole (little decay), round, few branch stubs, flat on ground,
3 bark mostly gone, soft bole, oval, sinking into ground.

3.9 Ground Cover

Each plot is assessed for a general description of ground cover by broad category. Figure 9 shows the relative abundance of each type of category for the plots measured from 1999 to 2003. For the high, medium and low categories[11], the most commonly encountered ground cover is leaf litter, other moss[12], and slash/woody debris respectively. The numbers to produce this graph appear in Appendix I, Table 10.

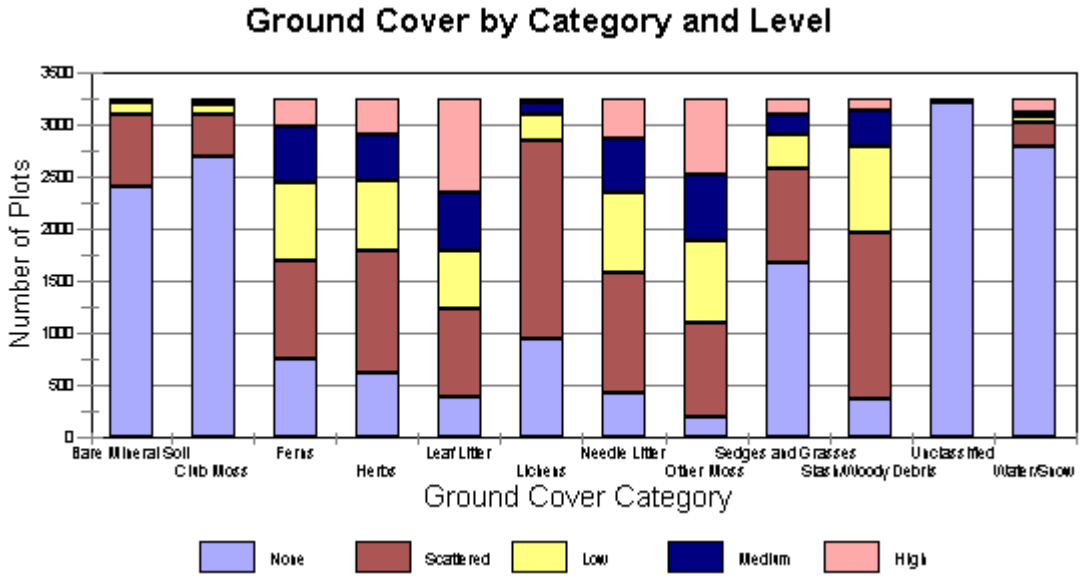


Figure 9. Ground cover category by cover level and number of plots.

[11]Ground Cover Level of coverage:

1	None (0)
2	Scattered (1-10%)
3	Low (11-40%)
4	Medium (41-70%)
5	High (71-100%)

[12]Other moss: "any moss not called a club moss"

4.0 Quality of the Merchantable Volume

Merchantable trees are primarily assessed for quality in two ways. First, any significant damages are recorded for each individual tree. Second, each tree is assigned a product code which has quality implicit in the product definition. It is this second quality assessment which is presented here.

Softwood merchantable volume is comprised of the following: 69 % sawlog quality, 30% roundwood and 1% cullwood. The softwood of sawlog quality is further divided into 3 classes of 1, 2 and 3, with 1 being the best quality. The percent of softwood sawlogs in each class is 9, 51 and 40 respectively. The 30% of softwood roundwood will contain many potential sawlog trees, as the limiting diameter at breast height is 17.8 cm (7 inches). Given time, most of these trees will become large enough for sawlogs.

Hardwood merchantable volume is comprised of 67% roundwood and 3 % cullwood. A sawlog category is comprised of selected species which are 24.5 cm (10 inches) or larger at breast height. For each of these large sawlogs, technicians carry out a rigorous data collection routine to describe and record all scale and grade defects. This data is then compiled in a hardwood tree grading program developed by the NSDNR Timber Management group. Many of these sawlog size trees do not make it through the subsequent assessment. However, initial indications (unpublished) show that approximately 12.8 million cubic metres of sawlog volume can be derived from some of these larger trees and are estimated to contain 7% - G1, 19% - G2 and 74% - G3[13]. As a further description of this sawlog volume, the primary species are: red maple (30%), sugar maple (23%), and yellow birch (20%). Similar to softwood trees, the 67% roundwood volume is comprised of many trees not yet large enough to be sawlogs. In 2003, technicians began assessing the sawlog potential of the smaller diameter roundwood trees (7-10" or 17.8 - 25.3 cm DBH) and information will be compiled on these in a few more years.

Literature Cited

NSDNR, FOR 1999-1. Forest Resources Inventory Report. Nova Scotia Department of Natural Resources, Forest Inventory Section. Cat. Log. Report FOR 1999-1. 29 pp.

NSDNR, FOR 2000-1. Nova Scotia Forest Inventory Based on Forest Inventory Permanent Sample Plots Measured between 1994 and 1998. 15 pp.

Calvert, W.W. and F.J. Petro, 1993. Grading Standing Hardwood Trees in Nova Scotia, 71 pp.

[13]G1, G2 and G3 are tree grades which relate to potential lumber yield. G1 is the highest quality and G3 the lowest quality. For more information on this grading system, see “Grading Standing Hardwood Trees In Nova Scotia” (Calvert and Petro, 1993)

Appendix I

Table 1. Provincial Area by Ownership and Forest Cover Type from Photo Interpretation Inventory (Internal, Colleen, February, 2004).

Forest Cover Type	Crown (ha)	Large (ha)	Small (ha)	Federal (ha)	Total (ha)
Softwood	708,325	468,481	921,055	52,967	2,150,828
Mixedwood	260,332	188,366	538,566	27,203	1,014,467
Hardwood	158,835	94,862	252,216	12,583	518,496
Other	103,265	153,641	294,501	21,648	573,055
Total	1,230,757	905,350	2,006,338	114,401	4,256,846

Table 2. Provincial Merchantable Volume (m^3) by Ownership and Forest Cover Type. Average plot m^3/ha volumes were multiplied by area from Table 1.

Forest Cover Type	Crown (m^3)	Large (m^3)	Small (m^3)	Federal (m^3)	Total (m^3)
Softwood					
Softwood	60,165,126	55,013,724	93,533,135	3,945,512	212,657,497
Hardwood	3,732,873	4,103,894	9,044,760	254,771	17,136,298
Total	63,897,999	59,117,618	102,577,895	4,200,283	229,793,795
Mixedwood					
Softwood	15,791,739	14,336,536	33,369,549	1,652,310	65,150,134
Hardwood	12,717,218	10,343,177	29,346,461	1,368,311	53,775,167
Total	28,508,957	24,679,713	62,716,010	3,020,621	118,925,301
Hardwood					
Softwood	1,205,558	1,015,023	2,174,102	50,961	4,445,644
Hardwood	14,793,892	10,424,385	24,636,459	1,394,196	51,248,932
Total	15,999,450	11,439,408	26,810,561	1,445,157	55,694,576
All					
Softwood	77,162,422	70,365,283	129,076,786	5,648,783	282,253,275
Hardwood	31,243,983	24,871,456	63,027,680	3,017,278	122,160,397
Total	108,406,405	95,236,739	192,104,466	8,666,061	404,413,672

The hardwood and softwood total values in this table vary from those in Table 6 because the values in Table 2 are weighted by area, whereas those in Table 6 are not.

Table 3. Provincial Area by Ownership, Forest Cover Type and Age Class, using Photo Interpretation Inventory total areas (Table 1) and representative fractions by plot.

Forest Cover/ Age Class	Ownership				
	Crown (ha)	Large (ha)	Small (ha)	Federal (ha)	Total (ha)
Softwood					
Up to 20 Years	38,067	33,924	40,827	1,513	114,331
21 to 40 Years	130,517	117,928	171,473	0	419,918
41 to 60 Years	217,528	132,467	390,305	15,133	755,433
61 to 80 Years	190,337	106,620	210,667	18,160	525,784
81 to 100 Years	95,168	50,079	76,755	10,593	232,595
101 + Years	36,708	27,463	31,028	7,567	102,766
Unevenaged	0	0	0	0	0
Total	708,325	468,481	921,055	52,966	2,150,827
Mixed					
Up to 20 Years	14,962	5,573	26,870	0	47,405
21 to 40 Years	35,908	36,782	91,124	2,863	166,677
41 to 60 Years	105,729	61,303	254,680	10,022	431,734
61 to 80 Years	73,811	54,615	119,162	8,590	256,178
81 to 100 Years	25,933	24,521	32,711	2,863	86,028
101 + Years	3,990	5,573	14,019	2,863	26,445
Unevenaged	0	0	0	0	0
Total	260,333	188,367	538,566	27,201	1,014,467
Hardwood					
Up to 20 Years	13,693	6,874	28,733	839	50,139
21 to 40 Years	22,821	9,624	32,990	839	66,274
41 to 60 Years	57,509	41,244	95,778	1,678	196,209
61 to 80 Years	41,991	28,871	75,558	5,033	151,453
81 to 100 Years	17,344	4,124	14,899	3,355	39,722
101 + Years	5,477	4,124	4,257	839	14,697
Unevenaged	0	0	0	0	0
Total	158,835	94,861	252,215	12,583	518,494
Other					
Up to 20 Years	103,265	153,641	294,501	21,648	573,055
21 to 40 Years	0	0	0	0	0
41 to 60 Years	0	0	0	0	0
61 to 80 Years	0	0	0	0	0
81 to 100 Years	0	0	0	0	0
101 + Years	0	0	0	0	0
Unevenaged	0	0	0	0	0
Total	103,265	153,641	294,501	21,648	573,055
Total					
Up to 20 Years	169,987	200,012	390,931	24,000	784,930
21 to 40 Years	189,246	164,334	295,587	3,702	652,869
41 to 60 Years	380,766	235,014	740,763	26,833	1,383,376
61 to 80 Years	306,139	190,106	405,387	31,783	933,415
81 to 100 Years	138,445	78,724	124,365	16,811	358,345
101 + Years	46,175	37,160	49,304	11,269	143,908
Unevenaged	0	0	0	0	0
Total	1,230,758	905,350	2,006,337	114,398	4,256,843

Table 4. Provincial Area by Basal Area Class, Forest Cover Type and Age Class, using Photo Interpretation Inventory total area (Table 1) and representative fractions from plots.

Forest Cover/ Age Class	Basal Area Class (m^2/ha)							
	0 - 10 (ha)	11 - 20 (ha)	21 - 30 (ha)	31 - 40 (ha)	41 - 50 (ha)	51 - 60 (ha)	61+ (ha)	Total (ha)
Softwood								
Up to 20 Years	62,542	19,830	18,305	9,152	3,051	1,525	0	114,405
21 to 40 Years	131,185	141,863	108,304	35,084	1,525	0	0	417,961
41 to 60 Years	125,084	210,507	208,981	161,694	36,610	4,576	1,525	748,977
61 to 80 Years	97,626	154,066	144,914	100,677	28,983	3,051	0	529,317
81 to 100 Years	68,643	70,169	50,339	35,084	4,576	7,627	0	236,438
101 + Years	28,983	22,881	21,356	12,203	10,678	4,576	3,051	103,728
Unevenaged	0	0	0	0	0	0	0	0
Total	514,063	619,316	552,199	353,894	85,423	21,355	4,576	2,150,826
Mixed								
Up to 20 Years	14,492	13,378	11,148	7,804	1,115	0	0	47,937
21 to 40 Years	42,362	64,658	43,477	14,492	1,115	0	0	166,104
41 to 60 Years	55,740	89,184	176,138	88,069	20,066	1,115	0	430,312
61 to 80 Years	20,066	59,084	95,873	73,577	8,918	0	0	257,518
81 to 100 Years	5,574	16,722	30,100	18,952	13,378	1,115	1,115	86,956
101 + Years	1,115	6,689	10,033	5,574	2,230	0	0	25,641
Unevenaged	0	0	0	0	0	0	0	0
Total	139,349	249,715	366,769	208,468	46,822	2,230	1,115	1,014,468
Hardwood								
Up to 20 Years	23,044	12,570	13,617	1,047	0	0	0	50,278
21 to 40 Years	26,187	24,092	16,759	0	0	0	0	67,038
41 to 60 Years	31,424	51,326	82,750	26,187	2,095	0	0	193,782
61 to 80 Years	18,854	29,329	70,180	29,329	3,142	0	0	150,834
81 to 100 Years	4,190	8,380	14,665	12,570	2,095	0	0	41,900
101 + Years	0	4,190	8,380	2,095	0	0	0	14,665
Unevenaged	0	0	0	0	0	0	0	0
Total	103,699	129,887	206,351	71,228	7,332	0	0	518,497
Other								
Up to 20 Years	573,054	0	0	0	0	0	0	573,054
21 to 40 Years	0	0	0	0	0	0	0	0
41 to 60 Years	0	0	0	0	0	0	0	0
61 to 80 Years	0	0	0	0	0	0	0	0
81 to 100 Years	0	0	0	0	0	0	0	0
101 + Years	0	0	0	0	0	0	0	0
Unevenaged	0	0	0	0	0	0	0	0
Total	573,054	0	0	0	0	0	0	573,054
Total								
Up to 20 Years	673,132	45,778	43,070	18,003	4,166	1,525	0	785,674
21 to 40 Years	199,734	230,613	168,540	49,576	2,640	0	0	651,103
41 to 60 Years	212,248	351,017	467,869	275,950	58,771	5,691	1,525	1,373,071
61 to 80 Years	136,546	242,479	310,967	203,583	41,043	3,051	0	937,669
81 to 100 Years	78,407	95,271	95,104	66,606	20,049	8,742	1,115	365,294
101 + Years	30,098	33,760	39,769	19,872	12,908	4,576	3,051	144,034
Unevenaged	0	0	0	0	0	0	0	0
Total	1,330,165	998,918	1,125,319	633,590	139,577	23,585	5,691	4,256,845

Table 5. Provincial area by Merchantable Volume Class, Forest Cover Type and Age Class, using Photo Interpretation Inventory total area (Table 1) and representative fractions by plot.

Forest Cover/ Age Class	Merchantable Volume Class (m^3/ha)					
	Less than 40 (ha)	41-80 (ha)	81-120 (ha)	121-160 (ha)	161+ (ha)	Total (ha)
Softwood						
Up to 20 Years	65,593	12,203	13,729	9,152	13,729	114,406
21 to 40 Years	157,117	111,355	83,898	48,813	16,780	417,963
41 to 60 Years	125,084	163,219	149,490	114,406	196,778	748,977
61 to 80 Years	103,728	105,253	86,948	76,271	157,117	529,317
81 to 100 Years	70,169	47,288	33,559	27,457	57,966	236,439
101 + Years	28,983	18,305	12,203	7,627	36,610	103,728
Unevenaged	0	0	0	0	0	0
Total	550,674	457,623	379,827	283,726	478,980	2,150,830
Mixedwood						
Up to 20 Years	15,607	11,148	7,804	4,459	8,918	47,936
21 to 40 Years	51,281	52,395	27,870	23,411	11,148	166,105
41 to 60 Years	49,051	74,691	102,561	95,873	108,135	430,311
61 to 80 Years	23,411	33,444	59,084	55,740	85,839	257,518
81 to 100 Years	4,459	13,378	18,952	12,263	37,903	86,955
101 + Years	1,115	3,344	5,574	7,804	7,804	25,641
Unevenaged	0	0	0	0	0	0
Total	144,924	188,400	221,845	199,550	259,747	1,014,466
Hardwood						
Up to 20 Years	21,997	12,570	5,237	5,237	5,237	50,278
21 to 40 Years	27,234	15,712	17,807	5,237	1,047	67,037
41 to 60 Years	32,471	36,661	48,183	38,756	37,709	193,780
61 to 80 Years	14,665	20,949	21,997	42,946	50,278	150,835
81 to 100 Years	2,095	5,237	7,332	8,380	18,854	41,898
101 + Years	0	1,047	4,190	5,237	4,190	14,664
Unevenaged	0	0	0	0	0	0
Total	98,462	92,176	104,746	105,793	117,315	518,492
Other						
Up to 20 Years	573,054	0	0	0	0	573,054
21 to 40 Years	0	0	0	0	0	0
41 to 60 Years	0	0	0	0	0	0
61 to 80 Years	0	0	0	0	0	0
81 to 100 Years	0	0	0	0	0	0
101 + Years	0	0	0	0	0	0
Unevenaged	0	0	0	0	0	0
Total	573,054	0	0	0	0	573,054
Total						
Up to 20 Years	676,251	35,921	26,770	18,848	27,884	785,674
21 to 40 Years	235,632	179,462	129,575	77,461	28,975	651,105
41 to 60 Years	206,606	274,571	300,234	249,035	342,622	1,373,068
61 to 80 Years	141,804	159,646	168,029	174,957	293,234	937,670
81 to 100 Years	76,723	65,903	59,843	48,100	114,723	365,292
101 + Years	30,098	22,696	21,967	20,668	48,604	144,033
Unevenaged	0	0	0	0	0	0
Grand Total	1,367,114	738,199	706,418	589,069	856,042	4,256,842

Table 6. Provincial merchantable Volume by Species and Ownership, using Total Merchantable Volume from Table 1 and representative fraction of species on all 3255 plots.

Species	Crown	Large	Small	Federal	Total
Red Spruce	20,495,675	33,086,126	37,719,755	856,043	92,157,599
Balsam Fir	21,702,774	13,573,642	35,866,023	1,205,330	72,347,769
White Pine	11,885,078	10,577,925	9,386,774	1,890,294	33,740,071
White Spruce	6,051,296	2,905,257	19,866,380	221,301	29,044,234
Black Spruce	6,373,687	3,444,163	4,918,077	421,865	15,157,792
Eastern Hemlock	777,244	2,902,101	7,427,976	288,696	11,396,017
Tamarack	2,290,930	674,247	3,716,163	16,849	6,698,189
Red Pine	1,476,907	372,361	172,993	111,461	2,133,722
Jack Pine	414,338	109,745	28,442	0	552,525
Scots Pine	8,333	0	52,868	0	61,201
Norway Spruce	23,562	20,336	335	0	44,233
Sitka Spruce	0	9,116	0	0	9,116
Japanese Larch	0	8,064	0	0	8,064
European Larch	575	351	0	0	926
Softwood Total	71,500,399	67,683,434	119,155,786	5,011,839	263,351,458
Red Maple	14,279,449	13,733,526	31,479,305	893,953	60,386,233
Yellow Birch	6,796,645	3,665,055	9,605,608	604,609	20,671,917
Sugar Maple	6,979,104	3,948,709	7,163,969	640,250	18,732,032
White Birch	3,890,529	2,734,504	7,264,017	470,143	14,359,193
Trembling Aspen	1,019,181	799,068	6,745,040	40,502	8,603,791
Largetooth Aspen	1,271,174	859,025	2,311,141	600,721	5,042,061
Beech	758,854	256,656	3,379,881	16,849	4,412,240
Red Oak	1,064,292	1,154,950	1,023,233	329,846	3,572,321
White Ash	463,473	191,089	2,157,556	6,156	2,818,274
Grey Birch	108,038	102,732	813,433	2,916	1,027,119
Striped Maple	80,741	24,193	244,264	24,301	373,499
Ironwood	32,182	56,450	141,205	0	229,837
Pin Cherry	44,824	9,116	147,228	10,368	211,536
Black Cherry	70,685	7,363	98,710	0	176,758
Manitoba Maple	0	0	103,729	0	103,729
Willows	3,161	351	96,367	0	99,879
Apples	9,195	0	44,838	0	54,033
Mountain Ash	4,310	5,961	13,050	13,285	36,606
Service Berry	5,747	2,104	27,438	0	35,289
Mountain Maple	14,079	0	13,719	324	28,122
White Elm	0	0	27,773	0	27,773
Choke Cherry	1,724	2,454	15,727	0	19,905
English Oak	0	0	11,377	0	11,377
Balsam Poplar	3,161	0	6,023	0	9,184
Black Ash	4,310	0	3,346	0	7,656
Alders	1,149	0	7,027	0	8,176
Hawthorn	0	0	3,681	0	3,681
Hardwood Total	36,906,007	27,553,306	72,948,685	3,654,223	141,062,221
Grand Total	108,406,406	95,236,740	192,104,471	8,666,062	404,413,679

The hardwood and softwood total values in this table vary from those in Table 2 because the values in Table 2 are weighted by area, whereas those in Table 6 are not.

Table 7. Provincial Area by Ownership and Land Capability Class using total area from Photo Interpretation Inventory (Table 1) and representative fraction by plot.

Land Capability (m^3/ha/yr)	Ownership				
	Crown (ha)	Large (ha)	Small (ha)	Federal (ha)	Total (ha)
Undefined	2,273	2,865	0	0	5,138
up to 0.5	25,002	12,893	15,075	4,638	57,608
0.6 to 1.5	71,595	27,218	56,188	10,822	165,823
1.6 to 2.5	127,281	31,515	130,193	20,097	309,086
2.6 to 3.5	175,011	104,574	223,383	21,643	524,611
3.6 to 4.5	221,604	151,847	378,244	20,097	771,792
4.6 to 5.5	292,063	246,393	479,657	18,552	1,036,665
5.6 to 6.5	144,327	150,414	341,242	12,368	648,351
6.6 to 7.5	98,870	81,653	174,047	3,092	357,662
7.6 to 8.5	34,093	50,138	109,636	1,546	195,413
8.6 to 9.5	25,002	25,785	41,113	0	91,900
9.6 to 10.5	6,819	11,460	31,520	0	49,799
10.6 to 11.5	2,273	2,865	17,816	1,546	24,500
12.6 to 13.5	2,273	2,865	4,111	0	9,249
13.6 +	2,273	2,865	4,111	0	9,249
Total	**1,230,759**	**905,350**	**2,006,336**	**114,401**	**4,256,846**

Table 8. Tree species on the woody vegetation plot by density and height.

Species	Plots	Average Density (per 10 m^2)	Average Height (cm)
Balsam Fir	1872	25	43
Red Maple	1192	14	44
Red Spruce	957	12	44
White Birch	402	8	90
Black Spruce	355	8	65
Yellow Birch	321	7	62
White Pine	220	8	27
Sugar Maple	200	14	37
White Spruce	198	3	71
Striped Maple	190	9	60
Alder (Speckled)	179	13	134
Trembling Aspen	111	8	99
Beech	90	6	102
Pin Cherry	89	8	111
Mountain Maple	79	7	65
Red Oak	78	4	31
Serviceberry (Shadbush)	71	10	61
Tamarack Larch	65	5	115
Grey Birch	62	10	87
White Ash	60	5	88
Mountain Ash	51	4	67
Eastern Hemlock	43	4	55
Choke Cherry	26	10	104
Large Tooth Aspen	22	3	83
Willow	18	9	102
Norway Spruce	16	5	67
Chokeberry	8	3	79
Black Cherry	5	4	71
I Ironwood	3	11	7
Apple	3	4	55
Jack Pine	3	2	143
Scots Pine	2	3	7
Red Pine	2	2	105
Western Larch	2	1	43
Alder (Green)	1	9	180
Black Ash	1	4	200
Eastern Cedar	1	4	10
Hawthorns	1	2	15
Basswood	1	1	23

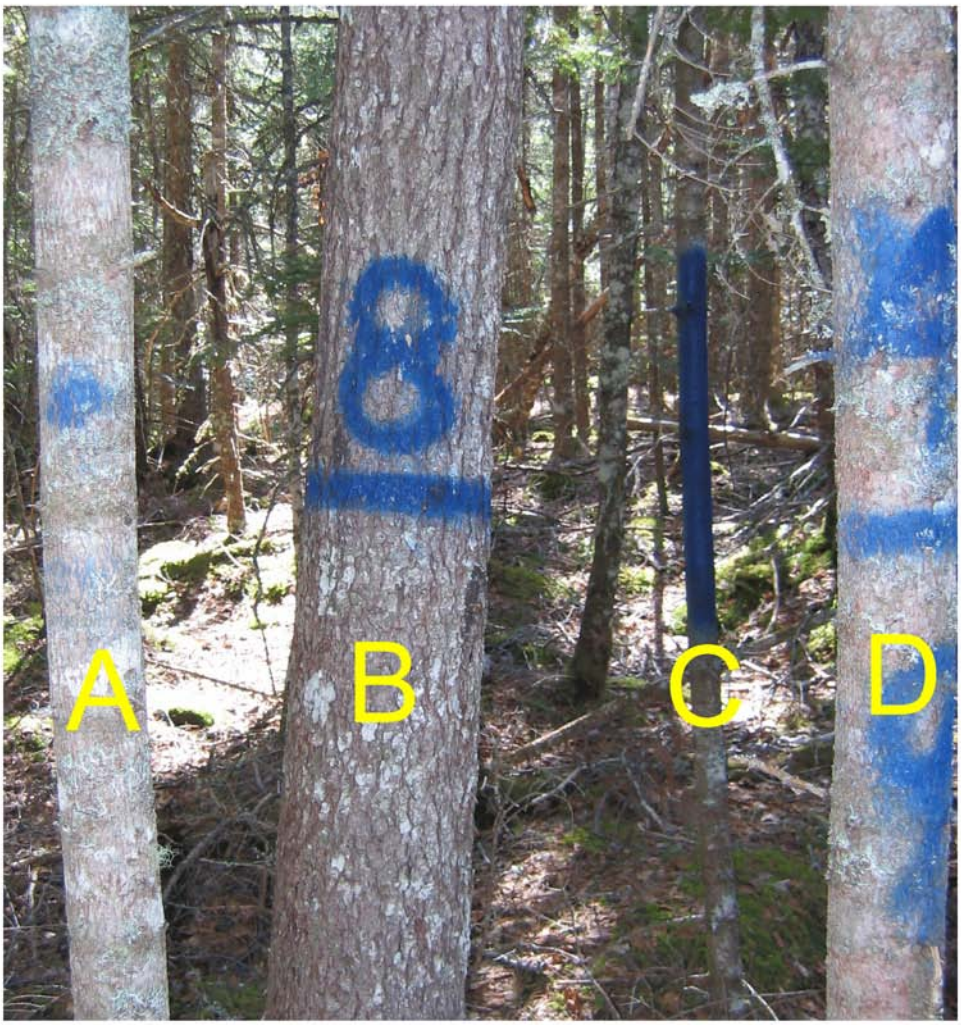
Table 9. Woody vegetation shrubs by density and height.			
Species	**Plots**	**Average Density (per 10 m^2)**	**Average Height (cm)**
Lambkill	967	84	28
Blueberry	819	41	17
Witherod (Wild Raisin)	385	11	89
Raspberry	325	45	36
Other Woody Shrubs	148	24	63
Holly (Canada, Winterberry)	147	18	73
Labrador-tea	143	46	34
Holly (False)	108	11	72
Huckleberry	103	46	72
Blackberry	96	18	48
Rhodora	90	39	65
Witch-hazel	53	6	82
Hazelnut	43	7	91
Hobble-bush	42	12	95
Honeysuckle (Fly)	33	14	53
Roses	31	16	53
Leather-leaf	25	20	33
Sweet Fern	25	20	57
Elder (Common)	19	5	63
Bayberry	18	27	56
Elder (Red-berried)	15	10	67
Currants	9	9	30
Ground Hemlock (Yew)	8	22	17
Dogwood (Red Osier)	7	3	56
Dogwood (Alternate-leaved)	6	5	61
Other Hardwood (Dead Only)	4	10	34
Juniper (Ground & Creeping)	2	7	53
Highbush-cranberry	1	9	100

Table 10. Ground cover category by cover level for each plot recorded.

Description	High	Medium	Low	Scattered	None
Leaf Litter	891	567	563	847	373
Other Moss	733	625	795	900	188
Needle Litter	373	530	768	1158	412
Herbs	352	430	676	1171	612
Ferns	257	555	736	955	738
Sedges and Grasses	157	185	322	900	1677
Water/Snow	134	28	57	233	2789
Slash/Woody Debris	115	334	837	1605	350
Lichens	42	102	264	1891	942
Club Moss	19	32	99	398	2693
Bare Mineral Soil	11	26	120	685	2399
Unclassified	1	1	5	18	3216

Appendix II

Picture 1. Forest technician John MacLeod sits behind the plot centre stake and prepares to enter sapling tally. Some data is collected and compiled by hand, before being entered into the electronic data recorder.



Picture 2. From left to right, A: a sapling, B: merchantable tree # 8 (a 24.3 cm white spruce) C: a boundary tree outside the plot, and D: merchantable tree # 49, (a 9.8 cm balsam fir). This picture illustrates the use of paint on a plot to identify trees. The merchantable trees also have a numbered metal tag attached below stump height and facing the centre stake.

Picture 3. Board with hardwood increment cores. Cores are taken to determine plot age and age of Land Capability trees. Cores that cannot be easily counted in the forest are handled by this method. The cores are glued into the precut grooves, sanded, and then the rings are counted to get the tree age at breast height.

Picture 4. Diameter at breast height is taken on tree number 1, a 26.3 cm balsam fir.

Picture 5. Cruiser measures diameter of down, coarse woody debris. The cruiser will also determine species and decay class. This is one of the many additional variables that were added to the plot collection routine in 1998.

Picture 6. Soil pit used to collect samples and describe soil on plot 5334. A subset of the NS forest inventory plots are used to collect additional information for the National Forest Inventory plots. Information from these plots are combined with that of other provinces and territories to monitor the extent, state and sustainable development of Canada's forests in a timely and accurate manner. In addition, they will provide a framework for collecting additional data to report on progress towards sustainable development, as well as data related to forest health (e.g. insect damage, disease infestation), biodiversity and forest productivity.

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