

FOREST RESEARCH REPORT



Nova Scotia Department of Natural Resources
Forest Management Planning

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Report FOR 2007-7 No. 83

Survey of plantations established between 1998–2000 (6–8 years of age) on eastern Crown land without herbicides.

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Introduction

Stora Enso has a Crown license agreement with the province of Nova Scotia and is responsible for managing Crown land in the counties of Victoria, Inverness, Cape Breton, Richmond, Antigonish, Guysborough, and Pictou. Since 1998, Stora Enso has not used herbicides in its forest management activities. There is concern about the performance of these plantations in the absence of chemical weeding. Competition in plantations in Nova Scotia can be severe and the growth and survival of planted seedlings can be adversely affected if not released. The performance of plantations also has implications on future wood supply projections. The intent of this report is to summarize how these plantations are performing without the use of herbicides.

Methods

Plantation Selection

All areas fully planted between 1998-2000 and >0.5ha were included in the selection process with the intent of representing plantations established during this period. Plantations originating in 1998 were chosen since this was the first year herbicides were no longer used. This provided the longest time frame with which to determine the survival and growth of plantations under this regime. One hundred and one plantations were randomly selected from the population stratified over three years, 34 plantations from 1998, 34 plantations from 1999, and 33 plantations from 2000 providing a representative sample of this period.



Field Sampling Procedures

A sampling intensity of 5 plots/ha was used with a minimum of 10 plots and a maximum of 100 plots per plantation. The plot radius was calculated based on the prescribed planted spacing of the different species between 1998 and 2000. During this period, black spruce was planted at 2.1x2.1m spacing and all other species were planted at 2.4x2.4m spacing, which translates into plot radii of 2.37m and 2.71m respectively. Plots were established in a uniform grid pattern providing full coverage of each plantation. Each plot was broken down into 4 quadrants with the first clockwise to the direction of travel. Full stocking is achieved when all 4 quadrants are occupied by a planted tree (Figure 1).

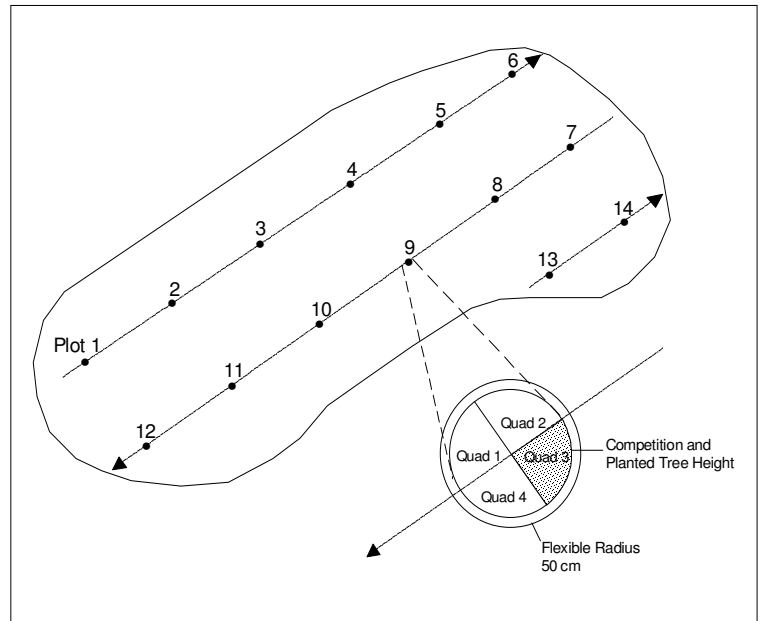


Figure 1. Example of Plot Layout

Each quadrant was assessed for the presence of a planted tree which was classified as healthy, unhealthy or dead and damage was also recorded. Each living planted tree was evaluated for crop potential, a judgement on whether a stem has future commercial value based on vigour, severity of damage, suppression, and ability to respond to treatment. In instances where there was no planted tree within a quadrant, the plot radius was extended an additional 50 cm for a planted tree on the periphery of the plot. Where more than one planted tree per quadrant was present, the extra stem was recorded. If the planted tree within the quadrant was missing, dead, or was deemed not to have future crop potential a natural replacement was used, providing it had crop potential and was at least $\frac{1}{2}$ the height of the average planted tree. The species eligible to be natural replacements include all softwoods plus yellow birch (*Betula alleghaniensis* Britt.) and sugar maple (*Acer saccharum* Marsh.). When a quadrant was deemed unplantable the reason was recorded. The spacing between planted trees, along the row (X) and across the row (Y), was measured as a means of verifying the original planted spacing.

The total height and leader of the planted tree in the 3rd quadrant was measured up to the last full year's growth. A judgement was made on the planted tree's ability to maintain its position into maturity without further release and is referred to as a free-to-grow assessment. If no planted tree was present in the 3rd quadrant, the closest planted tree to the centre of the plot became the substitute. Competition was also assessed in the 3rd quadrant, all natural trees and vegetation greater than half the height of the planted tree were recorded. Remnant mature trees left standing after harvest were quantified using a basal area sweep (2-factor prism), and the 3rd quadrant percent cover by remnant trees. At the end of each plantation survey, past treatments, harvest method, and general comments regarding the overall status of the plantation were recorded along with any suggestions by field staff for remedial treatments.

Pre-Harvest Species Composition

Interpretation of aerial photographs at a scale of 1:10,000 was used to determine the pre-harvest species composition of the stands. Plantations were assigned a pre-harvest cover type as follows; Softwood: 70% or greater softwood species in the overstory; Hardwood: 70% or greater hardwood species in the overstory; Mixedwood: all others. The pre-harvest species composition influences the species that re-colonize after harvest, and thus the competition present within plantations. Re-colonization can occur through suckering, sprouts, stores of dormant seedbeds, and dispersal of seed from neighbouring stands and remnant mature trees left standing on site.

Results

Survey Description

During the summer of 2005, 101 plantations were surveyed. After the conclusion of the field season it was discovered that 4 of the surveyed plantations were site prepared with herbicides in 1997 and then planted in 1998. These herbicided plantations are excluded from this report, except when treatment response is being explored (Figures 7, 9, 12, 15). The intent is to describe plantation survival and growth in the absence of herbicides. Due to the exclusion of the herbicide treated stands, 97 plantations are summarized in this report totaling 780 ha using 3716 plots. This represents 33% of the 2380 ha of plantations (full plants) established from 1998 to 2000 (Figure 2). An additional 1300ha was fill planted during this period but is not part of the survey.

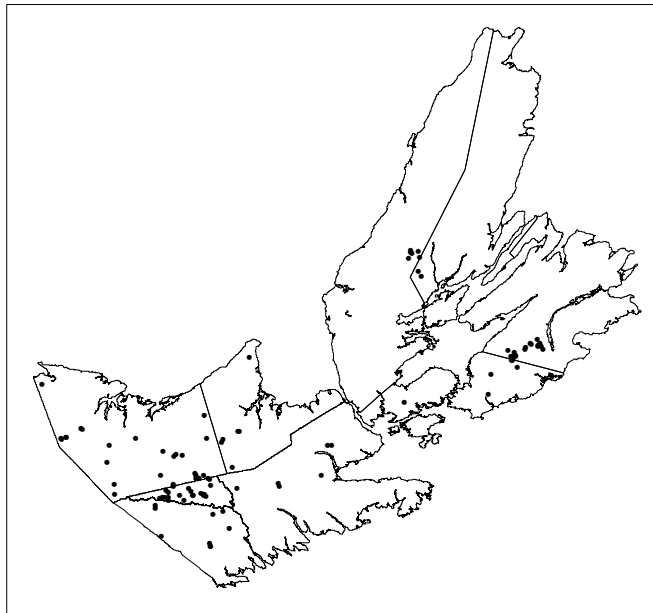


Figure 2. Distribution of surveyed plantations.

The largest concentration of surveyed plantations was in Guysborough county, followed by Pictou county. More than 2/3 of the surveyed plantations were on mainland Nova Scotia, the remaining were on Cape Breton Island. The majority of the surveyed plantations were less than 5ha, the average plantation size was 8ha, and they ranged in size from 0.5ha - 40ha. Eighty-five plantations were established on clearcuts and another 12 were established on partially harvested areas. The species composition of stands prior to harvest was predominantly softwood with a smaller proportion of hardwood and mixedwood stands. Almost all the hardwood sites were tolerant hardwood, as for the mixedwood sites the hardwood component was predominantly intolerant for 11 sites and tolerant for 7. Black spruce was the most widely planted species during this period, followed by Norway spruce, red spruce, and white spruce. Of the plantations surveyed, 16 were manually weeded, 6 hot planted, and 4 were planted with large stock in conjunction with hot planting (Figure 3).

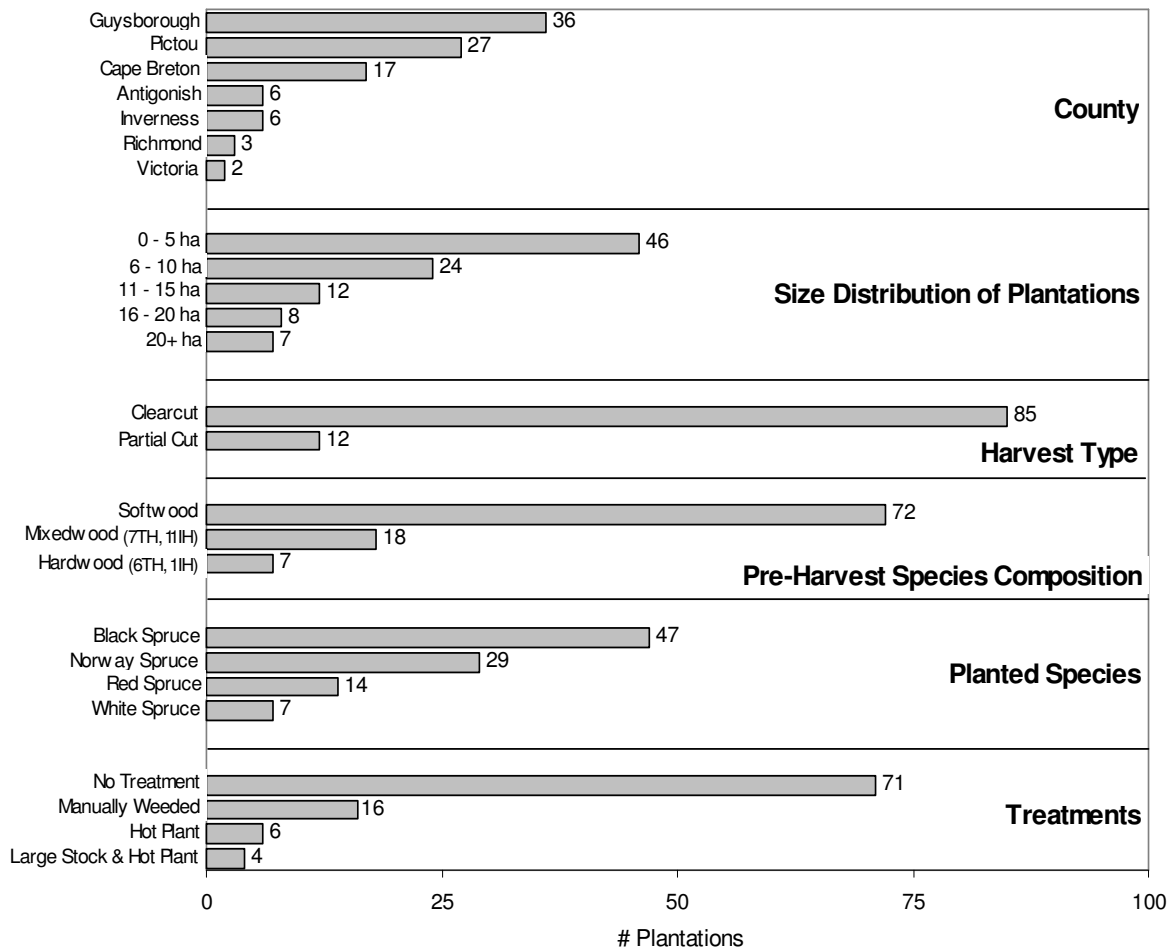


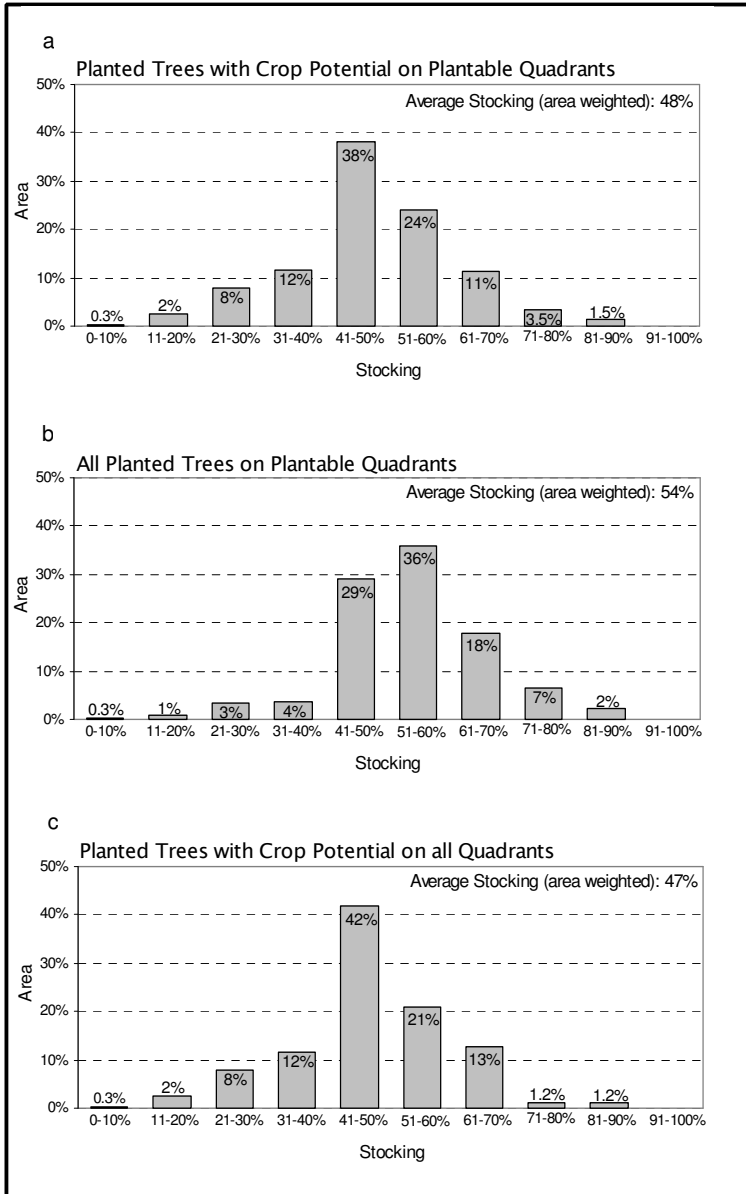
Figure 3. Description of surveyed plantations.

Stocking

The area-weighted average stocking of planted trees with future crop potential on plantable quadrants is **48%** (Figure 4a). If all planted trees regardless of future crop potential are included the average stocking is **54%** (Figure 4b). Planted flex trees, which are trees on the periphery of the plot ($\leq 50\text{cm}$), were included in the above calculations. Without the inclusion of these flex trees, the average stocking of planted trees with crop potential on plantable quadrants is 43%, and the average stocking of all planted trees on plantable quadrants is 49% (Appendix 1). Extra planted trees per quadrant were not included in stocking calculations, however if included, average stocking would be increased by 1% (Figure 4a,b,c). When natural replacements are included (softwoods, plus yellow birch and sugar maple), the average stocking ranges from 75% - 78% for the different categories (Figure 4d,e,f).

Ninety-eight percent of planted area is less than 81% stocked, and 84% of planted area is less than 61% stocked with planted trees with future crop potential on plantable quadrants (Figure 4a). If natural replacements are included, 47% of planted area is greater than 80% stocked, and 84% of planted area is greater than 60% stocked (Figure 4d). Survival of planted trees has been poor and natural regeneration now forms a significant portion of the total crop tree stocking within these plantations.

Planted Trees



Planted Trees + Natural Replacements

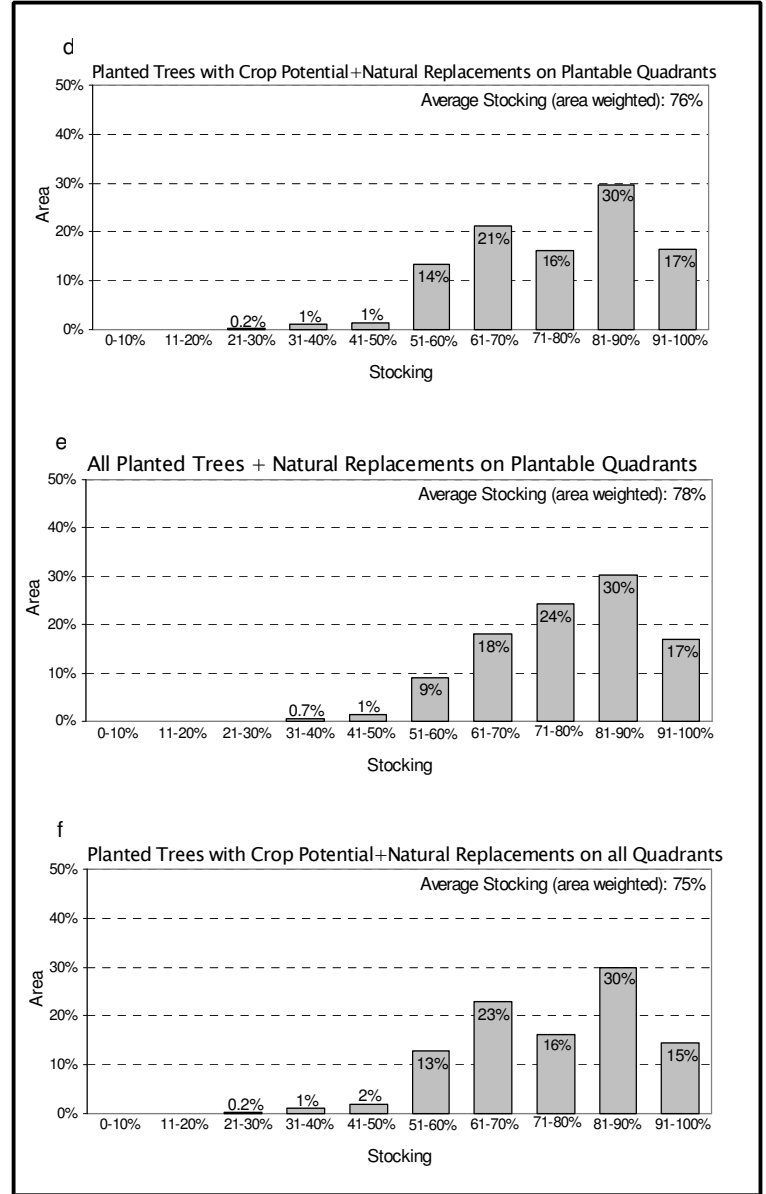


Figure 4. The % plantation area by stocking class and the area weighted average stocking. Graphs a-c relate to the stocking of only planted trees while graphs d-f include planted trees and natural replacements (softwoods, plus yellow birch and sugar maple). Graphs a, c, d, and f with “Crop Potential” in the title are based on 87 plantations covering 735 ha. Graphs b and e are based on 97 plantations covering 780 ha.

Based on the results of this survey, the average stocking of commercial natural regeneration is 69% (Figure 5a). Sixty-two percent of surveyed area is greater than 60% stocked to naturals, and 37% is greater than 80% stocked to naturals. The stocking calculations for natural regeneration are based on the 3rd quadrant where all trees greater than half the height of the planted stock were included.

Figure 5b displays the best possible species mix which could be attained if all areas were successfully tended using the following species preference list: red spruce, black spruce, white spruce, balsam fir, yellow birch, sugar maple, white ash, pine species, larch, white birch, red maple and aspen species. Spruce (predominantly black spruce) and balsam fir have the potential to make up 60% of the total natural regeneration stocking. Yellow birch another valued species has the potential to comprise 14% of the total natural regeneration stocking.

In the absence of tending, Figure 6b represents the likely species mix based on the dominant species. Hardwoods and non-commercial species are more prevalent due to their fast initial growth. The average stocking of commercial natural regeneration without tending is 64% as some of the dominant non-commercial species such as pin cherry and grey birch are serving to reduce the potential stocking (Figure 6a).

Natural Regeneration

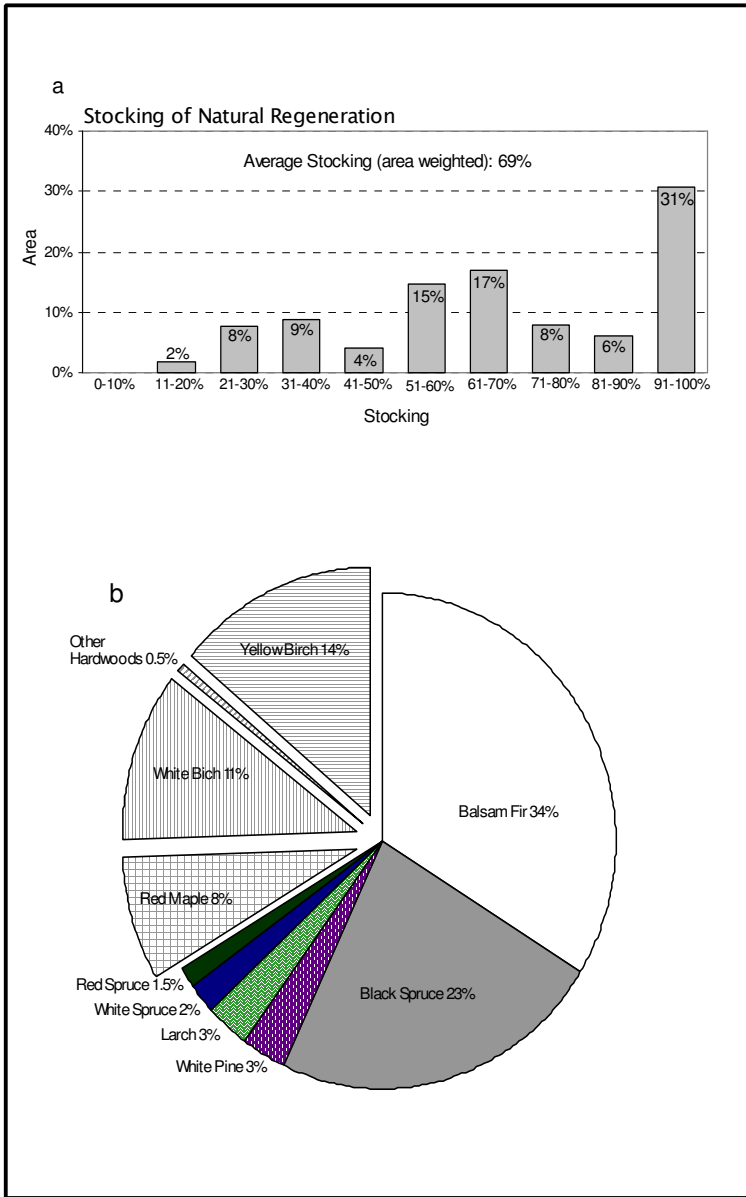


Figure 5.

a -The average stocking of commercial natural regeneration and the distribution of planted area by stocking class.

b- The % species composition of the stocking from Figure 5a if tended.

Natural Regeneration (Dominant)

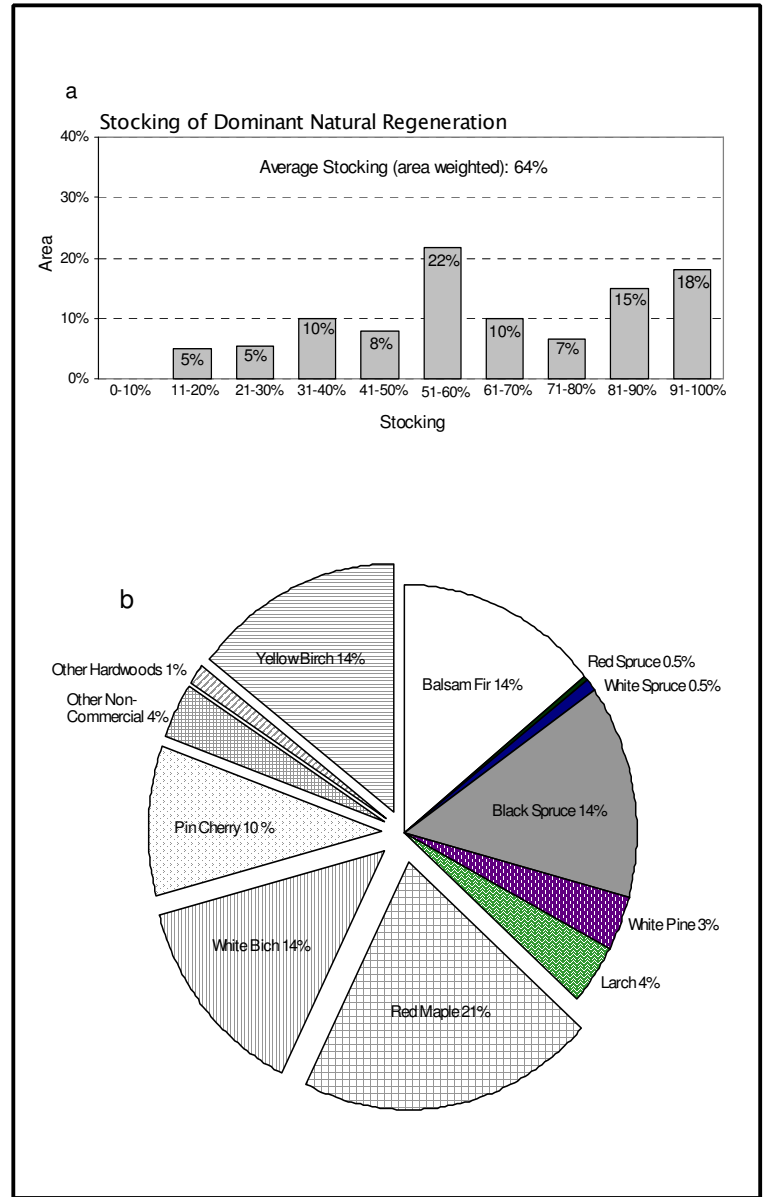


Figure 6.

a -The average stocking of commercial natural regeneration using the dominant species and the distribution of planted area by stocking class.

b - The % species composition of the stocking from Figure 6a if left untended.

The potential stocking of each species individually, regardless of the presence of other species, is shown in Table 1. Balsam fir, red maple, yellow birch, white birch, black spruce, and pin cherry were the most common listed in decreasing order of frequency.

Table 1. Potential stocking of each species.	
Species	Stocking
Balsam fir	27.3%
Red maple	24.3%
Yellow birch	20.2%
White birch	18.0%
Black spruce	15.6%
Pin cherry	15.0%
White pine	4.7%
Larch	3.8%
Mountain maple	2.6%
White spruce	1.6%
Aspen species	1.4%
Grey Birch	1.4%
Red spruce	1.1%
Striped maple	0.7%
Sugar maple	0.6%

There have been several surveys of plantations over the years within Nova Scotia (Table 2). The different surveys are not entirely comparable due to different age ranges, harvest and silviculture techniques, regions, tenures, and assessment procedures. In spite of this, the different surveys do provide an opportunity for generalized comparisons.

The survey of 9-14 year old plantations (NSDNR 2004) is particularly comparable because a portion was performed on Stora Enso licensed crown land using almost identical assessment procedures during the period when herbicides were still used as a silvicultural tool. Only 12 Stora Enso plantations were surveyed, however the plantations cover 169ha. Of the 12 plantations surveyed for the 2004 report, 72% of the area received a herbicide treatment and the stocking of planted trees was 76%, compared to 54% from this survey.

The average planted stocking across all tenures and regions from the 2004 report was 73% which is similar to the results for the Stora Enso plantations but represents a much larger sample size. For the survey of 1-3 year old plantations (NSDNR 2003), 45% of the surveyed area received a herbicide treatment. These same plantations were re-visited for the survey of 9-14 year old plantations (NSDNR 2004) using a smaller subset of the original (82% of the plantations or 67% of the area) (Table 2).

Table 2. Comparison of different plantation surveys in Nova Scotia.				
Age Range of Plantations	Yrs. Plantations Established	Planted Stocking	Total Stocking	Source
1-3 years	1989-1991	81% (SCL) 84% (all tenures, all regions)	85% (all tenures, all regions)	NSDNR (2003)
1-7 years	1978-1984	72% (private land, all regions)	77% (private land, all regions)	NSDLF (1988)
6-8 years	1998-2000	54% (SCL)	*78% (SCL)	This survey
9-14 years	1989-1991	76%(SCL) 73% (all tenures, all regions)	85%(SCL) 82% (all tenures, all regions)	NSDNR (2004)
* In addition to commercial softwoods, this survey also includes yellow birch and sugar maple as acceptable natural replacements which differs from the other surveys which only include softwoods.				
SCL (Stora Enso Crown Licensed): where available numbers specific to Stora Enso Crown licensed land were used.				

The surveyed large stock/hot planted plantations achieved an average stocking of 62% to planted trees (Figure 7). This is based on a limited sample size of 4 plantations in three locations. The plantations that received a herbicide site preparation treatment showed relatively good stocking (61%) of planted trees. These plantations also show above average total stocking, possibly due to the removal of competing hardwoods and other vegetation allowing for the establishment and survival of natural softwoods. The plantations that were hot planted or received a manual weeding treatment did no better in terms of stocking than plantations which were not treated. No definitive conclusions regarding the effectiveness of the different treatments can be made due to the limited sample size of many of the categories.

All large stock plantations were excluded from average stocking calculations for the other categories (pre-harvest species composition, harvest type and species planted) so that the large stock treatment effect would not overshadow the other factors. Black spruce showed superior planted tree stocking; there was very little difference in planted stocking among the other species (red spruce, white spruce, and Norway spruce). Plantations established in partial cuts on average showed reduced planted tree stocking. Results concerning pre-harvest species composition were inconclusive (Figure 7).

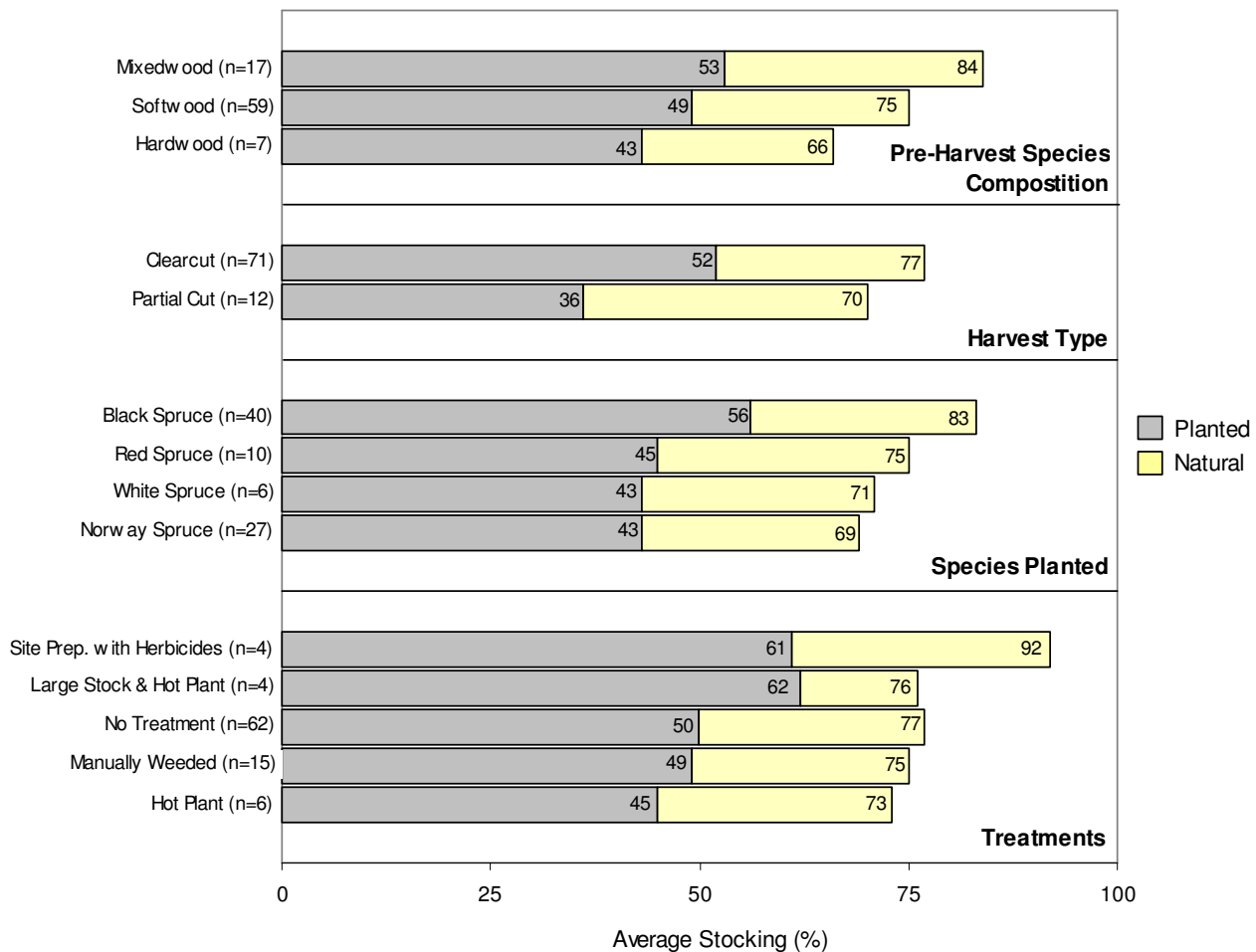


Figure 7. The average stocking by pre-harvest species composition, harvest type, species planted, and treatments. The heavier shading is the average stocking of planted trees with crop potential. The entire bar is the total stocking of planted trees with crop potential plus natural replacements. All stocking calculations exclude unplanted portions of plantations. The “n” following each title is the number of plantations represented.

Height

The plantations at 5-7 years of age were on average 1m tall with an average leader of 18cm, calculated on an area weighted basis using only planted trees. Plantations (planted trees) ranged in height from 27cm - 192cm (Figure 8).

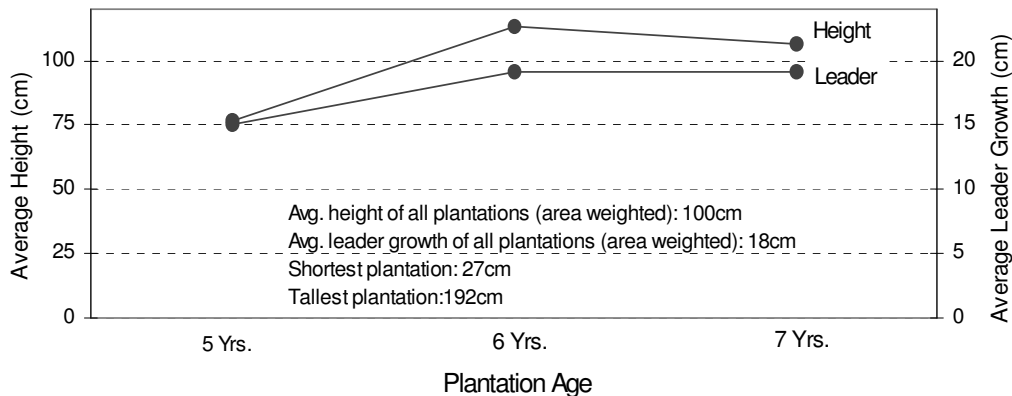


Figure 8. The average height and leader growth of plantations.

On average, black spruce exhibited superior height growth compared to the other species. Norway spruce was generally taller than white or red spruce, however results were quite variable likely due to the incidence of browsing and the small sample size within species. Red and white spruce were both generally slower growing (Figure 9).

In terms of treatment effect, the limited sample size of each category does not allow for any definitive conclusions to be made as other factors such as site conditions could be responsible for much of the variation. This being said, the six year old red spruce large stock/hot planted plantations are almost twice as tall as the red spruce regular stock plantations planted that same year. The plantations that received a herbicide site preparation treatment were for the most part taller than the other plantations planted that year (Figure 9).

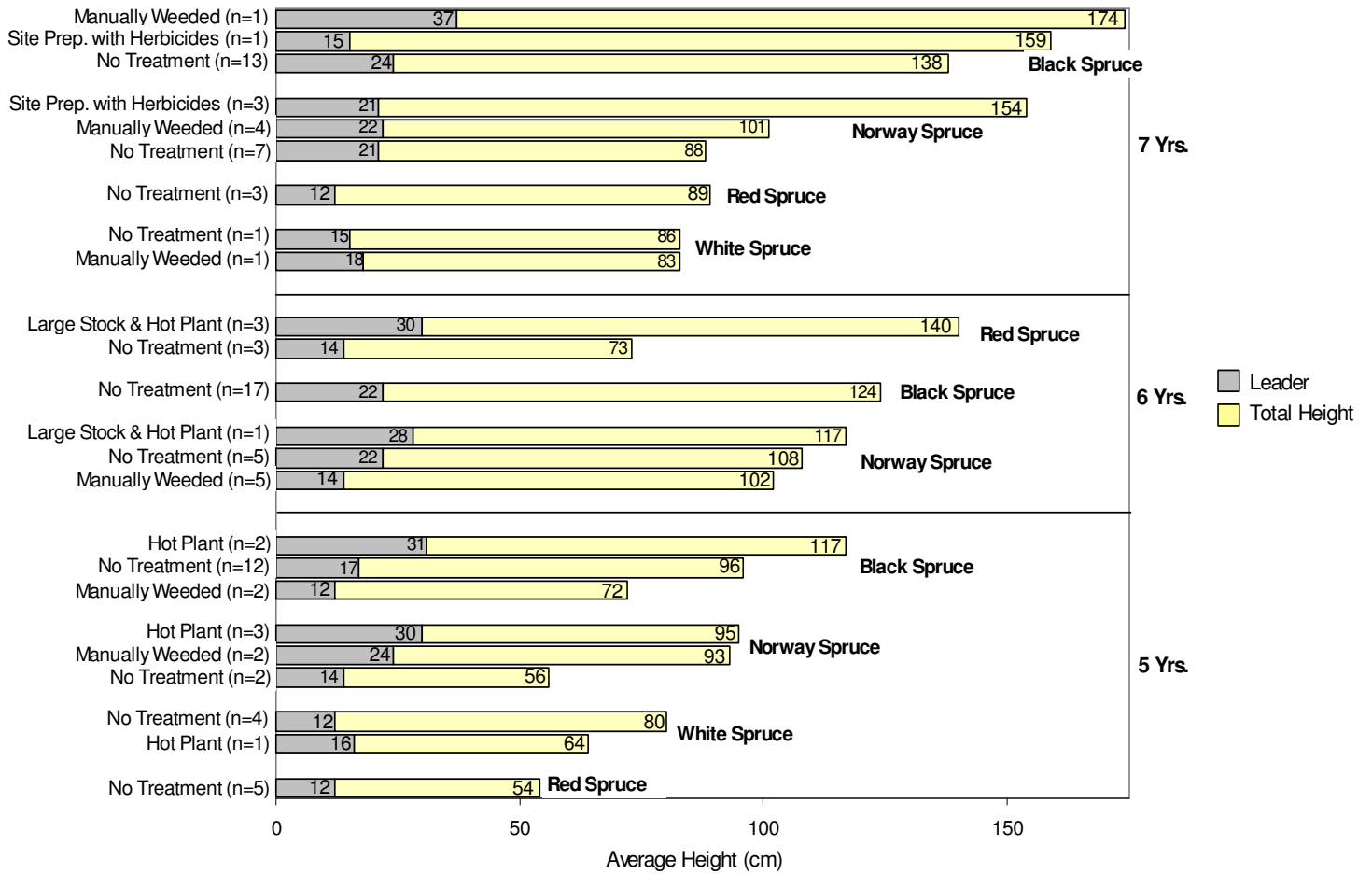


Figure 9. The effect of species and treatment on average height and leader growth by plantation age. The dark shading is the leader, the entire bar is the total height. The “n” following each title is the number of plantations represented.

Excess Stems

Only the stems at least half the height of the planted stock were included in excess density calculations. The density of excess stems (commercial and non-commercial) for all plantations averaged 17,571 stems/ha (area weighted) and ranged between 585 stems/ha and 69,364 stems/ha (Figure 10a). 32% of the planted area contains more than 20,000 excess stems/ha. On average there are considerably more excess stems within plantations from this survey compared to the 2004 plantation survey report (NSDNR 2004) in which herbicides were used as a management tool. Excess density from the 2004 survey averaged 5,518 stems/ha compared to 17,571 stems/ha from this survey. Only 1.4% of the plantation area from the previous survey was in the 20,000+ density category compared to 32% for this survey. However, some of those differences could be attributable to site variation, tenure and regional differences as the previous survey was province wide. Also, the other survey represents older plantations (9-14 years) compared to this survey (6-8 years).

The species breakdown of excess stems across all plantations is 70% hardwood, 19% softwood, and 11% non-commercial of which pin cherry accounts for the majority (64%). Yellow birch is the most abundant tree species comprising 28% of excess stems, followed by red maple (21%), white birch (20%), and balsam fir (13%) (Figure 10b).

All Plantations

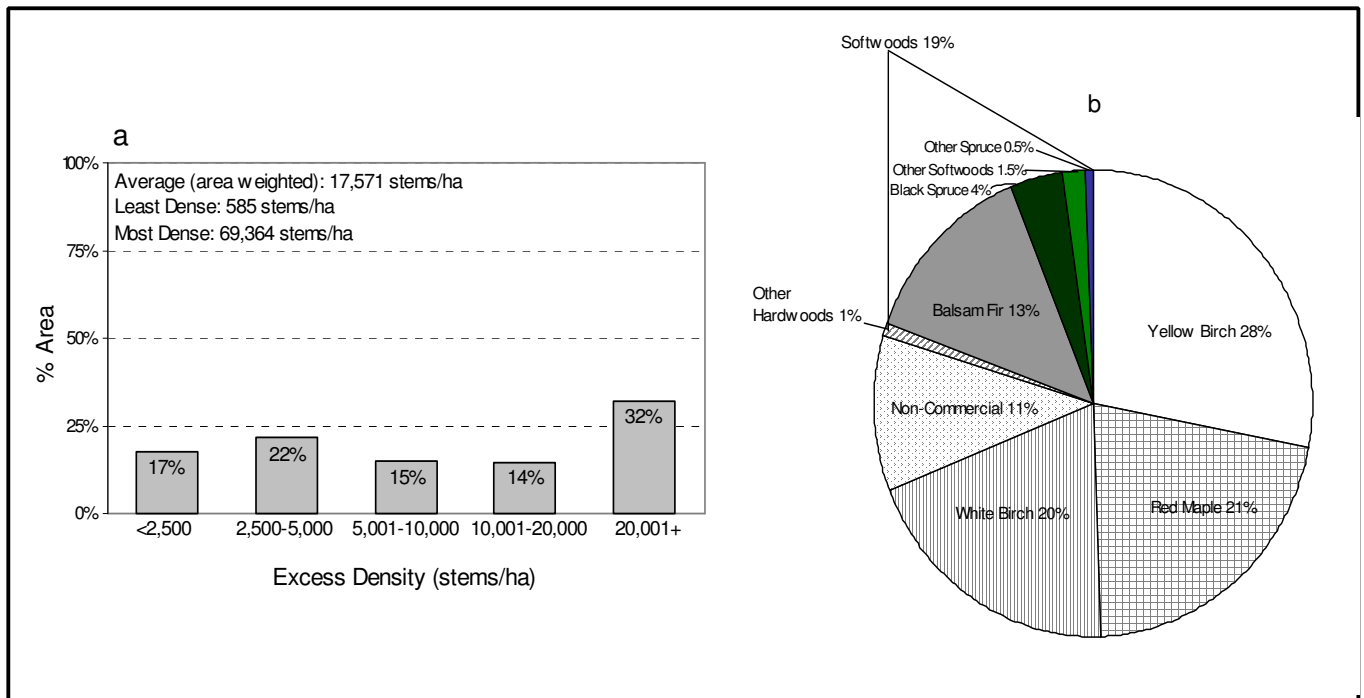


Figure 10.

a -The area weighted average density of excess stems and the distribution of surveyed area by excess stem density classes for all plantations.

b -The % species composition of the excess stems from Figure 10a.

For those plantations that were manually weeded the average density of excess stems was 36,138 stems/ha, with an overwhelming majority of the area (87%) containing more than 20,000 stems/ha (Figure 11a). It appears that plantations with severe competition are being targeted for manual weeding, however these efforts do not appear effective as the majority are still excessively dense. The species composition of excess stems for manually weeded plantations is 79.5% hardwood, 12% non-commercial, and 8.5% softwood (Figure 11b). Eleven of the 16 plantations that were manually weeded were previously hardwood or mixedwood stands.

Manually Weeded Plantations

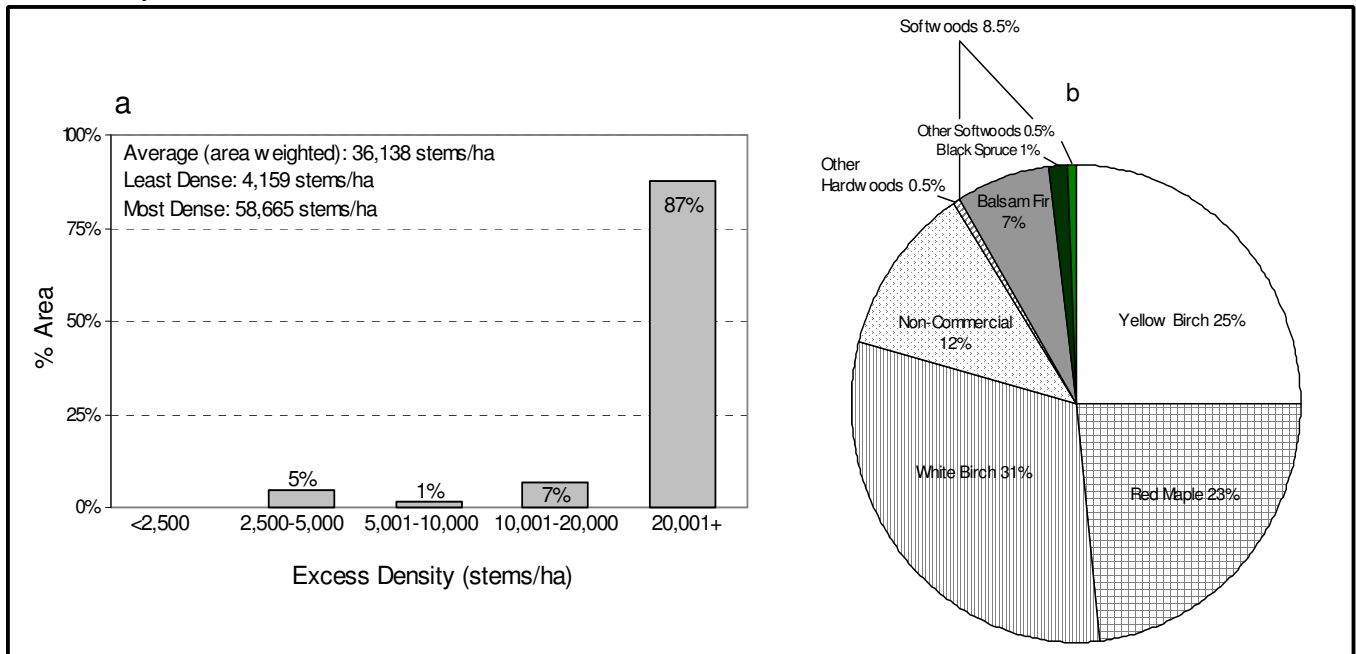


Figure 11.

a -The area weighted average density of excess stems and the distribution of surveyed area by excess stem density classes for manually weeded plantations.

b -The % species composition of the excess stems from Figure 11a.

Pre-harvest species composition has a strong influence on the density of excess tree competition present within plantations. Stands that were predominantly hardwood prior to harvest resulted in the greatest density of excess stems after harvest. Stands that were partially harvested contain slightly more stems than areas that were clearcut, however pre-harvest species composition could be the over-riding factor. Six of the 12 sites that were partially cut were previously hardwood or mixedwood stands (Figure 12).

The manually weeded sites remain excessively dense. Eleven of the 15 plantations that were manually weeded were previously hardwood or mixedwood stands. Eight years after sites received a herbicide site preparation treatment, natural regeneration has re-established. Large stock/hot planted and hot planted plantations contain the least number of excess stems likely due to site characteristics. All large stock/hot planted plantations were established on clearcuts that were softwood prior to harvest, the same applies to most hot planted plantations (Figure 12 & Appendix 1).

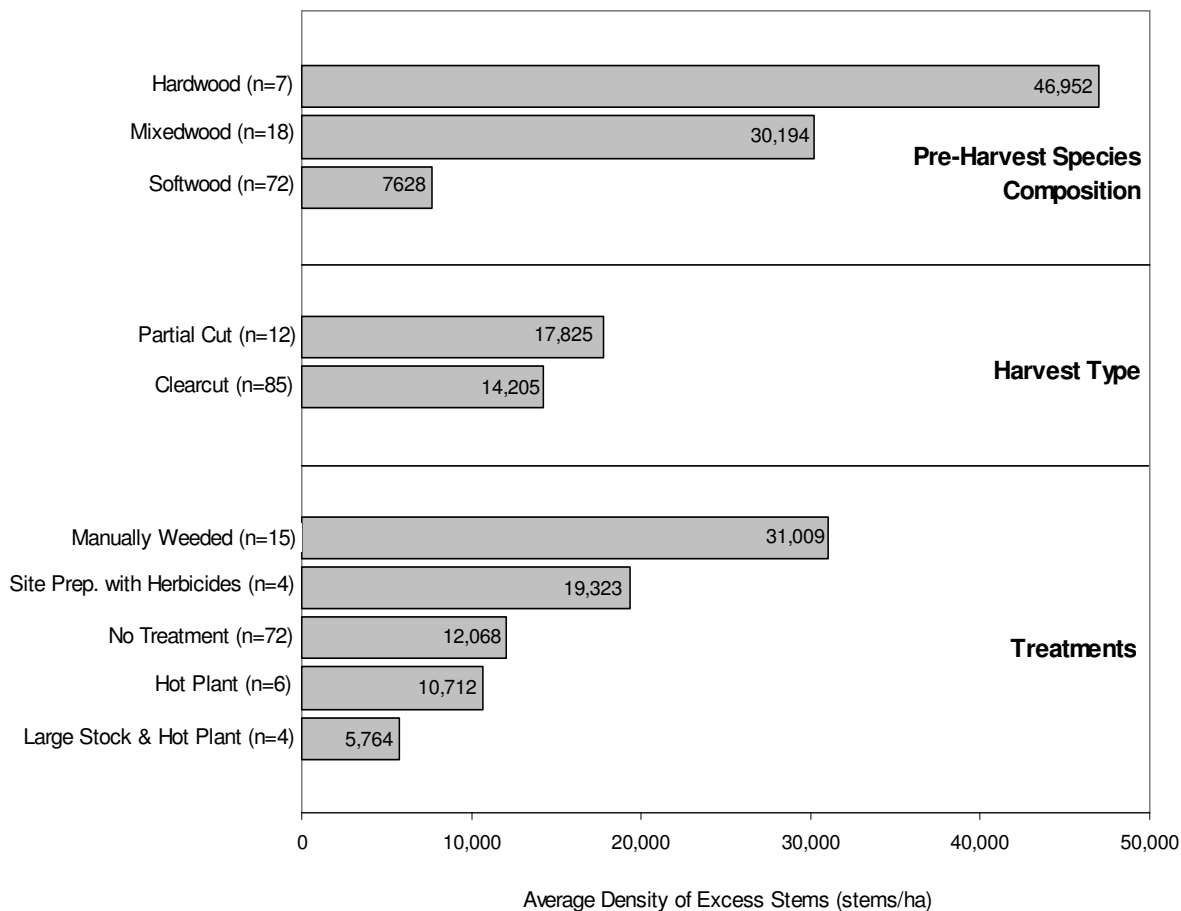


Figure 12. The average density of excess stems by pre-harvest species composition, harvest type, and treatment. The “n” following each title is the number of plantations represented.

Competition

Competition was assessed in the 3rd quadrant of every plot. All natural trees and vegetation greater than half the height of the planted tree were assessed for percent cover and average height. This information was used to calculate a competition index for each plantation using the following formula;

$$\text{Competition Index (CI)} = \frac{\text{Spp. 1 (\% Cover x Avg. Ht)} + \text{Spp. 2 (\% Cover x Avg. Ht)} + \text{Spp. n (\% Cover x Avg. Ht)}}{\text{Avg. Ht. of Planted Stock}}$$

Where; Ht = Height

Spp. = Species

n = Repeat the same calculation for all remaining species.

The average competition index (area weighted) for all plantations is 73, ranging from 1-638. Indices of 61-100 indicate moderate competition and indices of 100+ indicate severe competition. Thus 24% of the surveyed planted area is experiencing moderate competition and 27% is experiencing severe competition for a total of 51% (Figure 13).

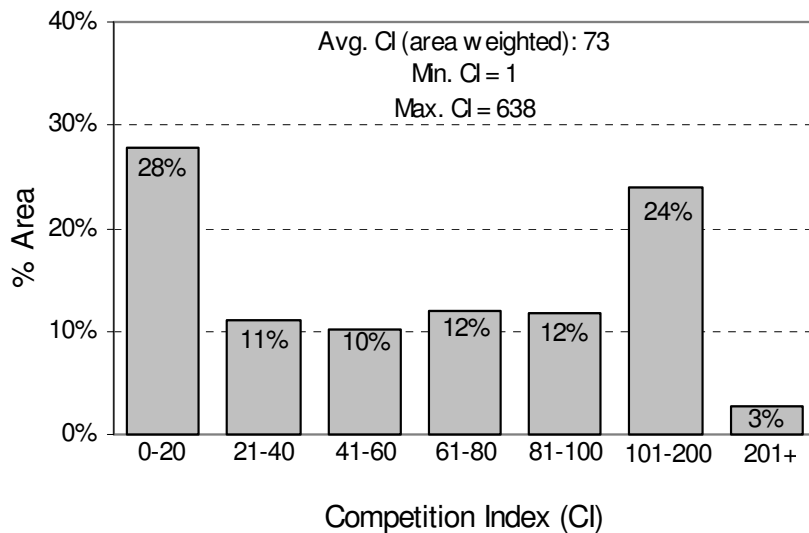


Figure 13. The area weighted average competition index for all plantations and the distribution of surveyed planted area by competition index classes.

Figure 14 shows a relationship between competition and plantation stocking and growth. As competition increases plantation mortality increases and the remaining planted trees show inferior height growth. At low competition levels the average stocking (planted and total) tended to be lower, this is likely due to poor site conditions which deters the establishment of competition along with the survival of planted trees. Survival of planted trees drops when competition levels reach 60, and again at 200+. At this extreme end of competition, a greater proportion of remaining planted trees are no longer deemed to have future crop potential likely due to extreme suppression and an inability to respond to treatment. The height of planted trees drops progressively with increasing competition. When competition levels reach 200+ the height of planted trees drops dramatically.

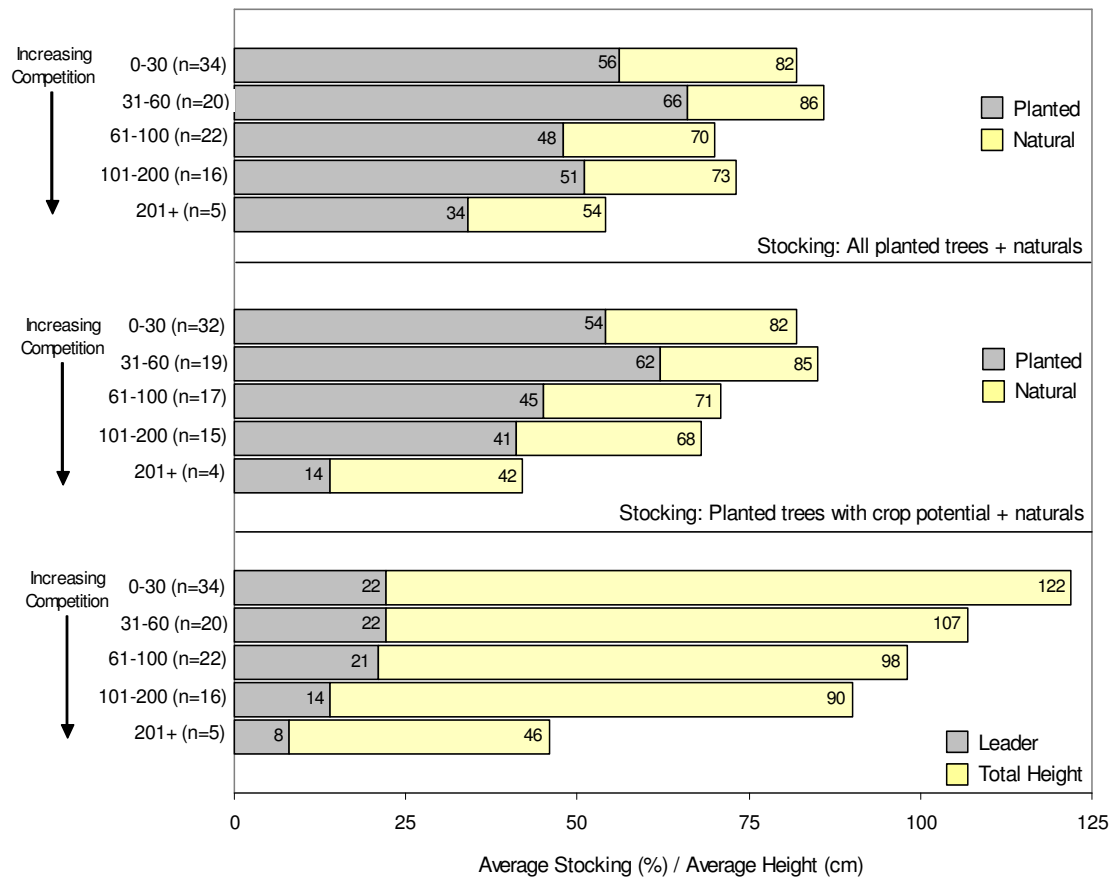


Figure 14. The effect of increasing competition on stocking and height of plantations. All stocking calculations exclude unplanted portions. The “n” following each competition index class is the number of plantations represented.

Stands that were dominated by hardwood prior to harvest resulted in greater competition indices. Stands that were partially cut and then planted appear to result in greater competition indices than areas that were clear cut, however the stand's original species composition is likely the ultimate factor influencing competition levels as 6 of the 11 partially cut plantations were in hardwood or mixedwood stands. One of the sites (5078 - Appendix 1) was not included in the average for partial cuts. This plantation had already failed and the extreme competition index was skewing the results given the small sample size (Figure 15).

It is difficult to evaluate manual weeding without the original competition index prior to treatment, as these plantations could have been worse to begin with. However, even if competition levels have been reduced the present level of competition is still excessive. All large stock/hot planted and hot planted plantations have slightly lower levels of competition than plantations with no treatment. On average, the plantations that were site prepared with herbicides had the lowest levels of competition (Figure 15).

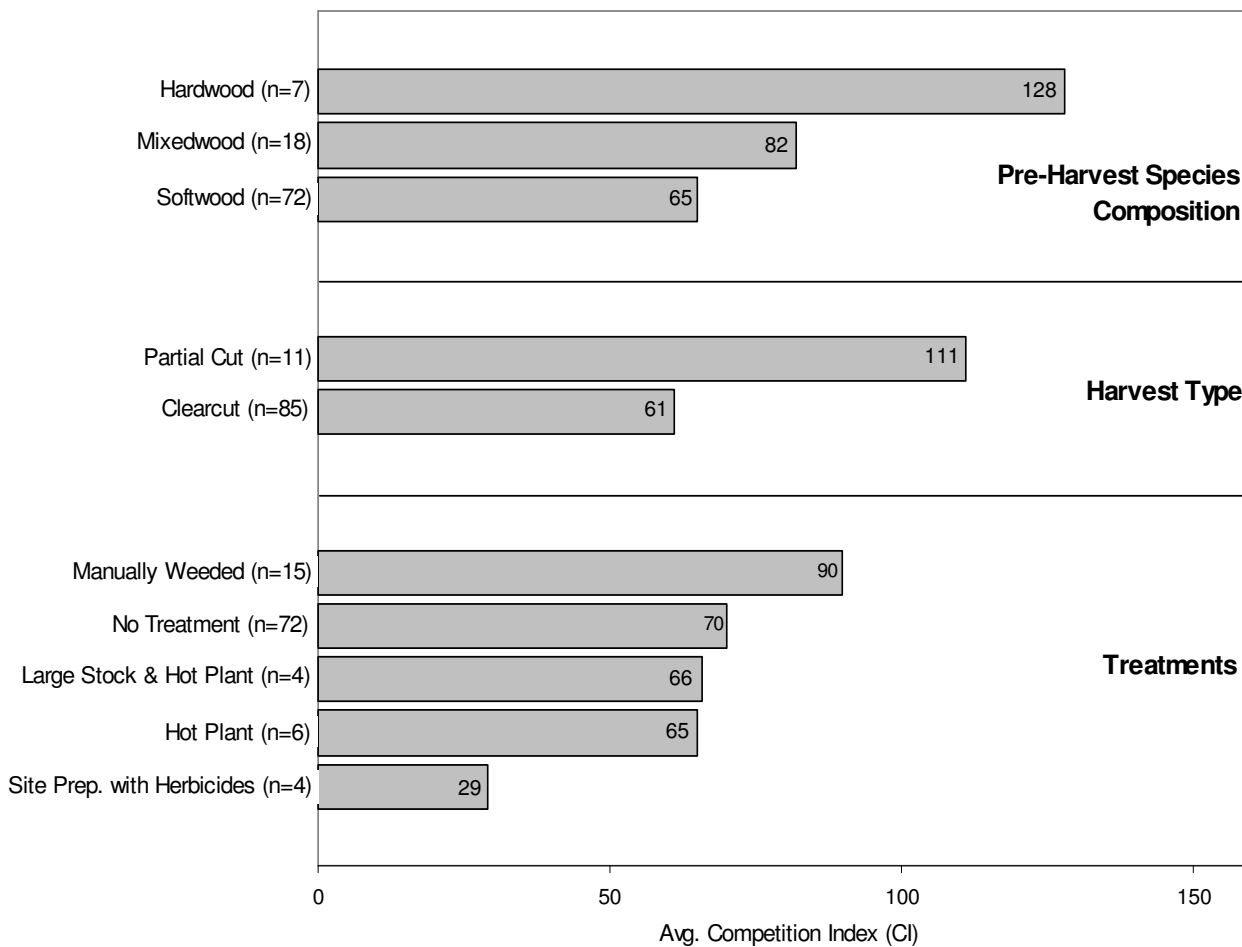


Figure 15. The average competition index by pre-harvest species composition, harvest type and treatment. The “n” following each title is the number of plantations represented.

The surveyed area is divided into competition categories in Table 3. Forty-two percent of the area surveyed had significant hardwood competition (avg. Hw cover = 39%) that was almost double the height of the planted stock, which means many plantations will likely develop as hardwood stands without further release. Many of the plantations in this category were originally hardwood or mixedwood stands. The average competition index is 136, and the average stocking of planted trees with crop potential is 44%. Yellow birch, red maple, white birch, and pin cherry comprise most of the hardwood competition in these stands.

Table 3. The surveyed area by competition categories.										
Main Competition	Avg. % Cover Avg. Height (cm)	Pre-Harvest Species Composition (# / Total #)	# Plan- tations	% Area	Avg. Comp. Index	Avg. Stocking Planted (Crop Potential)	Avg. Stocking Planted (All)	Most common species in order of abundance		
								Hardwoods	Softwoods	Other Vegetation
Hardwoods	Hw =39%@ 201cm Sw =7%@129cm Other veg.=35%@75cm Planted = 112cm	Hw = 7/7 Mw = 13/18 Sw = 15/72	35	42.4%	136	44%	53%	*Yellow birch = 28% Red maple = 27% White birch = 24% Pin cherry = 12%	*Balsam fir = 83% Black spruce = 9% Red spruce = 4%	*Ferns = 43% Raspberry = 23% Goldenrod = 6%
Herbaceous Vegetation	Other veg.=84%@76cm Hw =8%@ 136cm Sw =3%@97cm Planted = 118cm	Mw = 2/18 Sw = 9/72	11	7.8%	74	38%	46%	Pin cherry = 26% White birch = 25% Yellow birch = 19% Red maple = 19%	Balsam fir = 71% Black spruce =16% Red spruce = 7%	Ferns = 31% Raspberry = 29% Goldenrod = 8%
Herbaceous Vegetation/ Large Stock	Other veg.=88%@90cm Hw =6%@ 195cm Sw =4%@79cm Planted = 170cm	Sw=3/72	3	2%	59	69%	72%	Red maple = 49% Pin cherry = 48%	Balsam fir = 97% Red spruce = 3%	Raspberry = 66% Ferns = 18% Goldenrod = 4%
Minor Competition	Sw =7%@ 123cm Hw =4%@149cm Other Veg.=23%@58cm Planted = 130cm	Mw = 3/18 Sw = 45/72	48	47.8%	28	56%	57%	Yellow birch = 30% Red maple = 27% White birch = 22% Pin cherry = 17%	Balsam fir = 42% Black spruce = 39% Larch = 9%	Lambkill = 37% Ferns = 30% Blueberry = 16%
Hw = Hardwoods, Mw = Mixedwoods, Sw = Softwoods * Explanation of percentages from the last 3 columns using examples: Yellow birch comprises 28% of the total hardwood cover (Hw=39%) from column 2. Balsam fir comprises 83% of the total softwood cover (Sw=7%) from column 2. Ferns comprise 43% of the "Other veg." cover (Other veg.=35%) from column 2.										

Herbaceous species were the main competition on 7.8% of the surveyed area. Ferns, raspberry, and goldenrod were the most common species. The average herbaceous cover on these plantations was 84% at an average height of 76cm. The average stocking of planted trees with crop potential of the regular stock was 38% compared to 69% for the large stock under similar conditions (Table 3).

The “minor competition” category includes the remaining surveyed areas which contain modest competition. This category is mainly comprised of softwood origin stands. The average competition index is 28, and the average stocking of planted trees with crop potential is 56% (Table 3).

The frequency, abundance and average height of the herbaceous and small woody shrub competition is presented in Table 4. Fern species were the most common, present on 49% of plantations with an average site coverage of 24% at an average height of 75cm. Bracken fern was the most common species identified, followed by wood fern and hay-scented fern. 34% of the fern coverage was not identified to species, however it’s likely a combination of the species previously mentioned. Raspberry competition was also very common and was present on 41% of plantations with an average site coverage of 20% and an average height of 71cm. Other common herbaceous competition includes goldenrod, fireweed, grass species, aster and sedge species. Several plantations were on ericaceous sites and the main competition was lambkill and blueberry (Table 4).

Table 4. Herbaceous and small woody shrub competition			
<u>Vegetation</u>			
Species	Frequency (% of Plantations)	Abundance (*% Cover)	Avg. Height (cm)
Ferns (all species)	49%	24%	75
Of the 24% cover for ferns: Unidentified=34%, Bracken fern=30%, Wood fern =18%, Hay-scented fern=11%, Other =7%			
Raspberry	41%	20%	71
Lambkill	19%	31%	37
Blueberry	18%	17%	24
Goldenrod	13%	14%	70
Fireweed	11%	12%	96
Grass spp.	10%	11%	52
Aster	5%	20%	78
Sedge spp.	5%	7%	76
* The % cover by species was calculated based on only those plantations which contain that species.			

Damage

Each plot was subdivided into 4 quadrants, 45% of surveyed quadrants were classified as missing a planted tree, 44% contained a healthy planted tree, 9% contained an unhealthy planted tree, and 1% contained a dead planted tree, another 1% was deemed unplantable. The majority of the unplantable category is attributed to slash (72%), followed by rock (14%), wet condition (12%), and other reasons (2%) (Figure 16).

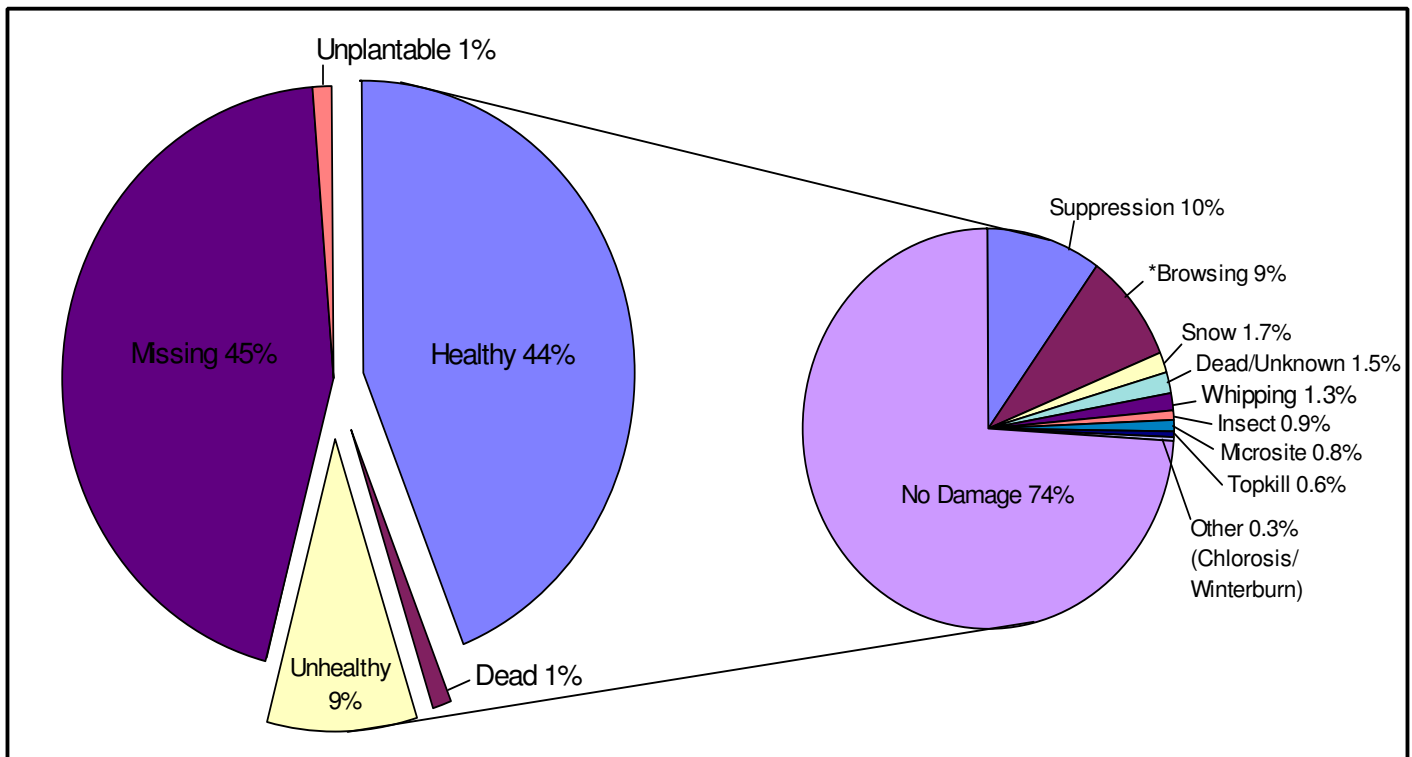


Figure 16. The classification of quadrants is shown in the 1st pie graph. Damage to planted trees (alive and dead) is shown in the 2nd pie graph. (*Browsing: Browse leader = 36%, Browse laterals (light damage) = 26%, Browse laterals (moderate damage) = 23%, Browse laterals (severe damage) = 10%, Browse Complete = 5%).

When a planted tree was present, alive or dead, damage was recorded. This damage is displayed in the 2nd pie chart (Figure 16). Seventy-four percent of planted trees had no visible signs of damage, while the remaining 26% were dead or had some form of damage; mainly suppression or browsing damage. Ten percent of planted trees showed signs of suppression such as stunted growth and overall poor health. It is likely that only the extreme cases of suppression were recorded and that less severe suppression resulting in growth loss went unrecorded. Browsing occurred in 9% of remaining planted trees. Most was leader damage and light to moderate lateral damage. Norway spruce was the preferred species in terms of browsing. When the incidence of browsing by species is calculated relative to the total number available by species 19% of remaining planted Norway spruce were browsed, 7% of black spruce, 4% of red spruce, and 2% of white spruce. In instances where planted trees were dead (1%), the reason for the mortality was largely unknown (90%). Snow damage, whipping damage from nearby trees, insects, poor microsite, topkill, chlorosis, and winterburn constitute the remaining portion of the reported damages in decreasing order of frequency.

Plantation Success

Table 5 shows the distribution of surveyed area by total stocking and the amount that is attributed to planted trees as a means of determining plantation success. A plantation is deemed to be successful in terms of its stocking composition if the stocking to planted trees with crop potential is at least 60% and the total stocking amounts to at least 80%. The results of this survey show that 13% of the area surveyed meets the stocking criteria for a successful plantation (Table 5).

Free-to-grow status is another component of a successful plantation. Plantations were deemed to be free-to-grow if the excess stem density was less than 6000 stems/ha and the competition index was less than 60 which was determined to be a critical competition threshold for planted tree survival. Only 3% of the area surveyed meets both the stocking and free-to-grow criteria for a successful plantation (Figure 17). Ten percent of the surveyed area meets the stocking criteria but requires maintenance to achieve free-to-grow status. The remaining 87% of the area surveyed are considered unsuccessful plantations.

Total Stocking (planted+naturals)	Planted Stocking									
	100%-80%		79%-60%		59%-40%		39%-20%		19%-0%	
	#	% Area	#	% Area	#	% Area	#	% Area	#	% Area
100%-80%	4	1.4%	18	11.5%	21	30.9%				
79%-60%			8	5.3%	20	25.5%	9	13.8%		
59%-40%					5	3.3%	7	5.7%	2	1.2%
39%-20%							2	0.7%	1	0.7%

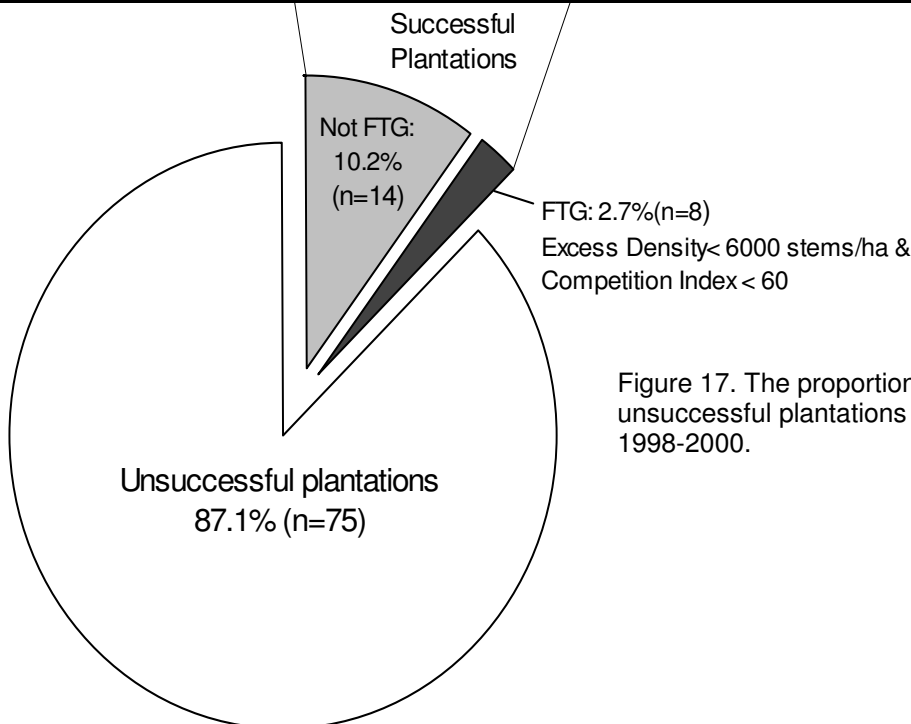


Figure 17. The proportion of successful and unsuccessful plantations established from 1998-2000.

Summary

During the summer of 2005, 97 plantations ranging in age from 6-8 years were surveyed using 3716 plots representing 780 ha. This amounts to 33% of the plantation area established during this period (1998-2000). The following is a summary of how these plantations are performing without the aid of herbicides;

- **Stocking of Planted Trees:** The average stocking of planted trees with crop potential on plantable sites is 48%. The average stocking of all planted trees regardless of crop potential on plantable sites is 54%.
- **Total Stocking:** The average stocking of the surveyed area is 75%. This includes planted trees with crop potential and natural softwoods plus yellow birch and sugar maple on all quadrants.
- **% Area by Stocking Class:** 98.5% of the surveyed area is less than 81% stocked to planted trees with crop potential, and 84% is less than 61% stocked. If natural replacements are included, 47% of the planted area is greater than 80% stocked, and 84% is greater than 60% stocked.
- **Stocking of Natural Regeneration:** The average stocking of commercial natural regeneration is 69%. 62% of the surveyed area is greater than 60% stocked with naturals. The most common species were balsam fir, red maple, yellow birch, white birch, and black spruce.
- **Planted Height:** The average height of the planted trees at 5-7 years is 1m, average leader growth is 18cm.
- **Density:** The average density of excess stems is 17,571 stems/ha (ranging from 585-69,364stems/ha). 32% of the area surveyed contains more than 20,000 excess stems/ha. 81% of the excess stems are hardwood or non-commercial species.
- **Competition Index:** The average competition index across all plantations is 73. Competition showed detrimental effect on stocking when indices reached 60. The height of the planted trees drops progressively with increasing competition. 24% and 27% of the surveyed area is experiencing moderate (60-100) and severe (100+) competition respectively.
- **Competition:** 42% of the area surveyed had significant hardwood competition with percent cover of hardwoods averaging 39% at an average height of 2m. This hardwood competition is almost double the height of the planted stock. Yellow birch, red maple, white birch and pin cherry comprise most of the hardwood competition.
- **Damage:** 45% of the surveyed quadrants were missing a planted tree, of the remaining trees 10% showed visible signs of suppression, and 9% were browsed. Norway spruce was the preferred species in terms of browsing.
- **Plantation Success:** 3% of the area surveyed meets both the stocking and free-to-grow criteria for a successful plantation. Another 10% meets the criteria of an adequately stocked plantation, but requires maintenance. The remaining 87% of the area surveyed are unsuccessful plantations.

Acknowledgements

I would like to take the opportunity to acknowledge the many people that played a part in the production of this report. I would like to acknowledge Tim McGrath from the Department of Natural Resources (DNR) in Truro for collaboration and assistance throughout the project. I would also like to acknowledge Dave Arseneau and Eric Misener from DNR in Truro for their efforts. The sample areas for the survey were spread over seven counties so the assistance of DNR Regional and District staff was integral to the completion of this project. The many days of rigorous field work on the part of DNR staff is greatly appreciated. The collaboration of Stora Enso staff on matters relating to survey procedures and GIS data support were also greatly appreciated.

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Appendix 1: Plantation Summaries

Stand ID	Area (ha)	County	Yr. Plant	Harv. Spp.	Past Treat.	Yr.	Pre-Harv.	Excess Density	Avg. Basal Area (m ² /ha)		Comp. Index	Stocking (%)								Height (cm)			Competition						Status	FTG					
												Plantable Quadrants				All Quadrants							Natural Regen.	Softwood		Hardwood		Other Vegetation							
												Within plot		Flexible plot (50cm)		Planted Crop	Planted All	Planted Crop+Nat.	Planted Crop	Planted All	Planted Crop+Nat.	Planted Crop+Nat.		Leader	LFY Height	MS. Ht.	% Cover	Avg. Ht.			% Cover	Avg. Ht.	% Cover	Avg. Ht.	Most common (listed in order of abundance)
												Planted Crop	Planted All	Planted Crop+Nat.	Planted Crop																				
5001	0.8	Pic.	Bs	1998	CC		Sw	5,896			16	68%	68%	83%	70%	70%	85%	85%	60%	28	177	205	5%	61	3%	89	67%	40	Fern(9%), blueberry(8%)	Plantation	FTG				
5002	3.6	Pic.	Bs	1998	CC		Sw	9,070			58	58%	60%	72%	60%	61%	72%	72%	89%	24	138	163	14%	204	8%	115	90%	48	Fern(52%), blueberry(18%), Lambkill(15%)						
5003	14.4	Pic.	Bs	1998	CC		Sw	8,976			16	39%	39%	81%	46%	46%	85%	84%	67%	24	165	189	12%	175	3%	248									
5004	4.1	Inv.	Ns	1998	PC		Hw	14,608	14	91%	9%	150	18%	38%	59%	20%	42%	60%	60%	52%	6	57	63	2%	117	35%	185	40%	70	Fern(40%)					
5005	1.2	Guys.	Bs	1998	CC		Sw	5,215			21	53%	53%	70%	55%	55%	73%	73%	50%	41	177	217	12%	165	1%	173	20%	122	Raspberry(9%), W. raisin(9%)						
5006	3.8	Guys.	Bs	1998	CC		Sw	8,951			23	42%	43%	80%	61%	62%	96%	96%	63%	28	155	182	14%	129			23%	92	Fern(13%), W. raisin(9%)	Plantation					
5007	40.0	Inv.	Vs	1998	PC	M. Weed	2001	Hw	31,446	8	100%	119	42%	54%	84%	47%	60%	86%	86%	95%	18	83	101	5%	126	45%	147	51%	87	Fern(38%), B. berry(7%), Rasp(6%)					
5008	15.3	Inv.	Vs	1998	PC		Mw	25,434	10	99%	1%	111	38%	48%	82%	41%	51%	84%	84%	96%	15	86	101	7%	111	44%	175	39%	70	Fern(33%)					
5009	9.2	Inv.	Ns	1998	PC	M. Weed	2001	Mw	30,079	10	100%	74	35%	48%	72%	41%	54%	76%	76%	93%	18	86	103	5%	146	33%	144	24%	84	Fern(22%)					
5010	4.0	Vic.	Ns	1998	CC		Sw	15,598	5	46%	54%	95	31%	39%	66%	33%	42%	68%	68%	100%	25	100	126	19%	155	31%	213	31%	70	Fern(20%), Rasp(6%), G. rod(5%)					
5011	2.1	Guys.	Bs	1998	CC		Sw	4,535			39	57%	59%	90%	61%	64%	91%	91%	64%	11	96	105	14%	173	1%	103	25%	67	Fern(15%), Lambkill(5%)	Plantation	FTG				
5012	24.4	Guys.	Bs	1998	PC		Sw	6,757	2	63%	37%	55	60%	60%	83%	63%	63%	85%	85%	77%	16	104	119	14%	112	2%	72	100%	45	Lambkill(59%), fern(28%), blueberry(26%)	Plantation				
5013	5.0	Ant.	Ns	1998	CC		Sw	624			32	37%	41%	44%	44%	48%	52%	50%	20%	22	78	99	1%	93			62%	52	Rasp(24%), G. rod(16%), blueberry(16%)						
5014	22.6	Guys.	Rs	1998	CC		Sw	2,894			7	43%	43%	84%	46%	46%	85%	85%	86%	13	93	106	5%	136											
5015	9.4	Cap.	Ns	1998	CC	M. Weed	2001	Mw	45,393			60	41%	51%	91%	47%	57%	93%	90%	91%	20	81	100	7%	99	46%	112								
5016	10.2	Cap.	Ns	1998	CC		Sw	25,383			38	37%	42%	99%	46%	51%	99%	98%	96%	16	70	84	14%	96	17%	99									
5017	5.2	Cap.	Bs	1998	CC		Mw	15,960			24	71%	76%	98%	77%	82%	98%	93%	88%	28	128	147	4%	172	15%	156					Plantation				
5018	9.1	Vic.	Ns	1998	PC		Sw	8,666	4	72%	28%	51	30%	37%	64%	33%	41%	64%	64%	76%	29	129	157	6%	157	22%	164	52%	63	G. rod(18%), fern(11%), rasp(8%)					
5019	1.0	Ant.	Ns	1998	CC		Sw	2,253			25	35%	38%	55%	35%	38%	55%	55%	40%	23	94	117	8%	135			46%	48	blueberry(25%), G. rod(14%), rasp(7%)						
5020	0.5	Ric.	Ns	1998	CC		Sw	21,664			27	50%	58%	100%	64%	72%	100%	100%	100%	25	89	114	18%	112	8%	148					Plantation				
5023	18.8	Guys.	Rs	1998	CC		Sw	3,448			36	67%	69%	71%	71%	73%	75%	73%	26%	14	96	111			7%	139	62%	49	Lambkill(22%), fern(22%)						
5024	2.3	Cap.	Ns	1998	CC	M. Weed	2002	Sw	38,995			30	40%	40%	100%	44%	44%	100%	100%	100%	27	126	144	26%	87	23%	92								
5025	4.6	Cap.	Ns	1998	CC	M. Weed	2002	Mw	41,821			47	56%	67%	95%	60%	71%	96%	96%	100%	23	112	128	5%	125	43%	116					Plantation			
5027	20.0	Pic.	Bs	1998	CC		Sw	3,596			6	44%	44%	71%	47%	47%	73%	72%	58%	22	138	160	4%	141	2%	229									
5028	12.8	Guys.	Bs	1998	CC		Sw	1,453			2	51%	51%	67%	55%	56%	70%	70%	36%	30	166	196	1%	142	1%	178									
5029	8.0	Guys.	Rs	1998	CC		Sw	2,296			11	50%	57%	80%	50%	58%	81%	80%	55%	10	77	87	3%	115	1%	172									
5030	2.5	Guys.	Bs	1998	CC		Sw	3,663	1	100%		28	79%	79%	92%	81%	81%	94%	94%	77%	22	131	153	10%	146	1%	140	50%	56	G. rod(11%), rasp(8%), fern(7%)	Plantation	FTG			
5031	18.5	Cap.	Bs	1998	CC		Mw	36,502			34	53%	61%	98%	56%	68%	98%	96%	95%	20	91	111	9%	105	24%	109									
5032	2.8	Cap.	Bs	1998	CC	M. Weed	2000	Mw	39,521			38	60%	62%	96%	69%	71%	100%	98%	93%	37	174	211	10%	167	30%	219					Plantation			
5033	14.6	Pic.	Bs	1998	CC		Sw	4,100			8	48%	48%	83%	51%	51%	86%	85%	68%	17	125	143	5%	154	2%	197									
5034	5.3	Cap.	Ns	1999	CC	M. Weed	2001	Hw	55,074			121	40%	45%	58%	44%	51%	61%	61%	100%	15	138	152	4%	195	61%	279								
5035	10.1	Cap.	Ns	1999	CC	M. Weed	2001	Hw	50,468			122	35%	45%	45%	37%	47%	46%	44%	92%	13	126	139	2%	173	58%	275	8%	58	Raspberry(5%)					
5036	3.3	Cap.	Ns	1999	CC		Hw	49,037			103	57%	60%	63%	63%	66%	66%	66%	94%	15	149	164	1%	195	56%	290									
5037	26.6	Cap.	Bs	1999	CC		Mw	58,352			77	52%	60%	95%	57%	67%	96%	92%	96%	18	119	137	7%	121	46%	212									
5038	6.2	Ric.	Bs	1999	CC		Sw	19,530			30	54%	55%	89%	65%	67%	93%	91%	84%	15	161	175	8%	189	11%	232	18%	66	Fern(10%), lambkill(8%)	Plantation					
5039	3.5	Guys.	Bs	1999	CC		Sw	2,394			4	39%	44%	74%	48%	53%	83%	82%	61%	13	92	104	5%	83											
5040	0.9	Guys.	Bs	1999	CC		Sw	2,721			4	58%	58%	80%	73%	73%	90%	90%	60%	35	174	209	5%	150								Plantation	FTG		
5041	2.2	Guys.	Bs	1999	CC		Sw	1,443			1	57%	61%	75%	64%	68%	80%	80%	45%	31	190	221	1%	138								Plantation	FTG		
5042	2.5	Guys.	Bs	1999	CC		Sw	2,093			13	48%	50%	88%	58%	60%	92%	92%	23%	13	102	115	6%	140			9%	71	Fern(7%)						
5043	12.5	Guys.	Bs	1999	CC		Sw	1,224			5	24%	26%	54%	27%	29%	57%	57%	30%	12	83	95	2%	115	1%	140									

Stand ID	Area (ha)	County	Yr. Spp.	Harv. Plant Type	Past Treat.	Yr.	Pre-Harv.	Excess Density	Avg. Basal Area (m ² /ha)			Stocking (%)					Height (cm)			Competition						Status	FTG					
									BA	Hw	Sw	Plantable Quadrants			All Quadrants		Natural Regen.	Leader	LFY Height	MS. Ht.	Softwood		Hardwood		Other Vegetation							
												Planted Crop	Planted All	Planted Crop+Nat.	Planted Crop	Planted Crop+Nat.					% Cover	Avg. Ht.	% Cover	Avg. Ht.	% Cover			Avg. Ht.	Most common (listed in order of abundance)			
																													Within plot		Flexible plot (50cm)	
5044	9.1	Pic.	Bs	1999	CC		Sw	10,303				71		47%	*56%		53%	*62%	*56%	80%	27	132	155	5%	73	19%	119	98%	79	Fern(40%), lambkill(37%), sedge(6%)		
5045	6.8	Pic.	Bs	1999	CC		Mw	24,877				182		46%	*68%		51%	*72%	*68%	91%	12	91	102	14%	70	59%	204	59%	93	Fern(22%), rasp(11%)		
5046	6.7	Guys.	Bs	1999	CC		Sw	2,868				30		51%	*60%		63%	*71%	*60%	50%	29	128	148	4%	84	3%	128	71%	53	Lambkill(20%), fern(17%), rasp(14%)		
5047	1.1	Pic.	Rs	1999	CC		Sw	1,386				61		20%	*63%		20%	*63%	*63%	70%	17	68	79	6%	128	3%	140	71%	49	Fern(31%), lambkill(18%), blueberry(18%)		
5048	12.2	Pic.	Ns	1999	CC		Sw(of)	13,865	1	94%	6%	184	40%	45%	68%	47%	53%	72%	70%	80%	16	70	86	14%	180	44%	224	36%	69	Grass(11%), G.rod(10%), fern(7%)		
5049	2.4	Pic.	Bs	1999	CC		Sw	3,212				85		25%	*38%		29%	*42%	*38%	42%	31	116	140	2%	46	3%	120	95%	110	Raspberry(79%)		
5050	2.5	Pic.	Bs	1999	CC		Sw	2,442				57		54%	*62%		60%	*67%	*62%	38%	31	137	163	3%	107	5%	97	100%	72	Rasp(45%), Blueberry(36%), aster(15%)		
5051	23.5	Pic.	Ns	1999	CC		Sw	1,386				9	53%	55%	63%	58%	61%	68%	68%	24%	24	125	149	3%	147	1%	240					
5052	3.3	Ant.	Ns	1999	CC	HotPlant	Sw	11,112				88	37%	38%	76%	41%	43%	79%	79%	65%	28	117	145	17%	215	21%	206	62%	84	F.weed(24%), G.rod(19%), grass(13%)		
5053	8.2	Ant.	Ns	1999	CC		Sw	2,536				67	39%	43%	49%	43%	47%	52%	52%	56%	27	91	118	1%	160	9%	195	82%	77	G.rod(26%), rasp(25%), fern(16%)		
5054	8.4	Pic.	Rs	1999	CC	HotPlant	Sw(of)	7,013				60	56%	60%	75%	70%	73%	85%	81%	53%	32	147	178	7%	87	15%	252	70%	91	Raspberry(54%)		Plantation
5055	3.6	Pic.	Rs	1999	CC	HotPlant	Sw	770	1	100%		71	49%	50%	51%	57%	58%	58%	58%	17%	27	131	158	1%	78			100%	98	Raspberry(64%), fern(37%)		
5056	3.0	Pic.	Rs	1999	CC	HotPlant	Sw	4,159				46	65%	68%	72%	82%	85%	83%	83%	40%	31	142	173	4%	71	3%	138	95%	81	Raspberry(55%), fern(27%)		Plantation FTG
5057	2.0	Guys.	Bs	1999	CC		Sw	2,721				24		53%	*55%		60%	*63%	*55%	40%	35	149	172	3%	49	2%	118	71%	60	Lambkill(36%), rasp(16%), fern(14%)		
5058	1.7	Pic.	Ns	1999	CC	M.Weed	2002	Sw	7,799			241	20%	38%	23%	23%	45%	25%	25%	50%	10	55	65	1%	90	29%	259	77%	77	Fireweed(54%), grass(12%)		
5059	6.4	Guys.	Bs	1999	CC		Sw	3,401				7	47%	48%	80%	51%	52%	82%	82%	44%	15	91	106	3%	167	1%	163					
5060	17.4	Guys.	Rs	1999	CC		Sw	1,554				9	36%	37%	58%	41%	43%	62%	62%	39%	14	77	91	3%	120	1%	163	5%	81	Fern(5%)		
5061	3.9	Guys.	Bs	1999	CC		Sw	3,061				11	35%	38%	88%	43%	45%	90%	90%	55%	13	88	101	4%	123	1%	133	7%	74	Fern(5%)		
5062	11.6	Guys.	Bs	1999	CC		Sw	2,033				3	53%	53%	66%	58%	59%	70%	70%	33%	23	132	155	1%	111	1%	165					
5063	8.5	Guys.	Rs	1999	CC		Sw	2,378				11	47%	50%	73%	56%	59%	77%	77%	56%	13	76	88	2%	125	2%	140					
5064	14.7	Cap.	Bs	1999	CC		Mw	57,915				86	61%	72%	99%	68%	79%	99%	98%	96%	19	126	144	3%	122	50%	241					Plantation
5065	18.8	Cap.	Ns	1999	CC	M.Weed	2001	Hw	58,665			147	41%	53%	61%	44%	57%	63%	62%	94%	13	120	133	3%	187	66%	287					
5066	2.1	Pic.	Ns	1999	CC	M.Weed	?	Mw	12,132	1	100%	104	49%	56%	65%	53%	65%	70%	68%	91%	16	72	88	6%	105	34%	149	30%	79	Fern(12%), grass(9%), rasp(7%)		
5067	7.1	Ric.	Bs	2000	CC		Mw	48,720				68	52%	54%	81%	56%	59%	81%	81%	94%	15	134	149	10%	178	36%	228	10%	55	Fern(7%)		
5068	0.6	Cap.	Ns	2000	CC	M.Weed	?	Mw	13,172			36	47%	53%	90%	62%	68%	94%	85%	70%	21	86	101	2%	85	10%	99	32%	78	Grass(17%), fern(7%), rasp(6%)		Plantation
5069	3.6	Cap.	Ws	2000	CC		Mw	51,687				77	41%	44%	57%	47%	50%	59%	59%	100%	15	174	189	2%	187	60%	230					
5070	3.6	Cap.	Bs	2000	CC	M.Weed	2003	Mw	13,983			44	74%	75%	90%	85%	86%	96%	96%	67%	10	69	79	4%	118	6%	141	54%	49	Fern(33%), lambkill(12%)		Plantation
5071	16.9	Cap.	Bs	2000	CC		Hw	69,364				134	40%	51%	77%	46%	59%	79%	77%	94%	14	118	133	5%	264	58%	276					
5072	17.9	Inv.	Ws	2000	PC		Mw	8,200	9	94%	6%	99	32%	42%	59%	37%	48%	62%	62%	62%	10	46	56	1%	102	15%	123	61%	60	Fern(55%)		
5073	13.0	Guys.	Bs	2000	CC		Sw	5,407				8	49%	49%	82%	51%	51%	83%	82%	57%	19	101	120	5%	109	3%	143					
5074	1.8	Guys.	Rs	2000	CC		Sw	12,998				60	68%	68%	92%	82%	82%	100%	98%	100%	22	77	99	11%	80	21%	143	29%	62	Raspberry(20%)		Plantation
5075	3.3	Guys.	Rs	2000	CC		Sw	11,622	2	32%	68%	68	49%	49%	87%	57%	57%	90%	88%	82%	20	72	92	9%	67	14%	147	63%	56	Fern(31%), lambkill(16%)		
5076	3.1	Guys.	Bs	2000	CC		Sw	605				4	20%	20%	47%	25%	25%	53%	52%	27%	12	80	92	1%	107	1%	200					
5077	6.2	Guys.	Bs	2000	CC		Sw	585				96		31%	*46%		34%	*48%	*46%	16%	14	60	73	2%	82			100%	53	Lambkill(55%), fern(42%)		
5078	2.1	Pic.	Rs	2000	PC		Sw	17,016	4	76%	24%	638	0%	8%	53%	0%	8%	53%	52%	91%	3	27	30	11%	101	51%	204	79%	94	Rasp(30%), fern(25%), B.berry(22%)		
5079	7.6	Pic.	Rs	2000	CC		Sw	4,222	2	90%	10%	370	10%	25%	53%	11%	28%	54%	53%	74%	6	41	46	4%	92	25%	289	100%	87	Rasp(49%), fern(27%), B.berry(13%)		
5080	5.7	Pic.	Ws	2000	CC		Sw	5,976				236		36%	*47%		41%	*51%	*47%	48%	13	55	68	6%	64	20%	197	100%	81	Rasp(49%), Aster(20%), fireweed(14%)		

Stand ID	Area (ha)	County	Yr. Spp.	Harv. Plant Type	Past Treat.	Yr.	Pre-Harv.	Excess Density	Avg. Basal Area (m ² /ha)		Comp. Index	Stocking (%)					Height (cm)			Competition						Status	FTG							
												Plantable Quadrants			All Quadrants					Softwood	Hardwood	Other Vegetation												
												Within plot		Flexibile plot (50cm)	Natural Regen.	Leader	LFY Height	MS. Ht.	% Cover			Avg. Ht.	% Cover	Avg. Ht.	% Cover			Avg. Ht.	Most common (listed in order of abundance)					
												Planted Crop	Planted All	Planted Crop+Nat.						Planted Crop	Planted All								Planted Crop+Nat.	Planted Crop+Nat.	%	Avg. Ht.		
5081	3.8	Pic.	Ns	2000	CC		Sw	5,564			238	22%	49%	37%	24%	50%	38%	38%	58%	8	53	61	1%	42	27%	230	100%	75	Aster(36%), rasp(21%), grass(20%)					
5082	1.0	Guys.	Bs	2000	CC		Sw	14,966			56	78%	85%	88%	78%	85%	88%	88%	90%	22	105	127	19%	148	5%	155	59%	63	Lambkill (10%), fern (10%)		Plantation			
5083	6.2	Guys.	Bs	2000	CC		Sw	12,947	1	78%	22%	100	40%	42%	57%	47%	50%	60%	60%	87%	19	87	107	2%	86	35%	173	53%	72	Rasp.(15%), fern (11%)				
5084	8.9	Guys.	Bs	2000	PC	M. Weed	2001	Sw	22,424	2	88%	12%	114	27%	30%	51%	28%	31%	53%	52%	82%	15	75	90	5%	100	35%	179	52%	64	Fern(21%), lambkill (8%), rasp. (7%)			
5085	4.8	Guys.	Rs	2000	CC		Sw	1,372	1	7%	93%	92	39%	42%	73%	41%	44%	74%	74%	46%	11	53	64	5%	110	2%	121	100%	45	Fern (41%), lambkill (36%), blueberry(29%)				
5086	29.7	Guys.	Bs	2000	CC		Sw	4,263			88	28%	33%	62%	36%	42%	66%	65%	58%	9	50	59	10%	95	1%	80	93%	49	Lambkill(51%), fern(23%), blueberry(14%)					
5087	11.9	Pic.	Bs	2000	PC		Sw	20,975	1	100%		148	37%	52%	79%	41%	57%	83%	83%	85%	16	82	98	24%	79	27%	256	76%	73	Raspberry (31%), fern (30%)				
5088	5.4	Pic.	Ns	2000	CC	Hot Plant	Sw	4,686			74	11%	15%	33%	13%	17%	35%	35%	37%	29	91	119	5%	62	9%	109	100%	69	Rasp.(49%), aster(17%), grass(10%)					
5089	2.0	Pic.	Bs	2000	CC	Hot Plant	Sw	18,594			25	48%	48%	92%	50%	50%	93%	93%	100%	36	132	166	11%	118	9%	101	27%	72	Raspberry (27%)					
5090	6.0	Ant.	Ns	2000	CC	M. Weed	2004	Sw	4,159			48	46%	49%	58%	48%	51%	60%	60%	40%	27	100	127	4%	149	3%	82	68%	79	Raspberry (33%), G.rod(15%)				
5091	0.6	Ant.	Ns	2000	CC		Mw	5,199	4	100%		130	10%	10%	65%	20%	20%	73%	73%	90%	19	59	78	2%	90	17%	246	80%	78	Rasp.(27%), G.rod(23%), fern(14%)				
5092	3.8	Guys.	Bs	2000	CC		Sw	955			3	61%	63%	76%	67%	70%	83%	83%	32%	33	145	179	1%	105							Plantation	FTG		
5093	5.8	Guys.	Ns	2000	CC	Hot Plant	Sw	5,080			20	51%	52%	89%	56%	56%	90%	84%	55%	29	109	132	4%	69	2%	120	28%	70	Raspberry (27%)					
5094	1.8	Guys.	Bs	2000	CC		Sw	36,508			46	65%	68%	93%	68%	70%	93%	93%	100%	19	106	122	26%	120	14%	141					Plantation			
5095	1.6	Pic.	Ns	2000	CC	Hot Plant	Sw	6,499			86	52%	57%	70%	64%	70%	75%	73%	75%	32	85	117	10%	112	11%	189	79%	88	Raspberry (51%), Blackberry (1%)					
5096	3.2	Pic.	Ws	2000	PC	Hot Plant	Sw	13,756	3	10%	90%	114	56%	59%	73%	56%	59%	73%	73%	63%	16	64	81	6%	85	24%	169	56%	64	Fern (39%), raspberry (7%)				
5097	27.6	Inv.	Ws	2000	PC		Mw	14,544	13	98%	2%	187	27%	48%	59%	28%	50%	60%	60%	67%	10	43	53	2%	107	30%	159	62%	84	Fern (45%), raspberry (10%)				
5098	13.3	Guys.	Bs	2000	CC	Hot Plant	Sw	15,657			69	26%	27%	73%	33%	36%	74%	73%	70%	26	101	127	21%	111	11%	194	40%	104	Fireweed(18%), rasp.(12%), fern(6%)					
5099	5.5	Guys.	Bs	2000	CC		Sw	3,077			6	58%	59%	83%	61%	62%	84%	83%	68%	12	86	99	4%	111	1%	134					Plantation	FTG		
5150	2.5	Pic.	Ns	1999	CC		Sw	1,866			70		58%	*63%		65%	*71%	*63%	38%	27	106	129	4%	71	2%	85	100%	71	Rasp.(48%), blueberry(36%), B. berry(8%)					
779.7		Area Weighted Averages:		17,571							73	43%	49%	73%	48%	54%	76%	75%	69%	18	100	117												

Plantations that received a herbicide treatment

5021	11.7	Ric.	Ns	1998	CC	Site P. H.	1997	Mw	17,741			34	44%	47%	88%	52%	57%	90%	87%	87%	18	166	184	10%	272	12%	258	6%	79		
5022	10.7	Ric.	Ns	1998	CC	Site P. H.	1997	Mw	27,441			36	50%	57%	90%	57%	64%	91%	91%	85%	19	192	211	4%	257	29%	214	7%	58		
5026	10.5	Cap.	Ns	1998	CC	Site P. H.	1997	Sw	19,228			21	58%	60%	98%	65%	67%	98%	98%	98%	26	104	125	11%	103	14%	106				
5100	9.2	Ric.	Bs	1998	CC	Site P. H.	1997	Sw	20,610			26	60%	61%	82%	69%	71%	87%	87%	100%	15	159	174	7%	265	13%	212				

Spp. Species planted: Bs = Black spruce, Ns = Norway spruce, Rs = Red spruce, Ws = White spruce

Harv. Type Harvest Type: CC = Clearcut, PC = Partial cut

Past Treat. Past Treatment: M. Weed = Manually weed, Site P. H. = Site Prep. with herbicides, L. St. = Large stock

Pre-Har Pre-harvest Species Composition: Sw = Softwood, Sw(of) = Softwood old field, Mw = Mixedwood, Hw = Hardwood

Comp. Index Competition Index

Planted Crop Planted trees with crop potential

Planted All All planted trees regardless of crop potential

Planted Crop+Nat Planted trees with crop potential plus natural replacements

* For several plantations the crop potential data for planted trees is missing. In these instances all planted trees are substituted; these plantations are not used to derive the area weighted average stocking (Planted Crop+Nat) for all plantations.

Natural Regen All commercial natural regeneration

LFY Height Height up till last full year.

MS. Ht. Mid Season Height: Comparable to height of competition.

FTG Free-to-grow