

Intensive Forest Management Science Partnership: NEBIE Plot Network

Kapuskasing Installation Set

The Kapuskasing installation set is one of eight study sites of the *Intensive Forest Management Science Partnership: NEBIE Plot Network* research project. Established in 2002, this site provides research partners (see partner list – pg.6) with the opportunity to understand how silviculture intensities affect fibre production, biodiversity, soil properties, and coarse wood components of a poplar - black spruce forest type on clay soils.

The NEBIE framework (i.e., N-natural disturbance and Ex-extensive, B-basic, I-intensive, and EI-elite silviculture) has been applied on 4 blocks of five 2 ha treatment plots (see Figure 1).

Site description

- Location: Lake Abitibi ecoregion, Clay Belt ecodistrict (3E-1)
- Climate: Daily average January temperature: -18.7°C; daily average July temperature: 17.2°C; average rainfall: 544.6 mm; average snowfall: 313 cm; days with minimum temperature above 0°C: 150.9¹
- Pre-harvest stand: Dominated by trembling aspen (Po), white birch (Bw), and black spruce (Sb) in varying mixtures with the aspen showing evidence of decline
- Pre-harvest growth and yield: average basal area of 29.9 m² ha⁻¹ and average volume of 255.9 m³ ha⁻¹ (Table 1)
- Northeastern Ontario forest ecosystem classification²:
 - Ecosites: ES 6f – Black spruce – trembling aspen – fine soil and ES 7f – Trembling aspen – white spruce – white birch – fine soil
 - Dominant vegetation types: V10 – Trembling aspen – balsam poplar – speckled alder, V15 - Black spruce – herb rich

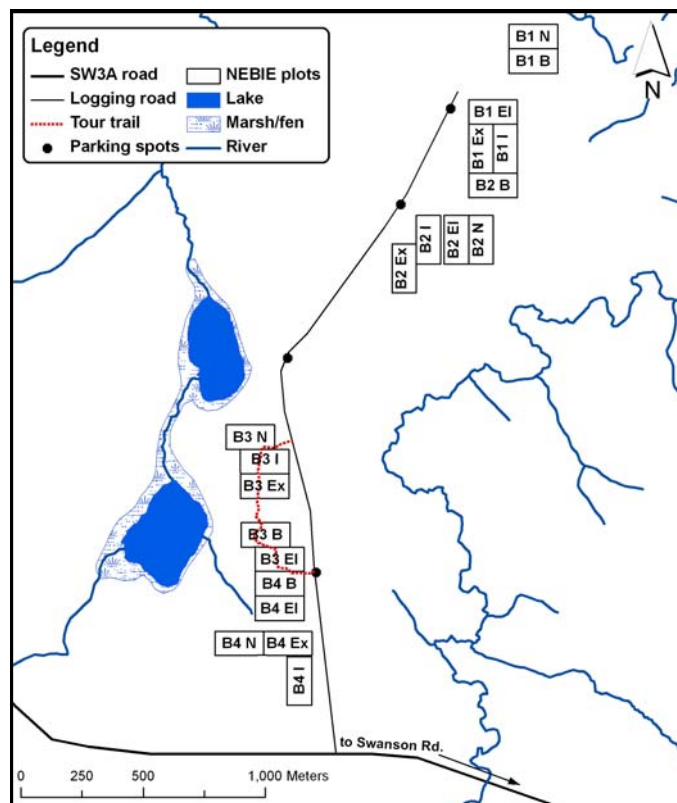


Figure 1. Layout of the blocks (B1–B4) and treatment plots at the Kapuskasing installation set (49°08'N, 82°28'W)

Table 1. Pre-harvest site description attributes for the Kapuskasing installation set of the NEBIE plot network. (Percents indicate the portion of the block that is the specified stand, example Block 1 is 92% Po7Bw2Sb1)

	Species composition ^a	Site class ^a	Stocking ^a	Age ^a (years in 2003)	Soil texture	Gross total volume ^b (m ³ ha ⁻¹)
Block 1	Po7Bw2Sb1 (92%)	2	1.0	107	clay soil, organic matter typically < 20 cm	253
	Sb7Bw2Po1 (8%)	1	0.9			
Block 2	Po7Bw2Sb1 (97%)	2	1.0	107	clay soil, organic matter typically < 20 cm	222
	Sb8Po2 (3%)	1	1.0			
Block 3	Po7Bw1Pj1Sb1 (94%)	3	0.9	107	clay soil, organic matter typically < 20 cm	322
	Sb5Po4Bw1 (6%)	1	0.8			
	Sb5Po4Bw1 (65%)	1	0.8			
Block 4	Po7Bw1Pj1Sb1 (32%)	3	0.9	107	clay soil, organic matter typically < 20 cm	227
	Sb10 (3%)	1	1.0			

^a Forest Resource Inventory (FRI), 1988 interpretation; ^b Pre-harvest growth and yield (20 plots/block)

¹ Environment Canada climate normals 1971-2000, Kapuskasing Airport, <http://www.climate.weatheroffice.ec.gc.ca>

² Taylor, K.C., R.W. Arnup, B.G. Merchant, W.J. Parton and J. Nieppola. 2000. Field guide to forest ecosystems of northeastern Ontario. Ont. Min. Nat. Resour., Northeast Sci. Technol., South Porcupine, ON. NEST Field Guide FG-001.

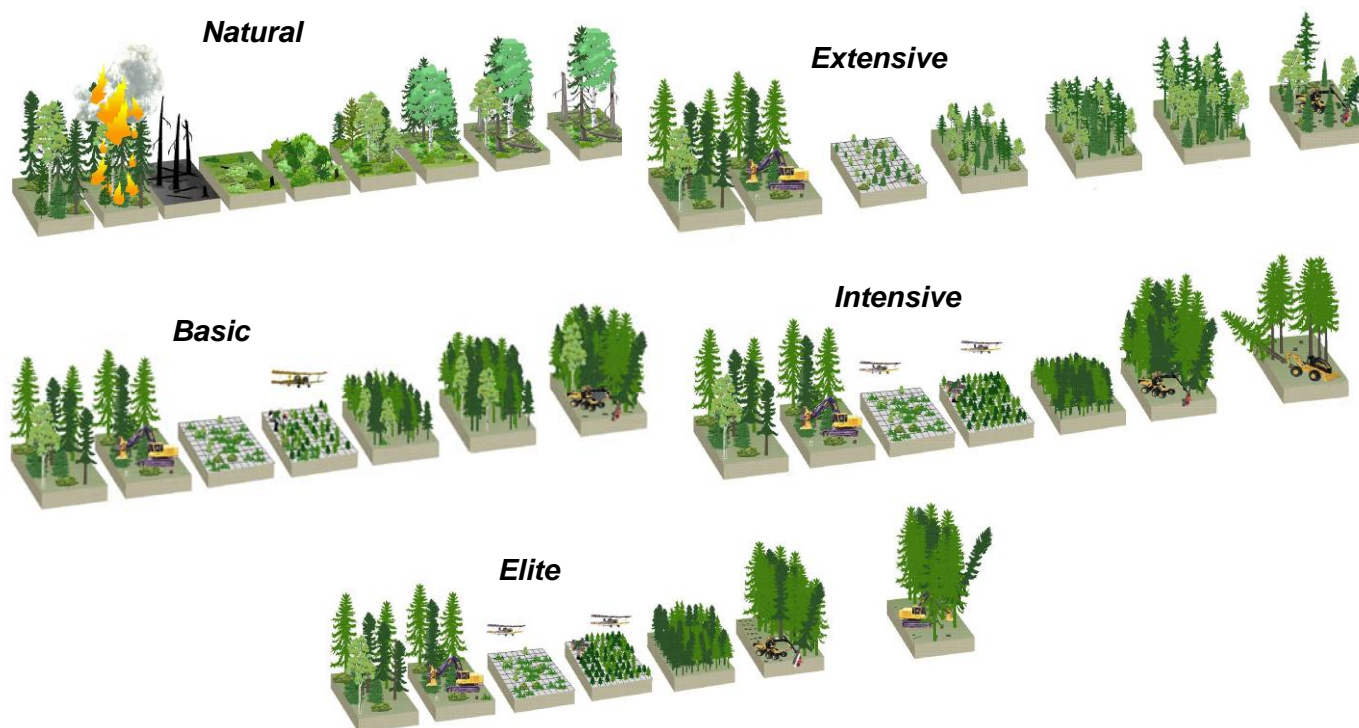
NEBIE treatments

Silvicultural work at the Kapuskasing installation set began in 2002 with the development of roads and the subsequent harvest in 2003. The objective of each silvicultural intensity treatment level and the associated silvicultural activities are described in Table 2 and illustrated in the graphic below. The natural treatment was not harvested and left to undergo natural succession.

Table 2. Objectives and silvicultural activities at the Kapuskasing installation set of the NEBIE plot network by treatment.

	<i>Extensive</i>	<i>Basic</i>	<i>Intensive</i>	<i>Elite</i>
Objectives	>40% stocking of naturally regenerated Po, Sb, Sw, Bf, Bw, Ce free of major insect pests	>60% stocking of Sb and Sw free of interspecific competition and major insect pests	>80% stocking of genetically superior Sb and Sw free of intra- and interspecific competition and major insect pests	>80% stocking of genetically superior Sb and Sw free of nutrient deficiencies, intra- and interspecific competition and major insect pests
Harvest	Fall 2003 - clear cut using full tree logging to roadside. Leave 25 trees ha ⁻¹ (at least 5-6 seed trees and 5-6 wildlife trees ha ⁻¹)			
Site preparation	none	none	August 2004 - Aerial spray with Vision® herbicide	
Tree plant	none	May 2005 - planted with regular Sb and Sw at a 2:1 ratio, 1.8 m x 1.8 m spacing, approx. 2400 trees ha ⁻¹ actually planted	May 2005 - planted Sb F2 enhanced and Sw F1 regular at 1:1.5 ratio, 1.5 m x 1.5 m spacing, approx. 3200 trees ha ⁻¹ actually planted	May 2005 - planted Sb F2 enhanced and Sw F1 regular at 1:1.5 ratio, 1.5 m x 1.5 m spacing, approx. 3000 trees ha ⁻¹ actually planted, species planted in rows for future silviculture options
Vegetation management	none	August 2006 - Aerial spray of Vision® herbicide		
Refill tree plant	none	May 2007 - refilled selected spots with Sb (18,000 total), Basic spacing 3.3 m x 3.3 m, Intensive and Elite spacing 2.8 m x 2.8 m.		
Future options	none	none	commercial thinning leaving large diameter Sw	commercial thinning leaving large diameter Sw, fertilizer application, pruning

Bf = balsam fir, Bw = white birch, Ce = cedar, Po = poplar, Sb = black spruce, Sw = white spruce



Sample plots and data collection

- **Growth and yield** information was collected in 2002, 2005 and 2008 to represent the pre-harvest, year 2 and year 5 conditions (G&Y plots in Figure 2). These data are collected to assess fibre production, tree quality, and fate of residual trees ≥ 2.5 cm diameter at breast height (DBH).
- Trees < 2.5 cm DBH are also assessed in the G&Y plots. Stem counts, average height, and % foliar cover are assessed in ten 2 m x 2 m **stocking** quadrats, which are also used to estimate **tree and shrub diversity**. The stocking quadrates were assessed in 2003, 2005, and 2008.
- **Diversity of herbaceous, grass, sedge, fern and fern ally, lichen and bryophyte species** has been assessed in 2003, 2005, and 2008 (FEC plots in Figure 2).
- **Coarse woody material** was measured in 2003 and 2005 to assess abundance and the distribution of carbon (2 soil plots in Figure 2 – 3 treatments/3 blocks only).
- **Fine woody material and organic matter** samples were collected in 2003, 2005, and 2008 to assess the distribution of carbon, nitrogen, and base cations (3 soil plots in Figure 2 – 3 treatments/3 blocks only).
- Other data collected at this site has included: post-harvest microsite descriptions; pathology of harvested trees; litter composition, abundance, and decomposition rates; photographs from specific points; height:diameter ratios for each tree species; and weather parameters.

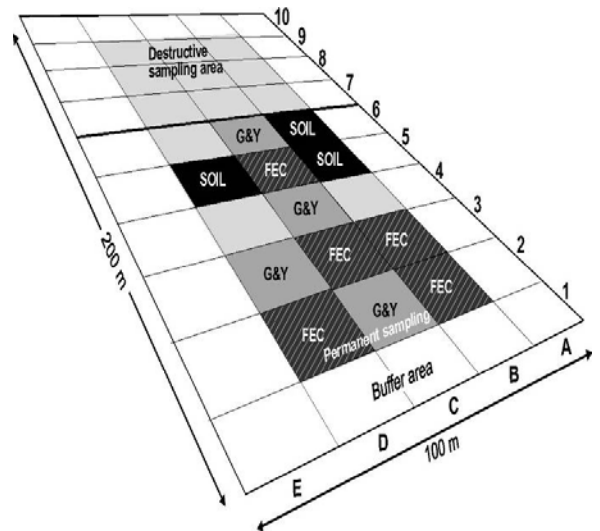


Figure 2. Standard two hectare experimental plot showing alpha-numeric grid and an example of a random layout of sample plots.

Current site conditions

Growth and yield volume and density by diameter class

Fifth year re-measurement of the growth and yield plots (trees ≥ 2.5 cm DBH) was completed in 2008. The extensive treatment had a larger number of stems in the smaller diameter classes (mainly trembling aspen) due to the herbicide application in the basic, intensive, and elite treatments (Figure 3). The small diameter classes in the natural treatment were dominated by balsam fir. Note the 2 cm diameter class ranges from 2.5 to 3.0 while all other diameter classes represent a full 2 cm interval.

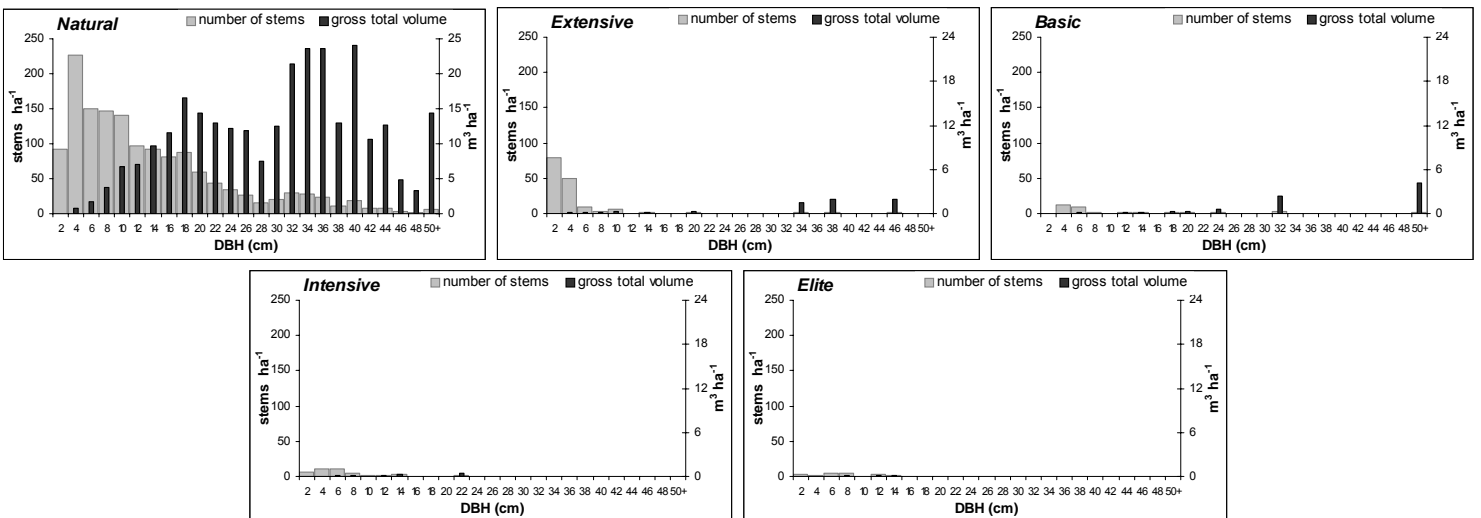


Figure 3. Number of stems and gross total volume by diameter class – 2008 data by treatment.

Stocking

Stocking provides a measure of regeneration success. Fifth year stocking (2008) of spruce was 13% in natural, 11% in the extensive, 64% in the basic, 74% in the intensive, and 76% in the elite treatments, respectively (Figure 4; Table 3). When all stems <2.5 cm were included, the densities per hectare of spruce ranged from 359 stems in the extensive treatment to 3,469 stems in the intensive treatment (Figure 5; Table 4).

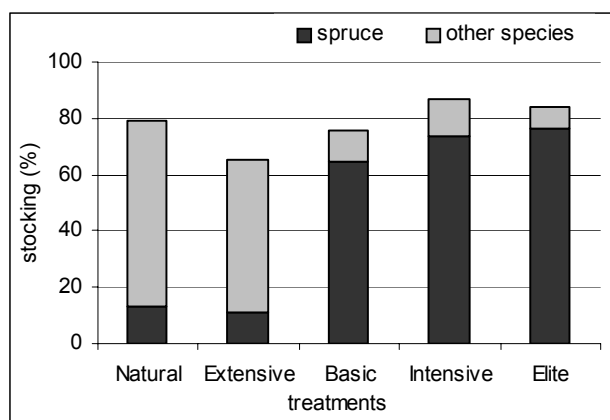


Figure 4. Percent of 2 m x 2 m quadrats stocked with stems <2.5 cm DBH in 2008 by treatment.

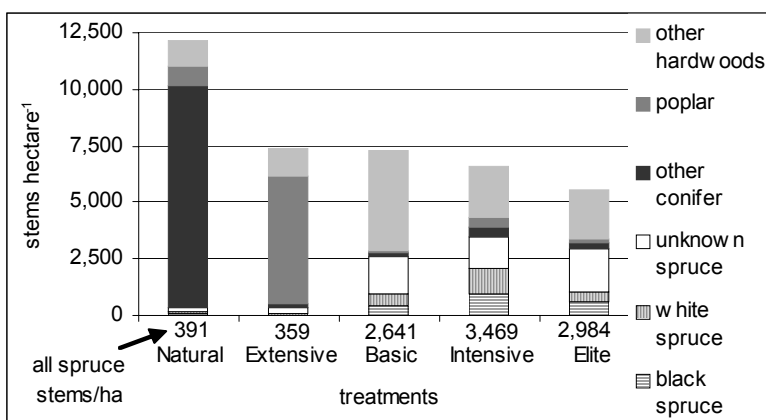


Figure 5. Total stems <2.5 cm per hectare in 2008 by treatment.

Table 3. Stocking of trees <2.5 cm DBH by treatment in 2005 and 2008 on the Kapuskasing installation set.

Treatment	Year	No. of filled quadrats ¹	Stocking (%) ²	Stocking by species (%) ²									
				balsam fir	white birch	tamarack	white spruce	black spruce	total spruce ³	balsam poplar	trembling aspen	pin cherry	white cedar
Natural	2005	not assessed											
	2008	127	79	64	9	0	3	3	13	8	15	0	3
Extensive	2005	128	80	4	33	0	1	2	10	38	44	5	0
	2008	104	65	4	21	0	4	0	11	31	38	3	0
Basic	2005	131	82	4	26	0	19	33	54	18	43	3	0
	2008	121	76	4	36	0	13	14	64	1	4	1	0
Intensive	2005	130	81	9	36	0	35	28	64	19	29	1	0
	2008	139	87	10	36	0	34	29	74	6	6	0	0
Elite	2005	140	88	4	24	1	19	43	64	15	41	3	0
	2008	134	84	4	33	3	11	21	76	2	4	0	0

¹ # of filled quadrats refers to the number of 2 m x 2 m plots (of 160) that contain a tree (regardless of how many)

² stocking refers to the percent of assessed 2 m x 2 m plots containing a tree

³ total spruce includes black and white spruce

Table 4. Density of trees <2.5 cm DBH in 2005 and 2008 by treatment on the Kapuskasing installation set.

Treatment	Year	Total density (stems ha ⁻¹)	Density by species (stems ha ⁻¹)									
			balsam fir	white birch	tamarack	white spruce	black spruce	total spruce*	balsam poplar	trembling aspen	pin cherry	white cedar
Natural	2005	not assessed										
	2008	12188	9609	1141	0	78	78	391	281	625	0	141
Extensive	2005	14484	172	3156	0	31	47	328	4156	6203	469	0
	2008	7391	188	1094	0	94	0	359	2578	3031	141	0
Basic	2005	14609	125	1938	0	531	953	2031	1453	8938	125	0
	2008	7281	125	4359	0	516	406	2641	16	125	16	0
Intensive	2005	9547	313	2344	0	1219	1016	2641	1984	2250	16	0
	2008	6578	453	2234	0	1125	938	3469	234	188	0	0
Elite	2005	9594	156	1484	16	578	1406	2563	813	4438	125	0
	2008	5547	125	2141	141	375	641	2984	47	109	0	0

* total spruce includes black and white spruce

Number of species encountered by life form

Regardless of treatment intensity, species diversity remained relatively similar among the treatments. Compared with the natural treatment, the number of tree, shrub, and herb species remained stable, while numbers for ferns and fern allies, mosses, and lichens decreased, and grasses and sedges increased (Table 5). Tree and shrub data was collected in 2008, data for all other groups is from 2005.

Table 5. Total number of species by life form for each treatment and all treatments combined.

Species group	Treatment					Total on site
	Natural	Extensive	Basic	Intensive	Elite	
Trees	8	9	9	7	7	10
Shrubs	26	23	20	23	19	28
Herbs (non-woody plants)	25	30	27	29	30	54
Grasses	2	5	7	5	4	9
Sedges	1	4	7	4	6	8
Ferns and fern allies (pteridophytes)	11	5	5	7	4	13
Mosses and liverworts (bryophytes)	23	11	9	21	21	29
Lichens	11	10	4	9	4	11
Total number	107	97	88	105	95	162

Most abundant species by treatment

- Abundance of a species was assessed using foliar cover
 - Percent cover (%C) represents the average cover of a species across all plots in a treatment
 - Percent occurrence (%O) indicates the percentage of plots in which a species was found
- The ten most abundant species in each treatment are listed in Table 6.

Table 6. Most abundant species by treatment (Woody species data were collected in 2008, all others in 2005; %C = percent cover, %O = percent occurrence).

Natural			Extensive			Basic			Intensive			Elite		
species	%C	%O	species	%C	%O	species	%C	%O	species	%C	%O	species	%C	%O
balsam fir	18	73	red raspberry	31	97	blue-joint grass	22	100	red raspberry	15	98	red raspberry	15	97
speckled alder	9	34	blue-joint grass	24	98	large leaved aster	21	100	large leaved aster	9	100	large leaved aster	8	100
mountain maple	8	31	large leaved aster	23	100	red raspberry	14	93	fireweed	8	98	dwarf raspberry	6	65
red raspberry	8	50	bush honeysuckle	11	74	dwarf raspberry	7	84	dwarf raspberry	6	83	fireweed	5	100
woody mniun moss	6	100	dwarf raspberry	10	91	bear sedge	3	100	blue-joint grass	4	98	unknown spruce	3	54
large leaved aster	5	100	beaked hazel	8	42	unknown spruce	2	46	balsam fir	4	19	blue-joint grass	2	100
bush honeysuckle	5	29	balsam poplar	7	36	long-stalked sedge	2	75	bear sedge	2	100	bear sedge	2	100
bristly club-moss	5	100	trembling aspen	7	43	sweet-scented bedstraw	2	100	black spruce	2	75	sweet-scented bedstraw	2	100
wild sarsaparilla	4	100	speckled alder	5	21	skunk currant	1	34	white spruce	2	34	Shreber's moss	2	100
dwarf raspberry	4	83	prickly rose	4	41	Shreber's moss	1	100	skunk currant	1	33	rough bedstraw	1	95

Active Research Partners

- Ontario Ministry of Natural Resources
- University of Guelph
- Tembec Industries Inc.

Additional Sponsors

- Living Legacy Trust
- Forestry Futures Trust
- Natural Sciences and Engineering Research Council of Canada (NSERC)

For more information, contact:

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NOTES:

