

# Intensive Forest Management Science Partnership: NEBIE Plot Network

## Sioux Lookout Installation Set

The Sioux Lookout installation set is one of eight study sites of the *Intensive Forest Management Science Partnership: NEBIE Plot Network* research project. Established in 2001, this site provides research partners (see partner list – pg.6) with the opportunity to understand how various silviculture intensities affect fibre production, biodiversity, soil properties, and coarse wood components of a jack pine forest type on dry, fine to coarse-textured mineral 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 Nipigon ecoregion, Savanne ecodistrict (3W-2)
- Climate: Daily average January temperature: -18.6°C; daily average July temperature: 18.6°C; average rainfall: 517.2 mm; average snowfall: 204.0 cm; days with minimum temperature above 0°C: 167.8<sup>1</sup>
- Pre-harvest stand: Dominated by jack pine (Pj) and black spruce (Sb) (Table 1)
- Pre-harvest growth and yield data: Average basal area of 32.5 m<sup>2</sup> ha<sup>-1</sup> and average volume of 225 m<sup>3</sup> ha<sup>-1</sup> (Table 1)
- Northwestern Ontario forest ecosystem classification<sup>2</sup>:
  - Vegetation type: V32 – jack pine – black spruce – ericaceous shrub – feathermoss
  - Soil type: Predominately S1

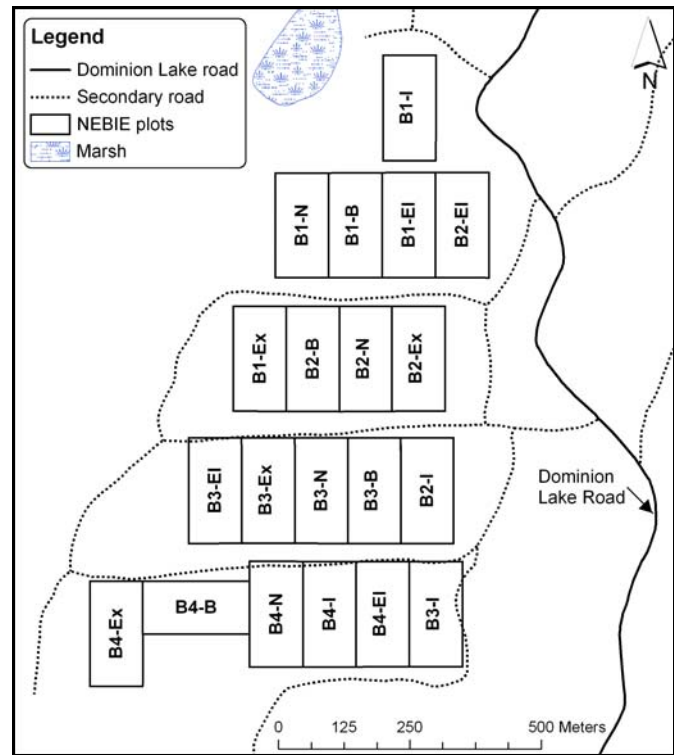


Figure 1. Layout of the blocks (B1-B4) and treatment plots at the Sioux Lookout installation set (50°00'N, 91°28'W).

Table 1. Pre-harvest site description attributes for the Sioux Lookout installation set of the NEBIE plot network. (Percents indicate the portion of the block that is the specified stand, example Block 1 is 80% Pj10)

	Species composition <sup>a</sup>	Site class <sup>a</sup>	Stocking <sup>a</sup>	Age <sup>a</sup> (years in 2002)	Soil texture	Gross total volume <sup>b</sup> (m <sup>3</sup> ha <sup>-1</sup> )
<b>Block 1</b>	Pj10 (80%)	2	1.3	90	coarse sand	227
	Pj7Sb3 (20%)	2	1.0	85		
<b>Block 2</b>	Pj10 (75%)	2	1.3	90	coarse sand	216
	Pj7Sb3 (25%)	2	1.0	85		
<b>Block 3</b>	Pj10 (35%)	2	1.3	90	coarse sand	224
	Pj7Sb3 (65%)	2	1.0	85		
<b>Block 4</b>	Pj10 (95%)	2	1.3	90	coarse sand	232
	Pj7Sb3 (5%)	2	1.0	85		

<sup>a</sup> Forest resource inventory, 1997 update; <sup>b</sup> Pre-harvest growth and yield (20 plots/block)

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

<sup>2</sup> Sims, R.A., W.D. Towill, K.A. Baldwin, P. Uhlig and G. M. Wickware. 1997. Field guide to the forest ecosystem classification for northwestern Ontario. Ont. Min. Nat. Resour., Northwest Sci. Technol. Thunder Bay, ON. Field guide FG-03. 176 pp.

## NEBIE treatments

Silvicultural work at the Sioux Lookout installation set began in 2002 with the development of roads and subsequent harvest. 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 Sioux Lookout installation set of the NEBIE plot network by treatment.

	<i>Extensive</i>	<i>Basic</i>	<i>Intensive</i>	<i>Elite</i>
<b>Objectives</b>	jack pine stocking >40%, free of major insect pests	jack pine stocking >60%, free of interspecific competition and major insect pests	jack pine stocking >80%, free of intra- and interspecific competition and major insect pests	jack pine stocking >80%, free of nutrient deficiencies, intra- and interspecific competition and major insect pests
<b>Harvest</b>	Summer 2002: clear-cut - full tree logging to roadside, no residual trees left on the harvested treatments			
<b>Site preparation</b>	none	May 2004: 2 string skidder configuration spaced at 7'. Each string started with a shark-finned barrel followed by a 13' spiked anchor chain and 4' length of backhoe pads, 2' wide.		
<b>Aerial seeding</b>	none	April 3, 2005: aerial seeding of jack pine at 50,000 seeds ha <sup>-1</sup> onto a 80 cm+ snow layer		
<b>In-fill tree plant</b>	none	none	May 2007: in-filled 9000 jack pine seedlings with an average of 550 trees ha <sup>-1</sup>	
<b>Vegetation management</b>	none	none	none	none
<b>Future options</b>	none	none	pre-commercial and commercial thinning	pre-commercial and commercial thinning, fertilizer application

### Natural



### Extensive



### Basic



### Intensive



### Elite



## Sample plots and data collection

- **Growth and yield** information was collected in 2002 and 2007 to represent the pre-harvest 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  $\geq 2.5$  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 quadrats were assessed in 2002, 2004, and 2007.
- **Diversity of herbaceous, grass, sedge, fern and fern ally, lichen and bryophyte species** has been assessed in 2002, 2005, and 2007 (FEC plots in Figure 2).
- **Coarse woody material** was measured in 2004 and 2009 to assess abundance and the distribution of carbon.
- **Fine woody material, organic matter, and mineral soil** samples were collected in 2002 (natural, intensive, and elite treatments), 2004 (intensive and elite treatments) and 2007 (natural, extensive, and intensive treatments) to assess the distribution of carbon, nitrogen, and base cation contents of these materials.
- 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.

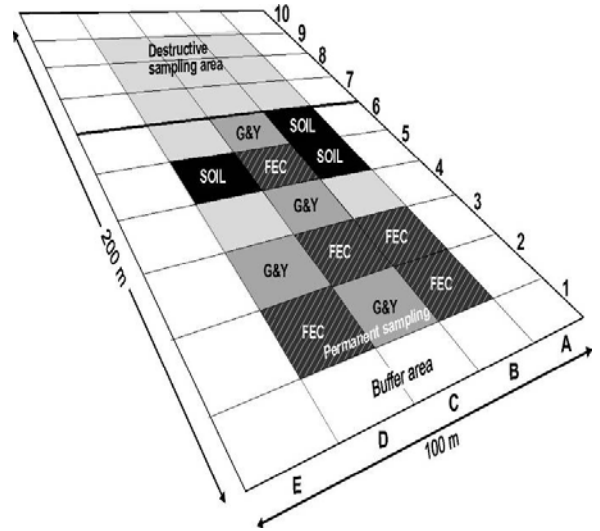


Figure 2. Standard two hectare experimental plot showing alpha-numeric grid and an example of a random layout of sample plots.

## Current site conditions

### Growth and yield volume and density by diameter class

Fifth year re-measurement of the natural treatment growth and yield plots (trees  $\geq 2.5$  cm DBH) was completed in 2007. In the small diameter classes, stems were almost exclusively black spruce (Figure 3). The middle diameter classes included both jack pine and black spruce (60:40). The other treatment plots (Ex, B, I, EI) did not yet contain any trees  $\geq 2.5$  cm DBH. Note the 2 cm diameter class ranges from 2.5 to 3.0 while all other diameter classes represent a full 2 cm interval.

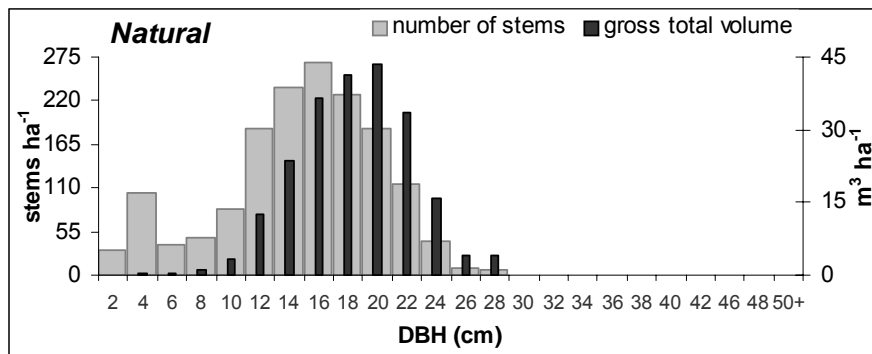


Figure 3. Number of stems and gross total volume by diameter class for the natural plots – 2007 data.

## Stocking

Stocking provides a measure of regeneration success. In all treatments, 5<sup>th</sup> year stocking meets the silvicultural objectives (Figure 4; Table 3). When all stems were included, densities in the treatment plots ranged from 4328 jack pine per hectare in the extensive treatment to 6688 jack pine per hectare in the intensive treatment with smaller components of black spruce and pin cherry (Figure 5; Table 4). Regeneration <2.5 cm DBH in the natural plots was almost entirely black spruce. In all treatments, stocking increased substantially from 2004 to 2007 due to seeding in 2005 and subsequent refill plant in 2007.

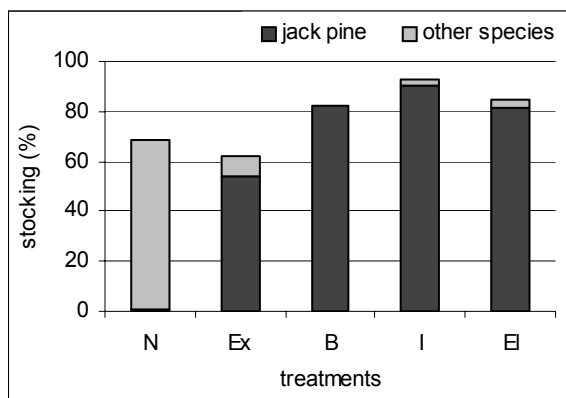


Figure 4. Percent of 2 m x 2 m quadrats stocked with stems <2.5 cm DBH in 2007 by treatment.

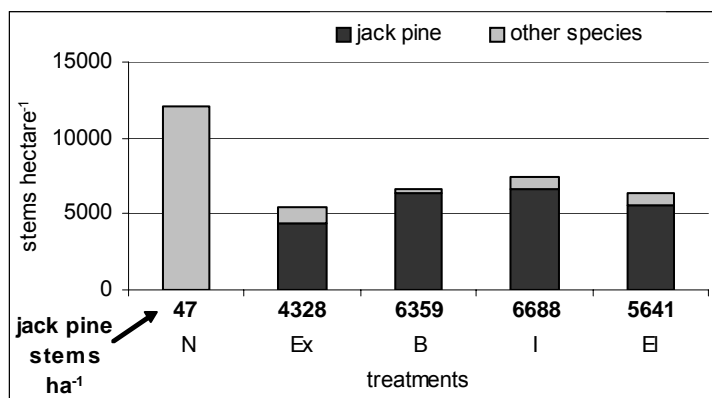


Figure 5. Total stems <2.5 cm DBH per hectare in 2007 by treatment.

Table 3. Stocking of trees <2.5 cm DBH by treatment in 2004 and 2007 on the Sioux Lookout installation set.

Treatment	Year	No. of filled quadrats <sup>1</sup>	Stocking (%) <sup>2</sup>	Stocking by species (%) <sup>2</sup>						
				balsam fir	white birch	tamarack	jack pine	black spruce	trembling aspen	pin cherry
<b>Natural</b>	2004	not assessed								
	2007	110	69	1	0	0	1	68	0	0
<b>Extensive</b>	2004	69	43	0	0	1	37	9	0	5
	2007	99	62	0	1	1	54	16	0	8
<b>Basic</b>	2004	45	28	0	1	0	24	2	0	3
	2007	132	83	0	1	0	82	4	1	4
<b>Intensive</b>	2004	35	22	0	0	0	14	7	0	4
	2007	149	93	0	0	1	90	9	0	8
<b>Elite</b>	2004	36	23	0	0	0	14	7	0	3
	2007	135	84	0	0	0	81	6	0	9

<sup>1</sup> # of filled quadrates refers to the number of 2 m x 2 m plots (of 160) that contain a tree (regardless of how many)

<sup>2</sup> stocking refers to the percent of assessed 2 m x 2 m plots containing a tree

Table 4. Density of trees <2.5 cm DBH in 2004 and 2007 by treatment on the Sioux Lookout installation set.

Treatment	Year	Total density (stems ha <sup>-1</sup> )	Density by species (stems ha <sup>-1</sup> )						
			balsam fir	white birch	tamarack	jack pine	black spruce	trembling aspen	pin cherry
<b>Natural</b>	2004	not assessed							
	2007	12125	125	0	0	47	11953	0	0
<b>Extensive</b>	2004	3938	0	0	16	3000	719	0	203
	2007	5500	0	31	16	4328	844	0	281
<b>Basic</b>	2004	1172	0	31	0	1000	47	0	94
	2007	6641	0	16	0	6359	109	31	125
<b>Intensive</b>	2004	1172	0	0	0	688	391	0	94
	2007	7406	0	0	16	6688	391	0	313
<b>Elite</b>	2004	1297	0	0	0	797	422	0	78
	2007	6438	0	0	0	5641	484	0	313

## Number of species encountered by life form

Regardless of treatment intensity, 5 years post-harvest, species diversity of trees, shrubs, herbs, and ferns remains similar (Table 5).

Table 5. Total number of species by life form for each treatment and all treatments combined – 2007 data.

<i>Species group</i>	<i>Treatments</i>					<i>Total on site</i>
	<i>Natural</i>	<i>Extensive</i>	<i>Basic</i>	<i>Intensive</i>	<i>Elite</i>	
Trees	3	5	5	4	3	7
Shrubs	12	14	11	11	14	19
Herbs (non-woody plants)	13	12	10	9	10	18
Grasses	0	3	1	1	2	3
Sedges	0	5	3	3	3	5
Ferns and fern allies (pteridophytes)	1	1	1	1	0	3
Mosses and liverworts (bryophytes)	21	15	11	10	13	28
Lichens	19	2	1	2	2	20
<b>Total number</b>	<b>69</b>	<b>57</b>	<b>53</b>	<b>41</b>	<b>47</b>	<b>103</b>

## 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 10 most abundant species in each treatment are listed in Table 6.

Table 6. Most abundant species by treatment. (Data collected in 2007; %C = percent cover, %O = percent occurrence).

<i>Natural</i>			<i>Extensive</i>			<i>Basic</i>			<i>Intensive</i>			<i>Elite</i>		
species	%C	%O	species	%C	%O	species	%C	%O	species	%C	%O	species	%C	%O
Shreber's moss	86	100	velvet-leaf blueberry	19	94	velvet-leaf blueberry	14	93	velvet-leaf blueberry	16	96	velvet-leaf blueberry	16	92
black spruce	18	78	low sweet blueberry	13	86	low sweet blueberry	9	79	low sweet blueberry	10	78	low sweet blueberry	12	88
velvet-leaf blueberry	12	96	bristly sarsaparilla	6	100	bristly sarsaparilla	7	100	bristly sarsaparilla	9	100	bristly sarsaparilla	8	100
wild lily-of-the-valley	7	100	bunchberry	5	95	bunchberry	7	100	bunchberry	5	98	bunchberry	6	100
bunchberry	6	100	jack pine	5	60	jack pine	4	85	jack pine	4	93	jack pine	3	83
creeping snowberry	5	61	wild lily-of-the-valley	3	98	green alder	2	10	wild lily-of-the-valley	4	90	green alder	3	16
green alder	3	10	green alder	1	15	bush honeysuckle	1	10	bush honeysuckle	2	13	unknown sedge	2	98
low sweet blueberry	3	59	black spruce	1	18	wild lily-of-the-valley	1	90	wild sarsaparilla	1	63	wild lily-of-the-valley	2	95
feather moss	2	73	common bearberry	1	4	wild sarsaparilla	1	53	unknown sedge	1	98	bush honeysuckle	1	17
wavy-leaved moss	1	100	bush honeysuckle	1	6	unknown sedge	1	70	fringed black bindweed	1	45	black spruce	1	9

