

Intensive Forest Management Science Partnership: NEBIE Plot Network

Dryden Installation Set

The Dryden 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 black spruce – trembling aspen mixedwood forest type on shallow, variable coarse loamy to clayey soils.

The NEBIE framework (i.e., N-natural disturbance and Ex-extensive, B-basic, I-intensive, and EI-elite silviculture) has been applied on 3 blocks of five 2 ha treatment plots and 1 block of five 1.2 ha treatment plots (see Figure 1).

Site description

- Location: Lake Wabigoon ecoregion, Manitou ecodistrict (4S-5)
- Climate: Daily average January temperature: - 17.5°C; daily average July temperature: 18.8°C; average rainfall: 535.6 mm; average snowfall: 169.9 cm; days with minimum temperature above 0°C: 172.3¹
- Pre-harvest stand: Dominated by black spruce (Sb) and trembling aspen (Po), with a smaller component of white birch (Bw), balsam fir (Bf), jack pine (Pj), cedar (Ce), white pine (Pw), larch (L), and white spruce (Sw). Selecting suitable locations for the treatment plots proved difficult due to terrain, which created varying stand conditions, and the presence of osprey nests, which required adjustments to proposed harvest operations.
- Pre-harvest growth and yield: average basal area of 12 m² ha⁻¹ and average volume of 100.2 m³ ha⁻¹ (see Table 1 for details)
- Northwestern Ontario forest ecosystem classification²:
 - Vegetation types: V33 – Black spruce/feathermoss; V8 – Trembling aspen (white birch)/mountain maple; V6 – Trembling aspen (white birch) – balsam fir/mountain maple; V36 – Black spruce/bunchberry/sphagnum (feathermoss)

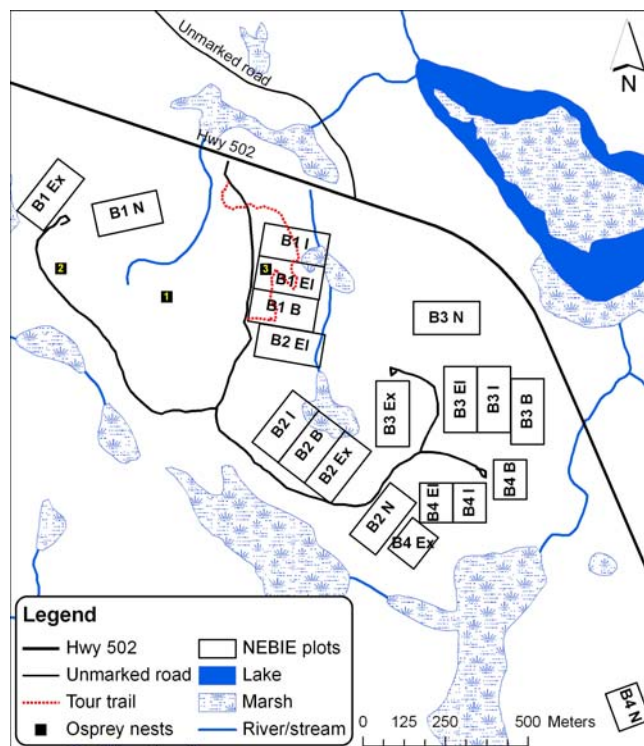


Figure 1. Layout of the blocks (B1-B4) and treatment plots at the Dryden installation set (49°38'N, 92°46'W).

Table 1. Site description attributes for the Dryden installation set of the NEBIE plot network.

(Percents indicate the portion of the block that is the specified type, example Block 1 is 34% Sb6Po2Bf1Bw1)

	Species composition ^a	Site class ^a	Stocking ^b	Age ^b (years in 2001)	Soil texture ^c	Gross total volume ^d (m ³ ha ⁻¹)
Block 1	Sb6Po2Bf1Bw1 (34%) Sb4Po3Bw2Bf1 (28%)	1 (54%) 2 (46%)	0.6	90	silty clay	69
Block 2	Sb5Po2Bw2Pj1 (40%) Sb8Po1L1 (31%)	1 (63%) 2 (37%)	0.5	92	sandy/silty clay	94
Block 3	Po5Sb3Bw2 (52%) Sb5Po2Bw2Pj1 (24%)	2 (54%) 1 (46%)	0.6	76	loamy medium sand/rock	124
Block 4	Po5Sb3Bw2 (54%) Sb5Po3Pj1Bf1 (46%)	2 (69%) 1 (31%)	0.6	66	loamy coarse sand/rock	113

^a Forest Resource Inventory (FRI), 2001 interpretation; ^b Averages from the FRI; ^c Pre-harvest soil pits (n=10); ^d Pre-harvest growth and yield (n=20 plots/Block 1, 20 plots/Block 2, 16 plots/Block 3 and 4 plots/Block 4)

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

² 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.

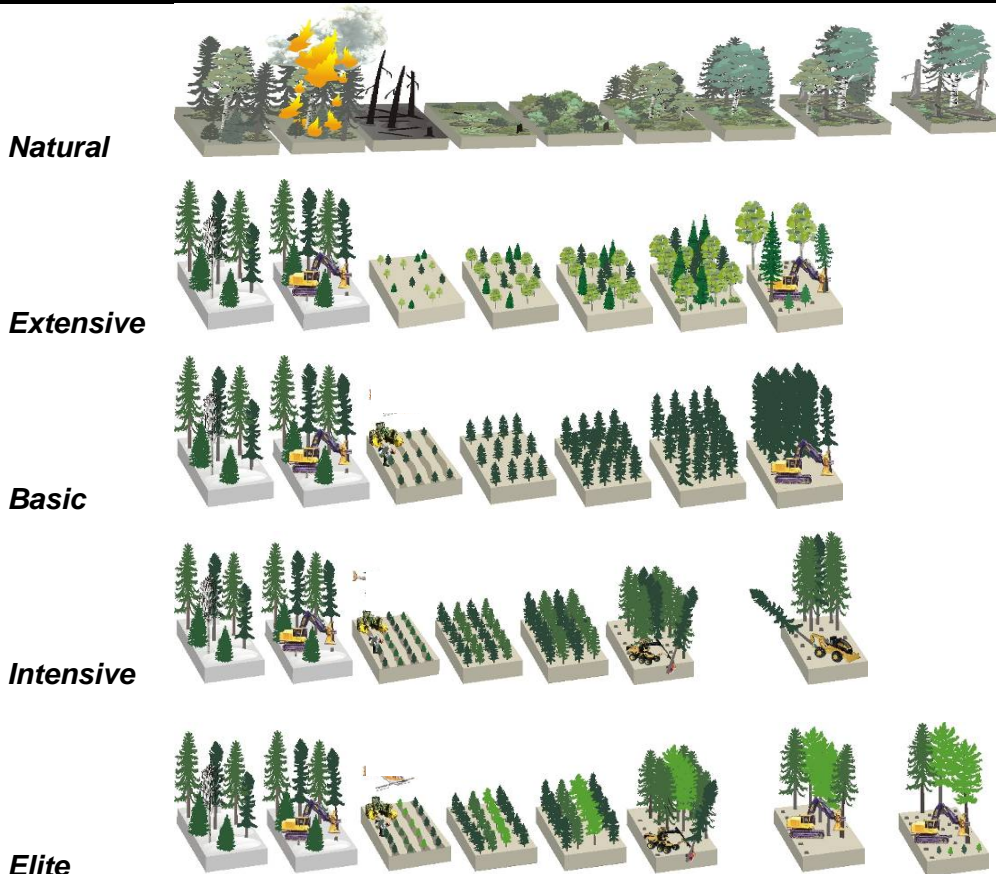
NEBIE treatments

Silvicultural work at the Dryden installation set began in 2005 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 Dryden 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 Sb, Bf, Po, Bw, Pw	>60% stocking of Sb, free of interspecific competition and major insect pests	>80% stocking of Sb and Sw, free of intra- and interspecific competition and major insect pests	>80% stocking of Sb, Sw and Pw, free of nutrient deficiencies, intra- and interspecific competition and major insect pests
Harvest	March 2005: clear cut using full tree logging to roadside. Two white spruce ha ⁻¹ (6 in extensive), all standing snags and white and red pine left according to management plan			
Site preparation	none	Oct. 2005: disk trenching at 3 m spacing	Oct. 2005: disk trenching at 2.5 m spacing	
Tree plant	none	May 2006: 1200 Sb ha ⁻¹	May 2006: 1250 Sb ha ⁻¹ and 1250 Sw ha ⁻¹ planted as 2 rows of Sb followed by 2 rows of Sw	May 2006: 1000 Sb/ha, 1000 Sw ha ⁻¹ and 500 fertilizer enhanced Pw ha ⁻¹ as 2 rows of Sb, 1 row of Sw, 1 row of Pw, and 1 row of Sw
Vegetation management	none	Aug. 2007: Broad cast ground spray of glyphosate to control broad leaved trees and shrubs		
Future options	none	none	vegetation management, commercial thinning	vegetation management, motor manual tending, commercial thinning, fertilizer application

Bf = balsam fir, Bw = white birch, Po = poplar, Pw = white pine, Sb = black spruce, Sw = white spruce



Sample plots and data collection

- **Growth and yield** information was collected in 2002, 2006 and 2009 to represent the pre-harvest and year 2 and 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 quadrats were assessed in 2002, 2006, and 2009.
- **Diversity of herbaceous, grass, sedge, fern and fern ally, lichen, and bryophyte species** has been assessed in 2002, 2007, and 2009 (FEC plots in Figure 2).
- **Coarse woody material** was measured in 2003 and 2006 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 and 2006 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, photographs from specific points, height:diameter ratios for each tree species, and weather parameters.

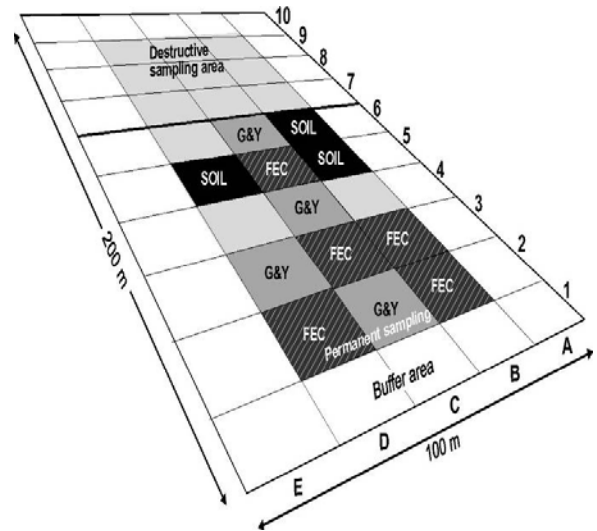


Figure 2. Standard two hectare experimental plot showing alpha-numeric grid and an example of a random layout of sample plots.

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 2009. The extensive treatment had a larger number of stems in the smaller diameter classes (mainly trembling aspen and white birch) 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 with a smaller amount of white birch. Note the 2 cm diameter class ranges from 2.5 to 3.0 while all other diameter classes represent a full 2 cm interval.

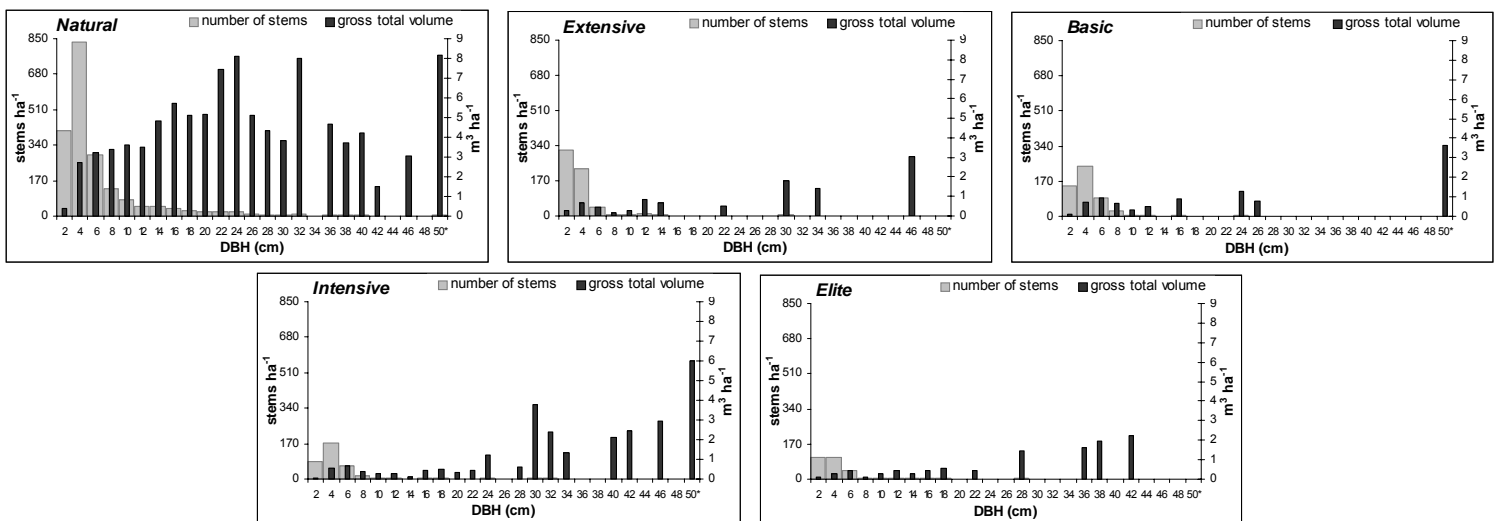


Figure 3. Number of stems and gross total volume by diameter class – 2009 data by treatment.

Stocking

Stocking provides a measure of regeneration success. Fifth year stocking of spruce or white pine is not yet meeting the objective at 46% in the basic treatment, 56% in the intensive treatment, and 63% in the elite treatment in 2009 (Figure 4; Table 3). In all treatments, stocking remained constant from 2006 to 2009. When all Sb, Sw, and Pw stems <2.5 cm DBH were included, densities per hectare ranged from 469 in the extensive to 3109 in the elite treatments (Figure 5; Table 4).

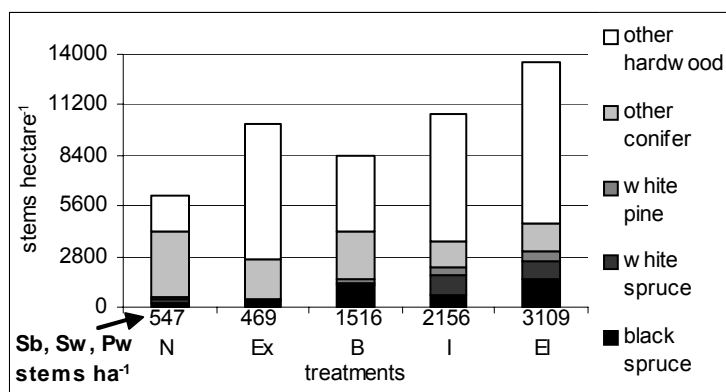
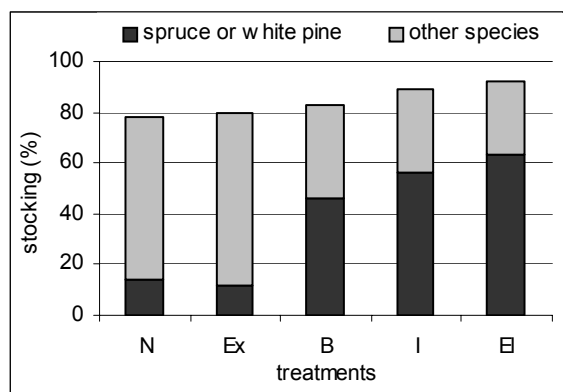


Figure 4. Percent of 2 m x 2 m quadrats stocked with stems <2.5 cm DBH in 2009 by treatment.

Figure 5. Total stems <2.5 cm per hectare in 2009 by treatment.

Table 3. Stocking of trees <2.5 cm DBH by treatment in 2006 and 2009 on the Dryden installation set.

Treatment	Year	No. of filled quadrats ¹	Stocking (%) ²	Stocking by species (%) ²												
				balsam fir	red maple	white birch	jack pine	white spruce	black spruce	total spruce ³	red pine	white pine	balsam poplar	trembling aspen	pin cherry	
Natural	2006	121	76	60	1	19	0	5	3	11	0	3	0	26	1	
	2009	125	78	60	2	18	0	6	5	12	0	3	0	23	3	
Extensive	2006	128	80	36	3	37	0	1	0	5	0	3	0	43	7	
	2009	128	80	35	5	33	0	3	6	11	1	1	0	45	11	
Basic	2006	146	91	43	1	37	0	3	1	43	0	3	1	58	8	
	2009	133	83	43	8	28	0	5	36	41	1	7	1	22	4	
Intensive	2006	150	94	31	5	33	0	0	3	58	0	4	0	58	16	
	2009	143	89	27	11	44	1	34	22	53	1	11	0	33	21	
Elite	2006	142	89	34	13	41	0	3	1	53	0	16	4	30	18	
	2009	147	92	31	23	48	0	31	26	55	2	18	6	27	20	

¹ # of filled quadrates 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 by treatment in 2006 and 2009 on the Dryden installation set.

Treatment	Year	total density (stems ha ⁻¹)	Density by species (stems ha ⁻¹)												
			balsam fir	red maple	white birch	jack pine	white spruce	black spruce	total spruce*	red pine	white pine	balsam poplar	trembling aspen	pin cherry	
Natural	2006	6297	3719	31	922	0	156	94	375	0	63	0	1156	31	
	2009	6141	3688	47	969	0	156	188	469	0	78	0	828	63	
Extensive	2006	14984	2313	63	2453	0	31	0	156	0	63	0	9641	297	
	2009	10125	2125	250	1500	0	63	266	453	16	16	0	5219	547	
Basic	2006	15719	2844	47	2422	0	78	31	1359	0	63	47	8594	344	
	2009	8359	2641	266	2547	0	141	1016	1344	16	172	31	1203	141	
Intensive	2006	16047	1688	172	2094	0	0	203	1859	0	109	0	8375	1750	
	2009	10656	1422	578	3734	31	1031	625	1781	16	375	0	1453	1266	
Elite	2006	16016	1516	859	3047	0	125	234	2031	0	500	344	5594	2125	
	2009	13578	1453	1172	5344	0	938	1297	2578	47	531	375	1094	984	

*total spruce includes black and white spruce

Number of species encountered by life form

Regardless of treatment intensity, species diversity remains similar (Table 5). Tree and shrub data was collected in 2009, data for all other groups is from 2007.

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	9	9	10	11	10	12
Shrubs	22	23	24	24	25	32
Herbs (non-woody plants)	30	41	39	36	41	57
Grasses	5	10	10	9	10	12
Sedges	6	13	12	8	9	19
Ferns and fern allies (pteridophytes)	13	13	13	9	12	15
Mosses and liverworts (bryophytes)	64	50	47	49	45	79
Lichens	23	18	18	23	20	36
Total number	172	177	173	169	172	262

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 2009, others in 2007; %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
mountain maple	49	89	wild red raspberry	20	89	wild red raspberry	26	94	wild red raspberry	20	94	wild red raspberry	23	97
balsam fir	27	81	beaked hazel	20	56	balsam fir	15	55	balsam fir	9	46	balsam fir	9	51
beaked hazel	16	58	mountain maple	17	61	mountain maple	11	64	large-leaved aster	7	60	large-leaved aster	7	68
Schreber's moss	13	85	trembling aspen	13	51	large-leaved aster	10	70	fringed black knotweed	7	80	beaked hazel	7	43
bush honeysuckle	10	56	bush honeysuckle	11	60	fringed black knotweed	6	73	mountain maple	6	53	wild sarsaparilla	6	88
white birch	7	33	balsam fir	11	48	beaked hazel	4	39	fireweed	5	65	white birch	6	57
wild sarsaparilla	5	88	white birch	7	46	dwarf raspberry	4	73	bush honeysuckle	5	51	mountain maple	5	40
<i>Sphagnum girgensohnii</i>	5	40	dwarf raspberry	5	93	wood horsetail	4	40	white birch	4	51	fireweed	4	58
trembling aspen	3	31	wood horsetail	5	50	white birch	4	38	dwarf raspberry	3	80	dwarf raspberry	4	68
wood horsetail	3	23	large-leaved aster	4	55	wild sarsaparilla	4	73	wild sarsaparilla	3	90	fringed black knotweed	3	73

Active Research Partners

- Ontario Ministry of Natural Resources
- University of Guelph
- Domtar Inc.
- Forest Ecosystem Science Co-op

Additional Sponsors

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

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NOTES:

