Family Forest Network

Restoration Silviculture Project

Progress Report #S1
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Introduction

In March 2022, the Nova Scotia Department of Natural Resources and Renewables (Department) and the Family Forest Network (FFN) signed a 5-year agreement to explore ways to increase the benefits of restoration-oriented silviculture on small private woodlands that extend beyond current technical standards.

In keeping with Department management objectives for ecological matrix forest land in Nova Scotia, the main objectives of the FFN restoration silviculture project are:

- To apply alternative or modified silviculture practices that promote development of multi-aged and multi-species stands dominated by long-lived, shade-intermediate and shade-tolerant (LIT) species.
- To target sites that do not qualify for current (traditional) silviculture funding, but which require intervention to restore or speed up the transition to desired stand conditions.
- To integrate biodiversity assessment and management objectives into applied silviculture treatments.
- To integrate climate change adaptation objectives into applied silviculture treatments.
- To develop measurable criteria to evaluate treatment success.
- To document treatment methods, outcomes, costs, and benefits to produce evidence-based management recommendations for small private woodland owners across Nova Scotia.

This progress report outlines accomplishments and challenges from the first year of project work.

Treatments

The initial treatment investigated was a restoration thinning in young stands that were either not treated within current criteria windows (average < 7m height for softwoods and < 9m for hardwoods), or that were inadequately treated in the past. The goal is to reduce overall density in these "too tall" developing stands while favoring crop trees that can provide increased economic value, be more resilient to climate impacts, and increase management options for continued restoration.

Before treatments were conducted, pre-treatment assessments (PTAs) and biodiversity assessments were carried out within candidate sites, with sampling intensity following guidelines set out in the Association for Sustainable Forestry's *Silviculture Assessments Procedures Manual*. Site selection criteria are provided in Appendix 1. The protocol for biodiversity assessments was created by the Mersey Tobeatic Research institute (MTRI), a Family Forest Network partner, who also conducted the assessments.

Set-Backs

Due to the impacts of Tropical Storm Fiona in September 2022, many partner organizations and contractors were tied up with salvage operations. This made it difficult to find resources for, and plan for, silviculture operations. As such, we received fewer submissions of potential treatment sites than expected, and only three sites in central Nova Scotia were treated before winter 2023.

In addition to Fiona related constraints, winter conditions did not always allow for effective assessment of candidate sites. However, new sites are now being nominated and assessed on a regular basis, and we expect several more sites to be treated through the summer and fall of 2023. In addition, we plan to have a list of sites laid out and assessed before the onset of winter to allow for continuous operations where and when feasible.

Results

A summary of restoration thinning sites completed in 2022 is shown in Table 1. A total of 60.5 ha were treated at three locations for a cost of $72,010.13 before taxes.

Table 1.

Location (PID)	Hectares (ha) Treated	Cost per ha ($)	Days to Complete	Total Cost ($) (before tax)	Cost per Day ($)
25091091	28.9	1,190.25	87.0	34,398.23	395.38
20311007	7.2	1,190.25	22.0	8,569.80	389.54
20017067	24.4	1,190.25	73.5	29,042.10	395.13
Totals	**60.5**		**182.5**	**72,010.13**	

The treatments focused on promoting potential survival and growth of LIT species. This was achieved by reducing overall density within treatment areas, creating gaps within the canopy, and leaving LIT species free of competition. Post-treatment conditions also facilitate future operability and partial harvesting options, while enhancing wind firmness of residual trees, thereby promoting climate adaptation as well as biodiversity in these stands. Finally, promoting growth of LIT species and creating opportunities for earlier transition to multi-age, structurally diverse stands should promote increased carbon sequestration and storage as these stands continue to develop. More details of each site treated is provided below, with biodiversity assessment summaries shown in Appendix 2.

Site 1

Family Forest Network
North Nova – Bonnyman PCT
PID: 25091091
Treatment: Restoration Thinning (tall PCT)

Site Description

The Bonnyman site is located in Ecodistrict 340 (Cobequid Hills) and falls within the Tolerant Hardwood Hills Eco-element (Bush and Baldo, 2019). Overall, balsam fir was the dominant species found, with lesser amounts of yellow birch, red maple, and red spruce (main vegetation type: SH8 – Balsam fir / Wood fern / Schreber's moss). The site is mainly underlain by ST2-L soils with ST2, ST8, and ST3-L soils also found. The area was classified as dominantly ecosite AC10+ tending to AC13- in some sections (Neily et al., 2023). Average heights for non-LIT species and LIT species were 7.4m and 7.1m respectively, with an overall average of 7.3m.

Treatment

Treatment took place in November-December 2022 and focused on lowering overall stand density and retaining LIT species trees where possible (mainly yellow birch with some red spruce) (Figs. 1-2). All work was completed using clearing saws. Coarse woody material created from the treatment was left in place to meet biodiversity assessment recommendations (Appendix 2).

Overall stocking was reduced from approximately 17,667 stems/ha to 2,893 stems/ha, with post-treatment LIT species percentage doubling from about 11% to 22% (Table 2). Mean LIT species height (mainly yellow birch) increased from 7.1m to 8.4 m after treatment, while mean diameter at breast height (DBH) increased from 8.9cm to 10.5cm. However, there was more variability in post-treatment data as shown by increased standard deviations (Table 2).

Table 2. Pre- and post-treatment data for the Bonnyman site (sd = standard deviation).

Parameter	Pre-treatment	Post-treatment
Plots (n)	15	30
Total Stem/ha)	17,667	2,893
Non-LIT (stem/ha)	15,667	2,264
LIT (stem/ha)	2,000	629
LIT (%)	11.3	21.7
LIT DBH (cm)	8.9 (sd 1.1)	10.5 (sd 3.2)
LIT Ht. (m)	7.1 (sd 0.8)	8.4 (sd 1.6)

Fig. 1. Post-treatment images at Bonnyman showing thinned balsam fir and yellow birch.

Site 2

Family Forest Network
North Nova – Hempal PCT
PID: 20311007
Treatment: Restoration Thinning (tall PCT)

Site Description

The Hempal site is located in Ecodistrict 530 (Northumberland Lowlands) and falls within the Red Spruce Hummocks Eco-element (Bush and Baldo, 2019). Aspen, balsam fir, black spruce, and red maple were the dominant species found, with lesser amounts white pine, red spruce, and grey birch (main vegetation type: MW10 – Black spruce – Aspen / Bracken / Sarsaparilla). The site is underlain by ST5 and ST6 soils and the area was classified as a mix of ecosite AC6 and AC7 (Neily et al., 2023). Average heights for non-LIT species and LIT species were 10.3m and 7.8m respectively, with an overall average of 9.1m.

Treatment

Treatment took place in November-December 2022 and focused on lowering overall stand density and retaining LIT species trees where possible (mainly white pine and red spruce). Although not classified as a LIT species at this site, red maple was also retained where appropriate for climate adaptation and biodiversity purposes. All work was completed using clearing saws. Coarse woody material created from the treatment was left in place to meet biodiversity assessment recommendations (Appendix 2).

Overall stocking was reduced from approximately 12,333 stems/ha to 2,873 stems/ha (Table 3). Post-treatment LIT species percentage increased from about 7% to 15%. Mean LIT species height increased from 7.8m to 8.9m after treatment, while mean DBH increased from 8.4cm to 12.5cm. The large increase in DBH was due to the increased percentage of white pine after treatment, but diameters were also more variable as shown by increased standard deviation after treatment (Table 3).

Table 3. Pre- and post-treatment data for the Hempal site (sd = standard deviation).

Parameter	Pre-treatment	Post-treatment
Plots (n)	15	11
Total Stem/ha)	12,333	2,873
Non-LIT (stem/ha)	11,467	2,455
LIT (stem/ha)	867	418
LIT (%)	7.0	14.6
LIT DBH (cm)	8.4 (0.9)	12.5 (4.5)
LIT Ht. (m)	7.8 (3.1)	8.9 (2.0)

Fig. 2. A post-treatment image at Hempal showing patchy, thinned conifers.

Site 3

Family Forest Network
North Nova – Risley PCT
PID: 25091091
Treatment: Restoration Thinning (tall PCT)

Site Description

The Risley site is located in Ecodistrict 530 (Northumberland Lowlands) and falls within the Red Spruce Hummocks Eco-element (Bush and Baldo, 2019). Balsam fir and aspen were the dominant species found, with lesser amounts of red maple, red spruce, and grey birch (a mix of MW7: Balsam fir – Red ample / Wood-sorrel – Goldthread and MW2a: Red spruce – Red maple – White birch / Goldthread Aspen variant). The site is underlain by a range of soils (ST2, ST2-L, ST3, ST6), and the area was classified as a mix of ecosite AC6(+) and AC7(+) with inclusions of wet AC8 (Neily et al., 2023). Average heights for non-LIT species and LIT species were 8.3m and 6.5m respectively, with an overall average of 7.5m.

Treatment

Treatment took place in November-December 2022 and focused on lowering overall stand density and retaining LIT species trees where possible (mainly red spruce). All work was completed using clearing saws. Coarse woody material created from the treatment was left in place to meet biodiversity assessment recommendations (Appendix 2).

Overall stocking was reduced from approximately 10,000 stems/ha to 3,547 stems/ha (Table 4). Post-treatment LIT species percentage increased from about 17% to 25%. Mean LIT species height was essentially unchanged at 6.5-7.0m, while mean DBH decreased from 11.0 cm to 8.4 cm. It is unclear why mean DBH decreased while height remained the same, although this could be related in part to increased variation (standard deviation) associated with post-treatment DBH data (Table 4).

Table 4. Pre- and post-treatment data for the Risley site (sd = standard deviation).

Parameter	Pre-treatment	Post-treatment
Plots (n)	19	15
Total Stem/ha)	10,000	3,547
Non-LIT (stem/ha)	8,263	2,667
LIT (stem/ha)	1,737	880
LIT (%)	17.4	24.8
LIT DBH (cm)	11.0 (1.3)	8.4 (1.8)
LIT Ht. (m)	6.5 (0.6)	7.0 (1.5)

Fig. 3. Post-treatment images at Risley showing thinned areas and wet inclusions.

Discussion

Overall, initial results from the three restoration thinning operations were mixed. A summary of positive aspects and areas for improvement are listed below.

Bonnyman Site

Positive Aspects:

- The quality of thinning was good, stumps were low, and all cuts were below live limbs.
- The percentage of LIT species was increased across the site.
- Sugar maple seedlings present on site were not damaged by the thinning operation.
- Overall spacing was good, stocking hit target levels, albeit on the high end.

Areas for Improvement:

- More effort could have been spent getting better release of yellow birch.
- Some strips had cut trees hung up in crop trees and suppressed stems that could have been removed – this requires more follow up with workers.

- Where diameters were larger than normal, spacing saws were not efficient or effective. More developed patches should be treated with a chainsaw and directional felling.
- While not common, there were a few instances where yellow birch and/or maples were cut, and a balsam fir left as a crop tree – this requires more follow up with workers to ensure they understand treatment objectives.

Hempal Site

Positive Aspects:

- Overall spacing was good, stocking hit target levels albeit on the high end.
- The percentage of LIT species was increased across the site.
- Crop tree selection was very good, favoured spruce and maple where possible.
- Layout done well, excluded wet areas and pockets of mature timber.

Areas for Improvement:

- Too many suppressed fir, spruce, and grey birch were retained that are unlikely to become merchantable.
- Some strips were done very well, others had too high stocking – this requires more follow up with workers to ensure they understand treatment objectives.

Risley Site

Positive Aspects:

- The percentage of LIT species was increased across the site.
- In portions of the stand where softwoods were dominant, spacing was reasonably well done and stocking is at good levels.
- Good selection of crop trees, it did not appear that any dominant LIT species were cut.
- No missed areas, full site was treated.

Areas for Improvement:

- Too many suppressed fir and grey birch retained that are unlikely to become merchantable.
- Where diameters were larger than normal, spacing saws were not efficient or effective. More developed patches should be treated with a chainsaw and directional felling.
- Some portions of the site are dominated by trembling aspen with no LIT species and could have been excluded (at least in part) from the treatment area, thereby reducing costs.

Treatment Costs

Costs for the treatment ($1,190.25/ha) were higher than the current maximum PCT rate of $1,050/ha. This reflects, in part, challenges associated with larger average piece size and variable densities. It is assumed that per hectare costs can be reduced somewhat with more experience, matching of equipment with conditions (i.e., a mix of spacing saw and chainsaw), and by not treating patches that will not benefit from thinning. There may also be a mechanical option for this type of treatment whereby a small excavator with a shearing head can be used to thin multi-sized stems (Fig. 4). This option will also be explored with future treatments.

Fig. 4. A small, tracked excavator with shearing head suitable for tall PCT work.

Literature

Bush, P. and C. Baldo. 2019. Ecological landscape analysis Cobequid Hills Ecodistrict 340: 2019 Update for Part 1 and 2. Nova Scotia Department of Lands and Forestry. 340CobequidHillsParts1&2_2019.pdf (novascotia.ca)

Bush, P. and C. Baldo. 2019. Ecological landscape analysis Northumberland Lowlands Ecodistrict 530: 2019 Update for Part 1 and 2. Nova Scotia Department of Lands and Forestry. 530NorthumberlandLowlandsParts1&2_2019.pdf (novascotia.ca)

Neily, P., S. Basquill, E. Quigley, K. Keys, S. Maston, and B. Stewart. 2023. *Forest ecosystem classification for Nova Scotia (2022): Field Guide*. Biodiversity Tech Report 2023-002. Nova Scotia Department of Natural Resources and Renewables.

Appendix 1. Selection Criteria

To be eligible the site must conform to the following criteria prior to treatment:

Stand Density	> 5000 stems/ha
Average Height	Softwood: minimum 7m Hardwood: minimum 9m
Forest Group	SH, SP, TH, IH, OF, MW
Overstory Cover	< 40%
Age	< 40 years
Land Capability	5 m^3/ha/yr or greater (red spruce reference species)
Crop Trees	Softwood: BS, RS, WS, JP, RP, WP, EH, BF Hardwood: RM, SM, WA, WB, YB, RO, LA, TA, BE WE, BS, IW

Post-treatment criteria are as follows:

Stand Density	1200 – 2200 stems/ha
Crop Tree Stocking	Minimum 500 crop trees*/ha
% LIT Species	Must remain the same or increase post-treatment
Live Crown Ratio (LCR)	> 1/3 average for site

*Can include any tree from the crop tree species list. A crop tree may be retained due to it's potential to produce a future sawlog, but also for restoration, resilience, and carbon sequestration purposes. Sites where LIT species stocking is low may classify any healthy LIT tree as a crop tree regardless of form.

NOTE: As these sites are experimental in nature and could have high variability, these criteria represent a framework for the majority. Sites that fall outside both traditional silviculture funding criteria and the criteria listed above will be considered on a case-by-case basis. If the site is approved, FFN staff will develop pre- and post-criteria specific to that site.

Appendix 2. Biodiversity Assessment Result Summaries – Restoration Thinning Project Sites

Bonnyman Site:

FFN Biodiversity Assessment Results
Mersey Tobeatic Research Institute

Date:	12-Oct-22	**Location:**	Westchester Road
Owner:	Bonnyman	**Assessor(s):**	Abby Lewis
Management Plan:	Yes, do not have access	**Co-op:**	NN
Woodlot Maps Provided:	Yes	**MTRI .kmz shared:**	Yes
Treatment Stand:	Treatment stand identified by NN	**Stand Assessed:**	Treatment stand identified by NN
Species at Risk Identified:	None	**Prescription:**	PCT

Observations

Dense bF with some patches of dense yB throughout. Evidence of machine traffic, patchy harvests and silviculture activity. Few large legacy trees (yB) throughout. South of transmission line, stand transitions to sM and yB dominant in patches outside of dense bF stands. Erosion risk elevated on south side of transmission line where machine traffic and runoff are evident. Small wet patches frequent throughout.

Point Features

No specific features of concern located in the PCT treatment area.

Beneficial Management Practices Recommended

The PCT work prescribed should occur outside of May 15-Aug 15 to respect migratory bird nesting season.
Protect coarse woody material for future benefits to soil and improvement of forest habitat value.

Hempal Site:

FFN Biodiversity Assessment Results
Mersey Tobeatic Research Institute

Date:	18-Nov-22	**Location:**	Tatamagouche
Owner:	Hempel	**Assessor(s):**	AL
Management Plan:	Yes, do not have access	**Co-op:**	NN
Woodlot Maps Provided:	Yes		
Treatment Stand:	PCT	**Stand Assessed:**	PCT

Observations

Old harvest/pasture site. Few emergent wP and rM throughout. Wetland throughout/adjacent, may be attractive to birds. Tractor ruts present. Wetland between treatment blocks.

Point Features

Feature	UTM E	UTM N	UTM Z	Notes
No point features of note located.				

Beneficial Management Practices Recommended

The PCT work prescribed should take place outside of May 15-Aug-15 to respect migratory bird nesting season. Protect emergent trees and coarse woody material for future benefits to soil and improvement of forest habitat value.

Risley Site:

FFN Biodiversity Assessment Results
Mersey Tobeatic Research Institute

Date:	11-Oct-22	**Location:**	East Earltown
Owner:	Risley	**Assessor(s):**	Laura Carter, Abby Lewis
Management Plan:	Yes, do not have access	**Co-op:**	NN
Woodlot Maps Provided:	Yes	**MTRI .kmz shared:**	Yes
Treatment Stand:	Treatment stand identified by NN	**Stand Assessed:**	Treatment stand identified by NN
Species at Risk Identified:	None	**Prescription:**	PCT

Observations

Dense stands composed of non-LIT species with the exceptions of the western and eastern extents of the woodlot where mature trees of diverse species dominate. Stand becomes wet and mature to the east, approaching field. This is where features of highest biodiversity value are located (structural diversity, snags and cavity trees, mature and diverse tree species) but are likely outside of planned treatment zone. Overall, structural diversity is low within treatment area. Evidence of machine traffic throughout. Signs of significant beaver activity and a large wetland are located within the lot.

Point Features

Feature	UTM	Notes
Possible permanant retention trees	487254, 5058005	Mature rS and rM
Cavity tree	487233, 5058040	eH
Possible permanant retention tree	487255, 5058189	Mature rM
Wet area	487509, 5058167	

Beneficial Management Practices Recommended

The PCT work prescribed should occur outside of May 15-August 15 to respect migratory bird nesting season.
Protect coarse woody material for future benefits to soil and improvement of forest habitat value.