

Bravakis Property
Forest Management Plan
March 12, 2020

This forest management plan is a blueprint for responsible land stewardship. It is the result of a planning process that incorporated an assessment of the history and current conditions on the property, consideration of the various courses of future development that the forest could follow, and discernment as to which outcomes best suit the landowners' particular objectives.

By signing below, I certify that I approve of—and agree to manage my forestland according to—the following management plan. I further certify that any of my forestland that is enrolled in Vermont's Use Value Appraisal program is under active long-term forest management in accordance with the state's minimum acceptable standards for forest management. These standards include following Acceptable Management Practices to maintain water quality on logging operations.

Landowner

Date

Landowner

Date

Landowner

Date

Landowner

Date

This forest management plan meets the standards promulgated by the Vermont Department of Forests, Parks and Recreation as required for eligibility in the Use Value Appraisal Program.

County Forester

Date

Effective date of plan
April 1, 2020

Property

81 acres and dwelling
Worcester, VT
SPAN 788-251-10063
Mapping based on VMP photo(s)
144212, 148212

Owner

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624 Hampshire Hill Road
Worcester, VT 05682

Prepared by

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Introduction

This plan covers the ten year period from 2020 to 2029. It lays out the near- and medium-term actions that should guide the development of the Bravakis Forest. It also qualifies the property for Use Value Appraisal (UVA) and commensurate reduction in property taxes.¹ Owners participating in the Use Value Appraisal program are obliged to manage their property according to the plan and to make any reasonable investments for improvement that the plan recommends.²

The plan is organized to reflect the forest decision making process. It begins with a general overview of the property, then lays out the landowner's management goals, before exploring the forest in detail and discussing the actions that could be taken to help meet those goals. Its recommendations were developed in accordance with the principles and practices of scientifically sound forestry, as described in the relevant management guidelines, textbooks and academic journals.

¹ Further information about UVA and current valuations can be found at the Vermont Tax Department's website: <https://tax.vermont.gov/property-owners/current-use>.

² UVA management plan standards are determined by the Department of Forests, Parks, & Recreation and are available at https://fpr.vermont.gov/forest/your_woods/use_value_appraisal or through a County Forester.

Property Description

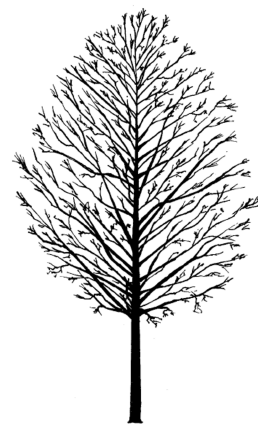
Some 70 percent of the 81 acre Bravakis property is productive forestland that will be managed according to this plan. Its elevations range from 1050 to 1390 feet above mean sea level. The property is located on the eastern slope of Mount Worcester, in one of Central Vermont's most important habitat blocks; which encompasses the Worcester Range and acts as a major wildlife corridor, connecting the unbroken forests of the Green Mountains to the Northeastern Highlands. Two unnamed headwater streams converge on the property and flow east into the North Branch of the Winooski River. It is the last property on the town maintained section of Hampshire Hill Road in northern Worcester. Property lines are mostly marked with old intermittent wire fences. Soils, forest health, and other pertinent topics are discussed in the individual stand area descriptions that follow.

Principles, Goals & Strategies For Forest Management

The following sections describe the chief principles and goals that should guide forest management on the property; and outline the general strategies that can be used to support them.

Conservation

The ecological functioning, productive capacity and biological diversity of the forest resource should be maintained or improved over time so as to provide opportunities for the current or future landowners to continue to enjoy and use the property. A management strategy that



is sustainable in the long-term and viable in the short- and medium-terms offers a strong measure of protection against future development or conversion.

Ecological integrity, wildlife habitat, and biodiversity

Management should prioritize the protection of critical ecological functions, water resources, and threatened or rare plant and wildlife communities. Wetlands and stream-side riparian zones should be carefully delineated and protected; and management should give consideration to the habitat needs of native wildlife populations and to the relationship between the property, its neighbors and the larger landscape they are nested within. Management should be informed by and aim to improve landscape diversity, wildlife travel corridors, and habitat connectivity. Locally under-represented habitat types should be identified and promoted. Stand scale and sub-stand scale management should focus on developing or maintaining species-specific habitat needs, such as nesting sites, cover, mast production, preferred browse or other unique structural and compositional requirements.

Timber management

Management should provide regular returns from timber harvesting. Long-term value growth is provided by maintaining full site occupancy with healthy trees capable of producing high quality sawtimber or veneer. Tree species which yield sought-after, high-value wood should be promoted within each stand or, when regenerating a new stand, attention should be paid to creating stand conditions that favor the establishment of those species. At a property-wide scale, a variety of species should be maintained, providing options for seizing future market opportunities and a hedge against species-specific market depreciation. Among desired species, additional preference should be given to individual trees of sufficient vigor and grade-potential for strong future value growth. Consideration of economic efficiency should inform the timing and coordination of infrastructure investments and stand maintenance, improvement and harvest operations.

Stand Descriptions & Management Recommendations

Presented below are detailed stand-by-stand descriptions of the forest, the long-term structural, compositional and functional goals for each stand, and the near-term silvicultural treatments or management activities that have been prescribed to advance each stand toward those goals. The data presented in the following pages was obtained from a field examination of the property in February of 2020. General

Management Schedule

2023

- Area 5: Dominant-Tree Thinning

2029

- Reinventory forest

conditions were assessed qualitatively in conjunction with quantitative sampling. Observational notes and sample summary statistics together provide the basis for the area descriptions and management recommendations. All sampling was done using a systematic sample and variable radius plots. In stands with uneven-aged structures, all trees 6" dbh and larger were measured in each plot. In stands with even-aged structures, all main-canopy trees were measured in each plot.

When contractors are used to implement silvicultural prescriptions, they should be highly skilled, properly equipped, fully insured, and closely supervised. A professional forester should prepare and administer commercial treatments, and logging operations should be timed to coincide with favorable weather conditions (working on wet soils only when they are frozen, for instance) and favorable timber markets. Use Value Appraisal program guidelines allow any management activities prescribed in this plan to be carried out up to three years before or after the date indicated. Landowners in the Use Value Appraisal program must file a Forest Management Activity Report with the County Forester by February 1st if any commercial logging occurred in the previous year.

The property should be reinventoried in 2029 and the findings brought to bear on a reassessment of the goals and strategies proposed in this plan, leading to a formal management plan update. At any point over the course of this management period, this plan may be updated to incorporate new information and to reflect any new thoughts, concerns or considerations on the part of the landowner or the foresters helping to manage the land.

Area 1

Mixedwood

11.23 legal acres | 11.78 measured acres

Site-specific information

- **Soils:**
Peru gravelly fine sandy loam (deep, moderately well drained, dense glacial till on backslopes)
- **Site Class:**
II (determined from soil mapping and field assessment)
- **Access:**
Mostly easy to access from field. Less than one mile.
- **Stand history:**
Old pasture abandoned 1940 or 1950. Poor quality trees were removed from the eastern section and chipped some 30 years ago, triggering the establishment of a second cohort (age-class) there.

Current forest information

- **Age Class Structure:**
Two-aged
- **Average stocking (with 95% confidence intervals):**
95 sq ft basal area (+/- 10 sq ft)
9.4" quadratic stand diameter (+/- 1.9")
199 trees per acre (+/- 61 trees)

Size Class	Total	AGS	UGS
6-11 in.	55	55	0
12-15 in.	35	30	5
16-21 in.	5	5	0
22+ in.	0	0	0
Total	95	90	5

Current basal area (sq ft/ac) of total growing stock, acceptable growing stock (AGS), and unacceptable growing stock (UGS) by size class.

- **Species (% stocking):**
soft maple (58%), spruce (32%), fir (5%), white pine (5%)
- **Regeneration:**
Soft maple and spruce regeneration throughout. Much stump sprouted soft maple in the northeast, where the logging occurred.
- **Forest health:**
Good. No exotic invasives noted.

Diameter distributions for common species

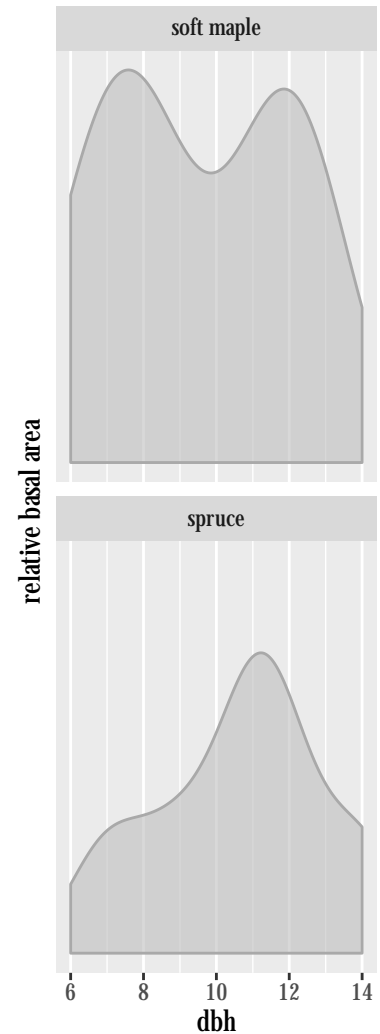


Figure 1: Distributions are approximated with kernel density estimation. Common species are those that account for at least 8 percent of the total stocking and areas under each curve represent species basal areas.

Inventory information

- 2 points, 10 BAF, February, 2020

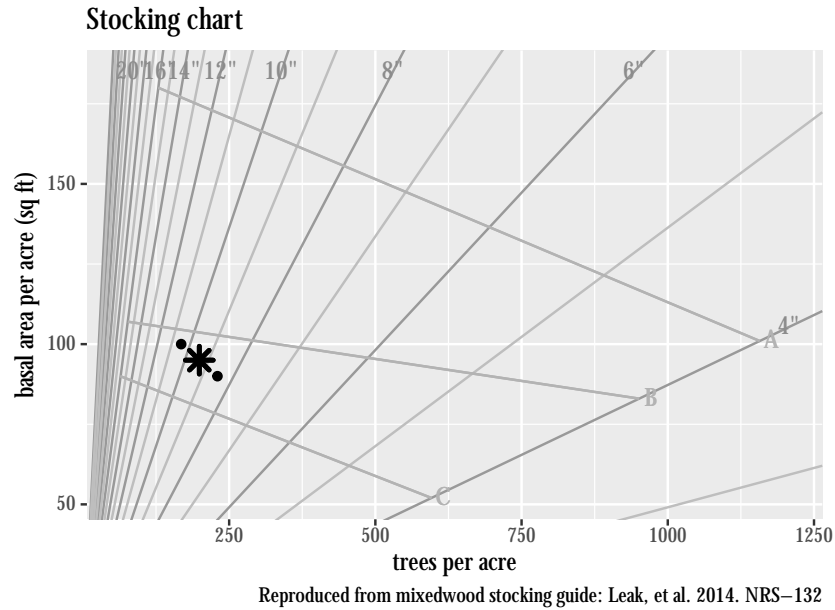


Figure 2: Points represent individual plots. Asterisk represents stand average. Radial lines are quadratic stand diameters.

Long-term management system

Even-aged System

The stand should generally be treated as even-aged, despite the second cohort that has developed in the northeast. The stocking is lower in that area, and young trees will have enough light to continue developing until the overstory is eventually removed, in 30 years or so. We generally expect a 100 year rotation length (the overstory is about 70 now) and thinnings every 10 or 15 years (perhaps once more before regeneration). The southernmost corner of the stand is part of an area the state has mapped as deer wintering habitat, which should be taken into consideration when the time comes to regenerate. Also, an intact canopy should be retained along the stream, to shade the water and protect stream-side wildlife habitat; and some larger declining trees and snags should be kept there, as den trees are especially important near streams (DeGraaf et al. 2006).

Silvicultural prescription

No treatment is necessary in the next decade, as the stocking is already near b-line.

Area 2

Mixedwood

7.15 legal acres | 7.50 measured acres

Site-specific information

- **Soils:**
Tunbridge-Lyman complex (relatively deep to shallow, well drained to somewhat excessively drained, loose, very rocky glacial tills on backslopes, shoulders, and summits)
Peru gravelly fine sandy loam (deep, moderately well drained, dense glacial till on backslopes)
- **Site Class:**
 II & III (determined from soil mapping and field assessment)
- **Access:**
 Adjacent to field, but steep terrain limits movement somewhat in the east.
- **Stand history:**
 There is some age class structure in the stand, but the majority of trees look to date to the 1950s. The area may have been a ledgy, unimproved pasture, or it may have remained forested and had all the older trees cut out at some point. A bit of tending has been done recently.

Current forest information

- **Age Class Structure:**
 Uneven-aged
- **Average stocking (with 95% confidence intervals):**
 113 sq ft basal area (+/- 69 sq ft)
 9.3" quadratic stand diameter (+/- 1.3")
 241 trees per acre (+/- 204 trees)

Size Class	Total	AGS	UGS
6-11 in.	77	57	20
12-15 in.	30	20	10
16-21 in.	7	7	0
22+ in.	0	0	0
Total	113	83	30

Current basal area (sq ft/ac) of total growing stock, acceptable growing stock (AGS), and unacceptable growing stock (UGS) by size class.

- **Species (% stocking):**
 spruce (47%), soft maple (15%), beech (12%), hard maple (9%), yellow birch (9%), ash (3%), black cherry (3%), hemlock (3%)

Diameter distributions for common species

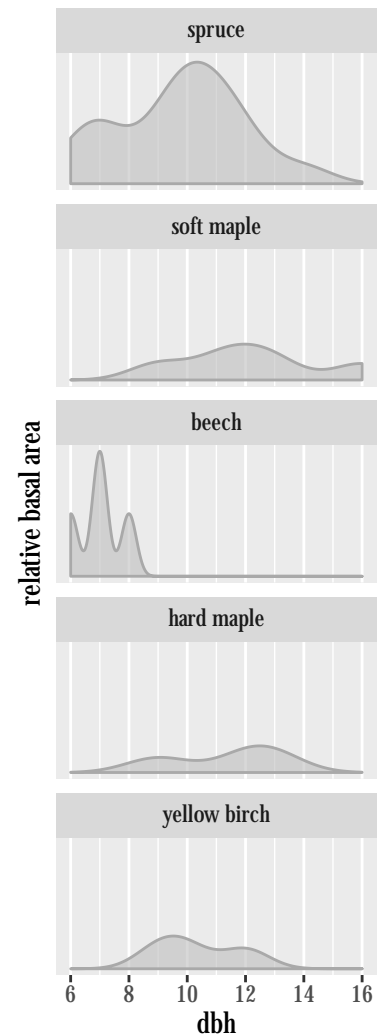


Figure 3: Distributions are approximated with kernel density estimation. Common species are those that account for at least 8 percent of the total stocking and areas under each curve represent species basal areas.

- **Regeneration:**
Very little. Widely scattered spruce, beech, and striped maple.
- **Forest health:**
Mostly good. No exotic invasives noted.

Inventory information

- 3 points, 10 BAF, February, 2020

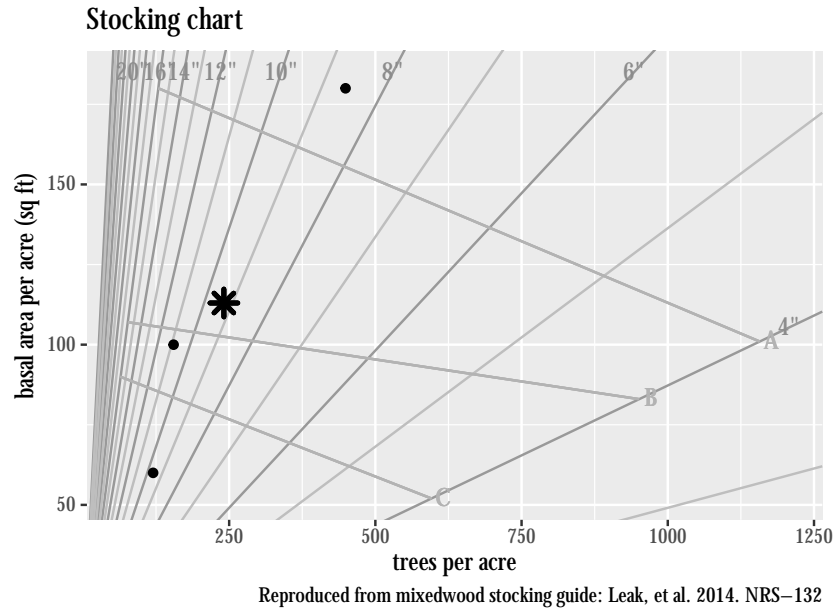


Figure 4: Points represent individual plots. Asterisk represents stand average. Radial lines are quadratic stand diameters.

Long-term management system

Selection System

The basal area is quite variable in this stand, and the age-class structure that does exist should be further developed using uneven-aged conversion techniques (Ralph D Nyland 2003). This will increase the stand's structural diversity, creating niches for more animal and plant species, while still allowing us to grow large, valuable trees. Diameter objectives will not be strictly adhered to during the conversion period, but eventually we expect to harvest high-quality hardwoods (hard maple, yellow birch, black cherry, and perhaps red oak) at 24 inches and other species at 18 inches. A cutting cycle of about 15 years should be used.

Silvicultural prescription

No treatment is necessary in the next decade, as the stocking accrues.

Area 3

Northern hardwood

8.64 legal acres | 9.07 measured acres

Site-specific information

- **Soils:**
Peru gravelly fine sandy loam (deep, moderately well drained, dense glacial till on backslopes)
Tunbridge-Lyman complex (relatively deep to shallow, well drained to somewhat excessively drained, loose, very rocky glacial tills on backslopes, shoulders, and summits)
- **Site Class:**
 II (determined from soil mapping and field assessment)
- **Access:**
 Fairly good. Less than one mile. Ledge limits maneuverability in places.
- **Stand history:**
 This area may have been pastured in the past, but was never plowed. Very few trees look to be older than 100. Periodic logging has maintained multiple cohorts and thoughtful, low intensity tending in the last two decades has favored the highest quality soft maples and spruce. A small section of the stand west of the excluded area is dominated by younger trees, and has much lower stocking as a result, but it is developing well.

Current forest information

- **Age Class Structure:**
 Uneven-aged
- **Average stocking (with 95% confidence intervals):**
 83 sq ft basal area (+/- 43 sq ft)
 8" quadratic stand diameter (+/- 1.1")
 240 trees per acre (+/- 80 trees)

Size Class	Total	AGS	UGS
6-11 in.	57	37	20
12-15 in.	17	17	0
16-21 in.	10	7	3
22+ in.	0	0	0
Total	83	60	23

Current basal area (sq ft/ac) of total growing stock, acceptable growing stock (AGS), and unacceptable growing stock (UGS) by size class.

Diameter distributions for common species

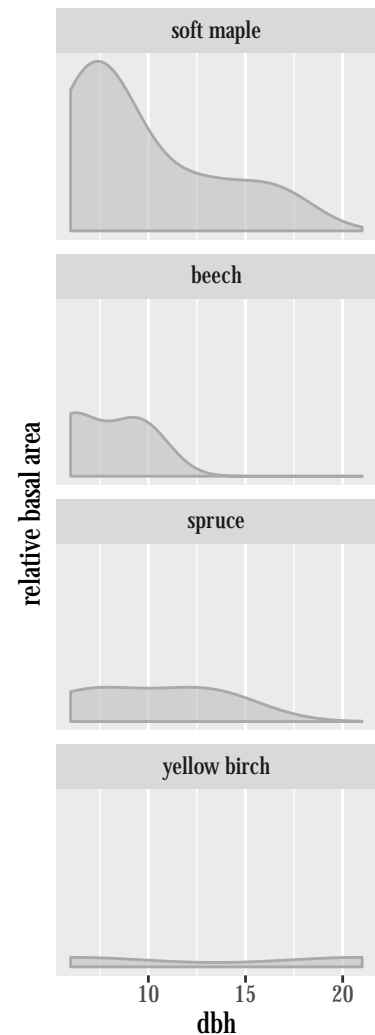


Figure 5: Distributions are approximated with kernel density estimation. Common species are those that account for at least 8 percent of the total stocking and areas under each curve represent species basal areas.

- **Species (% stocking):**
soft maple (52%), beech (16%), spruce (16%), yellow birch (8%), hemlock (4%), other hardwood (4%)
- **Regeneration:**
Lower intensity work in the last several decades has favored shade-tolerant regeneration, and spruce saplings and seedlings are common. Beech is present as well, but not dominant.
- **Forest health:**
No exotic invasives noted. Beech bark disease is affecting most all of the beeches, and their root suckers (which can grow very quickly) are impeding other regeneration in a few places.

Inventory information

- 3 points, 10 BAF, February, 2020

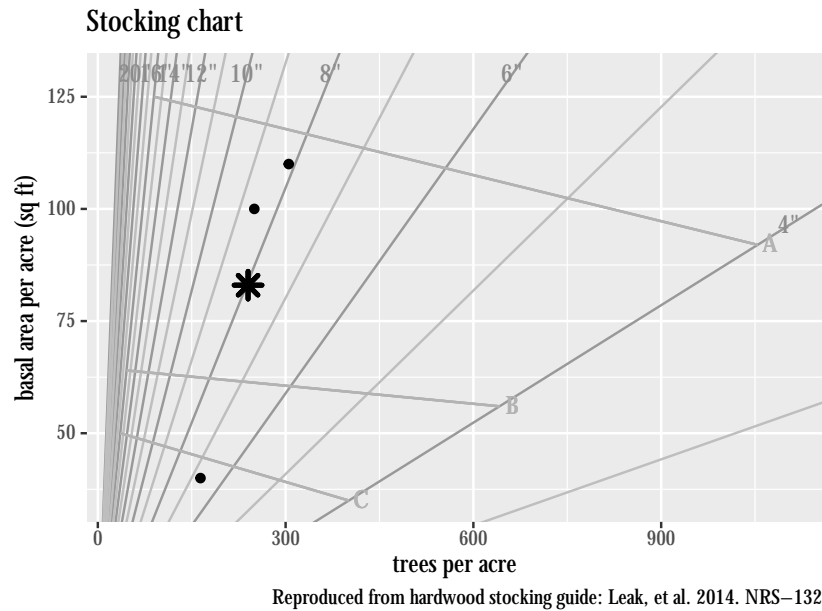


Figure 6: Points represent individual plots. Asterisk represents stand average. Radial lines are quadratic stand diameters.

Long-term management system

Selection System

The uneven-aged structure should be retained using a selection system (see Leak, Yamasaki, and Holleran 2014). Single tree selection has been used in the past, which is moving the stand toward shade tolerant species like spruce. The landowner should think about using some group openings as well to increase the species diversity and

recruit more valuable shade-intermediate hardwoods like yellow birch. Group openings could also help to overcome diseased beech in spots where it is interfering with desirable regeneration of other species (Ralph D. Nyland et al. 2006). Overall, high-quality hardwoods (hard maple, yellow birch, black cherry, and perhaps red oak) with veneer potential should be harvested at around 24 inches in diameter, and other species should be harvested at 18 inches. We expect a cutting cycle of about 15 years.

Silvicultural prescription

The stocking is in a good place for the time being and no work is necessary over the next decade.

Area 4

Northern hardwood

6.82 legal acres | 7.16 measured acres

Site-specific information

- **Soils:**
Tunbridge-Lyman complex (relatively deep to shallow, well drained to somewhat excessively drained, loose, very rocky glacial tills on backslopes, shoulders, and summits)
- **Site Class:**
II (determined from soil mapping and field assessment)
- **Access:**
Good. Less than one mile.
- **Stand history:**
Origin unclear. Somewhat regular logging has left an overstory of mostly healthy, fairly high quality trees. The last comprehensive logging operation was in 1975 and 1980, but some tending has been done since then. Maples were tapped in the past.

Current forest information

- **Age Class Structure:**
Uneven-aged
- **Average stocking (with 95% confidence intervals):**
97 sq ft basal area (+/- 7 sq ft)
11.3" quadratic stand diameter (+/- 3")
140 trees per acre (+/- 54 trees)

Size Class	Total	AGS	UGS
6-11 in.	47	20	27
12-15 in.	27	27	0
16-21 in.	20	20	0
22+ in.	3	0	3
Total	97	67	30

Current basal area (sq ft/ac) of total growing stock, acceptable growing stock (AGS), and unacceptable growing stock (UGS) by size class.

- **Species (% stocking):**
beech (28%), yellow birch (24%), soft maple (21%), black cherry (14%), hard maple (14%)
- **Regeneration:**
Well established understory of beech root suckers, which sprouted from parent trees infected with beech bark disease.

Diameter distributions for common species

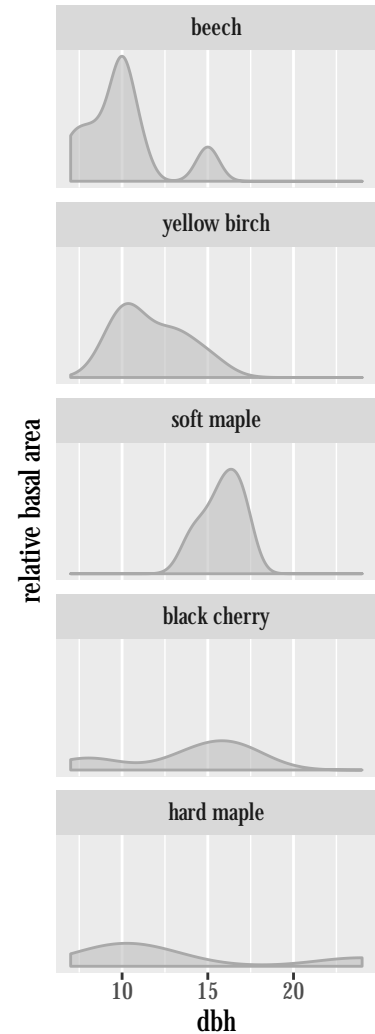


Figure 7: Distributions are approximated with kernel density estimation. Common species are those that account for at least 8 percent of the total stocking and areas under each curve represent species basal areas.

- **Forest health:**

Overstory trees are healthy, though healed-over tap-holes and associated sapstain probably limit timber grade in the maples. Diseased beech suckers are impeding the regeneration of other species. No exotic invasives noted.

Inventory information

- 3 points, 10 BAF, February, 2020

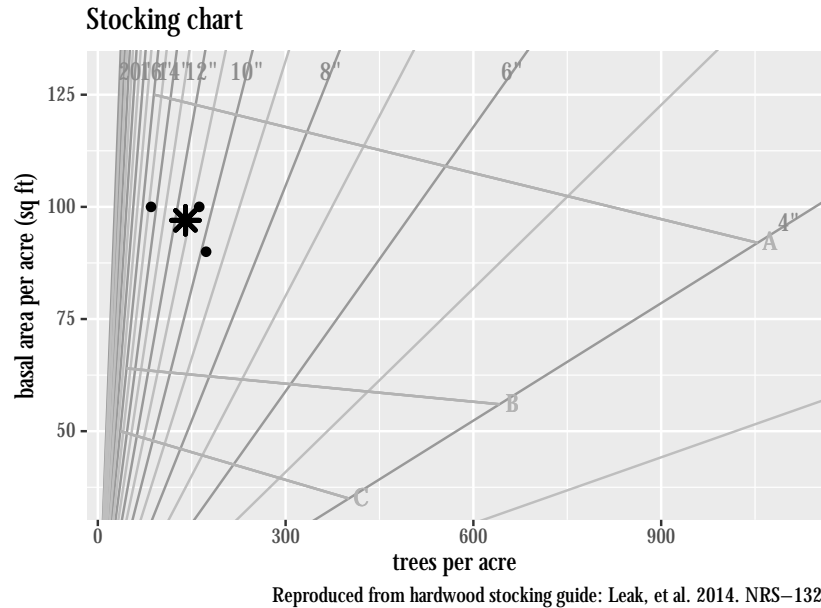


Figure 8: Points represent individual plots. Asterisk represents stand average. Radial lines are quadratic stand diameters.

Long-term management system

Group Selection or Even-aged Management

Unfortunately, diseased beech has accumulated in this stand's understory and is preventing the establishment of healthy young trees. Without some action to address the beech, the overstory will continue to age, trees will eventually begin to die, and a thicket of diseased beeches will be left behind. A group selection system could be adopted, where openings would be made in the canopy every decade or two and beech would be removed from them to allow healthy regeneration in targeted areas; or the existing overstory could be tended lightly to minimize canopy gaps and the whole stand could be regenerated at once later on. The former option would have a smaller visual impact, but would happen sooner and again at regular intervals. It would also generate more income sooner. The latter option would have

a much larger visual impact and put off income generation, but would happen all at one time and not for another two or three decades. The stand is at acceptable stocking levels now, so there's no need to make a decision right away. A firm direction can be set when the next plan update is written, in ten years.

Silvicultural prescription

No treatment is necessary in the next decade.

Area 5

Mixedwood

23.24 legal acres | 24.29 measured acres

Site-specific information

- **Soils:**
Berkshire fine sandy loam (very deep, well drained, loose, very stony glacial till on backslopes)
Peru gravelly fine sandy loam (deep, moderately well drained, dense glacial till on backslopes)
Cabot silt loam (very deep, poorly drained, very stony, dense glacial till on toeslopes and drainageways)
- **Site Class:**
 II (determined from soil mapping and field assessment)
- **Access:**
 Good from field. Less than one mile.
- **Stand history:**
 Improved pasture gradually abandoned, starting in 1940 or so. Many trees date to c. 1970, but some are significantly older; especially the pines. The area north of the stream was thinned in the 2000s, with a focus on removing declining older spruce, but the southern section was left alone.

Current forest information

- **Age Class Structure:**
 Even-aged
- **Average stocking (with 95% confidence intervals):**
 104 sq ft basal area (+/- 19 sq ft)
 3.9" quadratic stand diameter (+/- 1.5")
 1258 trees per acre (+/- 964 trees)

Size Class	Total	AGS	UGS
6-11 in.	63	54	9
12-15 in.	9	7	1
16-21 in.	6	3	3
22+ in.	1	1	0
Total	79	66	13

Current basal area (sq ft/ac) of total growing stock, acceptable growing stock (AGS), and unacceptable growing stock (UGS) by size class.

- **Species (% stocking):**

Diameter distributions for common species

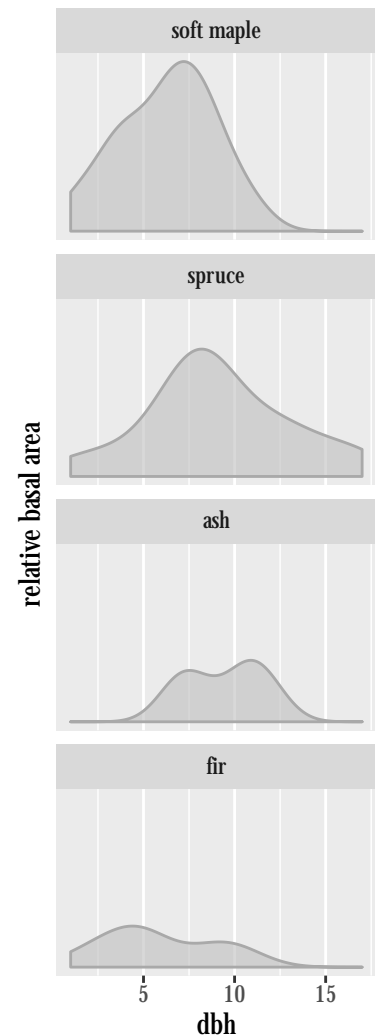


Figure 9: Distributions are approximated with kernel density estimation. Common species are those that account for at least 8 percent of the total stocking and areas under each curve represent species basal areas.

spruce (33%), soft maple (27%), ash (13%), aspen (9%), paper birch (5%), yellow birch (5%), fir (4%), beech (2%), white pine (2%)

- **Regeneration:**

There are many hard maple, soft maple, and yellow birch saplings, which are in the same cohort as the larger trees. Hard maple will come to play a bigger role in the stand eventually, though soft maple will probably still dominate for a long time. Spruce and fir saplings are common in the center of the stand, just south of the stream.

- **Forest health:**

Mostly very healthy, though some of the larger (and somewhat older) trees in the southern section are declining or poorly formed. Also, some of the older spruce was open grown and is branchy and of poor quality. No exotic invasives noted.

Inventory information

- 7 points, 10 BAF, February, 2020

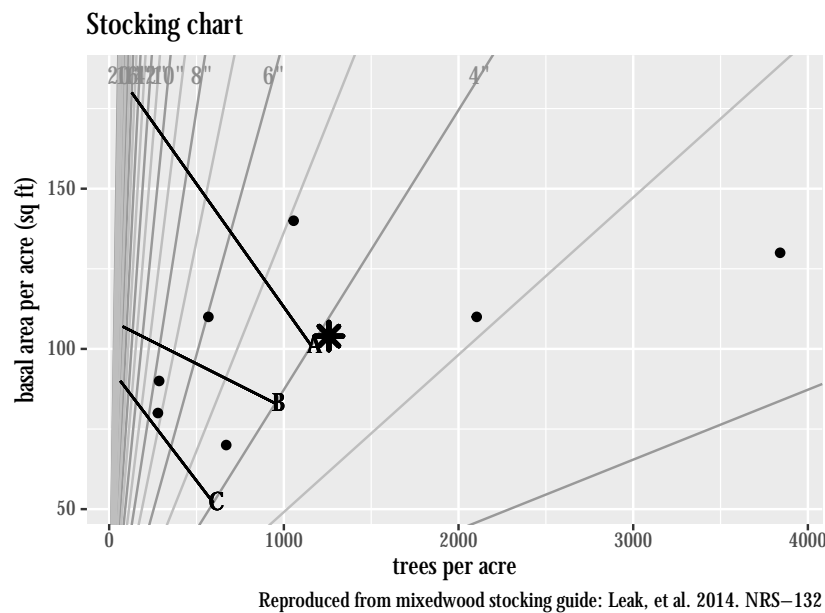


Figure 10: Points represent individual plots. Asterisk represents stand average. Radial lines are quadratic stand diameters.

Long-term management system

Even-aged System

In the previous management plan this area was considered two different stands (5 and 6); but they have similar histories, structures,

stocking levels, and species compositions and occupy very similar sites, so we have combined them. We plan to retain the even-aged structure that is present, and thinning should be used to focus growth on the highest quality trees of valuable species (maple, birch, and spruce mostly) while maintaining a relatively high species diversity. We expect a rotation length of about 110 years, and thinnings every 15 years or so. As in Area 1, care should be taken to protect the riparian area that runs through the stand, and snags should be left near the stream for the habitat they provide.

Silvicultural prescription

Dominant-Tree Thinning

Year: 2023

Much of the larger unacceptable growing stock was removed north of the stream in the 2000s. The same should now be done south of the stream to give acceptable growing stock trees more light and accelerate their growth. The thinning should focus on removing the larger unacceptable growing stock and declining trees, and the stocking should not be reduced below b-line (about 80 square feet per acre). This will be what Bill Leak refers to as a dominant-tree thinning (Leak 2015), and will best be carried out using mechanized equipment, which is more efficient at removing large volumes of lower-grade pulp and chip trees. Care should be taken to keep machinery away from the stream, to leave closed canopy conditions near the water, and to leave some of the declining trees along the stream bank to become den trees and snags.

References

DeGraaf, Richard M., Mariko Yamasaki, William B. Leak, and Anna M. Lester. 2006. *Technical Guide to Forest Wildlife Habitat Management in New England*. Lebanon, NH: University Press of New England.

Leak, William B. 2015. “Dominant-Tree Thinning in New England Northern Hardwoods—a Second Look.” NRS-RN-201. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. doi:10.2737/NRS-RN-201.

Leak, William B., Mariko Yamasaki, and Robbo. Holleran. 2014. “Silvicultural Guide for Northern Hardwoods in the Northeast.” NRS-GTR-132. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. doi:10.2737/NRS-GTR-132.

Nyland, Ralph D. 2003. “Even- to Uneven-Aged: The Challenges of Conversion.” *Forest Ecology and Management* 172 (2-3): 291–300. doi:10.1016/S0378-1127(01)00797-6.

Nyland, Ralph D., Amy L. Bashant, Kimberly K. Bohn, and Jane M. Verostek. 2006. “Interference to Hardwood Regeneration in Northeastern North America: Controlling Effects of American Beech, Striped Maple, and Hobblebush.” *Northern Journal of Applied Forestry* 23 (2): 122–32.