Forest Investments – Wilhelm Farm Examples

Trees and forest soils are an investment. In both, what we do today affects the near and long-term future. WE also consider the impact of what we do today on a variety of environmental values, including wildlife and water quality. Achieving our investment and environmental goals is best done by managing the density of trees per acre.

We measure stand density in two related ways. The simplest measurement is the number of stems per acre. But the more critical is how much of the acre is occupied by tree crowns and root systems. Crown occupancy is not easy to measure objectively, and root occupancy always is invisible. However, basal area is a reliable proxy of occupancy. Basal area is the stump area at 4-1/2 feet, so basal area per acre is the sum of all stems, measured in square feet on an acre.

As the average stem diameter goes up, it takes fewer stems to fully occupy an acre; to fully utilize the solar energy, moisture and nutrients available on the acre. Above 100% occupancy, we observe lower growth per stem and smaller volume per tree because growth is allocated to more, individually smaller tree stems. Reducing basal area below 100% capacity leads to more growth per stem and consequently bigger trees as measured by average diameter and log sizes.

Reducing the basal area too much, however, means that growth potential per acre is not captured in merchantable trees. It often also means that undesirable species invade, especially brush in the case of southern New England, which makes management operations and monitoring more difficult. For young, rapidly growing stands, 50% of capacity is about as low as reasonable to go with thinning of basal area. In older stands, 65% is a better target range for reducing basal area. Our guidelines are more conservative and use 80% (see Table1 below).

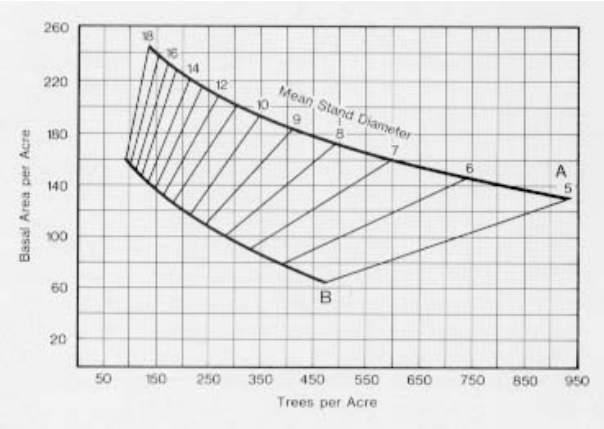

Figure 1: Stocking guide for eastern white pine (Leak and Lamson, 1999)

Stocking Guides for White Pine

Figure 1 is a stocking guide for white pine. Similar guides are available for hemlock, red oak, sugar maple and several other species. The guides visually present the relationships between the number of trees per acre and basal area. Line A in this diagram is capacity. More stems and basal area than this means smaller trees and often less healthy stands. Line B demarks the density below which where the area is not fully occupied and too much growth potential is lost, often to undesirable vegetation like brush.

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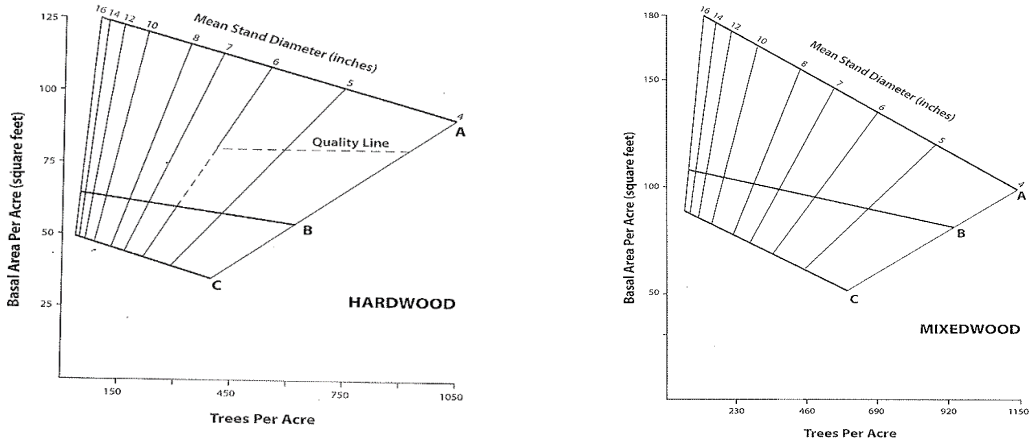

Figure 2: Basal area per acre by size class and trees per acre of mixed hardwoods and mix hardwood and conifers (Leak 1987b)**.**

Stocking Guides for Multi-Species Stands

Some research in northern New England has looked at the stocking of multi-species and ages. Hardwoods, in general, occupy more space per stem than conifers and the per tree space requirement rises more rapidly as trees age. In Figure 2, the left diagram illustrates hardwoods only. A similar diagram for only oak would be even more exaggerated because the crown and roots are more widely spaced than other hardwoods. Sugar maple is similar, while the birches occupy less space per stem. The right diagram in Figure 2 includes conifers (hemlock in this research case). Each stem occupies less space and the range of stem numbers is larger.

Managing basal area is how Wilhelm Farm manages a multi-age silvicultural system in its pine, oak, and mixed hardwood stands. We favor white pine, red and white oak, and sugar maple by the way harvests open spaces with strong light at ground level and by early precommercial thinning of less desirable species. One obvious target for removal is invasive brush species, especially multiflora rose, wild berries and wild grape, and Japanese barbury.

The second and less obvious target species is black birch. It is not that black birch is worthless – birch timber was selling for $65 to $75 per thousand board feet in late 2017 with veneer grade logs going for $150 west of the river. But it has two traits that make it less desirable. First, it contracts *Nectria* canker, which causes wood decay, lowering veneer and lumber value, and eventual death. Second – and most important given our silvicultural goals – black birch grows rapidly and overtops white pine seedlings and young saplings, delaying financial maturity by a decade or more. Black birch shade also delays growth of red and white oak and sugar maple. consequently, we are removing black birch where it suppresses white pine or desired hardwood species.

Our silvicultural strategy is to keep basal area above the B line (60 square feet or higher) and below the A line by harvesting every 7 to 10 years (10 tp15 years in pure hardwood stands because the basal area growth is slower). Trees to be harvested are marked with the goal of providing light and growing space for white pine and/or desired hardwoods.

We use multi-age and multi-species silviculture to achieve two goals:

- Provide habitat that attracts more species and more numbers of song birds. This goal is a personal one held by the owners. It began a generation ago when Fred Wilhelm attended the Coverts training in bird habitat management hosted by UConn forestry extension and Bill Bentley attended the Coverts training in 2004.
- Maximize value growth per acre (rather than per tree). Red and white oak and sugar maple, when financially mature, yields more dollar value per board foot harvested, but we can grow more white pine volume per acre because a pine stem only takes 25% to 30% less growing space of oak or maple stems. White pine achieves financial maturity earlier. The results are more volume per acre than the high-value hardwoods – enough to compensate for the difference in value – roughly $313/bd.ft. for oak species vs. $112 for white pines.

As we prepared for our 2013 timber sale and 2014-15 timber harvest, we worked with our forestry consultant to develop guidelines for marking trees to be harvested.

Table 1: Guidelines for Marking Trees for Harvest on Wilhelm Farm Forest, July 23, 2013[1]

Pine Stand 1A	
Current BA	143
Target BA	**80**
% removal	44%
Pine Stand 1B – no harvest because of regeneration failure following2007 harvest of pine	
Mixed Hardwood Stand 2	
Current BA	110
Target BA	**80**
% removal	27%
Mixed Hardwood and Conifer Stand 3A & B	
Current BA	100
Target BA	**70**
% removal	30%
Mixed Hardwood Stand 4	
Current BA	130
Target BA	**60**
% removal	46%
Stand 5 – Future silvopasture unit – Remove high percentage of BA to create sunny areas suitable for pasture grass. Priority for removal – dangerous stems, crooked stems, poisonous trees (e.g., cherry), mature commercial trees (not many). ***Comment – one consequence of this guideline was rapid resprouting and invasion by many brush species.***	

[1] Guidelines developed by Ian Branson, a CT and NRCS certified forester, after considerable discussion with owners Ann Wilhelm and William Bentley.

The results 3-4 years after harvest are encouraging. Natural regeneration of oaks and pine is commonly observed throughout the woods. We planted pine on the 2 acres that did not regenerate following the 2007 harvest and in understocked stands had over 95% survival and 2017 leader growth was spectacular – ranging from 18 inches to 39 inches (***note*** – the 2017 rainfall was very favorable to both tree and brush growth).

We are cooperating with Connecticut Audubon on a study of birds in small forest ownerships. The prompt is that *Northwest CT and its neighboring Northern Forest states support some of the highest species diversities and densities of breeding birds in the continental U.S.*[2] Our goal is to support that diversity and density on our property as a social good, but we also enjoy watching these bird species.

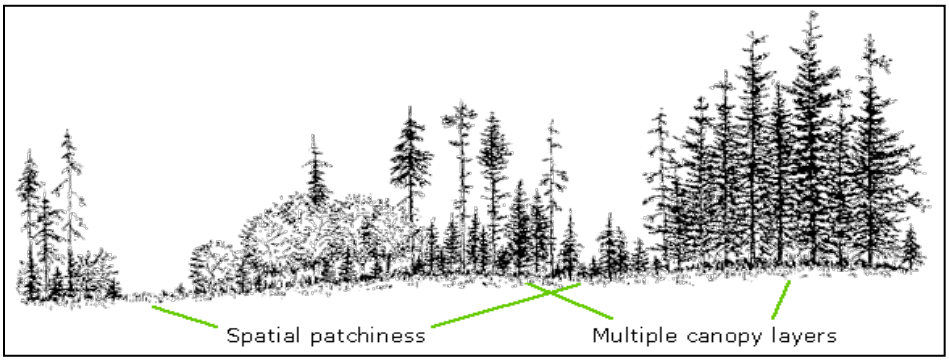

Figure 3. Illustration of horizontal and vertical diversity in forest habitat structure to encourage birds (From British Columbian Ministry of Forests via CT Audubon 2106)

Figure 4. Examples of the species our silviculture favors (PowerPoint slide from Audubon 2016 – see footnote 2).

[2] *New England Forest Birds & Agro-Forestry: Basic concepts for the forester, farmer & landowner.* A PowerPoint presentation by Audubon CT and Ferrucci & Walicki, LLC, to New England Society of American Foresters Annual Winter Meeting, Sturbridge MA, March 9, 2016.

Analysis of Wilhelm Farm Timber Investments

Wilhelm Farm investments in its woods have two important starting points. First, all our woods are in PA490 under forest land use. Our 2017 property tax on the 35 acres of forests was only $42.49. Second, almost all the regeneration since the initial planting of pine in 1936 has been natural seedlings. Consequently, the cash invested has been minimal.

Looking at the 17 acres of pine and hardwoods harvested in 2015, we received $740 revenue per acre from the harvest. This represent 8 years of growth following the 2007 harvest, which released the pine for rapid growth. Subtracting the annual taxes as costs, the present net worth per acre is $572.[3]

Because the area harvested included approximately 3 acres of low value timber (badly weevilled white pine and low grade red maple and black birch), the estimated present net value per acre is conservatively low. These 3 acres are now part of our silvopasture unit.

Two dirty forest owners after a day of pine tree planting in 2016

The exception to the above example was replanting the 2+ acres in 2015 where natural regeneration failed following the 2007 harvest. We planted 1,000 white pine seedlings from the NYS Forest Nursery in Saratoga NY, which cost $160. We did not keep precise records on the planting time, but 20 to 25 hours per acre at $15 per hour is a reasonable estimate of what labor would have cost in Granby. We will use the estimate of $375, so a total of $535 per acre.

Rough estimates of the present net worth of this investment range from $37 to $190 per acre, assuming 2014 white pine prices and fully occupying the stand with white pine or quality hardwoods. It appears to breakeven or make a small profit. And it recaptures this site for trees and adds to the diverse bird habitat with a younger pine stand.

Our experience since 1996 includes 3 harvests where financially mature trees were removed:

1996-97 - 144,000 board feet
2007 - 110,000 board feet
2014-15 – 155,000 board feet

- Over 75% of volume harvested was white pine
- Hardwoods were mainly oak, maple & birch
- Silvicultural system is a modified shelterwood to favor multi-age/multi-height forest habitat

Ann with a deck of large, high-value white pine logs.

[3] We use Excel for these calculations. The annual taxes on 17 acres of 20.64 or discounted at 3% to -$8.51 per acre. he revenue of $735.59 is discounted at 3% to the present, equaling $580.68. Adding the two together yield the present net value of **$572.17** per acre.

We think in terms of real value growth rates per acre relative to our guiding rates of interest. In simple terms, we use the following rules:

If stand has real Value Growth rate	**> Interest rate, hold tree investment**
If stand has real Value Growth rate	**≤ Interest rate, harvest these trees**

A stand of trees is like a portfolio of stock investments – periodically you want to separate out the underperforming stocks. Coupled with understanding of how stand density affects the growth, we harvest the trees that have low future value growth potential, usually because they are bigger and financially mature.[4] The remaining trees have more sun and less root competition from neighbors, so they grow faster in both biological and financial terms.

Summary Comments

Wilhelm Farm examples of forest investments illustrate a few important points:

1. Investments in timber can be evaluated like other types of household and farm investments.
2. Trees have value and the value of tree growth is a primary determinant of how productive a timber investment will be.
3. Tree quality is an important factor in rate of value growth, especially as log quality moves into higher grades with size and expectation of clear wood.
4. There is information from many sources on the web regarding timber growth and yield.
5. Forest investments can include returns other than dollars (e.g., bird habitat); maple syrup, firewood for home use, family recreation, hunting and many other values can be considered).
6. The family ownership goals determine what is optimal on a family farm and forest, not dollars or present net worth alone.[5]

References and Further Reading

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[4] See Wilhelm Farm Factsheet No. 5, ***Trees as an investment***, for the definition of financial maturity.
[5] A forthcoming Wilhelm Farm Factsheet, *Home Economics of Agroforestry, etc.*, will further develop this point.

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