Where Are We Headed?

An Analysis of Forest Statistics for Maine, 2001

by Mitch Lansky, January 2003

Cover photo:
tractor sled train
from
The Timber Resources of Maine
by Roland Ferguson and Franklin Longwood
USDA Forest Service, 1960

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Executive summary

This document is based on statistics from the following Maine Forest Service documents: *2001 Silvicultural Activities including Annual Report on Clearcutting, 2001 Wood Processor Report Including Import and Export Information, The 2001 Biennial Report on the State of the Forest and Progress Report on Forest Sustainability Standards,* and *Third Annual Inventory Report on Maine's Forests.* In this document I ask the following questions:

- Who owns Maine woods?
- How has landownership changed?
- Who does the cutting?
- What kind of cutting is being done, by whom?
- How heavy is the cutting?
- How much is considered regeneration cutting?
- How much is cut per acre per year on average
- Who is doing intensive management (early stand management)?
- How much is being cut?
- How is the wood being used?
- How much is being exported unprocessed?
- How has stand type changed?
- How has stocking changed?
- How has stand size changed?
- Is cut less than net growth?
- How has volume changed?

In answering these questions, I use data from these reports to make graphs, so that the user of this report can *see* what the numbers mean. I conclude with a discussion of the policy tools that the state is using to improve forestry practices. I suggest that the state use these tools to promote not just improved forestry (emphasizing improvements in partial cuts), but also reduced wood product consumption, and increased forest reserves.

Some noteworthy trends graphed in this document include:

- Industrial share of Maine timberlands has declined from 7.3 million acres to 5.7 million acres between 1995 and 2001, a loss of 1.6 million acres.
- Industrial owners are responsible for 28% of the acres cut in 2001 but did 82% of clearcuts, 82% of pre-commercial thinning, 83% of the plantations, and 91% of herbicide release.
- While clearcuts have declined greatly over the last decade (making up less than 3% of all cuts in 2001), cutting is still heavy, so that the acreage of regeneration cuts (clearcuts plus overstory removals) has not declined at all since 1994 (around 93 thousand acres in 1994 and around 94 thousand acres in 2001), and the average cut per acre per year has declined very little (from 12 cords per acre in 1996 to 11 cords per acre in 2001).
- Although the volume cut per year might go up or down from one year to the next, the long-term trend is towards increasing volume removals. From 3.5 million cords in 1960 to 4.8 million cords in 1980 to 6.3 million cords in 2001.
- Most of the wood being cut (around 50%) is being used for pulp. Only around 43%, down from 51% in 1999, is being used for lumber. Nearly 7% of the wood is going for biomass.

- Certain species of sawlogs are being exported unmilled at a very high rate. The biggest examples are 61% of spruce-fir, 53% of yellow birch, and 52% of hard maple. Most of the exports are to Quebec sawmills.
- The spruce-fir stand type has continued its decline, from 7.8 million acres in 1982, to 5.2 million acres in 2001. The northern hardwood and intolerant hardwood types have increased over the same period.
- From 1995 to 2001, the percentage of forest in fully-stocked stands declined (as it did from 1982 to 1995). The trend of an increasing percentage of the forest in acres with low basal area also continued.
- The forest continued its trend of increased acreage in seedlings and saplings. The spruce-fir type continued its trend of reduced acreage in sawtimber and especially poletimber.
- Between 1995 and 2001 the MFS noted a continued trend of cut being greater than net growth (as measured in basal area, rather than volume). This led to a trend of a 1.3% decline per year in basal area for all species with around a 2.4% a year decline for spruce-fir and intolerant hardwood types.
- The MFS measured more volume per acre (16 cords) in 2001 than had been measured by the US Forest Service in 1995 (15 cords), but these findings contradict the other findings (of lowered percentage of fully stocked stands, increased acreage in seedlings and saplings, and declines in basal area) noted above. This brings into question the reliability of comparisons of the 1999-2001 figures to other inventory years. As in other inventories, the methodology has changed, making comparisons difficult.

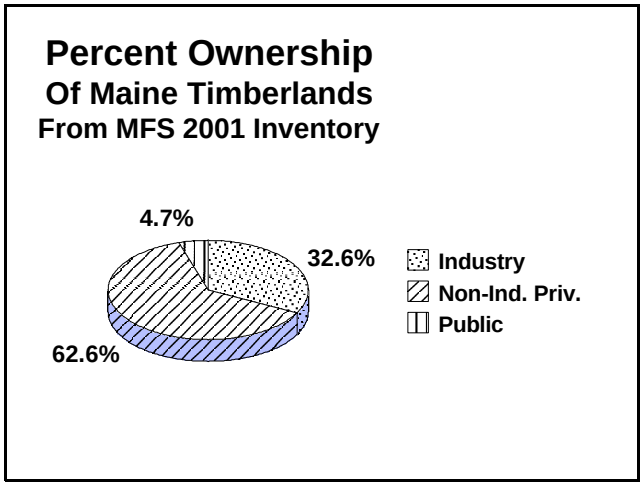
I conclude that these trends are not sustainable. If Maine is to grow more volume of high value wood, then heavy cutting and diameter-limit cutting, leading to increased acreage in small diameter trees, decline in stocking quality, and shift to shorter-lived species, need to be addressed with each of the state's forest policy tools such as research, data collection, demonstration, education, regulations, tax incentives, easements, and certification. To promote a forest with increased growth and value, enhanced biodiversity values, and improved recreation and aesthetic opportunities, the state should be promoting increased use of low-impact forestry, decreased consumption of forest products (through reduced waste and increased efficiency), and more forest reserves.

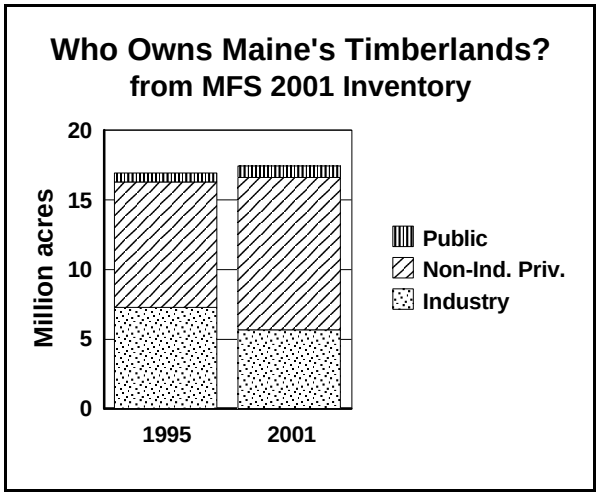
I. Where Are We Headed?

Who owns the Maine woods?

There has been dramatic change in landownership since 1995. The industrial share of Maine timberlands has declined from 7.3 million acres in 1995 to 5.7 million acres in 2001, a loss of 1.6 million acres. This continues a trend that started earlier in the 1990s. In 1982, the acreage of industry ownership (ownership of land by a mill owner) was more than 8 million acres.

A new ownership class has emerged--large-scale timberland investor, or institutional investors (combined in the graphs below with other non-industrial private). These are

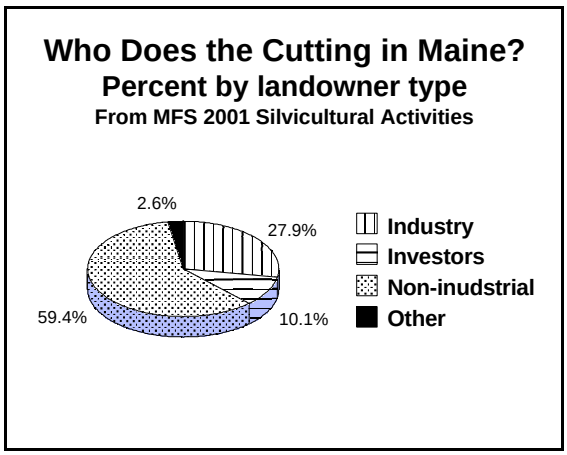


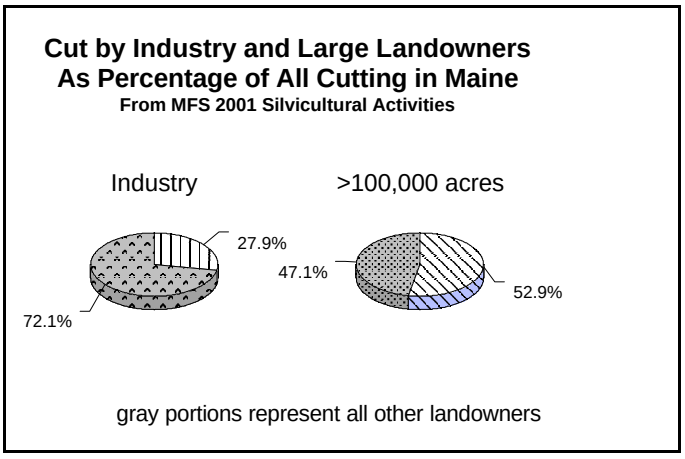


organizations that hold assets as fiduciaries for the benefit of others. This ownership class has bought up much of the former industry lands (they now own 2.5 million acres). Since the land is an investment, the time horizon of this ownership can be short (the state estimates 6-15 years), depending on markets for wood and land.

Who does the cutting?

The next graphs show the percentage of acres cut by industry and by large landowners (of which industry is a subgroup) who own more than 100,000 acres. While industry is cutting a slightly lower share of acreage (compared to its ownership), this does not necessarily translate into lower share of volume. As we shall see, industrial landowners do a higher percentage than other landowner types of regeneration cuts, cuts that remove the mature trees and start a new stand.





This would indicate that industrial landowners probably remove a higher average volume per acre compared to other landowner types.

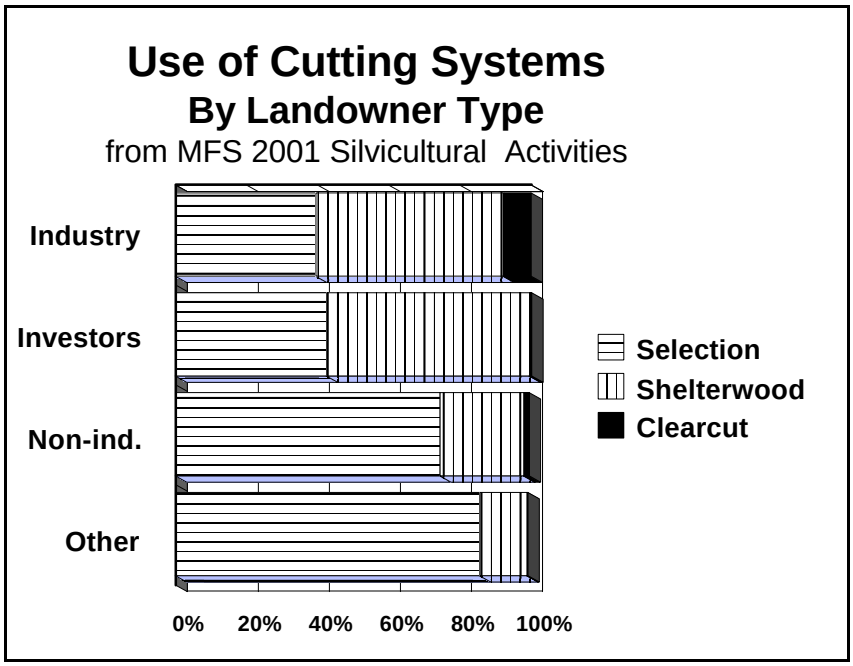
What kind of cutting is being done, by whom?

Industrial landowners have the highest proportion of clearcuts of any ownership group. The other groups looked at are investors, non-industrials and "other." "Other" includes public lands and Tribal lands.

A *Clearcut*, in Maine, is defined as a "Harvest method on a site greater than 5 acres that results in a residual basal area of acceptable growing stock trees >4.5" DBH of less than 30 square feet per acre, unless after harvesting the site has a well-distributed stand of acceptable growing stock 3 feet tall for softwood and 5 feet for hardwoods (Overstory Removal)."

Basal area is a measure of the cross sectional area of a tree at "breast height" (4.5 feet). Basal area per acre is the combined basal area of all the trees in an acre. *DBH* is diameter at breast height. *Acceptable growing stock* is a tree that is not rough or rotten.

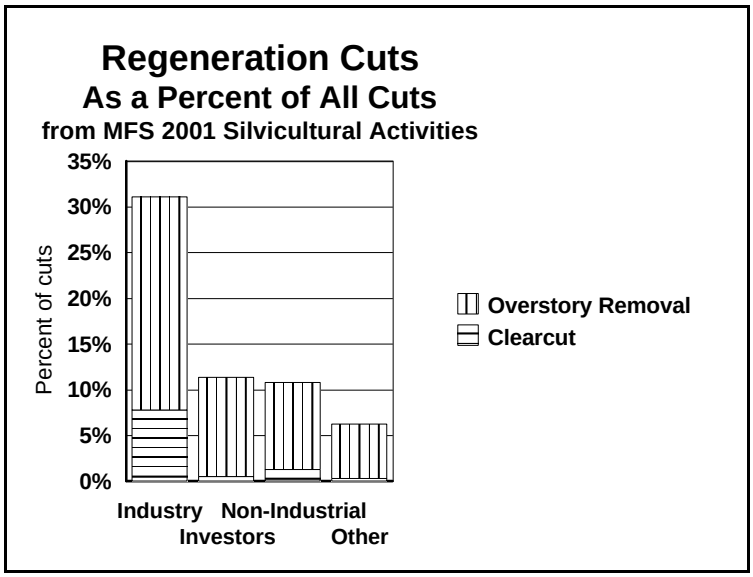
Overstory Removals are the last stage of a shelterwood cut. *Shelterwood* is defined as a "Harvest method of mature trees from a forest site in two or more stages. The first stage removes only a portion of the trees to allow establishment of regeneration before the remaining trees are removed in subsequent harvest."



The definition the Maine Forest Service gives for *Selection* is a "Harvest method where trees are removed individually or in small (<5 acre) patches." This latter definition is highly inaccurate and misleading when referring to the silvicultural system of "selection," which is geared towards creating an uneven-aged forest. Most of what the Maine Forest Service is calling "selection" is more appropriately labeled as *diameter-limit cutting*, where the logger is told to cut all trees (by species) over a certain diameter, or even to *commercial clearcuts* or heavy highgrading, where the logger cuts everything of value and leaves everything else. The MFS is thus calling anything that leaves more than 30 square feet of basal area, or where less than 5 acres is cleared "selection," leaving the reader of these statistics with a false impression that some legitimate silvicultural system is being practiced, when in reality, that is often not the case: trees are being removed, but not for the purpose of improving the residual stand.

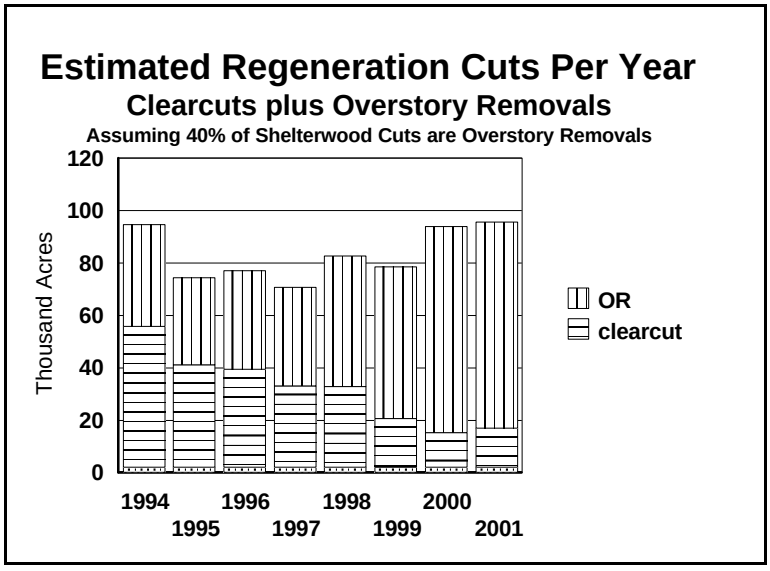
What percentage of cuts are regeneration cuts?

Regeneration cuts, in general, are heavy cuts that remove so much of the overstory that, essentially, a new stand is established. The total of regeneration cuts is determined by adding the acreage of shelterwood cuts that are overstory removals (the final cut in the shelterwood system, where the mature trees are removed) to the acreage of clearcuts.



Industrial landowners do the most regeneration cuts as a percentage of all cuts. Indeed, industrial landowners only did "selection" on less than 40% of the acres cut in 2001. Assuming that 60% of industrial land is managed under an even-aged system, this means the apparent rotation time (based on the percentage of the even-aged portion that is regenerated each year) is around 60 years.

Because the Maine Forest Service's definition of "selection" includes many acres of what is actually even-aged management (which only has one or two major age-classes), it is quite likely that a higher proportion of cutting is truly regeneration cutting than what I have graphed.[1]



While clearcutting has declined dramatically during the 1990s, shelterwood cuts have increased dramatically. The MFS has only given the acreage of overstory removals (as a component of shelterwood cuts) in recent years. In 2001, overstory removals made up around 40% of all shelterwood cuts. Assuming this ratio is a typical average, and ignoring heavy "selection" cuts, then regeneration cuts (clearcuts plus overstory removals) have not changed much in recent years, even though clearcutting is on a decline.

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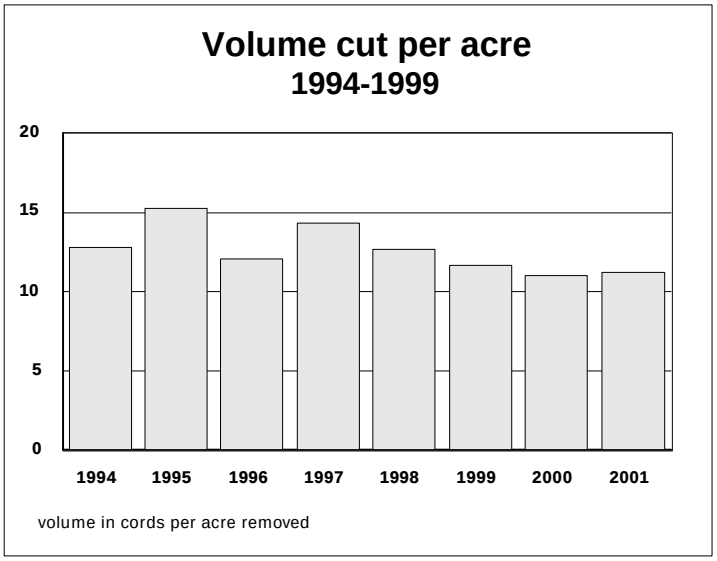
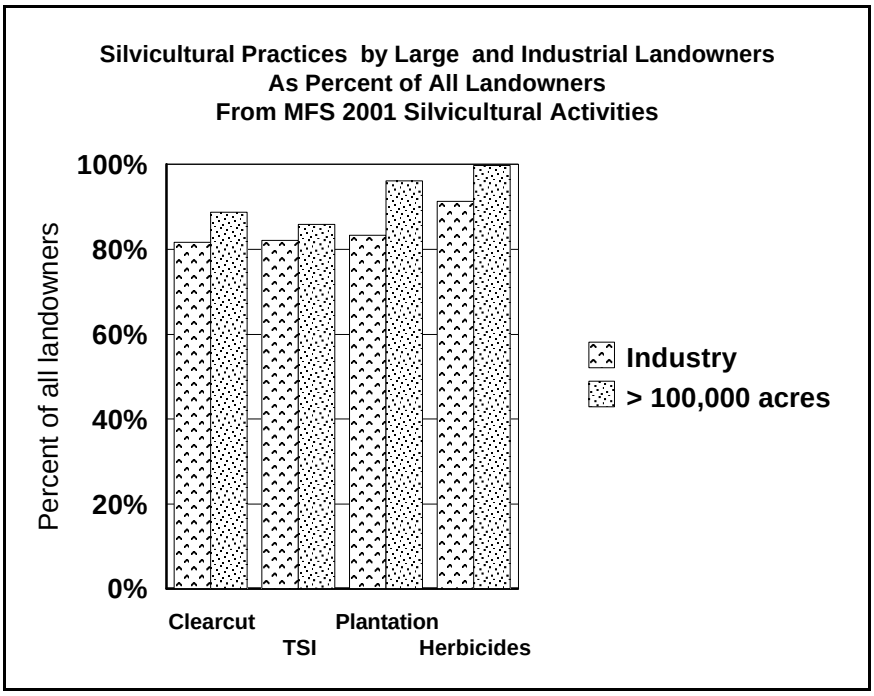
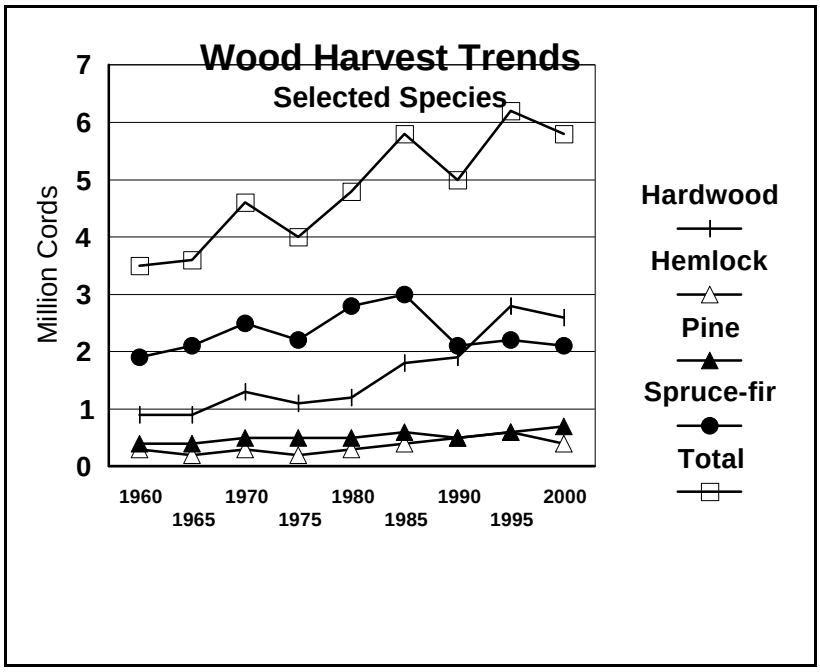
[1]An analysis of MFS data by Mitch Lansky, *After the cutting is done, what's left? An evaluation of forest practices in Maine 1991-1993*. March 1996, showed that 43% of all partial cuts left a residual stand below the C line (see page 10 of this report for explanation of the C line)



How much is cut per acre per year on average?
Further evidence that cutting continues to be heavy, despite the decline in clearcutting, is found by dividing volume cut each year (found in the annual processor reports) by acres cut (found in annual silvicultural reports). Over the last eight years, the volume per acre cut has fluctuated, with a slight decline in the last 4 years. This slight decline in the average removal per acre (from 12 cords per acre in 1996 to 11 cords per acre in 2001) is due more to an increase in lighter partial cuts ("selection" and shelterwood thinnings) than to a decrease in regeneration cuts.

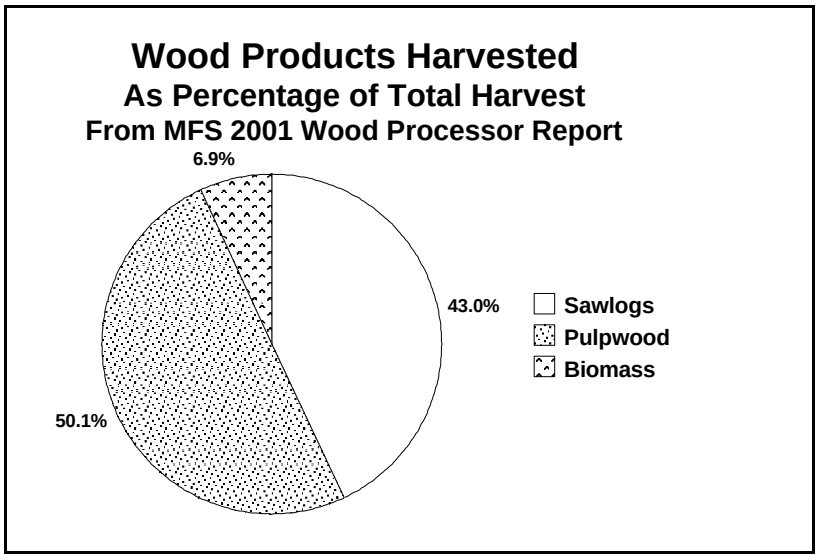
Who is doing intensive management (early stand management)?
Although industrial landowners are doing less than 28% of cutting by acreage, they are doing most of the intensive management, including 82% of all clearcuts, 82% of pre-commercial thinning (called timber stand improvement or TSI in the graph), 83% of the plantations, and 91% of all herbicides. Landowners with more than 100,000 acres (of which industrial landowners are a subgroup) do 89% of clearcuts, 82% of TSI, 96% of the plantations and nearly all the herbicide release spraying. Because industrial landowners do most of these intensive practices, and because industrial acreage is declining, the combination of herbicides, plantations, and thinnings has declined in the last few years (see graph on page 26).

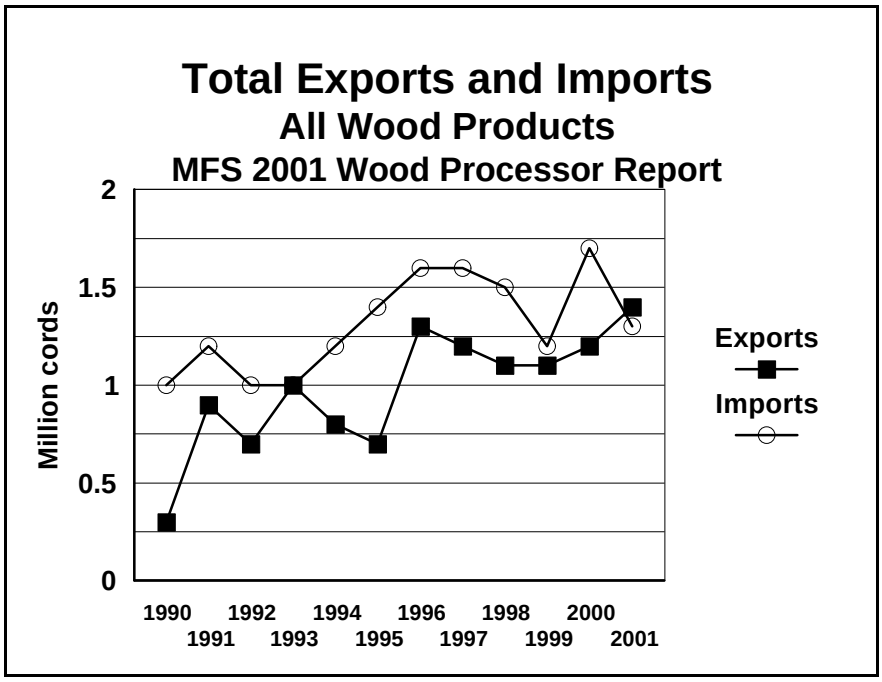




How much is being cut?
Although the volume cut per year might go up or down from one year to the next, the long-term trend is towards increasing total volume removals. From 3.5 million cords in 1960 to 6.3 million cords in 2001. While the cut in 2000 was 5.8 million cords, the average from 1995 to 2000 was 6.1 million cords per year. This represents an average increase in cut of around 1.4% per year. If this rate of increase in cutting persists for a thousand more years, the cut in the year 3000 would be more than 6.66 trillion cords, a level more than a million times current levels of cut. It is quite likely, however, that limits to the growth of the forest will be reached before this level of cutting is attained, despite recent efforts at intensive management.

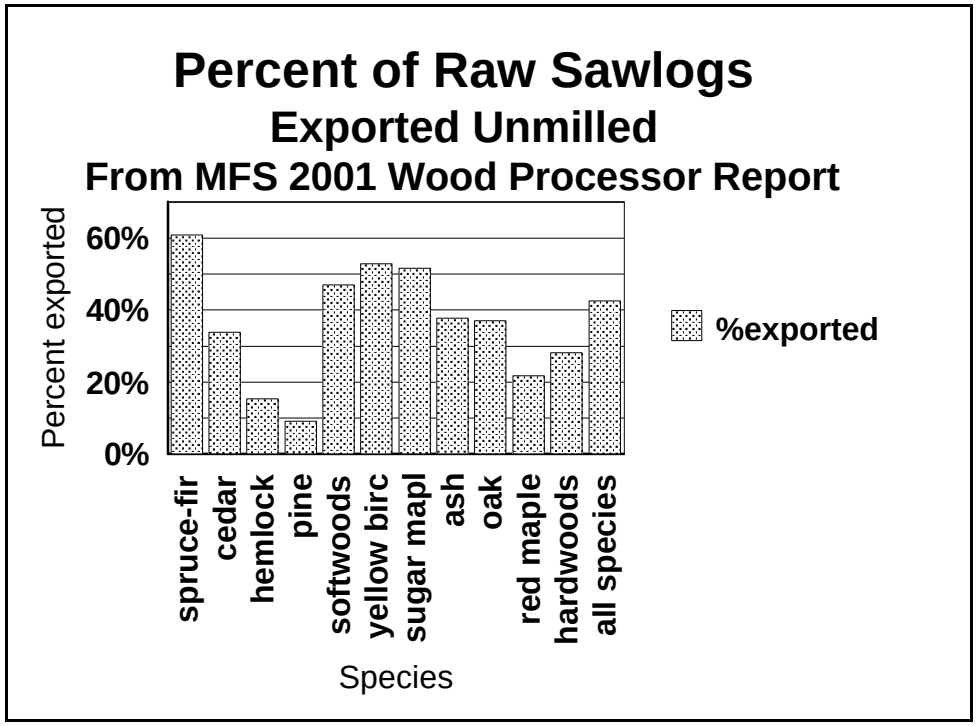
How is the wood being used?
Most of the wood being cut (around 50%) is being used for pulp. Around 43% is used for lumber. This is down from 51% in 1999. Sawmill technologies can now recover more of a log and can use smaller diameter wood than in the past. Mill closures in Maine, however, have caused more softwoods to go in the pulp pile in the last few years. Nearly 7% of the wood is going for biomass. Markets for low-quality wood are thus consuming 57% of the volume of what is cut. It has been argued that to improve the quality of a forest, one needs markets for low-quality wood. Maine landowners have certainly been cutting plenty of pulpwood and biomass over the last few decades, but it is not clear that this has been leading to improved quality of forest stands as measured in species ratios, stocking, or acreage in sawtimber (which measurements we will discuss later).



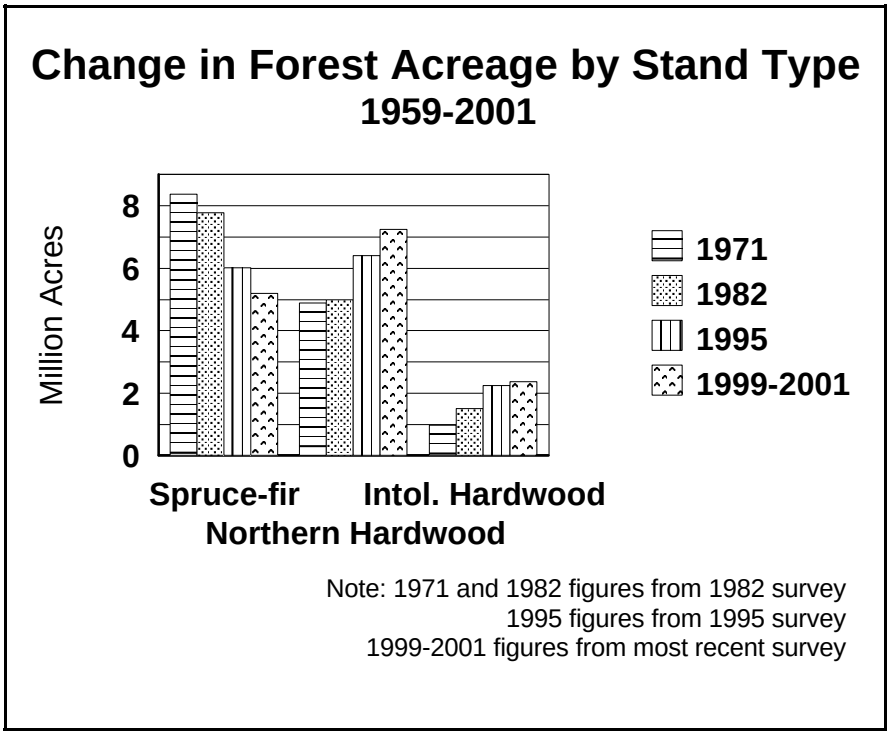


How much is being exported unprocessed? During the 1990s, imports have generally been greater than exports in Maine. Most of the imports have been pulpwood, but biomass markets are also a net importer. Most of the exports have been sawlogs. In 2001, however, Maine was actually a net exporter, as the rate of export of sawlogs increased, while imports decreased.

Indeed, certain species of sawlogs are being exported unmilled at a very high rate. The biggest examples are 61% of spruce-fir, 53% of yellow birch, and 52% of hard maple. Most of the exports are to Quebec sawmills. These exports represent a loss of potential value-added processing and support jobs, as well as income and property tax revenues that would go to help support local and state governments.



A Round Table to Study Economic and Labor Issues Relating to the Forest Products Industry report from the legislature in early 2002 gave suggestions that could help lower this rate of raw log export by strengthening existing timber processing businesses. So far the legislature has not acted on these recommendations.



How has stand type changed?

The spruce-fir stand type has continued its decline, from 7.8 million acres in 1982, to 5.2 million acres in 2001. The northern hardwood and intolerant hardwood types have increased over the same period. This trend indicates both heavy cutting (leading to regeneration to the intolerants), and high grading (cutting the spruce out of former mixedwood stands and converting them to hardwoods).

The spruce-fir type was once the most widespread forest type in Maine. It now comes in second to the northern hardwood type. Spruce-fir has been the backbone of both the pulpwood and sawlog economies of the state.

It is possible that the spruce-fir type may start to rebound as the vast acreage of young softwoods starts to mature. This softwood regeneration is dominated, however, by balsam fir. Of all trees between 1 and 2 inches, 40.8% are fir. Of trees between 2 and 3 inches, 36.2% are fir. Of trees between 3 and 4 inches, 32.8% are fir. Balsam fir is a relatively short-lived tree that is most vulnerable to the spruce budworm, an insect that caused massive mortality in the 1970s and 1980s and led to multi-million acre pesticide spray programs in Maine and Canada during the outbreak. Fir is also vulnerable to rot, windthrow, and balsam woolly adelgid.

How has stocking changed?

Stocking is defined as, "The relative degree of occupancy of land by trees, measured as basal area or the number of trees in a stand, by size age, or spacing; as compared to the basal area or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard." The USDA Forest Service used 5 stocking classes:

Nonstocked is < 10% stocking,
Poorly Stocked is > 10% and < 35% stocking,
Moderately Stocked is > 35% and < 60% stocking,
Fully Stocked is > 60% and < 100% stocking, and
Overstocked is > 100% stocking.

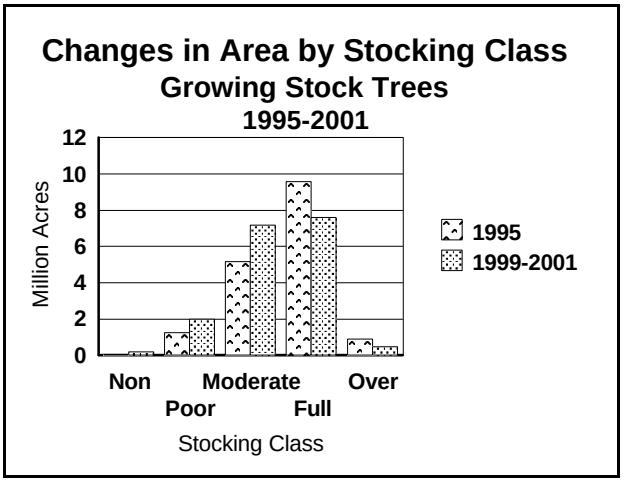
These standards correspond somewhat to the A, B, and C lines used by silviculturalists for thinning. The A line is average maximum stocking. The B line (around 60% of the A-line) is

recommended minimum stocking for adequate growth response per acre. The C line (around 40% of the A line) is the minimum amount of acceptable growing stock for a manageable stand.

As shown in the charts to the right of this page, the number of trees it takes to reach a given stocking standard depends on the average diameter of the trees in the stand. With smaller diameters, it takes more trees to fill the growing space.

The Maine Forest Service, in its summary of the latest inventory data stated that "87% of the timberland area is in desirable stocking classes (moderately stocked and fully stocked), essentially unchanged from the 1995 estimate."

There are a few problems with this statement. First, it asserts that 35% of full



stocking (which can be below the C line) is "desirable." Second, fully-stocked stands declined from 57% of all acres to 44% while moderately stocked and poorly stocked stands increased in percentage. This is not desirable. This decline in fully stocked stands between 1995 and 2001 is continuation of a similar decline towards lower stocking classes that happened between 1982 and 1995.

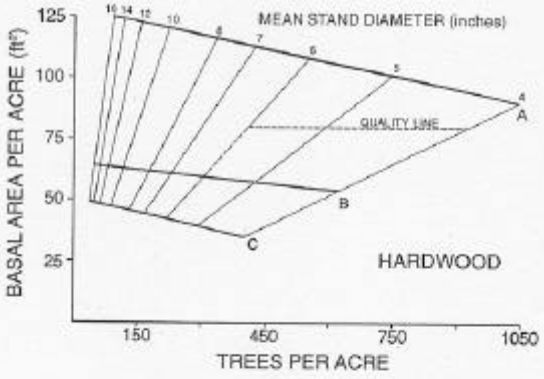


Figure 1.—Stocking chart for northern hardwoods is based on trees in the main crown canopy. The A line is average maximum stocking. The B line is recommended minimum stocking for adequate growth response per acre. The C line defines the minimum amount of acceptable growing stock for a manageable stand. The quality line defines the stocking measure in young stands for maintaining quality development.

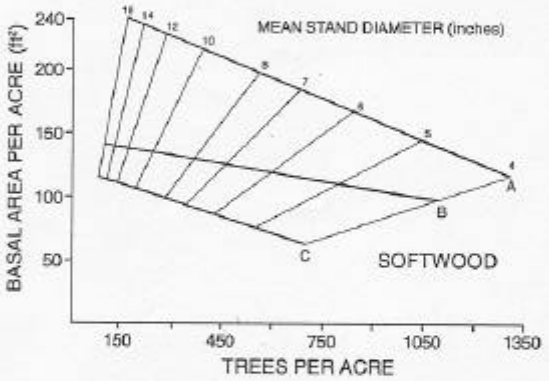


Figure 2.—Stocking chart for spruce—fir stands is based on trees in the main crown canopy. The A line is average maximum stocking. The B line is recommended minimum stocking for adequate growth response per acre. The C line defines the minimum amount of acceptable growing stock for a manageable stand.

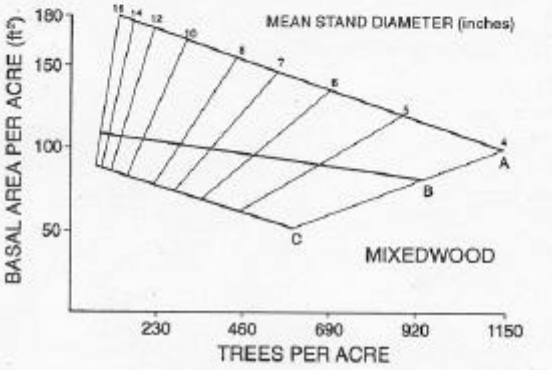
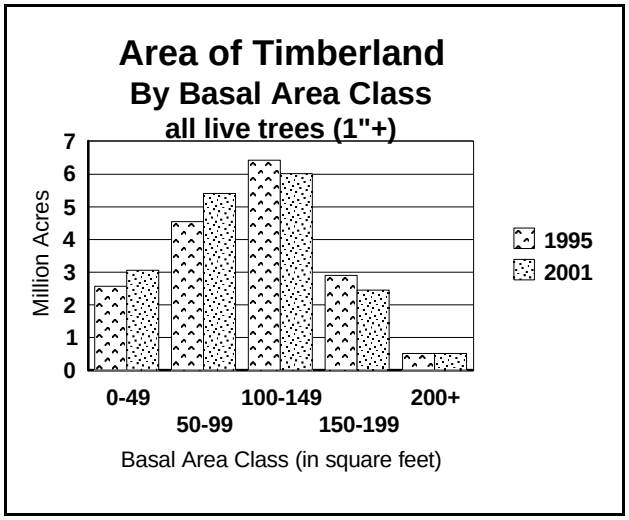
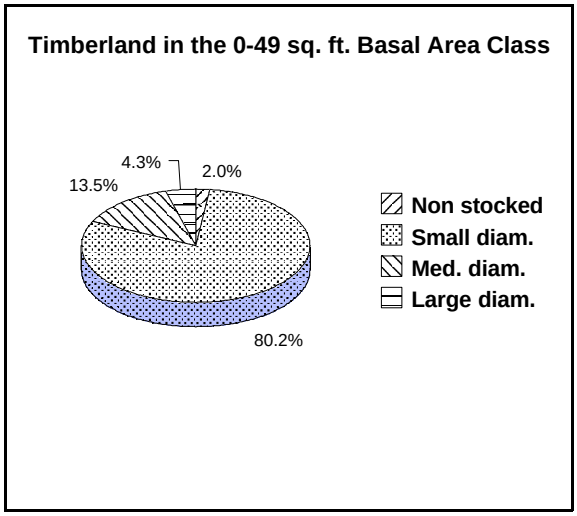


Figure 3.—Stocking chart for mixedwood stands is based on trees in the main crown canopy. The a line is average maximum stocking. The B line is recommended minimum stocking for adequate growth response per acre. The C line defines the minimum amount of acceptable growing stock for a manageable stand.

If one looks at just the basal area class (how many square feet of basal area per acre) rather than to stocking tables, the same trend is evident--a shift from higher stocking to lower stocking. The Maine Forest Service was concerned that there are over 3 million acres of stands stocked with less than 50 square feet of basal area. Further analysis shows that most of these are not understocked stands of larger trees but, rather, stands dominated by seedlings and saplings





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How has stand size changed?

Stand size refers to which size-class of trees constitutes the plurality of stocking in the stand. In the past, the Forest Service referred to Sawlog, Pole, and Sapling/Seedling stands. In the latest inventory it refers to Large Diameter, Medium Diameter, and Small Diameter stands--which are, essentially, the same thing. The technical definition of each of these classes requires at least 10% of full stocking of trees of any size (less than that is considered *non-stocked*) and:

Large Diameter Stand Size Class has greater than 50% stocking of trees having diameters equal to or greater than 5 inches in diameter at breast height (dbh) and the stocking of large diameter trees exceeds the stocking of medium diameter trees.

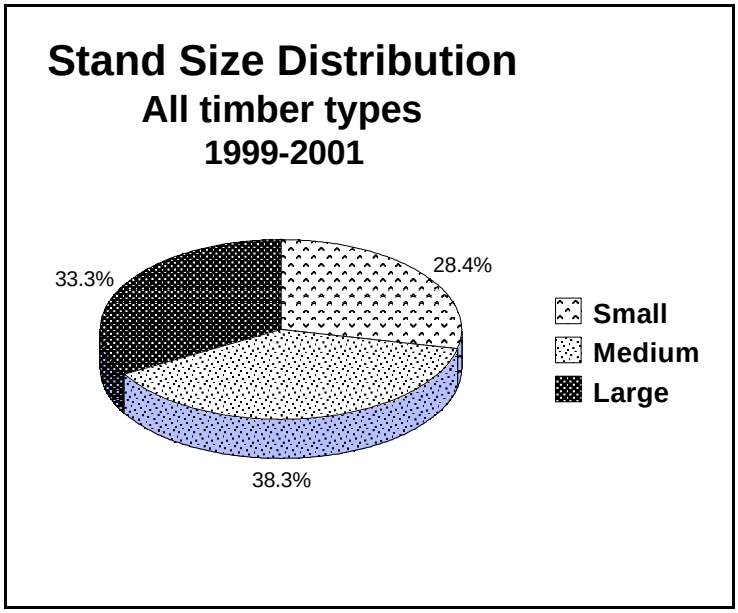
Medium Diameter Stand Size Class has greater than 50% stocking of trees equal to or greater than 5 inches dbh and the stocking of medium diameter trees exceeds the stocking of large diameter trees.

Small Diameter Stand Size Class has more than 50% of its stocking in trees smaller than 5 inches dbh.

Small Diameter Trees have a dbh less than 5 inches. The definition of a *Medium Diameter Tree* for softwoods is a tree with a dbh between 5 and 8.9 inches and for hardwoods a tree with a dbh between 5 and 10.9 inches. A *Large Diameter Tree* for softwoods would have a dbh greater than 9 inches and for hardwoods a dbh greater than 11 inches.

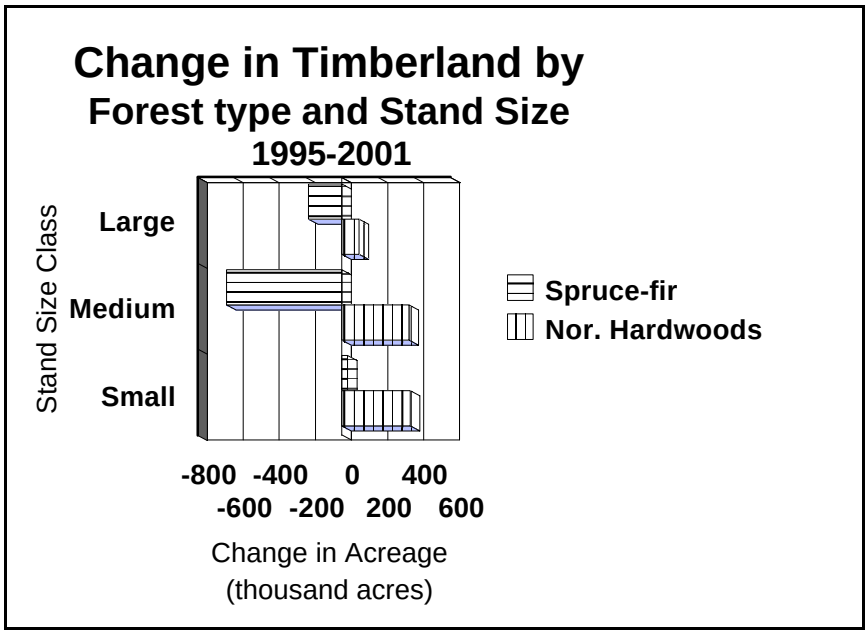
We can see, from these definitions, that a "large diameter stand" might have as low as 2.6% of full stocking in large diameter trees (10% of full stocking for the whole stand with 50% of that in trees larger than 5 inches dbh and more than 50% of that (thus more than 25% of the 10%) in large diameter trees). It is therefore important to combine stocking standards with stand size to determine in reality how many well-stocked stands there are having mature trees.

Unfortunately, the Forest Service does not combine these two statistics in its tables.The inventory does give basal area classes by timber type. From this we can determine that 4.8% of the area of



the spruce-fir type has a basal area greater than 200 square feet per acre. This is a stocking one would expect to find in fully stocked, large diameter stands. There is a much higher percentage of northern hardwoods in high basal area classes (10% more than 150 square feet). These are most likely older mixedwood stands. For hardwoods, fully-stocked large diameter stands would have more than 125 square feet. Such older stands of all types are important for biodiversity. They represented a substantial part of the landscape in the presettlement forest of Maine.

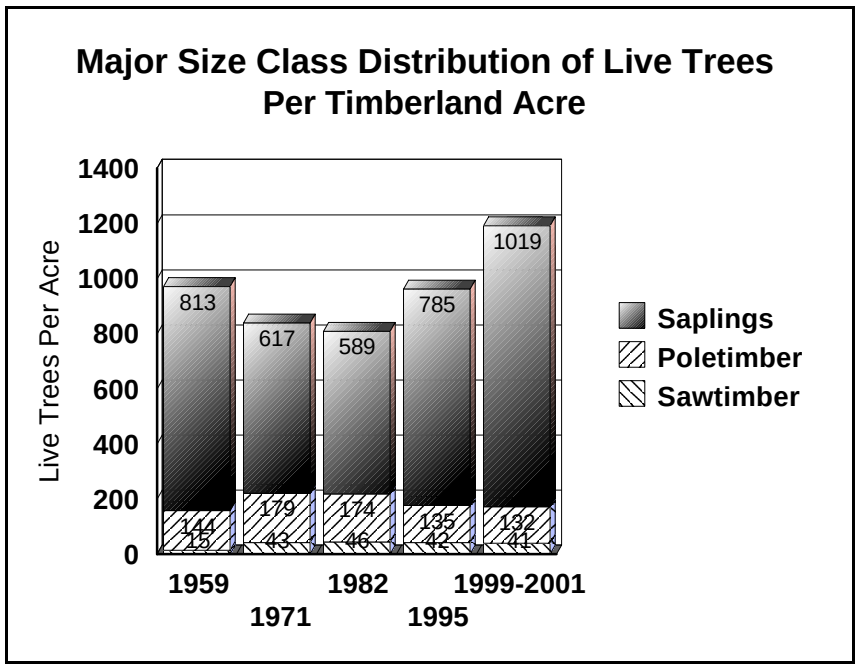
The Maine forest now has over 28% of its area (nearly 5 million acres) in seedlings and saplings. This is an increase of nearly half a million acres since 1995 and is yet another bit of evidence of heavy cutting, despite the reduction in clearcuts.



The two most common timber types are northern hardwoods and spruce-fir, which together make up 73% of the area of the entire Maine timberlands. Except for small-diameter classes, these two timber types had stand size classes that changed in opposite ways.

The spruce-fir type continued its trend (established 1982-1995) of reduced acreage in sawtimber and especially poletimber, while increasing its acreage in small-diameter stands (seedlings and saplings). This does not bode well for the next few decades for any industries depending on larger-diameter spruce-fir.

The northern hardwood type increased in all stand size classes, with most of the increase going into small and medium diameter size classes. A smaller proportion of hardwood than softwood is used for lumber. Since the late 1980s, more hardwood than softwood logs have been cut for pulp. Unfortunately for landowners, pulp mills pay very little for hardwood. Sometimes the price paid is less than the cost of cutting and hauling the wood. Unfortunately for the state, the acreage of wood suitable for hardwood pulp is growing.



If, instead of looking at the distribution of the acreage of stand types, we look at the average distribution of tree sizes per acre, we find similar trends.

There are now, on average, more trees per acre than at any time since these inventories have been done. When one looks at average size class distribution per acre, however, it becomes evident that sawtimber sized trees have declined since 1982, and poletimber sized trees have declined even more dramatically since 1971. Most of this poletimber decline has been in the spruce-fir types. Seedlings and saplings, however, have increased greatly since 1982. If there is good news for industry from these trends, it is in the distant future.

Is cut less than net growth?

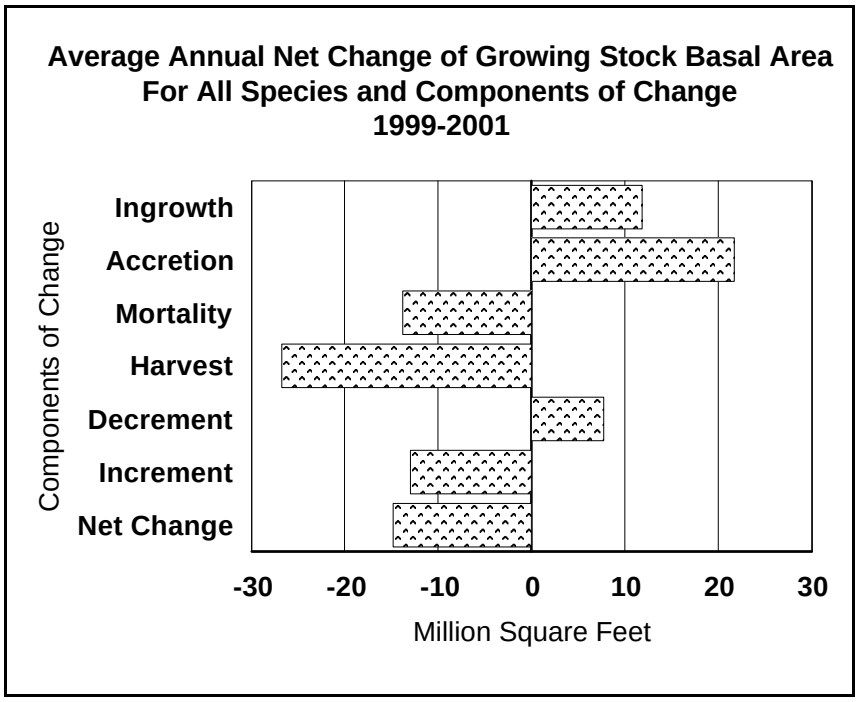
One key criterion for determining if forestry is sustainable is the ratio of cut to net growth. If the cut is less than growth, the inventory will increase. If the cut is greater than growth, the inventory will decline. If the trend of cutting more than growth persists, management will not be sustainable.

The Forest Service uses a number of measurements to determine net growth. *Accretion* is growth on trees that were measured in the previous inventory (trees that were 5 inches or more dbh). *Ingrowth* refers to trees that were less than 5 inches dbh in the previous inventory but are now 5 inches or more dbh. *Cull increment* refers to trees that were previously measured to be sound, but are now considered rough or rotten. Because of the Ice Storm in Maine in 1998, this figure is atypically high. *Cull decrement* refers to trees that were previously measured as culls, but are now considered growing stock. *Mortality* refers to trees that were over 5 inches dbh and were alive in the last survey but are now dead. *Harvest* refers to trees that were over 5 inches dbh in last inventory but were cut before the latest inventory.

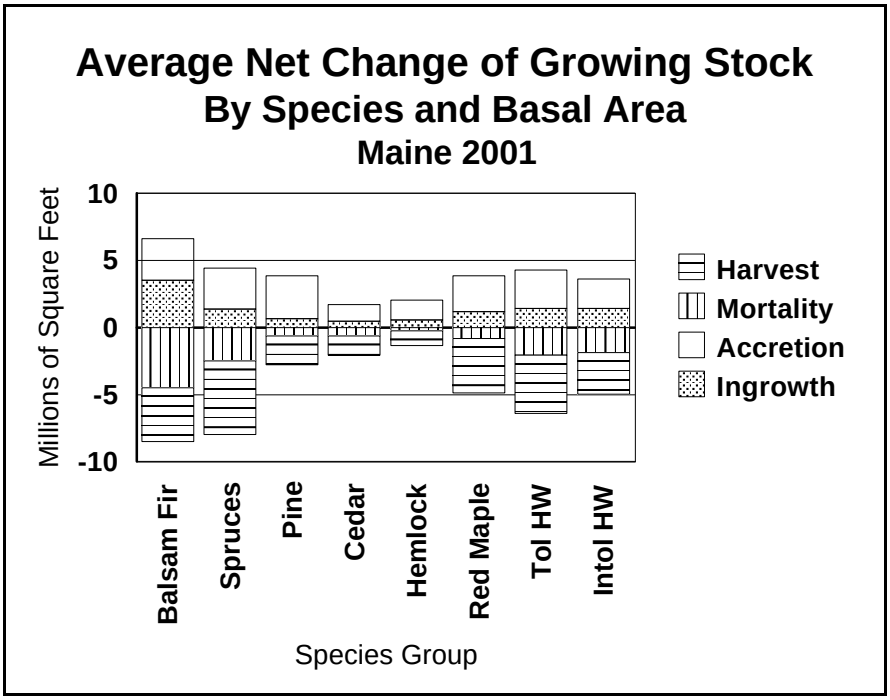
Net growth is determined by adding accretion, ingrowth, and cull decrement and then subtracting mortality and cull increment. Net growth per year is determined by dividing the total net growth between inventories by the number of years intervening. Between 1982 and 1995, cut was greater than net growth, and the inventory declined. Maine was the only state in the region to have such a decline.

The Maine Forest Service did not have enough remeasured plots to create valid measures of change in volume. Instead, for the 2001 inventory report, the MFS made estimates in basal area--a two dimensional, rather than three dimensional figure. These changes in basal area, however, showed that the previous trend of harvest being greater than net growth have continued.

The rate of decline per year, measured by basal area, for all species was around 1.3% from 1995 to 2001. Some species, however, such as pine and hemlock, increased. The biggest decreases, of around 2.4% a year, were for spruce-fir and intolerant hardwood types.

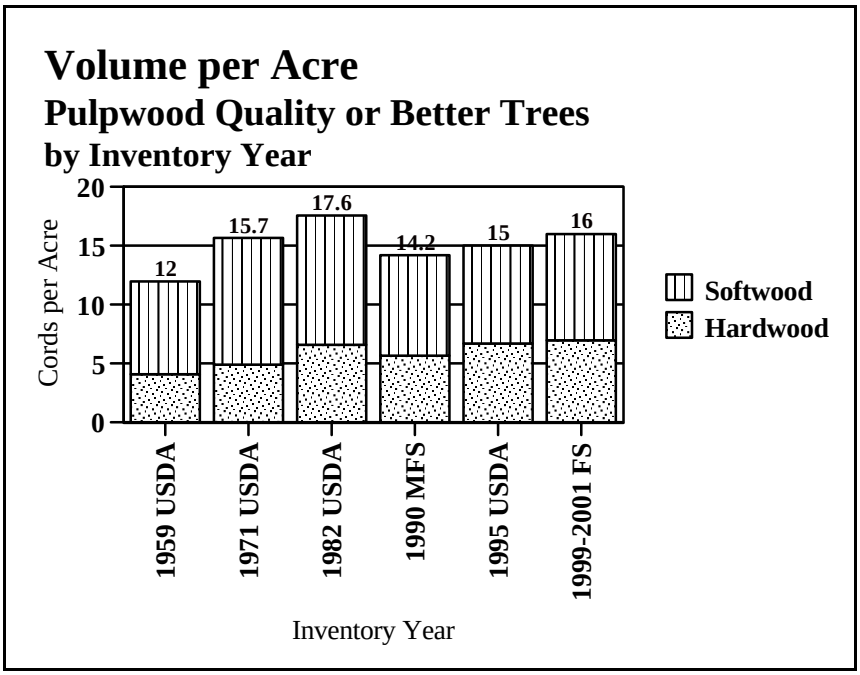


The MFS sees some hope of a rebound in growth, however, in the tremendous ingrowth of balsam fir. The ingrowth for fir was greater than the accretion, showing that a lot of young trees have recently passed the 5 inch dbh threshold. This indicates that there will be greater growth in the future as these trees mature--if they do not get hit by drought, spruce budworm, balsam woolly adelgid, rot, or other problems to which fir is susceptible. Currently mortality in fir is greater than either ingrowth or accretion. The same is true with harvest of fir.



How has volume changed?

The MFS measured more volume per acre (16 cords) in 2001 than had been measured by the US Forest Service in 1995 (15 cords), but these findings contradict the other findings (of lowered percentage of fully stocked stands, increased acreage in seedlings and saplings, and declines in basal area) noted above. This brings into question the reliability of comparisons of the 1999-2001 figures to other inventory years. As in other inventories, the methodology has changed, making comparisons difficult.



I relayed my concerns over these discrepancies to Ken Laustsen, the Biometrician for the Maine Forest Service. His reply, quoted below, suggests that the 1995 inventory may have been underestimated due to problems with calculations of height (used to calculate volume) and to estimates of culls.

Laustsens's reply makes it clear that the changes in sampling protocol and even of definitions of various components of change make comparisons from one survey to the next very difficult, unless the previous figures are recalculated (which has not yet been done for the 1995 figures).

"Historically, successive periodic inventories have never been additive due to multiple levels of change in plot design, definitions, algorithms for category assignments (i.e., forest type, stand size, stocking), and the lack of a 100% remeasurement of the previous plot sample. This lack of additivity is evident over the period from the published 1972 periodic inventory to the published 1982 periodic inventory and then again from the published 1982 periodic inventory to the published 1995 periodic inventory.

To counteract this obvious lack of additivity, the United States Forest Service FIA re-tabulates select Tables under current protocols so that they can be directly compared from periodic to periodic inventory. These select Tables for the 1972 periodic inventory are contained in the published 1982 periodic inventory report and again the select 1982 Tables are contained in the published 1995 periodic inventory report. In releasing its three annual reports, Maine has not followed suit in retabulating select Tables from 1995 raw data for direct comparison to current annualized data collected in 1999 - 2001.

In converting to the national core plot design and the systematic sample of an annualized panel, Maine only retained approximately 50% of the 1/5 acre plot locations measured for the 1995 periodic inventory. For inventory estimates, this sparse location overlap between the sample in the 3rd Annual report and the 1995 Periodic Inventory is further confounded with a potential sampling difference in that we are comparing a single 1995 - 1/5 acre plot to the annualized design of 4 - 1/24 acre plots

surrounding the original 1995 location, but on only 50% of the inventory samples. The remaining 50% of inventory samples are brand new and introduce another level of potential sampling differences.

Ideally, the current design and sample size is robust enough to counteract these potential differences and adequately represent the same forest resource populations as estimated in 1995. My confidence is in the inventory estimates developed from the 1999 - 2001 annualized sample, my basis is that each of the single or combined panels, so far, has estimated similar inventory levels that are singly or collectively significantly higher than the 1995 estimate.

When looking at components of change, there is a further dilution of the data. Only a 1/24 acre sample of the 1995 - 1/5 acre plot is actually remeasured on the annual panel in this first 5-year cycle. MFS is reporting change estimates on a sample that effectively represents only 12% of the previous 1995 data. This small replicated sample is fraught with potential for estimating change differences that do not align with differences in successive inventory estimates. Again, my confidence lies in the components of change estimated from the limited, but available 1999 - 2001 annualized sample data.

I have also noted and tried to evaluate the impact of several variables with measurement discrepancies between 1995 FIA crews and current United States Forest Service and Maine Forest Service FIA crews. I strongly advocate that current crews are better trained, have a more stringent and applied quality control and data collection verification system, and have new measurement protocols that enhance the collection of reliable and consistent data. MFS is concerned with differences in bole height assignments between a very small sample of identical remeasured trees in 1982, 1995, and the 1999-2001 annual panels. The finding is that the 1995 assignment is underestimated for a significant number of trees, regardless of species or total height.

MFS also has a concern with discrepancies in the Cubic Foot Cull Discount percentage between identical trees in the 1995 data and the 1999-2001 panel data. This finding is that the 1995 discount value is overestimated. When combined, the suspicious differences in height and cull discounting cause the selected 1995 individual tree volumes to be underestimated in comparison to the current annual panel estimate of net merchantable cubic feet. While this perceived underestimation of individual 1995 tree volumes cannot be totally verified or corrected, it does cast suspicion on the published 1995 estimates.

To sidestep these suspicions about the current validity of a very small sample being used to estimate components of change in merchantable volume, I decided to report estimates of change based solely on basal area. As a direct construct of the DBH measurement, I was confident that these calculated change estimates would better reflect REAL change for the period of 1995 through 2001."

II. Changing Direction

In just half a decade, the forest has shown continued trends in reduction in spruce-fir acreage, reductions in fully stocked stands, increases in small diameter stands, and cut levels greater than net growth. These trends are evidence of reliance on heavy cutting and diameter-limit cutting that have been steadily degrading forest quality and value. On the use side, an alarming trend is in the percentage of unmilled high-value sawlogs that are being exported. The percentage of the landscape in large-diameter, well-stocked older forests is very low, especially for the spruce-fir type. In the presettlement forest, such older stands (more than 150 years from last heavy disturbance) represented the majority of the landscape.

These trends need to be turned around to create a policy that encourages better stocked forests with higher quality timber, more value-added processing in the state, and a trend towards having more late-successional forests in the landscape.

The Maine Forest Service has a number of policy tools that could be used to move towards these directions. These tools include: research, data collection, demonstration, education, regulation, tax incentives, easements, and certification of landowners and loggers, market assistance, and changed consumption patterns. Many of these tools have been in place while the long-term trends of degradation have continued. If these tools are going to work to reverse the negative trends, changes will have to be made. In this section I will briefly outline some of the needed changes.

A. Policy tools

Research

To do ecosystem-based forestry, we need to better know how ecosystems function. The forestry experiment needs a control. Such controls, or reserved forests, need to be in every timber type and region of the state. They need to be big enough to sustain both the largest expected catastrophic disturbances (so the full range of successional stages are not truncated and habitats and associated species lost) and large enough to sustain viable populations of all native species that would be part of the forest ecosystem. Maine does not currently have such a reserve system.

We also need more research on logging technologies and techniques that reduce impacts to residual stands. Current technologies, such as feller bunchers and grapple skidders, can remove 25% of the forest just for trails.

The Penobscot Experimental Forest has decades of research comparing selection to diameter-limit, shelterwood, and commercial clearcuts. Simulated older forests with a higher content of large-diameter trees is a newer concept and needs more research.

The University of Maine's Cooperative Forestry Research Unit, while it has done valuable research on soils and tree growth, has too much of an emphasis on such items as herbicides, planting, fertilizing, and other industrial-agricultural style treatments to forests. Such research is applied on a minority of the forest in the state--mostly on industry land. State funding would more appropriately be directed toward research with more benefits to all landowners and to restoration of forest ecosystems, not to stand simplification and expanded pesticide use.

Data collection

To know where we are headed we need to know where we are and have been. The key is to make sure that the most essential data for measuring improvement are not only collected, but adequately analyzed so that they are more transparent to the public.

While the annual inventory will be of great help to understand where we are, it is frustrating that inventories in the past are not considered comparable. At some point, one would think that inventories could be standardized so that the public could have a better moving picture of inventory changes.

The annual inventories are helpful to determine the stocking, volume, and quality of the whole forest, but we also need more data about the status of recent cutting. A starting point would be more accurate reporting of silvicultural activities. The Maine Forest Service used to report acreage of diameter-limit cuts and single species cuts along with selection. Now this is all considered "selection," which is not only an improper use of terminology, but also unhelpful. The MFS could clearly define the terms so that landowners or their foresters know which category to use in filling out the forms.

The MFS did a survey of cutting in Maine from 1991-1993 that had data about pre-harvest and post-harvest stocking as well as post harvest quality. Such random sampling is the only way to monitor changes in forest practices, since the silvicultural reports do not include such information. A one penny per acre fee for forest landowners would easily pay for such monitoring.

Demonstration

Maine has a number of demonstration forests including the Baxter State Park Scientific Management Area, The Bureau of Parks and Lands, and the Penobscot Experimental Forest. The first two are certified under Forest Stewardship Council. The state has the opportunity to use these lands to demonstrate and document management that improves growth, quality, and value while protecting biological and social values. The state can make its management more visible to the public and document costs and benefits--eventually over long time periods.

The state can also use these lands for workshops and trainings for loggers to do low-impact logging. The state can measure progress towards lowering impacts to residual trees, soil and water. The state can show, on its own lands, how to pay loggers to get the best results. If the state does not demonstrate exemplary forestry, it cannot expect private landowners to do so. If it is not economically viable for the state to do exemplary management, that would indicate a problem for private landowners as well and would indicate areas in need of reform.

Education

The state can educate the public in a number of ways. One is to inform the forestry debate with facts gathered through state studies. The other is to give information to landowners and the public on how to improve forest management. Unfortunately, in regard to the first goal, the state has a bad habit of putting a spin on data to make things look better than they are. Here are just a few examples (from *The 2001 Biennial Report on the State of the Forest* as well as annual silvicultural reports and the 2001 inventory report):

- most cutting in the state is by the "selection" method;
- "liquidation" cutting (as narrowly defined by the MFS) occurs on a small percentage of Maine's cuts (3-12%) and mostly happens in organized townships--what companies like

Georgia-Pacific and other large landowners in the unorganized territories did (leaving poorly-stocked stands over hundred of thousands of acres and then selling the land) was not liquidation;

- the fact that cut has been greater than growth for many years, leading to a shift in stand structure towards younger age classes, is not a problem over the long term;
- a young forest is a vigorous and healthy forest (so it must be OK that we have 5 million acres of seedlings and saplings and old growth must be decadent and sick?);
- "desirable stocking" (moderate plus full) has remained the same (even though fully stocked stands have declined);
- acreage of the two most common forestry types (spruce-fir plus northern hardwoods) has remained stable (even though spruce-fir has declined);
- each acre sprayed with herbicides can be considered another acre in "intensive management" (which, supposedly, leads to yields of more than 0.8 cords to the acre per year) (to be discussed later);
- we have reached the limits to regulatory approaches (to be discussed later);
- certified acres are sustainably managed, as are acres cut by certified loggers, or acres where the cutting is supervised by foresters (to be discussed later);
- easements protect the forest (to be discussed later); or
- the Tree Growth tax is working and needs to be stabilized (to be discussed later).

The MFS needs to be more forthcoming about the trends that are leading to degraded forests and lost jobs. The MFS also needs to be more forthcoming about the shortcomings of various initiatives it is endorsing. By not doing so, this public agency has hindered attempts to reform the system.

The MFS has recently been working on improving its second educational task--informing landowners about better management opportunities. State foresters have developed and are distributing literature and have also made materials available on the Web. It is too early to assess the impact of this material.

Regulation

The 2001 Biennial Report draft claims that it has become “clear,” “that we have reached the limits of what a prescriptive regulatory framework has to offer.” This is an extraordinary statement given that current regulations under the Forest Practices Act hardly deal with silviculture (issues such as stocking, species, quality, size, etc.). Instead, the FPA deals mostly with the size and distribution of clearcuts over the landscape. Since clearcuts, by MFS definitions, only make up less than 3% of all cuts, the FPA has almost no influence on most of the cutting in the state.

Other states have gone much further along regulatory lines Maine has not yet addressed. Vermont, for example, has a heavy cutting bill (triggered when cutting goes below the C line) and a land gains tax designed to lessen the incentive for liquidation cutting.

Despite this statement on the limits to regulation, the MFS has recently proposed new regulations on riparian zone management. Unfortunately, these new proposed rules do not live up to some of the stocking recommendations for small streams agreed upon by the Maine Council on Sustainable Forest Management and the Maine Forest Biodiversity Project.

Tax incentives

The 2001 Biennial Report argues that attempts to change the Tree Growth Tax are destabilizing the program. The author makes little attempt at explaining why so many efforts have been made to change the Tax. The answer is that, as now interpreted, the Tax has neither led to sustainable forestry nor has it deterred widespread subdivision and development. Many people question whether the benefits justify the millions of dollars of tax shifts each year.

Currently the only requirement in Maine is for a forestry plan that has no serious silvicultural standards and that no one has to see. There is no effective mechanism to check for compliance. A requirement for a management plan that is designed to improve stocking and quality over the long run and a provision for a random sampling by the MFS to check for compliance would go a long way to prevent some of the worse abuses to the system. Rather than continue defending a program that is giving questionable public benefits, the MFS could take a more proactive stance and suggest that the program be stabilized in a form that actually leads to desirable results that the MFS can check on and measure.

The MFS has, as one of its benchmarks of sustainability, the percentage of cutting supervised by foresters. The changes in Tree Growth, requiring a management plan, have led to more forester involvement in smaller ownerships. It must be remembered, however, that industrial landowners have had, for many years, a high percentage of cuts where there is a management plan and forester involvement. Does the MFS have information that shows that these lands have low stand damage, minimal highgrading,

The need to add "strings" to the Tree Growth Tax

The Tree Growth Tax in northern Maine has neither stopped large-scale development nor ensured "sustainable" forestry. During the 1990s, for example, tens of thousands of acres of former Diamond lands were subdivided, stripped of timber, and sold--all the while the land stayed under Tree Growth. The only penalties were on the fraction of land sold as house lots (often only ½ acre).

According to statistics gathered from reports by the Northern Forest Lands Council, Maine has 60% of the four-state Northern Forest region's land, but 89% of the land taxed under current use. One might expect that Maine would have the least development and the best management--if there were a correlation with low tax rates and these issues. The Council's research, however, found that between 1980 and 1992, Maine's Northern Forest Lands had 96% of the parcelizations, 91% of the subdivisions, and 76% of the conversions in the four-state region.

Between 1982 and 1995, according to US Forest Service inventories, Maine was the only state in the region to have a decline in inventory. The declines were greatest in the counties having the highest percentage of lands in current-use taxation. While the spruce budworm was certainly a factor in this decline, in some of these counties--Franklin, Somerset, and Piscataquis--the declines were in hardwoods as well as softwoods. As far as I know, the budworm did not feed voraciously on hardwoods in those counties. The state also saw a decline in the percentage of #1 grade hardwood sawtimber during this period. I would not go so far as to say that low tax rates *caused* poor forestry, but it certainly did not *prevent* it.

The heavy cutting of the 80s and 90s led to a decline in inventory and a shift over hundreds of thousands of acres from softwood to mixedwood and hardwood. The result was lower tax rates. One could hardly call this an incentive for sustainable forestry.

A study on "NIPF Tax Incentives: Do They Make a Difference?" by Charles Brockett and Luke Gebhard in the April 1999 issue of the *Journal of Forestry* found no significant correlation between lower-tax rates and improved forestry. The authors concluded that the tax program studied, "has functioned as a windfall for participating landowners without providing commensurate return for the rest of the area's citizens." Based on their findings, however, they did not reject current-use tax programs. Instead, they concluded that there should be *more* strings attached: "For example, participating owners could be required to have a *meaningful* management plan with effective oversight of *compliance*." (their emphases)

better stocking, improved species ratios, and improved average stand quality as a result? The data from the USFS 1995 inventory showed the highest cut to growth ratio and biggest drop in inventory on industry lands.

Best Management Practices (or BMPs) are recommended standards to protect water from siltation. Despite their name, BMPs are not the "best" one can do. They should more be looked at as a floor, rather than a ceiling. Indeed, a recent report on compliance found that in 35% of the cases that BMPs were used appropriately, the practices were ineffective at stopping soil movement. Astoundingly, the report found that BMPs were appropriately used 37.9% of the time with forester involvement, but 46.2% of the time with no forester involvement.[1] Unfortunately, there are still too many foresters who have more cellulose, than moral, fiber.

Easements

The state has millions of acres under, or proposed to be under, "conservation easements." While these easements have been described as "protecting" or "preserving" the forest, they are mostly designed to limit parcelizations and restrict development (mostly to buildings related to forest management or recreation). The mega-easements (over tens of thousands or hundreds of thousands of acres) are often located, however, in areas where there are no public roads, utilities, or amenities. There is very little threat of residential or business development in such remote areas. The biggest development threat in such areas is seasonal camps near water bodies.

Some of the water bodies in the areas to be “protected” already have protection through existing easements (West Branch of the Penobscot), or through LURC zoning (remote ponds). There are also LURC regulations to protect shorelands, deer yards, and sensitive mountain terrain. While it is admirable that some mountain slopes will be bought outright, it is not clear how threatened these areas are--in any case, they make up a small minority of the land to be “protected.”

Some of these mega-easements protect the status quo of industrial forestry rather than create a new level of protection that creates opportunities (such as unmanaged forests or non-motorized recreation) that currently are lacking. The promise that forests in areas with easements have to be managed “sustainably” rings a little hollow to those familiar with the difficulty of establishing standards and monitoring them. While landowners have previously paid to be certified through FSC, now the state is proposing that the public will pay landowners to be certified under, in many cases, looser standards that allow pretty much management as usual.

The “great deal” of lower immediate costs of easements over full-fee purchase may not be so great when one considers the annual costs of monitoring the easements and managing recreation. The costs increase as the terms (such as “sustainable management”) become more complex. Easements have their place in high-development-threat regions, but the mega-easements being created and proposed create the illusion of protection at a high cost--discouraging real protection in the same region.

Certification

Accrding to the Biennial Report, around 6.3 million acres are either certified or on the verge of certification by either Forest Stewardship Council (FSC) or Sustainable Forestry Initiative (SFI).

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[1] *2000-2001 Maine Forest Service Report on Forestry Best Management Practices Use and Effectiveness in Maine*, March, 2002

The Biennial Report assumes that because a landowner is audited by a third party, the management is sustainable and the certification is somehow valid.

Are the certifiers and standards "valid," however, if the on-the-ground results are poor? Are the acres that are, or will be, certified in better shape in terms of stocking, quality, volume/acre, or cut/growth ratios than the rest of the forest? Are we looking at the certification of actual past and present practices or the certification of promises that the landowner will do better in the future? Is the certification of promises "valid"? Is the certification of standards chosen by the landowner "valid"? Is certification "valid" if the landowner can choose (and/or has veto power over) who will be the on-the-ground certifiers? Is the certification "valid" if landowners who are getting certified are on the committee that writes the regional standards and have veto power (through consensus) over standards they do not like?

By far, most of the acres certified (or about to be certified) belong to large landownerships, including industrial lands. We have already determined, however, that large landowners do most of the clearcutting and herbicide spraying, which may not be what consumers expect when they buy certified timber products. Industrial landowners have a disproportionate share of the acres of seedlings and saplings and have the lowest growth/acre/year of any landowner class and the worst cut/growth ratio.

Certification is a relatively new phenomenon and standards are still controversial and evolving. While establishing standards and certifying that landowners are meeting those standards is an approach with promise, much depends on who sets those standards, what the standards are, and who interprets the standards. Currently, none of the certification systems has clear, measurable, standards in such areas as targets for landscape in late-successional stands, stocking targets, species shifts, percentage of land in trails, or degree of residual stand damage.

The state does have clear, measurable standards for "Best Management Practices," and all certification systems require that loggers follow BMPs. However, a recent state report on BMPs found that "commercial landowners" (industry owned or large landownerships managed primarily for commercial timber production) only used BMPs appropriately 30.5% of the time. Most of the "commercial landowner" acreage is certified. Non-industrial private landowners (few of whom are certified) used BMPs appropriately 45.6% of the time.[1]

The MFS is using another indirect indicator with the percentage of loggers who have been certified by Certified Logging Professionals (CLP) to have gone through a 4-day training. What evidence, however, does the MFS have that the percentage increase in loggers who have this training has led to a commensurate change in percentage of logging damage? Training alone does not solve logging problems.

Loggers need to be paid an adequate wage so they can take the time to take care. Unfortunately, real (inflation-adjusted) wages have fallen over the past few decades. While demands for better logging are increasing, the pay incentives to do such logging, or even stay in the business, are decreasing. If the state is serious about reducing logging damage and encouraging more state citizens to take up logging as a profession (rather than import forest workers from Canada or Central America), it will have to address the issue of low wages. A starting point would be to follow the recommendations of the legislature's Round Table to Study Economic and Labor Issues Relating to the Forest Products Industry.

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[1] *2000-2001 Maine Forest Service Report on Forestry Best Management Practices Use and Effectiveness in Maine*, March, 2002, p. 8.

Market Assistance

The state of Maine is losing enormous value-added opportunities as a large share of wood of high-value sawlogs is being exported unmilled. The state could do much more to help existing medium and small producers become more efficient and more competitive. Often these smaller producers do not have the expertise in marketing that larger producers have.

The state can also do a better job at creating markets for local producers by finding ways to close the leaks in local economies. We are currently importing wood or energy that we could be producing ourselves. Import substitution could create new markets as well as save money.

For example, the University of Maine has also been exploring ways to use what is currently low-value wood to make laminated timbers that are exceedingly strong. Many of the products developed by the University of Maine are being produced out of state. The state could explore ways to encourage production in state from Maine wood.

Many public buildings, such as schools, could be heated by wood energy. This could create a market for waste wood from mills, such as edgings or sawdust. Using wood for heating, where up to 80% of the energy can be captured, is much more efficient than using wood for electric generation, where more than 2/3 of the energy can be lost as waste. The legislature's forestry Round Table has a number of suggestions relating to improved marketing assistance that would be worth following.

B. Directions

Improving yield with low-impact forestry

In the Biennial Report, the Maine Forest Service only lists acreage of "high-yield silviculture" in its section on "silvicultural trends." There is no mention of improvements of other silvicultural practices. The MFS defines high-yield silviculture as "the management of stands where spacing (stocking), density and species composition are controlled via significant investment in pre-commercial treatments such as planting or spacing, for the purpose of increasing timber yields to at least 0.8 cords/acre/year (mean annual increment)." The *mean annual increment* (or MAI) is the average growth of the stand over the entire rotation, as opposed to the *annual increment*, which is the growth for a given year. In the Biennial Report, the MFS estimated that by 1999, 4.7% of Maine's timberlands were in high-yield practices (determined by adding acres of herbicide release, pre-commercial thinning, and plantations).

In the minds of MFS officials, increasing this acreage is a good thing. Indeed, various policy recommendations have proposed rewards to landowners who practice intensive management. There were recommendations, for example, in drafts of the Maine Council on Sustainable Forest Management to allow those who used intensive practices to have less land in older forests. The Compact, which went up for referendum twice in the 1990s, had a provision that allowed landowners to clearcut a higher percentage of their land base per year if they followed the clearcuts with intensive practices.

In 1998, the MFS did a timber supply projection that showed that over the next 50 years, if then current levels of cutting and silviculture continued, there would be a long term deficit in the balance between annual growth and harvest--which the MFS considered unsustainable. The MFS stated that investment in intensive management was an important strategy for achieving a sustainable cut. Some researchers have been advocating a Triad of extensive forestry, intensive

forestry, and reserves. The intensive practices are supposed to increase yields so much that they can free up surplus land for the reserves while leaving the level of cut undiminished.

There are a lot of problems with this approach to increasing timber yields, however:

- By far the bulk of "high-yield silviculture" in Maine has been herbicide spraying. Not every acre sprayed once with herbicides, however, is going to have a yield of 0.8 cords/acre/year because some of these acres have spotty stocking of softwoods, or have a resurgence of competition. The MFS is assuming, rather than proving, that all acres treated with intensive practices will have high yields.
- The high yields, if there are any (assuming there are no insect or disease problems in what can be unnatural concentrations of boreal softwoods in Acadian mixedwood or hardwood sites) are in the *future,* not *now* . The heavy cutting of the last few decades that initiates the intensive management has been yielding, so far, seedlings and saplings. Industrial landowners are doing by far the bulk of intensive management. In 1995 these landowners had average growth rates of 15.5 cubic feet per acre per year, which (figuring 80 cubic feet per cord) is less than 0.2 cords/acre/year. In contrast, other private landowners (who did very little intensive management) were averaging around 0.39 cords/acre/year during the same time period. Landowners using intensive practices were thus *lowering* the average growth rate, rather than *increasing* it.
- Landowners who invest in expensive early stand treatments have an incentive to recover their investments as soon as possible by shortening rotations. Thinning helps to create larger diameters faster so the wood can be harvested sooner to recoup the investment. Short rotations of simplified stands, however, are a problem for many reasons.
- Whole tree clearcuts remove substantially more nutrients than bole only clearcuts. After heavy clearcuts, there is nutrient leaching as the soil heats up and organic matter breaks down. Pioneer species (such as raspberries, pin cherries, poplar, and birch) help to slow this leaching. To speed up rotations, however, landowners spray herbicides. Killing the pioneer species reinitiates nutrient leaching. Because of whole tree removals and leaching, rotations should be *longer* to recover nutrients to preharvest levels, not *shorter*.
- Simplified landscapes increase the risk of pest problems, leading to increased pesticide use. Canadian researchers B.A. Pendrel and T.R. Renault wrote that "the belief that the larger monocultures suffer relatively larger, more intense pest problems seems firmly rooted in reality. Not just monocultures are susceptible, but semi-monocultures and unnatural concentrations that replace the natural diverse forest can be detrimental. These problems arise from the destruction of the former complex community and subsequent reduction in natural enemies of insects or barriers to disease spread. Tree pests remaining in a simplified situation are free to increase in the absence of their normal controls."[1] Recently there have been problems with balsam woolly adelgid on intensively-managed fir and yellow-headed spruce saw fly on intensively-managed black and white spruce stands in some parts of the state.
- There is a state policy to reduce reliance on chemical pesticides. Reducing reliance on pesticides is also a theme in some certification schemes. Increasing reliance on plantations, most of which get sprayed with herbicides and have increased susceptibility to insect problems, thus goes against state pesticide policy.

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[1]B.A. Pendrel and T.R. Renault, "Insects and Diseases in Plantations," in R.D. Hallet, M. D. Cameron, and T.S. Murray, eds., *Reforestation in the Maritimes* (Fredericton, New Brunswick, Maritimes Research Center, 1984), p. 138.

- Mean Annual Increment *culminates* (or reaches its peak) when the annual growth equals the average growth. While early stand thinning leads to larger-diameter trees sooner, it also *lengthens* the time it takes to reach the culmination of mean annual increment. Rotations should, therefore, be *longer*, not *shorter* if there is thinning. Research on red spruce thinning in Nova Scotia found that the culmination of the mean annual increment was the same for all spacings, but the culmination for widest spacing (9.5' X 9.5') came *25 years later* than for the closest spacing (4' X 4').[1]
- For even-aged management, one longer rotation produces more volume, and far more board feet, than two shorter rotations. For example, according to *A Silvicultural Guide for Spruce-fir in the Northeast* by Robert Frank and John Bjorkbom,[2] on good secondary softwood sites, one 80 year rotation yields 4.4 times as many cubic feet of wood as one 40 year rotation. The spruce-fir guide did not look at yields in board feet, but the silvicultural guide for northern hardwoods shows that the mean annual increment measured in board feet culminates decades later than that measured in cubic feet and is more than 100-120 years, depending on site quality.[3] Except for poplar and fir, Maine's public lands have rotations of more than 100 years for even-aged stands because longer rotations are better for yield, quality, and biodiversity. Uneven aged stands are even better.
- Just looking at volume misses an important issue. The quality and value of stands grown "intensively" with early thinnings are inferior for either lumber or pulp to that grown in partial shade in uneven-aged stands. Stands of open-grown, thinned trees have branches nearly to the ground, and lots of taper. Such factors lead to more knots, fatter growth rings, lower density, a higher percentage of juvenile wood, and more lignin than trees grown over longer periods in partial shade. These factors lead to more waste in lumber making and a need for more wood and more energy for paper making.[4]
- The state's definition of "high-yield" only includes follow-ups to clearcuts. Intensive management promoters have claimed plantations of boreal softwoods (white and black spruce) can increase yields per acre by a factor of four or more. But they are comparing estimates based on experimental plots on good sites to typical high-graded stands (full of low-value hardwoods) on average sites. Average yield figures (that account for plantation establishment failures or growth reductions due to insects, drought, or disease) from operational intensive management are not used because such figures do not yet exist.
- Intensive management promoters are also only looking at the yield of softwoods in such stands--ignoring the hardwood growth. They are not comparing plantations on good sites to selection on good sites. On good sites, selection management can yield more than 0.8 cords to the acre per year of wood that is of higher quality and value.
- The silvicultural guide for northern hardwoods gives a net growth (looking only at sawtimber portion of growth) of 55 cubic feet/acre/year for selection cutting on a site index 55 for sugar

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[1] *Fifteen Year Assessment of Thirty Year Old Red Spruce Stands Cleaned at Various Intensities in Nova Scotia*, Forest Research Report No. 2 (Truro, Nova Scotia: Nova Scotia Department of Lands and Forests, 1988).

[2] USDA Forest Service General Technical Report NE-6, 1973, pg. 13

[3] William Leak, Dale Solomon and Paul DeBald, *Silvicultural Guide for Northern Hardwood Types in the Northeast (revised)*, USDA Forest Service, Research Paper NE-603, p. 19

[4] Robert Shepard, James Shottafer, and William Bragg, *Stand Age and Density Effects on volume and Specific Gravity of Black Spruce*, Me. Ag. Exp. Sta. Techical Bulletin 139, 1991

maple (pg. 6). Site index indicates the height of trees at age 50. Site index 55 is on the lower end of site quality for hardwoods. Hardwoods put on volume more slowly than softwoods (although they both put on solid fiber at a similar rate--hardwoods are denser than softwoods). The guide suggests (pg. 18) that mixedwood stands can grow 25% more volume per year than hardwood stands (especially if measured in board feet, rather than cubic feet). That would mean a mixedwood stand on a similar site would put on around 68 cubic feet/acre/year, or nearly 0.86 cords/acre/year.

The northern hardwood guide shows yields for even-aged stands on different site indexes. The stands are periodically thinned to the B line. For site index 70, the mean annual increment for hardwoods for stands averaging 18 inches in diameter at age 92 would be 69 cubic feet. Adding 25% for mixedwood would yield 86 cubic feet/acre/year which is 1.1 cords/acre/year.

- Intensive management advocates are not even comparing plantations to a real control--a site that has not been cut. Such a "control" site at Weymouth Point, was analyzed by UM researcher Robert Seymour in 1995. The chart (below), generated from Seymour's research shows that this stand (which is not "virgin" but has not been cut for a long time) had nearly 75 cords to the acre of spruce and was growing 0.875 cords/acre/year. This growth was on a stand with site index 40, which has much lower productivity than many of the sites chosen for plantations.

  The annual growth at Weymouth Point was still greater than the average growth for both the trees started after 1920 *and* the older cohort of trees, some of which were 275 years old. The mean annual increment had not yet culminated! This means that as time goes on**,** the mean annual increment will *increase*. So, here we have an unmanaged "control" on a not particularly productive site whose growth was a multiple of "intensively managed" industrial lands during the same time period. The high yield from high volumes of bigger trees suggests a more productive model for forestry than short-rotation fiber farms.

Stocking and growth of a fully stocked, two-aged, red spruce stand on the Weymouth Point Control Watershed, T4R12, Maine. Volumes are total stemwood; site index = 40[1]

Cohort	Trees per acre	Basal Area (ft^2/acre	1995 Volume (ft^3/acre	1920 Volume (ft^3/acre)	1990-94 Growth	Mean Annual Increment since 1920
1920-Origin	500	108	2,615	0	52.8	34.9
Pre-1920 residual	180	121	3,368	735	50.5	35.1
Total stand	680	229	5,983	735	103.3	70

- Low-impact forestry (LIF), that tries to maintain forest structures similar to older forests while doing minimum damage during logging, is an alternative approach that could lead to higher yields. LIF can lead to improved growth for a number of reasons:
  - ✓ With less land taken out by trails and yards, more land is available for trees, especially crop trees. For example, if only 8% of the land is used for trails instead of 25%, there will be nearly 23% more crop trees left standing.

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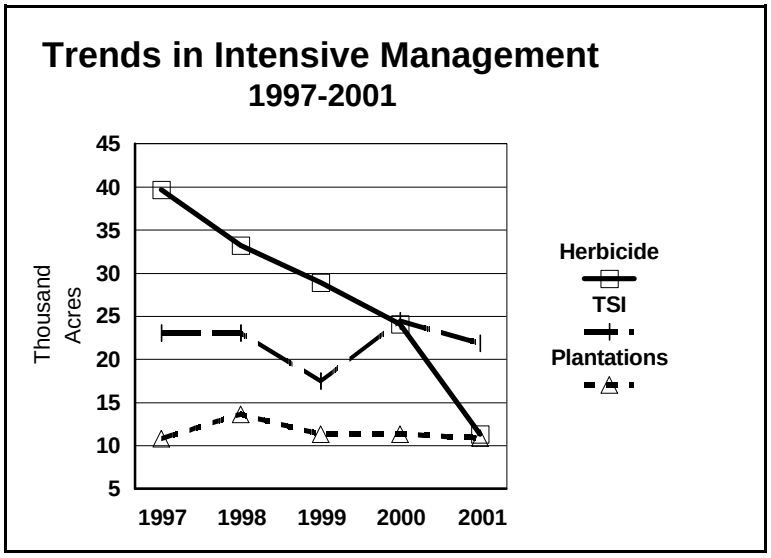
[1]From "Growth and Yield," by Robert Seymour in the *1995 Annual Report of the Cooperative Forestry Research Unit*.

- ✓ LIF leaves well-stocked stands with better potential for growth and quality.
- ✓ LIF focusses the cut on slower-growing, suppressed trees, leaving trees with healthier crowns and root systems and greater growth potential.
- ✓ LIF does less damage to residual trees. Damage to residual trees can lead to lower growth, as the tree spends precious energy compartmentalizing wounds.
- ✓ LIF favors leaving longer-lived tree species that can grow to bigger diameters. Larger trees are more efficient at producing stem per unit of leaves.
- ✓ By leaving better stocking of healthier trees, there is less risk of losses from blowdowns or insects and disease. Net growth (which accounts for mortality), therefore, is improved.
- ✓ LIF avoids the downtime between harvest and stand regeneration that occurs with clearcuts. By encouraging multiple canopies, LIF ensures that there are established replacement trees to fill the gaps caused by harvest of mature trees.
- ✓ The trees growing in the gaps have to reach a canopy occupied by older trees, and thus tend to grow taller than trees that are open grown (where light can be captured better with side branches than with leaders).
- ✓ By focussing growth on higher value trees and higher value products, LIF yields far more *value* per unit of growth.



- As industrial acreage declines, and as the economy weakens, so are the acres of intensive management, especially herbicide spraying. From 1977 to 2001 there was a dramatic decrease in total acreage of intensive management, mostly due to a drop in herbicide use, raising questions as to the stability of future investments in such practices.
- Most of the early-stand thinning and planting in Maine is done by Central American guestworkers. These workers come from some of the poorest countries in the hemisphere and are vulnerable to exploitation. In 2002, 14 such guestworkers drowned while a van driver was rushing them to work (a 2.5 hour drive). As a result, there may be more regulations that make the use of such workers more expensive. Increased costs could lead to even greater decreases in investments.
- Besides industrial landowners, no other landowner class has determined that intensive management (involving large investments in early stand management) is a viable economic strategy on a large scale. Industrial landowners have been cutting more than growth *now* in the hopes of greater growth in the *future*. This is the Accelerated Cut Effect (or ACE). Because the payback from early stand management is decades into the future, these landowners have been able to justify the expenses through either accounting gimmicks (such as tax write-offs) or subsidies (which have been a major factor in Canada).

While industrial landowners may want to maximize softwood volumes for their mills, other landowners, who are selling stumpage, want to grow value. There is a better return from raising sawlogs and veneer, with no investment in early-stand management, than in raising low-value, short-rotation boreal softwoods requiring expensive early-stand costs that are carried for decades.

- Clearcutting to establish plantations now is an odd strategy for dealing with a low in spruce-fir inventory that is already upon us. By the time the plantations are big enough to cut in 40 or so years, the huge acreage of spruce-fir seedlings and saplings that are already established will also have trees ready to cut. A better strategy for dealing with a low supply of mature wood in the more immediate future is to increase growth on existing trees, rather than to start seedlings.
- Simplified stands and short rotations are undesirable for biodiversity. Triad proponents suggest that the higher yields from plantations justify these simplified stands. They argue that having more wood growing on fewer acres permits reserves to be established without lowering the cut. So far, the landowners doing the most intensive management have not volunteered to take land out of production for reserves. Instead, we are supposed to be pleased that landowners are simplifying landscapes and spraying pesticides because of the *promise* this will allow reserves. Higher yields, if there are any, may just be used by the landowners to supply more wood to their mills.
- If there is to be a tradeoff of reserves for intensive management, this raises the question of when the reserves will be established. If the reserves are established *now*, it will be at a time *before* improved growth rates have kicked in. This means that to get the same amount of wood requires cutting *more* acres. But, after taking out reserves, there would be *fewer* acres to cut on.
- If landowners wait 40 or so years for the improved growth, so that fewer acres are needed to produce the same amount of wood, the area available for reserves will be cut-over land. These are not the "win-win" scenarios that intensive management advocates have promised to landowners and environmentalists.

The above analysis shows that an emphasis on intensive management, which is mostly done by industrial landowners, is a misplaced strategy for improving growth and yields for the entire state. Promoting intensive management leads to promoting increased chemical use, simplified stand structures, and exploitation of Third-World labor--all of which the public would like to see *reduced*, not *expanded*.

Partial cutting makes up by far the majority of all cuts in Maine. Most partial cuts in Maine, however, are a variation on diameter-limit cutting, rather than true selection. Diameter-limit cutting is a system of tree removal, not of silviculture designed to improve stocking, growth, or quality. A recent study comparing diameter-limit cutting to selection cutting at the Penobscot Experimental Forest in Bradley, Maine concluded that diameter-limit cutting, "resulted in diminished stand quality, poor control of residual stocking, and unfavorable shifts in species composition. [...] These findings imply that fixed diameter-limit cutting results in residual stands of slower-growing, smaller, and potentially less valuable trees."[1] There is thus more

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[1]Laura Kenefic, Paul Sendak, John Brissette, Kevin Sobal, and Michael Greenwood, "Diameter-limit versus selection cutting in northern conifers," from *Conference Proceedings of Eastern CANUSA Forest Science Conference*, Oct 19-20, 2002, U of M, Orono

potential for improved productivity at a much lower investment with a quicker payback (than with intensive management) by doing real silviculture in partial cuts, rather than simply cutting trees.

Reduced consumption

In the Biennial Report, the MFS brought up the issue of the "consumer consumption ethic." In talking about the consumption ethic and how it conflicts with the "conservation ethic," the report did not mention that the very people who own the mills (and millions of acres of forest) are also promoting the consumption ethic through advertisements. These companies, and the state, tend to assume continued growth in consumption--and project these assumptions with computer programs that have this built-in bias. Then we are told that because consumption (promoted with advertisements) will be growing, we have to not only cut more wood, but also manage more intensively to grow more wood. We can't afford more wilderness. Since the state is involved in these "Trend is Destiny" exercises, it seems odd that it should be pointing any fingers at consumers. The state should, rather, be aggressively encouraging reduction of consumption, along with increases in recycling.

Putting the blame on consumers' consumption ethic takes the blame off of landowners who do the heavy cutting, who can now claim, "The consumers made me do it." There is a demand for every tree in a given woodlot, but woodlot owners do not need to use this as an excuse to cut every tree right now. The landowner responsibility is to manage sustainably. Consumers have to live with what is reasonably available within biological constraints. If demand outstrips supply, then prices will go up--which would lead to more conservation.

Part of the "consumption ethic" is government policies that encourage the production of cheap consumer products. Cheapening resources tends to encourage waste (such as junk mail and unnecessary packaging). To the extent that these products are cheap because labor is underpaid, rivers and air are polluted, energy is squandered, and landfills are overloaded--the market is inefficient. These are external costs that the government can sometimes allow or encourage through subsidies or lax regulations. More expensive products that internalize costs would lead to less waste and more conservation. In a global market economy, however, internalizing costs only in Maine could put Maine companies at a disadvantage. We therefore need international reform.

There is no need to wait for such international reform of market externalities to justify reduced consumption. There is tremendous opportunity *to save money* and resources *now*. Many countries, companies, colleges, and government agencies have already achieved major cost reductions by waste reduction and increased efficiency.

The point of development is not to manufacture and consume more and more products; it is to better meet needs and have a better quality of life. Part of human needs are to have fresh air, pure water, healthful surroundings, and functional social systems. Our economic measuring stick, the Gross National Product, includes expenditures on air and water pollution controls, dumps, prisons, and hospitals as *benefits* to our national "wealth" rather than as *costs* of "illth." A more thoughtful approach for government is to consider impacts on the whole system, rather than benefits to a very few at the expense of the many.

Reducing demand on wood products is a strategy that benefits the whole system. There are possible savings and efficiencies at every step of paper or lumber chains that lead from growing the wood, to harvesting, to manufacture, to consumption. These savings multiply

through the chains leading to major reductions in the acreage required for cutting while still meeting the needs of consumers.

The United States, with less than 5% of world population, uses around 30% of all the world's paper products. Paper use is correlated, to some extent, to Gross Domestic Product per capita, but there are countries, such Switzerland, Finland, Japan, and Sweden that have a higher GDP/capita than the US, but lower paper consumption rates. There is ample room for use reductions in the US with no reductions in quality of life.[1] For example, with writing and copy paper (21% of all paper use in the US):

- There can be major reductions in paper need through more use of electronic communications and information storage.
- Paper use can be more efficient. Copiers and printers can be set for double-sided printing. Paper printed on one side can be used for drafts or scratch paper. Cover pages for faxes could be eliminated. Envelopes can be reused by adding stick-on labels.
- Users can go to lower weight paper (that uses less material to meet same need). Bank of America, for example, saved half a million dollars a year by shifting to a lower weight paper for its ATM receipts.
- More paper recycling means less raw timber needs. The US currently recycles 45% of its paper, which is well below the 70% recycle rate in Germany, demonstrating that there is ample room for improvement. Bank of America saved another half million dollars of waste hauling feels by recycling 61% of its paper.
- There can also be substitution of other products such as kenaf, hemp, or agricultural waste to reduce raw wood in the pulp mix.
- An increasing percentage of the softwood pulp in Maine is coming from sawmill waste. This percentage could increase.
- Paper mills can become more efficient in production with less waste, by upgrading equipment and techniques.
- Timber harvesting could be more efficient with less waste.
- Landowners can grow more wood per acre (as described in last section).

Even giving modest increases in efficiencies at each of these stages multiplies through the chain, yielding major savings. For example, if we give the following savings for each of the items above (the figures are for % of original product needed at this stage)--90% for more electronic communications and storage, 70% for more double-sided uses, 80% for going to lower weight paper, 90% for increasing recycled uses, 95% for using other materials, 95% for using more saw mill waste, 95% for increased mill efficiency, 95% for increased harvest efficiency, and 60% for increased yields per acre (going from 0.3 cords/acre/year to 0.5 cords/acre/year of growth--an easily achievable goal expressed by the MFS in the Biennial Report)--we get a final tally of needing only 22% of the original forest area to meet the original use needs for communicating and storing information.

Savings can be greater than these figures by eliminating unnecessary uses. Do we really need all the current uses of paper? Secondary packaging (almost all of which is unnecessary), and junk mail (which consumers are surely not clamoring to receive) are clearly candidates for major reductions that would result in no hardship to the public. A World Watch paper, *Paper Cuts: Recovering the Paper Landscape*, estimates that global consumption of wood fiber for paper

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[1]Some of the web sources used for this section include: www.woodconsumption.org/products/paper.html, www.marketsinitiative.org.reduction_initiatives.html, www.iied.org/smg/pubs/rethink.html

making could be cut by more than 50% by trimming paper consumption in industrial countries, improving efficiencies in paper making, and expanding the use of recycled and non-wood sources.[1]

With lumber, there are similar chains of savings. For example:

- The average house size has gone from 1500 square feet in 1965 to 2150 square feet in 1997, while the average family size has dropped from 3.3 to 2.6 people.[2] Big houses (over 2000 square feet) use more resources and land for construction and more resources for lighting, heating, and cooling. Much of this increase in size can be considered waste--rooms with single uses (formal dining rooms, for example), or excessively large rooms (bathrooms the size of bedrooms, or large bedrooms that are only used for sleep). Houses, thus can be smaller, but more efficient in use of space, or household size can increase to substantially reduce lumber used per capita.
- House construction can be more efficient in wood use. Engineered wood products can use less material to create products with greater strength (wooden I-beams and laminated timbers, for example) that can build the same area structure with less wood. One source estimates that use of engineered wood can save 70-74% of wood used in a wall and about 50% in an entire house.[3]
- There can be more use of salvaged lumber and building materials (currently, only around 5% of lumber is recycled in the US).
- There can be substitutions of local materials (such as stone, straw bales, rammed earth) for wood.
- Saw milling can be more efficient (band saws yield more wood per tree due to smaller kerf diameter, for example, and computers can aid in more efficient use of a log to make boards and dimensional timbers).
- Harvesting can be more efficient if loggers cut to more precise lengths and cut with less waste and less damage to trees.
- And landowners can grow more wood per acre.

The savings from pursuing such a policy of waste reduction and increased efficiency are more than just dollars. Rather than external *costs*, there would be external *benefits*. There would be reductions in energy consumption, air and water pollution, and global warming. Forty percent of garbage going to landfills is from paper products, a percentage that surely can be reduced. There would be opportunities to eliminate imports of wood products and oil. Inefficient, polluting factories and generators could be shut down and replaced with smaller, more efficient, less polluting substitutes. And there would be more land freed up for other dominant uses besides timber harvesting.

The alternative, trying to meet ever growing demands with ever growing intensification of management, is clearly not sustainable. There are limits to forests and limits to how much forests can produce, even with the most intensive of management. Projecting growth in consumption for a thousand years clearly shows the insanity of such a strategy. We would have to grow trees in outer space, as there would not be enough room for them on earth.

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[1]see www.worldwatch.org/pubs/paper/149.html

[2]Mary Berlik, David Kttredge and David Foster, *The Illusion of Preservation: a global environmental aregument for the local production of natural resources*, Harvard Forest, Petersham, Ma. 2002

[3]Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism: creating the next industrial revolution*, Little Brown and Co., Boston, 1999, p.182

The paybacks for a reduction strategy, therefore, are great. While Maine may not be able to reform the forest-resource consumption habits of the US, let alone the industrialized world, it can certainly be part of the solution rather than part of the problem. The state could start by doing audits of paper consumption its own agencies and publicize its paper reduction strategies and successes. At a time of budget shortfalls, reducing costs while increasing benefits would be a smarter strategy than cutting needed programs.

More wilderness

According to the 2001 inventory, 258,594 acres of productive forest land and 37,006 acres of unproductive forests are "reserved" from cutting. This means that 1.7% of Maine's forests, or 1.5% of Maine's total land is in reserves. If, as Thoreau states, "a man is rich in proportion to the number of things he can afford to leave alone," our state is not wealthy with reserved land. While some more examples of "pocket wilderness" of steep mountain slopes have been added to the mix since 2001, there has not been a friendly attitude toward larger reserves from state officials.

Indeed, current state policy, for the Land for Maine's Future Board, states that “LMF is prohibited by statute to acquire land for which the primary use value has been or will be commercially harvested or harvestable forest land. This does not prohibit the acquisition of conservation easements on working forest lands which allow for timber production while securing public access and the conservation of other natural resource values."

Forest management is a long-term experiment. Scientific experiments require controls, but Maine lacks an adequate representative reserve system on its current public lands and is denied, by statute, purchasing managed forests to fill in what is missing. Reserves are also important for protecting biodiversity, ensuring that the full range of habitat types, including old growth, is represented on the landscape. Reserves can also supply a niche for remote, non-motorized recreation in a state where there is a very small percentage of land set aside for such purposes.

The Maine Forest Biodiversity Project (MFBP)--a group of around a hundred individuals representing industry, government, academia, and environmentalists--met for five years to discuss pro-active ways to protect biodiversity in the forests of Maine. Members of the MFBP recognized that biodiversity could best be maintained by a combination of a reserve system and improved management. The final products of this group included an assessment of biodiversity in Maine, a study of potential ecological reserves on existing conservation lands in Maine, and a book on managing forests in ways that maintain and enhance biodiversity.

The Biodiversity Project established a Scientific Advisory Panel to get guidance on how large reserves should be to withstand disturbances and still support viable populations of species. The panel came up with a minimum recommendation of a system averaging from 5-12 thousand acres per unit. This was significantly less than recommendations from similar panels looking to establish ecological reserves in New Brunswick and Nova Scotia. New Brunswick scientists, for example, came up with a minimum average recommendation of 60,000 acres. The difference, I was told, was due to a focus in Maine on vegetation groups, rather than animal populations. Also, Canadian provinces have a lot more public land with which to work. The second explanation sounds suspiciously political, rather than scientific.

The goal of the reserve system contemplated by the MFBP is to set up representative “benchmark” reserves, rather than a reserve system large enough to maintain or restore biodiversity on its own. There was an underlying assumption, which we in the project were never

given an opportunity to discuss, that the managed landscape “matrix” was sufficient to protect biodiversity when combined with these representative reserves. The project’s own research into the status of biodiversity, however, showed that this “matrix” has a lot of problems.

The Project’s *Ecological Reserve Study Inventory*,[1] which looked primarily at the potential for reserves on existing public lands, came up with a median size of only 1,893 acres for lands that met their criteria. Only 25% of potential reserves had the scientific advisory committee's minimum acreage. Only 23% (16 of the 69 potential reserves) would be "self contained" (have the ecosystem all in reserve boundaries). Only 46% of ecosystem types are represented at least once by geographical area in the potential reserves. In other words, we could stand to have a lot more land in reserves to even meet the minimum standards of protecting representative ecosystem.

In 2001, the legislature passed LD 477, an act that created an ecological reserve system in Maine. the bill has some odd features that might indicate a set back rather than a leap forward. The bill, for example, limits the Maine Bureau of Parks and Lands to use no more than 15% of its lands in an ecological reserve system over the next 15 years. Hunting, fishing, trapping, or snowmobiling would not be restricted, unless there were compelling evidence for a need for restrictions. The bill declares that the Bureau cannot reduce its level of timber harvest as a result of taking land out for a reserve system. The bill further specifies that the Bureau cannot cut less each year than the average cut from the preceding last ten years. This, in effect, forces the Bureau to cut more. If we are to have even the minimum "representative" reserve system envisioned by the MFBP, the state would need to change both its policies regarding land purchase and its policies regarding uses of public lands for reserves.

Setting up a reserve system should not be seen as an either/or issue of lichens against loggers. We need a forest policy that sets up ecological reserves *and* improves forest practices *and* improves the viability of industry *and* strengthens local communities, *and* encourages efficiencies in resource use. It is entirely possible to cut fewer acres, but generate more value and create more jobs if we have a sensible forest policy. Unless we change our direction, however, we will wind up where we are headed.

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[1] McMahon, J. , *An Ecological Reserves System Inventory: Potential Ecological Reserves on Maine’s Existing Public and Private Conservation Lands*. Maine Forest Biodiversity Project, Maine State Planning Office, 1998.

For more information on Low-Impact Forestry, see *Low-Impact Forestry: Forestry as if the Future Mattered,* edited by Mitch Lansky and published by the Maine Environmental Policy Institute, 2002. This book deals with ecological, silvicultural, technological, labor, and economic issues connected with low-impact forestry. It can be obtained from Chelsea Green at www.chelseagreen.com or by calling 1-800-639-4099.

For more information about the book, see www.lowimpactforestry.org.

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