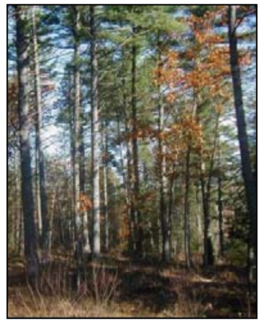
Maine's Forest Resources

Maine Future Forest Economy Project



Current Conditions and Factors Influencing the Future of Maine's Forest Products Industry

March 2005

Prepared for:

Department of Conservation – Maine Forest Service
and
Maine Technology Institute

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MAINE'S FOREST RESOURCES

BY

MAINE FOREST SERVICE
DEPARTMENT OF CONSERVATION

Maine Forest Resources

Overview –Maine's forest resources are at a critical juncture where past and current activities might continue in a business as usual venture or perhaps undergo a redirection to more fully realize the potential of resource productivity, manufacturing capability, and lead to an enhanced forest economy.

Maine has a rich history of collecting, analyzing, and forecasting forest resource issues, in addition to the periodic inventory status. These historic assessments range from some very specific species and impact issues to more generalized and broad-based outlooks. A recounting of these includes the following:

- The earliest timber supply outlook was a 3-page assessment contained in the 1972 published report ***The Timber Resources of Maine***, which provided alternative scenarios and projections of growth and removals to the year 2000.
- The first focused analysis was an attempt in the early 1980's to project the specific impacts of the ongoing Spruce Budworm epidemic and alternative management practices (James W. Sewall Company. 1983. Spruce-fir wood supply/demand analysis. Prepared for the Maine Dept. of Conversation, Augusta, Maine).
- The Mid-cycle Resurvey of 1986 was a follow-up review and status of the spruce-fir resource and it provided a confirmation to the 1983 report (Seymour, R.S., and R. C. Lemin. 1998. Timber Supply Projections for Maine, 1980 – 2080).
- In 1993, the Maine Forest Service published ***Assessment of Maine's Wood Supply***, an interim analysis of both the present (1990) and future supply of forest resources. It was intended to fill an information gap because the next USDA Forest Service Periodic Inventory wasn't scheduled for publication until 1995 at the earliest.
- The ***Timber Supply Outlook for Maine: 1995 – 2045***, published by the Maine Forest Service in September, 1998 was the most intensive and detailed technical assessment of future wood supply, using computer modeled simulations to project growth, harvest, and silvicultural practices.
- The most current modeling project was commissioned by the North East State Foresters Association in 1999, and resulted in the 2002 publication of ***A Forest Model for New York, Vermont, New Hampshire, and Maine***. This analysis included four different modeling scenarios and an expanded ecological insight on the interactions across the entire region and individual state-level assessments.
- The most current published data and analysis on statewide forest resources is contained in the October 2003 release of ***Fourth Annual Inventory Report on Maine's Forest***. Where appropriate, analysis representing the **DRAFT *FORESTS OF MAINE, 2003*** report is incorporated for a better understanding of long-term trends.

Neither the separate nor the combined outcomes of all of these modeling and projection efforts have materialized. That is not to imply that the work was done in vain. Rather as a result of efforts, forest managers began or implemented new management behavior to counteract the sometimes-dire projections.

a) **Status of major forest resource components**

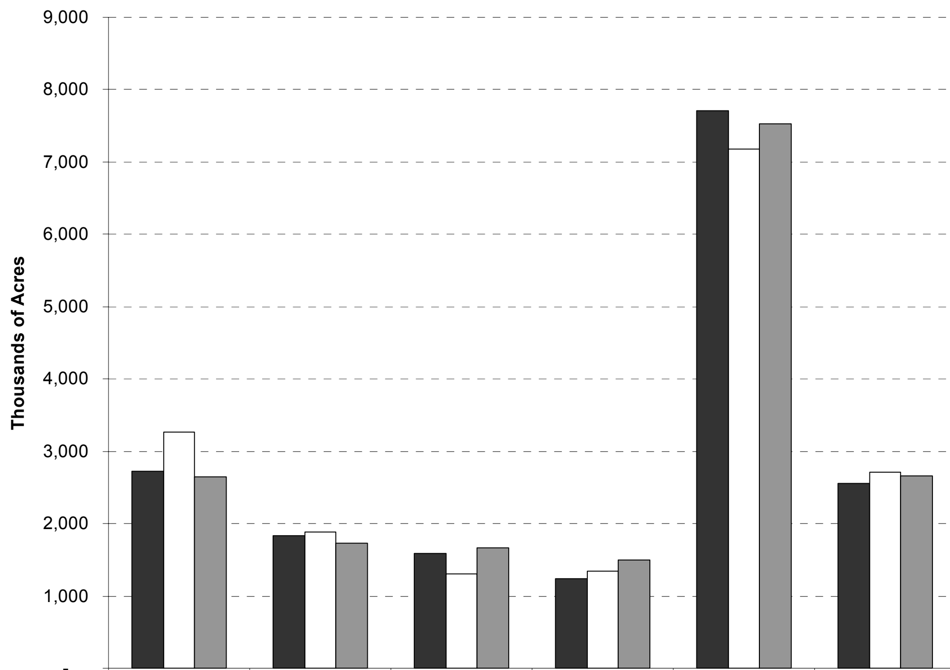
1. Acreage Distribution

(1) Timberland – Over the last 30 years, Maine's forestland base has remained relatively stable and leads the nation, representing 90 percent of all land-based acres. Of all forested lands, 97 percent are classified as being timberland, acreage that is productive, accessible, with harvesting not prohibited. The distribution of these timberland acres are in flux, with conversion losses to nonforested land uses and cover occurring in southern Maine, being more than offset by reversion of agricultural lands to forests in northern Maine.

(2) Ownership – has seen a major shift of approximately 3.5 Million acres in just the last seven years transitioning from the traditional forest industry class to the broad category of non-industrial private landowners. The bulk of this transition has been to a new emerging "Investor" owner class.

(3) Forest Type – there are three major groupings, the northern hardwoods, which are comprised of Sugar Maple/Beech/Yellow Birch, constitute 41 percent of the timberland acreage, while a 30 percent share is classified as Spruce/Fir, and Aspen/White Birch comes in with a 14 percent representation. These types are based on computer-derived algorithms that categorize a type based on stocking (stand density), stand size, and species composition of primarily merchantable sized trees. Because Maine has had a very extensive and intensive harvest experience over the last thirty years, many of these type assignments will prove to be very ephemeral when the plots are revisited over the next 5 to 10 years.

Figure 139. Forest Types for Maine Forestland - 1982, 1995, 2003



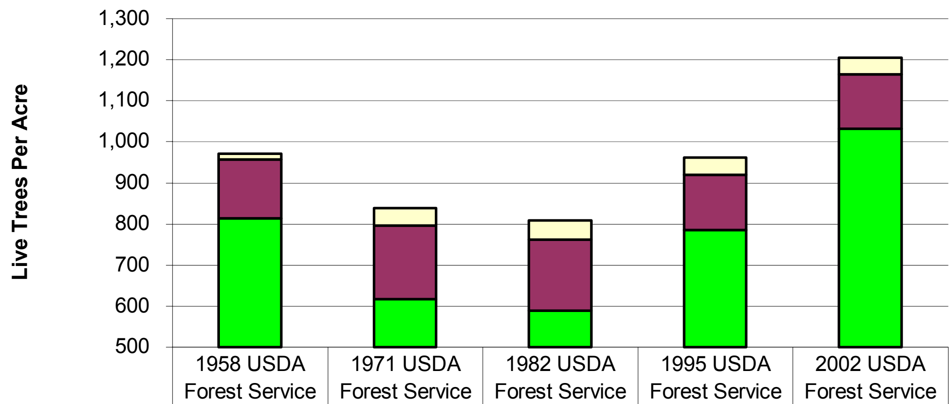
	Beech-Red Maple	Cedar-Black Spruce	Hemlock-Red Spruce	Oak-White Pine	Spruce-Balsam Fir	Sugar Maple-Ash
1982	2,731	1,840	1,590	1,238	7,712	2,551
1995	3,269	1,888	1,309	1,336	7,180	2,716
2003	2,652	1,724	1,667	1,492	7,523	2,659

FIBER Habitat

(4) Stand Size – Historically, the current distribution achieves a very desirable balance with 29 percent of the acreage in sawtimber-sized stands, 42 percent in poletimber, and 24 percent in sapling stands.

2. Tree Distribution – the below Figure 3, from the 4th Annual Report, provides the best depiction and representation of changes in the distribution of tree sizes over the last 40 years. The current high representation of saplings in 2002 is also reflected in the previous discussion on stand size.

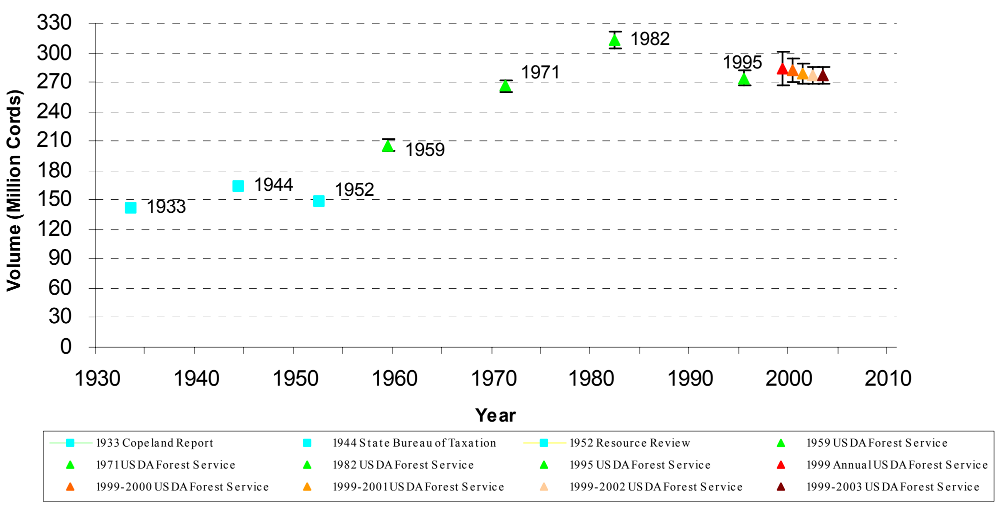
Figure 140. Major Size Class Distribution of Live Trees per Timberland Acre (Average Live Trees/Acre by DBH Grouping displayed)



	1958 USDA Forest Service	1971 USDA Forest Service	1982 USDA Forest Service	1995 USDA Forest Service	2002 USDA Forest Service
Sawtimber	15	43	46	42	41
Poletimber	144	179	174	135	132
Saplings	813	617	589	785	1,032

3. Volume Distribution – can be an extensive discussion depending upon the desired species and product of interest. To provide a more natural progression, the discussion will proceed from the encompassing high-level product of biomass down to the more specific level with estimates of sawtimber supply and quality characteristics for specific species.
    (1) Biomass – There has been a renewed and increased interest over the last few years for this product. Interest comes from such disparate arenas as carbon accounting, availability of fuel stocks for energy, and the potential emerging technology of pyrolysis. In 1995, the overall statewide biomass estimate was 900 Million Dry Tons and included both timber and nontimber components. The equivalent 2002 estimate is 990 Million Dry Tons, with most of the overall 10 percent increase occurring in the sapling component. These are the only current estimates of biomass available for Maine's forest resources.
    (2) Pulpwood – is a unique inventory estimate representing the net volume of the Forest Inventory & Analysis (FIA) tree classes of growing stock and rotten cull trees that are 5.0"+ dbh, have a minimum bole length of 4 feet, and to a minimum 4" top. The following figure depicts the best historic estimates of pulpwood quality in Maine.

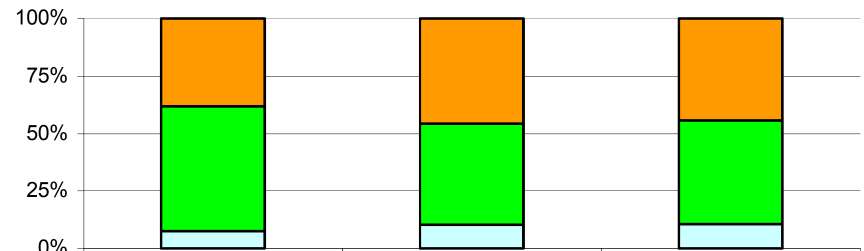
Figure 141. Volume Estimates of Pulpwood Quality[229] or Better Trees and the 95% Confidence Interval



229 Pulpwood Quality or Better Trees contain the tree classes of "growing stock" and "rough cull".

From a statistical viewpoint, Maine's pulpwood inventory volume has remained stable since 1995 and is approximately 87 percent higher than the similar inventory volume in 1952. With the parsing of pulpwood to three major species groups, the inventory picture is a little more volatile. Pine has steadily increased its share over the last 20 years, while Other Softwoods (predominantly Spruce/Fir) have decreased by approximately 9 percent, and hardwoods have realized an overall 6 percent gain.

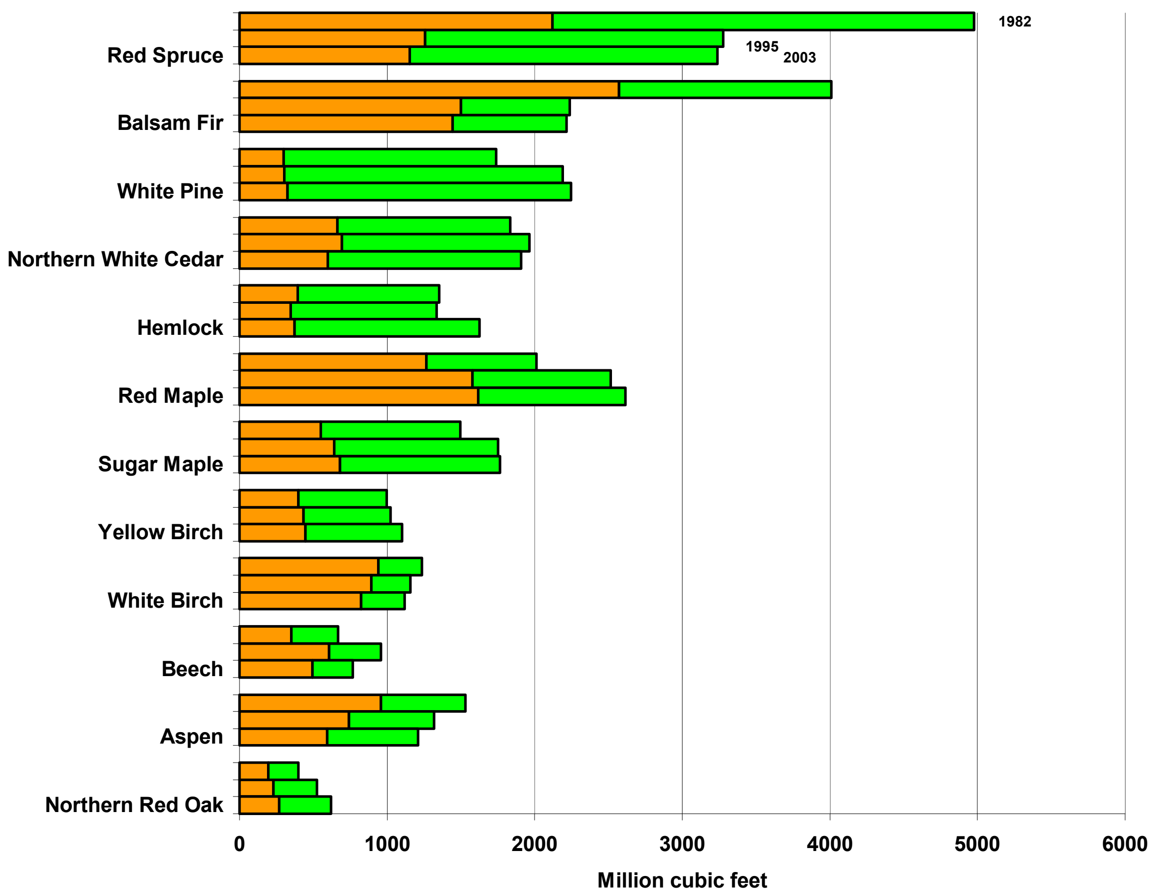
Figure 142. Distribution of Pulpwood Volumes by Major Species Groupings



	1982	1995	2003
Hardwoods	38%	46%	44%
Other Softwoods	54%	44%	45%
Pine	7%	10%	11%

(3) Sawtimber Volume – is based on quality trees that are 9.0"+ dbh for softwood or 11.0"+ dbh for hardwood and contain at least a single 12 ft log segment or 2 – noncontiguous 8 ft. segments in the bole to a respective 6" or 8" top. Since 1995, there have been no significant changes in the volume of any species group. The below series of graphs display the distribution of potential sawtimber volume (Orange), which is below the qualifying dbh and the sawtimber volume (Green) for selected species over the last 3 inventories.

Figure 143. Trends in potential (orange) and current sawtimber (green) inventory for selected species in Maine, for 3 Inventories



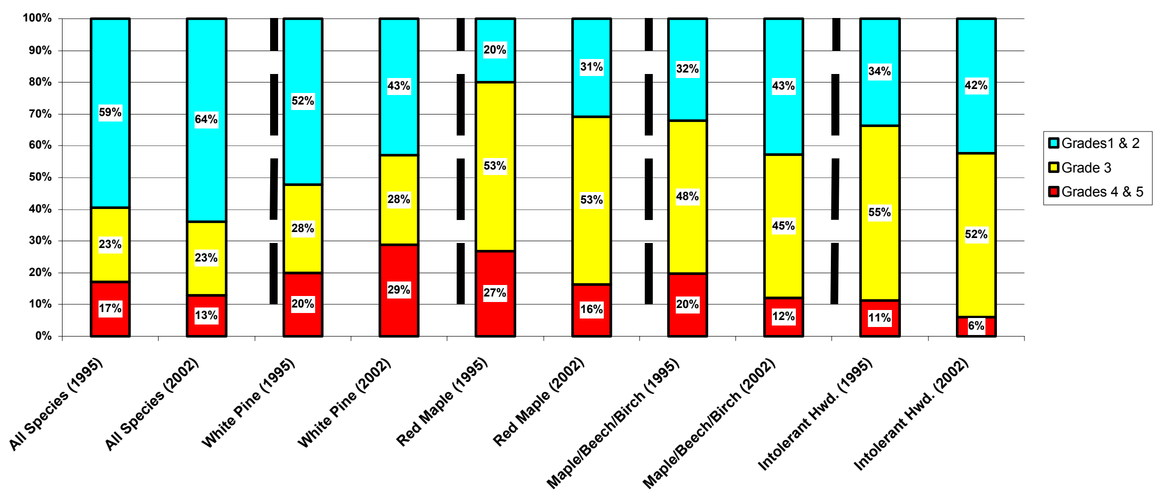
With the exception of Balsam Fir, the other four selected softwood species show signs of a maturing resource, steadily increasing their share of sawtimber volume over the 20-year period.

Of the depicted hardwood species, four species are selected for their opposite successional representation, with red maple and white birch being considered as more pioneer, and sugar maple and yellow birch as more late-successional. The sawtimber volume distribution also reflects that successional spectrum with the pioneer species having the majority of volume contained in potential sawtimber, less than 11.0" dbh, whereas sugar maple and yellow birch have a sawtimber majority. The other noteworthy observation is the consistency in distribution for these four species over the 20-year period.

The final two hardwood species, beech and northern red oak are selected for their divergent response over the last twenty years. Beech has steadily declined in its sawtimber distribution due to the ongoing dual impacts of disease and drought, which brought increased quality degradation and mortality. Northern red oak is the bright spot in the hardwood resource, with a steady increase of 6 percent over the 20-year period.

(4) Sawtimber Quality – is assigned using a tree grading process that evaluates the bottom 16 feet of the tree bole. The grading process and the partition of tree volume to various grades has undergone multiple revisions over the 40-year period of inventory data gathering. The following graph compares the 1995 and 2002 grade assignments, using identical grading procedures, at a variety of levels.

Figure 144. Grade Distribution (%) of All Sawtimber for All Species and for 4 major Species Groups, 1995 and 2002



Grades 1 and 2 are the prime grades representing high quality trees that are 16.0"+ dbh and 13.0"+ dbh respectively. Veneer quality material is not separately graded, but can be considered to be incorporated within the Grade 1 assignment. Grade 3 represents the pallet log market, and grades 4 and 5 are assigned to identify markets of local use and utility.

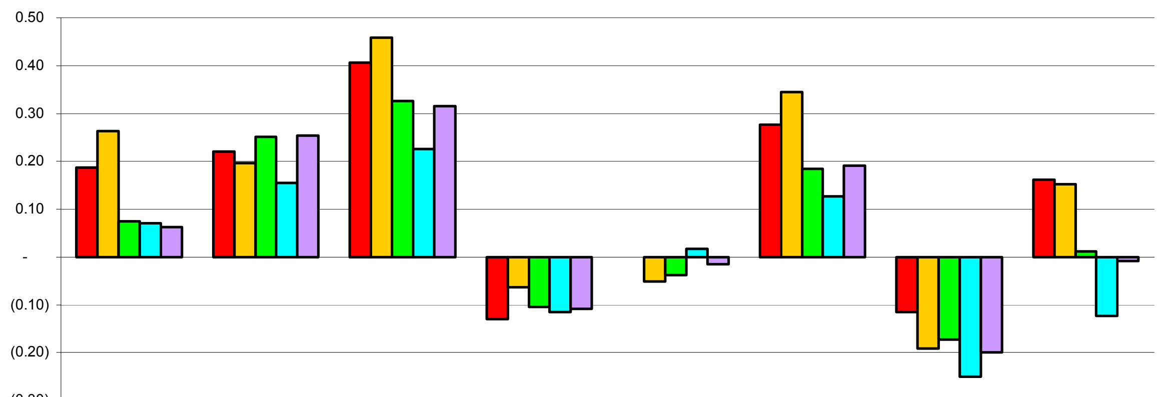
For all species the share of grades 1 & 2 has increased 5 percent over the last 7 years, another indication of Maine's maturing resource. The other encouraging development is the 4 percent reduction in grades 4 & 5. White pine is a species of concern due to the 9 percent reduction in grades 1 & 2 and the corresponding increase of 9 percent in Grades 4 & 5. Without further specific analysis, it is unknown whether this grade swap is due to the degradation of large trees (13.0"+ dbh), i.e. 1998 Ice storm, or an influx of smaller sawtimber trees (9,0" – 12.9" dbh) that are of very poor quality.

The increase in red maple's share of the top grades is encouraging and may provide a new marketing opportunity. As discussed earlier, sugar maple and yellow birch are responsible for the 11 percent increase in the prime grades within the Maple/Beech/Birch grouping. In the Intolerant group, the maturing resource of Aspen is predominantly responsible for the increase in grades 1 & 2, the white birch component rarely gets large enough to qualify for grade 1 (minimum 16.0" dbh).

b) **Long-term potential of forest resources**

1. **Components of Change** – are the forestry version of credit and debit accounting. Ideally net growth is sufficient to offset removals, providing a positive net change remainder that is then available for balancing against near-term and unforeseen catastrophes like insect/disease outbreaks, severe weather events, forest fires, or new manufacturing opportunities. The following four graphs provide a pictorial display of these components as originally published in the respective inventory report.

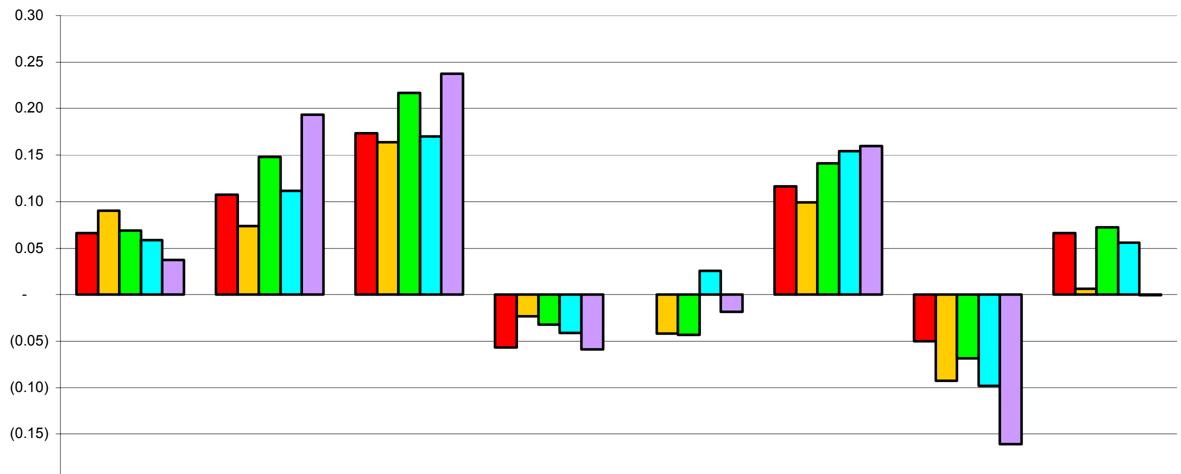
Figure 145. Softwood Components of Change (Cords/Acre/Year) by Inventory Year



	Ingrowth	Accretion	Gross Growth	Mortality	GS Increment	Net Growth	Total Removals	Net Change
1959	0.19	0.22	0.41	(0.13)	-	0.28	(0.12)	0.16
1972	0.26	0.20	0.46	(0.06)	(0.05)	0.34	(0.19)	0.15
1982	0.07	0.25	0.33	(0.10)	(0.04)	0.18	(0.17)	0.01
1995	0.07	0.15	0.23	(0.12)	0.02	0.13	(0.25)	(0.12)
2003	0.06	0.25	0.32	(0.11)	(0.02)	0.19	(0.20)	(0.01)

The net change estimate of -0.01 cords/acre/year for softwood is a welcome improvement from the 1995 estimate. The major historic factor that gives softwood its impetus is ingrowth, which in 1972 helped achieve the highest recorded gross growth estimate of 0.46 cords/acre/year, and then boosted the next inventory to a record 0.25 cords/acre/year accretion estimate. A goal for softwood is to implement forest management practices that either reduce mortality or pre-capture it in a harvest.

Figure 146. Hardwood Components of Change (Cords/Acre/Year) by Inventory Year

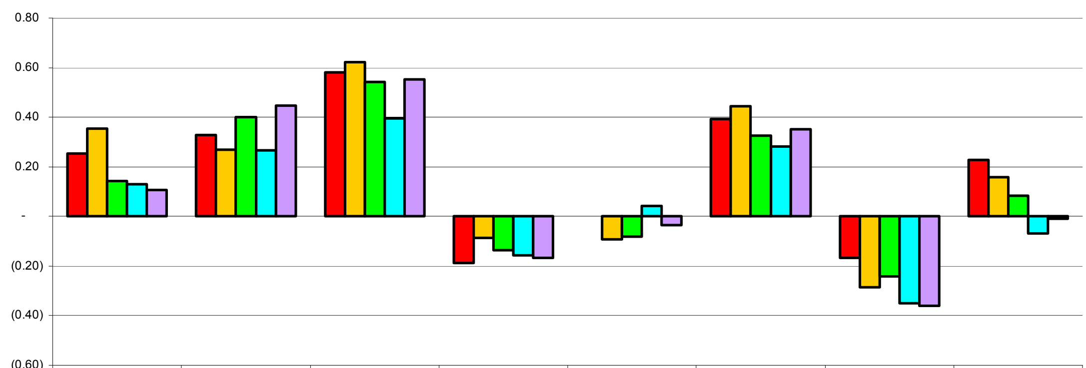


	Ingrowth	Accretion	Gross Growth	Mortality	GS Increment	Net Growth	Total Removals	Net Change
1959	0.07	0.11	0.17	(0.06)	-	0.12	(0.05)	0.07
1972	0.09	0.07	0.16	(0.02)	(0.04)	0.10	(0.09)	0.01
1982	0.07	0.15	0.22	(0.03)	(0.04)	0.14	(0.07)	0.07
1995	0.06	0.11	0.17	(0.04)	0.03	0.15	(0.10)	0.06
2003	0.04	0.19	0.24	(0.06)	(0.02)	0.16	(0.16)	(0.00)

The hardwood components of change have been and still are in relative balance; though the 50% increase in the removal rate since 1995 effectively have this group at a net change of zero in 2003. The forest management opportunity for hardwood is to eliminate the negative growing stock increment value by timely harvest and tree selection.

Combining the two species groups into the single graph below, serves as a surrogate for determining potential and long-term forest resource sustainability. The overall picture, while exhibiting some volatility, suggests that the historic downward trend may be reversing to a point where net change is rebounding to a near-neutral position. This is not the time for complacency in implementing active forest management practices with the intent to improve stand dynamics.

Figure 147. All Species Components of Change (Cords/Acre/Year) by Inventory Year



	Ingrowth	Accretion	Gross Growth	Mortality	GS Increment	Net Growth	Total Removals	Net Change
1959	0.25	0.33	0.58	(0.19)	-	0.39	(0.17)	0.23
1972	0.35	0.27	0.62	(0.09)	(0.09)	0.44	(0.28)	0.16
1982	0.14	0.40	0.54	(0.14)	(0.08)	0.33	(0.24)	0.08
1995	0.13	0.27	0.40	(0.16)	0.04	0.28	(0.35)	(0.07)
2003	0.11	0.45	0.55	(0.17)	(0.03)	0.35	(0.36)	(0.01)

To date, there have been 5 inventories of Maine's forest resources, starting with the initial data collection in 1952 and ending with the most recent annual panel in 2003. If this 40-year plus period is considered to be reflective of both the good and the bad in terms of forest management and resource impacts, what would be the idealized set of components of change that could better represent the potential of Maine's forests? This idealized construct was developed by separately evaluating softwood and hardwood components of change:

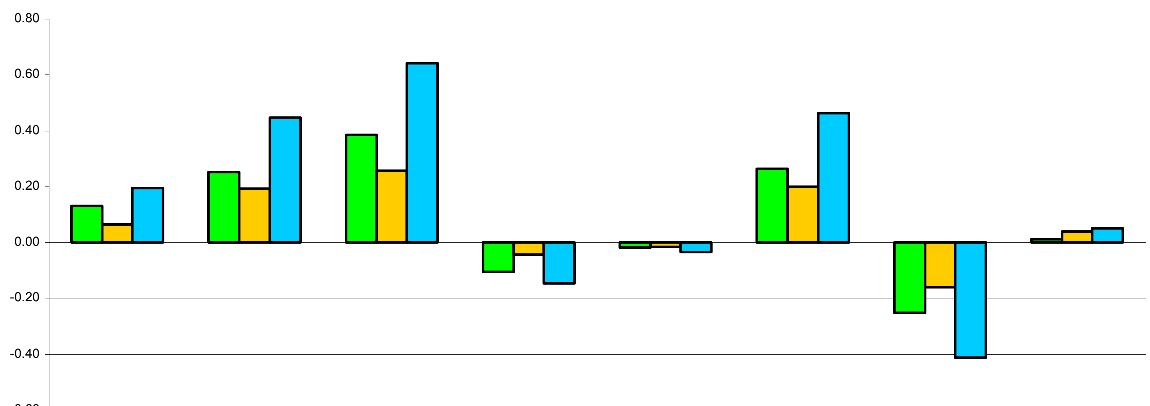
- **Ingrowth** – the management focus is to find a way to alter the traditional one-time periodic pulse and convert it to a steady trickle represented by a better distributed forest age/development structure. To represent that focus the 5 inventory estimates of softwood and hardwood ingrowth were separately averaged for a combined idealized component of change.
- **Accretion** – needs to be maintained at an optimum rate, reflecting management practices that focus the compounding growth increment on quality trees. To represent that focus, the highest softwood (1982) and hardwood (2003) accretion estimate was selected and then summed for this component of change.
- **Mortality** – like ingrowth, there is a need for implementing management practices that eliminate the periodic flush, primarily attributable to spruce budworm

epidemics, and ideally convert this estimate to a steady and minor trickle. To represent that focus the 5 inventory estimates of softwood and hardwood mortality were separately averaged for a combined idealized component of change. This value of –0.15 cords/acre/year can still be dramatically reduced to a more normal background mortality level of around –0.05 cords/acre/year through active management that pre-captures mortality into a useable forest product.

- **Growing stock increment** – this measure is the net effect of changes in tree quality, when it is negative it implies that tree degradation is more dominant. There are opportunities in forest management to improve the harvest selection and minimize harvest impacts to residual trees.
- **Removals** – for this component of change the highest recorded estimate was selected for both softwood (1995) and for hardwood (2003) and then summed in order to best represent and sustain existing manufacturing capabilities and export/import markets.

The results of this mathematical and selection process is depicted in the below graph.

Figure 148. Idealized Components of Change (Cords/Acre/Year)



	Ingrowth	Accretion	Gross Growth	Mortality	GS Increment	Net Growth	Total Removals	Net Change
Softwood	0.13	0.25	0.38	-0.10	-0.02	0.26	-0.25	0.01
Hardwood	0.06	0.19	0.26	-0.04	-0.02	0.20	-0.16	0.04
All Species	0.20	0.45	0.64	-0.15	-0.03	0.46	-0.41	0.05

To put into a more simple context, the chosen removal rates represent a 4.3 Million cord harvest of softwood and a 2.7 Million cord harvest of hardwood products, for a total harvest of 7 Million cords on an annual basis, a total that is currently about 1 Million cords more than the recent 8-year average. Even with this record harvest, there is still an idealized positive net change value remaining. The forest resources of Maine have a long and rich history of harvesting a multitude of products; this idealized concept shows that there is an equal and real need to develop an equally robust, long, and rich history on managing the growth side of the equation. The potential of a long-term overall annual net growth on the order of 0.46 cords/acre/year is not a crystal-ball guess, pie-in-the-sky, or a dream.

The overarching challenge is to implement forest management practices that improve net growth in order to sustain the desired harvest levels that recent history has recorded. This will need to be done concurrently with the management of new stress situations.

c) **Long-term threats to continued supply**

1. **Invasive Exotic Pests** – Maine's forests currently face an increasing threat from the potential introduction, establishment, and expansion of foreign invasive pest species. Native insects like spruce budworm periodically kill vast numbers of trees in Maine's forests, but the ecosystem is adapted to these perturbations. Although it can take years, the forest and the forest-based economy can recover. Foreign pests, because they are now in a situation without a complement of natural enemies and host resistance, can result in a situation far more devastating and permanent.
    (1) Previously established nonnative pests like beech bark disease, chestnut blight, Dutch elm disease, and gypsy moth have already diminished the character and diversity of Maine's forests. The loss extends beyond just losing commercially valuable trees, also seriously affecting wildlife dependent on these trees for food and shelter.
    (2) Other foreign pests like balsam woolly adelgid and browntail moth, that had been endemic in Maine for years, are resurging: intensifying and expanding their range; with concurrent impact to the forest and forest-dependant communities.
    (3) Hemlock woolly adelgid is now established in southern Maine, and nursery stock from nurseries infected with sudden oak death has been shipped into Maine. Asian longhorned beetle and emerald ash borer, although more removed, are at least as serious.
    (4) The combination of a very mobile society and the rapid movement of goods and services around the world virtually assures that the flow of additional pest species inadvertently brought to North America will continue; and the current fluctuations in climate patterns appear to increase the chances of successful establishment.

2. **Climate Change**

    (1) The current fluctuations in climate patterns are already producing measurable impacts on our forests: White pine decline and beech dieback associated with drought stress. The influences of drought extend well beyond direct effects; increased vulnerability to other stress agents, although difficult to quantify, is very real.
    (2) The recent spate of more moderate winters is increasing survival rates of several existing pest species (i.e. balsam woolly adelgid), allowing increased population intensity and pest range, and resulting in increased host mortality across a broader area of the state than we have seen in the recent past.

Situations like these could become more common and have more significant impact on the forest if climate trends in the future continue to stress the existing forest types while favoring their damage agents.

Recommendations

Actively managed forests will achieve the desired conditions, amenities, and products.

Continue to provide timely analysis and trend assessment:

(1) The current USDA FIA annualized inventory, being implemented with the cooperation of the Maine Forest Service, must be maintained on its current 5-year cycle of panels.

(2) The Maine Forest Service needs continued support and funding for data collection, analysis, and timely reporting.

Providing tools for informed changes in the forest management of Maine's extensive resources:

(3) A new and enhanced timber supply analysis is needed using the complete set of 5-year inventory data. The time is ripe for the Maine Forest Service and other partners to initiate and complete a new and enhanced timber supply analysis. Tools now exist that allow more detailed modeling of species, products, and silvicultural practices and the production of an optimized result, which can also incorporate ecological considerations. This will require staff dedicated to running, developing, and maintaining these complex models.

Glossary of Terms Used in the chapter "Maine's Forest Resources"

Accretion – The estimated net growth on surviving growing stock trees that were measured during the previous inventory (divided by the number of growing seasons between surveys to produce average annual accretion). Accretion does not include the growth on trees that were cut during the period, nor those trees that died. This component of change uses the incremental difference in the tree's basal area between the two inventories.

Gross Growth – The arithmetic sum of the Ingrowth and Accretion components of change.

Growing Stock Decrement – Includes growing stock trees in the previous inventory that are classified as rough or rotten in the current inventory (divided by the number of growing seasons between surveys to produce average annual growing stock decrement). This component of change uses the previous tree's basal area.

Growing Stock Increment – Includes either rough or rotten trees in the previous inventory that are classified as growing stock trees in the current inventory (divided by the number of growing seasons between surveys to produce average annual growing stock increment). This component of change uses the current tree's basal area.

Growing Stock Tree (or Growing Stock) – A classification of timber inventory that includes live trees of commercial species meeting specified standards of quality and vigor. Cull trees (rough and rotten trees) are excluded.

Ingrowth – Includes growing stock trees that became 5.0" diameter at breast height (dbh) or larger during the period between inventories (divided by the number of growing seasons between surveys to produce average annual ingrowth). Also, includes growing stock trees, 5.0" dbh and larger, that are growing on land that was reclassified from noncommercial forestland or nonforest land to timberland. This component of change uses the current tree's basal area.

Mortality – Includes growing stock trees that die from natural causes before the current inventory (divided by the number of growing seasons between surveys to produce average annual mortality). This component of change uses the previous tree's basal area.

Net Change – The difference between the current and previous inventory estimates of growing stock (divided by the number of growing seasons between surveys to produce average annual net change). It is the arithmetic sum of Net Growth minus Removals.

Net Growth – The resultant change from natural causes in growing stock during the period between surveys (divided by the number of growing seasons between the surveys to produce average annual net growth). It is the arithmetic sum of Gross Growth, minus Mortality, plus Growing Stock Increment, minus Growing Stock Decrement components of change.

Total Removals – Represents the arithmetic sum of the Harvest and Land Use Removal components of change.