An Assessment of Missouri Forest Health Issues
And
Their Impact on Future Management Priorities

A Report by the
Missouri Forest Products Association

February 1, 2013
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This analysis was initiated in January 2011 by MFPA after meeting with Missouri State Legislators who were concerned about the ability of state owned timberlands to help sustain rural communities through increased timber harvesting. MFPA analyzed U.S. Forest Service’s (USFS) Forest Inventory & Analysis (FIA) data to evaluate general conditions of forests statewide. The FIA is the only forest inventory system that periodically quantifies forest health and other characteristics on all forest ownerships throughout the United States.

The Missouri Forest Products Association (MFPA) represents 326 members and their 2,700 employees throughout Missouri, serving as the “collective voice” for Missouri’s forest products industry. A majority of our members live and work in rural Missouri and depend on healthy forests for their livelihood.

Missouri’s forests cover nearly 15 million acres and contribute $9.0 billion annually to its economy. Our citizens depend on healthy and sustainable forests for jobs, recreation, clean water and air, and other benefits. The forest products industry is equally dependent upon our forests as a source of raw material to produce lumber and other renewable products.

The health of state and federal forestlands, totaling over 2 million acres, is especially important to Missourians. These public forests are managed for variety of uses and outputs. Public forest managers, find it challenging to develop and implement forest management plans that meet stakeholder expectations. The greatest opportunity for improvement of forest health is with private timberlands and the 359,000 private landowners who own 85% of Missouri’s timberland. While objectives and interests vary, forest health is a shared goal.

To evaluate the current condition of Missouri’s forestland, MFPA conducted a study of federal, state and private timberland characteristics including: basal area (BA), stand age, sawtimber volume per acre, mortality and economic contributions. The first four are measures of forest health derived from the FIA data. The economic data (stumpage values) was compiled by MFPA member companies during an extensive survey of primary wood processing plants in southern Missouri.

We strongly believe the long-term sustainability of our timberlands should not be compromised for short-term economic gain. Although Missouri’s forests are more productive than at any time in the last 100 years, forest health indicators are describing portions of public and private forests as mature, over-mature or poorly managed. This report evaluates the current conditions of our timberlands to evaluate the effectiveness of our management practices will produce healthy forests for future generations. The opportunity exists to stimulate rural economies, while improving forest health, by optimizing utilization levels of both public and privately owned forest resources and by improving the productivity of private timberlands.

Those contributing to this report include: Tony Parks, Darwin Murray, Shelby Jones, Steve Jarvis and Brian Brookshire.
Introduction

This analysis encompasses a large-scale examination of forest resources of all timberland in Missouri. The source of all data used is publicly available in the U.S. Forest Service’s (USFS) Forest Inventory and Analysis (FIA). Tabular data was generated with USFS Evaluator 1.5.1.04 and FIDO software. Statistics are derived from over 4,000 permanent field plots measured for current forest conditions from 1989-2009. Forest trends were analyzed for three time periods from 1989, 1999-2004 and 2005-2009. Evaluator software 1.5.1.04 can be accessed at http://www.fia.fs.fed.us/tools-data/ and FIDO software can be accessed at http://apps.fs.fed.us/fido/

The tables focus on growing stock and sawtimber grown on timberland defined as:
1) Growing Stock includes the main stem portion of all live trees greater than 5.0 inches DBH (diameter breast high) and is measured in cubic feet units.
2) Sawtimber includes the main stem portion of all conifer species greater than 9.0 inches DBH and all commercial hardwood species greater than 11.0 inches DBH. It is measured in board feet units.
3) Timberland is defined as forestland not restricted from harvest by statute, administrative regulation, or designation, and capable of growing trees at the rate of at least 20 cubic feet per acre per year.
4) DBH – Diameter Breast Height – A measure outside the bark of the diameter of a tree 4 ½ feet above the ground line.

FIA defines the ownership groups within the State of Missouri as follows: U.S. Forest Service, U.S. Fish and Wildlife Service, Department of Defense, Other Federal, State, County and Municipal, Other Local Government and Private. No reserved lands such as parklands or natural areas were included in the estimated volumes, mortality, or annual growth. This analysis presents current data for public and private lands capable of providing commercial timber products.

For purposes of this study, federal timberland is in the Mark Twain National Forest (MTNF) and managed by the U.S. Forest Service. The majority of state timberland is owned and managed by the Missouri Department of Conservation. FIA reported 693,191 acres in state ownership; approximately 601,510 acres are managed by MDC and assigned to one of four categories:
1) General Forest Management Areas – active forest management via timber harvests to enhance wildlife habitat on 68% or 409,027 acres.
2) Natural and Wild Land Emphasis Areas – managed for natural plant and animal communities with limited timber harvesting on 8% or 48,121 acres.
3) Research, Education and Demonstration Areas – managed for educational purposes where timber harvesting may or may not occur, on 2% or 12,030 acres.
4) Urban and Intense Recreation Areas – managed for high-use recreational purposes with limited timber harvesting on 22% or 132,332 acres.

For the MTNF, the nearly 1.5 million acres of timberland are managed as follows:
1) Restoration/General Forest Areas – active forest management for a variety of purposes on nearly 70% or 1,046,100 acres of timberland.
2) Semi-primitive Motorized Areas – significantly reduced timber harvesting on about 17% or 258,600 acres.
3) **Wilderness/Recreation/Special Areas** - many areas prohibit timber harvesting, but some harvesting occurs on a portion of the remaining 13% or 191,400 acres.

**Improving Forest Health Sustains Rural Communities**

**KEY FACTS**

- **Missouri’s Forests are Growing** – Average board foot volume per acre increased 70% since 1989 on all ownerships. Since 2005, the harvest has averaged 25% of net annual growth. Growing stock on Missouri’s public and private forests is increasing each year.

- **Missouri’s Forests are Fully Stocked** – Two-thirds of public timberland and over half of private timberland are fully or over-stocked.

- **Missouri’s Forests are Maturing** – The number of acres of trees 100 years old or older has doubled since 1989. Annual mortality has more than doubled on public timberland and almost doubled on private timberland since 2004.

- **Missouri’s Forests are at Risk** – FIA data indicates that significant portions of Missouri’s forests are becoming over mature and over-stocked, making them more susceptible to decay, insects, disease and storm damage.

- **Missouri’s Forests require Different Management Techniques** – The historical focus of Missouri’s forest management has been of recovering from the overharvest of the early 20th century. Our forests have recovered substantially due to the collaborative efforts of state and federal agencies, forest products industry and private stakeholders. To maintain and improve our forests for the future, we must manage for sustainability. This will require revising the focus of current management objectives.

- **Missouri’s Forests are Valuable** – Missouri’s forest resources provide tangible and intangible benefits for all Missourians. For example, MDC’s standing timber resource has an estimated “market” value of $803 million, its timber “assets” grow over $19 million annually, and its annual harvest is valued at $1,510,000. MTNF standing timber is valued at $1.739 billion with annual growth of over $21 million and annual harvest receipts of $2,999,000.

- **Missouri’s Forests Sustain Rural Communities** – For each $1 of timber sold from the stump, $5.10 of economic activity is generated in the local and state economy. Missouri’s forests can be managed for an even greater contribution to local and state economies.

- **Missouri’s Forests are an Important Agricultural Crop** - Missouri’s forest products industry contributes over $9 billion annually to Missouri’s economy providing 47,600 jobs with a payroll of $2.2 billion and tax payments of $695 million. The forest products industry can maintain and increase these benefits through sustainable forest management practices.

- **Missouri’s Private Landowners have Varied Interests** – There are 359,000 private forest landowners who each own an average of 34 acres of timberland. It is estimated that 40-45% of this is owned for purposes other than production of wood products. In 2010, less than 1% of private landowners had an active Forest Stewardship Management Plan.

- **Missouri’s Sawmills Operate at 65% of Capacity** - An industry study in 2010 of 315 sawmills revealed a 30% loss of capacity due to the lack of availability of raw material and a 5% loss due to a decrease in market demand in a poor economy.
Healthy Forests are Key to the Sustainability of Natural Resources

The history of Missouri's timberland is a testimony to the resilience of the state's resources. In 1887, the first of many lumbermen arrived to harvest our vast forests to satisfy the increasing demand for wood products of a westward expanding population. By 1920, most of the state's timberland had been harvested of all commercially valuable timber, creating a need for forest restoration. This is one of the reasons for the creation of the Missouri Department of Conservation (MDC); with the goal “to sustain diverse, healthy plant and animal communities well into the future”. MFPA is supportive of this goal and has a vested interest in helping to provide future generations with the opportunity to enjoy a healthy and sustainable forest.

In the 1930’s, there were large tracts of “cut over” timberland in southern Missouri viewed as unproductive and abandoned by their owners. In 1939, the Mark Twain National Forest was created, initially from these abandoned properties. The purpose of establishing national forests was to insure our nation had forest resources for the future. Beginning in the 1950's, Missouri’s forest products industry reappeared and was reestablished as the forests grew back. Today the forest products industry employs 47,600 and contributes over $9 billion annually to our economy.

<table>
<thead>
<tr>
<th>Year</th>
<th>State (Acres*)</th>
<th>USFS</th>
<th>Private</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>402,870</td>
<td>1,320,557</td>
<td>11,363,532</td>
<td>13,086,959</td>
</tr>
<tr>
<td>2004</td>
<td>649,701</td>
<td>1,379,816</td>
<td>11,474,336</td>
<td>13,503,853</td>
</tr>
<tr>
<td>2009</td>
<td>693,191</td>
<td>1,447,836</td>
<td>12,570,019</td>
<td>14,711,046</td>
</tr>
</tbody>
</table>

Table 1 – Public and Private Timberland Ownership by Year
*As indicated by FIA Data

Missouri’s timberlands cover 14,711,046 acres, with 2,141,027 acres in public ownership and 12,570,019 acres in private ownership. This acreage is classified as commercial timberland and does not include Missouri’s parklands, scenic river corridors or other non-commercial forestlands.

Public and private timberlands are more productive than at any time in the last 100 years. Since the 1930’s, Missouri has been through a period of recovery of its forest resources. MFPA believes the forest products industry of Missouri can remain a significant contributor to our economy if forest resources are sustainably managed.

This requires resource managers to consider a wide range of variables, and develop consensus among stakeholders for selecting measureable “healthy forest” indicators. In this report, MFPA evaluated systemic indicators characteristic of forest health including: basal area (BA), stand age, volume per acre, and mortality. Additionally, the economic contributions of healthy forests were assessed. FIA data
from three measurement periods was used (1989, 2004 and 2009) along with other
publically available data to enhance the accuracy of the report.

Basal Area

Basal Area (BA) is a measure of stand density and indicates how much a site is
occupied by trees of all sizes and species. As BA increases, there is increasing
competition between trees for available nutrients, moisture and sunlight. Basal Area
is measured in square feet/acre of crosssectional area of all live stems

FIA reports BA into four ranges, 0-40, 41-80, 81-119 and 120+, expressed in square
feet per acre units. A lower BA indicates a recent disturbance, such as fire,
windstorm or harvest, has “thinned” the trees and reduced stocking levels.
Conversely, a higher BA indicates a longer period of time since a disturbance
allowing stocking levels to increase. For most forest stands, optimal growth is
maintained at a BA of 60 to 80 square feet per acre.

Timberland with a BA of 81 - 119 is considered fully stocked. The BA category,
120+, is higher than optimal and considered over-stocked. The following table
shows the percentage of acres in each stocking level in Missouri in 2009. Sustainable
forest management requires the introduction of new trees into the forest to replace
the over-stocked stands when they are thinned or harvested. Successful
reintroduction of the most commercially desirable species occurs when sunlight is
able to reach the forest floor. These conditions are most often present in forest
stands with a BA of less than 40.

<table>
<thead>
<tr>
<th>Owner</th>
<th>0-40</th>
<th>41-80</th>
<th>81-120</th>
<th>120+</th>
</tr>
</thead>
<tbody>
<tr>
<td>USFS</td>
<td>4%</td>
<td>24%</td>
<td>49%</td>
<td>23%</td>
</tr>
<tr>
<td>State</td>
<td>7%</td>
<td>30%</td>
<td>43%</td>
<td>20%</td>
</tr>
<tr>
<td>Private</td>
<td>10%</td>
<td>32%</td>
<td>42%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Table 2 – Basal Area Classes on Federal, State, and Private Timberland

The following graph represents the stocking within Missouri’s forest ownership.
The Ideal Curve represents an ideal stocking distribution where all stocking levels
are available within a forest to sustain forest growth and regeneration.
According to FIA data, the stocking “curves” of all ownerships are skewed to the right, indicating a trend toward heavier stocking levels, especially on USFS timberland. Both public and private forest land managers need to balance stocking levels to sustainably manage their timberlands.

**Trend Analysis**

**State** – 63% of state owned commercial timberland has a BA of 81 or higher, compared to 58% in 2004 and 52% in 1989. The highest BA category, 120+ has increased from 99,735 acres to 141,565 acres since 2004, representing 20.4% of state ownership. In 1989, the BA 120+ category was only 6.5% or 26,198 acres.

**USFS** – 72% of USFS timberland has a BA of 81 or higher and is considered fully stocked. Over-stocked (BA 120+) stands increased to 333,002 acres in 2009, or 23.4%. In 1989, the BA 120+ category was only 114,081 acres, or 8.6%.

**Private** – 58% of private timberland has a BA of 81 or higher, up from 54% in 2004 and 46% in 1989. From 2004 to 2009, the BA remained relatively constant in all categories. In 2009, over 2 million acres or 16% of private timberland was over-stocked, up from 591,588 acres or 5.2% in 1989.

Since 1989, the over-stocked category (BA 120+) has increased from 6% to 17% of the total acreage on all ownerships, with the highest percentages on federal and state timberland. (Chart 2) During the same period, the fully stocked acreage (BA 81-119) has remained relatively (≈ 42%) constant.
FIA estimates the average age of trees on each plot. The data is summarized into six categories, 0-20 years, 21-40 years, 40-60 years, 61-80 years, 81-100 years and 100+ years. Some species, such as white oak, pine and walnut can live much longer than 100 years. Several species in the red oak group have shorter life spans (≈ 100 years) and are in decline due to age, insects and diseases. Consideration of stand age is necessary in forest management decisions for promoting forest health.

**Trend Analysis**

**State** - FIA data (2009) shows 65,376 acres are 100+ years, up 105% from 2004. Nearly 60% of state forested acres were less than 60 years old in 2004, and by 2009 this percentage dropped to 49%. The progression of age classes from mature to over-mature on state owned timberland can be attributed in part to MDC’s old growth and woodland restoration efforts. However, 32% of MDC’s forests are primarily comprised of red oak and is the highest “at risk” species in Missouri.

**USFS** – The acreage in the younger age classes (60 years old and less) declined 20% during the past 20 years to 521,075 acres in 2009. During the same time period, the 61 to 100 age classes on USFS land increased by 40%, to 883,602 acres. The 100+ age class remained stable during the measurement period. These trends indicate a move toward maturity and less diversity on USFS timberlands. The need to replace the younger age classes will become critical as the medium age classes rapidly grow into mature, 81-100 year old, and over-mature, 100+ year old, stands.

**Private** – The harvest rate on private timberlands indicate a rapidly declining 0-40 year age class with a corresponding increase (57%) in the 41-80 year old age class since 1989. The (81+) age class has remained stable during the past twenty years. The continuation of this practice will lead to a reduction in the stocking of desirable species and less value for the landowner from future harvests.

The constant acreage in the 81 year old, and older, age classes may indicate consistent harvest pressure within the older age classes. With an average of 34
acres per owner, the data may indicate the smaller woodlots are owned for purposes other than commercial timberlands and are not harvested. Recreational owners are the fastest growing component of private forest ownership.

Chart 3 – Percentage of Stand Age Classes More Than 80 Years Old on Federal, State and Private Timberland (A clear trend toward older stand ages on all ownership types)

**Board Foot Volume per Acre**

Board foot (BF) volumes were tabulated for trees 9.0" DBH and larger for pine and 11.0" DBH and larger for hardwood. Although board foot volume per acre may not be a measure of forest health, it must be considered in the overall context of forest health characteristics. Board foot volume will increase with BA and stand age until the forest reaches maturity. Once maturity is reached, without disturbance the forest will move toward a climax composition of the longest-lived species, usually resulting in a decline in species diversity and stand structure.

<table>
<thead>
<tr>
<th>Owner</th>
<th>0-20</th>
<th>21-40</th>
<th>41-60</th>
<th>61-80</th>
<th>81-100</th>
<th>100+</th>
</tr>
</thead>
<tbody>
<tr>
<td>USFS</td>
<td>1,017</td>
<td>1,978</td>
<td>5,048</td>
<td>5,393</td>
<td>6,999</td>
<td>6,625</td>
</tr>
<tr>
<td>State</td>
<td>637</td>
<td>2,010</td>
<td>3,990</td>
<td>5,845</td>
<td>6,201</td>
<td>7,105</td>
</tr>
<tr>
<td>Private</td>
<td>409</td>
<td>1,372</td>
<td>3,226</td>
<td>4,100</td>
<td>5,465</td>
<td>6,109</td>
</tr>
</tbody>
</table>

Table 3 – Average Sawtimber Volume per Acre by Age Class on Federal, State, and Private Timberland

**Trend Analysis**

**State** - The average volume per acre for state timberlands increased 86% from 2,457 BF in 1989 to 4,570 BF in 2009. The volume in the oldest forest stands (100+ years) increased by 51% from 4,702 BF/acre to 7,105 BF/acre from 1989 to 2009.

**USFS** – During 1989 to 2009, the average volume per acre on USFS timberland increased 99%, from 2,540 BF to 5,052 BF. The board foot volume in the 100+ year old stands increased 97% from 3,355 BF/acre to 6,625 BF/acre during the same period.
Private - The average volume per acre on private timberlands increased by 89% from 1,837 to 3,475 board feet per acre from 1989 to 2009. In 2009, private timberland volume per acre was 32% less than state and 45% less than federal timberlands and is a result of a proportionally higher harvest of private timberlands.

![Chart 4 – Average Sawtimber Volume per Acre by Year on Federal, State and Private Timberland](chart)

The volume per acre for all ownerships is increasing, almost doubling during the past 20 years. Although this trend is healthy, especially on publically owned timberlands, many stands are entering a condition where competition for sunlight, water and nutrients will become a limiting factor. Once forest stands become fully stocked, competition intensifies and growth rates decline while mortality increases. **MFPA is concerned that Missouri’s public timberlands, particularly those dominated by red oak species, are becoming significantly over-stocked and in need of greater intensive management to address stocking levels and volume per acre.**

**Mortality**

Forest mortality is a measure of the loss of trees within a forest. It also can serve as a forest health indicator for selected tree species. In Missouri, many species in the red oak group (i.e., black and scarlet oak) have a life span of only 100-120 years and are in decline across the state in all ownerships. A reevaluation of rotation lengths for these species is indicated, especially regarding “old growth” management targets on public lands. It is possible to utilize a significant percentage of the current mortality by reducing re-entry intervals and reducing rotation lengths for red oak species.

**Trend Analysis**

State - From 2004 to 2009, annual mortality on state owned forestland averaged 26,345,865 board feet worth an estimated $2,090,237. During the same period, the actual saw timber harvest was 18,119,000 board feet with a value of $1,510,026. In the table below, the mortality rate doubled in volume in each measurement period and increased from 0.5% of the total growing stock in 2005 to 0.83%, or 38 board
feet per acre, in 2009. Note: MDC Forest Management Guidelines require leaving a number of dead snags per acre for wildlife habitat.

**USFS** - On USFS timberland annual mortality averaged 49,417,038 board feet from 2004 to 2009 worth an estimated $4,753,393. During the same period, annual saw timber harvest was 36,629,000 board feet valued at $4,372,000. The mortality rate increased from 0.38% in 2004 to 0.66%, or 34 board feet per acre, in 2009.

**Private** – On private timberlands, mortality increased from 0.5% to 0.6%, or 21 board feet per acre from 2004 to 2009. The value of timber lost to mortality was $18,542,360 annually. During the same period, the value of the timber harvested was estimated at $42,465,024.

<table>
<thead>
<tr>
<th>Mortality (Board Feet)</th>
<th>1989</th>
<th>2004</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTALS</strong></td>
<td>152,232,079</td>
<td>179,754,074</td>
<td>336,923,312</td>
</tr>
<tr>
<td><strong>USFS</strong></td>
<td>18,852,146</td>
<td>21,383,521</td>
<td>49,417,038</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>6,481,685</td>
<td>12,778,202</td>
<td>26,345,865</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>126,898,248</td>
<td>145,592,351</td>
<td>261,160,409</td>
</tr>
</tbody>
</table>

Table 4 – Total Volume of Sawtimber Mortality on Federal, State and Private Timberland

Mortality data indicates a greater volume of trees are dying than are being harvested on state and federal timberlands and presents an opportunity to utilize a higher percentage of the annual mortality with more intensive management (i.e. more frequent and lighter harvests). This will capture the value in the older trees at risk, and stimulate the growth of younger trees. Developing markets for biomass, a renewable energy alternative to fossil fuels, will provide additional options to reduce mortality in the smaller diameter classes and improve forest health.

**Economic Value of Forestland to Rural Communities**

Public forestland managers must consider many factors of forest health when making management decisions, including the economic impact of their decisions on rural communities. Forestry-related activity generates multiple economic benefits beyond the value of the timber harvest within a geographical area. A ripple effect of direct, indirect, and induced economic benefits can be felt. Rural communities are a major beneficiary of this activity and in many areas the viability of these communities is largely dependent upon the availability and utilization of these natural resources. This “economic multiplier effect” can generate significant tax revenues for both local and state entities.

The economic multiplier reflects the direct income received when a landowner sells standing timber; as well as, the income paid to the loggers who harvest the trees and deliver the logs to the mill; and, the mills and wood processors that convert that raw material into a finished product. Indirect economic effects are represented by the money spent on fuel, equipment, and all the supporting industries that provide
inputs into the harvest or processing of the timber. Induced economic effects are reflected in the wages paid to employees of all the direct and indirect activities along the value-added chain. In addition to these economic impacts, local, state, and federal taxes are generated throughout the process. At every step, additional economic activity is generated and continues until the end user purchases the finished wood products.

The US Forest Service uses IMPLAN, an economic modeling tool, to estimate the economic effects of its forest management plans. Although the IMPLAN model has been used sparingly to estimate the economic impact of forest industries in Missouri, economists with the University of Missouri Center for Agroforestry estimated that the total impact of increasing the forest harvest activity on State owned lands would have a multiplier effect of $5.1 for every $1 spent on stumpage. This multiplier is based on published Social Accounting Matrix (SAM) economic multipliers from an IMPLAN analysis of Forest Products Industries in Florida. It is recommended that an IMPLAN analysis be conducted for the Forest Products Industries in Missouri; however, until that research is conducted, the estimate presented in this summary is considered to be the most reliable available data.

An Assessment of Sawtimber Volume and Value

This section assesses the stumpage (i.e., standing timber) value of the sawtimber growing on state, federal and private timberlands in Missouri. FIA data was used to estimate the total volume of sawtimber-sized trees (≥ 9.0” for pine and ≥11.0” DBH for hardwood) in Missouri for the measurement periods of 1989, 2004 and 2009:

<table>
<thead>
<tr>
<th>Ownership</th>
<th>1989</th>
<th>2004</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>25,215,421</td>
<td>45,407,702</td>
<td>54,157,651</td>
</tr>
<tr>
<td>USFS</td>
<td>3,354,654</td>
<td>5,985,608</td>
<td>7,314,945</td>
</tr>
<tr>
<td>State</td>
<td>989,741</td>
<td>2,537,973</td>
<td>3,167,975</td>
</tr>
<tr>
<td>Private</td>
<td>20,871,026</td>
<td>36,884,121</td>
<td>43,674,729</td>
</tr>
</tbody>
</table>

Table 5 – Total Volume of Sawtimber on Federal, State, and Private Timberland

A comprehensive valuation model was developed by MFPA to calculate stumpage value. This included values by species, diameters, product category and current market pricing in 2009. Based on 2009 FIA data, the following is the estimated stumpage value of sawtimber on state, federal and private land:
### Value of Sawtimber

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Total Volume (MBF)</th>
<th>Total $ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>54,157,651</td>
<td>$6,402,796,712</td>
</tr>
<tr>
<td>USFS</td>
<td>7,314,945</td>
<td>$725,565,477</td>
</tr>
<tr>
<td>State</td>
<td>3,167,975</td>
<td>$318,170,129</td>
</tr>
<tr>
<td>Private</td>
<td>43,674,729</td>
<td>$5,359,061,106</td>
</tr>
</tbody>
</table>

Table 6 – Total Value of Sawtimber on Federal, State, and Private Timberland

A breakdown of sawtimber value by species on public and private ownerships can be found in the Appendix, Tables 11 and 12. Note: The Missouri Department of Conservation and the Mark Twain National Forest manage for a multitude of forest values in addition to timber production.

### Annual Sawtimber Harvest

Privately owned timberland represents 85% of the timberland acreage in Missouri and contributes 93% of the annual timber harvest. Public timberland is critically important to nearby sawmills that depend on a consistently available supply of timber.

### Volume of Sawtimber Harvest

<table>
<thead>
<tr>
<th>Ownership</th>
<th>1989</th>
<th>2004</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>224,137,772</td>
<td>357,449,038</td>
<td>486,990,630</td>
</tr>
<tr>
<td>USFS</td>
<td>31,530,098</td>
<td>33,415,000</td>
<td>26,527,000</td>
</tr>
<tr>
<td>State</td>
<td>6,236,884</td>
<td>13,320,694</td>
<td>18,119,000</td>
</tr>
<tr>
<td>Private</td>
<td>186,370,790</td>
<td>310,713,344</td>
<td>442,344,630</td>
</tr>
</tbody>
</table>

Table 7 – Total Annual Harvest by Year on Federal, State, and Private Timberland

Over the past 20 years, timber harvest levels on state timberland has tripled and more than doubled on private timberland to meet the increased demand for raw material. Harvesting on USFS timberland decreased over the past five years. The percentage of timber coming from private land has increased to nearly 93% of the total harvest in Missouri, up ten percent over the past twenty years, to possibly compensate for the decline in USFS harvest levels coupled with increasing demand for raw material by the wood products industry.

### Annual Sawtimber Growth

Annual sawtimber growth, less mortality, by forest ownership was summarized as follows:
### Table 8 – Total Net Annual Growth by Year on Federal, State, and Private Timberland

<table>
<thead>
<tr>
<th>Ownership</th>
<th>1989</th>
<th>2004</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>785,358,611</td>
<td>2,278,807,081</td>
<td>1,918,606,056</td>
</tr>
<tr>
<td>USFS</td>
<td>108,006,590</td>
<td>246,866,588</td>
<td>210,427,170</td>
</tr>
<tr>
<td>State</td>
<td>27,975,973</td>
<td>114,222,126</td>
<td>124,440,740</td>
</tr>
<tr>
<td>Private</td>
<td>649,376,048</td>
<td>1,917,718,367</td>
<td>1,583,738,146</td>
</tr>
</tbody>
</table>

**Volume of Net Annual Sawtimber Growth (Board Feet)**

**Annual Harvest vs. Annual Growth**

A surplus of growing stock is revealed when comparing annual sawtimber harvest to net annual growth. The decline in harvesting on the Mark Twain National Forest is illustrated below. The percentage of net annual growth harvested on USFS timberland dropped from 29.2% in 1989 to 12.6% in 2009.

**Conclusion**

The current forests, private and public, resulted from the harvesting practices of the late 1800’s and early 1900’s. Today’s forests are a testimony to the resilience of our timber resources. Within the last 130 years, Missourian’s have seen many changes in the condition of our timberlands. In the late 1800’s, westward development of our country depleted our forest resources. Timberland was exploited for its wood products and abandoned. Results of exploitation created a concerned public that enacted conservation measures.

Missouri has paid the price for the overharvest of the past. That wait is over, and our forest resources have recovered. Today, Missouri possesses bountiful forest resources producing multiple benefits. Missouri depends on forestland to provide
sustainable benefits to every segment of our society. For this to continue, maintaining and improving forest health is essential.

The primary beneficiary of this improvement will accrue to private forest owners. Their purpose for ownership has evolved from subsistence, where income from timber harvesting was the primary objective, to multiple-use i.e., including economic, recreation and aesthetic objectives. The management of private forestland will be dictated by the objectives of its owners and their education about sustainable forest management practices is critical to improving forest health.

The forest products industry is another group having an impact on forest management decisions. Their future depends on the wise use of our forest resources. A recent survey of 315 sawmills conducted in 2010 by McClain Forest Products revealed the average mill was operating at 65% of capacity. 30% of this operating loss was due to a lack of raw material availability and 5% to a lack of sales. It should be noted that as market pricing for finished forest products decreased in 2010 in the general economy through the 1st quarter of 2011, stumpage prices did not decline, but remained steady. This was a direct result of a decreased supply of available stumpage. A sustained supply of raw material for the forest products industry is necessary for the economic health of our rural communities.

In the opinion of the authors of this report, statewide forest inventory data indicates a critical need to focus on forest health issues. We strongly believe the sustainability of our forest should not be compromised for short-term economic gain. Missouri’s forestlands are potentially more productive than at any time in the last 100 years. However, forest health indicators are describing significant portions of our Missouri’s forests as mature, or over-mature. Long term trends in the characteristics of our forest resource contained in FIA data indicate that more intensive management is critical for healthy and sustainable forests for future generations.

MFPA acknowledges the projections in this report probably represent the upper limits of the potential annual saw timber harvest on publically owned timberland. Many factors impact timber harvest levels including logging infrastructure, production capacity of the forest products industry, and current market conditions. However, significant increases in commercial timber harvesting are possible, desirable and necessary for sustaining healthy public and private forests.

The need to increase harvest levels to improve forest health is occurring at a time of fiscal crisis at local, state and federal levels. The impact of the economic stimulus that can come from well managed forests, while improving forest health, is overwhelmingly positive not only in our rural communities, but throughout our state.
Observations

State Forests
FIA data suggests significant portions of MDC forestlands are becoming mature to over-mature. Almost ten percent (9.4%) of state owned forest stands are more than 100 years old as compared to 4.5% of the total timberland acreage within Missouri. Red and black oak comprise 33% of the total sawtimber volume on state owned timberland and are in decline due to over-maturity with associated susceptibility to insects and disease. The red oak group accounts for over 40% of the annual mortality on state timberland.

FIA data shows that annual sawtimber growth on state owned timberland is 102,555,000 board feet with an estimated market value of $19,691,668. The economic activity potentially generated from harvesting annual growth is $100,427,506 per year, with an economic multiplier of 5.1. This is an estimate of the sustainable economic potential of state owned forest resources.

The total estimated value of state owned commercial timberland in 2009 was $803,404,000, which includes an estimated value of $318,170,000 for sawtimber and $485,234,000 for land. The average annual harvest value from 2005-2009 was $1,510,000. With an annual budget of over $145 million, MDC could benefit from an increase in annual timber harvest levels.

It should be noted that MDC Conservation Areas have many non-timber benefits as well, contributing to the $3.3 billion spent each year by those enjoying various outdoor recreational opportunities in Missouri.

Federal Forests
The forests on the Mark Twain National Forest (MTNF) are becoming less diverse as indicated by stand age, BA and volume per acre. Of the 1,447,836 acres on the MTNF, 64% of the acreage is 61-100+ years old and contains 74% of the volume. 72% of the acreage (1,043,354 acres) has a BA of 81+ and is fully stocked, with an additional 338,548 acres considered over-stocked (BA>120).

As the 61+ years and older acreage increased, the 0-60 year old classes declined from 57% to 36% of total acreage. In 2009, the board foot volume per acre for this age class was 3,673, or 6% higher than the total for all age classes in private ownership. If the decline in acreage of younger stands continues, the age and diameter distribution of the MTNF may face an unsustainable period, due to the lack of management for regeneration that will ultimately replace the mature and over-mature trees.

Annual mortality increased by 131% from 2004 to 2009. The value of the timber lost annually through mortality was $49,987,000. Over 74% of the mortality was in the red oak group. For the same period, annual growth was valued at $21,273,000.

The total value of the commercial timberland on the MTNF is estimated at $1.739 billion, with $725 million in sawtimber and $1.013 billion in land. The average annual sawtimber harvest receipts from 2005-2009 were $4,372,000. In FY 2009, the MTNF budget was $28,242,324.
**Private Forests**
From 1989 to 2009, stand age, BA and mortality have remained constant and the annual growth rate was higher than MTNF timberlands, but less than state timberlands. In 1989, private timberlands provided 83% of the sawtimber harvest statewide, but by 2009, this percentage increased to 93%.

Privately owned timberlands have the lowest productivity among ownerships, averaging 126 BF/Acre/Year as compared to the MTNF (145 BF/Acre/Year) and state (179 BF/Acre/Year). Private ownership has the lowest stocking levels and quality of forest resources as compared to other ownerships due to harvest pressure. In Missouri, privately owned timberlands are 85% of the acreage, containing 80% of the volume and currently producing 93% of the harvest.

**Recommendations**

**State Forests**
MFPA recommends that comprehensive indicators of forest health such as basal area, annual growth, age, volume per acre, mortality and their trends be utilized to evaluate and improve forest health. These should be broad and general as current trends indicate a progressive and deliberate movement toward forest maturity. For the majority of these forests, recovery appears to be complete. MDC's stated primary objective is the enhancement of wildlife habitat, but the need to improve forest health must be considered a primary objective too. Future forest management plans should focus on the techniques required to sustainably manage state forest land for its commercial forest resources with equal priority to wildlife habitat. Indications are that the two objectives are mutually compatible and economically desirable.

**Federal Forests**
MFPA recommends an evaluation of the impact of current management efforts on hardwood diameter distribution and modify the long-term forest sustainability objectives of the MTNF accordingly. From 2005 to 2009, mortality was 135% of harvest (49.4 vs. 36.6 million BF) indicating significant oak decline that should have been identified and harvested. During the same period, there was a decline in annual harvest volumes, especially in the sawtimber size classes. Our state and nation are in a period in which the utilization of our sustainable resources is necessary to stimulate the economies of rural communities. It appears that current management practices on MTNF are not contributing equitable economic support from timber sale receipts to communities and the wood processing sectors in the state. Significant efforts should be forthcoming to utilize timber mortality volume as well as a greater amount of annual growth.

**Private Forests**
The number of private timberland owners was estimated at 359,000, with each owning an average of 34 acres. Most private timberland owners do not seek professional advice with management decisions. The best way to improve forest health on private timberland is by building landowner awareness of "healthy" forest management. Over the years, the American Tree Farm Program and other related
initiatives have attracted participation by only a small percentage of private timberland owners. MDC foresters and consulting foresters are available to provide management assistance to private landowners. Incentives for private landowners to seek technical forestry assistance and implement forest management practices should be developed in the public sector and promoted vigorously.

In order to bridge the “knowledge gap” with Missouri’s private timberland owners, the Forest and Woodland Association of Missouri (FWAM) has been launched with a primary objective of providing educational opportunities for private timberland owners. In addition, MDC and MFPA have initiated a Professional Timber Harvester training and a Master Logger certification program as ways to reach private landowners with sound forest management techniques. The “Call Before You Cut” program by MDC attempts to reach forest landowners who are considering a timber harvest.

However, more comprehensive efforts are essential by public agencies, associations and the wood products industry to reach private timberland owners in Missouri. The future health and sustainability of Missouri’s privately owned forests depend on the management decisions made today.

The future of rural communities, especially in the forested regions of Missouri, depends largely on the forest products industry for their economic livelihood. The forest products industry depends on the professional management of the state’s forest resources and sustainable timber harvesting on public and private timberland. **There is a significant opportunity to stimulate rural economies, while improving forest health, by increasing harvest levels on under-utilized public forest resources and improving the management on private lands.**
Appendix

Case Study – Ozark Region


The Ozark Region as defined contains about two-thirds of State timberland and nearly all of the USFS timberland as well as 7.1 million acres of privately owned timberland. It should come as no surprise that the majority of the primary wood processing mills are located in the Ozark Region.

Due to the heavy concentration of the forest products industry in the Ozark Region, a comparison of the forest health at the statewide level on all three ownerships is warranted. Here are some of the key findings:

- **Stand Age** – the percentage of acres that are at least 80 years old is slightly lower (14% vs. 16%) on private, slightly higher (23% vs. 20%) on state, and about the same on federal (18%) timberland in the Ozark Region compared to the statewide figures.

- **Basal Area** – the percentage of acres that are fully to over-stocked (BA 81+) on both state and private timberland are slightly lower in the Ozark Region (56.4% and 57.5%) compared to statewide (63.3% and 58.5%) figures. Over 72% of USFS acres are fully or over-stocked.

- **Volume/Acre** – the board foot volume per acre of sawtimber has doubled on all ownerships in the Ozark Region as well as the statewide level. However, the volume per acre on state (4,260 BF) and private (2,974 BF)
timberland in the Ozark Region is significantly less than the statewide averages of 4,570 BF (state) and 3,475 BF (private).

- **Mortality** – the rate of mortality on state and private timberland in the Ozark Region is less than half the statewide mortality rate for both ownership categories.

In summary, there are few significant differences in the four forest health indicators on the three land ownership categories when the statewide averages are compared to the Ozark Region. One possible exception is the reduction of the mortality rates on state and private timberland due to higher timber harvest rates in the Ozark Region compared to the rest of Missouri.

### Acres of Missouri Timberland by Stocking Level (BA) & Ownership

#### 2005-2009

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Total</th>
<th>0-40 sqft/ac</th>
<th>41-80 sqft/ac</th>
<th>81-120 sqft/ac</th>
<th>120+ sqft/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>14,711,046</td>
<td>1,343,358</td>
<td>4,530,992</td>
<td>6,351,679</td>
<td>2,485,016</td>
</tr>
<tr>
<td>USFS</td>
<td>1,447,836</td>
<td>51,112</td>
<td>353,369</td>
<td>704,806</td>
<td>338,548</td>
</tr>
<tr>
<td>State</td>
<td>693,191</td>
<td>45,802</td>
<td>208,622</td>
<td>297,202</td>
<td>141,565</td>
</tr>
<tr>
<td>Private</td>
<td>12,570,019</td>
<td>1,246,443</td>
<td>3,969,001</td>
<td>5,349,672</td>
<td>2,004,903</td>
</tr>
</tbody>
</table>

#### 1999-2004

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Total</th>
<th>0-40 sqft/ac</th>
<th>41-80 sqft/ac</th>
<th>81-120 sqft/ac</th>
<th>120+ sqft/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>13,763,451</td>
<td>1,408,605</td>
<td>4,620,693</td>
<td>5,747,783</td>
<td>1,986,370</td>
</tr>
<tr>
<td>USFS</td>
<td>1,379,816</td>
<td>47,700</td>
<td>369,925</td>
<td>699,683</td>
<td>262,508</td>
</tr>
<tr>
<td>State</td>
<td>636,298</td>
<td>58,598</td>
<td>207,775</td>
<td>270,190</td>
<td>99,735</td>
</tr>
<tr>
<td>Private</td>
<td>11,747,336</td>
<td>1,302,306</td>
<td>4,042,993</td>
<td>4,777,910</td>
<td>1,624,127</td>
</tr>
</tbody>
</table>

#### 1989

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Total</th>
<th>0-40 sqft/ac</th>
<th>41-80 sqft/ac</th>
<th>81-120 sqft/ac</th>
<th>120+ sqft/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTALS</td>
<td>13,086,960</td>
<td>1,117,092</td>
<td>5,711,908</td>
<td>5,526,093</td>
<td>731,867</td>
</tr>
<tr>
<td>USFS</td>
<td>1,320,557</td>
<td>99,822</td>
<td>439,719</td>
<td>666,934</td>
<td>114,081</td>
</tr>
<tr>
<td>State</td>
<td>402,872</td>
<td>25,322</td>
<td>169,071</td>
<td>182,280</td>
<td>26,198</td>
</tr>
<tr>
<td>Private</td>
<td>11,363,532</td>
<td>991,947</td>
<td>5,103,118</td>
<td>4,676,879</td>
<td>591,588</td>
</tr>
</tbody>
</table>

Table 9 – Basal Area Distribution on Federal, State, and Private Timberland
Table 10 – Stand Age Classes on Federal, State and Private Timberland

Table 11 – Total Volume & Estimated Value of Sawtimber by Species on Public Timberland
## 2009
### Total Volume & Stumpage Value of Sawtimber by Species
(Thousand Board Feet & Dollars)

#### PRIVATE

<table>
<thead>
<tr>
<th>Species</th>
<th>Volume (Thousand Board Feet)</th>
<th>Value (Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loblolly &amp; Shortleaf Pine</td>
<td>1,643,739</td>
<td>$73,121,141</td>
</tr>
<tr>
<td>Eastern White Pine</td>
<td>11,798</td>
<td>$283,146</td>
</tr>
<tr>
<td>Eastern Redcedar</td>
<td>696,991</td>
<td>$33,455,576</td>
</tr>
<tr>
<td>Select White Oaks</td>
<td>10,929,086</td>
<td>$1,877,067,568</td>
</tr>
<tr>
<td>Other White Oaks</td>
<td>3,896,762</td>
<td>$491,644,871</td>
</tr>
<tr>
<td>Other Red Oaks</td>
<td>10,264,966</td>
<td>$812,985,304</td>
</tr>
<tr>
<td>Hickory</td>
<td>3,920,837</td>
<td>$240,268,908</td>
</tr>
<tr>
<td>Hard Maple</td>
<td>537,779</td>
<td>$18,929,821</td>
</tr>
<tr>
<td>Soft Maple</td>
<td>811,935</td>
<td>$23,383,723</td>
</tr>
<tr>
<td>Beech</td>
<td>30,997</td>
<td>$991,907</td>
</tr>
<tr>
<td>Sweetgum</td>
<td>42,943</td>
<td>$2,404,809</td>
</tr>
<tr>
<td>Tupelo and Blackgum</td>
<td>257,668</td>
<td>$8,245,374</td>
</tr>
<tr>
<td>Ash</td>
<td>1,064,038</td>
<td>$92,784,114</td>
</tr>
<tr>
<td>Cottonwood</td>
<td>746,256</td>
<td>$44,775,330</td>
</tr>
<tr>
<td>Yellow-Poplar &amp; Basswood</td>
<td>142,629</td>
<td>$8,215,451</td>
</tr>
<tr>
<td>Black Walnut</td>
<td>1,599,990</td>
<td>$1,051,332,763</td>
</tr>
<tr>
<td>Other Eastern Soft Hardwoods</td>
<td>3,188,593</td>
<td>$91,831,489</td>
</tr>
<tr>
<td>Other Eastern Hard Hardwoods</td>
<td>602,103</td>
<td>$14,210,617</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>43,674,729</strong></td>
<td><strong>$5,359,061,106</strong></td>
</tr>
</tbody>
</table>

Table 12 – Total Volume & Value of Sawtimber by Species on Private Timberland