# Sustainable Forestry in the Balance

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ABSTRACT

In the United States we increasingly restrict wood production in the name of sustainability while going abroad for an ever larger share of the wood we consume, even though our own forest resources per capita are greater than the rest of the Earth. The unintended consequence is we transfer impacts of harvesting and consumption elsewhere. If we believe impacts of harvesting and consumption are primarily positive, we should embrace them locally. If we believe impacts are negative, we should take responsibility for them locally and mitigate them. Sustainable forest management requires scalable solutions across geopolitical units: states, regions, nations, and Earth. There are some simple measures of sustainability applicable across all these scales to establish sideboards for sustainable forest management.

**Keywords:** consumption, growth, harvest, sustainability

Sustainable forestry has always been difficult to define in quantitative terms. There have been Herculean efforts to identify specific performance indicators that should be measured to shed light on sustainability (e.g., Montreal Process Working Group 2005), and there have been some remarkable efforts to quantify and monitor those values regionally or nationally (e.g., Carpenter et al. 2003, USDA Forest Service 2004). However, as a natural resource community we have not done particularly well at interpreting what those performance indicators really mean with regard to sustainability. For example, we can readily monitor the area of forest types by age class and see that it is changing, but there is no general consensus on what range of outcomes indicate sustainability or unsustainability. Although we have the benefit of an excellent statistical profile of forest conditions in the United States based on a broad suite of carefully chosen criteria and indicators (USDA Forest Service 2004), very few threshold values have been identified for those indicators that would indicate if forest management practices are unsustainable at state, regional, national, or global scales.

However, there is one threshold related to sustainable forest management that, for all practical purposes, can be viewed as an absolute. It is the first of seven simple concepts related to sustainability. Namely, forested ecosystems are not sustainable if volume or biomass losses exceed growth over large areas or long periods of time. Losses could be removals for wood products or fuel, the result of land clearing, or the consequence of insect or disease outbreaks. Whatever the cause, if losses exceed growth (i.e., there is a net decline in volume or biomass) over large areas (e.g., thousands of acres) or over long periods of time (e.g., 10 years or more), most people would agree the situation is not sustainable. There may be many other reasons to conclude that forest conditions or forestry practices are not sustainable (e.g., related to forest ecosystem diversity, nontimber values, ecosystem services, etc.), but the aforementioned concept of large-scale, long-term, nondeclining volume is clear, measurable, and deeply rooted in our conservation ethic.

A cursory examination of net change in forest resources in the United States seems to indicate that we are on the right track with regard to this basic tenet of forest sustainability. The volume of US timber has increased steadily over the past 50 years from 616 to 856 billion cu ft (Smith et al. 2003). If we look no deeper, we can feel good about the situation. However, an examination of our patterns of forest growth, removals, and consumption in a broader context raises the concern that our current situation is not sustainable in a global context and may even be unethical in a global context.

If we start with that first simple concept of sustainable timber volume and add six more equally simple but related concepts, it completely changes the picture with regard to sustainability of forestry in the United States. The following sections describe six more simple ideas and how they shape a broader view of sustainable forestry.

## Second Simple Concept

Most people are not enamored with timber harvesting. As forestry professionals we readily see that timber harvesting can serve important purposes such as producing commodities, maintaining biodiversity, providing specific types of wildlife habitat, and improving forest health. However, most people find harvesting unaesthetic and would prefer not to see it where they live, recreate, or travel. Thus, decisions about where, when, and how much to harvest must have a sound scientific and social basis, because harvesting generally is unpopular and likely to remain so.

## Third Simple Concept

We use a lot of wood in the United States—about 20 billion cu ft per year (Haynes 2003, Howard 2003). That is the equivalent of 67 cu ft of wood per person per year (and far more than the global average annual consumption of 21 cu ft per person [Gardner-Outlaw and Engelman 1999]). To help put our national wood and fiber consumption in perspective, think of it as one continuous log, 3 feet in diameter, running through a mill at 60 miles per hour 24 hours per day, 365 days per year; or think about the area of land required to satisfy annual wood consumption at current rates of forest productivity (Figure 1). If the 20 bil-

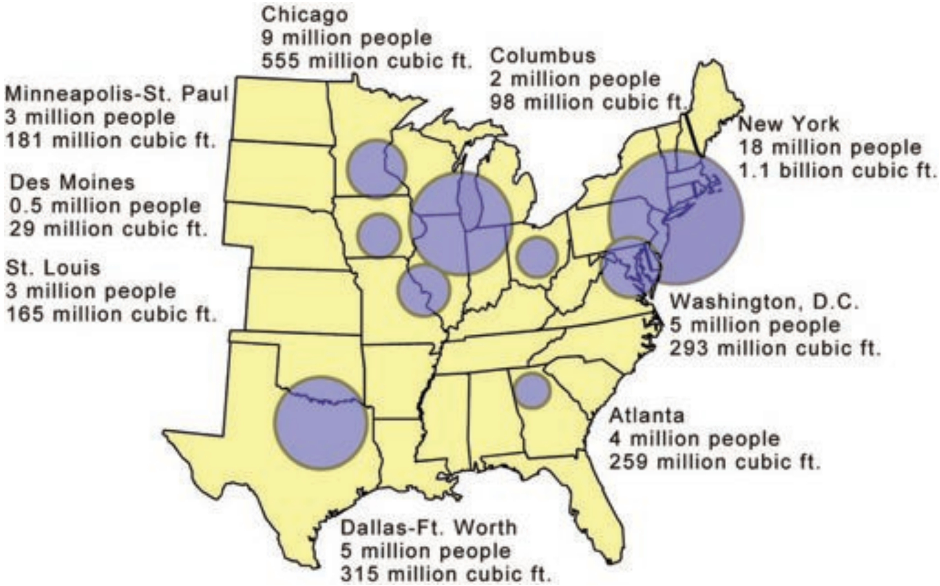


**Figure 1. Conceptual woodsheds, 2000. Circles show the approximate area required to satisfy annual wood consumption (on a simple cubic foot basis) for each named metropolitan area. Circles indicate area where current net annual growth of growing stock on timberland is equal to 87% of consumption for the metro area population. Analysis assumes 13% of consumption could be met from nongrowing stock trees, and that total per capita wood consumption in 2000 was 70.1 cu ft (Howard 2003). Analysis takes into account differences in the total area and productivity of timberland in the vicinity of each metropolitan area (e.g., compare total consumption and woodshed size for Des Moines versus Atlanta). This conceptual diagram assumes all persons within the circular woodshed but outside the named metropolitan area would need to obtain wood elsewhere. (Patterned after Shifley and Sullivan (2002); based on data and online analysis tools from Miles et al. (2005) with additional analyses by the author.)**

lion cu ft of wood corresponding to our annual consumption were stacked in 1-cubic-foot blocks, they would reach to the moon and back nearly eight times.

Consumption of wood in the United States is expected to increase over time as our population increases. There are two components related to total wood consumption in the United States: how much wood we consume per person, and how many people live here. Between 1965 and 2002, the per capita consumption of timber products has varied between 67 and 83 cu ft (Howard 2003). After 5 years of slowly declining per capita consumption, in 2002 (latest data) it stands at 67 cu ft or slightly below the 1965 level. However, over that same period the US population increased by nearly 50% (from 194 to 288 million people) and total US consumption of wood increased by nearly the same proportion. Projections are that by 2050, increases in the US population will drive US wood consumption up to 27.5 billion cu ft per year. That is an increase of 40%, relative to 1996 values, even with a projected slight decline in per capita wood consumption over that period (Haynes 2003).

## Fourth Simple Concept

The United States is a net importer of wood and has been for roughly 90 years (Haynes 2003). In the United States we both import and export logs, lumber, and finished wood products. For example, about one-third of the softwood lumber we consume comes from Canada (Adams 2003, Howard 2003, Society of American Foresters 2004), and we obtain many finished wood products from abroad. At the same time we export veneer logs, wood chips, and finished products throughout the world. However, on balance, imports substantially exceed exports. In 1991 net imports amounted to about 2% of total consumption. By 1996 they were 9% of consumption. By 2002 they were 16% of total consumption (Haynes 2003, Howard 2003). Absent any major changes in policy, the net balance of imports over exports is projected to increase to 19% of total wood consumption by 2050 (Haynes 2003).

## Fifth Simple Concept

As we import wood and wood products we also export to other nations the environmental, economic, and other social consequences (both the positive and the negative) associated with wood production, manufacturing, and consumption. As stated by Forest Service Chief Dale Bosworth (Bosworth 2003), "Out of sight, out of mind"—that is the danger of a system that separates consumption of forest products in one place from production in another. Our system today raises serious questions of both equity and sustainability. We need more of a dialogue on how to bring consumption in the most developed parts of the world into balance with production elsewhere."

Currently, we export the consequences associated with net annual imports of about 3 billion cu ft of wood. By 2050 we could be exporting the consequences associated with net annual imports of nearly 5 billion cu ft of wood (Haynes 2003).

## Sixth Simple Concept

There are many good reasons to use wood as a natural resource. Wood has many desirable properties for construction and manufacturing. It is abundant, renewable, recyclable, and biodegradable. Forests can provide numerous amenities such as clean water, wildlife, and recreation opportunities while producing wood. Trees sequester carbon dioxide (a greenhouse gas) from the atmosphere as they grow. Compared with alternative materials (e.g., steel), it requires relatively little energy to convert wood to useful products. Based on total life cycle analyses (including production, use, and eventual disposal), wood and wood fiber construction materials have been found preferable from an environmental perspective when compared with substitute materials (e.g., metal, concrete; Lippke et al. 2004, Bowyer 2005).

## Seventh Simple Concept

There is finite area from which the wood we use must come. All the wood consumed on Earth must be produced from the 9.6 billion ac of forestland on the planet. That acreage changes a little from year to year because of forest clearing and afforestation, but the bottom line is that the Earth has a finite amount of forestland, a finite area that is capable of supporting forests (even with aggressive afforestation), and many competing land uses that are incompatible with forestry. When we view US forest resources within that global context, it becomes much easier to gauge sustainability of our own forests, and, as luck would have it, the math is very easy. By sheer coincidence, the proportion of forest in the United States is nearly identical to that of the Earth as a whole. Specifically,

- About 30% of the land mass of the Earth is forested (Food and Agriculture Organization 2000, 2001; Figure 2).
- About one-third of North America is forested (Smith et al. 2003, Natural Resources Canada 2005).
- About one-third of the United States is forested (Smith et al. 2003).

This rather amazing series of coincidences is enormously instructive in defining sustainable forestry in the United States and even at smaller spatial scales within the United States. In the United States we have forest resources that are proportional to those found in the rest of the world. In fact, because our population is relatively low, we have the benefit of more forest per capita than the world as a whole (Table 1).

## Sustainable Forestry—The Larger Picture

Sustainable forestry requires a conceptual link between the consumption and production of wood at global, national, and regional levels (Strigel and Meine 2001). This is something that we have for the most part failed to do, and for US forests it has resulted in a situation that is not globally sustainable and that has undesirable social consequences. If our goal is globally sustainable forests, then it is illogical to remain a net importer of wood when we have forest resources that on an area basis are equivalent to those of the rest of the world and on a per capita basis are more abundant than those of the rest of the world.

Wood is a global commodity. From a short-term economic standpoint it may make perfect sense for the United States to be a net importer of wood. Billions of discrete purchasing decisions by US consumers lead us to that end result year after year. However, as we all know, forest sustainability is not determined on the basis of simple, short-term economics. In the past 50 years we have learned that sustainable forestry has many facets that can not be measured in board feet or dollars and cents. Forest resources are different from other commodities. Most resources we consume are not sustainable. Oil, gas, coal, concrete, and metals are all extracted resources. For those resources our policy is relatively simple: get it cheap, use it up, and look for more. Through the first half of the 20th century that also was our basic policy on wood as a natural resource. It is no longer our policy for forests, and the balance sheet of production and consumption must reflect that change.

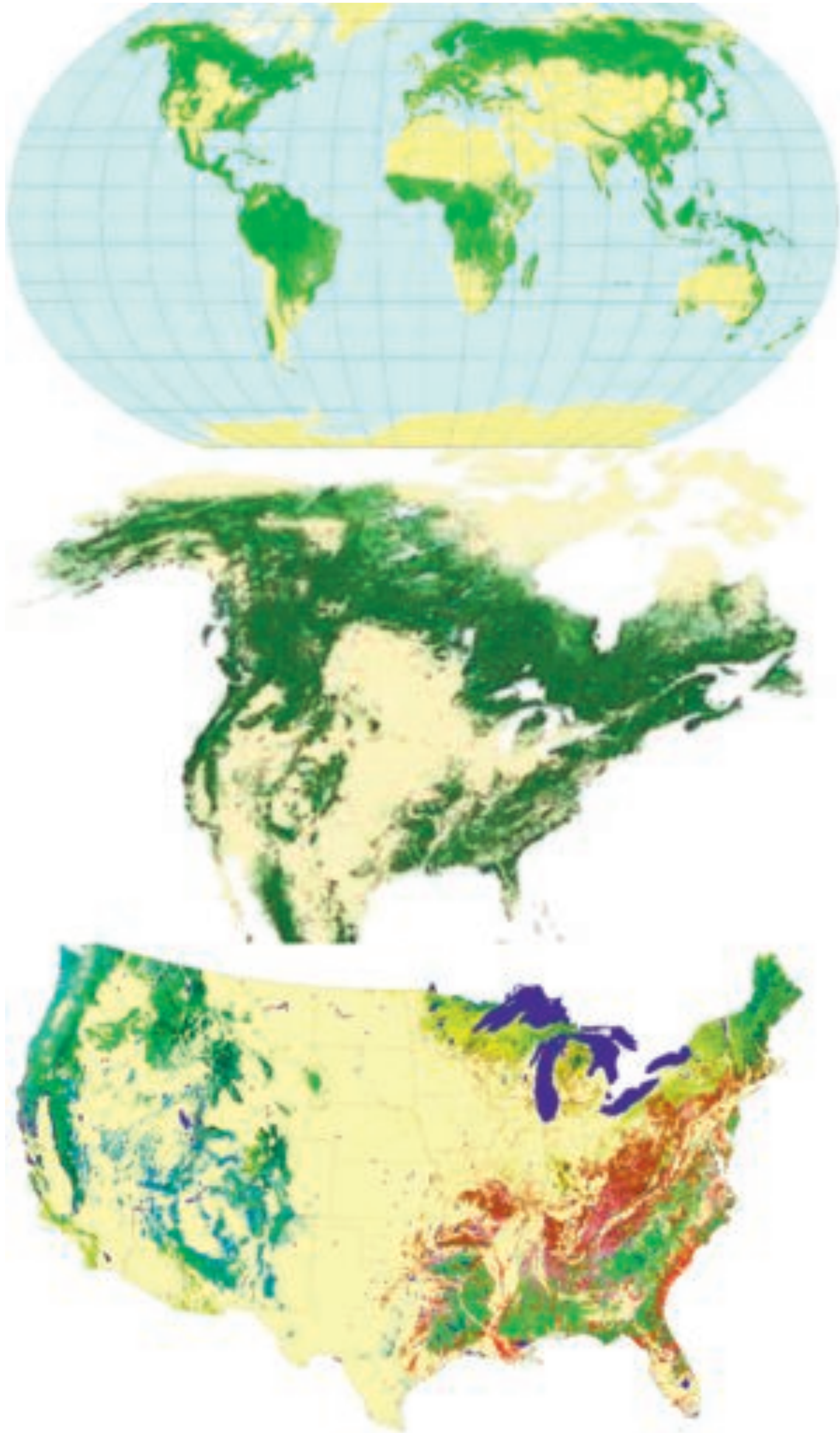

**Figure 2. US forest resources in a global context. The land mass of the Earth is about one-third forested, North America is about one-third forested, and the United States is about one-third forested. (Sources: World map, Food and Agriculture Organization [2005]; North America map, United Nations Environmental Programme [2005]; United States map, Zhu and Evans [1994]).**

**Table 1. Area of forestland and forest per capita.**

| | United States | World |
|---|---|---|
| Total forestland area, 2000 (ac) | 749 million | 9.6 billion |
| Population, 2000 | 281 million | 6.1 billion |
| Projected population, 2050 | 420 million | 9.2 billion |
| Forest land per capita, 2000 (ac) | 2.7 | 1.6 |
| Projected forest land per capita, 2050, Assuming no net change in forestland (ac) | 1.8 | 1.0 |

Source: Food and Agriculture Organization 2000, Smith et al. 2003, US Census Bureau 2005a,b.

## The Disconnect

Contemporary notions of sustainable forestry stipulate that we need to be concerned about dozens of different measures of forest condition and social well-being (Montreal Process Working Group 2005), and, of course, we are. However, contemporary notions of sustainability do not discourage us from creating "sustainable" forests at home by simply going elsewhere to get the wood and products that improve our lives, and, of course, they should. That is the big disconnect in our current notions of sustainable forestry. Currently, there is no social or economic penalty associated with overconsumption or underproduction of forest products as long as we can export our environmental issues to other nations that feed our demand for wood.

We spend a lot of time and energy in this country on debates and court battles over individual timber sales or other management actions. For the most part, those battles take place in the absence of any overarching principles regarding our national role as a global partner in sustainability. The outcome is that we increasingly restrict our domestic wood production in the name of sustainability while going abroad for the wood we consume.

The unintended consequence is that we push the impact of our consumption of wood products to other places. The impacts (both the positive and the negative) go out of sight and out of mind to places where we have neither the will nor the means to ensure that local forestry practices are sustainable. This does not seem to be a sound policy for sustainable forestry given that

- Our own forest resources are every bit as abundant as on the rest of the Earth.
- Our own forest resources per capita are far greater than the global average.
- The growth of our own forests greatly exceeds harvest and natural mortality.

Can we tout our own efforts directed at forest sustainability in the United States if success comes at the expense of an ever-increasing reliance on wood products produced elsewhere where we take little or no responsibility for the methods of production?

Unless the total amount of wood we put on the market is commensurate, on a gross volume basis, with the amount of wood we consume, we are not practicing sustainable forestry in a global context. This is not to suggest that we should be internally self-sufficient in all the various types of wood products we consume. Of course, we will continue to trade in global markets. However, if we are to be truly sustainable in our forest practices, then on balance we should be producing in the United States a total quantity of wood that is commensurate with our level of consumption. To do less is disingenuous and simply transfers the impacts of harvesting and consumption elsewhere. If we believe the impacts of harvesting and consumption are primarily positive impacts, we should embrace them locally. If we believe the impacts are negative, we should take responsibility for them locally and mitigate them. If we believe the impacts are a mix of positive and negative, we should welcome the positive aspects and mitigate the negative aspects as we endeavor to do a better job of forest ecosystem management.

## Scalable Solutions

An underlying premise of the proceeding discussion is that approaches to sustainability are scalable. The appropriate scale varies with the issue, but national, state, and county scales are essential. Those are the scales at which most laws, regulations, policies, penalties, and subsidies that affect forests and forest management are debated and enacted. If we were to adopt a national goal of annually producing a volume of wood that is commensurate with our consumption, there is abundant information about how the nation, the 50 states, and the thousands of counties are progressing with respect to that goal (Table 2). The math is easy. Policy decisions based on such a goal are not as easy when there are competing interests for all the things that forests provide. But at least there is a national and global yardstick of production and consumption that can be applied at many different spatial scales. There are abundant data available to examine state and regional patterns in current and potential forest growth, harvest, and consumption (Figure 3).

There also are minimum relevant scales for forest sustainability analyses. We can readily compute what would be required of each acre of US timberland if we were to balance current domestic wood production with current wood consumption, but we don't typically manage individual forest acres. Rather, we manage stands, which are components of forest ownerships that occur with other ownerships on landscapes that provide many products, services, and amenities. All the spatial scales where forest management policies are established are relevant to sustainability. These certainly include individual forest ownerships: private nonindustrial, industrial, or public. Simple math tells us that the larger the extent of an area under scrutiny, the closer that area must be to meeting national goals, whatever those goals may be. Forty acres that miss the mark will have little impact on a national evaluation of forest sustainability. The same can not be said of 40 states that miss the mark. Sustainable forestry can not be achieved directly at the global scale. Sustainable forestry occurs cumulatively through smaller spatial scales—nations, states, counties, and private ownerships—when those entities measure progress in the context of broader goals and responsibilities.

The Montreal Process is the current standard for assessing forest sustainability globally and nationally (Montreal Process Working Group 2005). The ideas in this article are meant to help refine that process for the United States in particular. Montreal Process criterion 2 addresses "Maintenance of productive capacity of forest ecosystems" and one of the key indicators is the "annual removal of wood products" compared to the volume determined to be sustainable. Criterion 6 addresses "maintenance and enhancement of long-term multiple socioeconomic benefits to meet the need of societies" and includes four indicators related to production, consumption, and value of wood and wood products.

**Table 2. Current forest area, growth, and removals by state and region with estimates of a hypothetical 'fair share' of volume production if states and regions produced wood in proportion to their timberland area or to their potential productivity.**

| (1) Region | (2) Forest land per capita (ac) | (3) Percent forested (%) | (4) Percent of all US timberland (%) | (5) Current net growth (million cu ft/yr) | (6) Potential net growth (million cu ft/yr) | (7) Current removals (million cu ft/yr) | (8) Current net increase in volume (million cu ft/yr) | (9) Potential net increase in volume (million cu ft/yr) | (10) Ratio current growth to current removals | (11) Ratio potential growth to current removals | (12) Percent of current US net growth (%) | (13) Parity production at 20 billion cu ft of consumption (million cu ft/yr) | (14) Current production deficit for 20 billion level (million cu ft/yr) | (15) Parity production at 27.5 billion cu ft of consumption (million cu ft/yr) | (16) Current production deficit for 27.5 billion level (million cu ft/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *North* | | | | | | | | | | | | | | | |
| **Northeast** | | | | | | | | | | | | | | | |
| Connecticut | 0.5 | 60 | 0.3 | 55 | 91 | 12 | 44 | 79 | 4.7 | 7.7 | 0.2 | 48 | −36 | 66 | −54 |
| Delaware | 0.5 | 31 | 0.1 | 16 | 22 | 8 | 9 | 15 | 2.1 | 2.9 | 0.1 | 12 | −4 | 16 | −9 |
| Maine | 13.9 | 90 | 3.4 | 402 | 934 | 442 | −40 | 493 | 0.9 | 2.1 | 2.5 | 496 | −54 | 682 | −240 |
| Maryland | 0.5 | 41 | 0.5 | 107 | 159 | 41 | 67 | 118 | 2.6 | 3.9 | 0.4 | 84 | −44 | 116 | −75 |
| Massachusetts | 0.5 | 62 | 0.5 | 97 | 170 | 16 | 82 | 155 | 6.2 | 10.9 | 0.5 | 90 | −75 | 124 | −109 |
| New Hampshire | 3.9 | 84 | 0.9 | 170 | 239 | 140 | 30 | 98 | 1.2 | 1.7 | 0.6 | 127 | 14 | 174 | −34 |
| New Jersey | 0.3 | 45 | 0.4 | 55 | 93 | 11 | 45 | 82 | 5.3 | 8.8 | 0.2 | 49 | −39 | 68 | −57 |
| New York | 1.0 | 61 | 3.1 | 590 | 849 | 141 | 449 | 707 | 4.2 | 6.0 | 2.3 | 450 | −309 | 619 | −478 |
| Pennsylvania | 1.4 | 59 | 3.1 | 630 | 849 | 216 | 414 | 633 | 2.9 | 3.9 | 2.3 | 451 | −235 | 620 | −404 |
| Rhode Island | 0.4 | 58 | 0.1 | 8 | 18 | 2 | 6 | 16 | 4.6 | 10.1 | 0.0 | 9 | −8 | 13 | −11 |
| Vermont | 7.6 | 78 | 0.9 | 190 | 235 | 77 | 113 | 158 | 2.5 | 3.0 | 0.6 | 125 | −48 | 172 | −95 |
| West Virginia | 6.7 | 79 | 2.4 | 510 | 821 | 167 | 343 | 653 | 3.0 | 4.9 | 2.2 | 436 | −268 | 599 | −432 |
| **Total Northeast** | **1.4** | **67** | **15.6** | **2,832** | **4,479** | **1,272** | **1,561** | **3,208** | **2.2** | **3.5** | **11.9** | **2,378** | **−1,106** | **3,270** | **−1,998** |
| **North Central** | | | | | | | | | | | | | | | |
| Illinois | 0.3 | 12 | 0.8 | 172 | 350 | 69 | 103 | 281 | 2.5 | 5.0 | 0.9 | 186 | −117 | 256 | −186 |
| Indiana | 0.7 | 20 | 0.9 | 224 | 411 | 97 | 127 | 314 | 2.3 | 4.3 | 1.1 | 218 | −122 | 300 | −203 |
| Iowa | 0.7 | 6 | 0.4 | 41 | 144 | 25 | 16 | 119 | 1.6 | 5.7 | 0.4 | 76 | −51 | 105 | −80 |
| Michigan | 1.9 | 53 | 3.7 | 756 | 1,290 | 316 | 441 | 975 | 2.4 | 4.1 | 3.4 | 685 | −369 | 942 | −626 |
| Minnesota | 3.4 | 33 | 2.9 | 370 | 911 | 316 | 54 | 595 | 1.2 | 2.9 | 2.4 | 484 | −168 | 665 | −349 |
| Missouri | 2.5 | 32 | 2.7 | 239 | 722 | 168 | 72 | 554 | 1.4 | 4.3 | 1.9 | 383 | −215 | 527 | −359 |
| Ohio | 0.7 | 30 | 1.5 | 293 | 391 | 101 | 192 | 290 | 2.9 | 3.9 | 1.0 | 208 | −106 | 286 | −184 |
| Wisconsin | 3.0 | 46 | 3.1 | 489 | 1,147 | 347 | 142 | 800 | 1.4 | 3.3 | 3.0 | 609 | −262 | 837 | −490 |
| **Total North Central** | **1.4** | **30** | **16.0** | **2,585** | **5,367** | **1,439** | **1,146** | **3,927** | **1.8** | **3.7** | **14.2** | **2,849** | **−1,410** | **3,917** | **−2,478** |
| *Total North* | **1.4** | **41** | **31.5** | **5,418** | **9,846** | **2,711** | **2,707** | **7,135** | **2.0** | **3.6** | **26.1** | **5,227** | **−2,516** | **7,187** | **−4,476** |
| *South* | | | | | | | | | | | | | | | |
| **Southeast** | | | | | | | | | | | | | | | |
| Florida | 1.0 | 47 | 2.9 | 685 | 942 | 560 | 124 | 381 | 1.2 | 1.7 | 2.5 | 500 | 61 | 687 | −127 |
| Georgia | 3.0 | 66 | 4.7 | 1,519 | 1,821 | 1,448 | 71 | 373 | 1.0 | 1.3 | 4.8 | 966 | 481 | 1,329 | 119 |
| North Carolina | 2.4 | 62 | 3.7 | 1,160 | 1,452 | 958 | 202 | 495 | 1.2 | 1.5 | 3.9 | 771 | 187 | 1,060 | −102 |
| South Carolina | 3.1 | 65 | 2.4 | 945 | 926 | 683 | 263 | 243 | 1.4 | 1.4 | 2.5 | 491 | 191 | 676 | 7 |
| Virginia | 2.1 | 63 | 3.1 | 848 | 1,120 | 655 | 193 | 465 | 1.3 | 1.7 | 3.0 | 595 | 60 | 818 | −163 |
| **Total Southeast** | **2.0** | **60** | **16.8** | **5,157** | **6,260** | **4,304** | **853** | **1,957** | **1.2** | **1.5** | **16.6** | **3,323** | **980** | **4,570** | **−266** |
| **South Central** | | | | | | | | | | | | | 0 | | |
| Alabama | 5.2 | 71 | 4.6 | 1,460 | 2,156 | 1,299 | 162 | 857 | 1.1 | 1.7 | 5.7 | 1,145 | 154 | 1,574 | −275 |
| Arkansas | 7.0 | 56 | 3.6 | 896 | 1,562 | 796 | 101 | 766 | 1.1 | 2.0 | 4.1 | 829 | −33 | 1,140 | −344 |
| Kentucky | 3.1 | 50 | 2.5 | 384 | 807 | 276 | 108 | 531 | 1.4 | 2.9 | 2.1 | 428 | −152 | 589 | −313 |
| Louisiana | 3.1 | 50 | 2.7 | 834 | 1,513 | 959 | −25 | 555 | 0.9 | 1.6 | 4.0 | 803 | 156 | 1,105 | −146 |
| Mississippi | 6.5 | 62 | 3.7 | 1,105 | 2,045 | 1,150 | −45 | 895 | 1.0 | 1.8 | 5.4 | 1,086 | 64 | 1,493 | −343 |
| Oklahoma | 2.2 | 17 | 1.2 | 243 | 374 | 133 | 110 | 241 | 1.8 | 2.8 | 1.0 | 199 | −65 | 273 | −140 |
| Tennessee | 2.5 | 55 | 2.8 | 738 | 1,192 | 384 | 354 | 808 | 1.9 | 3.1 | 3.2 | 633 | −249 | 870 | −486 |
| Texas | 0.8 | 10 | 2.3 | 705 | 1,198 | 770 | −64 | 428 | 0.9 | 1.6 | 3.2 | 636 | 134 | 874 | −105 |
| **Total South Central** | **2.6** | **33** | **23.4** | **6,365** | **10,847** | **5,766** | **599** | **5,081** | **1.1** | **1.9** | **28.8** | **5,758** | **8** | **7,918** | **−2,151** |
| *Total South* | **2.3** | **40** | **40.2** | **11,522** | **17,108** | **10,070** | **1,452** | **7,037** | **1.1** | **1.7** | **45.4** | **9,082** | **988** | **12,487** | **−2,417** |

Table 2 continues on p. 192

**Table 2 continued.**

| (1) Region | (2) Forest land per capita (ac) | (3) Percent forested (%) | (4) Percent of all US timberland (%) | (5) Current net growth (million cu ft/yr) | (6) Potential net growth (million cu ft/yr) | (7) Current removals (million cu ft/yr) | (8) Current net increase in volume (million cu ft/yr) | (9) Potential net increase in volume (million cu ft/yr) | (10) Ratio current growth to current removals | (11) Ratio potential growth to current removals | (12) Percent of current US net growth (%) | (13) Parity production at 20 billion cu ft of consumption (million cu ft/yr) | (14) Current production deficit for 20 billion level (million cu ft/yr) | (15) Parity production at 27.5 billion cu ft of consumption (million cu ft/yr) | (16) Current production deficit for 27.5 billion level (million cu ft/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rocky Mountain* | | | | | | | | | | | | | | | |
| **Great Plains** | | | | | | | | | | | | | | | |
| Kansas | 0.6 | 3 | 0.3 | 26 | 94 | 7 | 19 | 86 | 3.6 | 13.0 | 0.2 | 50 | −42 | 68 | −61 |
| Nebraska | 0.6 | 2 | 0.2 | 14 | 54 | 10 | 4 | 44 | 1.4 | 5.2 | 0.1 | 29 | −18 | 39 | −29 |
| North Dakota | 1.0 | 2 | 0.1 | 7 | 20 | 1 | 6 | 19 | 6.6 | 19.8 | 0.1 | 11 | −10 | 15 | −14 |
| South Dakota | 2.1 | 3 | 0.3 | 40 | 62 | 21 | 19 | 41 | 1.9 | 3.0 | 0.2 | 33 | −12 | 45 | −24 |
| **Total Great Plains** | **0.8** | **2** | **0.9** | **87** | **229** | **39** | **47** | **190** | **2.2** | **5.8** | **0.6** | **122** | **−82** | **167** | **−128** |
| **Intermountain** | | | | | | | | | | | | | | | |
| Arizona | 3.8 | 27 | 0.7 | 124 | 155 | 14 | 111 | 142 | 9.2 | 11.5 | 0.4 | 83 | −69 | 113 | −100 |
| Colorado | 5.0 | 33 | 2.3 | 291 | 529 | 21 | 271 | 509 | 14.1 | 25.7 | 1.4 | 281 | −260 | 386 | −366 |
| Idaho | 16.7 | 41 | 3.3 | 635 | 1,365 | 253 | 382 | 1,112 | 2.5 | 5.4 | 3.6 | 725 | −472 | 996 | −743 |
| Montana | 25.8 | 25 | 3.8 | 583 | 1,088 | 168 | 415 | 920 | 3.5 | 6.5 | 2.9 | 577 | −409 | 794 | −626 |
| Nevada | 5.1 | 15 | 0.1 | 6 | 21 | 1 | 4 | 19 | 4.3 | 15.5 | 0.1 | 11 | −10 | 15 | −14 |
| New Mexico | 9.2 | 21 | 0.9 | 140 | 195 | 19 | 122 | 176 | 7.4 | 10.3 | 0.5 | 104 | −85 | 142 | −123 |
| Utah | 7.0 | 30 | 0.9 | 77 | 223 | 8 | 68 | 215 | 9.2 | 26.9 | 0.6 | 118 | −110 | 163 | −155 |
| Wyoming | 22.3 | 18 | 1.1 | 119 | 246 | 14 | 104 | 232 | 8.4 | 17.4 | 0.7 | 131 | −116 | 180 | −165 |
| **Total Intermountain** | **7.7** | **25** | **13.2** | **1,975** | **3,822** | **498** | **1,477** | **3,325** | **4.0** | **7.7** | **10.1** | **2,029** | **−1,531** | **2,790** | **−2,292** |
| ***Total Rocky Mountain*** | **6.0** | **19** | **14.0** | **2,062** | **4,051** | **537** | **1,525** | **3,514** | **3.8** | **7.5** | **10.8** | **2,151** | **−1,614** | **2,957** | **−2,420** |
| *Pacific Coast* | | | | | | | | | | | | | | | |
| **Total Alaska** | **202.4** | **35** | **2.4** | **207** | **549** | **142** | **65** | **406** | **1.5** | **3.9** | **1.5** | **291** | **−149** | **400** | **−258** |
| **Pacific Northwest** | | | | | | | | | | | | | | | |
| Oregon | 8.7 | 48 | 4.7 | 1,728 | 2,431 | 863 | 865 | 1,568 | 2.0 | 2.8 | 6.5 | 1,291 | −427 | 1,775 | −911 |
| Washington | 3.7 | 51 | 3.4 | 1,426 | 1,905 | 867 | 559 | 1,038 | 1.6 | 2.2 | 5.1 | 1,011 | −144 | 1,390 | −523 |
| **Total Pacific Northwest** | **5.5** | **49** | **8.2** | **3,154** | **4,336** | **1,730** | **1,424** | **2,606** | **1.8** | **2.5** | **11.5** | **2,302** | **−572** | **3,165** | **−1,435** |
| **Pacific Southwest** | | | | | | | | | | | | | | | |
| California | 1.2 | 40 | 3.5 | 1,325 | 1,689 | 634 | 692 | 1,056 | 2.1 | 2.7 | 4.5 | 897 | −263 | 1,233 | −599 |
| Hawaii | 1.4 | 43 | 0.1 | 1 | 96 | 0 | 1 | 96 | | | 0.3 | 51 | −51 | 70 | −70 |
| **Total Pacific Southwest** | **1.2** | **40** | **3.7** | **1,326** | **1,785** | **634** | **693** | **1,151** | **2.1** | **2.8** | **4.7** | **948** | **−314** | **1,303** | **−669** |
| ***Total Pacific Coast*** | **4.9** | **38** | **14.2** | **4,687** | **6,670** | **2,506** | **2,181** | **4,164** | **1.9** | **2.7** | **17.7** | **3,541** | **−1,035** | **4,868** | **−2,362** |
| **United States** | **2.7** | **33** | **100.0** | **23,689** | **37,675** | **15,824** | **7,865** | **21,850** | **1.5** | **2.4** | **100.0** | **20,000** | **−4,176** | **27,500** | **−11,676** |

Notes, indexed by column number:
(4) Timberland excludes forestland that is legislatively or administratively restricted from harvest (e.g., parks, and wilderness) and that which is unsuitable for producing commercial crops of timber.
(6) Estimated from reported potential site productivity as reported by Smith et al. (2003; Table 4).
(8) Column (5) − Column (7).
(9) Column (6) − Column (7).
(10) Column (5)/Column (7).
(11) Column (6)/Column (7).
(13) Based on state's proportion of US timberland, volume of wood production needed to supply proportional share of 20 billion cu ft/yr; 20 billion cu ft is approximate US consumption in 2002.
(14) Column (13) − Column (7).
(15) Based on state's proportion of US timberland, volume of wood production needed to supply proportional share of 27.5 billion cu ft/yr; 27.5 billion cu ft is projected US consumption in 2050.
(16) Column (15) − Column (7).
Source: Data from Smith et al. (2003) and US Census Bureau (2005b) with additional computations by the author.

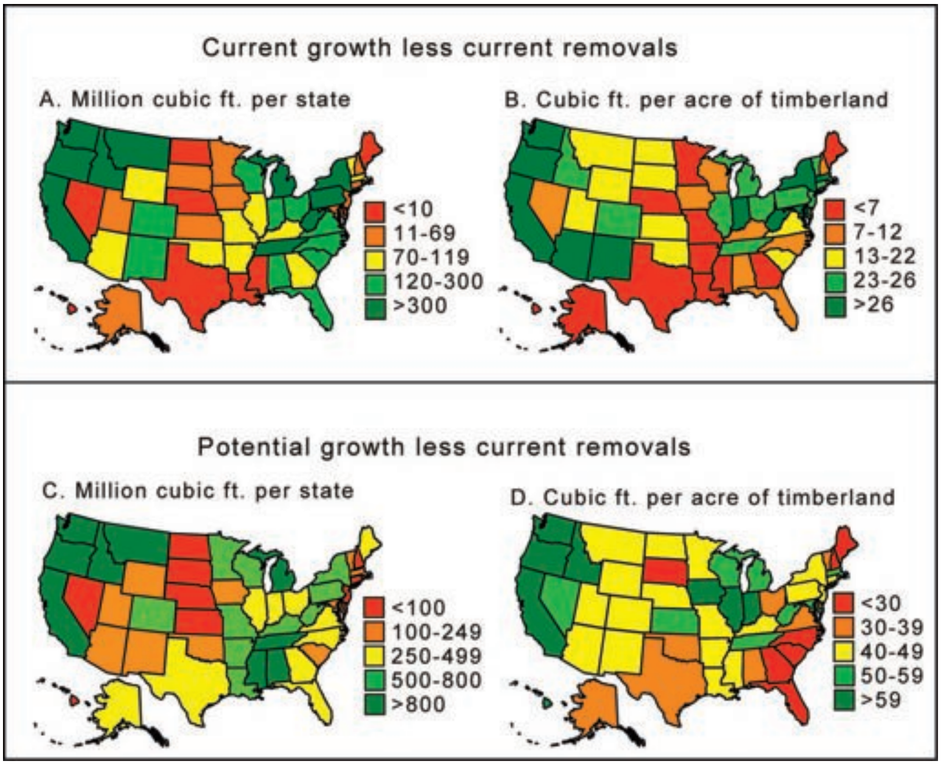


**Figure 3. Views of current and potential additional wood production capacity by state. The difference between current average annual growth and average annual removals of growing stock on timberland indicates where wood is accumulating (A and B). (A) Shows the total per state. Because states differ greatly in area of timberland, (B) shows the difference expressed per acre of timberland. States such as Arizona, New Mexico, and Indiana have relatively few total acres of timberland but high growth compared with removals for the average acre. The difference between estimated potential annual growth and current annual removals (C) per state and (D) per acre of timberland indicates where wood would accumulate if growth were closer to potential productivity. Current growth greatly exceeds harvest along the Pacific coast, in the Midwest, and the central Appalachians. (Based on data from Smith et al. (2003) with additional analyses by the author.)**

Implicit in this article is the concept that any notion of "sustainable" forestry must account for many layers of complexity, including the unintended consequence of simply transferring negative effects to other places. The Montreal Process is focused on sustainable forestry at the national level within a global context. It requires assessing multiple criteria that often are qualitative rather than quantitative, that change over time, and that may be vaguely defined. The Montreal Process continues to evolve. Two things that speed that evolution are (1) thoughtful discussion of the many facets of sustainable forestry and (2) using the best available quantitative data to help set realistic sideboards or limits on what constitutes sustainable forestry. Because sustainable forestry is so complex and difficult to define, it is useful to identify a wide range of conditions or processes that are clearly unsustainable (e.g., declining timber volume or wholesale export of harvest impacts) and then to ensure that we consistently avoid those in our pursuit of all the other facets of sustainable forestry.

## Changing the Balance

There are many ways to change the balance among growth harvest and consumption of wood products and to move closer to a sustainable condition. Consumers, managers, producers, manufacturers, and policymakers all play a role (Figure 4). In all likelihood, even with dedicated efforts to reduce unnecessary consumption and increase recycling, US wood consumption will increase at a rate slightly less than the rate of population increase. We will need to harvest and process more wood in the United States if our collective forest resources are to be used at a globally sustainable level. In fact, harvest levels will have to increase by about 40% in the next 45 years to keep pace with projected increases in US population (Haynes 2003). We are fortunate in a sense, because our projected rate of population increase will be slightly less than that for the rest of the world and our total forest area per capita will be much greater than for the rest of the world.

What would it take for the United States to sustainably produce a volume of wood commensurate with the volume consumed?

- Increased harvest—from 18 billion cu ft currently to more than 27 billion cu ft in 2050 (Table 2; projections on total consumption from Haynes 2003).
- A more even geographic distribution of harvests, and greater visibility of harvesting practices.
- A stronger commitment to the use of best management practices.
- More professionals on the ground guiding decisionmaking.
- Greater involvement of nonindustrial private owners in managing their forests and selling timber through forest management plans.
- Matching regional forest harvest levels to the area and productivity of forest resources.
- Estimating the "right size" for commercial forest production by state and ecoregion based on forest resources (Table 2).
- An ongoing commitment to balancing all the products, values, and services that we depend on forests to provide.
- Changing the context of local debates away from isolated battles over individual timber sales toward addressing the question, "How do we sustainably produce a quantity of wood that is in balance with our consumptive pressures and our local forest resources viewed in a global context, now and in coming decades?"

Balancing growth, harvest and consumption of US forests will require greater management intensity, particularly in the Midwest, North, and Northeast (Table 2). That could be beneficial in many respects because management can improve forest health. Gypsy moth, Asian long-horned beetle, oak decline, sudden oak death, emerald ash borer, wildfire, global warming—all are here or are on the way. They will become part of US forest ecosystems, and with or without management intervention, forests eventually will adapt and persevere. But active management is the only way to mitigate the severity of the impacts, maintain forest health, reduce rate of spread, salvage products, reduce fire risk, and reduce habitat loss. Forest management is the only technique we have to be proactive when

**Consumers** can:

- Consume less
- Recycle more
- Alter consumption of wood relative to alternative products and commodities and relative to environmental costs and benefits

**Resource managers/owners can:**

- Increase forest growth per acre through improved management of natural forests
- Increase forest growth per acre through intensive plantation culture
- Increase the number of forested acres in production through tree planting and agro-forestry.
- Change the amount of wood they sell.

**Manufacturers can:**

- Increase the efficiency of converting wood into products
- Engineer products that extend the utility of a given amount of harvested timber
- Engineer products that are environmentally benign over their life cycle (production, use, disposal)

**All of us can devote effort to discussing the issues and formulating solutions.**

**Figure 4. Changing the balance of growth, harvest, and consumption (from Shifley and Sullivan 2002). There are many complimentary strategies for bringing wood consumption, forest growth, and forest harvest into balance.**

faced with disturbance by insects, disease, weather, fire, or other undesirable agents of change. The consequence of inactivity or nonresponsive management is to become victims when faced with these and other inevitable agents of disturbance. Forests are dynamic and so is sustainable forest management.

Economic considerations are inextricably tied to sustainable forest management decisions, but economic considerations are only one component of sustainable forestry. Sustainable forestry has both costs and benefits that can not be reduced to an annual financial balance sheet. We can not measure in dollars and cents the long-term, large-scale, cumulative effects of forest management decisions on all the products, services, and amenities that forests provide. Thus, we must incorporate other principles into our discussions and decisions about what constitutes sustainable forestry.

## Conclusions

My conclusion, based on the simple concepts presented in this article, is that our current course of action with regard to timber production and consumption is not sustainable in a global context. Our forest resources are greater than those enjoyed by the world as a whole. If we are to be equitable partners with regard to global forest resources, our aggregate national volume of timber harvest must be brought into balance with our aggregate rate of domestic wood consumption, now and for future decades. There are many complementary ways to work toward that goal, and consumers, conservationists, and environmentalists of every ilk have important roles.

A scalable, proportional approach to sustainable forestry based on timberland area and wood consumption is a first step. It deals with forest attributes that are easy to measure. The same type of proportional assessment of productive capacity and accomplishments can be applied to sustainability assessments for other renewable resources such as wildlife, water, or recreation. Obviously, management decisions will always need to take into account special places, threatened and endangered species, the interactions of communities and forests, multiple use, and multiple expectations. If, given our vast natural resources and intellectual capabilities, we are unable to achieve a general balance between wood production and consumption nationally and regionally, then global sustainability is virtually impossible to achieve.

The ramifications of such an approach toward sustainable forest management in the United States are enormous. The ramifications of the status quo are equally large and, in my opinion, much harder to justify on a wide range of biological, social, and ethical grounds.

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