THE ILLUSION OF PRESERVATION

A GLOBAL ENVIRONMENTAL ARGUMENT FOR THE LOCAL PRODUCTION OF NATURAL RESOURCES

MARY M. BERLIK

DAVID B. KITTREDGE

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DAVID R. FOSTER

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Mary M. Berlik

David B. Kittredge

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Front cover: A dawn view of the forested landscape of central Massachusetts.
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SUMMARY

The United States and other affluent countries consume vast quantities of global natural resources, but contribute proportionately less to the extraction of many raw materials. This imbalance is due, in part, to domestic attitudes and policies intended to protect the environment. Ironically, developed nations are often better equipped to extract resources in an environmentally prudent manner than the major suppliers. Thus, although citizens of affluent countries may imagine that preservationist domestic policies are conserving resources and protecting nature, heavy consumption rates necessitate resource extraction elsewhere and oftentimes under weak environmental oversight. A major consequence of this "illusion of natural resource preservation" is greater global environmental degradation than would arise if consumption were reduced and a larger portion of production was shared by affluent countries. Clearly, environmental policy needs to consider the global distribution and consequences of natural resource extraction.

This paper considers one resource — wood, and one region — Massachusetts, to examine some implications of a global perspective for consumption, management, and conservation at a local scale. The global perspective reveals increasing rates of wood consumption, resulting in increased logging in many regions where it is environmentally damaging. A comparison of the feasibility and environmental impact of various strategies for dealing with rising wood demand suggests that the U.S. should strive to: (1) reduce per capita consumption of wood and its substitutes, (2) recycle forest products more effectively, (3) protect extensive areas of intensively managed and unmanaged forests, and (4) promote sound forest management where the environmental consequences are mild.

A strong case can be made that regions like Massachusetts are environmentally desirable places to manage forests intensively. Careful logging in such areas with resilient forests and the potential for strong environmental oversight would impose minor ecological effects compared to many current source areas of timber; the region's conservation-minded population might improve global environmental quality by matching a larger portion of its wood consumption with responsible production. Importantly, local production of wood might connect consumer consumption patterns with the environmental consequences of this behavior, a connection often lost when resources are imported. Forestry in Massachusetts might allow preservation of primary forests elsewhere in the world.

Many challenges exist to this proposition. The percentage of Massachusetts' landowners managing their forests is decreasing and, although harvesting is widespread, it is occurring at low rates and in a haphazard fashion despite the rising value and maturity of the forests. Shifting production source areas alone will not address the environmental issues or provide a major percentage of Massachusetts' wood needs. However, if aggressive reductions in consumption (e.g., to European levels), and effective recycling (e.g., at European rates) were combined with judiciously increased harvest levels, 50 percent of the state's wood consumption could be met at sustainable rates, even while preserving large, undisturbed blocks of forest.

Many management options, tax policies, conservation measures, and marketing approaches for "green" products exist for consideration by those with authority to make decisions about land management or public policy. But the most crucial change is undoubtedly one of philosophy and practice. Mainstream environmentalist ideology must embrace multiple uses of the forest including harvesting — and local citizens must consider the use of resources in their own backyard while maintaining a keen awareness of the global environment.

The Illusion — A Clash between Local Consumption and Global Protection

As a nation of affluent consumers, the United States appropriates an enormous portion of the world's total resources. As a nation of environmentally aware citizens, the U.S. champions the protection of nature, especially within its borders. Notably and somewhat hypocritically, the protectionist attitude often fails to address the link between high levels of domestic natural resource consumption and the unavoidable impacts that this imposes on the global environment, especially beyond U. S. borders. In addition to the tangible issue of whether humankind can live sustainably within the earth's ecological limits, there is the environmental question of whether the burden of providing natural resources should be placed on often pristine or fragile landscapes, and the intriguing sociological question as to whether affluent citizens might alter their patterns of resource consumption if the environmental consequences of this consumption were apparent in their own backyards.

To support high levels of consumption, the U.S. relies heavily on imported raw materials. At the same time, the American public is increasingly interested in reducing the use of domestic resources in order to protect the natural environment (Bowyer, 1994; Bowyer and Stockman, 2001). This attitude frequently ignores the fact that reducing domestic production with no corresponding change in consumption simply requires other parts of the globe to supply the resources. Consequently, well-intentioned environmental activism may generate unanticipated environmental degradation if it fails to recognize that natural resource preservation is but an *illusion* if it only serves to shift the source of resources, especially to locations where extraction is less environmentally sound. In order to achieve true environmental protection, it is essential to consider both consumption **and** the global distribution of resource production. This principle can be highlighted through a focus on a major resource and a critical global environment — wood and the world's forests.

GLOBAL WOOD NEEDS

The environmental impacts of wood extraction depend on the condition and sensitivity of the forest and the expertise and approach of those managing it. For this reason, it is critical to focus on where and how wood is actually harvested. In principle, wood is a renewable resource, but in the absence of well-planned management, short-term exploitation can target inappropriate areas and induce environmental impacts or conversion to other uses yielding results better likened to mining than sustainable use (Allen, 1998).

Even though much of the world is forested, population and consumption growth rates are jeopardizing the reliability of the global wood supply (Dekker-Robertson and Libby, 1998; Solberg, et al., 1996; Bowyer and Stockman, 2001). Global annual wood harvests average about 3.4 billion m^3. With mean projections for 2010 of 4.6 billion m^3 (a 35% increase in ten years), a shrinking amount of forest will need to provide increasing volumes of wood. Current projections forecast a gap between global fiber demand and availability of 400 to 800 million m^3 in 2010 (World Resources Institute, 1998).

THE CONSEQUENCES OF U.S. ATTITUDES AND POLICIES TOWARDS FOREST PROTECTION POLICIES

Affluent nations are implementing ever stricter policies to limit and control logging, ranging from public land management reforms to logging bans, and wilderness designation (Dekker-Robertson and Libby, 1998). In the U.S. these activities are shifting harvesting regionally and overseas. For example, in the Pacific Northwest, national policies have reduced production to 20% of 1980–1989 levels (Dekker-Robertson and Libby, 1998). Some of this decline has been offset by higher harvesting rates in the Southeastern U.S., but imports from Canada, Middle and South America, Southeast Asia, China, South

Africa, and Russia have grown throughout the 1990s and are increasing (The International Tropical Timber Organization (ITTO), 1999; WFI 2000, Tromborg, et al., 2000; Figure 1).

Efforts to reduce domestic harvesting extend nationally. Harvesting levels in national forests have decreased by 70% since the mid-1980s, reaching their lowest level since World War II (Society of American Foresters (SAF), 2000). In a plan approved by President Clinton shortly before leaving office, logging will be reduced by 50% in 11 million acres of national forests in the Sierra Nevada range (Doering, 2001). Meanwhile, at the local level municipalities have passed local bylaws regulating or limiting harvesting on private lands.

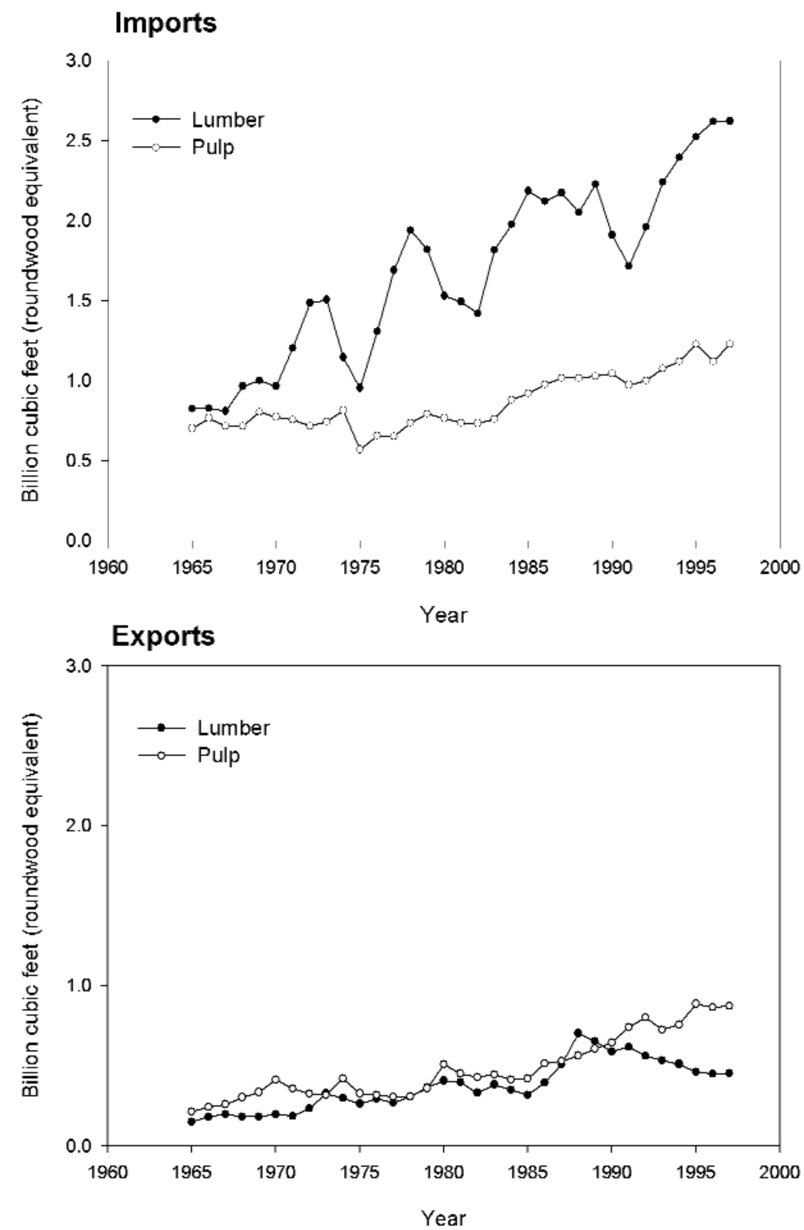

FIGURE 1. U.S. Wood Imports and Exports: 1965–1997. Imports of both lumber and pulp exceed exports, indicating the reliance on foreign wood by the United States economy. [Source: Howard, J. L. 1999. "U.S. timber production, trade consumption, and price statistics 1965–1997." USDA Forest Service General Technical Report FPL-GTR-116. 76 pp.]

Such U.S. domestic environmental protection may exert profound, though often unintended impacts on the global environment. According to Sohngen (SAF, 1999) "North America currently produces 35 percent of global timber. Conserving only 5 to 10 percent of timberland in a region that supplies such a large proportion of global harvests will increase harvests elsewhere, including tropical forests that at present are inaccessible." A recent study found that approximately one hectare of *primary* forest (i.e., forest that has never been harvested before) in Asia, South America, Africa, and Russia is logged for every 20 hectares of forest protected from harvest in North America and Europe (Sohngen, et al., 1999). Harvesting these remote forest areas requires the construction of roads that make them accessible for broadscale conversion for agriculture and other uses (Kittredge, 1996; Mather, 1990; Food and Agricultural Organization of the United Nations (UN FAO), 1997).

Thus, well-intentioned American decisions may generate undesired environmental consequences. Consequently, it is imperative that environmental stewards go beyond the question of which areas to protect from timber production to ask what resources, in what quantities should be **produced** and **where** they should be obtained. Furthermore, all people must evaluate options to minimize environmental impacts both beyond their backyard and across the globe.

An Evaluation of Strategies for Meeting Global Wood Needs and Reducing Stresses on Forests

There are several strategies that the U.S. could employ to address its wood needs and reduce stress on forests, including: (1) substitute other products for wood, (2) reduce natural resource consumption, (3) increase protection of forested areas, (4) increase wood imports, and (5) intensify local wood production (Bowyer, 1994; Dekker-Robertson and Libby, 1998). These options vary in terms of feasibility and global environmental impact.

Strategy 1: Increase the Use of Wood Substitutes

Several materials may substitute for wood in paper production and in building construction, although most incur increased environmental costs. Pulp constitutes about 30% of U.S. wood consumption and may be replaced by agricultural products and waste (Howard, 1999; Bielski, 1996). However, production of these replacements would require massive fiber plantations that contribute even less to biodiversity than tree plantations and generally require intensive chemicals applications (Dekker-Robertson and Libby, 1998).

Although steel, concrete, and aluminum may replace wood in construction, these materials also incur serious environmental, transportation, and energy costs (Bowyer, 1994). Lumber is the least energy intensive construction material and its production releases significantly less carbon dioxide and toxic products than substitutes (Table 1). In addition, wood is renewable and forest growth may contribute to carbon sequestration, thereby yielding even greater trade-offs.

Strategy 2: Decrease Wood Consumption

Vast opportunities exist in the U.S. to decrease per capita wood consumption; this remains the most straightforward way to reduce pressure on the world's forests. Average American wood consumption is 2.5 times the European and 3.4 times the world averages (Howard, 1999; UN FAO, 1997). In all major categories of wood

TABLE 1: Energy use by material.

Material	Fossil fuel energy (MJ/kg)	Fossil fuel energy (MJ/m^3)
Rough sawn timber	1.5	750
Concrete	2	4,800
Steel	65	266,000
Aluminum	435	1,100,000

[Source: www.fwprdc.org.au/publications/online/epotbrochure/manufacture. Ferguson, I., B. La Fontaine, P. Vinden, L. Bren, R. Hateley, and B. Hermesec, 1996, "Environmental Properties of Timber." Research Paper commissioned by the Forest & Wood Products Research & Development Corporation.]

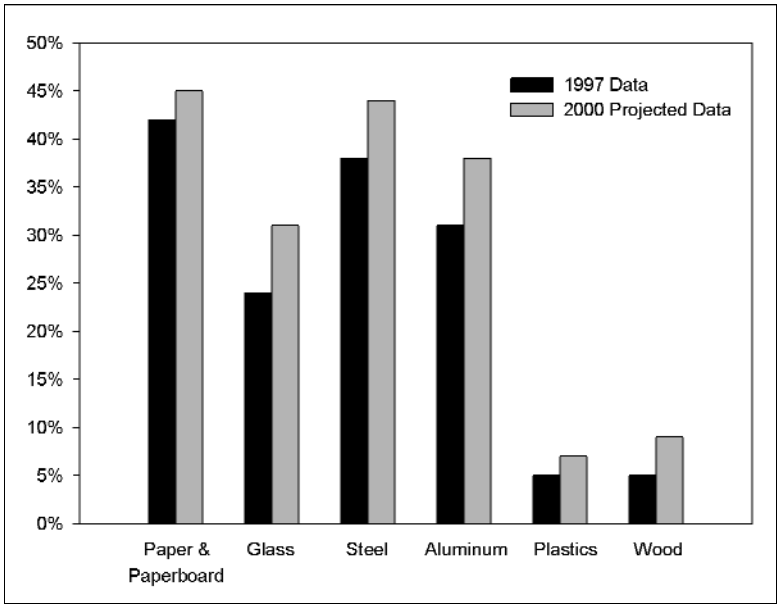

FIGURE 2. U.S. Recycling Rates By Material. Although paper and paperboard recycling rates are relatively strong, rates for solid wood and plastics lag well behind. [Source: Characterization of MSW in the U.S.: 1998 Update, U.S. EPA, Washington, D.C.]

use, American consumption rates are at least double European rates.

Paper and housing are areas where U.S. consumption is especially high and major reductions are possible. Since pulp constitutes approximately 30% of U.S. wood consumption, a 15% decrease in total wood use would be achieved if the U.S. adopted European levels of paper use (Robbins, 1996; Howard, 1999). Meanwhile, over the past 30 years (1965–1997) the average size of the American home has increased 44% — from 1500 to 2150 square feet — while average occupancy has dropped 21% — from 3.3 to 2.6 people (Howard, 1999; www.census.gov/). U.S. homes average 1.7 to 2.2 times larger than in the U. K. and Japan (Wolff, 1992). Lumber accounts for nearly 50% of U.S. wood consumption, with 30% of this used for new housing (Howard, 1999; Regional Planning Association (RPA), 2001). Consequently, if U.S. homes were to return to 1960's size (or to match those in England or Japan), per capita wood consumption would decrease by about 5% (Howard, 1999; RPA, 2001)

Wood consumption could be reduced further through increased recycling. Recycling rates for solid wood and fiber are low compared to most materials (Bowyer, 1997). Even paper recycling, which at 44%–46% is high for the U.S., falls well short of the 70% rate in Germany and Austria (U.S. EPA, 1998; Environment Watch, 1997; Figure 2). Although there are technological limits to recycling (e.g., paper can only be recycled about 4 to 9 times), and the reduction in virgin wood demand afforded by recycling is relatively low compared to increases in global demand (Dekker-Robertson and Libby, 1998), increased wood recycling would still ease the pressure on the world's forests.

Decreased consumption and increased recycling are guaranteed ways to reduce demand. However, even if these are applied aggressively, wood demand will still increase as the population grows (Ince, 1994). Therefore, additional measures will be needed.

Strategy 3: Increase Protection of Forested Areas

Through population growth, land conversion, and a haphazard pattern of harvesting forest area, the size of unmanaged forest blocks is dwindling. Faced with the challenge of protecting ecological resources while improving the global standard of living, land-management decisions must be made judiciously. Habitats supporting uncommon species and large intact forest blocks should be protected to maintain aging ecosystems, promote old-growth and other uncommon communities, and provide opportunities for natural ecological patterns and processes that are unimpeded by human influences. As forest elsewhere is either lost to other competing land uses or managed intensively for timber products, these protected natural areas will increase in importance as critical refugia for taxa, communities, and processes that can also serve as benchmarks against which other areas can be compared.

Strategy 4: Import More Wood

Increasing wood supplies from other parts of the world could meet short-term needs. However, major future suppliers of wood for the United States include Canada and Siberia for softwoods and tropical countries for hardwoods. These are areas where the environmental effects of harvesting are generally more severe than in the Northeastern U.S. (Bowyer, 1994 and 1997).

British Columbia, Canada's main source of exports (Garner, 1991), supports more than half of the old-growth temperate rainforest in North America (Sierra Legal Defense Fund (SLDF), 2000). The environmental cost of resources from these forests is high, and involves the loss of a unique ecosystem. Although Siberia offers a new and large source of wood, it is a region where "economic and environmental concerns may limit harvests" (Bowyer, 1995). It is estimated that due to outmoded Russian technology, 40% of material harvested in Siberia is wasted relative to U.S. timber operations (Lippke, 1992 as cited in Dekker-Robertson and Libby, 1998). Movement of material from this remote location also has high energy costs. But the greatest argument against shifting harvesting pressure to Siberia is ecological: In this land of deep permafrost and long winters, trees are small and grow so slowly that rotation lengths are extremely long and immense areas are required to yield large volumes of wood.

The tropics, especially Indonesia, Malaysia, and Brazil are a growing source of hardwoods (ITTO, 1999). These regions all experience severe environmental impacts including the logging of primary forests, timber exploitation, forest quality degradation, land-use conversion, and wildlife persecution. Another disadvantage of wood importation from these areas is the introduction of exotic pests and pathogens, such as the recently arrived Asian Longhorn beetle (USDA Forest Service, 2002).

Strategy 5: Increased U.S. Forest Management

Conducted well, intensive forest management has the potential to address environmental and social needs and provide benefits including: (1) offset forest losses through reforestation and agroforestry, (2) increase carbon sequestration (*U.N. Climate Change Bulletin,* 2000), (3) create, restore or maintain diverse woodland habitats, and (4) connect people to their environment and source of natural resources (Winjum, et al., 1993; Brooks, et al., 1992; Bowyer, 1997; Dekker-Robertson and Libby, 1998; Sohngen, et al., 1999).

The U.S. has the resources, economy, and environmental oversight to develop a broad program of sustainable forest management. However, major questions loom: Will the American public allow the intensive management necessary to provide significantly higher supplies of wood? And will the timber suppliers pursue this object in an environmentally sound fashion? Through individual decision-making on their own lands, engagement in planning on public lands, and involvement in the political and regulatory arenas, Americans can exert a significant influence on wood production. To date, concern over management has caused Americans to protect increasing amounts of forestland without proactively searching for environmentally preferable places or ways to harvest. Concerns with logging are not unwarranted and range from clearcutting, herbicide use, and high grading of forests to ill-conceived and excessive road building in sensitive areas (Durbin, 1996). Environmental analysis is critical in identifying areas both to leave unharvested *and* to meet rising wood demand.

Many experts recommend the establishment of highly productive forest plantations to increase national wood production (e.g., Dekker-Robertson and Libby, 1998; Bowyer and Stockman, 2001; Winjum, et al., 1993). Plantations provide high yields in small areas and thereby allow other forestlands to be set aside and preserved. But tree plantations generally contribute less to biodiversity, recreation, aesthetics, and ecosystem function than natural forests and often require the suppression of competing vegetation through chemicals or physical removal. Thus, plantations may supplement, though not replace, the management of natural forests as an important means to meet rising wood needs.

A Threefold Solution

Clearly no simple solution exists for meeting global wood needs, improving equity in resource production/consumption, and protecting the environment. However, a threefold approach may be a useful starting point:

1. Decrease consumption of wood products (and substitutes) for paper and construction;

2. Increase recycling rates of wood fiber, solid wood, and paper products;

3. Pursue a balanced approach to forest conservation based on large forest preserves, increased and sustainable production from native forests, and intensive management of plantations.

Why Focus on Massachusetts?

To consider further the *Illusion of Preservation* and a global strategy for sound resource management we focus on Massachusetts, the eighth most forested state in the nation (by area), and an affluent region with consumption rates that are among the highest in the U.S. Forest harvesting rates are relatively low in Massachusetts and the vast majority of local wood needs are met through imports. Environmental concern is high throughout New England, and ironically, though not surprisingly, the citizens of Massachusetts have little interest in seeing "their" forests harvested for wood products. A recommendation for more intensive management of these forest resources is certain to have a mixed and largely negative reception.

Could Massachusetts balance more of its wood consumption with environmentally sustainable production? "Yes," says William Libby of the University of California, but the greatest challenge will be getting "well-intentioned people to understand that their decision to not cut wood locally often does great damage to the things they value someplace else" (Libby, 1999). Seventy-eight percent of the state's forests are owned by non-industrial individuals and families, each faced with many management options (Alerich, 2000). The challenge may be to educate these individuals about the global consequences of their decisions and to expose the illusion of preservation.

The Forest Resource of Massachusetts: Functional and Ecological Dimensions of Its Use

Before drawing conclusions concerning forest management in Massachusetts, it is important to explore some ecological and economic facts. How much forest is there and what are its characteristics? What is its history and how is it changing? At what intensity is the forest currently managed and how does this compare to the local population's impact on the global forest environment? What areas ought to be protected from human interference or land-use conversion? Does it make environmental and economic sense to expand local harvesting and wood production?

Massachusetts is heavily forested, despite the fact that 785 people per square mile make it the third most densely populated state in the nation (U.S. Census, 2000). The state contains 3.1 million acres of forest covering 62% of the land area (Alerich, 2000). A full 85% of those forested acres is classified as timberland (i.e., capable of growing more than 20 cubic feet per acre per year, and not withdrawn from harvesting) according to the USDA Forest Service. Current forest management is highly varied due to the diverse ownership pattern (Alerich, 2000).

The structure and composition of Massachusetts' forests are a legacy of historical patterns of natural and human disturbance. In the mid-nineteenth century, nearly 70% of the land was cleared for agriculture and remaining forests were cut, burned, and grazed (O'Keefe and Foster, 1998). In the late 1800s, agriculture declined and second-growth forests, dominated by white pine, established across the region's abandoned farmland. This supply of "old-field" white pine spurred a timber harvest boom that peaked in 1910–1911 and yielded even-aged stands of predominantly hardwoods (Steer, 1948; O'Keefe and Foster, 1998; Figure 3). White pine is especially susceptible to windthrow and the 1938 hurricane continued the process of forest conversion from pine to even-aged hardwoods. Today, the most common tree species are red maple, eastern hemlock, and white pine (Alerich, 2000).

Since 1938, logging and forest succession have been the main forces shaping forest composition. However, harvesting has not kept pace with tree growth since at least 1957 (Bond, 1991), and over the past three decades (1972 to 1998) wood volumes have increased by 105% for softwoods and 149% for hardwoods (Dickson and McAfee, 1988; Alerich, 2000). Since 1985, sawtimber volume has increased by 41 percent. Currently, average

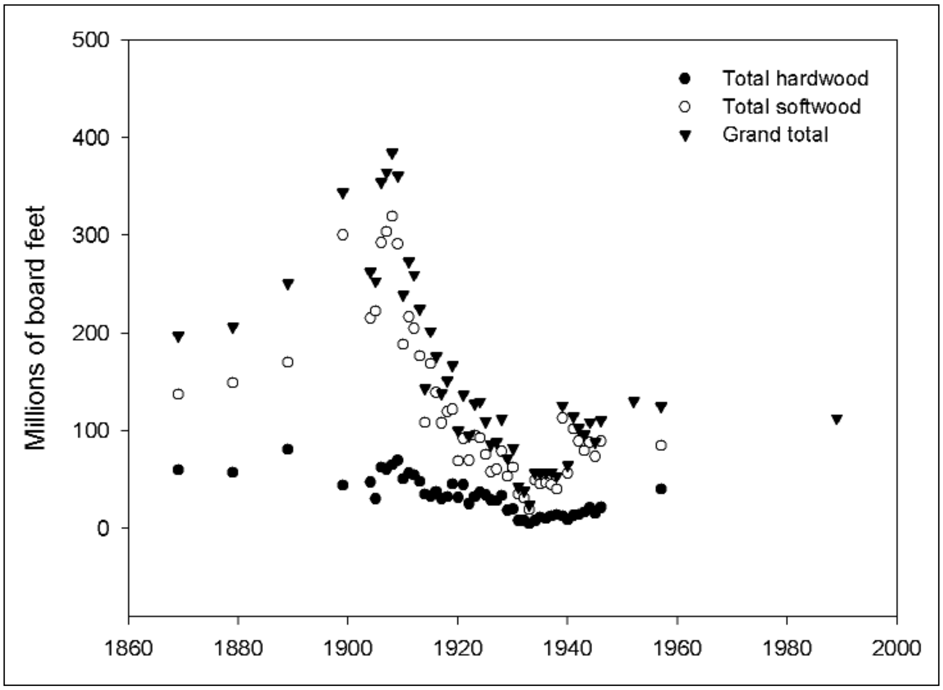

FIGURE 3. Reported Massachusetts Lumber Production, 1869–1996. Softwood lumber production peaked at the turn of the last century, based on white pine stands that had been established on abandoned agricultural land following the height of farming around 1860. Softwood lumber production also jumped based on salvage following the 1938 hurricane. [Source: Steer, 1948, Bond, 1962, MA DEM, 1997.]

annual growth is 99.9 million cubic feet, whereas annual removals average 52.3 million cubic feet (*see* Alerich, 2000; Figure 4). The history of lumber production (1869 to 1996) corroborates the high productivity of the Massachusetts forest (Figure 3). In spite of the fact that very little of the landscape was in mature forest in 1869, lumber production was twice then what it is today (O'Keefe and Foster, 1998). Given the aggressive way

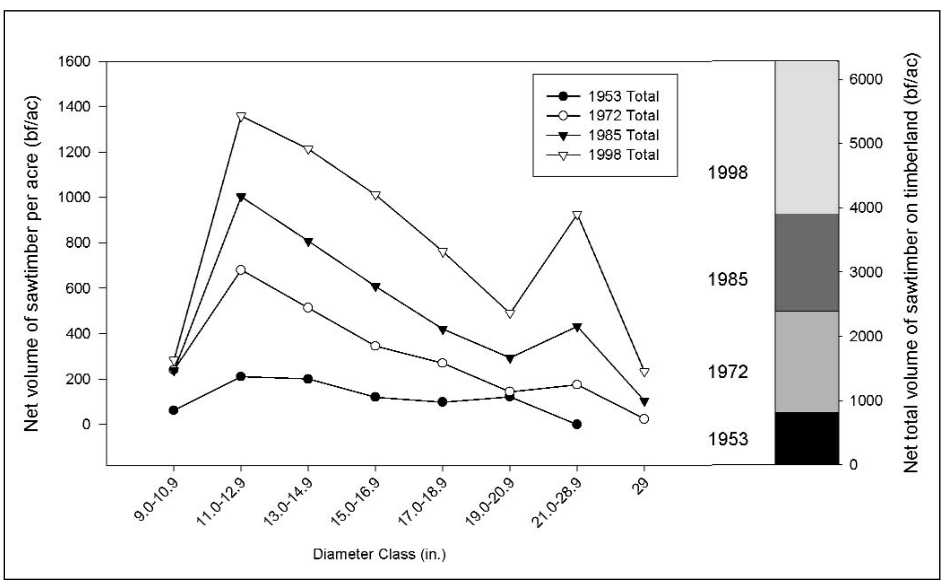

FIGURE 4. Net volume of sawtimber per acre of timberland, by diameter class: 1953, 1972, 1985, 1998. Sawtimber volumes per acre have increased dramatically in the last fifty years, even after accounting for removals through mortality or harvesting. [Source: Dickson and McAfee, 1988, Alerich, 2000.]

that the forest rebounds from disturbance and regenerates naturally, it is logical to look at the extent to which this resource can meet some of the consumptive need for wood.

The Massachusetts Wood Consumption-Production Ratio

Limited, and often poor forest management, coupled with a prosperous standard of living suggests that Massachusetts has embraced the "illusion of preservation." International comparisons highlight the consumption-production disparity. Massachusetts is comparable to Germany, Switzerland, Japan, and France in forest cover and the ratio of human population to forest area (*see* Figure 5). Yet, assuming that U.S. averages apply to Massachusetts (probably a conservative assumption, given the state's high standard of living), per capita consumption is 3 to 4 times the level in these countries (Figure 6). Meanwhile, Japan (a wood-importing nation) harvests nearly 5 times the wood volume per hectare of forest than Massachusetts, and Germany's harvest rate is 17 times greater (Figure 6). As in most of the U.S., there is little connection between lifestyle and resource production in Massachusetts.

The Lumber Market in Massachusetts

Massachusetts currently generates a small amount of structural lumber, primarily from white pine, which is light, strong, and easily worked. The other major softwood species is hemlock, which is used less frequently but like white pine is used for framing and home construction (Drath, 1947). These two species could substitute in many applications for Douglas fir and Sitka spruce from the Pacific Northwest and British Columbia. More than half of the lumber sawn in Massachusetts is oak, which is highly valued for furniture and other uses (Bond, 1991). However, red maple, the most common tree species, is barely utilized, despite its potential as a substitute for imported wood in the construction of flooring, furniture, and polymer-plastic products. The pace of wood product substitution is accelerating, especially outside of the U.S., and there may be opportunity to increase the utilization of this hardwood species (D. Damery, pers. comm., 1999).

Shifting the Consumption-Production Ratio

Data on wood production and consumption in Massachusetts are rough but annual harvest figures from

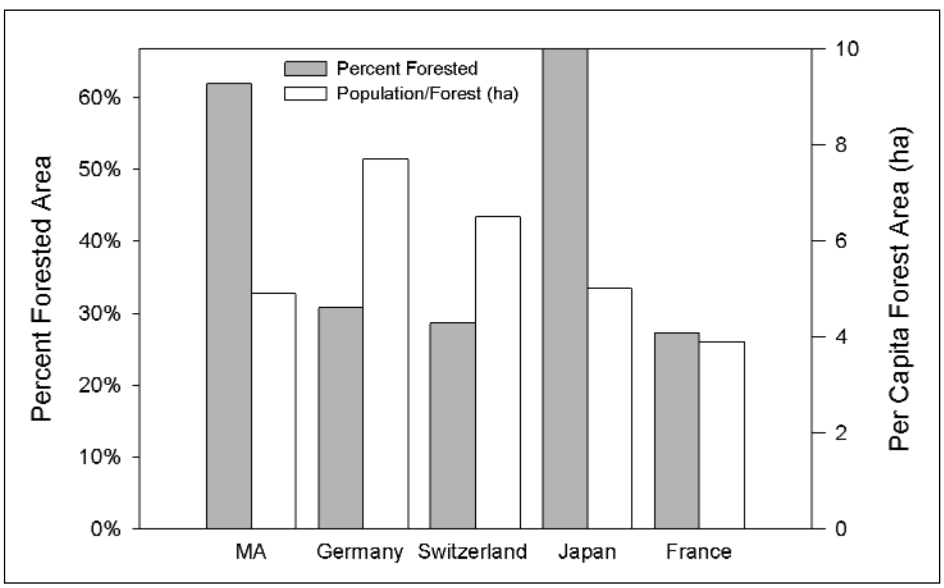

FIGURE 5. Comparison of percent forested area and population density per forested area; Massachusetts, Germany, Switzerland, Japan, and France. Massachusetts is more than 60% forested by area, and experiences a population density per forest area comparable to Japan and France. [Source: Massachusetts, Alerich, 2000; other nations, World Resources 1998–1999, World Resources Institute.]

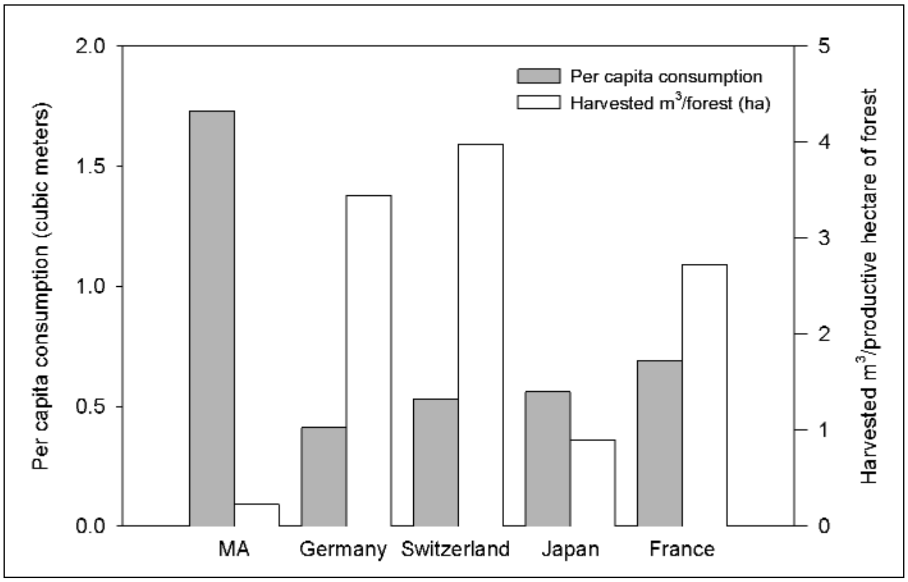

FIGURE 6. Per capita wood consumption, and harvest per forested area: Massachusetts, Germany, Switzerland, Japan, and France. Although relatively heavily forested, harvesting per unit area from Massachusetts forests is low compared to other countries. In contrast, per capita consumption of wood is several times greater in Massachusetts. [Source: Massachusetts DEM; Alerich, 2000; Howard, 1997; MISER., other nations, FAO 1997.]

the Department of Environmental Management's (DEM) Forest Cutting Plan applications support the widely held conviction that total harvest volumes are low and only equivalent to about 2% of wood consumption gauged by national rates (Howard, 1999, Figure 7). The amount of wood produced annually from Massachusetts forests is further complicated by the fact that some wood (exact volumes are unknown) is produced by the one-time conversion of forest to other developed uses. Even the extent of land conversion varies, with Massachusetts Audubon estimating 16,000 acres of "open space" (i.e., not necessarily forest) lost annually between 1972 and 1996 (Steel, 1999), and the USDA Forest Service estimating a loss of 281,000 acres of timberlands between 1985 and 1998 (i.e., 20,071 acres annually; Alerich, 2000). Forest Service Forest Inventory Analysis (FIA) results indicate an average of 6,282 board feet per acre of timberland. This represents an estimated total one-time removal of 126 million board feet (297,537 m^3) annually through land conversion. Annual harvest removals from forestland that remains forest (i.e., through timber harvesting regulated by DEM) are estimated to be 311,190 m^3. Thus, even if all volume removed through land clearing were captured commercially and converted to usable product, while it would almost double the amount of product, it would still represent a very small increase in the total amount produced compared to what is consumed (Figure 7). It is also important to remember that this additional 297,537 m^3 is a one-time, completely non-sustainable contribution towards meeting consumption, since the land it comes from is no longer in forest.

Estimates of wood consumption in Massachusetts are based on overall American per capita consumption rates (Howard, 1999), and the current Massachusetts population. Consumption is estimated to be the simple difference between the amount of wood that the United States produces, imports, and exports. Consequently, these estimates of consumption do not include a sensitivity to the amount of recycled material that may be used and substituted for original wood. Consumption in this case simply refers to the amount of wood product used, and does not incorporate estimates of recycling.

Given this disparity between production from Massachusetts forestland and consumption, would increased harvesting make a difference? Below we examine this question under different management and consumption scenarios.

We estimate potential sustainable harvest levels based on statewide estimates of forest growth taking into consideration local variation in growth with stand age and density, soil type, and species composition. An analysis of several sources of indirect evidence suggests a

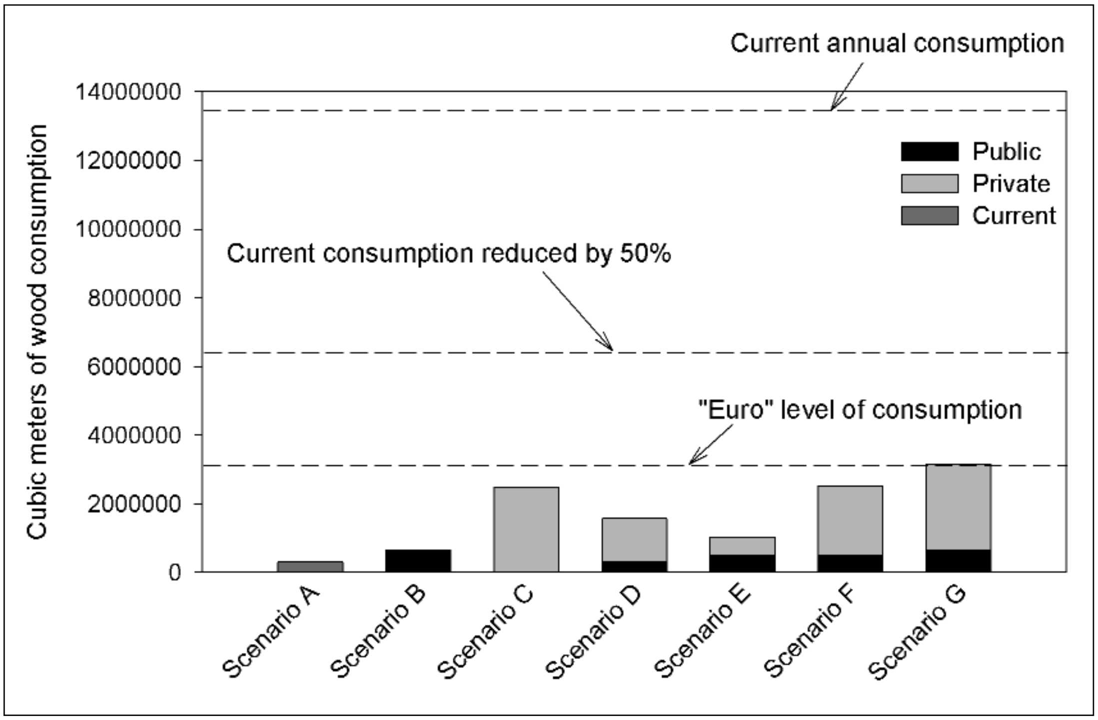

FIGURE 7. Massachusetts hypothetical harvest scenarios compared to different levels of statewide consumption (m^3/year). The current annual harvest contributes little to meeting the estimated consumption of wood products in Massachusetts. Through potential decreases in consumption, coupled with various approaches to increased timber management on public and private lands, the gap between production and consumption can be made smaller.

Scenario A: current annual MA harvest of 311,190 m^3
Scenario B: 100% timber management of public land, 0% timber management of private land.
Scenario C: 0% timber management of public land, 100% timber management of private land.
Scenario D: 50% timber management of public land, 50% timber management of private land.
Scenario E: 80% timber management of public land, 20% timber management of private land.
Scenario F: 80% timber management of public land, 80% timber management of private land.
Scenario G: 100% timber management of public land, 100% timber management of private land.

regional growth rate and corresponding rough estimate for sustainable harvesting of 275–350 board feet/acre/year (1.0 – 1.2 m^3/ac/yr) (Box 1). Based on this estimate it is possible to illustrate several timber management production scenarios for public and private forestland in Massachusetts compared to: The total statewide wood per capita consumption volumes at current rates (2.1 m^3 per year), current per capita rates reduced by 50% (1.05 m^3 per year), and the "European" per capita level of 0.5 m^3 per year (Figure 7).

In the most extreme scenario (Scenario G in Figure 7), Massachusetts could produce the equivalent of its entire annual wood consumption if all of its public and private forestland were managed for timber at the estimated statewide sustainable rate of 1.2 m^3/ac/yr (or 340 bf/ac/yr), *and* consumption was reduced to "European levels," i.e., per capita rate of 0.5 m^3 per year. This scenario of "self-sufficiency" is of course unrealistic, since more than three-fourths of the forest is owned by hundreds of thousands of private individuals, and there would never be unanimous will to adopt timber management. The scenario is simply used to show one end of the "management potential" spectrum.

If all private forests and no public forestland were to be managed for timber according to our sustainable estimate of (1.2 m^3/ac/yr), as in Scenario C (Figure 7), 20% of consumption could be matched with sustainable production. This aggressive scenario for Massachusetts would be less stringent than current Swedish forest management policy where both private and public forest is considered a national resource to, "be managed in such a way as to provide a valuable yield and at the same time preserve biodiversity" (Swedish Forestry Act: www.svo.se/eng/act). If Massachusetts' consumption

Box 1: Estimating a Landscape Level Sustainable Harvest Rate in Massachusetts

There are several ways to arrive at an average growth rate. Comparison of the 1998 Forest Inventory Analysis of Massachusetts by the U.S. Forest Service with previous surveys indicate that these forests grew by 180 board feet (bf)/acre/year from 1985 to 1998, 117.3 bf/acre/year from 1972 to 1985 and 83.2 bf/acre/year from 1953 to 1972. These are estimates of net growth after deducting negative effects such as disease, natural disturbance, and harvesting.

A Harvard Forest study from 1956 to 1987 found similar rates in the years corresponding to the FIA surveys (unpublished data, Tom Swamp Tract). A stand simulator developed by the USDA Forest Service (NE-Twigs) predicted for an average Massachusetts stand accumulations of 291.4 bf/acre/year for 2000–2005, 333.6 bf/acre/year for 2005–2010 and 177.2 bf/acre/year for 2010–2015. An analysis of ten published studies that estimated growth of unharvested New England mixed hardwood stands based on large data sets found an average growth rate of 278.2 bf/acre/year. However, there is reason to believe that the Massachusetts forests may exceed these mixed hardwoods stands due to the high growth rates of two conifers: eastern hemlock (10% of the basal area of Massachusetts forests) and white pine (30% of the basal area of Massachusetts forests). Kelty (1989) found that the yield of hardwood stands increases by 19% if they contain hemlock, since it can thrive in the shade of hardwoods without reducing their growth. Leak, et al., (1970) indicated that fully stocked white pine stands in Massachusetts have a mean growth rate of 865.9 bf/acre/year. Taking the mixed hardwood stands and hemlock and white pine into consideration, an overall sustainable growth rate for Massachusetts forests of 340 bf/acre/year seems reasonable (1.2 m^3/ac/yr), i.e,. 20% greater than 280 bf/acre/year. This, of course, can vary greatly depending on site quality, species composition, age and density, and the silvicultural treatment history of individual stands. For purposes of comparing potential production and consumption at a statewide level, we believe this growth rate estimate to be appropriate, and to represent a rate at which Massachusetts forests could be harvested in a sustainable and non-declining way into the future.

What would a forested landscape look like that was sustainably producing 340 bf/ac/yr? We do not believe that this is an aggressive growth rate that would require highly intensive silvicultural methods, such as planting, fertilization, pesticides, monocultures, genetically improved trees, or pre-commercial thinning. All the evidence considered in the development of our overall sustainable growth estimate was based on conventional silvicultural scenarios of natural regeneration of mixed stands of native species composition, and intermediate thinning typical of conventional New England "woodlot" management. If some stands were aggressively managed they could produce significantly more than our sustainable estimate. Such higher levels of production would contribute toward meeting our own needs at home, and lessen the need to bring wood from elsewhere. To the citizen, tourist, or person enjoying the outdoors in rural Massachusetts, we believe that such heightened timber management would not look appreciably different from the current heavily forested condition.

levels were reduced by 50% under Scenario C, 40% of annual statewide consumption could be met. In the unlikely event that consumption levels were reduced to European levels, 82% of consumption could be met.

A more realistic scenario would involve a combination of private and public forest management for timber. If 50% of public forestland and 50% of private forestland were managed at the estimated sustainable harvesting rate (Scenario D in Figure 7), Massachusetts could match 12% of current consumption, as much as 25% with current consumption reduced by half, and fully 52% of consumption at European consumption rates. Such a scenario would still allow the landscape to support extensive blocks of undisturbed forest. Achieving a 25% consumption-production ratio from the current 2% level through strategic harvesting and aggressive cuts in consumption would provide an immense service to the global environment.

Ecological Considerations

What might be the ecological consequences of much more intensive forest management in Massachusetts? Could this be accomplished in a fashion mindful of public concern for the local environment while also aiding the global environment?

Regulatory Oversight

In broad theory, but certainly not in all practice, Massachusetts is well ahead of the Northwestern and Southeastern U.S., British Columbia, and other major source areas in terms of regulatory oversight of cutting practices for public and private land (Kittredge, et al.,1999; Ellefson and Chang, 1994). In Massachusetts, environmental oversight of harvesting is provided by: A forest cutting practices act, a state endangered species act, a wetlands protection act, a rivers protection act, an old-growth policy, and required programs for both forester and logger licensing.

The Forest Cutting Practices Act (chapter 132) requires landowners to complete a cutting plan before each harvest including information, maps, and a notice of intent (Kittredge and Parker, 1995). The DEM reviews each plan to ensure that the harvest will not impact wetlands, water quality, or the habitat of rare or endangered species. Guidelines include minimum standards for tree cutting to promote rapid regeneration, logging road engineering regulations to prevent erosion and sedimentation, and buffer strip requirements to protect the visual quality of the landscape and the health of water bodies and certified vernal pools (Kittredge and Parker, 1995). After plan approval, a state service forester visits the harvest site to ensure compliance with regulations.

The Rivers Protection Act regulates harvesting activities in the 200-foot strip along all perennial streams. The Massachusetts Endangered Species Act protects the 173 animal species and 251 species of native plants currently listed as endangered, threatened, or of special concern (MA NHESP, 1999). The Wetlands Protection Act bars alterations to wetland habitats that will have an adverse effect on rare wildlife species (MA NHESP, 1999). The Natural Heritage and Endangered Species Program ensures that harvesting does not affect the habitat of protected species. A DEM policy excludes harvesting on all areas of old growth on its lands (MA DEM, 1998).

In contrast to most states, Massachusetts' Forest Cutting Practices Act restricts harvesting to licensed timber harvesters. This requires knowledge of all regulations and an average of three contact hours of continuing education annually. Similarly, professional foresters require a license based on formal education from a Society of American Foresters accredited university program, and several years of professional experience, defined by regulation. Both licenses are revocable if regulations are violated. If properly applied with forester supervision and environmental oversight, harvesting can be ecologically sustainable and environmentally sound.

Forest Resiliency, Nutrient Retention, and Biodiversity

The resiliency of the northern temperate forest makes it well suited for forest management. Following harvesting, planting is not required and forest cover quickly re-establishes, as evidenced by rapid regrowth after nineteenth century agriculture, the 1938 hurricane, and repeated episodes of logging and fire. Gentle topography and rapid succession minimize erosion and nutrient loss. Importantly, the vigorous aggrading forests that develop following harvesting retain nutrients in the ecosystem and store large amounts of carbon (Vitousek and Reiners, 1975; Borman and Likens, 1979).

Although logging is often insincerely legitimized as promoting wildlife habitat, it *may* be an important tool for managing biodiversity. For example, careful long-rotation logging can result in many qualities of mature and old-growth forest while providing some control over species composition, levels of standing and downed wood, and diversity of stocking. Many of the most rapidly declining species in the northeast are associated with early successional habitat: grassland, shrublands, and young forestland that were more abundant in the nineteenth century. Management can be used to maintain such landscapes or to enhance the particular species such as oak, which is valuable for wildlife, as well as timber. In like fashion, any decision not to harvest promotes a specific habitat type.

Confronting the Illusion of Preservation: Potential Strategies for Massachusetts and Beyond

Management of the 2.6 million acres of timberland in Massachusetts is determined by the decisions of more than 235,000 private families and individuals, as well as various agencies, communities, and non-profit groups (Dickson and McAfee, 1988). Private landowners are relatively free to manage their forests according to their personal goals. All evidence suggests that Massachusetts' landowners are far more interested in residential and recreational uses of the forest than timber production (Lindsay, et al., 1992; Archey and MacConnell,1982; Rickenbach, et al., 1998; Alexander, 1986; Kingsley, 1976). Few individuals owning less than 25 acres of forestland in southern New England intend to cut trees for timber (Tyson, et al., 1998). Owners place a high importance on non-income generating benefits of the forest, such as wildlife habitat, recreation, privacy, and aesthetics.

Given these landowners' attitudes, would it be possible to reduce Massachusetts' wood consumption and imports and increase interest in local forest management? The following discussion reviews the key barrier to "confronting the illusion" and suggests directions toward a solution.

Social Attitudes — A Major Barrier to Confronting the "Illusion"

The low intensity of forest management in Massachusetts is driven by lack of information and incentive, and social attitudes that scorn timber management. A "Preservation Ethic" views logging as a detriment to the environment that should be avoided by responsible landowners. Philosophical objections to harvesting are broadly shared by the public, as indicated by polls showing that 63% of Americans feel that there is not enough wilderness protected in national forests and 70% favor a ban on logging in national forest roadless areas (The Wilderness Society, 1999). A majority of people believes that logging is worse than non-management for the environment and favor increased protectionism.

The Forest Preservation Ethic is also manifested in local regulatory systems. Although one of the original purposes of the Forest Cutting Practices Act in Massachusetts was to implement statewide rules to govern logging and thereby eliminate the need for individual town regulations, more than thirty-five individual and idiosyncratic town bylaws have developed that make it increasingly difficult to harvest wood.

Deep-seated philosophical objections to harvesting are likely the greatest barrier to changing owners' approach to forest management. As long as the global consequences of consumption are ignored, widespread protectionism is heralded, and logging is abhorred (especially in one's backyard), efforts to reduce wood consumption, or to encourage sound management in areas of low ecological impact will be fruitless. Such efforts will only succeed if they are coupled with a fundamental change in attitude that reconciles the ideology of preservation with the reality that using wood means cutting trees — somewhere.

The Forest Preservation Ethic could lead to a globally effective and responsible movement. Educators, environmental activists, politicians, and writers could present the argument that reductions in wood consumption and wise management of resilient and productive forests would be good for the global environment. Massachusetts can be examined as a case study: Consumption soars above the rest of the world and the mature forest landscape is lightly, haphazardly, and poorly managed, while staggering areas of pristine and less resilient forests are being cut and degraded elsewhere.

Solution 1: Reduce Consumption of Wood

Massachusetts residents could reduce wood consumption by cutting paper usage and housing size, which account for 45% of consumption (Howard, 1999). Reducing paper consumption to European levels would decrease per capita wood consumption by 15%; decreasing the average home size to 1960's levels would result in an additional 5% reduction (Robbins, 1996; Howard, 1999). Immediate changes in consumer behavior could be facilitated by diverse institutional and government actions. For example, corporations, schools, agencies, etc. could budget paper and printing usage and emphasize environmental costs. Zoning could decrease new home size (currently 17% larger than existing homes) by limiting square footage in relation to lot size (RECS, 1997).

Solution 2: Increase Wood Recycling

Massachusetts has successful recycling programs for paper, plastics, and beverage containers. Currently, 85% of Masscahusetts residents have access to such programs; the recycling rate for newspaper, cardboard, glass, bottles, cans, scrap metal, and recyclable plastics is 34% with a near-term goal of 46% (MA DEP). The recycling rate for paper in Massachusetts is between 43% and 60% (NE Recycling Council; U.S. Census; MA DEP), compared to the national rate of 42 percent (EPA, 1998). However, Germany and Austria recycle 70% of paper, indicating that further achievements are possible. Furthermore, wood fiber and solid wood are not commonly included in Massachusetts recycling programs and the national recycling rate for solid wood is less than 10% (EPA, 1998).

Solution 3: Promote Forested Environments and Protect Critical Ecological Resources

The greatest threat to Massachusetts' forests remains conversion to non-forest uses; countering this trend should be a major priority. Timberland in Massachusetts decreased by 9.6% from 1985 to 1998, a trend that is expected to continue (Alerich, 2000). However, if Massachusetts seeks to increase local harvesting, there are crucial areas and ecosystems that warrant protection, such as wetlands, old-growth forests, endangered species habitat, uncommon communities, and large areas necessary to support landscape-level processes and certain species. Currently, protection for such areas (but with no larger preserves) represents approximately 17% of Massachusetts' land base (Steel, 1999). However, there is great need for broad-scale conservation of all remaining forests followed by regional planning and strategic selection of areas for intensive management, wildland protection, diverse recreation and other attributes.

Solution 4: Encourage Sustainable Production in Suitable Areas

There are many positive externalities to good forestry on private lands. Neighborhoods and local residents enjoy the scenery, wildlife, and healthy environment provided by a well-managed forest. Forestland also incurs lower town service costs than developed land (SNEFCI, 1995). Yet the taxes on forestland do not reflect the shared advantages of a well-managed forest. Chapter 61 of Massachusetts General Law gives preferential tax treatment to landowners that manage their forest for wood production. Currently, only landowners with an interest in timber management and the finances to lock their land into a singular future use (or risk paying hefty fines upon withdrawal) are rewarded for the social benefits of responsible timber production. As an alternative, Massachusetts could develop a tax structure that rewards landowners that are good stewards of the forest regardless of the specific management approach. With the right arrangement of incentives, more landowners will become interested in owning forestland and practicing ecologically sustainable management for forest products.

The potential of the tax system to change land-use patterns should not be underestimated. In Britain, changes in the taxation of forestland produced major results. Government implementation of tax offsets and grants to support private forestry, provided a huge incentive for wealthy individuals to invest in forestland and resulted in a 6% increase of forest cover in less than ten years (Grayson, 1993). The results generated public concern over the "high rate of change in the appearance of the countryside," and nature conservation caused the government to scale these measures back (Grayson, 1993). In Massachusetts, where the loss of forestland and the quality of forest management are of high concern, the tax system could be a very powerful tool to cultivate an interest in forest ownership and management while serving the public's interest in residence, recreation, water resources, and wildlife.

Because Massachusetts' substantial timber supply lies in a matrix of public and private ownership, the potential exists for a forester "Green Certification" program to encourage ecosystem-based management across property boundaries through collaborative management and cost-sharing (Campbell and Kittredge, 1996; Leak, et al., 1997). Green Certification is conveyed by a neutral third-party certifying agency that typically evaluates a company's timber harvesting practices according to its set of accepted standards of ecological impact (United Nations Economic Commission for Europe (UN/ECE) Timber Committee, 1997–1998). Besides differentiating the wood product to the consumer in the marketplace, this label can potentially translate into a slightly higher selling price (UN/ECE Timber Committee, 1997–1998).

A new form of Green Certification has been accepted by the international certification body known as the Forest Stewardship Council (FSC), whereby Resource Managers are certified, and multiple smaller properties in their care can fall under their certification. While few in number nationwide (i.e., Smartwood has conducted ten Resource Manager certifications between 1996 and 2000), this approach is promising as it enables small owners to voluntarily enter their land into certification, and attempts to keep costs low (Smartwood, 2001). If assemblages of landowners use a certified forester on a regional scale, then the total acreage becomes a more coordinated economic unit, rather than a collection of spatially and temporally separate operations, and hence a more reliable and viable means to harvest. By assuring that management is held to widely accepted environmental standards, and monitored by third-party auditors, Green Certification may provide a means by which landowners may become more comfortable with harvesting.

Conclusion

Nearly fifty years ago, Ferguson and Howard (1956) observed that the "rate of production is far less than the lumber demands of Massachusetts consumers. They must import from other states about ten times as much lumber as the sawmills in the state produce. The lumber freight bill alone is a sizable item. This large freight cost advantage for local lumber producers is potentially a major incentive for growing more sawtimber closer to Massachusetts markets." Although the issue addressed in this paper is clearly not new, now the stakes are both different and higher. The 1956 concern for freight bills is dwarfed by concerns for the global environmental consequences of Massachusetts' consumption levels and sources of wood. We now have the opportunity to cut trees locally, in a heavily forested and ecologically resilient landscape, in order to reduce the impact on often more fragile and globally threatened forests.

In a state like Massachusetts, where 78% of all forest is privately owned, it is not likely that any single argument will alter patterns of natural resource use or production. The diversity of ownership attitudes, socioeconomic conditions, and reactions to philosophical and financial incentives guarantee that there will always be owners who choose not to harvest. Can Massachusetts meet all its consumptive needs for wood locally? Not realistically. Can Massachusetts reduce its use of wood and its substitutes? Vastly. Can Massachusetts' forests contribute more to meet local wood demand on a sustainable basis? Absolutely. In so doing, are there global environmental benefits to be realized? Yes.

Currently there is no environmental ethic focused on meeting wood needs locally and little criticism of consumption behavior. Instead, an anti-logging ethic reigns and degradation of the global environment ensues. A new environmental effort is needed to expose this illusion of preservation. This effort will depend primarily on greater discussions concerning the ethical implications of excessive consumption joined with indiscriminate protectionism. The message could become stronger and more locally relevant in the context of programs that reduce wood use and encourage ecologically sound harvesting.

Management of forests is no longer as simple as knowing what you have, crafting goals and objectives, and designing management strategies to achieve them within the physical and biological constraints of the land. Removing forestland from the productive timber supply can have unintended consequences beyond the woodlot. The best management strategies today are those based on informed decisions — not only about the land, productivity, and objectives — but based also on regional, national and global environmental, and social consequences. This notion applies to a family considering options for their land, a land trust discussing alternatives for a newly acquired piece of property, a community studying alternatives for municipal holdings, even state and federal governments considering the management of public forestland. It is not the intention of this paper to promote the intensive production of timber on all forested lands, but to make a case for a bold reduction in wood use and a judicious and sustainable increase in locally produced wood.

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