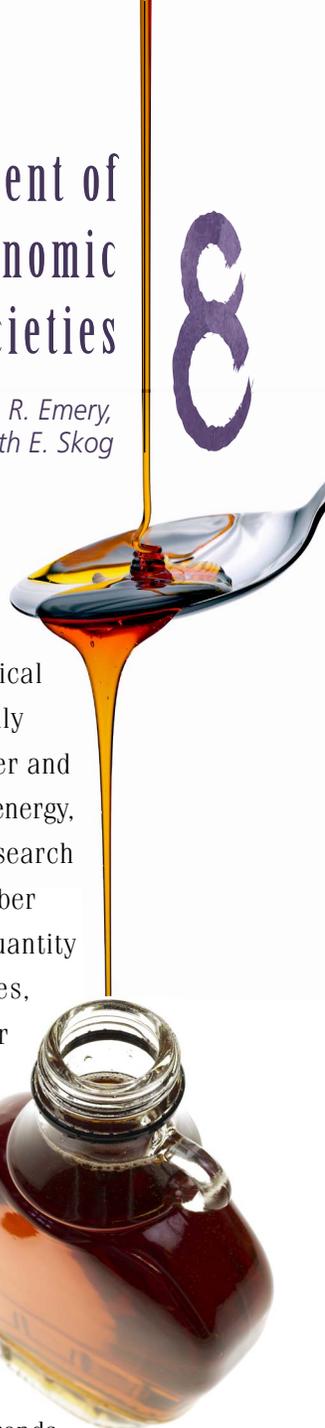




# Maintenance and Enhancement of Long-term Multiple Socioeconomic Benefits to Meet the Needs of Societies

*Nianfu Song, Stephen R. Shifley, J. M. Bowker, Marla R. Emery, Francisco X. Aguilar, Kenneth E. Skog*



## Introduction

**F**ORESTS ARE AN important source of timber and nontimber products, recreation, ecological services, and employment in the Northern United States. Timber products are primarily used for building homes; manufacturing flooring, furniture, and cabinets; and making paper and paperboard. Residues from forest harvesting operations and wood processing are used for bioenergy, charcoal, and landscaping mulch. The employment opportunities in forestry range from research and development to logging and manufacturing. Maple syrup is the most prominent nontimber forest product in the North in terms of annual quantity produced and market value. The quantity and value of nontimber products are dwarfed by the wood products and paper industries, but gathering nontimber products has considerable cultural and economic importance for local communities. The dollar value of forest-based recreation is hard to quantify, but the vast majority of people who participate is a strong indicator of its importance to society. In addition, forest-based recreation generates demand for travel and equipment and creates employment for recreation managers and service providers.

In addition to provisioning and cultural ecosystem services provided by forest products and recreation, regulating ecosystem services from forests includes clean water, carbon sequestration, and diversity of plant and animal species (Chapters 3, 4, 6, and 7). As with recreation, the value of these services is difficult to quantify, but maintaining them is an essential part of sustainable forest management.

This chapter describes indicators of tangible socioeconomic benefits from northern forests. To the extent possible, the indicators are

described quantitatively, but some are limited to qualitative descriptions because of large data gaps. For many indicators, descriptions are limited to trends rather than projections. The methods described in Chapter 2 were used to project growing-stock roundwood removals from 2010 to 2060 for the seven alternative scenarios. Forecasts of forest products were based on a forest products model described by Ince et al. (2011). Modeling of future recreation participation was based on assumptions about changes in population demographics, land use, and other factors.

## Key Findings

- Overall employment in forestry is declining, but productivity (total value of shipments per employee) is increasing.
- Capital investments by government in both production and research are negatively affected by the recent economic recession that followed the 2007 U.S. financial crisis.
- Real-dollar wages in forestry have been relatively constant from 2001 to 2010.
- Under scenarios that assume a constant rate of harvesting without added demands for bioenergy feedstocks, the average annual projected removal of growing stock on timberland from 2010 to 2060 would be 1.3 percent, about half of the projected rate of forest growth.
- Under scenarios that assume greater biomass consumption for energy, the average annual projected removals of growing stock on timberland from 2010 to 2060 would range from 1.7 to 2.7 percent of growing stock.
  - Production of lumber and wood panels is expected to increase under a scenario that assumes large gains in urbanization but would decrease under scenarios that assume smaller gains in urbanization.
- Paper and paperboard production is projected to be variable in the next decade and is expected to decrease before 2060 under scenarios that assume a constant rate of harvesting without added demand for bioenergy feedstocks.
- The low rates of wood recovered from construction and demolition waste can be attributed to high cost and low returns, but up to 70 percent of wood waste from construction and demolition could potentially be reused.
- The wholesale value of wild-harvested nontimber products is estimated at \$682 million for the entire United States.
- Nearly all commercial U.S. maple syrup production is from the North; total annual production in 2013 was about 3.5 million gallons and was valued at \$132 million.
- The total volume of wood and paper products from northern forests is about 40 percent of the quantity consumed by residents in this region; that percentage is expected to decrease under all scenarios by 2060.
- Projected population increases from 2008 to 2060 in the North are expected to cause per capita Federal and State park land to decrease by 19 percent and per capita non-Federal forest land to decrease by 26 percent.
- Under a scenario that assumes large gains in urbanization, increases in participation (compared to current participation) are projected for horseback riding on trails, downhill skiing, motor boating, and visiting interpretative sites; decreases are expected for hunting, back-country skiing, and snowmobiling.

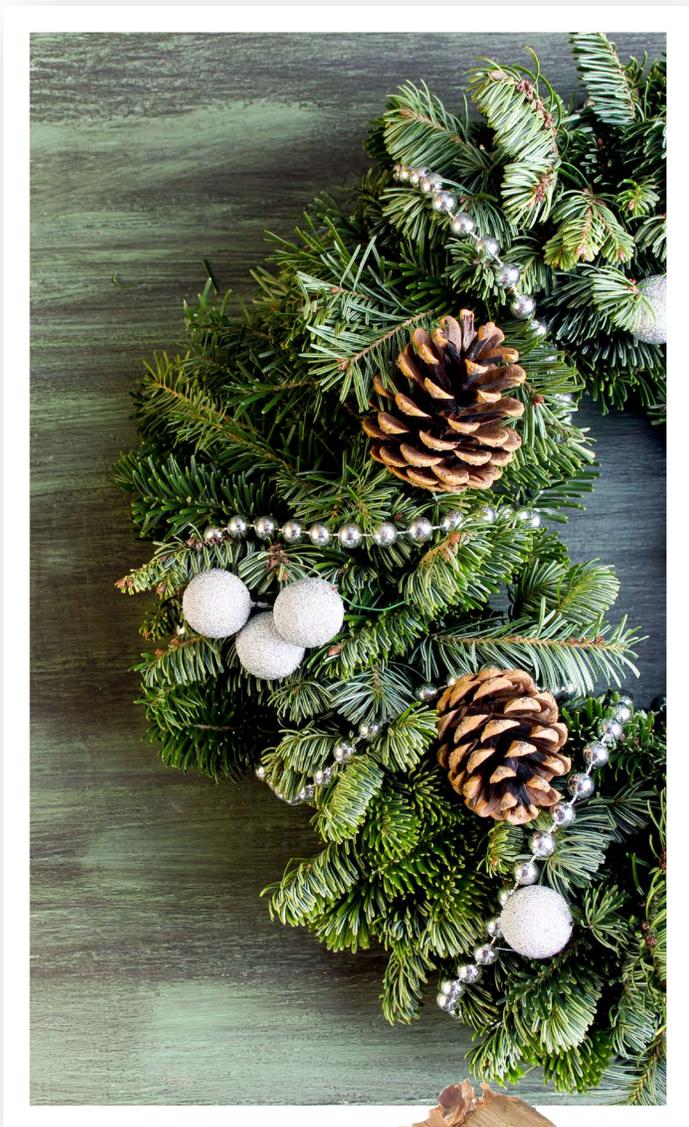


## WOOD AND WOOD PRODUCTS

### *Production Volumes*

As described in Chapter 4, volume removals attributable to harvesting and land-use change are projected to increase moderately under scenarios that assume a constant rate of harvesting without added demands for bioenergy feedstocks, but could more than double under scenarios that assume enhanced biomass consumption for energy (Chapter 7).

Removals on timberland in the North were about 3.6 billion cubic feet in 2007, and the removal rate as a proportion of total growing-stock volume was 1.4 percent, or roughly half the 2.5-percent net annual growth rate (Shifley et al. 2012). The projected 1.3 percent mean annual removals rate from 2010 to 2060 under scenarios that assume a continuation of current harvest rates (i.e., scenarios A1B-C, A2-C, B2-C, A2-EAB) are close to the 2007 baseline or about half of estimated net annual growth, but removals rates under the scenarios with enhanced biomass consumption would range from 1.7 to 2.7 percent (Table 8.1). When coupled with projected growth and mortality, the projected removals for the three scenarios with accelerated biomass harvesting are large enough to result in a net decrease in total standing volume over the period. Chapter 4 describes the volume growth, mortality, and removals patterns in detail for all scenarios.



**Table 8.1**—Projected average annual growing-stock removal rates on timberland in the North, 2010 to 2060. States are ordered from greatest to least growing-stock volume in 2012.

States	Estimated, 2010		Projected <sup>a</sup> annual removal rate, 2010 to 2060						
	Total growing-stock volume (billion ft <sup>3</sup> )	Removal rate (percent)	A1B-C	A2-C	B2-C	A2-EAB	A1B-BIO	A2-BIO	B2-BIO
Pennsylvania	32.0	1.3	1.3	1.3	1.1	1.3	2.6	1.9	1.6
New York	29.3	1.0	0.7	0.7	0.7	0.7	1.4	1.0	0.9
Michigan	28.4	1.2	1.3	1.3	1.2	1.2	2.8	2.1	1.7
West Virginia	25.0	1.3	1.3	1.3	1.3	1.3	3.0	2.2	1.7
Maine	23.1	2.4	2.3	2.3	2.3	2.3	4.7	3.8	3.1
Wisconsin	20.9	1.6	1.7	1.7	1.8	1.7	3.8	2.9	2.4
Missouri	16.8	1.0	0.9	0.9	0.9	0.9	2.0	1.4	1.2
Minnesota	14.5	2.0	1.8	1.8	1.7	1.9	3.7	2.5	2.4
Ohio	14.1	1.3	1.4	1.5	1.4	1.4	3.3	2.4	1.9
New Hampshire	9.5	1.0	1.2	1.1	1.1	1.1	2.8	2.0	1.6
Vermont	9.0	1.3	1.2	1.0	1.1	1.1	2.5	1.8	1.4
Indiana	8.6	0.9	1.3	1.2	1.1	1.1	2.8	2.1	1.6
Illinois	7.2	0.8	0.7	0.6	0.7	0.7	1.3	1.1	0.9
Massachusetts	6.9	0.5	0.4	0.4	0.4	0.5	0.6	0.6	0.4
Maryland	5.9	1.1	1.5	1.5	1.4	1.5	2.6	2.1	1.7
Connecticut	3.8	1.4	0.6	0.7	0.5	0.7	0.8	0.7	0.6
New Jersey	3.5	0.8	1.5	1.5	1.1	1.6	2.3	2.1	1.4
Iowa	3.0	1.5	1.4	1.3	1.7	1.3	3.4	2.3	2.1
Delaware	0.8	0.9	1.0	1.1	1.0	1.1	1.8	1.4	1.2
Rhode Island	0.7	0.3	0.7	0.8	0.4	0.7	0.9	0.8	0.4
Total	263.4	1.3	1.3	1.3	1.3	1.3	2.7	2.1	1.7

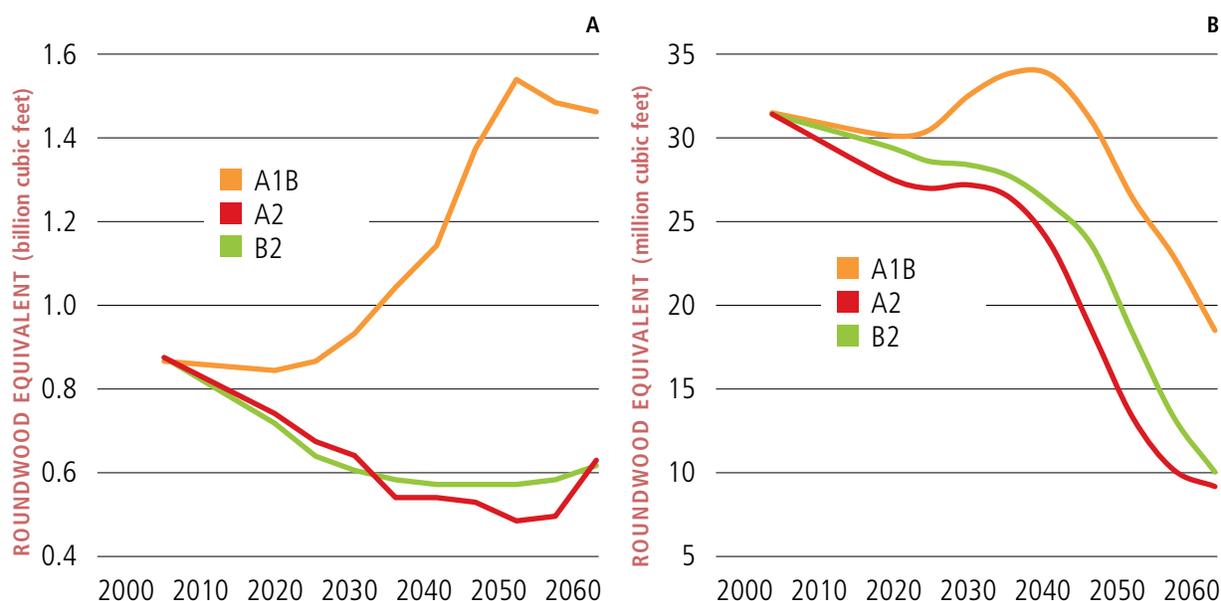
<sup>a</sup>Removal rates are projected under six scenarios, each representing a global greenhouse storyline (IPCC 2007)—A1B assumes moderate greenhouse gas emissions, moderate gains in population growth with large gains in income and energy consumption (but with a balanced renewable/fossil fuel portfolio), A2 assumes high greenhouse gas emissions, large gains in population growth and energy consumption with moderate gains in income, or B2 assumes low greenhouse gas emissions, moderate gains in population growth, income, and energy consumption—combined with the assumption that bioenergy demands will stimulate an increase in roundwood harvesting (-BIO) or that roundwood harvesting will stay constant (-C); a seventh scenario—A2-EAB—assumes that roundwood harvesting will stay constant and that all ash species will succumb to an infestation by the nonnative emerald ash borer.



The removals in Pennsylvania, Michigan, Maine, and Wisconsin are expected to account for about half of the total removals in the North. Predictions suggest that hardwoods will continue to dominate timber production and account for about three-fourths of total removals.

The future production of lumber, wood panels, and paper and paperboard in the North (Fig. 8.1) was estimated by Ince et al. (2011) using global demand and supply factors that affect wood product markets for all U.S. regions. Projected changes in production reflect anticipated market demand and therefore are greatly affected by the economic assumptions that underlay the greenhouse gas emissions

storylines and additional assumptions utilized by Ince et al. (2011). Under assumptions for storyline A1B, the production of primary solid wood products—the total of lumber and wood panels production—in the North could increase 68 percent from 870 million cubic feet in 2006 to 1,461 million cubic feet in 2060. However, in the same period under the assumptions for storylines A2 and B2, the production of primary solid wood products could decline by 28 percent (Fig. 8.1). The 50-year predictions for paper and paperboard production eventually trend downward under all storylines.



**FIGURE 8.1**

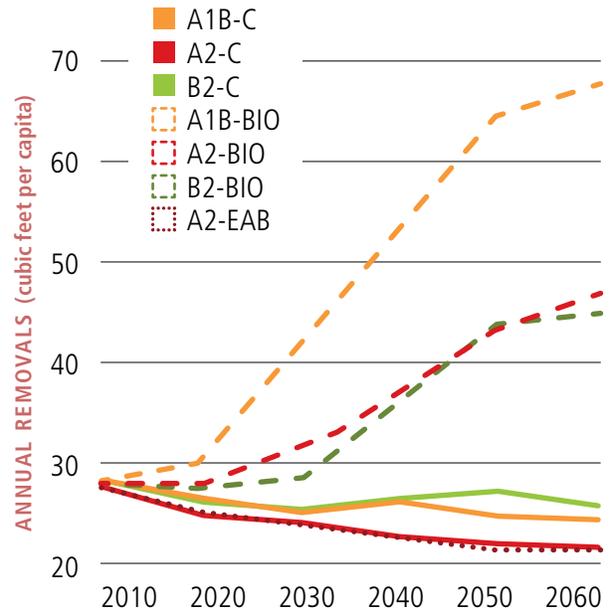
Projected (A) lumber and wood panels and (B) paper and paperboard production in the North, 2010 to 2060, based on the U.S. Forest Products Module (Ince et al. 2011) applied with three global greenhouse gas storylines (IPCC 2007). Storyline A1B assumes moderate greenhouse gas emissions, moderate gains in population, and large gains in income and energy consumption (but with a balanced renewable/fossil fuel portfolio); A2 assumes high greenhouse gas emissions, large gains in population and energy consumption, and moderate gains in income; and B2 assumes low greenhouse gas emissions with moderate gains in population, income, and energy consumption. Additional assumptions of the Forest Products Module are described by Ince et al. (2011).

Timber removals in the North totaled 3,045 million cubic feet in 2007, and the population was 120 million people at that time (Shifley et al. 2012, Smith et al. 2009). Thus, the average annual timber removals per capita in the North (including removals associated with conversion of forest to other land use categories) were only 25 cubic feet. Total wood production in the region is expected to increase by 2060 under all scenarios, but due to increased population, the removals per capita between 2010 and 2060 are expected to decline slightly for all scenarios except those with large increases in biomass harvest for energy (i.e., scenarios A1B-BIO, A2-BIO, and B2-BIO) (Fig. 8.2).



### Total and Per Capita Consumption

U.S. annual timber product consumption averaged 69 cubic feet per capita from 1965 to 2011. Due to weak market demand since 2007, per capita consumption hit a low of 41 cubic feet in 2009 and 2010 but rebounded modestly to 47 cubic feet by 2011 (Howard and Westby 2013, Howard et al. 2010). With recovery of the U.S. economy, housing starts and per capita timber product consumption will likely increase.



**FIGURE 8.2**

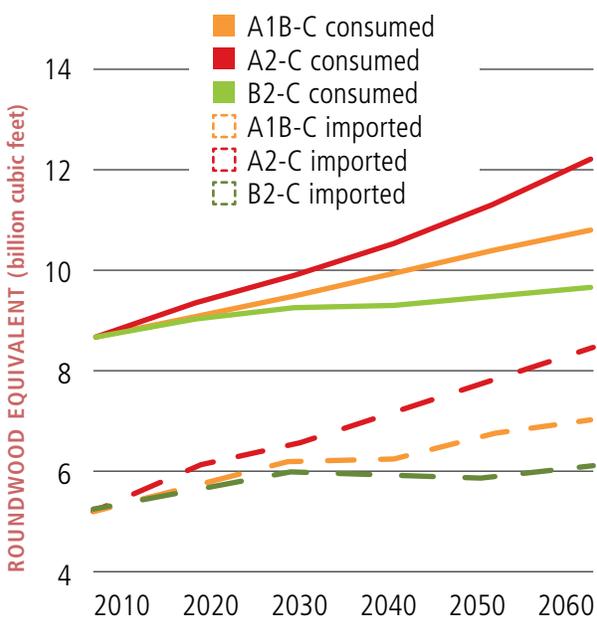
Projected per capita wood growing-stock removals on timberland in the North, 2010 to 2060 under seven scenarios, each representing a global greenhouse gas storyline (IPCC 2007) paired with a harvest regime. Storyline A1B assumes moderate greenhouse gas emissions, moderate gains in population, and large gains in income and energy consumption (but with a balanced renewable/fossil fuel portfolio); A2 assumes high greenhouse gas emissions, large gains in population and energy consumption, and moderate gains in income; and B2 assumes low greenhouse gas emissions with moderate gains in population, income, and energy consumption. Scenario projections assume harvest will continue at recently observed levels (labeled –C) or increase to reflect increased harvest for bioenergy production (labeled –BIO). Scenario A2-EAB is a variation of scenario A2-C that also assumes all ash species will gradually succumb to an expanding zone of infestation by the nonnative emerald ash borer.



Future total consumption of wood products in the North can be estimated from projections of population growth and per capita consumption. Based on the population projections for each of the 1,037 counties in the U.S. North and Washington, D.C., the predicted population in the region for 2060 would be 158 million people (+26 percent) under storyline A1B, 178 million people (+42 percent) under storyline A2, and 140 million people (+12 percent) under storyline B2 (Zarnoch et al. 2010). Assuming that future per capita wood consumption in the North would mirror the 46-year national average (69 cubic feet per year), the projected 2060 consumption reaches 10.9 billion cubic feet under storyline A1B, 12.3 billion cubic feet under storyline A2, or 9.7 billion cubic feet under storyline B2 (Fig. 8.3).

### Exports and Imports of Wood Products

The net import of wood products into the U.S. North can be estimated by calculating the difference between future consumption (assumed 69 cubic feet per capita) and the predicted production for scenarios A1B-C, A2-C, or B2-C. Table 8.2 suggests that a net equivalent of >60 percent of the wood products consumed in the region will have to be imported from other regions or foreign countries. The net import of wood products is predicted to increase over time under scenarios A1B-C, A2-C, and B2-C (Fig. 8.3). The assumption of 69 cubic feet per capita consumption does not apply to A1B-BIO, A2-BIO, and B2-BIO, which assume greatly increased woody biomass demand.



**FIGURE 8.3**

Projected roundwood equivalent volumes of wood products consumed and imported in the North, 2010 to 2060, under three scenarios, each representing a global greenhouse gas storyline (IPCC 2007) paired with a harvest regime. Storyline A1B assumes moderate greenhouse gas emissions, moderate gains in population, and large gains in income and energy consumption (but with a balanced renewable/fossil fuel portfolio); A2 assumes high greenhouse gas emissions, large gains in population and energy consumption, and moderate gains in income; and B2 assumes low greenhouse gas emissions with moderate gains in population, income, and energy consumption. These scenarios assume harvest will continue at recently observed levels, and when paired with a specific storyline these scenarios are labeled A1B-C, A2-C, and B2-C. Import values are estimated by subtracting the projected production from the assumed per capita consumption multiplied by projected population.

**Table 8.2**—Predicted proportion of total wood product consumption in the North, 2010 to 2060, that is expected to be met by net imports from other regions and countries.

Scenario <sup>a</sup>	2010	2020	2030	2040	2050	2060
	----- (percent) -----					
A1B-C	61	63	65	64	66	66
A2-C	62	66	66	68	70	70
B2-C	61	64	65	64	63	64
A2-EAB	62	65	67	69	70	71

<sup>a</sup>Removal rates are projected under six scenarios, each representing a global greenhouse storyline (IPCC 2007)—A1B assumes moderate greenhouse gas emissions, moderate gains in population growth with large gains in income and energy consumption (but with a balanced renewable/fossil fuel portfolio), A2 assumes high greenhouse gas emissions, large gains in population growth and energy consumption with moderate gains in income, or B2 assumes low greenhouse gas emissions, moderate gains in population growth, income, and energy consumption—combined with the assumption that bioenergy demands will stimulate an increase in roundwood harvesting (-BIO) or that roundwood harvesting will stay constant (-C); a seventh scenario—A2-EAB—assumes that roundwood harvesting will stay constant and that all ash species will succumb to an infestation by the nonnative emerald ash borer.

Many of the timber and nontimber products from northern forests are exported to other regions or other countries. However, available trade statistics are insufficient to track trade into and out of the region for specific products.

**NONTIMBER FOREST PRODUCTS**

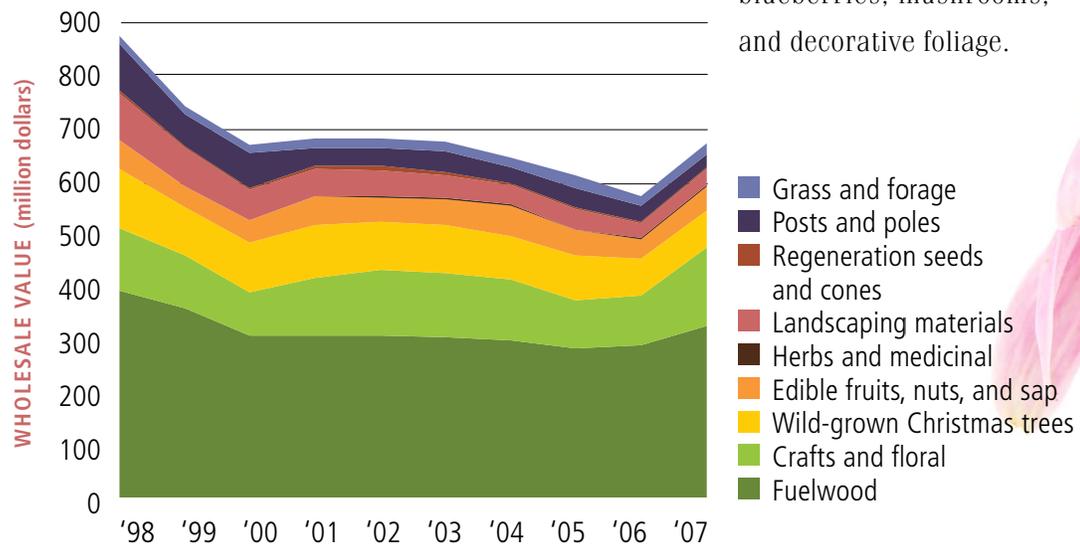
Nontimber forest products include hundreds of plant materials and fungi collected for food, medicine, and other purposes. While much of the nontimber forest products harvested are used for subsistence or personal consumption, or are traded in local markets, some are traded in national and global markets. The quantity and dollar value of northern nontimber forest products entering commercial markets is typically small compared to timber harvested for lumber, pulp, fuel, and similar commodities.

Nonetheless, nontimber products can be very important to local peoples and economies. Information about the type and quantity of nontimber forest products harvested and consumed is limited, but Alexander et al. (2011) estimated the 2007 wholesale value of U.S. wild-harvested nontimber forest products entering commercial markets at \$682 million (Fig. 8.4) and the corresponding value to nontimber forest product gatherers at their first point of sale (cash value to gatherers if selling to a wholesaler) at \$272 million or 40 percent of the wholesale value. The estimated total value of commercially traded nontimber forest products varies from year to year but has gradually decreased by 23 percent from 1998 to 2007. Product categories that increased in value were herbal and medicinal plants, craft and floral items, and grass and forage.



U.S. exports of major nontimber forest products tracked by the U.S. Department of Agriculture were >\$400 million in 2007, compared to >\$700 million in imports (Table 8.3). Although current data are not sufficient

to justify comprehensive regional or State-level analyses, they suggest that imports substantially exceed exports for several important northern nontimber forest products including maple syrup, wild blueberries, mushrooms, and decorative foliage.



**FIGURE 8.4**  
Estimated wholesale value (in nominal dollars) of commercially traded nontimber forest products in the United States, 1998 to 2007 (Alexander et al. 2011).

**Table 8.3**—Estimated annual value of U.S. imports and exports of selected nontimber forest products, 2007 (Alexander et al. 2011).

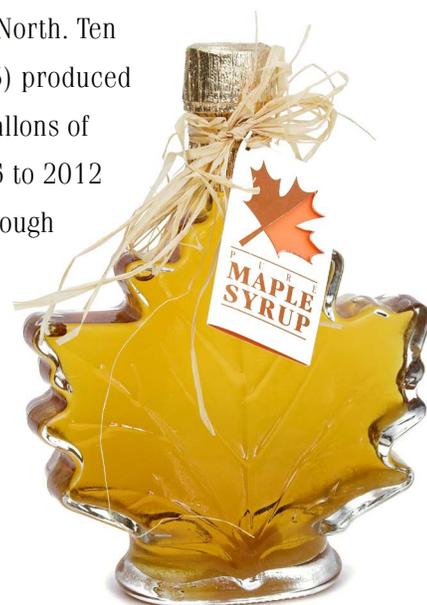
Exports		Imports	
Product	Value	Product	Value
	(million dollars)		(million dollars)
Pecans	187	Pecans	147
Ginseng, wild or cultivated	52	Maple syrup	142
Foliage, branches	48	Wild blueberries	109
Wild blueberries	48	Foliage, branches	96
Other fruits	32	Pine nuts	54
Mushrooms, truffles	14	Cranberries	49
Pine oil	12	Vanilla beans	43
Maple syrup, sugar	8	Mushrooms, truffles	34
Oil of cedarwood, clove or nutmeg	5	Ginseng, wild or cultivated	25
Gum, turpentine	5	Mosses and lichens	4
<b>Total</b>	<b>411</b>	<b>Total</b>	<b>703</b>



Common wild-harvested herbal and medicinal plants include 15 species found in northern forests (Table 8.4), but none are exclusive to the region. Harvesting estimates are not available separately for northern forests. However, large-scale field cultivation of ginseng occurs almost exclusively in Wisconsin, and 12 of the 19 States meeting Federal requirements for export of wild and wild-simulated ginseng are in the region: Illinois, Indiana, Iowa, Massachusetts, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, West Virginia, and Wisconsin (USDI FWS 2011).

The value of per capita consumption of commercially marketed nontimber forest products, adjusted for imports and exports, was estimated at \$2.46 for 2007, down from \$3.31 in 2003 (Alexander et al. 2011). These overall totals mask the economic importance of products such as ginseng, maple syrup, or balsam boughs to some individual households and communities.

Nearly all U.S. commercial maple syrup production occurs in the North. Ten Northern States (Fig. 8.5) produced an average of 2 million gallons of syrup per year from 2006 to 2012 (USDA NASS 2014). Although production has gradually increased over the last 20 years, there can be substantial year-to-year variation. In 2012, maple syrup production

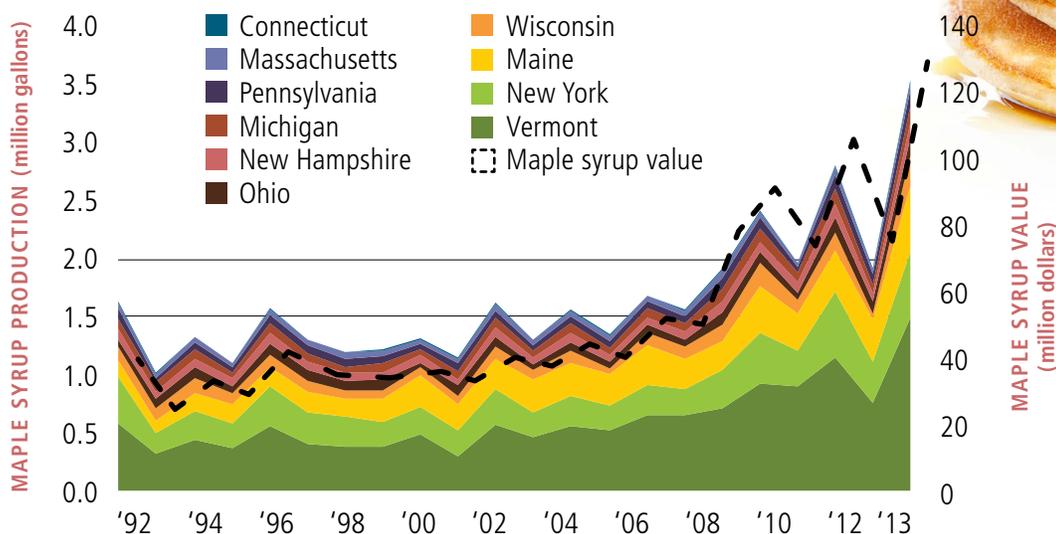




**Table 8.4**—Wild-harvested plants found in northern U.S. forests that are used for herbal and medicinal purposes, 1997 to 2005 (Alexander et al. 2011); entries are sorted from greatest to least total harvest weight for the United States as a whole.

Plant	Part(s) used	Estimated average annual U.S. harvest (pounds)
Black cohosh	root, rhizome	259,617
Slippery elm	bark	189,208
Goldenseal	root, rhizome, leaf	106,728
Wild yam	tuber	42,400
Bloodroot	root	28,798
Eastern purple coneflower	root, herb	20,208
Pale purple coneflower	root, herb	9,759
Blue cohosh	root	6,460
Fairywand	root	4,529
Red trillium	whole plant	1,234
Beard lichen	whole plant	1,094
White colicroot	root	1,019
Virginia snakeroot	root	149
Lady's slipper	whole plant	58
Arnica	whole plant	21
<b>Total</b>		<b>671,282</b>

and value dropped sharply throughout the North, attributable to prevailing high temperatures that limited sap flow. Weather conditions were favorable in 2013; consequently annual production in the North increased by 85 percent relative to 2012. Output in 2013 totaled 3.5 million gallons, which is 0.7 million gallons more than the highest output reported for the previous 30 years. The average value of maple syrup produced from 2006 to 2012 was \$75 million annually, up from \$39 million during the prior 5-year period. The value of production reached \$132 million in 2013. Vermont leads all States in maple syrup production (valued at \$49 million in 2013) and accounts for about 40 percent of total U.S. output.



**FIGURE 8.5**  
Volume and value (in nominal dollars) of maple syrup production in the North, 1992 to 2013 (USDA NASS 2014).

The annual variations in sap and syrup production attributed to weather conditions have heightened concerns about future impacts of climate change. In addition to concerns about unfavorable temperature for sap production, climate change is expected to reduce the extent of favorable habitat for sugar maple trees in the region (Iverson et al. 2008, USDA FS 2014) with the additional concern that maples are highly valued for autumn color and important to the recreation and tourism industries discussed in the Outdoor Recreation section of this chapter.

As is true for any commodity, markets and economic values for nontimber forest products can be expected to fluctuate in the future. Economic downturns will depress demand for discretionary items such as floral greens and decoratives, and research about adverse effects will continue to eliminate markets for individual medicinal species. However, growing interest in local foods and medicinal supplements can be expected to drive overall growth in demand for species that fill these niches. Economic downturns can also increase harvesting of desirable nontimber forest products for personal consumption and sale. As markets for herbal supplements and medicinal products develop, harvesting volumes can be expected to increase. For some species, markets will be short lived, but for those with enduring markets, cultivation efforts and offshore sourcing could fill a growing portion of demand, resulting in less harvesting from northern forests.

## **RECOVERY OR RECYCLING OF FOREST PRODUCTS**

Recycling of forest products includes the reuse of any wood and paper product except wood waste used for energy. Many wood products such as furniture, pallets, boxes, and wood from demolition are reused. The recycling rate for some types of wood products is already high. For example, most pallets in the United States are reused or repaired for reuse (Bush et al. 2007). Manufacturing wood residues are used as fuel wood or recycled for making engineered wood products, landscaping products, and animal bedding.

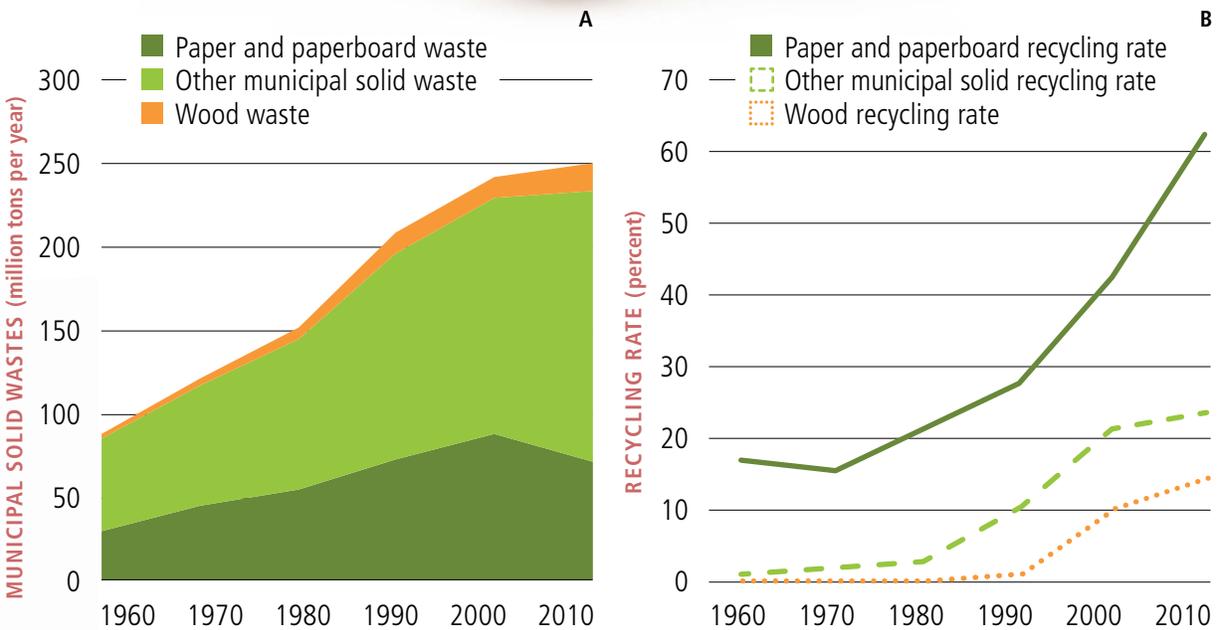
Paper and wood account for about a third of total U.S. municipal solid waste by weight (Fig. 8.6). In the Northeastern States (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont), paper and paperboard make up about 29 percent of municipal solid waste, and wood makes up about 6 percent of municipal solid waste (Northeast Waste Management Officials' Association 2009). With the growth of opportunities and requirements for recycling, an increasing proportion of wood and paper products will be reused in increasingly efficient ways. The national rate of paper and paperboard recycling was 67 percent in 2010, about twice the 1999 rate of 34 percent (Paper



Industry Association Council 2012). The recovery rate of wood from the municipal waste stream has also increased but is low compared to other reusable wastes (Fig. 8.6). For example, the U.S. recovery rate of wood from municipal solid waste in 2006 was only 12 percent.

Wood was an estimated 10 percent of construction demolition waste, and its estimated recovery rate is about 15 percent, with large variation among Northeastern

States (Northeast Waste Management Officials' Association 2009). Corresponding recovery rates in other Northern States have not been reported, but Falk and McKeever (2004) suggest that low rates of recovery of wood in construction demolition waste can be attributed to high costs and low returns, and also that up to 70 percent of such wood waste could be reused.



**FIGURE 8.6**

Comparison of wood-products and other materials in municipal wastes, 1960 to 2010, in the Northern United States by (A) volume generated and (B) percent recycled (US EPA 2011).

## FORESTRY INVESTMENTS AND RETURNS

### *Private Landowner Investments*

Historically, investments in tree planting in northern forests have been small compared to forests in other regions. This is partially because hardwoods, the dominant component, can regenerate naturally. The planted forest area in the North is <4 percent of total forest land compared to 8 percent for all U.S. forest land, and tree planting area has decreased to <0.2 million acres each year in recent decades (USDA FS 2009). The acreage planted is expected to remain at that level or slowly decrease unless there are large investments in wood bioenergy plantations.

The degree to which an assisted migration strategy for tree species could affect future rates of tree planting is unknown. Assisted migration uses planting to expand the occurrence of a species outside its natural range into locations that are presumed to be better suited to its growth and survival under a changing climate. Assisted migration is a widely discussed climate change adaptation strategy that remains controversial (McLachlan et al. 2007, Vose et al. 2012).

The increasing number of forest owners and the decreasing average size of private forest ownerships in the region contribute to low investments in forest management (Chapter 9). Nevertheless, participation of landowners in conservation programs in recent decades has increased as measured by tax deductions and increased enrollment in easements and other incentive programs (Land trust Alliance 2011, Song et al. 2014). Recreational investment is expected to increase in anticipation of an increasing number of people participating in outdoor activities (Bowker and Askew 2013, Bowker et al. 2012, Cordell 2012).





### Wood Products Industry Investments

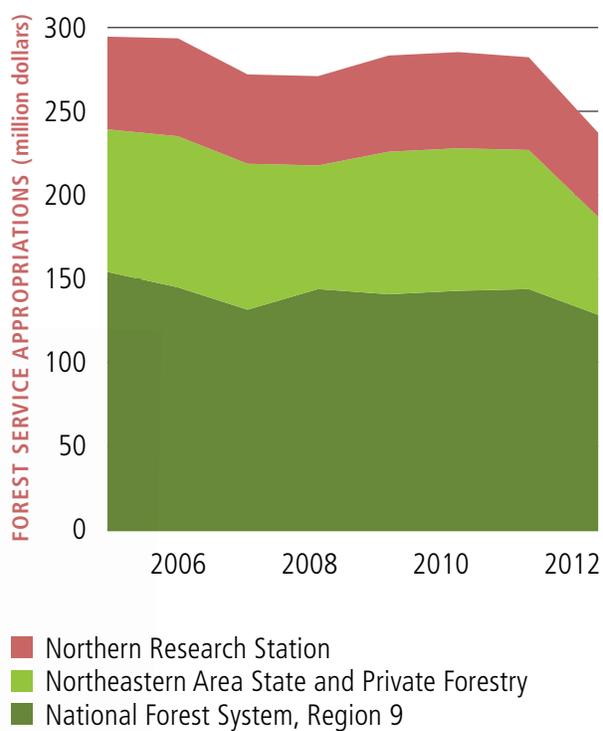
Capital investments in wood products—the North American Industry Classification System (NAICS) category 321—increased to \$1.2 billion in 2006 in the U.S. North (Shifley et al. 2012). After the 2007 U.S. financial crisis, capital investment in wood products decreased to a low of \$0.5 billion in 2011 (U.S. Census Bureau 2012), a rate that is expected to increase as the overall economy continues to recover.

In contrast, investment in pulp and paper production in the North has been declining since 1997 due to weak demand and intensive competition. Total investments in the pulp and paper industry in the North decreased from \$2.9 billion in 2006 to \$2.2 billion in 2010. It is unknown when the decline of investments in this industry will stop.



### Federal Investments

Federal government investment in forest management in the North has remained relatively flat. A modest increase in combined funding for the National Forest System and the State and Private Forestry Program of the U.S. Forest Service has been more than offset by the effects of the Federal budget sequestration (Fig. 8.7).



**FIGURE 8.7**

U.S. Forest Service discretionary appropriations in the North, 2006 to 2012, for the National Forest System (Region 9), Northeastern Area State and Private Forestry, and the Northern Research Station.

The total Federal government investment in forest research, landowner support, and national forest management decreased slightly in nominal dollars from 2005 to 2011 (Fig. 8.7). However, in 2012, the combined expenditure was \$280 million, down 5 percent from 2005 and down 15 percent from the 2011 high.

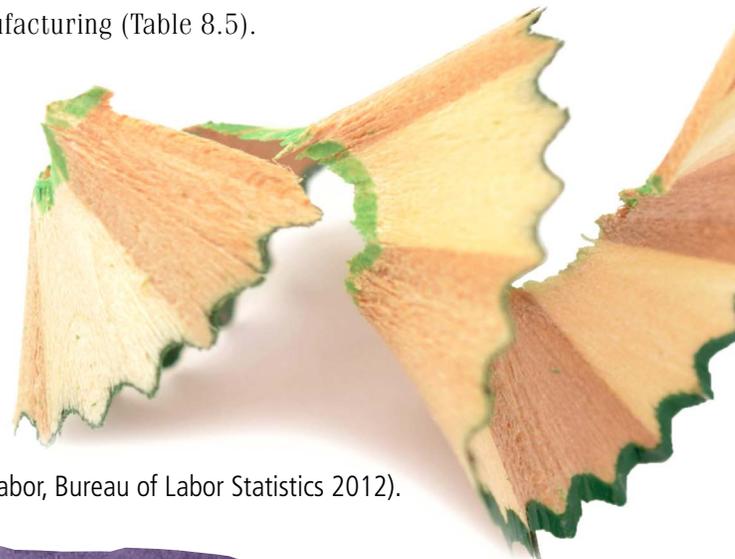
## EMPLOYMENT IN FOREST INDUSTRIES

### *Numbers of Employees*

Employment in six major NAICS categories is forest-related (Table 8.5). In addition, forest-associated employment includes jobs in forest administration offices, forest research stations, universities, consulting firms, and conservation organizations, but statistics for these jobs are indirectly included in employment numbers of

government, education, research, conservation, and other job categories and cannot be separated for forestry related employment.

Direct forest production and service sectors in the North provided a combined total 427,000 jobs in 2010, which was 36 percent of the U.S. total for these sectors (1.2 million jobs). Most jobs (94 percent) were in manufacturing: wood products manufacturing, paper and paperboard products manufacturing, and wood furniture manufacturing (Table 8.5).



**Table 8.5**—Comparison of forest production and service employment, 2001 to 2010, in the United States and in the North (U.S. Department of Labor, Bureau of Labor Statistics 2012).

	Employment North American Industry Classification System category (NAICS code)						Total
	Forestry and logging (113)	Hunting and trapping (1142)	Wood products (321)	Paper and paperboard (322)	Wood furniture (337110, 337122, 337211, 337212)	Parks and recreation (71219)	
<b>Northern States</b>							
2001 (employees)	12,243	809	205,516	300,389	125,389	11,993	656,339
2010 (employees)	9,495	407	125,390	197,905	78,626	15,121	426,944
Change (percent)	-22	-50	-39	-34	-37	26	-35
<b>United States</b>							
2001 (employees)	82,526	3,619	646,964	577,030	313,308	69,934	1,693,381
2010 (employees)	60,065	1,665	473,495	392,853	169,898	80,642	1,178,618
Change (percent)	-27	-54	-27	-32	-46	15	-30

## Forest-related Job Categories in the North American Industry Classification System

The job data used in this report are from the Quarterly Census of Employment and Wages (U.S. Department of Labor, Bureau of Labor Statistics 2012) for private establishments and government installations with one or more paid employees. Survey units without paid employees are excluded, as are government agencies, education, research, and conservation employees.

**Forestry and logging (NAICS 113)**—Establishments and government installations growing and harvesting timber on a long production cycle ( $\geq 10$  years). Consequently, Christmas tree production and other production involving production cycles  $< 10$  years are not in this subsector. Silvicultural activities, harvesting timber, and gathering forest products (such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, ginseng, and truffles) are included in this subsector.

**Hunting and trapping (NAICS 1142)**—Establishments that do commercial hunting and trapping or operate commercial hunting and game preserves.

**Wood products (NAICS 321)**—Establishments manufacturing wood products (from logs and bolts) that are sawed and shaped, and establishments purchasing sawed lumber and making wood products. Products of this subsector include lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (mobile homes), and prefabricated wood buildings.

**Paper and paperboard (NAICS 322)**—Establishments making pulp, paper, or converted paper products. Converted paper products are made from paper and other materials by various cutting, shaping, coating, and laminating activities. Products of converted paper products include paperboard containers, paper bags, coated and treated paper, stationery, sanitary paper, tissue paper, and disposable diapers. Excluded from this subsector are photosensitive papers.

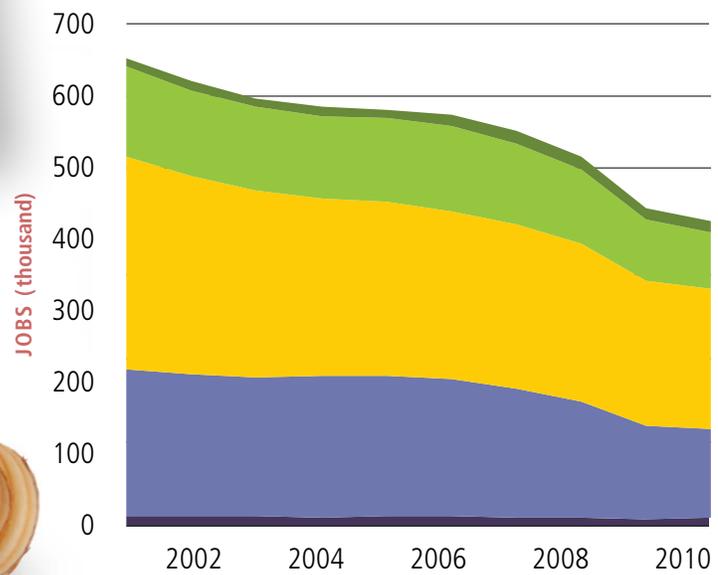
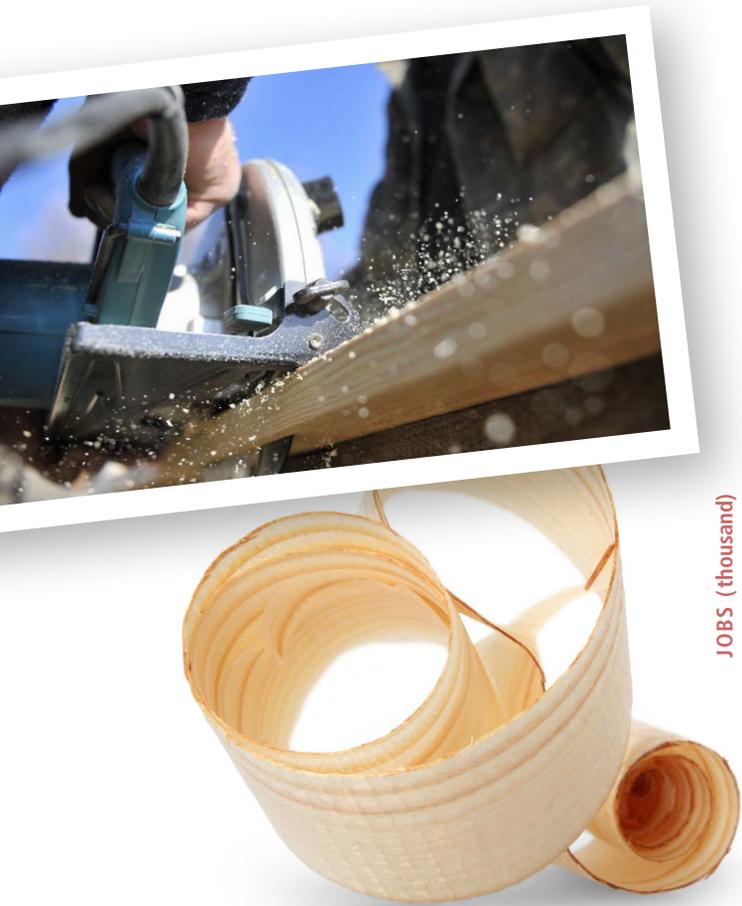
**Wood furniture**—Establishments manufacturing wood kitchen cabinet and countertop (NAICS 337110), non-upholstered wood household furniture (NAICS 337122), wood office furniture (NAICS 337211), and custom architectural woodwork and millwork (NAICS 337212).

**Parks and recreation (NAICS 71219)**—Establishments or government installations primarily engaged in the preservation and exhibition of natural areas or settings. National and State parks, reserves, conservation areas, wildlife sanctuary, and waterfalls are all included in this subsector.

Employment in the North from 2001 to 2010 declined in all the forest-associated categories except parks and recreation (NAICS 71219). During these years, total forest-associated employment in the region dropped by 35 percent; jobs in forestry and logging (NAICS 113) dropped by 22 percent, from about 12,000 to 9,000 jobs (Fig. 8.8); jobs in hunting and trapping dropped by 50 percent; jobs in wood products manufacturing dropped by 39 percent; jobs in paper and paperboard products manufacturing dropped by 34 percent; and

jobs in wood furniture manufacturing dropped by 37 percent. Although they make up a small proportion of the total, jobs in parks and recreation increased by 26 percent.

More than half of the decreases in forest-associated employment occurred after the 2007 U.S. financial crisis (Fig. 8.8). A long-term trend of declining employment in the forest-associated industries appears to have been exacerbated by the economic downturn. Future changes in employment will likely be linked to economic conditions, and future rates of decline could be smaller as the economy recovers. Table 8.5 shows employment numbers by job category for 2001 and 2010, and Table 8.6 shows employment numbers, by State, from 2001 to 2010.



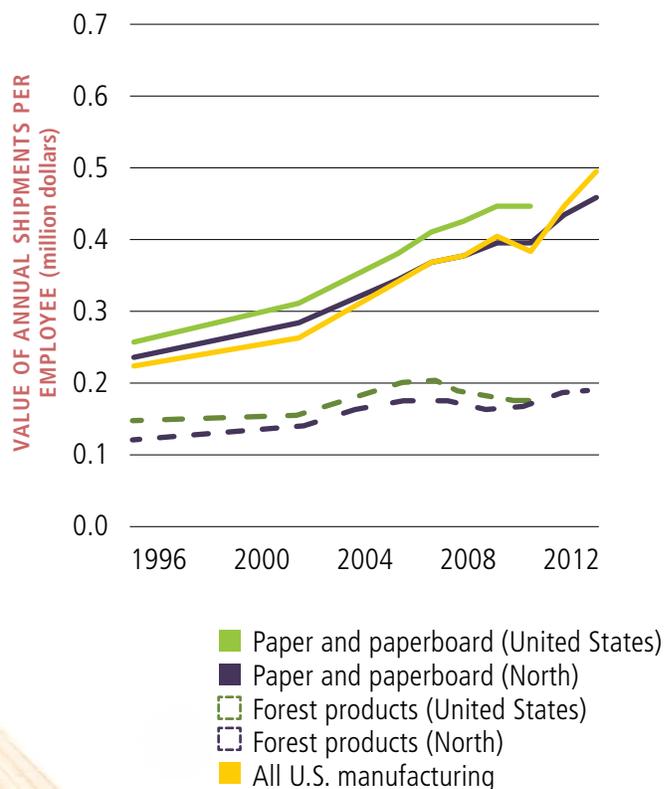
**FIGURE 8.8**  
Forest production and service job categories that employed >1,000 workers in the North, 2001 to 2010.

- Parks and recreation
- Wood furniture
- Paper and paperboard
- Forest products
- Forestry and logging



The economic recession that followed the 2007 financial crisis helps explain the particularly large drop in forest-related employment in 2009, as does the weak demand for U.S. paper products since 1990. An additional factor was an overall increase in productivity per employee (average dollars of product shipment per employee), which was a major reason for employment declines in the forest products industry and one of several reasons for declines in the paper and paperboard industry. From 1997 to 2011, per employee shipments increased from \$0.13 million to \$0.20 million in the forest products industry and nearly doubled from 0.24 to 0.45 million dollars in the paper and paperboard industry (Fig. 8.9).

Average productivity values measured in million dollars per job per year for these two industries generally increased from 1997 to 2011 but showed considerable variation among States (Fig. 8.10). The increasing value of shipments per employee suggests a trend of higher productivity in these industries (Maine Forest Products Council 2013). Similar trends exist for the northern logging industry, where the number of workers has decreased although total timber production has increased over the last half century.



**FIGURE 8.9**  
Comparison of forest-industry employee productivity (defined as shipment value per employee) in the United States and the North, 1997 to 2011 (U.S. Census Bureau 2012).

**Table 8.6**—Numbers of forest production and service jobs, reported for the U.S. North by State and year, 2001 to 2010, [NAICS categories 113, 321, 1142, 71219, 337110, 337122, 337211, and 337212] (U.S. Department of Labor, Bureau of Labor Statistics 2012).

State	2001	2002	2003	2004	2005
------(number of workers)-----					
Connecticut	11,211	10,666	10,432	10,017	9,369
Delaware	2,519	2,661	2,455	2,022	1,367
District of Columbia <sup>a</sup>	33	14	17	NA	NA
Illinois	49,626	47,589	46,325	44,248	44,786
Indiana	52,365	50,357	48,638	49,056	49,395
Iowa	21,720	20,887	20,979	20,684	22,061
Maine	23,478	22,332	19,849	19,835	20,011
Maryland	13,033	12,302	11,898	11,653	12,018
Massachusetts	24,463	22,878	21,488	21,169	20,251
Michigan	42,640	39,780	38,341	36,777	36,995
Minnesota	41,207	40,466	40,048	39,916	40,184
Missouri	29,397	27,962	26,778	26,720	26,012
New Hampshire	8,593	7,814	7,093	7,298	7,092
New Jersey	28,076	25,818	25,034	24,388	23,534
New York	50,826	47,126	45,082	44,626	43,990
Ohio	69,032	65,722	63,185	61,478	60,012
Pennsylvania	79,135	76,632	74,337	72,829	73,442
Rhode Island	3,685	1,011	3,337	2,488	2,234
Vermont	7,149	6,498	5,766	5,593	5,587
West Virginia	12,548	12,541	12,597	12,806	12,650
Wisconsin	85,603	83,141	76,576	74,452	73,691
North total	656,339	624,197	600,255	588,055	584,681
U.S. total	1,693,381	1,620,104	1,547,753	1,505,504	1,484,624
North/U.S. (percent)	39	39	39	39	39

<sup>a</sup>Record keeping stopped in 2004, designated as NA.



Table 8.6 continued

State	2006	2007	2008	2009	2010	Change 2001 to 2010
	------(number of workers)-----					(percent)
Connecticut	9,366	9,537	9,163	7,725	7,148	-36
Delaware	1,622	1,574	1,472	1,337	1,329	-47
District of Columbia <sup>a</sup>	NA	NA	NA	NA	NA	NA
Illinois	44,488	43,290	41,474	36,320	34,022	-31
Indiana	48,814	46,410	42,548	34,630	33,551	-36
Iowa	22,043	21,203	19,095	15,932	15,175	-30
Maine	19,151	18,170	17,196	15,013	14,888	-37
Maryland	11,717	10,586	9,545	8,035	7,432	-43
Massachusetts	19,139	18,780	17,145	14,682	14,251	-42
Michigan	35,523	34,095	31,768	27,248	26,597	-38
Minnesota	39,202	36,987	34,253	29,629	28,797	-30
Missouri	26,043	24,849	22,917	19,786	18,974	-35
New Hampshire	6,447	5,869	5,233	4,434	4,124	-52
New Jersey	22,670	21,533	20,747	17,910	17,654	-37
New York	46,827	45,634	43,753	38,240	33,177	-35
Ohio	58,221	55,932	52,711	45,009	43,402	-37
Pennsylvania	73,656	70,499	65,716	56,469	55,013	-30
Rhode Island	2,137	2,880	2,428	2,779	2,867	-22
Vermont	5,308	5,227	5,147	4,310	3,976	-44
West Virginia	12,501	11,552	10,147	8,465	8,091	-36
Wisconsin	72,145	69,775	66,337	58,360	56,476	-34
North total	577,020	554,382	518,795	446,313	426,944	-35
U.S. total	1,453,356	1,408,614	1,351,194	1,224,524	1,178,618	-30
North/U.S. (percent)	40	39	38	36	36	NA

<sup>a</sup>Record keeping stopped in 2004, designated as NA.

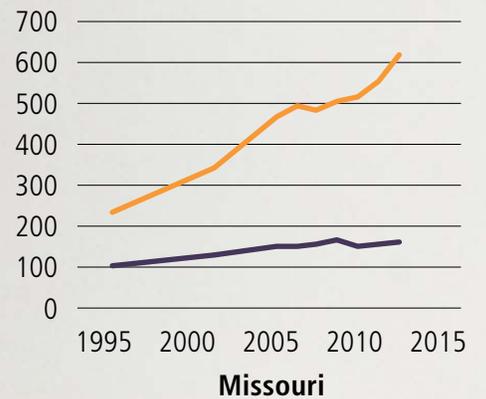
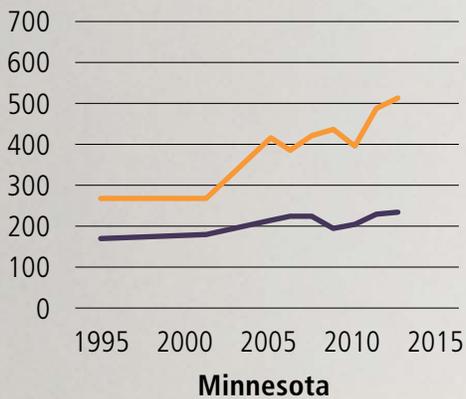
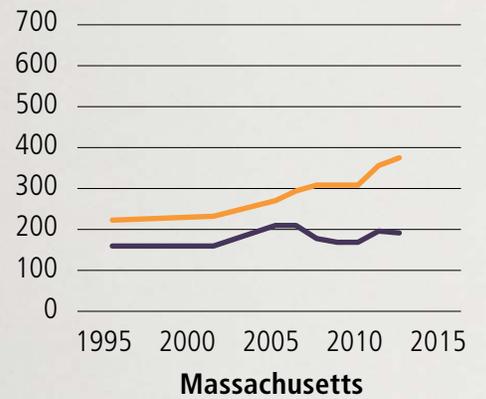
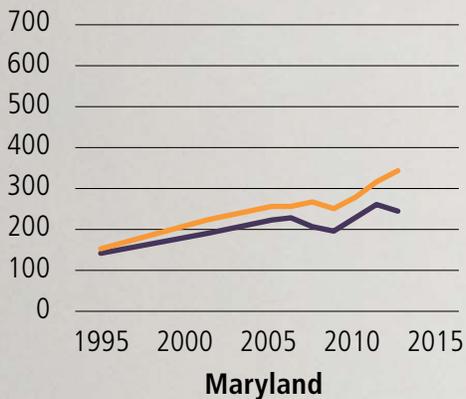
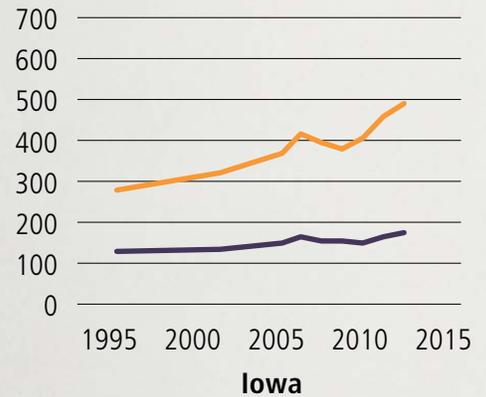
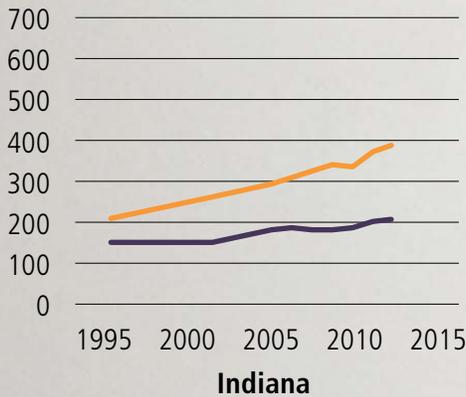
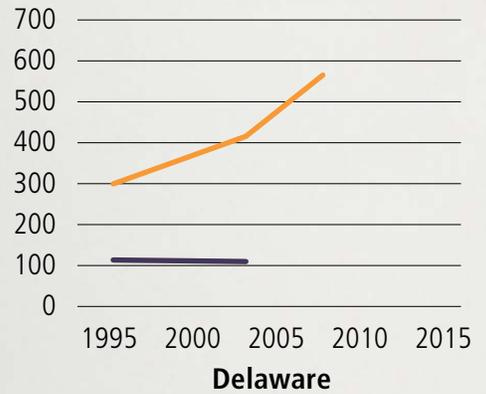
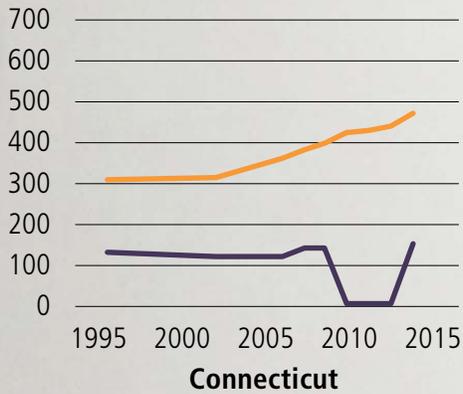


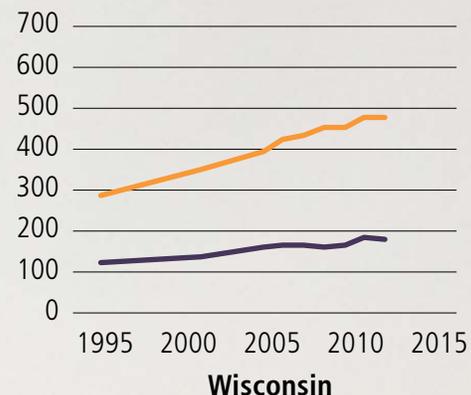
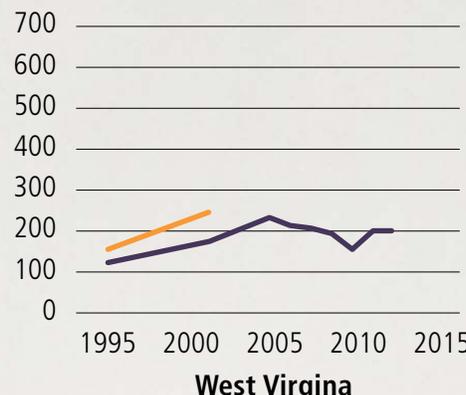
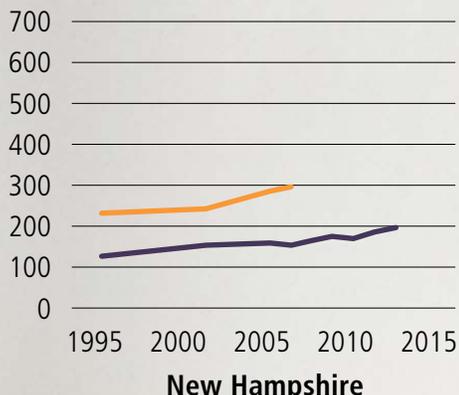
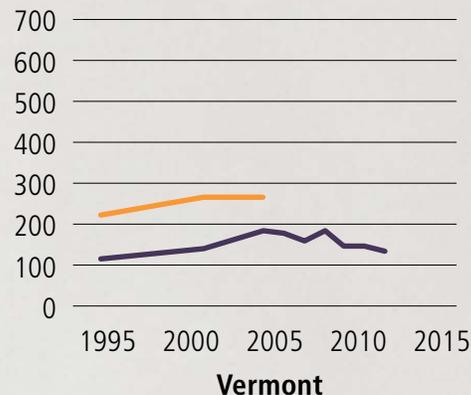
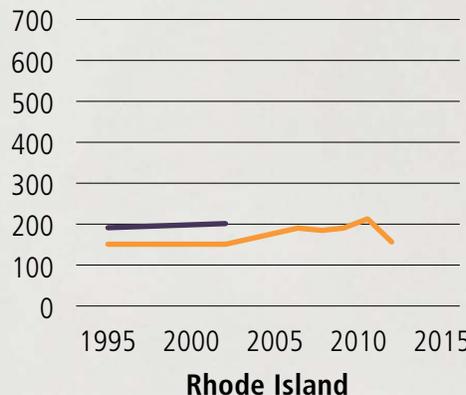
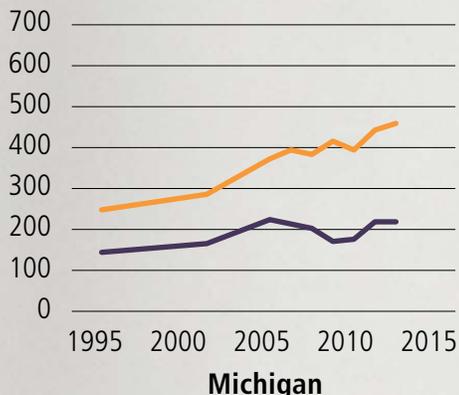
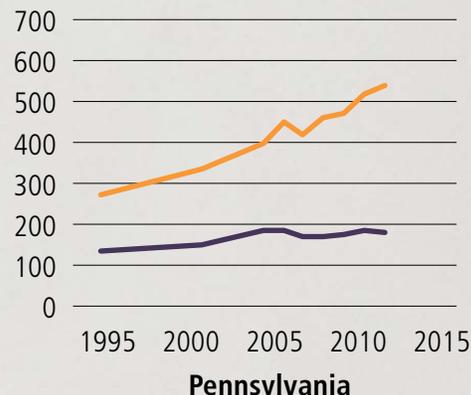
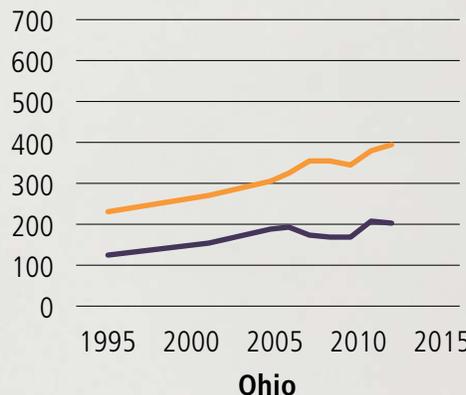
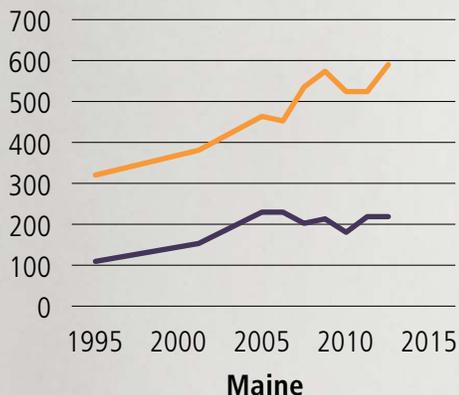
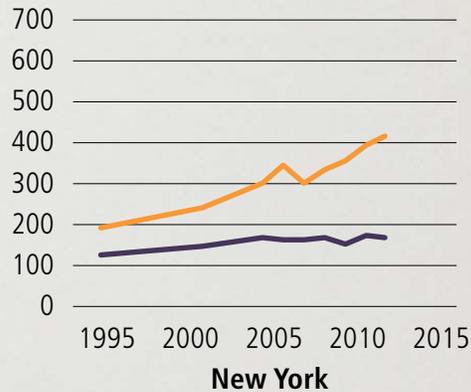
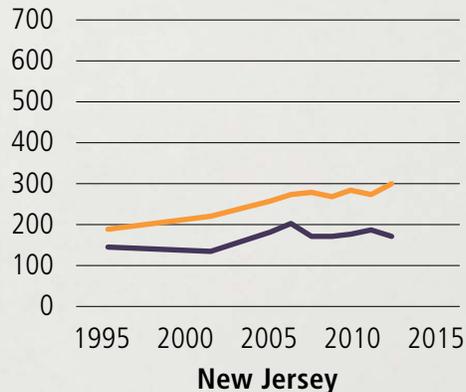
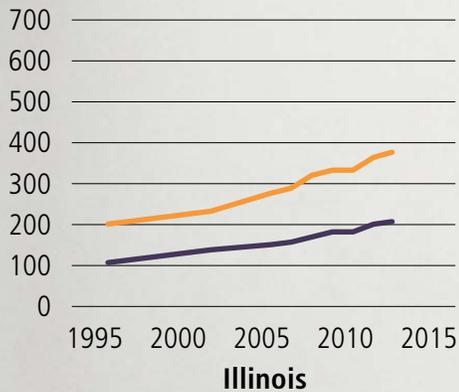
**PRODUCTIVITY**  
(thousand dollars per employee per year)

- Paper and paperboard manufacturing
- Wood products manufacturing

**FIGURE 8.10**

Employee productivity (defined as shipment value per employee) by States in the North, 1997 to 2011, forest products industry and the paper and paperboard industry (U.S. Census Bureau 2012).



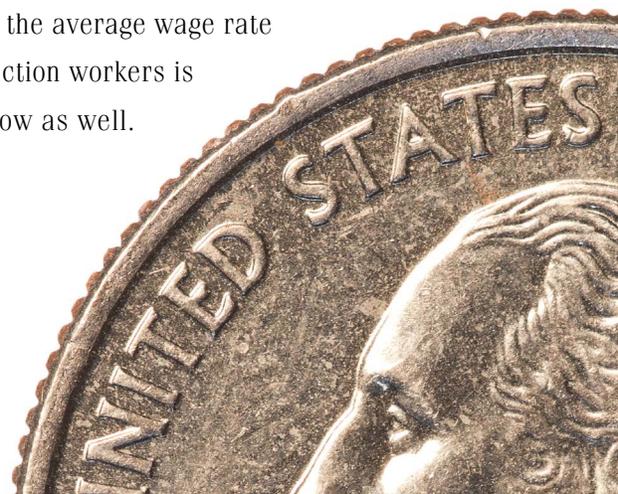


The historical trends of increasing productivity and declining employment in manufacturing industries, where a majority of forest-related jobs were created, implies that future forest-related employment will decrease if wood demand and removals follow historical trends in the North (e.g., under scenarios A1B-C, A2-C, and B2-C). However, if biomass energy demand grows rapidly (e.g., under scenarios A1B-BIO, A2-BIO, and B2-BIO), wood removal will be much greater (Chapter 4), and gains in employment in woody biomass energy production can help offset a potential decline in the manufacturing sectors (Woodall et al. 2012) or result in increasing forest-related employment in the future. With bioenergy-feedstock demands being increasingly sourced from urban areas, employment in urban forestry is expected to increase. Parks and recreation jobs will also increase over time should the current trend in this industry remain.

### *Income*

From 2001 to 2010, workers in the paper and paperboard industry earned on average \$45,000 annually (in 2001 dollar value), the highest wage rate among the six forest related industries; workers in wood furniture and forest products manufacturing earned the second highest annual wages (about \$30,000) and workers in other forest related industries earned <\$30,000.

Despite the recent economic recession, the average wages of forest related production workers in the North increased by 1 percent (in real dollars discounted by consumer price index) from 2001 to 2010 (Fig. 8.11). The average annual wage rate, weighted by total workers in 2010, increased by \$441 (in 2001 dollar value) in the same period. Although average nominal wage rates increased in five of the six job categories, the real value of the annual wage rate in the wood products category (NAICS 321) decreased by 4 percent from 2001 to 2010. In the same period, the real value of wage rates increased by 3 percent in paper and paperboard, 2 percent in wood furniture manufacturing, 5 percent in park and recreation services, 10 percent in forestry and logging, and 16 percent in hunting and trapping (Fig. 8.11). If the U.S. economy continues to grow as it did at the turn of the century, the average wage rate of forest production workers is expected to grow as well.



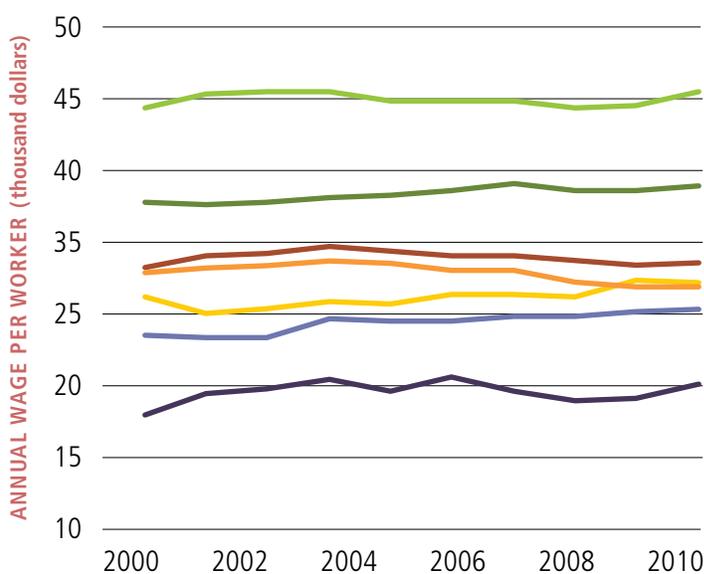


## OUTDOOR RECREATION

Most public forests in the North are open to all, meaning that 44 million acres or 26 percent of northern forest land is available for recreation. In recent decades the area of publically owned forests has increased slightly, and that component of forest-based recreation land appears relatively stable. Private forests in the hands of families or individuals—approximately 100 million acres in total—are used for recreation primarily by their owners. An estimated 18 million acres (18 percent) of those forests are open for public recreation. In addition, most forest-based U.S. skiing facilities are in the North, as are the majority of forest-based nature parks. Most northern forest-based recreation, sightseeing, and tourism businesses are concentrated in the Northeast and the Great Lakes States (USDA FS 2011).

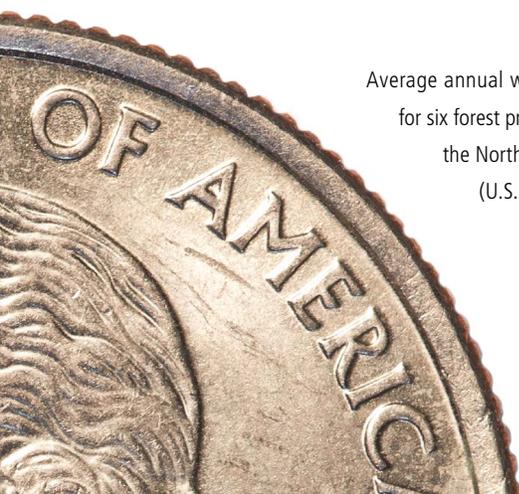
Cordell (2012) compared northern recreation trends and resources to those in other U.S. regions. That summary of participation rates and trends for 61 outdoor recreation activities describes the diversity of available recreation activities and participants, and it identifies activities in which participation rates have increased or decreased (Table 8.7).

Population demographics are expected to affect future participation in outdoor recreation. For example, the projected population increase from 2010 to 2060 in the North is expected to range from 15 to 50 million people (Chapter 2). This could result in a net increase in the total number of recreation participants, even for activities that are expected to experience constant or slightly decreasing participation rates. Increases in population would also reduce the area of potential recreation land and water per capita (Table 8.8). However, the per capita decreases in the North are expected to be lower than the national average because the rate of population increase will be lower.



**FIGURE 8.11**  
Average annual wage of workers in 2001 dollars for six forest production and service industries in the Northern United States, 2001 to 2010 (U.S. Department of Labor, Bureau of Labor Statistics 2012).

- Paper and paperboard (45%)
- Wood furniture (18%)
- Park and recreation (4%)
- Forest products (29%)
- Forestry and logging (2%)
- Hunting and trapping (<1%)
- U.S. all industries



**Table 8.7**—Rates of participation in nature-based activities by people aged ≥16 years in the Northern United States (adapted from Cordell et al. 2012).

Activity	Proportion of population participating, 2007 <sup>a</sup>	Change in total number of participants, 2000 <sup>b</sup> to 2007
	------(percent)-----	
<b>More than 30 million participants</b>		
Walking for pleasure	85	6
Attending family gatherings	75	7
Gardening or landscaping	67	3
Viewing or photographing natural scenery	64	12
Visiting an outdoor nature center or zoo	57	5
Picnicking	55	1
Viewing or photographing wildlife (other than birds and fish)	51	21
Viewing or photographing flowers or trees	51	23
Sightseeing	51	5
Driving for pleasure	50	4
Visiting beaches	45	15
Visiting historic sites	44	0
Swimming in lakes, ponds or streams	44	8
Swimming in outdoor pools	43	11
Bicycling	40	4
Viewing or photographing birds	38	18
Gathering mushrooms or berries	36	26
Visiting farm or agricultural settings	36	28
Day hiking	33	15
Visiting wilderness areas	31	11
<b>10 to 30 million participants</b>		
Viewing/photographing fish	25	13
Warm water fishing	25	17
Motor boating	24	5
Visiting watersides (besides beaches)	24	2
Sledding	21	5
Developed camping	21	-10
Mountain biking	20	-6
Participating in boat tours or excursions	19	-2
Visiting prehistoric sites	19	3
Off-road driving	18	25
Canoeing	12	8
Primitive camping	12	-3





**Table 8.8**—Per capita park, forest, and water area in the United States and the North with projections to 2060 (Cordell et. al 2012); projected declines in acreage per capita result from a combination of increasing population and decreasing forest area, particularly for private forest land.

Category of land or water	Estimate, 2008 <sup>a</sup>	Projected, 2060	Change from 2008 to 2060
	------(acres per capita)-----		(percent)
<b>Federal and state park land</b>			
North	0.16	0.13	-19
United States	2.06	1.40	-32
<b>Private forest land</b>			
North	1.19	0.88	-26
United States	1.27	0.80	-37
<b>Surface water<sup>b</sup></b>			
North	0.46	0.36	-22
United States	0.54	0.37	-31

<sup>a</sup>2010 for private forest land, 2008 for all other categories.

<sup>b</sup>Includes inland, coastal, territorial, and Great Lakes water surface area.

From 2000 to 2007, outdoor recreation participation increased for 48 activities and decreased for 13 activities in the North (Cordell 2012). Bowker and Askew (2013) modeled annual participation rates and participation days for 17 categories of recreation activities using data from 1999 to 2009. They then applied the models to project the number of participants and participation days for each activity from 2010 to 2060. The models take into account expected changes in socioeconomic factors such as population demographics, education, and income; as well as county-scale

recreation supply indicators such as per capita public land, forest, water, and mountain acreage. Projected recreation participation rates were indexed as increases or decreases compared to observed participation rates for 2008 (Fig. 8.12). Predicted changes in number of participants and participation days generally follow the trends plotted for the indexed per capita participation rates shown in Figure 8.12.



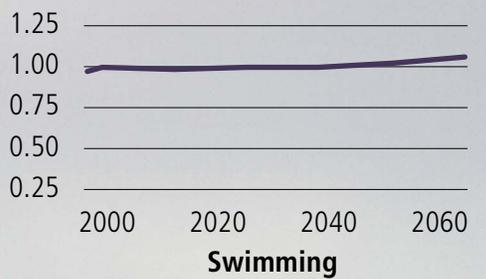
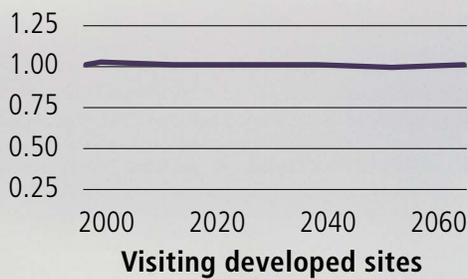
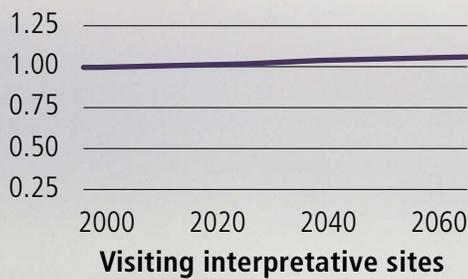
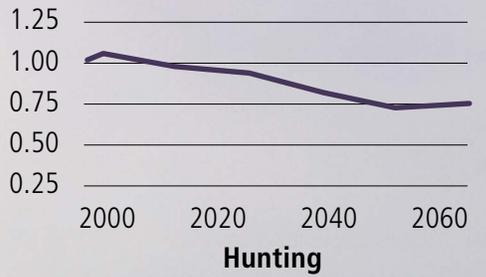
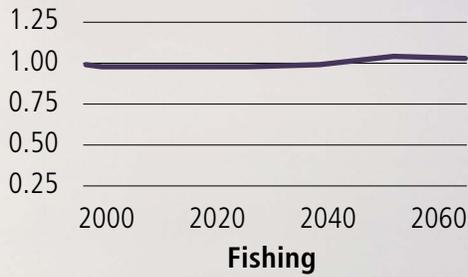
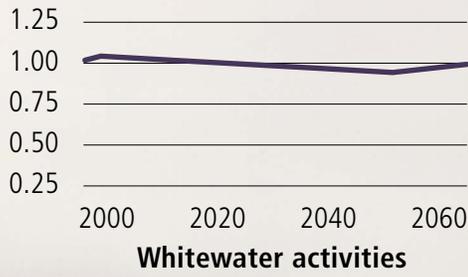
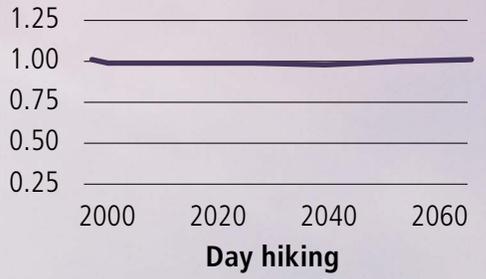
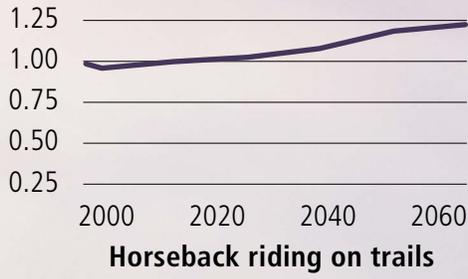
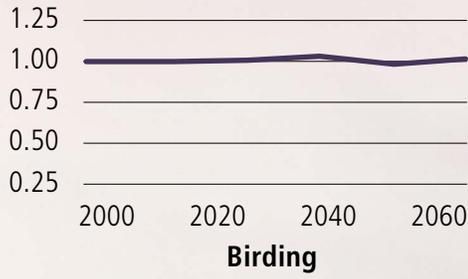


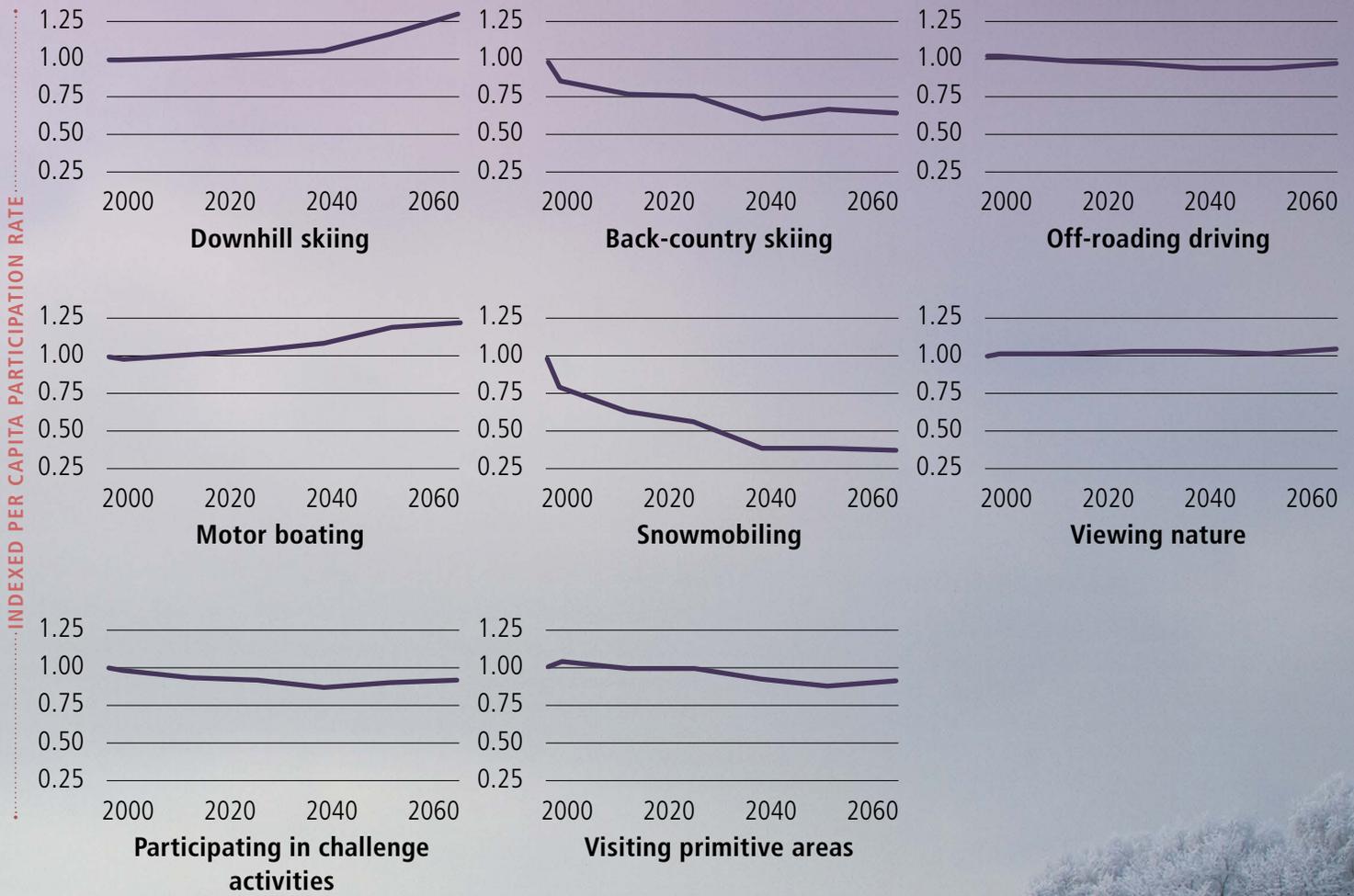
Future changes to forest ecosystems may impact outdoor recreation activities and local economies. An example is the expected change to the maple-beech-birch (*Acer* spp.-*Fagus* spp.-*Betula* spp.) forest-type group. Because sugar maples are valued for their brilliant autumn color, they are a key resource for the tourism and outdoor recreation industries at many northern locations. Projected decreases in the future area of the maple-beech-birch group are variable across the region (Chapter 3), but the projections do not specifically address gains or losses of sugar maple trees. Other analyses focused specifically on sugar maple indicate

that its range and relative abundance are likely to decrease across the region under a wide range of climate scenarios (Iverson et al. 2008, USDA FS 2014) with potentially negative consequences for recreation and tourism industries.



INDEXED PER CAPITA PARTICIPATION RATE





**FIGURE 8.12**

Change in per capita participation rates, 2008 to 2060, in the North for 17 categories of outdoor recreation activities under storyline A1B; a value of 1.0 was assigned to participation in 2008—values >1.0 indicate a relative increase and values <1.0 indicate a relative decrease (adapted from Bowker and Askew 2013).





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