

Criterion 2:

MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

Montréal Process Criterion 2 (Montréal Process Working Group 2010); Northern Area Forest Sustainability Indicators 5.1, 6.1, 6.2 (USDA FS 2010d)

The importance of the productive capacity of forest ecosystems

People rely on forests, directly and indirectly, for a wide range of goods and services.

Measures of forest productive capacity are indicators of the ability of forests to sustainably supply goods and services over time. An ongoing

emphasis on maintaining productive capacity of forests can help ensure that utilization of forest resources does not impair long term forest productivity, even though the goods and services expected from forests may change over time due to social, economic, or technological trends.

Changes in the productive capacity of forests can arise from natural causes such as forest aging and species succession or from disturbances by weather, insects, diseases, wildfires, or invasive plants. Human interventions such as forest management and land use changes also affect the productive capacity of forests. Changes in productive capacity may signal the need or the opportunity to modify policies, management practices, or products to ensure a sustainable flow of desired goods and services.

This criterion is focused primarily on the capacity to produce wood products. However, information on harvesting nontimber forest products is reported to the extent that it is available (see also Criterion 6)

Indicators of the productive capacity of northern forests

Forest land and timberland

Timberland is the subset of forest land that is suitable for wood production. Timberland excludes forest in parks, wilderness, and other protected areas where harvesting is prohibited by policy or legislation. It also excludes forest areas unsuitable for commercial wood production because they are unproductive or physically



Key Findings for Criterion 2

- The North has 172 million acres of forest land of which 95 percent is suitable for timber production.
- The region's timberland is 77 percent privately owned, but private ownership ranges from 46 percent in Minnesota to 96 percent in Maine.
- Regional wood growth has exceeded removals for at least five decades.
- Since 1953, standing volume has increased substantially in all 20 States.
- Only 3.5 percent (6 million acres) of northern forests are plantations.
- Pennsylvania, Michigan, New York, West Virginia, and Maine have the greatest total volume of timber among States in the North,—more than 20 billion cubic feet each.
- Massachusetts, Maryland, New Hampshire, Vermont, Connecticut, and West Virginia, have the highest average volume per acre of timberland—more than 1,900 cubic feet per acre, each.



Table 4—Timberland area and proportion by owner group for the Northern States, 2007, sorted from most to least forest land. Note that data have been standardized to an inventory year of 2007 and that newer State-specific data for some attributes are available from online sources (Miles 2010, Smith et al. 2009, USDA FS 2009b).

State and region	Forest land (1,000 acres)	Timberland (1,000 acres)	Timberland proportion of forest land (percent)	Private ownership (percent of timberland)	Public ownership (percent of timberland)	National Forest ownership ^a (percent of timberland)
Michigan	19,545	19,023	97	63	37	13
New York	18,669	16,015	86	89	11	0
Maine	17,673	17,163	97	96	4	0
Pennsylvania	16,577	16,019	97	73	27	3
Minnesota	16,391	15,112	92	46	54	12
Wisconsin	16,275	16,042	99	69	31	9
Missouri	15,078	14,674	97	83	17	10
West Virginia	12,007	11,797	98	88	12	8
Ohio	7,894	7,645	97	91	9	3
New Hampshire	4,850	4,674	96	77	23	13
Indiana	4,656	4,533	97	86	14	4
Vermont	4,618	4,482	97	86	14	6
Illinois	4,525	4,363	96	85	15	6
Massachusetts	3,171	2,946	93	72	28	0
Iowa	2,879	2,824	98	89	11	0
Maryland	2,566	2,372	92	82	18	0
New Jersey	2,132	1,877	88	69	31	0
Connecticut	1,794	1,732	97	77	23	0
Delaware	383	376	98	93	7	0
Rhode Island	356	351	99	85	15	0
North total	172,039	164,018	95	77	23	6
U.S. total	751,228	514,213	68	69	31	19

^aNational forest timberland is a subset of public timberland.

inaccessible. Of the 172 million acres of northern forest land, 95 percent (164 million acres) is classified as timberland, far larger than the U.S. average of 68 percent (Table 4). Most

timberland in the North is physically accessible and productive with relatively few tracts devoted to parks, wilderness, or other areas where harvesting is prohibited.



Overall, 77 percent of northern timberland is privately owned (Table 4), ranging from a low of 46 percent for Minnesota to a high of 96 percent for Maine (Fig. 17). Most private forest ownerships are small (Fig. 13), and most private owners do not consider wood production as their primary objective (Butler 2008).

Wood volume

The volume of standing wood on northern timberland exceeds 268 billion cubic feet (Table 5). Approximately 92 percent (248 billion cubic feet) of that total volume is classified as growing stock—comprised of species and tree characteristics (form, size, and number of defects) that are acceptable for commercial wood products. Growing stock volume in the North averages 1,500 cubic feet per acre compared to the U.S. average

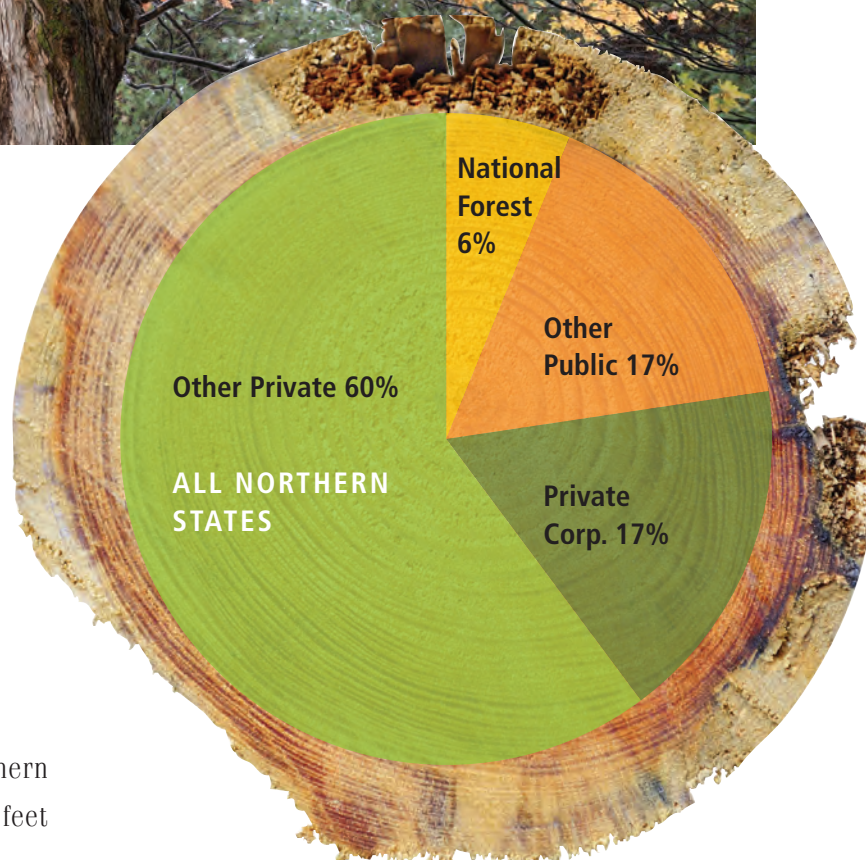


FIGURE 17

Proportion of timber land by owner group for all Northern States (this page) and by individual states (opposite page) ordered from lowest to highest proportion of all private timberland (Smith et al. 2009). Colors indicate the same owner category throughout all charts.

of 1,800 cubic feet. Among Northern States, growing-stock volume ranges from a low of 988 cubic feet per acre in Minnesota to slightly more than 2,200 cubic feet in Massachusetts.

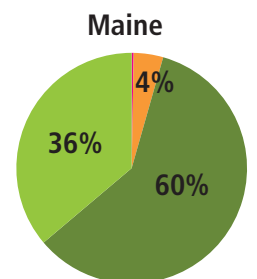
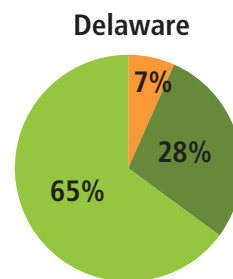
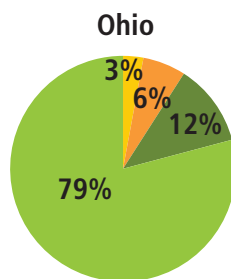
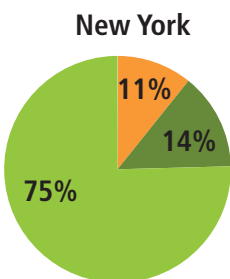
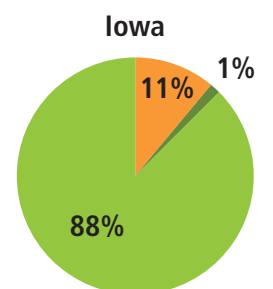
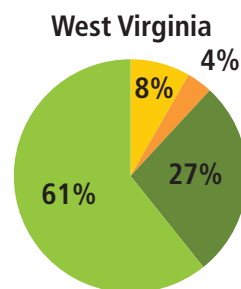
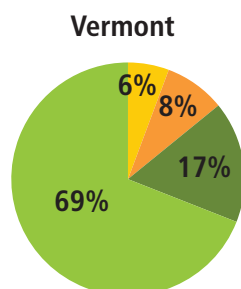
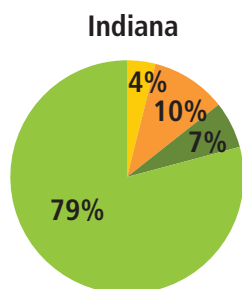
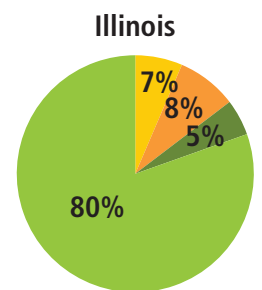
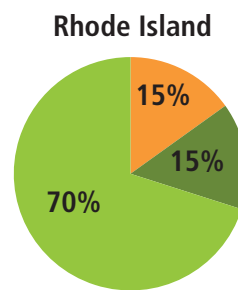
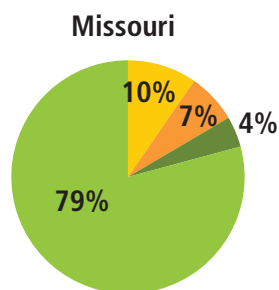
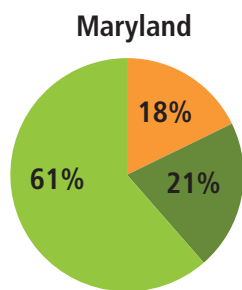
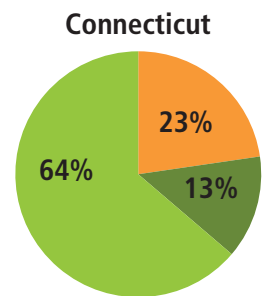
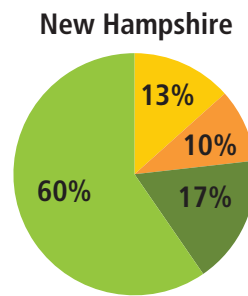
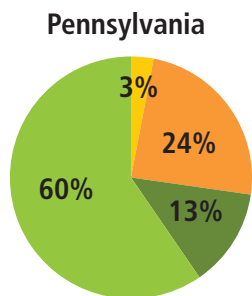
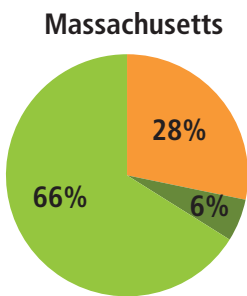
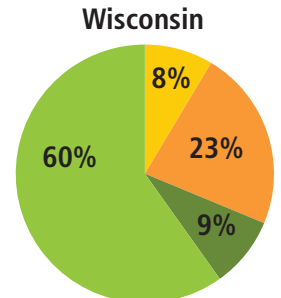
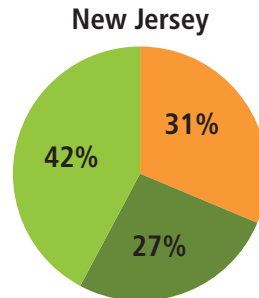
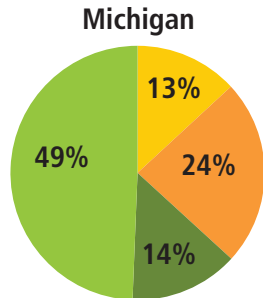
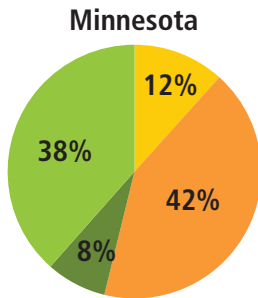


Table 5—Area of timberland and timber volume (2007) and growth and removals of growing stock (2007 or 2008) from timberland in the Northern States ordered from the largest to smallest ratio of growing stock growth to removals—a relative indicator of utilization pressure (Miles 2010, Smith et al. 2009).

State and Region	Total timberland area (1,000 acres)	Total volume (million cubic feet)	Cull or sound dead Proportion of total volume (percent)	Total growing-stock timber volume		Annual growth of growing stock		Annual removals of growing stock (million cubic feet)	Growth to removals ratio
				(million cubic feet)	(cubic feet per acre)	(million cubic feet)	(percent increase)		
Delaware	376	737	6	695	1,851	31	4.5	7	4.5
Rhode Island	351	663	4	637	1,814	19	3.0	4	4.4
Illinois	4,363	7,642	10	6,875	1,576	231	3.4	58	4.0
Indiana	4,533	9,098	9	8,281	1,827	318	3.8	80	4.0
New Jersey	1,877	2,968	5	2,819	1,503	95	3.4	29	3.3
Missouri	14,674	18,886	12	16,596	1,131	518	3.1	175	3.0
Maryland	2,372	5,254	3	5,092	2,147	178	3.5	67	2.6
Iowa	2,824	4,046	23	3,114	1,103	105	3.4	46	2.3
Massachusetts	2,946	6,978	6	6,530	2,216	144	2.2	62	2.3
Connecticut	1,732	3,501	5	3,312	1,913	89	2.7	41	2.2
Ohio	7,645	13,311	7	12,324	1,612	410	3.3	189	2.2
Michigan	19,023	30,418	8	28,029	1,473	703	2.5	339	2.1
New York	16,015	27,761	7	25,862	1,615	600	2.3	288	2.1
West Virginia	11,797	23,539	4	22,524	1,909	611	2.7	323	1.9
Pennsylvania	16,019	31,265	4	29,859	1,864	743	2.5	414	1.8
Wisconsin	16,042	22,268	9	20,271	1,264	598	3.0	327	1.8
Vermont	4,482	9,493	8	8,696	1,940	180	2.1	109	1.7
Minnesota	15,113	16,657	10	14,931	988	417	2.8	294	1.4
New Hampshire	4,674	9,880	7	9,156	1,959	164	1.8	150	1.1
Maine	17,163	23,935	6	22,402	1,305	573	2.6	562	1.0
North total	164,018	268,303	8	248,005	1,512	6,726	2.7	3,564	1.9
U.S. total	514,213	1,013,407	8	932,089	1,813	26,744	2.6	15,533	1.7

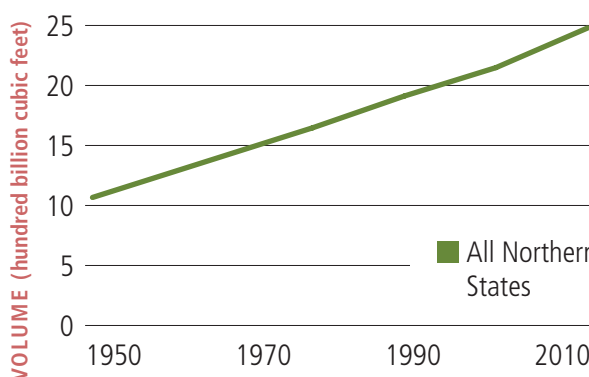
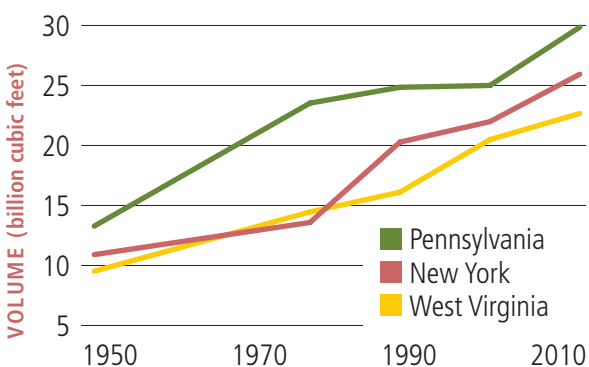
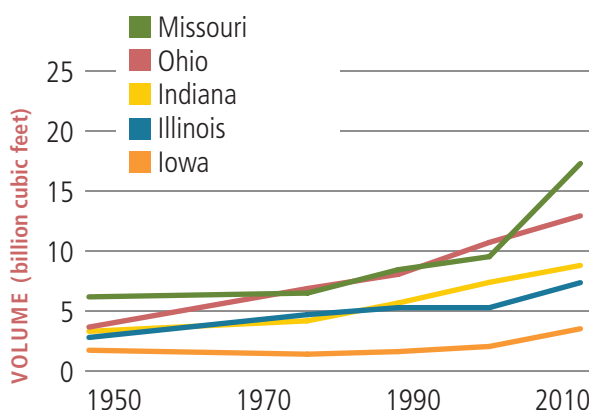
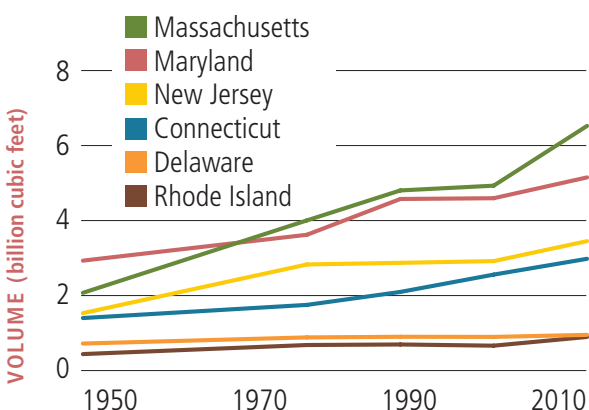
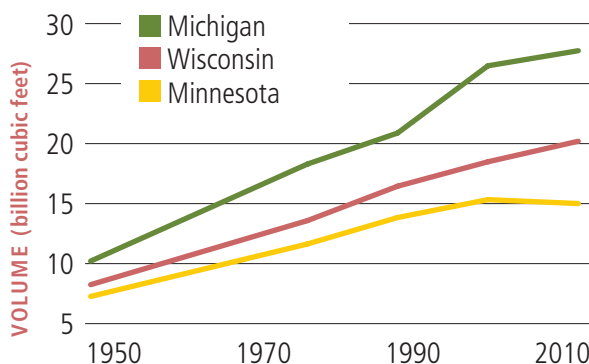
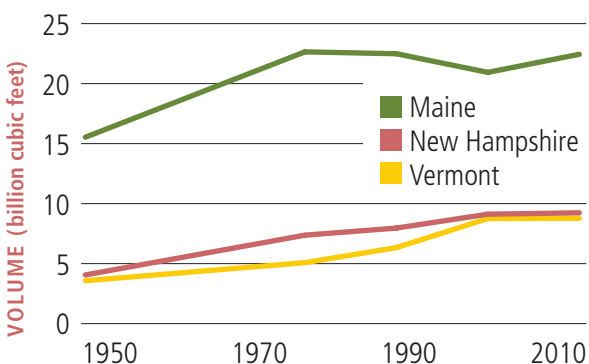


From 1953 to 2007 the volume of growing stock on timberland in the North more than doubled from 104 to 248 billion cubic feet (Fig. 18).

FIGURE 18

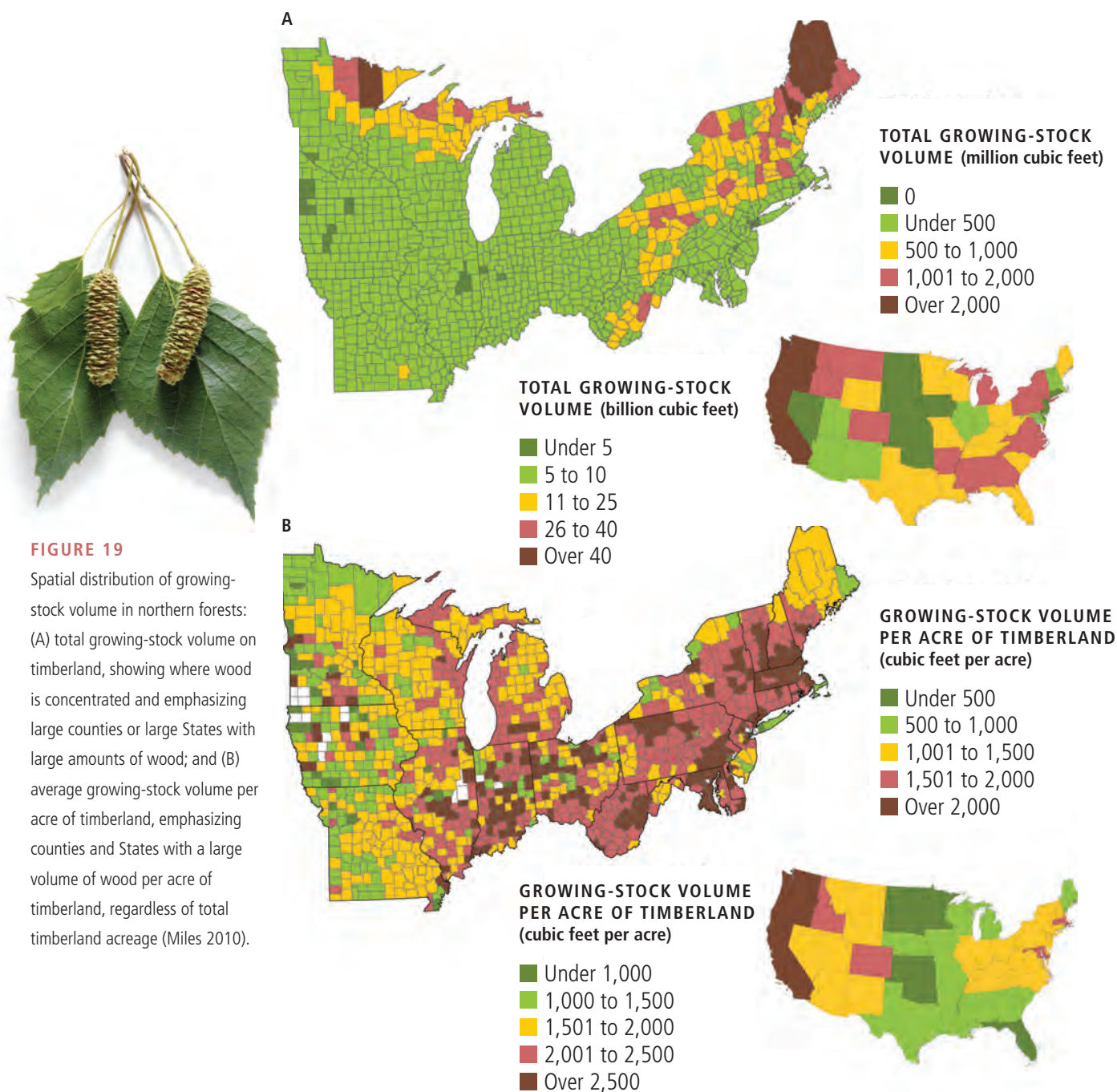
Growing-stock volume on timberland by Northern State, 1953 to 2007 (Smith et al. 2009).

All 20 states in the region showed substantial increases in volume over this period. Volume in Maine increased by 40 percent, the least proportion of any state; Rhode Island increased by 400 percent, and most states more than doubled standing volume (see Appendix Table A8).



The spatial distribution of total wood volume by county (Fig. 19A) mirrors the spatial distribution of forest cover (Fig. 1). However, wood volume per acre of timberland (Fig. 19B) gives a different perspective of the region's timber resources by emphasizing counties that

have high mean volume per acre of timberland, regardless of how many total timberland acres are in the county. Forests that are mature, healthy, and growing on productive sites have relatively high volume per acre.





Wood growth and removals

The annual volume growth rate of growing stock trees on northern timberland is 41 cubic feet per acre, well below the U.S. average of 52 cubic feet. Nevertheless, the annual growth of wood (growing stock) in the North exceeds removals by about 3.2 billion cubic feet (Table 5). The long-term trend of annual growth in excess of removals is the cause of the substantial volume increases in northern forest since the 1950s (Fig. 18).

The ratio of annual growth to removals is an indicator of the intensity of wood utilization. Removals estimates include wood removed during silvicultural operations as well as land clearing, with total removals including trees that were cut but unused as well as those used in products. A growth-to-removals ratio of 1.0 would indicate that wood is being removed as fast as it is growing. A ratio of less than 1.0 would indicate levels of harvesting and/or land conversion that are unsustainable over the long term because mean annual removals exceed mean annual growth. Across the North the current ratio of growth to removals is 1.9—each year growth is 1.9 times greater than removals (Table 5)—compared to a U.S. ratio of 1.7. Most Northern States have growth-to-removal ratios higher than 2; ratios are higher than 3 for Delaware, Rhode Island, Illinois, Indiana, and New Jersey. In States where management intensity and product utilization are relatively high—Maine, New Hampshire, and Minnesota—growth-to-removal ratios

are lower than 1.5. Compared to Maine and Minnesota, New Hampshire has experience more conversion of forest land to urban land (see Criterion 8: Urban and Community Forests).

Planted forests

Under the proper conditions, forest plantations can grow more wood per acre over a given period than naturally regenerated forests. Attention to site and species selection, planting stock quality, competition control, fertilization, thinning, and efficient utilization often contribute to high productivity per acre from planted forests. Although plantations usually have lower species diversity than native forests, they provide increased productivity per acre that can (at least theoretically) offset timber harvesting elsewhere. And when converting sites to forest from agricultural, mining, or other land uses, planting trees is often faster than natural succession for establishing a new, closed canopy forest.

Only 3.5 percent (6 million acres) of northern forests are plantations, compared to 21 percent in the South and 8 percent (63 million acres) for the entire United States. From 1993 to 2003, planting averaged about 142,000 acres per year in the North, equivalent to 6 percent of the total planted area per year in the United States (Smith et al. 2009).