



Forests in Flux

The Effects of Demographic Change on Forest Cover in New England and New York

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Summary

The New England states and New York are more than 50 percent forested, a rate well above the national average. Economies in this heavily forested region have historically relied on forest-based industries, and human population has clustered along coastal regions and major waterways, though recent trends suggest widespread in-migration to amenity-rich rural areas. Over the last decade, all states in this region have experienced notable declines in forest cover. In urban and suburban areas like southern New Hampshire, this loss of forest cover is likely related to increased demand for housing and services. It is also likely to be a permanent transition, since developed land rarely reverts to forest cover. Much of the forest cover loss in rural northern New England is due to commercial timber harvesting and is likely temporary, but in other portions of northern New England forest cover has declined consistently since 2001, and it is unclear whether this shift is the result of development or forest harvesting. These two types of forest cover change can have drastically different effects on the services local residents derive from forests. Because more developed regions have already lost much of their forest cover, a sustained loss of the remaining forestland has serious implications for vital ecosystem services like drinking water filtration, storm abatement, and air purification. This brief contributes to a better understanding of the linkages between demographic and forest cover change so as to inform policy efforts aimed at maintaining existing forested areas in and around sprawling urban centers.

KEY FINDINGS



Forest cover has declined throughout New England and New York over the last decade. In rural areas, forest loss is primarily due to commercial timber harvesting and represents a temporary change. In urban areas, the loss of forests to development is likely to be permanent.



Forest cover change is strongly linked to demographic variables throughout this region. Forest cover loss is most pronounced along the urban fringe, where population growth is greatest.



Amenity-rich rural areas are also experiencing high rates of population growth and regionally-high rates of forest cover loss. However, the causes of forest cover change in these areas are less certain.



Forest cover change has the potential to impact ecosystem services important to both local residents and the larger region.

Introduction

New England and New York form the most densely forested section of the United States.¹ Forests are a vital part of daily life for the region's residents, and also provide critically important ecosystem services. Many residents' cultural identity includes an aesthetic and spiritual attachment to the woods; the rugged and often remote forested environment imbues residents with a

sense of self-sufficiency, practicality, and a love of the outdoors.

These forested areas also drive the economies of New England and New York. The picturesque forested landscape draws tourists who enjoy hunting, fishing, skiing, hiking, bird watching, and viewing fall foliage. Forest-based recreation is a \$14 billion industry regionally and contributes an estimated \$1.12 billion annually to New Hampshire's economy.² Forests also provide timber and non-timber forest products—from lumber, furniture, and paper to birch bark and maple syrup—worth an estimated \$20 billion in revenue and contribute to the employment of more than 100,000 people.³ Forests also supply feedstock to the growing number of biomass energy production plants, which provide renewable heat and electricity at locations from Portsmouth, New Hampshire, to Niagara Falls, New York.⁴

Forests also provide critical ecosystem services that directly benefit local residents and indirectly contribute to the well-being of the large urban agglomerations further south.⁵ Some ecosystem services, like wilderness recreation or habitat for certain wide ranging wildlife species, require large blocks of undeveloped land and are not readily provided by suburban forests. Other services, like drinking water filtration and reduction of airborne pollutants can be derived from smaller patches of forest along the wildland-urban interface.⁶ In the latter case, the overall value of ecosystem services is in part a function of trees' proximity to human settlements, making suburban fringe forests potentially as valuable from a human perspective as pristine old-growth.⁷ Thus, depending on extent and regional context, alterations in forest cover can affect the health and well-being of local residents.

The majority of forests in New England and New York are privately held,⁸ with ownership ranging from industrial paper companies to amenity-seeking retirees. Landowner decisions impact both land cover and land use, which are defined slightly differently. Land cover refers to the complex of vegetation and human structures occupying the land surface, whereas land use incorporates the economic and social uses of land. Thus, recently harvested forestland that is quickly reoccupied by a mix of grass and tree seedlings is considered to have undergone a forest cover transition (from forest to grassland) but not a land use transition, since the land will quickly revert to forest cover and will support ecosystem services associated with forests.⁹ Conversely, forests converted to parking lots have undergone a change in both land cover and land use (that is, forest use to developed use).

Monitoring shifts in forest cover and determining their causes is important to protecting the region's natural resources.¹⁰ Both the amount of land cover transitioning to or from forest and changes in forest land use affect overall ecosystem function. For example, forest land converted to grassland

for pasture can still filter pollutants from drinking water and provide wildlife habitat, while a forest converted to a parking lot provides minimal ecosystem services.¹¹ Most land cover change is due to human land use decisions, so investigating land cover change requires attention to human variables. As we will demonstrate, demographic variables collected by the Census Bureau to measure housing density and population change can inform our understanding of forest cover changes throughout the region.

Forests in Flux

Total forest cover in the six New England states and New York diminished between 2001 and 2011 (Table 1).¹² The density of forest cover varies throughout New England and New York (Figure 1), and changes in density have been spatially uneven. This variability presents challenges to the region's forest stakeholders depending on their intended use of the land. Most changes in forest cover in the region are associated with either development or timber harvesting, the latter of which is detected in satellite imagery as a change from forest to shrub or grassland cover (Figure 2).

TABLE 1. FOREST COVER CHANGE, 2001–2011

	ACRES (1,000s)	PERCENT OF TOTAL LAND AREA	PERCENT OF 2001 FOREST COVER
Connecticut	-26	-0.9	-1.5
Massachusetts	-61	-1.2	-2.3
Maine	-117	-0.6	-0.8
New Hampshire	-111	-1.9	-2.5
New York	-103	-0.3	-0.6
Rhode Island	-6	-0.9	-2.0
Vermont	-35	-0.6	-0.8
Total	-459	-0.7	-1.0

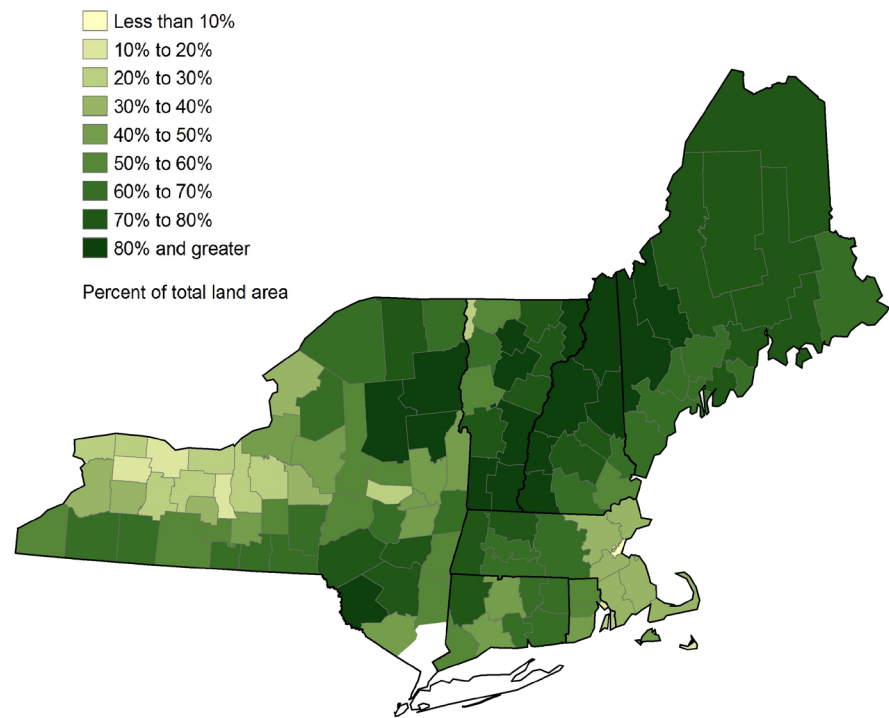
Low-density and large-lot housing are not always detected in the types of satellite imagery used for land cover mapping, but they are important in suburban and exurban portions of the region.¹³

Conversion to development includes any instance where trees are replaced with houses, roads, parking lots, or other permanent structures. Such transition in land cover occurs primarily on the periphery of previously developed urban areas (Figure 3), and is largely irreversible.¹⁴ Over the course of the last decade, urban centers in New England and New York have continued to expand, resulting in decreased forest cover in the surrounding suburban areas. In addition to the expansion of Boston and New York City metro areas, this pattern is evident on the urban periphery of Rochester, Buffalo, Albany, Hartford, Providence, Portland, and Manchester.

Rural areas in northern New England and New York have also experienced forest cover decrease over the last decade. Historically, these areas were heavily dependent on resource extraction and manufacturing and had limited human and economic capital to support expansion into other sectors.¹⁵ Though the prevalence of commercial timber harvesting has declined regionally, it is still widespread in rural New England and New York, and is a major driver of forest cover change (Figure 4).

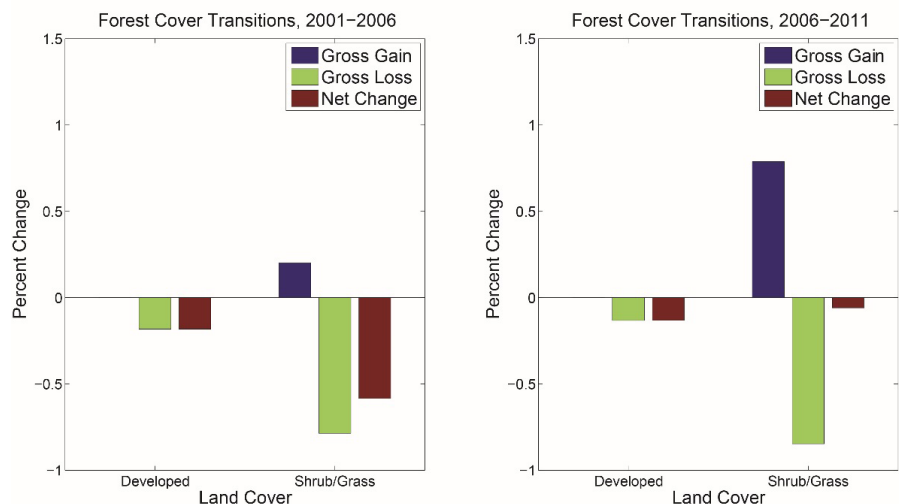
The effect of forest cover change on local residents, businesses, and the ecosystem is closely tied to the cause of the change. The forests of the Northeast generally regrow naturally. After a temporary shift to grass/shrub cover, harvested areas regenerate within a few years, a process often referred to as green-up.¹⁶

FIGURE 1. FOREST COVER AS A PERCENT OF TOTAL LAND COVER, BY COUNTY, 2006

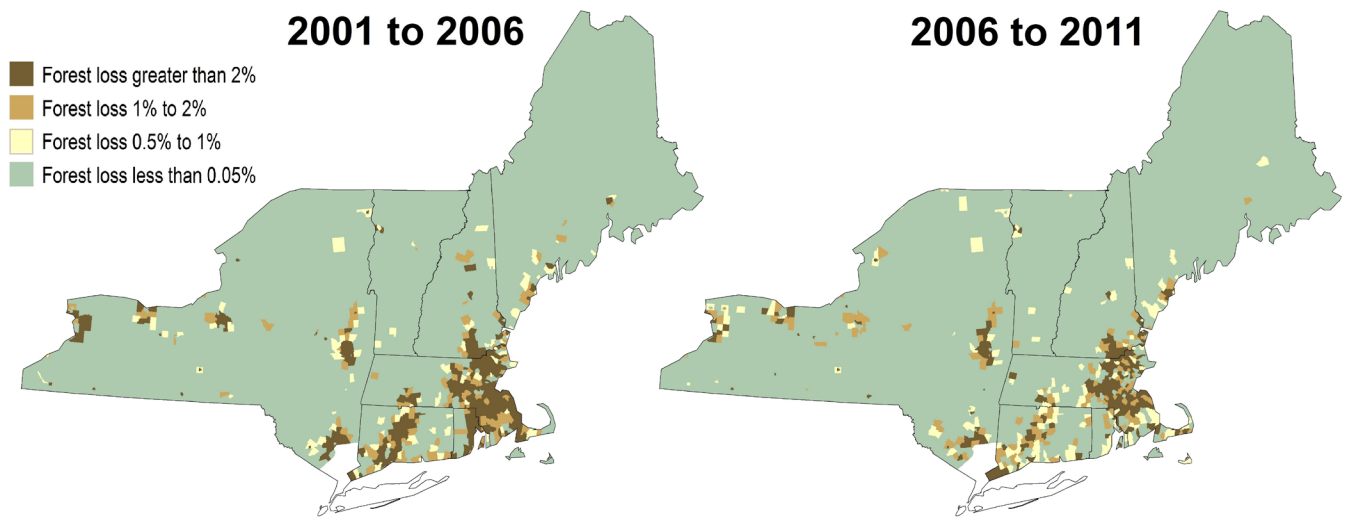


Source: Based on National Land Cover Dataset (Xian et al., 2009)

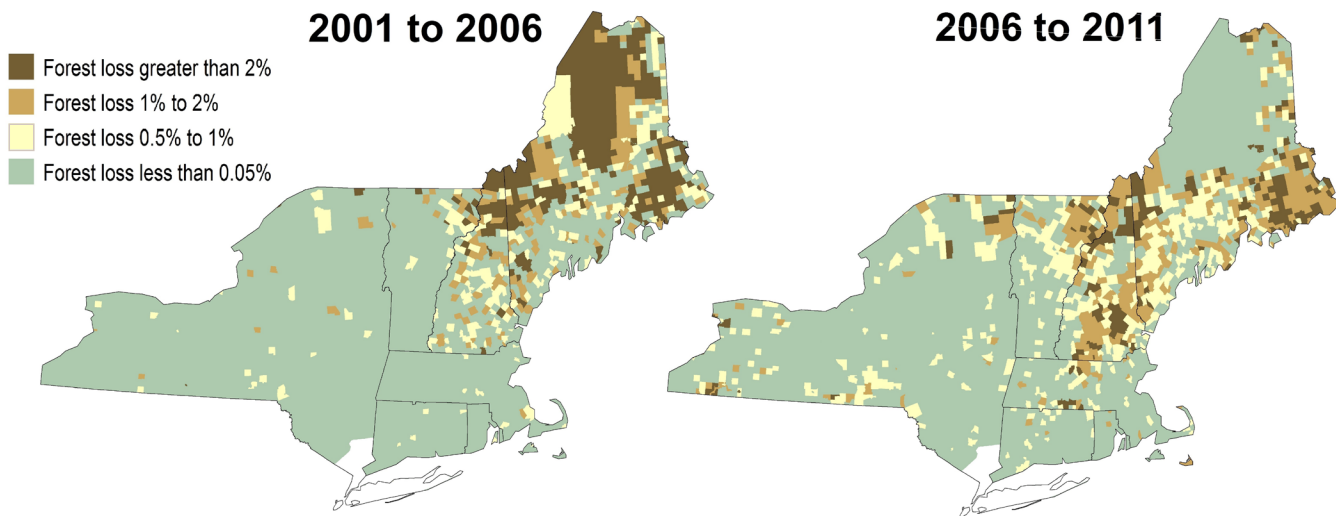
FIGURE 2. GROSS AND NET CONVERSION OF FORESTS TO DEVELOPED AND SHRUB/GRASS COVER TYPES, 2001–2006 AND 2006–2011



Source: Data from NLCD 2001, 2006, and 2011

FIGURE 3. NET CONVERSION OF FORESTS TO DEVELOPMENT, BY TOWN, 2001–2006 AND 2006–2011

Source: Based on National Land Cover Dataset (Jin et al., 2013)

FIGURE 4. NET CONVERSION OF FORESTS TO GRASS OR SHRUB COVER, BY TOWN, 2001–2006 AND 2006–2011

Source: Based on National Land Cover Dataset (Jin et al., 2013)

The maps in Figure 4 show that many of the areas with the highest forest-to-shrub conversion rates from 2001 to 2006 showed minimal conversion between 2006 and 2011. This trend is consistent with the early stages of forest regeneration and is exemplified by Somerset and Piscataquis counties in Maine, where green-up from industrial

logging resulted in forest cover actually increasing by more than 1.9 percent from 2001 to 2011.

In parts of central New England a large proportion of forest cover has recently been converted to grass and shrub lands, in a manner seemingly consistent with large-scale timber management. Yet industrial timber management is no longer prevalent

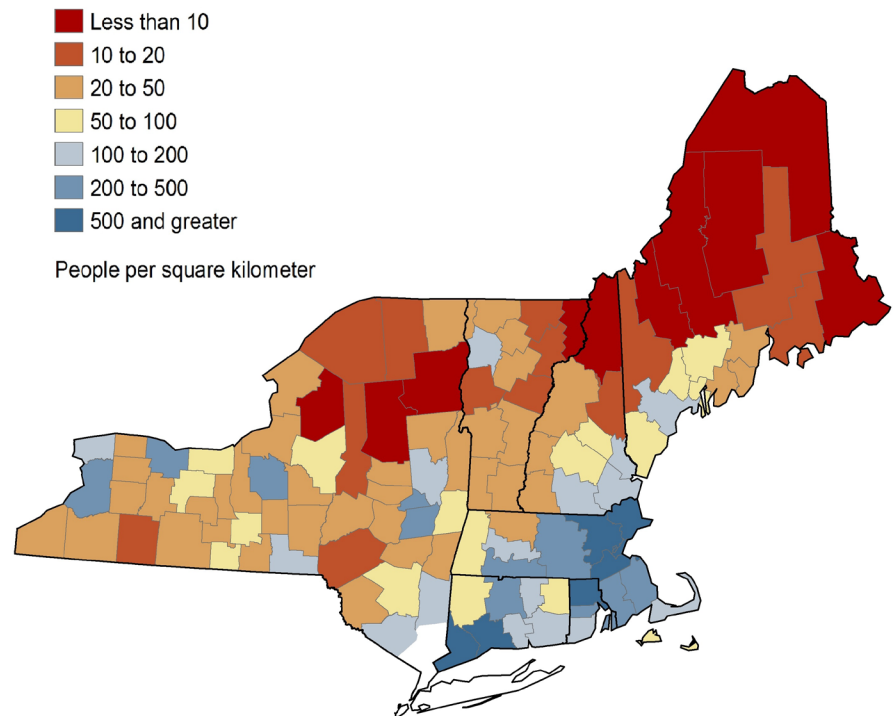
in these areas, and local ownership patterns don't resemble those typical of commercial forest harvesting.¹⁷ The cause of forest conversion in these areas is of considerable interest because the intended use of newly converted land has significant implications for the area's capacity to support ecosystem services in the future.

Population Trends in New England

Population density varies widely throughout New England and New York (Figure 5). Large, densely settled urban areas cluster along the coast and in the Erie Canal I-90 corridor.¹⁸ Population density declines in the interior of the region, particularly in the north. In many rural regions, the population has declined or grown at a very modest rate (Figure 6).¹⁹ Notable population declines are evident from Downeast Maine to upstate New York. In contrast, significant population gains are widespread in the region's urban and suburban areas. Some of the localized population losses are attributable to the declining economic viability of industrial manufacturing, including wood and paper processing.²⁰ Strong competition from the southern United States and a globalizing pulp and paper market has reduced the availability of jobs in rural New England and New York.²¹ Population growth has slowed in urban areas as well, though urban population losses have occurred only in a few older urban cores.

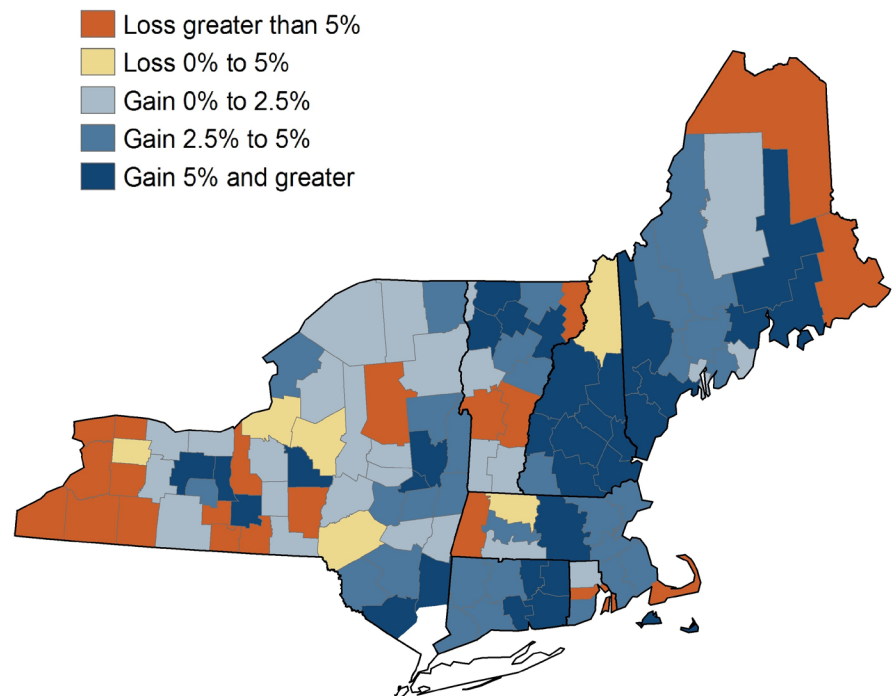
Clustered in northern New England and eastern New York is a group of counties designated by the USDA Economic Research Service as nonmetro recreation counties (hereafter recreation counties).²² Population growth in these recreation counties is consistently higher than in other nonmetro or metro counties throughout the United States, and is largely the result of in-migration.²³ In addition, these counties also have large and growing concentrations of second homes, often owned by those still in the labor force who plan to eventually move to the region permanently

FIGURE 5. POPULATION DENSITY, BY COUNTY, 2010



Source: U.S. Census, 2010

FIGURE 6. POPULATION CHANGE, BY COUNTY, 2000-2010



Source: U.S. Census, 2010

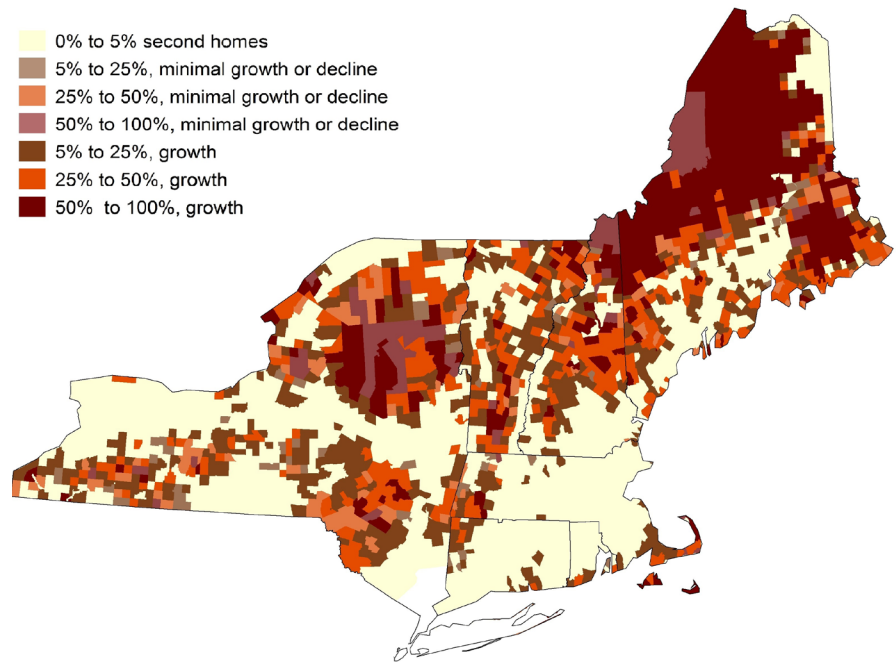
(Figure 7).²⁴ These so-called amenity migrants are attracted to areas rich in lakes, mountains, and scenic views, fueling population growth in the recreation counties of New England and New York. Figure 7 illustrates that the number of second homes is growing both in areas with relatively few second homes as well as in areas where a large percentage of all housing is already second homes. However, even as second-home gains have been widespread, they are far from universal in New England and New York. In part this reflects the conversion of a significant number of second homes to primary residences as owners retire.

Linking Demographic Change to Forest Cover Change

Several patterns stand out when comparing demographic and forest cover change in New England and New York. Most obvious is the forest cover converted to development on the peripheries of heavily populated urban areas, where population gains were highest. Population growth in sprawling suburban areas necessitates the construction of new homes, service locations, and infrastructure.²⁵ Suburban population growth is primarily driven by a trend toward living in developed areas, which has been underway for more than a century and is unlikely to reverse. Thus, forest cover loss to development is likely to continue in areas with high population densities (for example, > 100 people/km²).

Forest cover loss to development is far less likely in sparsely settled rural areas (for example, < 10 people/km²). Given these areas' low population density, expectations are for rural developments to

FIGURE 7. DENSITY AND CHANGE IN DENSITY OF SECOND HOMES, BY TOWN, 2000–2010



Source: U.S. Census, 2000 and 2010

expand slowly and population levels to grow at modest rates or, in some cases, decline. Decreasing populations, combined with aging in place and out-migration of working-age people as manufacturing and extractive industries continue to decline, diminishes the likelihood of forest cover being lost to development in these areas. When land is converted in rural areas, it is more likely to be a temporary land cover change caused by forest harvesting and less likely to negatively impact ecosystem services.²⁶

The exception to this pattern of population density and development is in areas rich in recreational and retirement activities. Concentrated in parts of central New England and New York, these areas have benefitted economically and socially from an influx of amenity migrants and occasional

or seasonal residents. There is some question whether these areas will continue to enjoy the influx of human, social, and economic capital provided by amenity migrants if large-scale, commercial timber harvesting were to alter forest cover in these areas.²⁷ Generally, the population density in recreation counties (about 10–100 people/km²) falls between that of urban areas (more than 100 people/km²) and non-recreation rural counties (fewer than 10 people/km²). Recreation counties are also growing faster than otherwise comparable non-recreation counties.²⁸ Furthermore, they have the highest density of second homes in the regions, and because second-home owners are not enumerated in the Census at their second homes, population density in recreation counties is underestimated at peak times of the year.

Research suggests that people migrating to recreation counties tend to be interested in land ownership for its aesthetic, cultural, and spiritual value, rather than for the economic value of natural resources like timber.²⁹ These owners tend to avoid actively managing their land, preferring to treat their property as a private retreat in the woods, a place to find peace and quiet and enjoy the outdoors.³⁰ Even for those interested in land management, many parcels in central New England and New York are too small to accommodate modern timber harvesting equipment,³¹ and it is doubtful that large tracts in this area are being harvested commercially.

Surprisingly, the 2011 National Land Cover Database (NLCD) shows forest to shrub conversion consistent with large-scale forest management in some recreation counties.³² However, this conversion may be an artifact of recent economic development rather than a change in timber harvesting trends. For example, consider Belknap County, New Hampshire, a designated recreation county. The NLCD data indicate that the proportion of total land area converted from forest to shrub cover in Belknap County jumped from 0.52 percent in 2001–2006 to 1.46 percent in 2006–2011. Over the same period, the proportion of forest cover converted to development remained essentially constant. Given the timing of this shift, it is possible that the economic impact of the Great Recession forced development projects to be postponed, allowing land cleared for new subdivisions or shopping centers near the end of the housing bubble to temporarily revert to grass and shrubs. If this increase in forest

to shrub conversion is the result of arrested development, much of the land converted to shrub cover near the end of the economic boom will likely be further converted to development as the economy continues to rebound.

Why Should We Care About Different Types of Forest Cover Change?

Forest cover provides a wealth of ecosystem services both to people living immediately adjacent to the forest and those more distant. The forest floor helps to cleanse drinking water of harmful pollutants and can help mitigate extreme flooding events.³³ Forest trees and soil provide long-term carbon sequestration that can contribute to larger efforts to combat global climate change.³⁴ Trees filter air, absorbing gaseous pollutants and helping to decrease the incidence of respiratory illnesses.³⁵ Forested landscapes also positively impact residents' quality of life, preserve biodiversity, and regulate natural disturbances.³⁶

Forest cover lost to development in and around urban areas can reduce the functionality of ecosystem services, with negative implications for local residents. While there are engineered solutions to address some of these shortages in ecosystem function (such as municipal water treatment plants replacing natural water filtration), these solutions are generally more expensive than maintaining healthy ecosystem function and may not remain viable options if populations continue to increase.³⁷ Other services, like the reduction in stress associated with greenspace, have no ready substitute if forest cover declines in developed areas. Thus, the most

severe consequences of sustained forest cover loss are likely to occur in urban areas, as these areas have the lowest proportion of forest cover and produce the largest strain on primary ecosystem services.

Maintaining forest cover and greenspace in developed areas, even in small blocks, helps preserve maximum ecosystem functionality for urban and suburban residents. Municipalities with the means to do so can permanently conserve land by purchasing it outright or by buying conservation easements that prevent any future development on the land while still allowing owners to use their land for other purposes. Where such methods are impractical, local governments can craft zoning laws with more strict acreage and road frontage requirements for new developments to increase the amount of greenspace retained on developed land.

The greater density of forest cover in rural counties reduces the risk of degraded ecosystem function. However, forest cover losses still have an effect. Many rural areas rely heavily on tourism and timber harvesting to drive their economies. While these two sectors have coexisted for generations, their continued mutual prosperity would require a renewed effort to foster a mutually beneficial and synergistic relationship. Forest management prescriptions and harvest operations have the potential to enhance rather than detract from scenic areas, and they can be designed so as not to degrade unique recreational opportunities.³⁸ Likewise, recreational organizations have the ability to help educate their members about the potential ecological benefits and economic utility of active timber management. As stated in the Nature Conservancy's Forest Operations Manual: "A healthy,

well-managed forest can provide economic benefits...and provide places of natural beauty for education, recreation, and pure enjoyment.”³⁹

Rural governments might consider encouraging economic diversification, since the availability of both timber- and recreation-based employment is likely to positively impact residents’ job prospects and well-being.⁴⁰ Unsustainable conversion of forests to shrub or grass cover or failure to allow sufficient time for green-up of adjacent tracts may have negative long-term implications for both the timber and recreation industries. In extreme cases, unchecked land conversion may also have the potential to reduce the region’s appeal to amenity migrants, diminishing the human, social, and economic capital they bring to the region.

Finally, the current trend toward reduction in forest cover has implications for carbon sequestration and global climate change.⁴¹ Where forest cover is converted to shrub cover there is a significant but temporary decrease in sequestered carbon followed by a steady, long-term increase as the forest regenerates.⁴² The net carbon flux depends heavily on the end use of the harvested wood.⁴³

For example, the effect of trees harvested and turned into furniture is very different from the effect of those burned to generate electricity. However, there are clear benefits when the intermediate shrub and grass cover stage is allowed to transition back to forest cover. In contrast, when forests and intermediate land uses are converted to development, there is little opportunity for future carbon sequestration.

Sustained forest cover loss will directly impact the provision of ecosystem services and thereby the quality of human lives. To preserve the benefits that forested landscapes provide to the people and institutions of the region, action is needed to maintain the health, diversity, and productivity of these forests.⁴⁴ However, the region’s growing population and its extensive working forests suggest it is unreasonable to expect a cessation in forest cover change. As we have noted, not all cover change has the same effect on forest health or the services people derive from forests. It is imperative to continue to monitor where forests are being converted, what they are being converted to, and what implications these changes are likely to have. In addition, careful planning by local and regional development agencies can better balance the decreased ecosystem function caused by permanent land use conversions with the benefits derived from working forests that have sustained the economic, social, and psychological health of the region for centuries.⁴⁵

Data

We used multiple sources of data for our investigation. All demographic analyses utilized data from the 2000 and 2010 decennial Censuses and from the Census Bureau Population Estimates program. Land cover data were acquired from the National Land Cover Database (NLCD). We utilized NLCD data from 2001, 2006, and 2011 for land cover estimation as well as land cover change assessments.

Definitions of Rural and Urban

Definitions of rural and urban vary among researchers and the sources of data they use. Here we have defined counties that are metropolitan as urban and those classified as nonmetropolitan as rural. The Office of Management and Budget defines a metropolitan area as: (1) a central county (or counties), containing at least one urbanized area with a population of at least 50,000 people, and (2) the counties that are socially and economically integrated with the urbanized area, as measured by commuting patterns.

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