LAND PRESERVATION AND Sustainability in America's Northeastern Northern Forest

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ABSTRACT

The Northern Forest remains one of the last intact, mostly private forests in the United States. Rural areas of Maine, New Hampshire, Vermont, and New York struggle to prosper in an economy driven by timber, eco-tourism, and a propensity for rural residential sprawl. This paper examines the correlation between preservation of the forest and sustainability characteristics. Specifically, counties with higher percentages of preserved land will exhibit a stronger positive correlation with economic, environmental, and social sustainability characteristics. Findings indicate surprising connections between land preservation and sustainability. Recommendations include additional research and planning measures to stem high levels of fragmentation and parcelization. Based on the limited federal protection, varied state systems, and growing role of land trusts, a regional planning initiative is proposed to prioritize future preservation efforts. *Keywords: environmental planning; natural resource management; regional planning; land preservation.*

Introduction

The Northeastern Northern Forest is America's first great forest, stretching 645 kilometers from Lake Ontario to the Atlantic Ocean. The area covers more than 10 million hectares, extending from New York's Tug Hill Plateau through the Adirondack Mountains and across Vermont, New Hampshire, and Maine (Governors' Task Force on the Northern Forest, 1990; Reidel, 1990). The Northern Forest Lands Study, published in 1990, identified locales with high levels of industrial forest (i.e. forests with processing mills) and marked the region as a priority area for protection. Unlike the 1990 designation, the Northern Forest in this paper encompasses all of the counties in Maine, New Hampshire, Vermont, and the New York counties which fall fully or partially within the Adirondack Blue Line. The Blue line encompasses 2.4 million hectares of private and public (44%) land and acts a proclamation boundary for the jurisdiction of the Adirondack Park Agency (APA) (Edmonson 2004).

The region's economy relies heavily on forestry, tourism, and outdoor recreation. While popular recreation areas exist, the Northern Forest is also a working landscape (Lapping 1982).

Over 75% of the land is privately owned, and forestry is the economic mainstay (Northern Forest Alliance 2006). Approximately a dozen multinational timber companies and investors own a majority of the land in the Northern Forest, more than 6 million hectares. An additional 1.6 million hectares are private non-industrial forest and are owned by private forest owners or farmers who do not own or operate wood processing facilities (Vlosky 2000).

Numerous internal and external forces have recently been causing a decline in the region's forest products industry. The loss of timber mills and jobs threatens the economic and social wellbeing of the region. For example, in Maine from 1974 to 2006, five forest products mills closed at a cost of thousands of jobs. Since 2000, more than 4,500 jobs have been eliminated in Maine's forest products industry (Scott 2005). Population growth, demand for second homes, regional timber competition, and international timber competition are all factors. Additionally, pro-growth and home-rule traditions in this area, frequently do not allow Maine to effectively manage land use planning (Boyle 2007).

As the forest becomes parcelized and fragmented through subdivision of properties and development, the wood products industry loses viability. The industry requires large expanses of undeveloped and uniform ownership to be efficient. Furthermore, land values rise along with conflicts from non-forestry landowners. This shift towards development of the rural countryside is evident across the region. Maine, for example, converted 352,000 hectares of rural fields and woodlots into suburbs (an area the size of Rhode Island) from 1980 to 2000 (Brookings 2006). In addition, four of the top fifteen national watersheds, which are projected to experience the greatest increase in housing density on private forestland, are in New Hampshire and Maine (Stein 2010). The social challenge is that people from outside of the region are the ones who are moving to and drastically changing this forested landscape.

It is therefore essential that land preservation, more specifically the purchase of development rights (conservation easements), be utilized as a tool for protecting the forested landscape of this region. In the United States there are bundles of rights associated with the purchase of a property; air rights, timber rights, mineral rights, development rights, etc. By purchasing development rights (PDR), NGOs or government agencies can perpetually ensure that there will be no development other than what already exists, on the property. With this conservation easement the holder of the easement can also monitor, and ensure a sustainable harvest plan that can have positive environmental outcomes. When the development rights are purchased, the land owner maintains fee simple ownership of the property. This allows the individual(s) to still own the land and existing structures on the property. In addition, they receive financial compensation for the development rights, and those rights then become extirpated or are held in perpetuity by a land trust or government agency. While it is a pay-for-environment approach, often the result is a reinvestment into the business and a multiplier effect for local related industry, continuing a cycle of working landscapes and sustainable forestry (Lind 2001)

Development rights could be purchased for historic viewsheds, agricultural land, recreational corridors, waterfronts, islands and other natural areas, as well as other working landscapes like forestry, ranching, and mining (Gustanski and Squires 2000). By utilizing land preservation, which offers permanence, a strong regulatory zoning mechanism, and other techniques (like urban growth boundaries and special farming/forestry districts) the formation of an effective

growth management plan is possible (Daniels and Lapping 2005; Daniels and Bowers 1997). In the Northern Forest, PDR has gained in popularity since 1990. It has proven to be the tool of choice for social acceptance, economic viability, and environmental planning (Levitt 2003). The conservation easement allows the timber industry to continue to operate according to a forest management plan, restores citizens' confidence in the local economy, generally provides for public access and outdoor recreation, and protects the land from residential or commercial development, in perpetuity.

This study has determined that in the Northern Forest, over four million hectares have been preserved to date. The majority of forestland preservation has taken place in the Adirondacks and in Maine – see figure 1. This land preservation fills the gap from a lack of protective low-density zoning, especially in Vermont and New Hampshire. The goal of forestland preservation is to support the local wood products and recreation industries, maintain ecosystem services, such as water recharge and wildlife habitat, and enable a degree of cultural independence in the Northern Forest. For instance, data from western states indicate that rural counties with greater than 10% of their land protected exhibit a 46% higher increase in jobs and a 27% increase in income than those without such protection (Daniels and Daniels 2003).

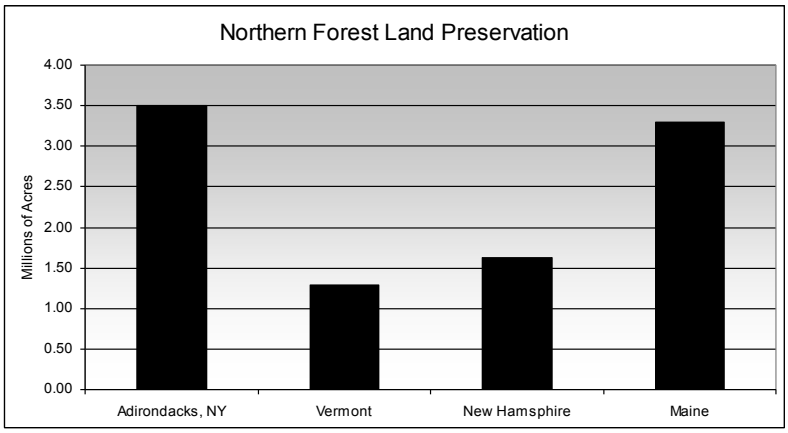


Figure 1. Northern Forest Land Preservation Comparative Graph, 2009.

Protecting the Northern Forest, in large intact parcels, can maintain and enhance a variety of positive ecosystem services. The most significant is the protection of major waterways. The headwaters of several major rivers originate in the region. These water bodies provide drinking water, recreation, aquifer recharge, and wildlife habitat. Significant river sources include the Hudson River in the Adirondacks; the Connecticut River in Northern New Hampshire; the Penobscot, Kennebec, and the St. John River in Maine. In addition, Lake Champlain, between Vermont and the New York, is an important water source for Canada's St. Lawrence River. Preserving large blocks of forestland can additionally protect the environment as trees filter pollutants out of the water, reduce temperatures, moderate flooding and erosion through absorption, and sequester carbon. Developing a large cohesive block of land preservation, or concentration area of preservation, as is possible in this region, can achieve the many environmental goals sought (Zonneveld 2007).

Testing for a Correlation between Forestland Preservation and Sustainability

Little research has been done linking land preservation and the triple bottom line of sustainability. This paper seeks to make a contribution by identify the correlation between all types of land preservation—working-forest, agricultural land, and passive recreation or wildlife habitat—with sustainability (triple bottom line factors for sustainability: environment, economy, and society). The hypothesis is that those counties with higher percentages of preserved land will exhibit a stronger correlation with economic, environmental, and social sustainability characteristics. If there is a strong correlation between land preservation and sustainability in the mostly private and rural landscape of the Northern Forest, policy recommendations can be developed to earmark efforts and funding for further preservation and long-term, nature-based growth across the entire region.

This study used geographic information system (GIS) techniques for data analysis of protected lands (Watkins 1997), and then a multiple linear regression with data from across 49 counties—an area of approximately 16.4 million hectares. This is considerably larger than the

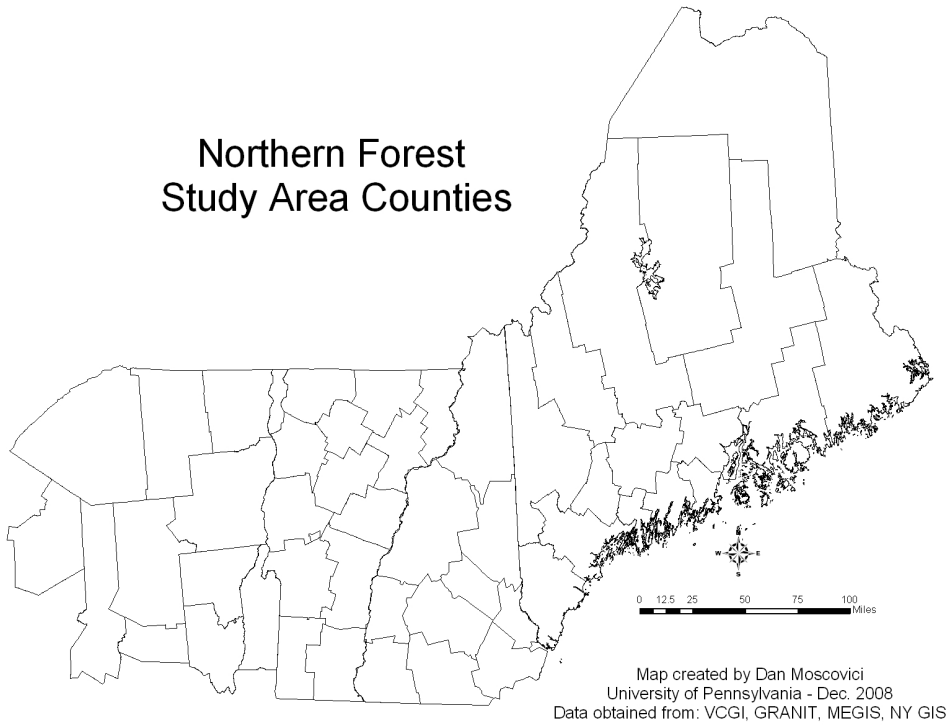


Figure 2. Northern Forest Study Area Counties Map

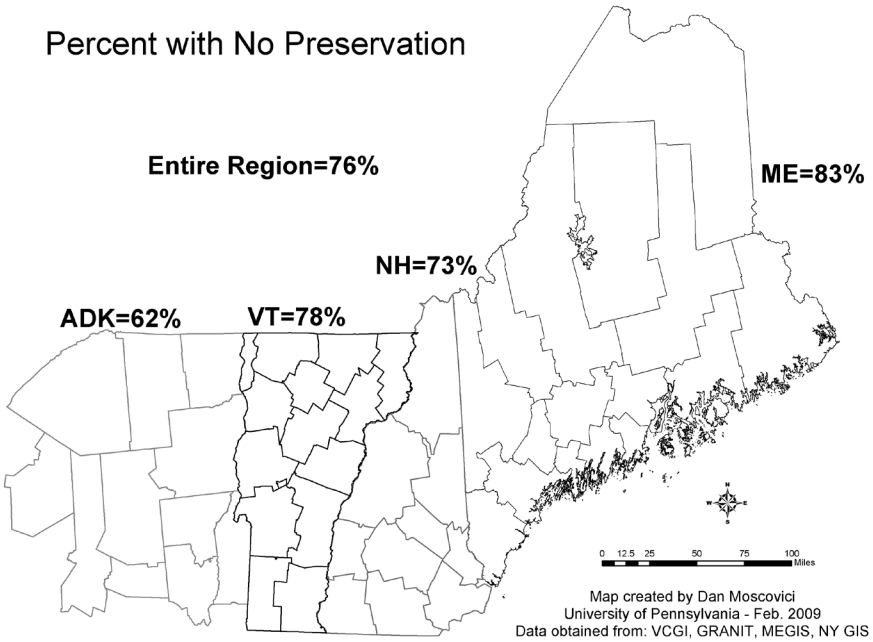


Figure 3. Percent of State or Region Lacking Preservation

original Northern Forest designation by the Governor's Task Force in 1990. While some counties are highly urbanized and others are mostly rural, all counties were selected to encourage a full regional view from all the states and stakeholders. These 49 include each county in Maine, New Hampshire, Vermont, and all of the counties that intersect with the Adirondack Park in New York. The Northern Forest in this study means these 49 counties in Figure 2.

Millions of acres have already been preserved through conservation easements, however 76% of this study area is still unprotected (see figure 3). While future funding is somewhat uncertain, particularly from the state and local governments, based on the historical involvement of the different governments, the motivation of the many non-profit organizations, and ongoing partnerships with the private sector, it is likely that forestland preservation will continue in all of these states.

Land Preservation & Northern Forest Status

Many agencies are involved in trying to conserve the Northern Forest, including the U.S. Forest Service, state agencies, and non-governmental organizations (NGOs), better known as land trusts. Large examples of this include the Pingree Forest Partnership (308,500 hectares) in

Maine, the Connecticut Lakes Headwaters Natural Area in New Hampshire (69,400), the Atlas and Champion lands in northeast Vermont (60,700) , and the Champion, International Paper, and Finch Pruyn lands in New York's Adirondacks (over 121,400 hectares). See table 2.

Federal Land

Total federal land ownership in the Northern Forest is small compared with much of the rest of the country. A mixture of national forests (Green Mountain National Forest and White Mountain National Forests), one major Department of the Interior national park (Acadia National Park), and a few fish and wildlife national wildlife refuges (Silvio O. Conte, Umbagog and Moosehorn National Wildlife Refuges) comprise the primary federal holdings (USFW 2008). In effect, the Northern Forest region is essentially a privately owned forest.

The White Mountains National Forest (310,737 hectares in New Hampshire & Maine) and The Green Mountain National Forest (131,526 hectares in Vermont) are managed by the U.S. Forest Service and operate under the principle of multiple-use sustained yield. They are managed for a range of uses, including outdoor recreation, range, timber, watershed, wildlife, and fishing (SPNF 2006; Public Law 86-517; Wilkinson 1987). Approximately half of these 450,000 hectares are managed as multiple use forests and approximately 16% are designation wilderness (Harper 1990). But this degree and definition of 'wild land' receives a great deal of debate and the value of the protection is often criticized (McMorran 2008).

Fee-simple purchases are no longer the sole choice for federal land preservation. As funds become scarce, pressure for development increases, and preservation measures become more and more urgent, the outright acquisition strategy has transitioned to purchasing conservation easements and developing partnerships. Funding is the new strategy. The Land and Water Conservation Fund (LWCF) exists to fund projects. The financing has ranged from $369 million in 1979, to four years of zero financing from 1996 to 1999. Funding from 2003 to 2008 was only $23 million (NPS 2008).

Another important funding opportunity, the Forest Legacy Program, has enabled the preservation of millions of hectares through the purchase of conservation easements. This program operates on a matching basis, so that a state must contribute at least 25 percent of the funding to receive federal funding. In 2010, almost one million hectares were preserved by the Forest Legacy Program (USDA 2010). From 2004 to 2008, funding ranged from $59 million to $62 million annually, and a majority of the funded projects were in the Northeast (U.S. Forest Service 2008).

State Land

Similarly, the states have taken a number of approaches to land preservation in the Northern Forest. These states balance the need for parkland and multiple-use management, while often bringing important revenue to the state. For example, total revenues coming to Maine through the state parks total $37 million for day use, $12 million for historic sites, and $8 million for

campgrounds. Taking the multiplier effect into account, park visitors generate $95.7 million in economic revenue for the state. This includes 1,449 jobs providing $31.1 million in personal income (Morris 2006).

Maine has really focused on conservation easements in the past decade. In 1995 they held development rights for 2,025 hectares and in 2009 over 242,000 hectares. The state has been able to successfully protect land using bond initiatives approved by the citizens of the state. Known as the Land for Maine's Future Program, the state has leveraged over $110 million in bonds; $35 million in 1987, $50 million in 1999 and $27 million on two bonds from 2005 and 2007, and an additional $9.75 million in 2010 (Land for Maine's Future 2010).

State	Coordinating Agency	Protected Hectares
Vermont	Agency of Natural Resources (ANR)	186,564
New Hampshire	Department of Resources and Economic Development (DRED)	81.551
Maine	Parks & Land Bureau	233,508 + 80,000 (Baxter State Park)
New York	Adirondack Park Agency + Department of Conservation (DEC)	1,052,205

Sources: (VGGI 2008; New Hampshire Division of Forests and Lands 2008; Maine Department of Conservation 2008; APA 2001)

Table 1. State Land

Furthermore, Baxter State Park is a unique example of protection. The more than 80,000 hectares that make up Baxter are held in trust by the state for the people of Maine. Former Governor Percival Baxter personally purchased all of this land and donated it along with restrictions and an endowment for management expenses. Baxter is the largest wilderness area throughout the states of Maine, New Hampshire and Vermont (Irland 1999).

The Adirondacks stands as the strongest state-level preservation system in the region. The devastation of New York's forested landscape in the late 1800s led to the passage of a critical law in 1894, which stated that the goal of the Adirondack Park and Preserve was to keep the Adirondacks region "forever wild." This includes 2.4 million hectares within the Adirondack blue line, 44% which is owned by the state (Edmonson 2004). The State of New York thus owns more public land than any government agency in the Northern Forest. Timber-harvesting is, however, forbidden on state lands; the state employs a preservation-for-recreation system, meaning the land has been preserved for recreation, water quality protection, and future generations. (APA 1999). It is the largest park and preserve in the lower 48 states (Klinkenborg 2011).

Additional protection measures have been achieved as each state offers forestland owner's tax incentives to encouraging timber harvesting and discourage development. Vermont and New Hampshire both have a Current Use Program/Law, in Maine it is called the Maine Tree Growth Tax Law, New York's DEC manages the Forest Tax Law, and New Hampshire (Bureau of Taxation 1993; DEC 2005; Smith 2004; VT Division of Forestry 2005). While this keeps millions of acres from development, it is not in perpetuity and tax penalties might not outweigh the benefits from development.

Vermont, Maine and New York are actively seeking both forest preservation and the continuation of a forest products industry. Purchasing conservation easements seems to be the new state government strategy. Partnering with non-profit organizations and timber companies can benefit the state economy and the local citizens. The NGO has therefore become an important stakeholder and funding source in the region.

Private Sector/NGOs

A growing non-profit community has facilitated the transition away from fee-simple acquisitions toward the purchase, bargain sale, and donation of conservation easements in hopes of eliminating the drawbacks associated with fee-simple. The non-profits have the ability to raise funds, create unique land deals, and transfer their titles to states for perpetual protection. The sheer growth in land trusts is indicative of a trend away from federal land ownership towards private partnerships. From 1980 to 2000, there was a 300% growth in the number of land trusts across the nation, from 431 to 1,263 (McQueen 2003). These conservation groups frequently maximize their dollars by purchasing development rights.

Non-governmental organizations have engineered some major deals in the Northern Forest (OSI 2008; TPL 2008; Northern Forest Alliance 2006; Fairfax 2005; SPNHF 2005; TNC 2005; Pataki 2004; Levitt 2003; OSI 2003; NH F&G 2003; VT Land Trust 1997). Some of the largest are highlighted in Table 2.

State	Project Name	Hectares	Finances	Players
Maine	Pingree Partnership	308,500	$30 million	TPL, TNC, US F&W, OSI, SPNHF, USDA Forest Legacy
Vermont	NE Kingdom – Champion Deal	69,400	$26.5 million	VLT, VT Housing & Conservation Board, Conservation Fund, Hancock Timber, US F& W, VT FPR, Freeman Foundation, Mellon Foundation
New Hampshire	CT lakes Headwaters	69,400	$32.7 million	TPL, SPNHF, Lyme Timber, State of NH, Forest Legacy, US F&W
Adirondacks	Sable Highlands	42,000	$24.9 million	Conservation Fund, TNC, NY State, Lyme Timber

Table 2. Largest Preservation Deals by State

The NGO community is frequently the intermediary. Their quick transactions, often transferred to the state, allow the NGOs to replenish their funds for the next big land sale or conservation easement opportunity. The only criticism is that these lands are being preserved

in a reactive manner responding to urban growth, and do not address the planning for sensitive ecosystems that may need urgent protection (RPA 2011). There is however a few organizations which are proactively attempting to ensure a working landscape and rural character in the region (Vermont Working Landscape Council 2011). Overall, preserving almost one million hectares in just over ten years is a very significant accomplishment on the part of the land trusts and a major step towards conservation integration in the region.

Conservation integration is successfully working. However, is preservation having a positive effect? Or is the Northern Forest accepting all the funding it can (a majority coming from NGOs outside the region) for reactive purchases of the next big parcel or easement in hopes of combating sprawl and taking over the lands of failing timber companies? It could also be that the priority of land trusts is not in line with the government policies and plans already in place, creating further conflicting planning paradigms.

Research Model

This model is built on the assumption that a region is in an ideal balance when the environment, economy, and society are sustainable. This model also assumes that forestry and recreation-based economies practice sound ecological methods, bolster local economies through jobs and output, and also encourage vibrant and healthy communities. Forestland preservation may be the key in moving counties in the Northern Forest toward greater sustainability. It is hypothesized that those counties with higher percentages of preserved land will exhibit a stronger positive correlation with characteristics of economic, environmental, and social sustainability.

The model to test the hypothesis begins with percentage of land preserved in a county as the dependent variable and the three measures of sustainability as the independent variables. An analysis of related theory, a literature review, and available data helped to determine the 15 independent variables used in the model. The premise is that by using several sustainability factors, correlations can be established between certain independent sustainability variables and land preservation. The breakdown is as follows:

% of all Land in Preservation = f (Triple Bottom Line (Environment + Economy + Society))

Environment = mean elevation + predominant forest type + total timberland + non-forested areas + (Preservation or Conservation)
Economy = median household income + median home value + sawlog and pulpwood harvest output + number of building permits
Society = population change 1990-2010 + persons over 65 years + college education + state + public land + percent poverty
N=49

Category	Variable	Name	Mean	Min	Max	Source
Dependent	Percent of Land Preservation per county area - 2009	%PRES	20.8	1.5	83.6	4
Economy - Independent	Median county household income - 2009 ($)	HSHLD_INC	47,083	31,861	70,196	1
	Median county home value - 2009 ($)	HM_VL	170,777	76,800	313,400	1
	Sawlog and pulpwood harvest output per county area - 2005 (mbf/acres)	TMB_HVST	7.51%	1.18%	22.86%	2
	Building permits in county 1990 - 2007	BLD_PMT	5,470	413	24,243	1
Environment - Independent	Mean county elevation (ft)	ELEV	935	112	1,986	4
	Predominant Forest Type (categorical - 0=33% hardwood, 1=33% softwood, 2=33% soft & hardwood)	FST_TYPE	0*	0	2	3
	Total timberland per county area †	TMBLD	71.72%	14.03%	95.03%	3
	Total forestland per county area †	FSTLND	78.35%	14.03%	97.36%	3
	Non forested areas per county area †	NON_FST	20.98%	1.97%	93.79%	3
	Percent of recreational land preservation per county area - 2009	REC_LSP	8.61%	0.41%	68.99%	4
	Percent of working landscape preserved per county area - 2009	WRK_LSP	12.07%	0.12%	37.06%	4
Society - Independent	Population change 1990 - 2010 (persons)	POP_2010	14,539	(15,066)	203,138	1
	Persons over 65 years per county area - 2010	SNR_65	2.22%	0.10%	8.32%	1
	Persons with bachelor's degree per county area - 2009	COLL	1.96%	0.05%	10.60%	1
	Which state - Maine, New Hampshire, Vermont or New York (categorical - 0=VT,1=NH,2=NY,3=ME)	STATE	3*	0	3	4
	Public land per county area †	PUB_LND	8.04%	0.00%	33.43%	3
	Persons below poverty line per county area - 2009	PCT_PVTY	12.09%	4.59%	20.35%	1

1 - US Census Bureau
2 - State Forest Service Agencies
3 - USDA Forest Service Forest Inventory and Analysis Division (FIA)
4 - GIS Calculations - this study

† = Data compiled in different years from USDA FIA Mapmaker & FIA Forest Statistic Manuals

* = mode

Table 3. List of Variables and Ranges of Input Values for Each Model.

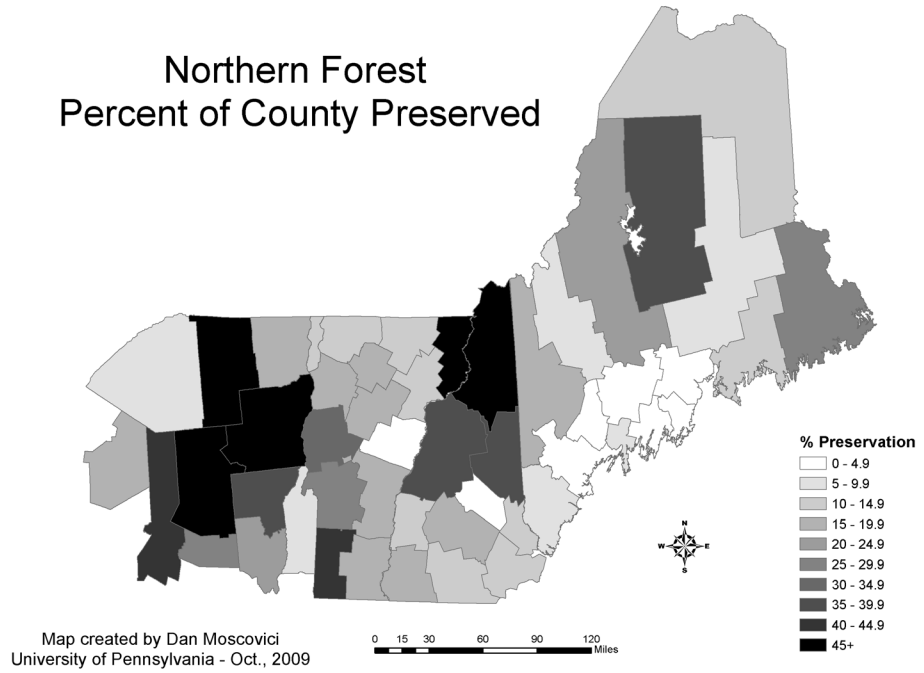


Figure 4. Northern Forest Percent of County Preserved.

Data

Dependent Variable

The model uses county-level data with a sample size of 49 counties spanning the states of Maine (14), New Hampshire (10), Vermont (14) and the Adirondack counties of New York (11) indicated in the map. Table 3 includes data sources and simple statistics for all the data used in the analysis.

The percent of land preservation (%PRES) by county has been selected as the dependent variable. This variable includes all land preservation in a county, including federal, state, local government and land trusts – both fee simple and conservation easements, compiled from a variety of state and NGO sources (Cheeseman 2008; Morrell 2008; APA 2001; Mcfaden 2006; Sundquist 2006; NH GRANIT 2008; VCGI 2008; Denis 2008; MEGIS 2008; Berry 2008; DeWolf 2008). However, to break out parcels by county, a GIS analysis was necessary which determined the land in each county preserved. The percentage was then calculated using land area statistics from the US Census Bureau. See figure 4.

Data for for Economic, Environmental & Social Variables

The first three variables for economic activity are median household income, median home value, and building permits. Each of these datasets was obtained from the US Census Bureau (US Census Bureau 2010; US Census Bureau 2010a). The fourth, amount of sawlog and pulpwood harvest output was acquired from individual state agencies (VT Division of Forestry 2008; Maine Forest Service 2008; Tansey 2006).

The environmental factors include county elevation (ELEV), which was calculated using a GIS zonal statistic calculation from the DEM layers (VCGI 2006; MEGIS 2006; NH GRANIT, 2006; APA 2001).

The second variable, primary forest type (FST_TYPE), in the entire county has been complied into categorical variables. Using the U.S. Forest Service FIA books by state, hardwood and softwood data were compiled to determine respective totals (McWilliams 2004; Frieswyk 2000; Frieswyk 2000a; Alerich 1995).

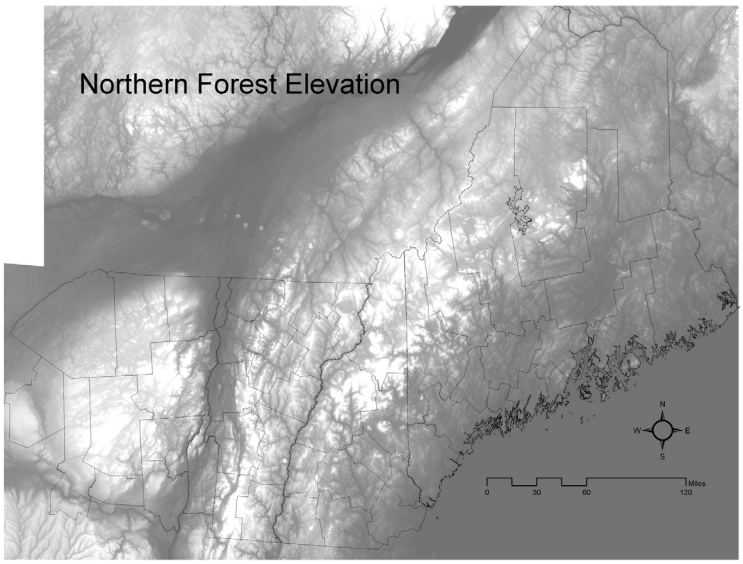
No existing research was available for a specific breakdown for this data; therefore a 33% threshold was used. Three categories represent with hardwood at greater than 33% of its timberland only, more than 33% of the county exhibited softwood timberland only, and counties that demonstrate greater than 33% for both hardwood and softwood—indicating a mixed hardwood/softwood forest.

Another environmental variable is total timberland (TMBLD), defined as "forestland producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre [.4 ha] per year) and not withdrawn from timber use" (Frieswyk 2000). The timberland data, as well as the variable for non-forested areas (NON_FST) was obtained from the US Forest Service's statistics books, the FIA Mapmaker or directly from department analysts (Frieswyk 2000; Frieswyk 2000a; FIA Mapmaker 2008; Alerich 1995; FIA Mapmaker 2008b; McWilliams 2004). The final environmental variable relates to the type of land preservation (WRK_LSP).

TABLE 4 - Significant Statistical Results

Variable	Category	Unstandardized Beta	Standardized Beta	Significance P-value	95% Confidence Interval Lower Bound	Upper Bound
Non Forest Areas	Env	-0.699	-0.606	<0.001	-0.987	-0.412
Mean Elevation	Env	9.281	0..283	0.011	0.000	0.000
Total Timberland per county	Env	-0.731	-0.721	<0.001	-0.947	-0.515
Bachelor's Degrees/ha - 2009	Soc	4.641	0.690	0.013	1.013	8.269
Persons over 65/ha – 2010	Soc	-6.971	-0.847	0.005	-11.673	-2.269

Table 4. Significant Statistical Results



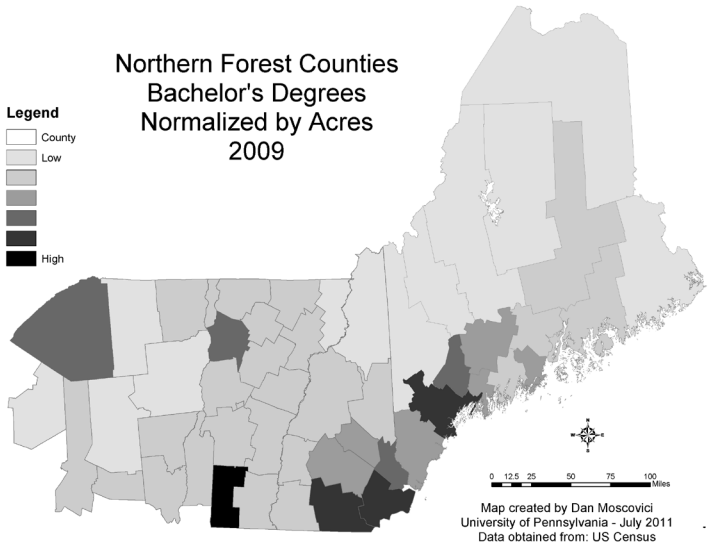
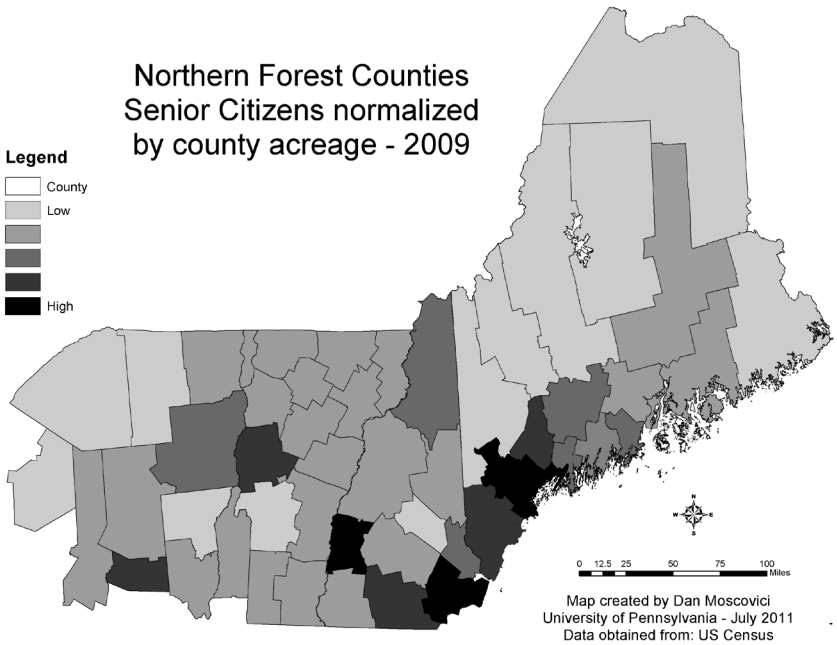
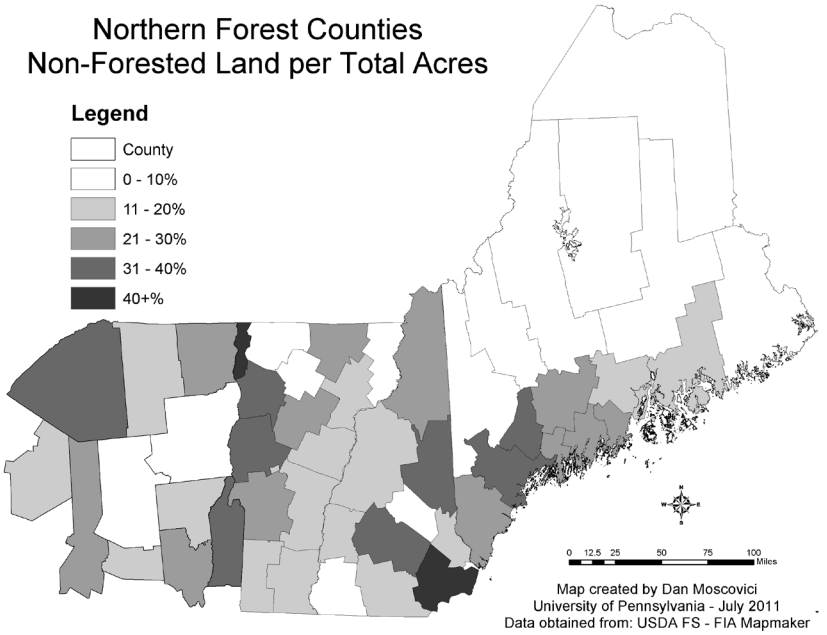


Figure 5. Geographic Representation of the Variables with Positive Correlation.





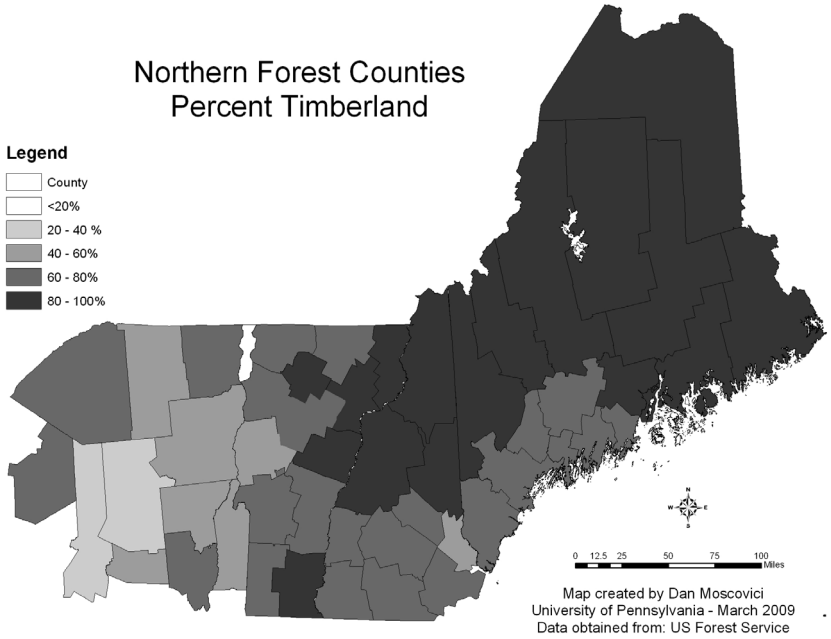


Figure 6. Geographic Representation of the Variables with Negative Correlation

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Among the different land preservation types are those set aside for recreational purposes or for wildlife protection. For example, the wilderness areas of the Adirondacks, Baxter State Park, and national wildlife refuges. These areas do not allow and will not permit timber harvesting of any kind, unless it occurs from a permitted salvage situation. The other type of land preservation protects parcels from subdivision and development, involves monitoring for and performing sustainable harvests with limited environmental impacts, and often includes recreational opportunities or additional riparian protection.

All of the preserved parcels, 24,709 GIS line items, were re-coded, intersected using a GIS analysis, recalculated geometry, and summarized. This figure was then divided by land area for consistency.

Societal well-being represents the final triple-bottom line sustainability goal. Land preservation is not merely an environmental or economic endeavor; it seeks to conserve forests for the benefit of the community. The five variables that were considered for the social portion of the analysis are as follows: county population; population over 65; population over 25 with college degree; the state geography; and the percentage of public land.

Population data (POP_2010) is the absolute population change from 1990 to 2010 (US Census 2010d). To test for the effect of age, education, and poverty, (SNR_65) (measured by persons over 65 years normalized by county land area), (COLL) education-level trends (mea-

sured by persons with a bachelor's degree normalized by land area), and poverty (PCT_PVTY) (measured by the percent of poverty) (US Census 2010b; US Census 2010c).

The effects of public land on land preservation (PUB_LND), was also included. The data sources include the UDSA Forest Service's FIA Forest Statistic Manuals and the FIA Mapmaker tools. In addition, the dataset is normalized by county hectares for comparable purposes (FIA Mapmaker 2008; FIA Mapmaker 2008a, FIA Mapmaker 2008b; McWilliams 2003; Frieswyk 2000; Frieswyk 2000a; Alerich 1995).

Finally, there are a variety of differences among the states across the region. Factoring state's forestry laws and growth management practices, and other initiatives inform the need for this state category (STATE). Therefore, a categorical variable helps distinguish between New York, Vermont, New Hampshire, and Maine.

Variations of data analysis

Understanding the correlations of individual and combined sustainability factors with land preservation (%PRES) may be useful for future preservation strategies. It is important to note that there are some overlapping effects of particular variables, which could result in some levels of multicollinearity, such as housing units and population. To deal with this problem, certain variables were removed from the final model based on their overall lack of statistical significance compared to their related variable, in order to develop the most accurate model.

Results

Many of the variables in the model exhibited insignificant outcomes. Table 3 indicates that five variables are correlated with the percent of land preservation in each county. These variables had a combined R-square of .754, indicating that mean elevation, total timberland, non-forested areas, college graduates, and populations 65 or older explain 75% of the variation in land preservation per county. All other variables were either removed due to multi-collinearity or their results exhibited no statistical significance.

Positive Correlation

Two variables exhibited a positive correlation with the percent of land preservation per county: college degrees and mean county elevation. The level of residents with a bachelor's degree in 2009 per hectare increases as population levels increase. Overall, this result was predicted. This finding could indicate two things, even though the findings do not indicate causation. First, educated people have a willingness to move towards areas with high levels of protection. Or, second, in areas with good levels of education there is a push to protecting the county.

The other variable to exhibit a significant positive correlation is mean county elevation. The positive correlation results again match the original supposition. There could be three reasons for this relationship. The first is that growth management techniques are encouraging land pres-

ervation and that, in combination, the laws and easements are having positive effects. Vermont's Act 250, the Adirondack Planning Agency's regulatory framework, and zoning in the LURC area are restricting development at high altitudes. Secondly, in Maine and New Hampshire, much of the development is along the coastline, with most of the preservation located at greater heights above sea level. These areas of high elevation—the White & Green Mountain National Forests, the Adirondack peaks, and Baxter State Park—are often the first to be preserved for recreation. Finally, high elevations are often not suitable for development, as steep slopes and rocky outcrops inhibit infrastructure requirements.

Negative Correlation

Eleven Three significant, yet negative, correlations also resulted from the model: population over 65; non-forested areas; and total timberland.

Contrary to the hypothesis, the percent of the population over 65 has a negative correlation with percent of county preserved. This suggests that, as the percent of seniors 65 or older decreases, there will be higher percentage levels of preservation. A quick spatial representation shows that the majority of seniors per county land area are congregated in the more urban areas and less in the rural regions.

Therefore, it seems incorrect to assert that the older populations are necessarily interested in maintaining forests in their natural state, for generations to come, while younger folks are interested in subdivision. In fact, seniors might have little, if any, preservation goals at all. Often time the elderly do not want to pay for land preservation within their communities because they are on a fixed income and increased taxes could jeopardize their monthly payments. However, for seniors owning land, they could be encouraged to sell and subdivide their land for retirement or their heirs (Stein 2010). In addition, it is possible that the preservation easement is still too new of an idea for the elderly population.

Another negatively correlated variable, non-forested areas, decreases statistically as land preservation increases, this matched the original hypothesis. Preservation in the region is typically in very rural areas and non forested territories could be considered a proxy for urbanization. Industrial forestland and recreational preserves tend to be far from urbanization. The third negatively correlated, significant relationship was between timberland and land preservation. The original hypothesis assumed that much of the preservation efforts in the region were geared towards the working landscape, and therefore more timberland would lead to higher levels of preservation. Interestingly, the average percentage of county land preserved for the working landscape (12.1%) is greater than county preservation for recreation or wildlife (8.6%) across the region. While this data seems to contradict the results of this analysis, the averages could be biased due to regional differences. Across the four states, there are six counties with greater than 25% of their land preserved for the working landscape.[1] However, only four counties have recreation or wildlife preservation over 25%, each of which is in New York.[2] In addition, Vermont could cause a disturbance in the overall analysis since the state actively protects farmland.

While fifteen variables were originally chosen to test correlation between the triple-bottom line and preservation in the Northern Forest, at the end of the analysis only five remained

statistically significant. However, with an R-square of 75%, the overall model was successful in explaining the statistical variation in the dependent variable.

From among the significant correlations, almost half of the predictions were correct. Increasing education levels, decreased non-forested areas, and higher elevations are all associated with higher percentages of county preservation. On the other hand, the remaining half of the significant variables resulted in very surprising outcomes. Smaller elderly populations and lower levels of timberland indicated higher levels of county preservation. These overall results can enhance the conversations surrounding land preservation, growth management, and environmental planning, and lend themselves to a variety of theoretical and practical conclusions, and future research applications.

Conclusion

The purpose of this study has been to evaluate if there is a link between land preservation and a sustainable future, one which embraces environmental, economic, and social prosperity, and not determine causation. From the process, a variety of interesting observations and conclusions can be added to the fields of growth management, environmental, and regional planning. They help develop transferability and opportunities for future policy implementation and research.

Preservation could in theory continue until all the land is purchased fee simple or development rights are acquired – however at what cost? A great sum of money is required for these initiatives and the funding is no longer plentiful from the state or federal coffers. Rather, much of the new money is coming from outside the Northern Forest. The many non-profits funding these projects, (e.g. The Nature Conservancy and the Open Space Institute) are having significant impacts on the forest landscape. They create fast, flexible, and creative deals which are becoming the primary mechanisms for landscape scale preservation. There is however, a risk in overdependence on NGOs. Funding could stop if preservation priorities become more immediate in other parts of the nation or world. In addition, competing priorities exist as land trusts often undertake their work in a manner that is largely uncoordinated with public agencies, efforts and plans.

Conservation priorities should focus on the large contiguous land areas that remain undeveloped. These have the greatest ability to cleanse water for drinking and reduce downstream runoff and flooding. Wildlife thrives in larger areas in which confrontations with people are limited. Recreational opportunities are greatest when hikers and canoers cannot see cities and areas of development. A productive and sustainable forest products economy can only survive if it can operate on large parcels, where there are no conflicts with homeowners.

A new planning paradigm might be suggested to combat the parcelization, fragmentation and decrease in the forestry and recreation industries in the region. . Embracing a common history, mutual economic interests, and many of the same conflicts and pressures, New Hampshire, Maine, Vermont and the Adirondack counties of New York could use a new regional inter-state plan. While populations are increasing in southern New Hampshire and along Lake Champlain in Vermont, and decreasing in the Adirondack interior and northern Maine, a regional plan-

ning structure for the entire 16.4 million hectares could benefit and balance the entire Northern Forest. Even with high levels of forestland throughout the entire region, preservation levels have been haphazard on a per county basis. By developing a regional growth management plan, informed by data and overall preservation priorities, there will be less competition between states and counties for economic growth and conservation funding. A regional viewpoint could induce a balancing of recreation and timber resources, as well as promote a vibrant rural lifestyle.

Future Research

This study is part of a continuing dialogue regarding the benefits, relationships, and priorities for forestland preservation in the Northern Forest. A refinement of statistical detail, the integration of more specific data, and the transferability of these findings to other areas represent ideas for future research.

Analyzing preservation efforts within the Northern Forest from a large cartographic perspective has served as an important first step towards understanding the different players within the region. However, a next phase could dissect the data into two completely different research agendas. The first would look specifically at industrial forestland and conservation easements, in order to understand the impact this type of preservation has on businesses, the environment, and the social wellbeing of the region. The second would focus exclusively on recreation management and wildlife preservation. Moving beyond questions of regional planning, this type of research could answer important questions for both tourism and forestry academics and professionals.

Two additional questions arose from this study. The first asks, "What is the impact of preservation over time?" The date of when the land was preserved has been loosely or inaccurately compiled, if at all, over the years by the agencies which have protected the properties. The second additional question asks, "What is the effect of preservation on parcelization?" Currently, the preservation data is organized so that many of the larger parcels are broken into subgroups. Researching and combining each of these parcels would generate data related to the effect of average parcel size on the triple-bottom line indicators. Finding the associated prices paid would also add a very important dataset.

Finally, the Northern Forest was chosen based on its large percentage of private land, and its recent increases in population and land sales. However, land trusts and government agencies are working to protect forestland across the United States. The methodology for the study of land preservation, presented within this analysis, is highly transferable to other forested regions. While regional differences will exist, the evaluation of land preservation for sustainability in rural areas with timberland is of utmost importance across the entire country.

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Notes

1. Working Landscape Preservation over 25% of county: Franklin, NY (26%); Essex, VT (34%); Coos, NH (37%); Grafton, NH (30%); Washington, ME (25%); Piscataquis, ME (25%).

2. Recreation/Wildlife Preservation over 25% of county: Essex, NY (44%); Hamilton, NY (69%); Herkimer, NY (39%); Warren, NY (35%).

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