

## Environmental, Economic, and Social Changes in Rural America Visible in Survey Data and Satellite Images

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### Changing Rural America

A decade into the twenty-first century, many rural communities across North America find themselves at a crucial point of transition. Traditional livelihoods in natural resource-based sectors have been eroded by a combination of factors involving technological change, increasing global competition, and energy costs. Although strategies for the economic and social reinvigoration of rural communities have been proffered, only a few resource-dependent communities have successfully reinvented themselves and achieved beneficial social, economic, and environmental outcomes. Social, economic, and environmental contexts of rural communities can make it more difficult to address questions and challenges of redevelopment. Exploring regional differences in these contexts is the focus of this brief.

Ideas about rural redevelopment often hinge on the potential of rural places to draw people there (as tourists or in-migrants). Some communities, especially those that have

#### Community and Environment in Rural America

The Carsey Institute's Community and Environment in Rural America (CERA) project seeks to better understand the connections between changing social, economic, and environmental factors and the implications for ecologically sustainable economic development policies. Work to date has focused on sites in the Colorado Rockies, the Pacific Northwest, the Northern Forest of New England, the Great Plains, Central Appalachia, the Mississippi Delta, the Black Belt of Alabama, the Upper Peninsula of Michigan, and Downeast Maine.<sup>1</sup> Out of this research, different types of rural America have emerged.<sup>2</sup> We compare three of these areas in this brief.

### Key Findings

- The different ways in which rural places are transforming affect local patterns of land-cover change. We find close connections between the physical landscape and environmental perceptions of local residents.
- In the Northern Forest, a patchwork of different land uses has produced a landscape where parcels are smaller, and recent change has taken place on a relatively small scale. In the context of a declining forest products industry, we see little change in land cover.
- In Central Appalachia, where the main economic driver is the extraction of coal, surface mining has had large-scale impacts on land cover.
- The Pacific Northwest is characterized by diversification; a mixture of sprawl, tourism, and logging has had large-scale effects on land cover.

substantial natural amenities making them physically attractive to outsiders, may stand a better chance at reinventing themselves as the role of rural places in an increasingly urban society shifts. Some amenity-rich rural areas are growing as baby boomers move there to retire, and as "footloose professionals" choose to settle in smaller communities endowed with greater natural beauty and recreational opportunities. Other places, long dependent on resources such as timber or farmland, are continuing a long trend of population loss as employment in these traditional industries declines. A third type consists of chronically poor communities where decades of underinvestment have left a legacy of deep poverty and weak, deficient community institutions. Finally, some places

are in a transitional phase in which traditional resource-based industries have declined in terms of employment, and the potential for new growth related to natural amenities or renewable resources exists. This process of rural restructuring has led to the emergence of a “differentiated countryside”<sup>3</sup> of heterogeneous rural spaces characterized by diverse identities, patterns of in-migration, and land use expectations.

In those rural places that sit at the uneasy juncture between traditional and new economies, ideas of landscape change and balance become increasingly important and contested.<sup>4</sup> Population growth and new housing developments are on the rise in many working landscapes across rural America as exurbanites and retirees seek areas rich in natural amenities, including scenery, outdoor recreation, and wildlife.<sup>5</sup> In other places, the decline of historically dominant resource-based industries has meant economic stagnation and depopulation despite the presence of substantial natural amenities. Associated with these trends are changes in land ownership, land use, and land cover, which will influence both native and non-native flora and fauna.<sup>6</sup> Disturbances (wildfire, floods, etc.) further affect communities, potentially exposing and magnifying vulnerabilities, challenging relationships between stakeholders and resource managers, and ultimately threatening community stability.<sup>7</sup>

This brief focuses on the changing landscapes of three areas in rural America where these social, economic, and ecological changes are occurring over large areas: the Northern Forest, Central Appalachia, and the Pacific Northwest. These three sites embody varying historical reliance on land and natural resources and represent very different socioeconomic contexts. By scaling up to the community level, we can better understand how individual land-use decisions and activities play out in the context of a broader landscape.

## Study Sites

### Northern Forest

The Northern Forest is a thirty-four county region stretching across the northern tier of New York, Vermont, New Hampshire, and Maine. A 26-million acre expanse of boreal and northern hardwood forest is the ecological base of this region, home to 2.3 million people. Coos County, New Hampshire, and Oxford County, Maine, form a contiguous area at the geographical center of the Northern Forest. The region has experienced modest population shifts in recent years; while the population of Coos declined by just over 1 percent between 2000 and 2007, Oxford grew by 3.5 percent. In 2007, the total population of the region was just under 90,000. According to 2007 CERA survey data, roughly half the residents are “newcomers,” having moved to the area as adults. Nearly half of the survey respondents reported annual household incomes between \$40,000 and \$90,000, creating a relatively large middle class. One-third of respon-

dents reported having a college degree, and 48 percent said that natural resources should be conserved for future generations rather than used to create jobs.

Communities here share an underlying dependence on forest resources, both through timber-based production and the increasing role of natural amenities. Recent economic and social changes in the Northern Forest are part of the larger story of the decline of rural manufacturing and technological change in natural resource-based industries. At the close of the twentieth century, these counties were dependent on both manufacturing and recreation, as classified by the United States Department of Agriculture Economic Research Service. Long-term trends in county industrial structure, as reflected in Bureau of Economic Analysis Regional Economic Information System data, parallel one another in the two counties; the manufacturing sector accounted for about 17 percent of total employment in each area in 2000, down from approximately 35 percent in the 1970s. The contraction of forest products industry employment has continued into the twenty-first century, particularly in Coos, where several mills shut down in 2006 and 2007.

### Pacific Northwest

The lands surrounding the mouth of the Columbia River form a region of considerable beauty and productive natural resources, where both the new and traditional economies are highly visible. The region saw steady population growth in every decade between 1960 and 2010. Clatsop County, Oregon, grew by 5 percent from 2000 to 2007, while Pacific, Washington, grew by 2.6 percent, giving the region a total population of just under 59,000 in 2007. CERA survey data for 2007 indicate that newcomers compose two-thirds of adult residents, and about half of the newcomers moved to the area in the past ten years. Forty-two percent of residents reported household incomes between \$40,000 and \$90,000, slightly lower than Coos/Oxford. Just over one-third (35 percent) of respondents reported graduating from college, and 40 percent said that conserving resources was more important than using them to create jobs.

The decline of the manufacturing sector has certainly affected the region, with manufacturing jobs composing less and less of total employment since the 1960s. But compared with Coos County, where the decline of the pulp and paper industry has left the region struggling to reinvent itself economically, Lower Columbia exemplifies emerging high-amenity places.<sup>8</sup> Less than a three hours’ drive from Portland and Seattle, the contiguous counties of Clatsop and Pacific feature beaches, mountains, rivers, and forests. The largest population center is the city of Astoria, Oregon, home to just under 10,000 people, and located a few miles inland on the southern banks of the Columbia River.

Beach communities to the north and south of the Columbia’s mouth are built on tourism, and share a history as weekend and seasonal getaways for affluent urbanites. De-

spite this recent amenity-based growth, the Lower Columbia is still very much connected to a historical resource-based economy in which timber and fisheries are central. More than 7 percent of all jobs in the region in 2002 were in fishing and forestry.<sup>9</sup> A fishing fleet based in Ilwaco, Washington, though down in numbers from its historical high of several hundred vessels, still employs several hundred workers between its boats and processing plants. Farther north, an oyster fishery forms much of the economic backbone of the area around Willapa Bay, while the forest products industry dominates the mill town of Raymond, Washington. In Astoria, logging trucks rumble through town regularly, many heading east to a Georgia Pacific paper mill just beyond the county line. Evidence of logging operations in the vast Douglas fir and hemlock forests is visible along the region's highways, while huge freighters move along the Columbia, carrying commodities such as timber and grain to the Pacific and finished goods upriver to Portland.

### Central Appalachia

Central Appalachia, where Kentucky, West Virginia, and Virginia come together in a mineral-rich, rugged landscape of mountains and valleys, presents a vastly different social, economic, and environmental context. In a continuation of decades-long decline, from 2000 to 2007 both counties lost more than 5 percent of their populations, leaving the region with a total population of 55,000 in 2007. According to the CERA survey, only about 27 percent of residents are not from the region. More than half (52 percent) reported annual household incomes below \$40,000. Conversely, just over one-third (34 percent) reported household incomes between \$40,000 and \$90,000, suggesting a smaller, weaker middle class in the region. One-quarter of respondents reported graduating from college, and 33 percent favored resource conservation over job creation.

This region's colonization by industrial interests in the late nineteenth century entrenched patterns of inequality and patronage and set it on a course that would lead to its contemporary position as one of the poorest and most environmentally challenged regions of rural America. Harlan and Letcher Counties in eastern Kentucky are at the heart of a region that has for decades been the focus of studies aimed at understanding the origins and persistence of its economic hardship, and its prospects for change.<sup>10</sup> As a heavily forested region, it shares a superficial resemblance to the Northern Forest and Pacific Northwest, but the presence and exploitation of its coal deposits have lent the area a vastly different form of resource dependence and resultant character. The region has also not been immune to industrial restructuring, having been decimated by job losses in the industries on which it has depended—most notably coal. Mechanization of the coal fields in the 1950s left tens of thousands without jobs, resulting in massive unemployment and outmigration, and drew the national spotlight as the focus of President

Johnson's War on Poverty in the following decade.<sup>11</sup> Still, in 2007, 17 percent of jobs in Letcher County and 14 percent of jobs in Harlan County were in mining, making the sector the single largest private employer in the region.

### Methods

We used land-cover maps to identify change over time in an area's land use and to compare the change with residents' views of their communities (Figure 1). Land-cover maps provide information about absence or presence, extent, and configuration of particular land-cover types, such as forests or crops.<sup>12</sup> We collapsed the National Land-Cover Dataset (NLCD) categories into four groups: water, forest, bare/developed, and other (crops, grass, shrubs, non-tree wetland vegetation) for each of the three study sites (Figure 2). We then used land-cover maps to create change trajectories in land-cover types. This technique helps determine the change between two or more time periods in a particular region or for a particular land cover. It also provides quantitative information about land-cover change and landscape fragmentation. In this way, we can examine the fate of, for example, forests from 1992 to 2001 by tracking which areas remained forest and which were converted to agriculture or residential areas. In addition, we analyzed the number of patches (i.e., the number of individual tracts of contiguous forest) and the average size of these patches.

To learn more about how residents of these sites view their communities and the environment around them, the Carsey Institute conducted telephone interviews (via random digital

**FIGURE 1. GUIDE TO LAND-COVER MAPS DERIVED FROM SATELLITE IMAGERY. MAPS A AND B: DENSE VEGETATION IS DEEP PINK; SCRUBLAND IS LIGHTER PINK; AND BARE EARTH, PAVEMENT, OR ROCK SHOWS AS DARK BLUE. MAP C: IN A LAND-COVER MAP, THE CORRESPONDING FOREST IS GREEN; BARE GROUND IS RED; AND SHRUB COVER IS YELLOW.**

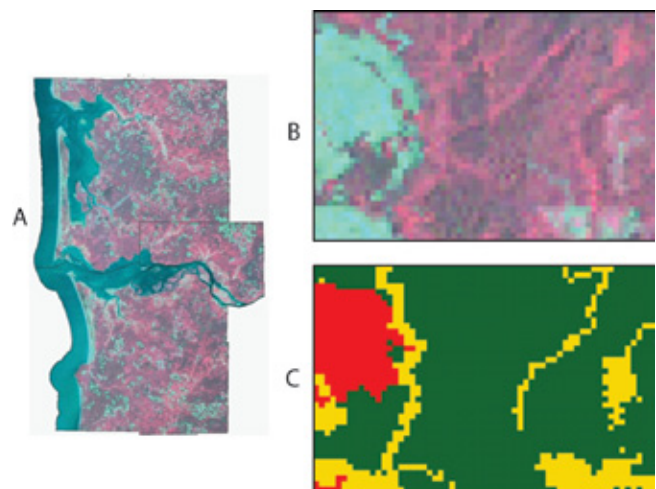
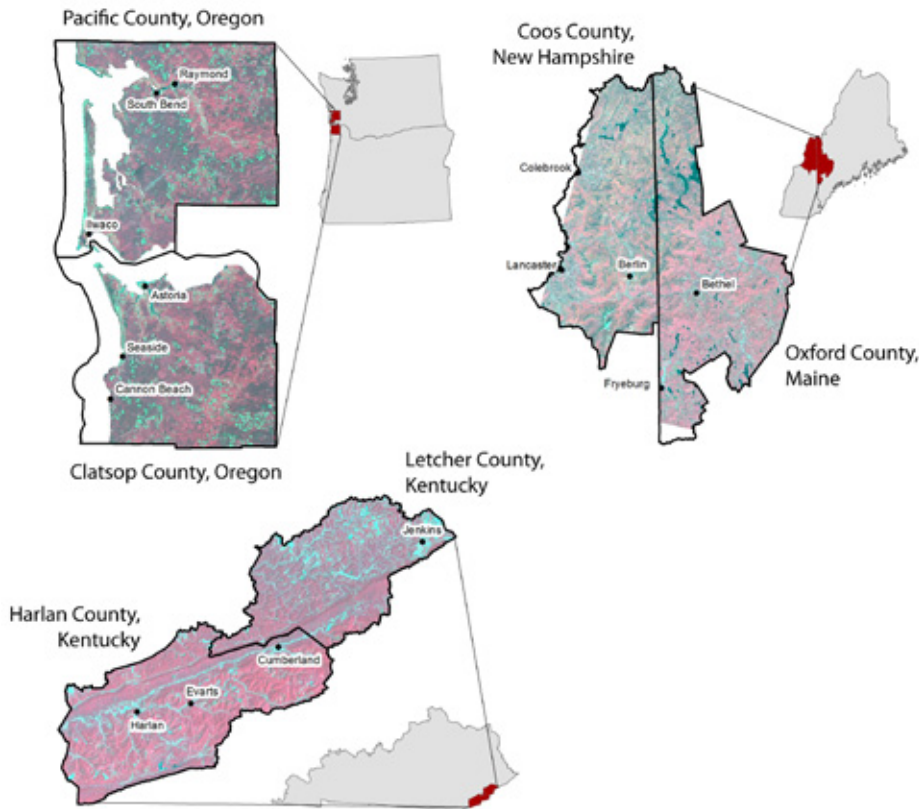


FIGURE 2. SATELLITE IMAGERY FROM THREE STUDY SITES: PACIFIC NORTHWEST, NORTHERN FOREST, AND CENTRAL APPALACHIA



dialing) with 3,720 adults in these three sites during the summer of 2007. Interviewers collected data on residents' experiences of change, their levels of concern about environmental issues, and the issues they see as most important in their communities. The total number of interviews in each county is as follows:

- Coos County (New Hampshire): 967
- Oxford County (Maine): 753
- Clatsop County (Oregon): 700
- Pacific County (Washington): 300
- Harlan County (Kentucky): 405
- Letcher County (Kentucky): 595

In total, 64 percent of respondents were female; 63 percent were age 50 years or older; and 95 percent were non-Hispanic white. We weighted the data to correct for potential sampling biases on the basis of age, sex, or race-ethnicity by deriving weights from an age/sex/race population profile of the region from the 2006 Census Population Estimates data (a maximum weighting factor was established to avoid unusual cases unduly influencing overall figures). The maximum margin of error (at a 95 percent confidence interval) is +/- 6 percent.

## Results

### Northern Forest

Overall, Coos and Oxford saw only small-scale land-cover change between 1992 and 2001 (Table 1). Most of the forest remained unchanged (83 percent), with a net loss of 2 percent (Table 2). Further, forest in the region became consolidated and more connected. The number of patches decreased (Oxford: 3,338 to 1,564; Coos: 2,139 to 989), while the size of these patches increased (Oxford: 358 to 746 acres;

TABLE 1. PROPORTION OF LAND-COVER TYPES IN 1992

	Forest (%)	Bare/developed (%)	Other (%)	Water (%)
<b>1992</b>				
Northern Forest	89.4	1.9	5.4	3.2
Central Appalachia	97.5	1.5	0.8	0.2
Pacific Northwest	91.6	0.9	6.8	0.6
<b>2001</b>				
Northern Forest	87.7	1.4	8.0	2.9
Central Appalachia	83.4	3.7	12.7	0.2
Pacific Northwest	72.2	4.3	23.1	0.4

TABLE 2. LANDSCAPE CHANGE BETWEEN 1992 AND 2001

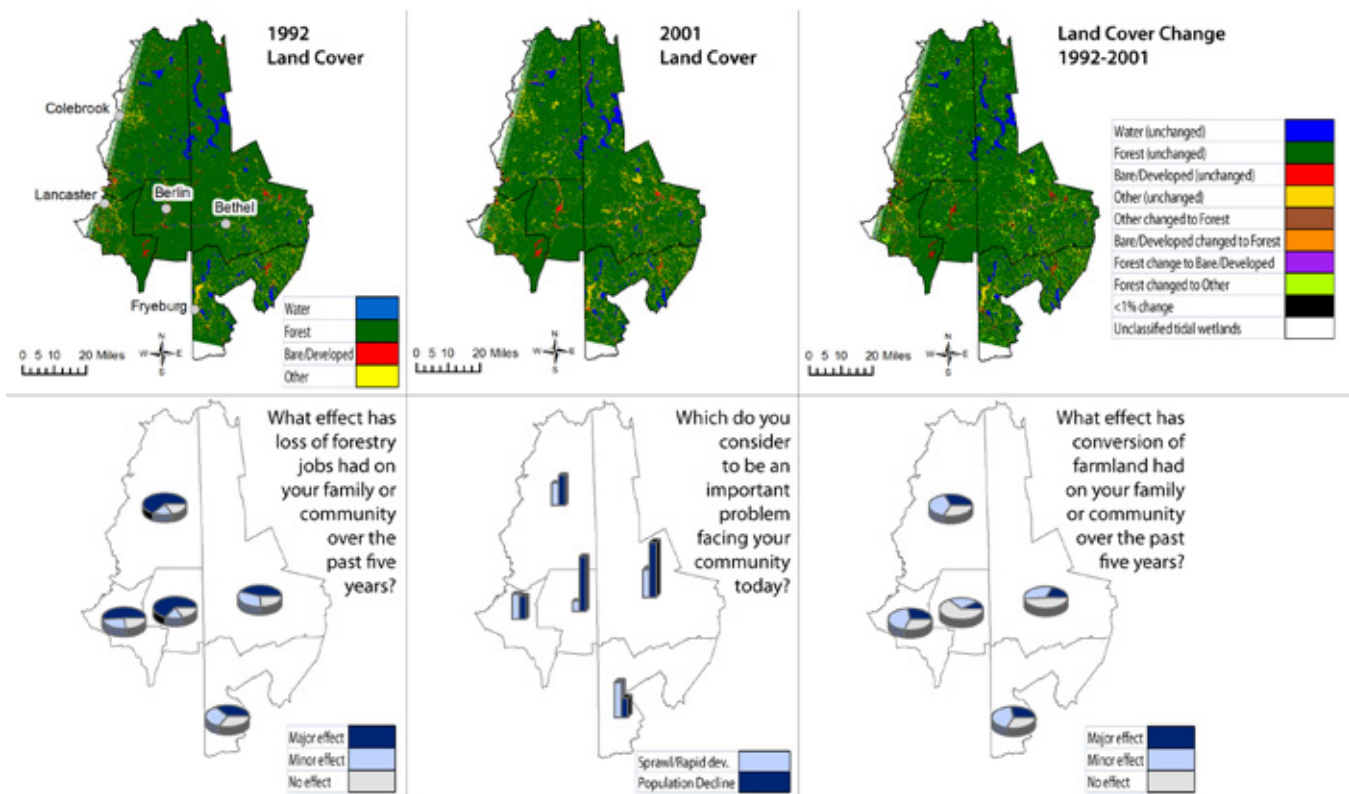
	Northern Forest		Central Appalachia		Pacific Northwest	
	% of Total Area	Extent (mi <sup>2</sup> )	% of Total Area	Extent (mi <sup>2</sup> )	% of Total Area	Extent (mi <sup>2</sup> )
<b>Unchanged Land Cover</b>						
Forest	83.4%	3209.7	78.4%	669.2	68.6%	1190.7
Bare/developed	0.4%	16.6	0.5%	4.0	0.4%	7.7
Water	2.6%	101.9	0.1%	0.7	0.3%	5.2
Other	2.1%	81.9	0.4%	3.2	3.1%	54.3
<b>Change in Land Cover 1992 to 2001</b>						
Forest Conversion	6.0%	231.8	14.0%	119.6	23.0%	400.3
Reforestation	4.0%	153.8	0.6%	5.3	3.5%	60.9

Coos: 469 to 1,003 acres). Logging continued through the 1990s, but it leveled off as the timber markets stagnated and mills began to close. Cut forests are now regenerating and overall forest conversion in this area remains small-scale and dispersed, with little large-scale forest conversion or commercial timber harvesting using clear-cutting methods.

While both counties appear to be experiencing the same general trends in landscape change (see Figure 3), their

population trends vary. The population of Coos declined by 5 percent while Oxford county's population increased by 4 percent between 1990 and 2000. Oxford's growth was likely driven by new residents moving to the area for the amenities, who likely purchased smaller parcels of land for second homes in the southern part of the county. Concern about sprawl and too-rapid development appears strongest in Oxford County. However, these concerns are also pronounced

FIGURE 3. LAND-COVER CHANGE 1992 TO 2001 AND PERCEPTIONS OF COMMUNITY MEMBERS IN COOS AND OXFORD COUNTIES (753 WERE SURVEYED IN COOS AND 967 IN OXFORD)



in southwestern Coos which, unlike the rest of the county, has seen modest population growth in recent years.

Concern about population decline was lowest in southwestern Coos and southern Oxford counties. By contrast, three-quarters of respondents in Berlin, New Hampshire, a city that has experienced considerable population loss over the past half-century, were worried about population decline, while comparatively few (15 percent) saw sprawl as an issue. Despite Oxford County's overall population growth, 54 percent of those in the northern part of the county, an area that is more remote and dependent on the forest products industry, were concerned about population decline.

Perceptions of continuity in land cover are evident in public surveys. In our Northern Forest site, there is generally little concern for sprawl and loss of farmland. The main concern is about loss of forestry jobs, which concurs with the land-cover change assessment. The stagnation of the forest products industry in the area coincides with only small-scale timber extraction, leading to the concerns of jobs. There is a somewhat stronger concern in Coos County than in Oxford County. The highest levels of concern were found around Berlin and Groveton, New Hampshire, both of which have experienced mill closures in recent years. Roughly two-thirds of respondents in these areas saw the loss of forest-based jobs as having major effects on their community. Further, those areas with greatest concern about loss of jobs have seen the largest amounts of depopulation between 1990 and 2000, and have the least concern about sprawl and development.

### Pacific Northwest

By contrast, the Pacific Northwest experienced the greatest degree of land cover change. With about 20 percent forest loss, there was a concomitant increase in bare/developed and other land-cover classes (Table 1). The forest products industry in the Pacific Northwest remains strong, and the region continues to be one of the country's largest producers of softwood. While it has inevitably faced decline in international markets, and companies and landowners have faced consolidation, timber production remains strong and a major source of income in the study site. Hence, much of this forest conversion can be attributed to active forest management, where forest has been cut (23 percent of land area) and some has regrown (3 percent) (Table 2). There is similar overall forest loss between the two counties because of continuing commodity timber production.

In contrast to the Northern Forest, this Northwest site's forest has become more fragmented and less connected. In Clatsop County, the number of forest patches has increased from 1,396 in 1992 to 5,280 in 2001. The number of patches stayed relatively constant in Pacific County: 2,472 in 1992 and 2,453 in 2001. Mean patch size has also decreased in both counties (Pacific: 219 to 180 acres; Clatsop: 341 to 174 acres). Fertile soil, a moderate climate, and abundant rainfall

contribute to swift softwood tree growth in this region, translating to a shorter rotation age (25 to 35 years versus 50 or more in New England forests that contain a mix of hard and softwood species). Therefore, forest conversion is evident in a much shorter time horizon than at the other two study sites (Figure 4). Further, the lack of significant change in number of tracts of forest or size of the patches is consistent with active industrial forest harvesting on large private lands.

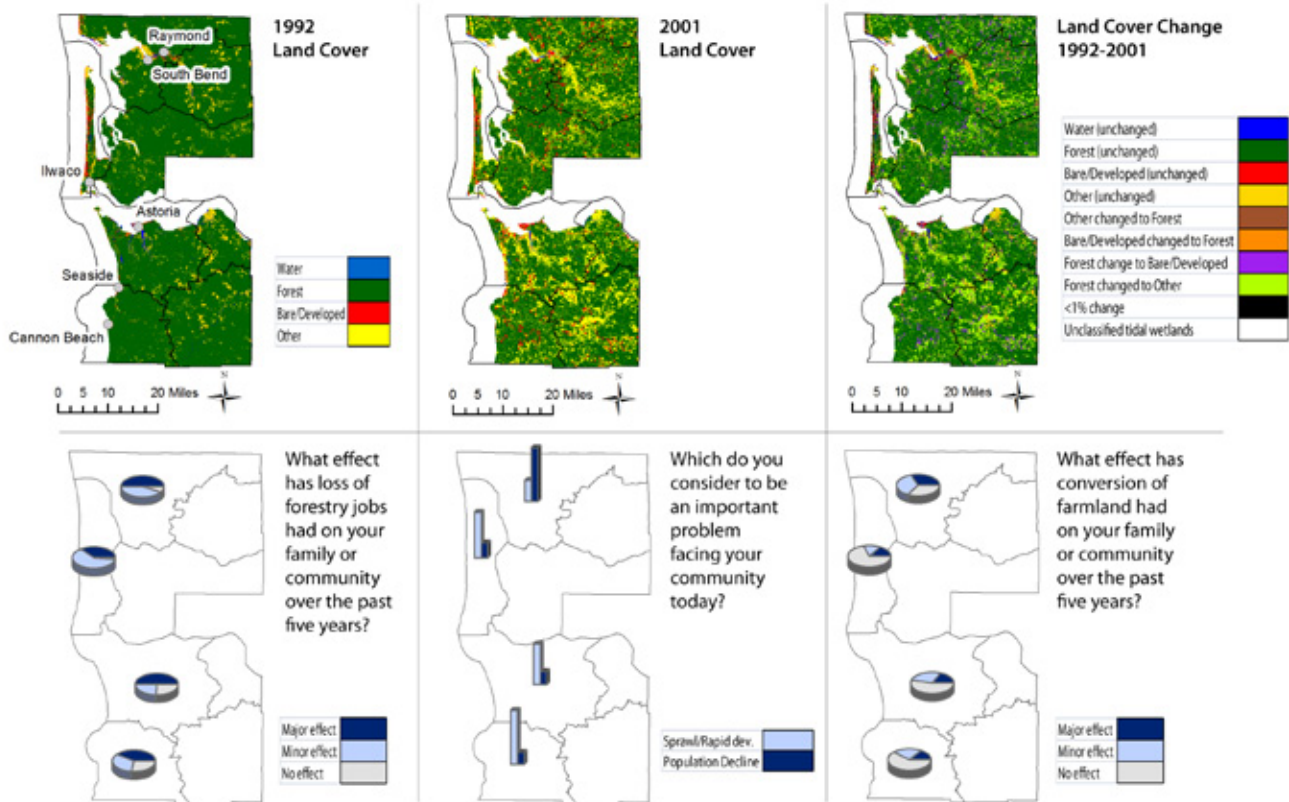
Clatsop and Pacific counties are experiencing different patterns of change. Both counties experienced population growth between 1990 and 2000; Pacific County increased by 11 percent and Clatsop County by 7 percent. Although Pacific County experienced a greater degree of growth, it is farther from Portland and has only dispersed residential development within the county, with smaller towns and little large-scale change. In contrast, Clatsop County has experienced large-scale change in part because of timber harvesting (mostly limited to the interior of the county), but also because of exurban growth from the greater Portland (Multnomah County) area just two hours to the southeast. Recently, retirees and amenity-seekers from Portland and California have moved to Astoria and communities along the Columbia River and Pacific coast. A combination of these forces has caused a major change in landscape configuration. Here, development and forest harvesting have led to an increase in the number of individual forest tracts, but the tracts that remain (or have been created) are smaller. Conversely, the number and size of developed land patches has increased.

Residents' environmental perceptions reflect these large-scale changes in landscape composition. A higher proportion of people (41 percent) have moved to Clatsop County than Pacific County (35 percent) within the last ten years. Further, Clatsop residents are much more concerned (43 percent) about rapid development and sprawl than Pacific residents (29 percent). Conversely, largely because of the influx of new residents, residents are much less concerned about population decline in Clatsop County (13 percent) than in Pacific County (34 percent). At the same time, despite ongoing timber production, residents were concerned about the loss of jobs in the forestry sector, though a greater percentage of Pacific (63 percent) than Clatsop (48 percent) residents saw job loss as having major effects on their community.

### Central Appalachia

Between 1992 and 2001, Central Appalachia also experienced large-scale forest conversion (Table 1), mainly because of mining. Overall, nearly 14 percent of forest was lost, and both "bare/developed" and "other" (farmland, fields, shrubs) land expanded considerably (Table 2). Both Kentucky counties experienced a similar pattern of change and amount of forest loss, with an almost 12-fold areal increase in other land-cover types. As a result of forest conversion, the forest that remains has become more fragmented (Figure 5), with

FIGURE 4. LAND-COVER CHANGE 1992 TO 2001 AND PERCEPTIONS OF COMMUNITY MEMBERS IN CLATSOP AND PACIFIC COUNTIES (700 WERE SURVEYED IN CLATSOP AND 300 IN PACIFIC)



the number of forest patches increasing in both counties (Harlan: 153 to 476; Letcher: 116 to 473) and mean patch size decreasing substantially (Harlan: 1,915 to 543 acres; Letcher: 1,821 to 341 acres) between 1992 and 2001.

Between 1990 and 2000, population declined by 6 percent in Letcher and 9 percent in Harlan County. Unlike many places in rural America whose economies are heavily dependent on agricultural and forest-based commodities and where working lands are being parceled up, land conversion in these Kentucky counties is not related to the exploitation of renewable resources. In Central Appalachia, where chronic underdevelopment has crippled many communities, forest loss is linked with strip (or contour) and mountain-top mining methods. While mining operations have increased and expanded between 1990 and 2001, there has been no corresponding increase in residential or commercial development. In other study sites, loss of forest primarily resulted from residential or commercial development, or logging in the case of Clatsop County. In Central Appalachia, concern about population decline corresponds to the areas that have seen the highest levels of forest conversion as a result of coal extraction.

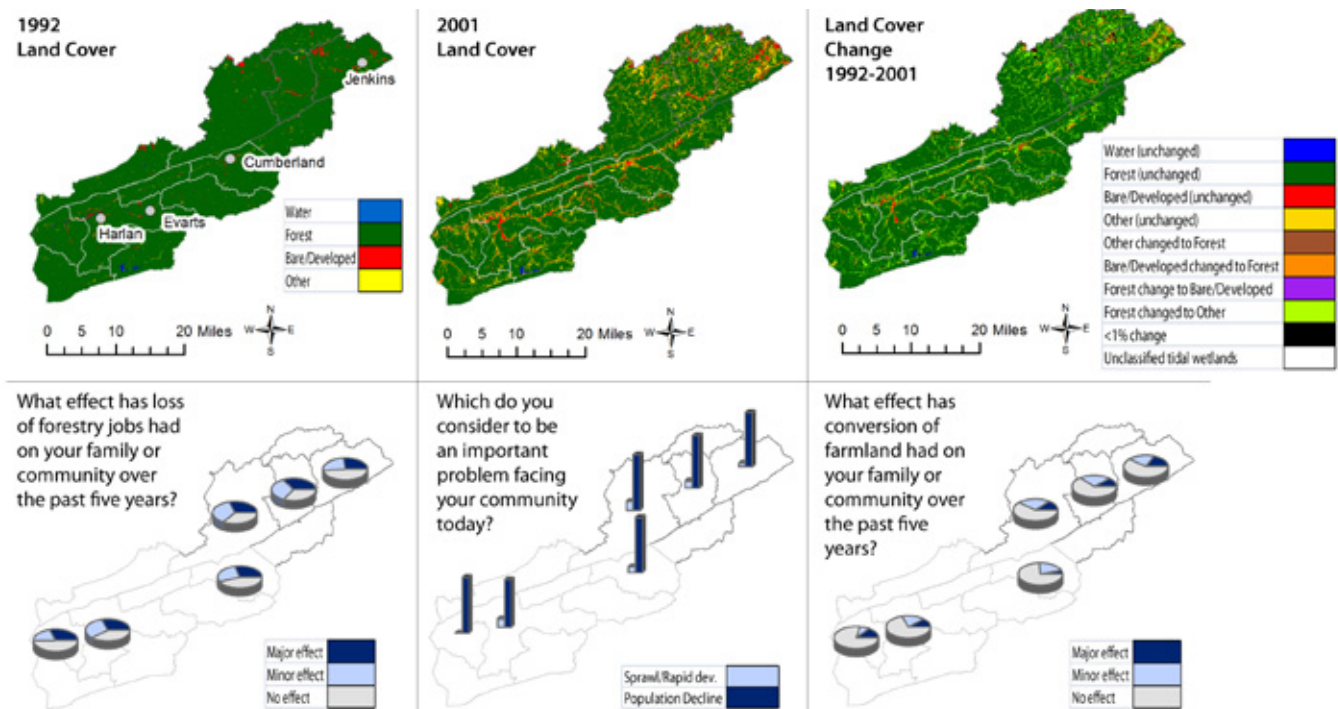
Loss of forestry jobs is a concern of some residents, but not a primary concern. Sixty-eight percent of community members have minor or no concern for loss of these jobs.

In recent decades, timber extraction has not been a large part of this region's economy. Moreover, as mines expand into forested lands, some employment in timber extraction may be gained. Likewise, because of the economic dependence on mining in Harlan and Letcher Counties, loss of farmland is not a major concern of most residents. Chronic underdevelopment has led to more concern about population decline (72 percent).

## Discussion

Our analysis shows how these different, but all historically forest-dependent, sites have experienced divergent transformations—both in pattern and amount of land-cover change. We relate these changes to economic, social, and demographic characteristics to examine how different forces within rural communities work to shape landscapes. With respect to land-cover trends, the Northern Forest site largely embodies stasis rather than change. However, this land continuity does not imply the absence of socioeconomic shifts. Countervailing trends of economic decline in forest-based industries and a modest degree of amenity-driven growth have resulted in only slight population change over the past two decades, and a mixture of concerns on the part of residents.

FIGURE 5. LAND-COVER CHANGE 1992 TO 2001 AND PERCEPTIONS OF COMMUNITY MEMBERS IN LETCHER AND HARLAN COUNTIES (405 WERE SURVEYED IN LETCHER AND 595 IN HARLAN). LETCHER IS THE EASTERN COUNTY AND HARLAN IS THE WESTERN COUNTY.



Land-cover change in our Pacific Northwest site embodies both continued timber production and substantial residential growth related to the area's considerable natural amenities. The population is concerned primarily with rapid growth, though community effects of recent shifts in forest-based industry are also at the forefront of many residents' minds.

Very different forces have led to land-cover change in Central Appalachia compared to the Pacific Northwest or the Northern Forest. Central Appalachia is much more dependent on mining—an industry whose technologies and methods carry severe and irreversible environmental effects. The large amount of forest conversion seen there is not from forest harvesting, but instead from coal mining. Today, almost half the coal in eastern Kentucky is extracted via surface mining.<sup>13</sup> Rather than embodying a process of renewable resource exploitation, the land-cover change seen in Harlan and Letcher counties is the product of an irreversible process of landscape alteration and environmental degradation.

Many communities in rural America are at the nexus of change. In all three study sites, many long-time residents are concerned with population decline and job loss as traditional industries continue to decline. These responses are indicative of other rural places in America. To a greater or lesser degree, in the Northern Forest and Pacific Northwest, the once dominant forest products industry has given way to other sectors. In the Pacific Northwest in particular, the

tourism and service sectors have grown, largely catering to exurbanites and amenity-seeking migrants. At the same time, these communities have seen shifts in demographics. Young people who have historically depended on blue-collar work have moved away as family-wage jobs have been replaced by seasonal service-sector employment and real estate prices have increased. Communities in Central Appalachia, in contrast, have not had the same influx of migrants, and these communities still largely depend on direct and indirect benefits of the mining industry.

## Implications for Rural America

Differences in economic structure across rural communities—products of both geography and historical and contemporary choices about development paths—have important and often dramatic implications for the local environment and ecology. Social and economic conditions within these places constrain certain behaviors and promote others, which in turn affect land use and land cover. Further, both public and private decisions about land use are often constrained by a potpourri of policies and regulations created by governing bodies from the federal to the municipal levels. The aggregate effect of land-use and land-cover change shown here reflects many small individual decisions made by a diverse array of landowners with varying interests. Land-



use decisions on 10-, 20-, or 40-acre parcels create a relatively small footprint that often is invisible at the regional scale. Other times, larger parcels are converted during mining and forestry operations. Together, these processes continue to break up landscapes into smaller parcels. The accumulation of many small land-use decisions can have dramatic and long-lasting ecological impacts, such as fragmented wildlife habitat, increased wildfire susceptibility, spread of noxious weeds, and decreased water availability. In some cases, past land-use decisions—surface mining in Central Appalachia is one—have created environmental conditions that reduce the options available for future development.

Land-use planning becomes particularly challenging in these rural areas. In high-amenity areas, the real estate values for housing development often surpass productive land values, for agriculture, grazing, or forestland, for example. While employment in extractive industries may be declining, the site's natural amenities continue to draw new residents.

At the other end of the spectrum, declining-resource dependent and chronically poor communities may face the biggest struggle in responding to landscape change. These communities encounter other challenges, and for very different social and economic reasons. They are often the most vulnerable, with few, if any, options for economic growth, and they can face the biggest challenges in mitigating the deleterious, and often cascading, impacts of landscape fragmentation on the environment. Where options for even low-skill jobs are limited, these communities may forgo long-term sustainability of resources and ecosystem services in order to continue down a development path they have known for generations—and perhaps exacerbate a downward spiral.

Landscapes embody historical and contemporary trends in industry, demographics, politics, and other social and economic forces. Landscape changes can affect communities' ability to effectively respond to new challenges and to take advantage of new opportunities. In some contexts, such as the Northern Forest and Pacific Northwest, these environmental constraints, while considerable, may be moderate enough to be overcome through careful and innovative planning. However, the constraints on development options posed by other forms of landscape change, such as that wrought by surface mining in Central Appalachia, may prove intractable.

## ENDNOTES

1. See <http://www.carseyinstitute.unh.edu/CERA/cera-home.html>.
2. Adapted from L.C. Hamilton et al., *Place Matters: Challenges and Opportunities in Four Rural America*. A Carsey Institute Report on Rural America (Durham, NH: Carsey Institute, University of New Hampshire, 2008).
3. J. Murdoch et al., *The Differentiated Countryside* (London: Routledge, 2003).
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7. C. G. Flint, B. McFarlane, and M. Mueller, "Human Dimensions of Forest Disturbance by Insects: An International Synthesis," *Environmental Management*, vol. 43 (2009): 1174-1186.
8. Chris Colocousis, "The State of Coos County: Local Perspectives on Community and Change." Issue Brief No. 7 (Durham, NH: Carsey Institute, 2008).
9. U.S. Bureau of Economic Analysis, Regional Economic Information System; this is the percentage of all jobs in the region in forestry, fishing, and related activities. According to the U.S. Census Bureau, in 2000, 6 percent of residents worked in agriculture, forestry, fishing, and hunting.
10. Dwight B. Billings and Kathleen M. Blee, *The Road to Poverty: The Making of Wealth and Hardship in Appalachia* (Cambridge, UK: Cambridge University Press, 2000); Mary Jean Bowman and W. Warren Haynes, *Resources and People in East Kentucky: Problems and Potentials of a Lagging Economy* (Baltimore: Johns Hopkins Press, 1963); Cynthia Duncan, *Worlds Apart: Why Poverty Persists in Rural America* (New Haven, CT: Yale University Press, 1999); John Gaventa, *Power and Powerlessness: Quiescence and Rebellion in an Appalachian Valley* (Urbana: University of Illinois Press, 1980); H. Dudley Plunkett and Mary Jean Bowman, *Elites and Change in the Kentucky Mountains* (Lexington: University Press of Kentucky, 1973); David S. Walls and John

B. Stephenson, *Appalachia in the Sixties: Decade of Reawakening* (Lexington: University Press of Kentucky, 1972).

11. Walls and Stephenson, *Appalachia in the Sixties*.

12. Land-cover maps were derived for 1992 and 2001 using the National Land-cover Dataset (NLCD) for the study sites. NLCD is a comprehensive land-cover data set compiled by the Multi-Resolution Land Characteristics Consortium collaboration that includes the U.S. Geological Survey, Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Forest Service, and others. NLCD was commissioned to provide a categorization of U.S. land cover in 1992 and 2001 derived from satellite imagery. The 1992 NLCD identified landscapes by 16 different categories, while the 2001 NLCD used 21 categories. To compare between the two data sets and focus on particular land-cover types, we collapsed the categories into four groups: *water, forest, bare/developed, other (crops, grass, shrubs, non-tree wetland vegetation)*. See [www.epa.gov/mrlc](http://www.epa.gov/mrlc).

13. Kentucky Office of Energy Policy, "Types of Mining: Expanded Online Kentucky Coal Facts." Available at [http://www.coaleducation.org/Ky\\_Coal\\_Facts/default.htm](http://www.coaleducation.org/Ky_Coal_Facts/default.htm).

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