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NATIONAL FORESTS ON THE EDGE: DEVELOPMENT PRESSURES ON AMERICA'S NATIONAL FOREST SYSTEM

Eric M. White[1], Susan M. Stein[2], and Ralph J. Alig[1]
[1]USDA Forest Service, Pacific Northwest Research Station
[2]USDA Forest Service, State and Private Forestry

Introduction

Nationwide, the national forest system covers 192 million acres and contains 155 national forests and 20 national grasslands. These national forest system lands provide a variety of social, cultural, and economic benefits to society. An increasing number of housing units are now located along and near the boundaries of national forests, resulting from desires to reside near natural amenities and an expanding population. Nearly a quarter of the U.S. population now lives in a county that contains national forest system land (Johnson and Stewart in press). Increases in the level of residential development on rural lands around the boundaries of national forests may threaten the provision of goods and services from national forests. The objective of this study is to identify national forests and grasslands in the conterminous U.S. that are likely to experience increases in residential housing densities on the currently rural private lands located outside their boundaries. This study is one in a series completed for the Forests on the Edge project sponsored by the State and Private Forestry branch of the USDA Forest Service.

Methods

The boundaries of administrative national forests located in the conterminous U.S. were identified from a coverage of national forest system lands (USDA FS 2000). Using a GIS, three spatial buffers with distances of 0 to ½ mile, ½ to 3 miles, and 3 to 10 miles were created around the external boundaries of national forest system lands. No buffers were created in private inholdings within national forest external boundaries. Overlapping buffers surrounding the external boundaries of individual parcels of the same administrative national forest were dissolved. Those buffers that overlapped between different administrative national forests were identified for use in future analytical steps but not dissolved.

Spatial layers (100 X 100 meter) of year 2000 and projected year 2030 housing density on private lands throughout the conterminous U.S. were obtained via the SERGoM v 1.0 model (Theobald 2004a; Theobald 2004b; Theobald 2005). For this study, housing densities observed in year 2000 and projected to the year 2030 were classified into three housing density categories: Rural I, Rural II, and Exurban-urban. Rural I lands were those with housing densities of 16 or fewer housing units per square mile, Rural II lands had more than 16 and less than 65 housing units per square mile, and Exurban-urban lands were those with 65 or more housing units per square mile. A single spatial layer identifying housing density increase on rural lands was created from the housing density layers for year 2000 and projected year 2030. Housing density was deemed to increase between year 2000 and projected year 2030 for a given 100 X 100 meter pixel if housing density moved from Rural I in 2000 to either Rural II or Exurban-urban in year 2030 or from Rural II in 2000 to Exurban-urban in 2030. More detailed descriptions of the housing density layers and the methods used in identifying projected increases in housing density are available in Stein et al. (2005a, 2005b).

The acres of all private rural lands projected to experience increases in housing density were tabulated for individual national forests and for all national forest land in the conterminous U.S. collectively. At the forest-level, total private land area and land area with increasing residential housing density were tabulated for the dissolved buffers surrounding administrative national forests. For the entire national forest system in the conterminous U.S., total private land area and acres with expected increases in residential development within the buffers were tabulated, taking into account the areas of overlapping buffers between administrative national forests that are adjacent to one another to avoid double counting.

Results and Discussion

Approximately 21.7 million acres of currently rural private lands within 10 miles of national forest boundaries are projected to experience substantial increases in the level of residential development by year 2030 (Table 1). These 21.7 million acres represent 8% of all private lands within 10 miles of national forest external boundaries. Of those lands closest to national forest boundaries (i.e., within ½ mile), substantial increases in the level of residential development are projected on 1.5 million acres of currently rural private lands, representing 7% of all private lands within ½ mile of national forest boundaries. Approximately 6.2 million acres of currently rural private lands located between ½ and 3 miles of external forest boundaries are projected to experience increases in housing density by year 2030.

Table 1. Area of Rural Private Land and Percent of All Private Land Adjacent to National Forest System Boundaries Nationwide Projected to Experience Housing Growth, 2000 to 2030

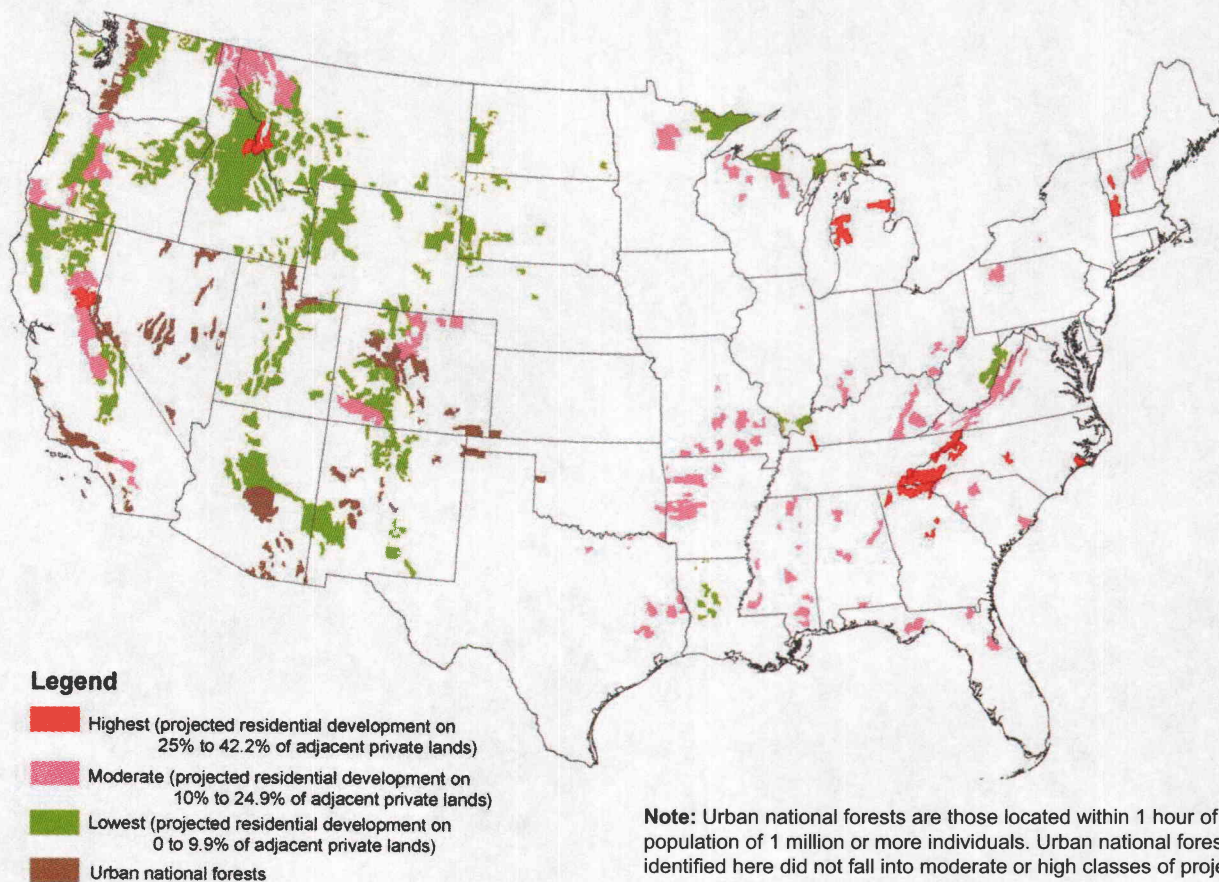| Distance from NFS boundary (miles)	Amount of private land projected to experience housing density increase	
	Percent	Area (in million acres)
0 to ½	7	1.5
½ to 3	7	6.2
3 to 10	8	14.1
0 to 10	8	21.7

NFS = National Forest System

National forests located in USDA Forest Service regions 8 and 9 (the southern and eastern U.S. regions, respectively) account for 15 million of the 21.7 million private acres projected to experience residential increases by 2030. Although the majority of national forests are located in the western U.S., national forests located in the eastern half of the U.S. account for more than half of the projected increase in residential development around national forest system lands. This pattern of projected residential development reflects the greater projected changes in population and more extensive private land base of the eastern half of the United States. Population projections indicate that the population of the eastern U.S. will likely increase by at least 53 million individuals by the year 2030 (USDC Census Bureau 2004). Comparatively, the projected population increase for the western U.S. over the same timeframe is 28 million individuals—with nearly half of those individuals residing in a single western state, California.

At the individual forest level, moderate and high increases in the level of residential development on currently rural private lands are projected throughout the national forest system (Figure 1). Among the western national forests, those located in Colorado, northwestern Montana and northern Idaho, Califor-

nia and Oregon are projected to experience the highest levels of residential increase. In the eastern U.S., moderate and high levels of residential density increase are projected around most national forests located in the southern states and around many forests located in the Northeast and Great Lakes regions.

Nine individual national forests are projected to experience increases on 25% or more of private lands located at one or more of the buffer distances considered in this study (Table 2). Across the entire 10-mile buffer, the Bitterroot National Forest located in Montana and Idaho is projected to have the greatest percentage of nearby private land undergo rural residential development. A large extent of the Bitterroot National Forest is located around the Bitterroot Valley in southern Montana. The Bitterroot Valley has recently experienced some of the highest growth rates in Montana and this population and housing expansion is projected to continue in the coming decades. The Plumas and Tahoe national forests in the Sierra Nevada Mountains of California are also projected to experience residential development on a high percentage of private lands. In the eastern U.S., six national forests are projected to experience substantial increases in residential development on approximately 30% of private lands located within 10 miles of national forest

Figure 1. National Forest System lands projected to experience increased housing density on rural private lands located within 10 miles of national forest or grassland boundaries, 2000–2030

Legend

🟥 Highest (projected residential development on 25% to 42.2% of adjacent private lands)

🟪 Moderate (projected residential development on 10% to 24.9% of adjacent private lands)

🟩 Lowest (projected residential development on 0 to 9.9% of adjacent private lands)

🟫 Urban national forests

Note: Urban national forests are those located within 1 hour of a population of 1 million or more individuals. Urban national forests identified here did not fall into moderate or high classes of projected residential development.

boundaries (Table 2). Three of these national forests are located in the Southeastern U.S.: the Chattahoochee-Oconee National Forests, the Cherokee National Forest, and the National Forests of North Carolina.

Management Implications

Increases in the level of residential development on currently rural lands surrounding national forests may have a number of implications for the resources and management of national forests. Three areas of concern are the potential impacts on native fish and wildlife populations, wildland fuels and fire management, and recreation access and visitation. Residential development on private lands can have impacts on wildlife populations on public lands (e.g., Danielson et al. 1997; Riley et al. 2003). On the Bitterroot National Forest, one concern is as of projected residential development. Loss of winter range in the Bitterroot Valley may limit useable habit, including food resources.

An increase in the number of houses on the landscape in the wildland/urban interface increases the likelihood of and potential impacts from wildland fire and increases the costs of wildland fire and fuels management (Cardille et al. 2001; Prestemon and Butry in press; Radeloff et al. 2005c). Nearly 30% of the private lands within 10 miles of the Huron-Manistee National Forest in Michigan's Lower Peninsula are projected to experience increases in residential development on currently rural lands (Table 2). Jack pine *(Pinus banksiana)* occurs in many locations within the Huron-Manistee National Forest and is prone to explosive stand-replacing wildland fires. The result of an escaped prescribed burn, the 1980 Mack Lake Fire on the Huron National Forest burned 20,000 acres of jack pine, razed 44 structures, and resulted in the loss of one life in a single 6-hour period (Simard et al. 1983). As more housing units are distributed on the landscape around the Huron-Manistee National Forest, and other fire prone landscapes, fire and fuels management may become increasingly challenging.

Increases in the number of residences located on the periphery of national forest lands may have impacts on the extent of recreation access to national forest land and the amount of national forest recreation use. In regard to the former, increases in the numbers of landowners and residential land parcels may decrease or eliminate traditional access points from private land to national forest land (Peterson and Williams 1999), potentially displacing recreation use to other recreation locations on the forest. Regarding the latter, population increases in the communities near national forests may lead to an increase in the total number of national forest recreation visits as a greater number of individuals will live in close proximity to national forest recreation resources and open space. Individuals living near national forest land currently account for more than half of all national forest recreation visits (Stynes and White 2006).

Conclusions

With the population of the U.S. projected to increase by 82 million by 2030 (US Census Bureau 2004), residential development on rural lands in proximity to natural amenities, including national forests, will likely continue. This study helps to identify those national forests that may experience some of the greatest changes in the level of residential development near their boundaries and the potential resource and management implications of that development. Such an understanding can help scientists, resource managers, and communities anticipate potential impacts, plan for prudent growth, and implement policies that take residential development into consideration. Future research should focus on projecting private residential development on inholdings within national forest external boundaries and further quantifying the linkages between residential development and the health, use, and management of national forests.

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Table 2. National Forest System Lands with at Least 25 Percent of Adjacent Private Land (at One or More Distances) Projected to Experience Housing Growth by 2030

National Forests and Grasslands	State	Percent of adjacent private land projected to experience housing density increase[1] —Distance from NFS boundary (miles)—			
		0 to 1/2	1/2 to 3	3 to 10	0 to 10
Western U.S.					
Bitterroot National Forest	ID, MT	33	42	50	42
Tahoe National Forest	CA	18	24	29	26
Plumas National Forest	CA	25	24	24	24
Eastern U.S.					
Chattahoochee-Oconee National Forests	GA	31	35	35	35
Cherokee National Forest	TN	30	36	31	32
National Forests in North Carolina[2]	NC	26	29	30	30
Huron-Manistee National Forest	MI	31	32	26	28
Land Between the Lakes	KY, TN	5	23	31	28
Green Mountain and Finger Lakes National Forests	VT, NY	28	31	25	27

NFS = National Forest System
[1] Percentages of 25 percent or higher are highlighted in red
[2] Croatan, Uwharrie, Pisgah, Nantahala national forests

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