Chapter 8: Socioeconomic Well-Being and Forest Management in Northwest Forest Plan-Area Communities

Susan Charnley, Jeffrey D. Kline, Eric M. White, Jesse Abrams, Rebecca J. McLain, Cassandra Moseley, and Heidi Huber-Stearns[1]

Introduction

Given the need to conserve forest biodiversity and produce forest products, President Clinton's vision for the Northwest Forest Plan (NWFP, or Plan) was that it would provide "a balanced and comprehensive strategy for the conservation and management of forest ecosystems, while maximizing economic and social benefits from forests" (USDA and USDI 1994: E-1). The Plan was expected to support the production of a predictable, sustainable level of timber and nontimber resources from federal forests to contribute to the stability of local and regional economies over the long term (Charnley et al. 2006a). The Plan also aimed to help rural communities affected by cutbacks in federal timber production by providing economic assistance programs to promote long-term economic development and diversification and minimize the adverse effects of job loss from reductions in timber harvesting (Dillingham 2006).

To monitor effectiveness in achieving these goals, the NWFP record of decision contained two socioeconomic monitoring questions: (1) Are predictable levels of timber and nontimber resources available and being produced? (2) Are local communities and economies experiencing positive or negative changes that may be associated with federal forest management? (USDA and USDI 1994: E-9). After the first 10 years of socioeconomic monitoring, the Regional Interagency Executive Committee identified a new monitoring question: what is the status and trend of social and economic well-being in the Northwest Forest Plan area (at the county level) (Grinspoon et al. 2016)? Socioeconomic well-being in relation to federal forest management continues to be an important concern among agency managers.

Thus, the goal of this chapter is to synthesize findings from NWFP monitoring and scientific research on the relationship between federal forest management and socioeconomic well-being in forest communities in the NWFP area (which includes 72 counties in western Washington, western Oregon, and northwestern California), recognizing that there is a reciprocal relationship between them. We build on Breslow et al. (2016) and define socioeconomic well-being as a state of being with others and the environment that arises when human needs are met, when people can act meaningfully to pursue their individual and collective goals, and when people and communities enjoy a satisfactory quality of life.

"Community" has been defined in many ways in the literature, making it difficult to adopt one general definition here. However, our main focus is on communities of place having social and economic ties to nearby forests, which are typically located in rural areas, where the effects of the NWFP were greatest. Communities are not homogenous; they contain residents with diverse socioeconomic circumstances, values, interests, and relations to federal forests, and federal forest management affects different community residents differently. Although our focus is on the community as a unit of analysis, where possible we draw attention to the diversity that exists among subpopulations in the Plan area. Chapter 10 complements this chapter with a focus on low-income and minority populations and their relations to federal forests in the Plan area.

[1] **Susan Charnley** is a research social scientist, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 620 SW Main Street, Portland, OR 97205; **Jeffrey D. Kline** is a research forester, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; **Eric M. White** is a research social scientist, Pacific Northwest Research Station, 3625 93rd Avenue SW, Olympia, WA 98512; **Rebecca J. McLain** is an assistant research professor, Institute for Sustainable Solutions, Portland State University, 1600 SW 4th Avenue, Suite 110, Portland, OR 97201; **Cassandra Moseley** is a research professor and director of the Ecosystem Workforce Program, **Heidi Huber-Stearns** is an assistant research professor and associate director of the Ecosystem Workforce Program, and **Jesse Abrams** is a research associate, Institute for a Sustainable Environment, University of Oregon, 130 Hendricks Hall, Eugene, OR 97403.

Guiding Questions

This chapter focuses on six key questions pertaining to socioeconomic well-being in NWFP-area communities and federal forest management:

1. What is the statutory and policy foundation for considering socioeconomic well-being in federal forest management, and how does it reflect changing understandings of the relation between community well-being and federal forest management over time?
2. What has been the impact of the NWFP on rural communities in the Plan area?
3. How have social and economic conditions in rural communities in the Plan area changed over the past two decades?
4. How do goods, services, and opportunities from federal forests contribute to socioeconomic well-being in rural communities?
5. How do rural communities contribute to federal forest management?
6. What implications do changes in land use and land ownership over the past two decades have for federal forest management?

We summarize key findings pertaining to these questions at the beginning of the sections, below, which address each one in depth.

Summary—
Laws that direct the U.S. Forest Service and Bureau of Land Management (BLM) to create social and economic benefits for communities and the public date back to the inception of the agencies. Legislation in the first half of the 20th century emphasized provision of a continuous flow of timber from federal forests to promote economic stability in the forestry industry and forest communities. Legislation passed in the second half of the 20th century strengthened environmental goals and planning requirements associated with federal forest management, but also reaffirmed the economic goals of the Forest Service, and added or expanded social goals. Law and policy have also often given special consideration to people living near national forests and BLM-managed Oregon and California (O&C) Railroad Revested Lands in the form of payments to counties, for example.

With adoption of the NWFP, the goal of providing social and economic benefits to communities continued alongside an increased focus on environmental protection and restoration. At the same time, community benefit began to be conceptualized as coming from activities beyond traditional timber harvest and milling activities, such as ecosystem management, forest and watershed restoration, outdoor recreation, and the harvest of nontimber forest products. This shift reflected a change in thinking about well-being in forest communities from being a product of nondeclining, even flows of timber, to being influenced by a host of commodity and noncommodity benefits from federal forest lands.

Subsequent to the adoption of the NWFP and the occurrence of several large, high-visibility wildfires, wildfire became the central focus of national forest management-related law and policy. In parallel to the adoption of the NWFP, wildfire policy has shifted from a 20th-century focus on using fire suppression to protect natural resources (i.e., timber), to a focus on protecting firefighters and communities—especially

Key Findings

Statutory and Policy Foundation and Evolving Understandings of Socioeconomic Well-Being and Federal Forest Management

The relationship between federal forest management and community well-being has been understood from different perspectives over time, with both the Forest Service and Bureau of Land Management (BLM) being concerned with community well-being historically. The National Forest System was inspired in part by concerns about the predominant timber harvesting practices of the late 19th century, in which mobile logging camps exploited forests and then moved on without considering reforestation needs. Not only was this pattern of timber exploitation detrimental to U.S. forest stocks, it also raised concerns about the unstable

homes and other structures, community preparedness and forest restoration to create wildfire-resilient landscapes. In turn, the concept of community resilience has emerged, which focuses on the ability of a community to successfully cope with and adapt to natural disturbances and change. Wildfire is now a critical issue to address in the context of federal forest management and community socioeconomic well-being.

livelihoods and lifestyles of forest workers, and communities experiencing boom and bust economic cycles associated with unsustainable logging practices (Hibbard 1999, Quirke et al. 2017). Given many rural communities' high degree of economic dependency on lands that were designated as national forests, there has been a longstanding public policy concern with the effects of national forest management on community "stability" (Dana 1918, Kaufman and Kaufman 1946). Although the BLM came to manage forest lands within the NWFP area under a different set of historical circumstances, the policy framework for managing these Oregon and California (O&C) Railroad Revested Lands has likewise shown a long-standing concern with providing local community benefits (Richardson 1980). Thus, the NWFP focus on the impacts of reduced federal timber harvesting on rural community well-being has continuity with broader policy goals reflected throughout the histories of these agencies.

Conceptually, the social and economic dimensions of laws and policies associated with the Forest Service and BLM can be broken into two categories: (1) those that require or authorize the agencies to create social and economic benefits for the nation or particular populations, and (2) those that authorize or require the agencies to provide opportunities for input into the planning and management process by the public as a whole, or particular subpopulations. The former is the focus of this section.

Social and economic goals in federal forest management law and policy—
Laws that direct the Forest Service and BLM to create social and economic benefits for communities and the public date back to their inception. In the Forest Service's Organic Act of 1897, for example, forest reserves (later national forests) were to provide for water flow and a continuous supply of timber (Wilkinson and Anderson 1987). Under the Organic Act, a central goal of creating forest reserves was to ensure that western timber did not end up in the hands of private industry monopolies and was continually accessible for the "greatest good." Throughout the second half of the 20th century, the focus on timber as the primary public benefit of national forest and BLM O&C land management increasingly came into conflict with other uses and benefits of federal forest lands. Although the National Forest Management Act (NFMA), the BLM's Federal Land Policy and Management Act, the Wilderness Act, and other laws passed in the 1960s and 1970s strengthened environmental goals and planning requirements, Congress also reaffirmed the economic goals of the Forest Service, and added or expanded social goals in these same laws. For example, NFMA expanded the authority of the agencies to harvest timber by legalizing clearcutting, and the Wilderness Act was as much about protecting special places for recreation and scenic beauty as it was about environmental protection in its own right.

In parallel to the "greatest good" concept embedded in much of federal land management legislation, law and policy have also often given special consideration to people living near national forests and BLM O&C lands. The most well known of these laws is the 1908 Twenty-Five Percent Fund Act (Public Law 60-136), which requires the Forest Service to pay 25 percent of its revenue generated from timber sales and other goods and services from national forests to counties to help fund roads and schools. On the BLM side, although the revesting of O&C lands in western Oregon to BLM management was an effort to get timberlands out of the hands of a corrupt railroad company, decisions about what to do with those lands revolved around the likely local economic impacts on communities, specifically the local timber industry and local taxation (Richardson 1980). Ultimately, sustained-yield timber production, and paying counties a portion of agency timber revenues, also became an obligation of O&C forest management (Richardson 1980). Fifty percent of timber revenues from BLM O&C and Coos Bay Wagon Road lands were returned to counties to use for any general county purpose (Phillips 2006b).

The Sustained-Yield Forest Management Act of 1944 (16 U.S.C. Section 583), which authorized the secretaries of the Department of Agriculture and Interior to create sustained-yield units (or "cutting circles") on federal, or combined federal and private lands, is another example of local community consideration in forest policy. The act provided local lumber mills with exclusive access to federal timber and encouraged a continuous supply of timber that would stabilize forest industries, employment, and communities near federal forests. As reflected in the act, from the 1940s through the 1980s, national forest management was thought to be important in contributing to "community stability," defined in terms of stable timber industry employment and income in forest communities (Le Master and Beuter 1989). Contributing to community stability through a policy of sustained-yield timber harvesting to provide a nondeclining, even flow of forest products and associated jobs and income was a central goal of national forest management between the 1940s and 1980s (Le Master and Beuter 1989, chapters in Lee et al. 1990) (fig. 8-1).

The belief that national forest management can ensure community stability was questioned in the 1980s as it was recognized that many variables influence social and economic well-being in rural communities (Charnley et al. 2008b, Cook 1995, Force et al. 1993, Nadeau et al. 2003, Power 2006, Sturtevant and Donoghue 2008). Federal forest managers cannot ensure community economic stability through their management actions alone, particularly if such stability is assumed to arise from a consistent flow of timber. However, management of federal forests and investments in federal forest management (including the presence of a federal workforce) can contribute to community stability and business vitality. The positive economic and social outcomes in the Blue Mountains of Oregon from the Pacific Northwest Region's "eastside strategy" and the state of Oregon's Federal Forest Restoration Program (previously the Federal Forest Health Program) illustrate how investment in federal forest management can promote community well-being (Bennett et al. 2015, White et al. 2015).

Under the NWFP, the goal of providing social and economic benefits to communities continued even as an increased focus on environmental protection and restoration challenged the provisioning of traditional timber-based benefits from federal forest lands. At the same time, community benefit began to be conceptualized as resulting from activities beyond traditional timber harvesting and milling, such as ecosystem management, forest and watershed restoration, outdoor recreation, and the harvest of nontimber forest products (Hibbard and Lurie 2013, Kruger et al. 2008). As the Forest Service adopted

Susan Charnley

Figure 8-1—Coos Bay, Oregon, historically supported a diversity of logging and milling operations.

ecosystem management as its new management paradigm (Thomas 1996), it actively invested in job training and management projects with the goal of creating a new class of quality jobs in ecosystem management and restoration for displaced timber workers and communities affected by this transition in forest management (Spencer 1999). One effort to do so was the Jobs in the Woods Program, which began as part of the NWFP and included waivers of federal procurement law that allowed the Forest Service and BLM to set aside service contracts for ecosystem management to benefit contractors located in counties affected by the plan (Moseley 2005). Although this program was too small to offset the number of jobs lost in the timber industry, it did provide short-term employment for some displaced timber workers (Dillingham 2006). Moreover, its intent—to create jobs in local communities associated with restoration and ecosystem management—carried forward into subsequent agency programs (e.g., Secure Rural Schools Act projects, stewardship contracting, and community-focused National Fire Plan projects, described below).

Along with this shift toward ecosystem management, the 1990s gave rise to new understandings of community-forest relations that acknowledged the diverse contributions federal forests make to "community well-being." Studies recognized that well-being in forest communities included quality of life attributes beyond jobs and income, such as health, safety, educational attainment, political participation, social equity, empowerment, community cohesiveness, and access to social services (Beckley 1998, Doak and Kusel 1996, Harris et al. 2000). Studies also recognized that federal forests can contribute to community well-being in multiple ways, including both commodity (e.g., timber, grazing, minerals, nontimber forest products) and amenity (e.g., outdoor recreation, scenic beauty, clean air and water, open space, landscape) values they provide (Beckley 1998, Kusel 2001, Nadeau et al. 2003, Sturtevant and Donoghue 2008). Community capacity—defined as the ability of community residents to respond to internal and external stresses, create and take advantage of opportunities, and meet the needs of residents (Kusel 2001)—was found to be critical to well-being in forest communities.

In the past two decades, little congressional lawmaking has related to federal forest management. That which has occurred has tended to include some attention to local community social and economic needs. Laws that were designed to shore up payments to counties as timber harvest declined, first in the Plan area and then nationwide, are good examples. Timber-sale receipts comprised the vast majority of payments to county governments and dropped dramatically with the spotted-owl-related injunctions on timber harvesting in the early 1990s and subsequent implementation of the NWFP. Consequently, Congress passed a series of measures starting in 1991 to mitigate the lost revenues to counties using new formulas to calculate payments, the most recent of which was the Secure Rural Schools and Community Self-Determination Act of 2000 (Phillips 2006b). Although the Secure Rural Schools Act was initially set to expire in 2006, it has been reauthorized and extended several times, most recently on April 16, 2015, for 2 more years.[2] The Act was allowed to expire in 2017, prompting agencies to revert to making payments to counties from revenues generated by timber sales (25 percent for the Forest Service, 50 percent for the BLM) under the 1908 Payments to States Act. Congress continues to debate reauthorization; this is a subject of ongoing political debate and economic uncertainty in NWFP-area counties that relied heavily on these payments (Hoover 2015). In addition to payments to counties to backstop declining timber revenues, the Secure Rural Schools Act created local resource advisory committees to advise the Forest Service on priority ecosystem management and restoration projects that could be funded through Title II of the act. In addition, stewardship contracting, permanently authorized through legislation in 2014, has meeting local community needs as one of its central goals (P.L. 106-393; P.L. 106-291, Sec 323) (Kitzhaber 1998; Moseley and Charnley 2014). Similarly, for much of the 2000s, Congress provided appropriations language authorizing the Forest Service and BLM to consider local economic benefit when awarding restoration-related service contracts (e.g., PL 108-7, Sec 333). Although the exact language varies from

[2] http://www.fs.usda.gov/pts/.

law to law, typical beneficiaries include workers and businesses in forest communities, local communities, or isolated communities.

An area of significant rulemaking in the decades following NWFP adoption were efforts to revise the Forest Service planning rule, which elaborates how national forests should create long-term plans as required under the NFMA.[3] The planning rule had last been modified in 1982 under the Reagan Administration. Several subsequent revisions were attempted but never completed, so forest planning (either full plan revisions or plan amendments) continued to follow the 1982 planning rule (Schultz et al. 2013). From the beginning, the Obama Administration placed a strong emphasis on creating a new planning rule that could become successfully institutionalized, including provisions for significant public involvement and collaboration. The planning rule, as finalized in 2012,[4] requires assessment of numerous social values including social, cultural, and economic conditions and benefits that people obtain from forest plan areas and of recreation opportunities (FR 88 no 68. Sec. 219.6 (6)-Sec 291.6(13)); it directs plans to provide for social and economic sustainability (Sec. 219.8(b)). The planning rule also calls for multiple uses of national forests, including not only timber harvest but also aesthetic values; access to fishing, hunting, and gathering; and access to recreation and water supplies. Among many shifts in the planning rule from prior versions is the introduction of the concept of "ecosystem services," which is framed as the range of social, economic, and ecological benefits from national forests to be provided presently and into the future (Subpart A. Sec. 219.1).

Wildfire policy—

During the early years of the NWFP, the focus of forest management was centered around reconciling competing demands for timber production and threatened and endangered species conservation. However, subsequent to the adoption of the NWFP and the occurrence of several large, high-visibility wildfires in the region (Reilly et al. 2017), wildfire became the central focus of national forest management, eventually consuming over half of the agency budget by the mid-2010s (see chapter 3 for discussion of the wildfire issue). Wildfire policy and practice have also undergone dramatic transformation, although with only relatively little congressional involvement. With wildfire costs increasing from 16 percent of the Forest Service budget in the 1980s to more than 50 percent in 2015,[5] wildfire management now affects every corner of the agency by dramatically reducing funds available for other management activities.

Prior to the NWFP era, wildfire was rarely mentioned in law and policy (Nelson 1979), perhaps because wildfire occurrence nationwide was relatively low from the 1940s through the 1980s (Agee 1993). Nevertheless, wildfire management has deep roots in the founding and early management of the Forest Service (Pyne 1981), and there were decades of wildfire suppression capacity-building prior to the NWFP (Davis 2001). As noted above, the focus of wildfire policy has largely shifted from fire suppression to protect timber, to ensuring firefighter safety and protecting homes and other structures. Restoration for ecological objectives, including increasing the resilience of forests to fire and drought, has also become a forest management goal (chapter 3). The 2001 National Fire Plan increased the focus on community preparedness for wildfire, hazardous fuels reduction, ecosystem restoration, reintroduction of prescribed fire, and other management changes (Steelman and Burke 2007) (fig. 8-2). The Healthy Forest Restoration Act of 2003, among other things, created a community wildfire protection planning process that allowed national forests that had participated in community planning to use expedited planning processes for hazardous fuels reduction projects in the Community Wildfire Protection Plan (CWPP)-designated wildland-urban interface (WUI) (Vaughn and Cortner 2005). Increasingly, there are calls for managing wildfire more to meet the goals of reducing forest fuels and wildfire risk to communities and ecosystems (e.g., North et al. 2015), though it has been difficult to manage wildfire for resource benefits in practice in many landscapes (Calkin et al. 2015).

[3] http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362536.pdf.

[4] http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5362538.pdf.

[5] http://www.fs.fed.us/sites/default/files/2015-Fire-Budget-Report.pdf.

Susan Charnley

Figure 8-2—In the 2000s, wildfire policy has shifted to focus on community wildfire protection and preparedness.

The Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act) sought to reduce the growing impacts of wildfire expenditures on the rest of the Forest Service budget. It also required the creation of the National Cohesive Wildland Fire Management Strategy, which increases the focus on creating resilient landscapes, fire-adapted communities, and safe and effective wildland fire response. From the National Fire Plan of 2001 to the Cohesive Strategy adopted a decade later, there have been significant policy efforts to change wildfire management, many of which have increased focus on community preparedness and protection in wildfire. Both the use of fire (prescribed or naturally ignited) and the use of silvicultural treatments to alter fuels conditions are complicated by ecological, economic, and social challenges that reflect decades of past land use patterns and policies (Carroll et al. 2007). Although much change has occurred, there has been a significant pattern of stasis as well, making clear that wildfire management is an increasingly complex social-ecological problem with few easy solutions (Carroll et al. 2007, Fischer et al. 2016). Nevertheless, it is a critical issue to address in the context of federal forest management and community socioeconomic well-being.

As wildfire law and policy have shifted to emphasize community preparedness, hazardous fuels reduction, and reintroduction of prescribed fire to create wildfire-resilient landscapes, a parallel paradigm shift has occurred in thinking about community-forest relations. Much of this thinking now revolves around the concept of "community resilience" (e.g., Daniel et al. 2007, Lynn et al. 2011, McGee 2011, Paveglio et al. 2009), which focuses on a community's ability to cope with and adapt to natural disturbances and change. Building on Folke (2006), Magis (2010), and Walker and Salt (2006), community resilience is defined here as the

ability of a community to successfully cope with, adapt to, and shape change, while still retaining its basic function and structure. Federal land management policies that help promote community capacity to adapt to change may contribute to socioeconomic well-being (Anderson and Kerkvliet 2011).

The Impact of the Northwest Forest Plan on Rural Communities

From a social standpoint, the primary concern relating to socioeconomic well-being and federal forest management in Plan-area communities historically has been the impacts of reduced timber harvesting from federal lands on forest products workers, businesses, and timber-dependent communities in particular. In the Plan area, a steep harvest decline followed the 1990 listing of the northern spotted owl (*Strix occidentalis caurina*) as threatened under the Endangered Species Act (Charnley et al. 2008b) (fig. 8-3). In the 1980s, timber sales from Forest Service and BLM lands in the Plan area averaged 5.5 billion board feet annually (Charnley et al. 2008b). Intensive timber management on federal lands ended in the early 1990s owing to a series of lawsuits over the protection of the owl and associated species under the Endangered Species and National Forest Management Acts (Thomas et al. 2006), and related injunctions on federal timber sales within the range of the owl (Charnley 2006b). The social controversy engendered by the "owl wars," in which the interests of environmentalists concerned with the impacts of timber harvesting on old-growth forests and associated species were pitted against the interests of forest products workers and forest communities, is well documented (e.g., Carroll 1995, FEMAT 1993, Satterfield 2007). The NWFP was an attempt to balance these interests, and offer a solution that would provide "a sustainable level of human use of the forest resource while still meeting the need to maintain and restore the late-successional and old-growth forest ecosystem" (USDA and USDI 1994: 26–27).

Over the past two decades, a body of literature has emerged that assesses the impacts of the owl listing and NWFP on communities. This literature is composed of the results of NWFP socioeconomic monitoring (Charnley 2006a, Charnley et al. 2008a, 2008b; Grinspoon and Phillips 2011, Grinspoon et al. 2016) and a number of additional studies by economists and other social scientists. It is important to note that changes in the forest products industry in Plan-area communities and economies were not solely a result of declines in timber harvesting on federal forest lands. The most significant factors influencing the

Summary—
Numerous factors have influenced socioeconomic well-being in rural communities in the NWFP area; here we focus on the impacts of the NWFP. We begin by describing regional and national trends in the wood products industry to provide context for understanding Plan impacts. Regarding wood products production, market conditions facing the forest products industry are driven by overall consumer demand for wood products (e.g., lumber, paper, and engineered wood products), global competition, and technological change. Construction and remodeling account for the greatest demand for lumber and engineered wood products; therefore, changes in the housing market over the past 20 years have affected the forest products industry in the Plan area. Over and above changes in demand, industry restructuring and technological improvements have generally led to contractions in wood products manufacturing and a reduction in the number of workers required in the milling process. Nevertheless, demand fluctuations do influence employment levels in wood products manufacturing over short time periods, such as the increase in employment in wood products manufacturing that occurred when the overall economy improved post-2010, as the economic recession that began in December 2007 subsided.

Private forests currently contribute the vast majority of logs processed by mills in the Plan area. Greater timber harvest on federal forests would increase the number of logs available to mills and create additional work opportunities for logging contractors in the short term. If long-term mill output within the Plan area increased as

a result of higher federal harvest levels, these short-term changes in timber supply and harvesting contracts could extend for longer periods and could include additional work in processing facilities. However, log supply is not the sole determinant of the level of output from mills. Rather, demand for wood products in the United States and globally, mill production technology, currency exchange rates, and competition from other domestic and international wood product producers combine with other factors to influence levels of wood products production. As elsewhere in the West (and Nation as a whole), the wood products manufacturing sector in the Plan area has experienced mill closures and employee reductions. However, mills remaining in operation and those coming into production have greater production capacity and lower labor demands than those that closed. This trend results in the seemingly contradictory pattern of falling mill numbers and reductions in mill workers, but smaller declines (or even increases) in aggregate milling capacity, and increasing average mill capacity. Further, within the Plan area, mills are using more of that available capacity relative to mills elsewhere in the West, generally a sign of mill strength and demand for workers.

Within the Plan area, and especially in Oregon, much of the federal timber log supply comes from thinning harvests in plantations that are less than 80 years of age. Recent discussions about future federal forest management within the Plan area have proposed variable-retention harvests and ecological forestry within matrix lands to create more early seral vegetation through regeneration harvests, conserve older forests, and provide a more reliable flow of ecosystem services, including timber.

NWFP-related impacts on communities are associated primarily with cutbacks in federal timber harvesting, loss of federal agency jobs, reductions in federal contract spending, and the setting aside of reserve lands that exclude intensive timber production. Research examining the nature and extent of these impacts on communities has produced different findings. These differences may be attributed to the unit of analysis used to assess impacts (i.e., region, county, community); the period considered (first vs. second decade of the Plan); and the different datasets and indicators used to assess impacts. Most studies evaluate NWFP socioeconomic impacts using secondary indicator data pertaining to population change and economic variables such as employment, income, poverty levels, and property values, rather than primary data (data gathered at the community scale directly from community residents).

The findings of these studies can be generalized as follows:

1. Impacts attributed to the NWFP include population growth and decline, increases and decreases in socioeconomic well-being, and increases and decreases in economic indicators. Some studies found no NWFP impact on population and economic indicators.
2. NWFP impacts on communities differed at the community and county scales, and depended on local social, cultural, economic, and environmental contexts.
3. Impacts (both positive and negative) were greater during the first decade of the NWFP than they were during the second decade.
4. Impacts (both positive and negative) were greater in communities located close to national forests, or to reserved lands set aside by the NWFP, and in communities that had experienced a mill closure (not necessarily a result of the Plan).
5. Impacts were greater at the community scale than at the county and regional scales, and were greater in nonmetropolitan counties than they were in metropolitan counties.
6. Given the growing incidence of large and severe wildfires in the NWFP area, one important way in which federal forest management will affect rural communities moving forward relates to management for forest restoration and wildfire.

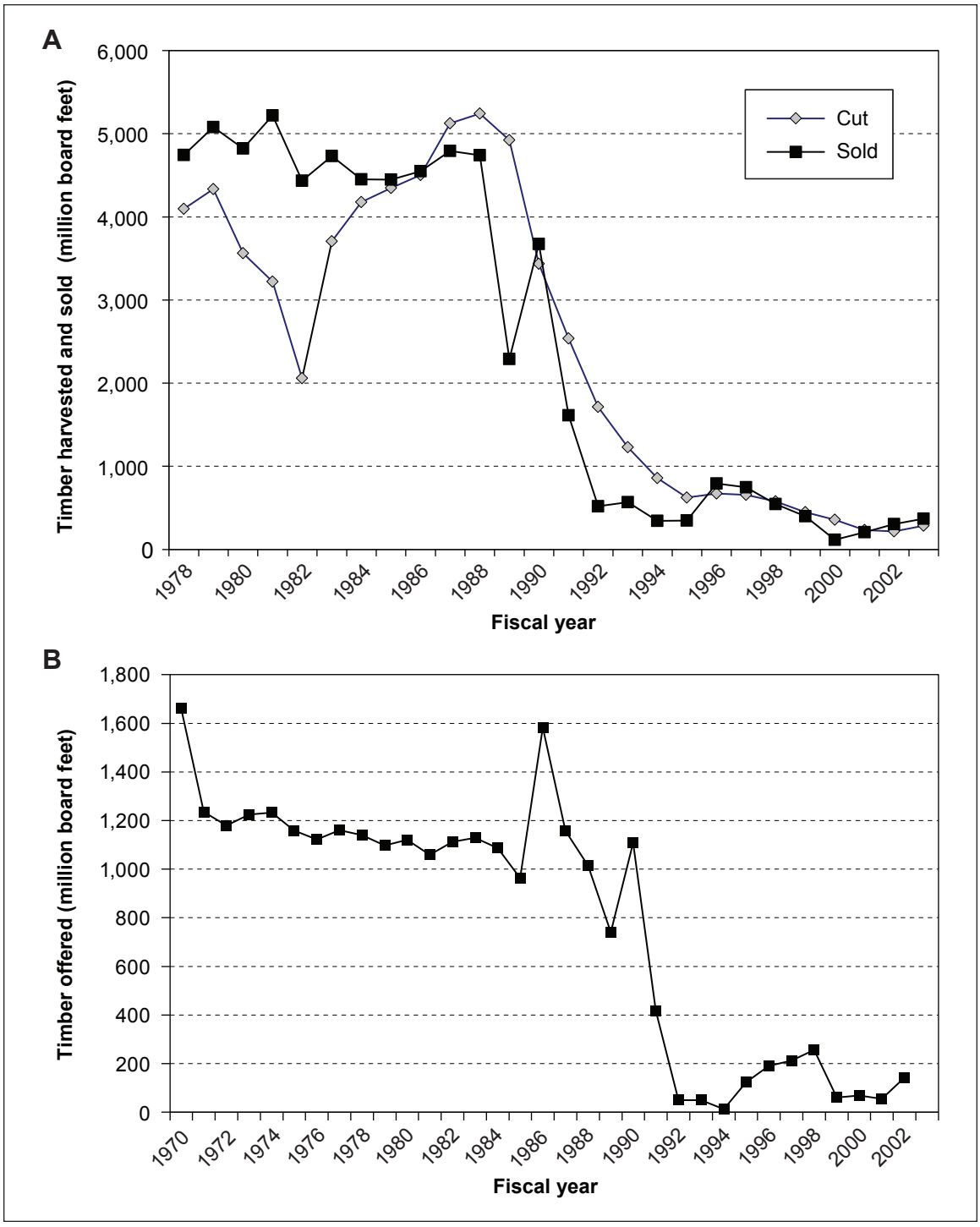

Figure 8-3—Volume of timber offered for sale, sold, or harvested from (A) Forest Service and (B) Bureau of Land Management units in the Northwest Forest Plan area, 1970s–2002. Source: Charnley 2006c.

industry are market conditions (e.g., demands for lumber and paper products), technological advances in wood processing, foreign and domestic competition, the cost of labor and manufacturing equipment, currency exchange rates, and timber availability (Keegan et al. 2006, Ince et al. 2011, Skog et al. 2012). Thus we begin this section by providing a broader picture of changes taking place in the wood products industry in the NWFP area and more broadly during the past three decades. We then focus on the role of federal forest management by discussing the impacts of the owl listing and the NWFP. We also briefly discuss the effects of wildfire management on local communities because wildfire on federal forests has become a salient factor affecting socioeconomic well-being there.

The wood products production market—
The primary wood products manufactured in Oregon, Washington, and northern California are dimensional lumber and plywood used in housing construction and remodeling. For the most part, the wood products produced within the NWFP area are commodity products, meaning they compete, in many cases, with products of the same quality produced from forests in different regions of the United States and around the world (Skog et al. 2012). Consumption of wood and paper products in the United States has risen in recent decades, but that consumption has been increasingly met through imports from other countries with lower costs of production (Skog et al. 2012). Further, wood products produced in the NWFP area must compete with nonwood products, such as concrete, steel, and composites that can be used in the same construction applications. These substitutes have been slowly taking market share from wood products over the past few decades because of consumer preferences, technological advances in materials, and cost (Ince et al. 2007). Although both heavy competition from other countries and substitute materials are anticipated, U.S. lumber production is still projected to increase through 2040, from a low point in 2010, under a variety of alternative future scenarios because of expanding domestic demand for wood products (Ince et al. 2011). The magnitude of the projected increase depends, however, on assumptions about the magnitude of increases in housing starts, gross domestic product (GDP) growth, and global demand for wood to use in energy production (Ince et al. 2011). Smaller increases in housing starts and GDP, and lower demand for wood for energy in foreign markets, yield lower levels of projected future U.S. lumber production.

Lumber production—
In the last decades of the 20th century, the Western United States was the Nation's "wood basket" and supplied the majority of softwood lumber produced nationally. That changed in the first decade of the 2000s, when the South became the predominant lumber-producing region. In 2010, lumber production in the Pacific Northwest states—the largest lumber producers in the Western United States—was at its lowest level since the 1950s (Keegan et al. 2011). The case of Oregon is illustrative. Since the mid-1950s, lumber production in Oregon has gone through cyclical ups and downs, but has generally declined over the long term (fig. 8-4) (Gale et al. 2012). The period since the early 1990s has been especially volatile, with dramatic swings influenced by changing timber availability and surges and collapses in the housing market.

The changing role of the Pacific Northwest in the nation's wood products industry reflects the combined effects of broad-scale changes that affect the industry across the United States and globally (i.e., changing demand for wood products, improved milling technology, foreign competition), and regional steep reductions in federal timber supply within the NWFP area. Despite this downturn, the wood products industry remains an important contributor to the economies of Oregon, Washington, and California, although not to the degree that it was in the past. For example, although wood products manufacturing in Oregon slipped from about 8 percent of the state's gross domestic product in the late 1980s to about 1 percent in 2009 (Lehner 2012), in many rural communities it remains an important source of jobs and income. Overall, the economies of the three states have diversified and expanded into other sectors, but this diversification has not necessarily occurred in some local communities.

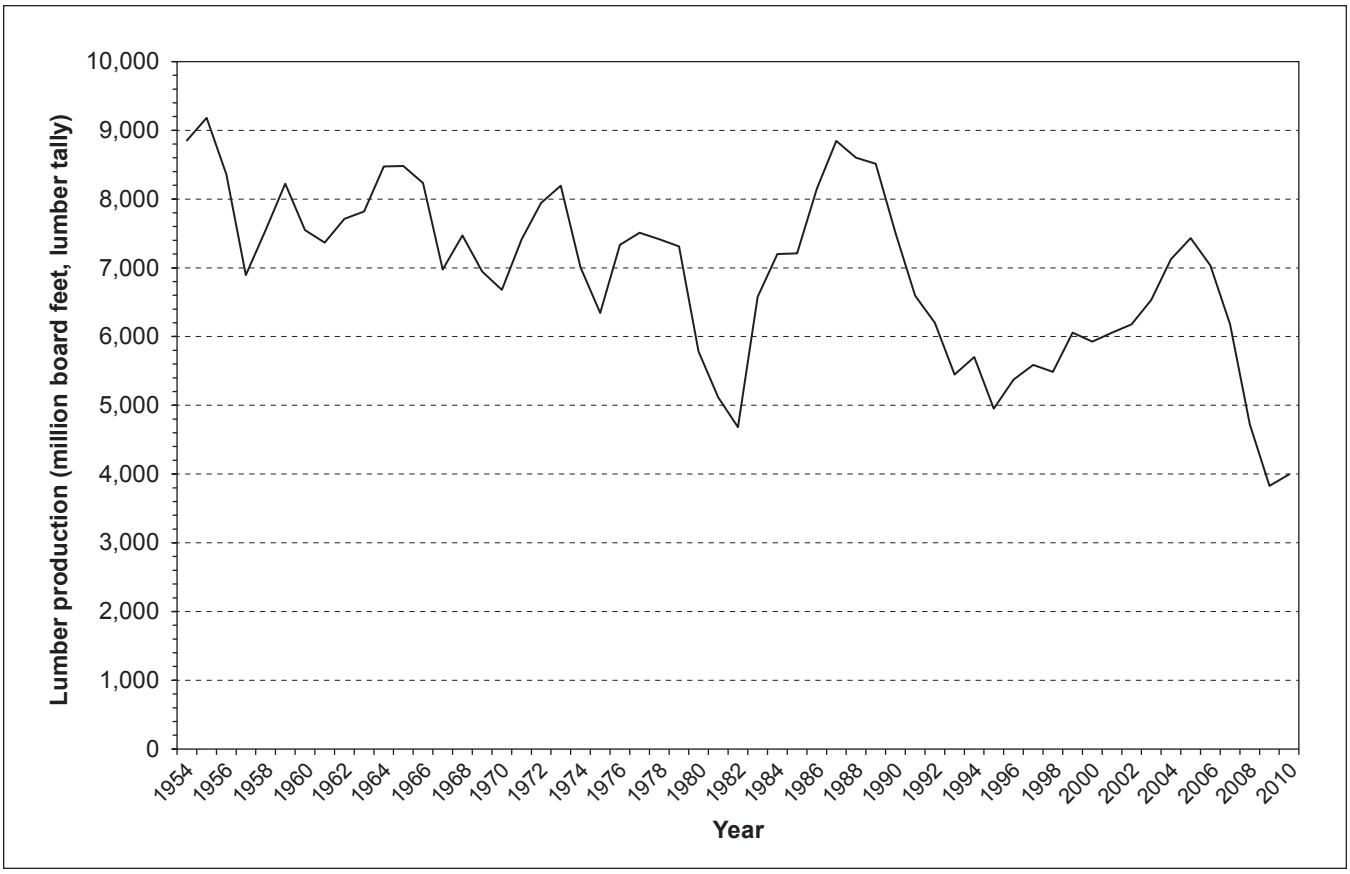

Figure 8-4—Oregon lumber production, 1954 to 2009. Source: Gale et al. 2012.

The role of timber supply—

In California, Oregon, and Washington, since the early 1990s, private (especially private industry lands) and state-owned forests have provided the majority of timber to wood processing facilities (Oswalt et al. 2014). Similarly, in the NWFP area, the majority of timber harvested has come from nonfederal lands (fig. 8-5). Increases in log supply from public or private lands can increase the employment at mills when there is unutilized mill capacity, a healthy market for wood products, and sufficient volume of new logs to warrant adding an additional shift at the mill, or opening another processing line. For example, a sawmill with unutilized capacity in John Day, Oregon, recently increased mill employment over the short term when Forest Service harvest volumes were increased (Bennett et al. 2015). Aside from the amount of federal timber supplied, mill employment remains influenced by market conditions for lumber and other wood products, and changes in milling technology that reduce the amount of necessary labor. Cyclical ups and downs in mill employment (e.g., Lehner 2012) for lumber production follow changing conditions in the economy and markets for housing construction, regardless of federal timber supply conditions (Keegan et al. 2011). Even when timber supply changes are happening, mill employment remains influenced by technological improvements to mill operations. For instance, Helvoigt and Adams (2009) found that 38 percent of the decline in employment at sawmills between 1988 and 1994 (when federal timber harvests declined precipitously) can be attributed to technological change that reduced labor requirements.

Increases in federal timber supply may lead to expansion in lumber production and hiring of mill employees if timber supply is constrained, demand for lumber products is strong, and mill capacity is underutilized. Within the Pacific Northwest, these mill conditions are thought to

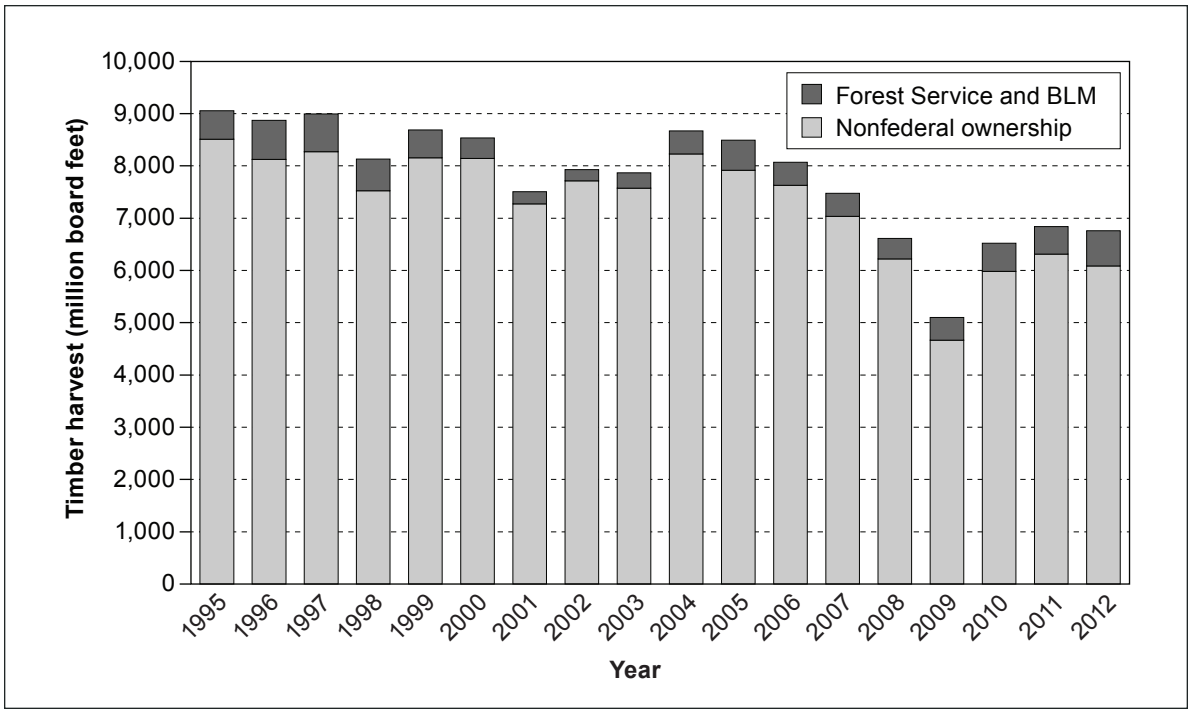

Figure 8-5—Since the 1990s, the majority of timber harvested in the Northwest Forest Plan area has come from nonfederal lands. Source: Grinspoon et al. 2016.

be more commonly found east of the Cascade Range, where productive forests are usually owned by the federal government, and severe losses in milling capacity (Swan 2012) have led to very limited processing infrastructure. In general, economic models have found that significant increases in federal harvest levels benefit wood products manufacturers because more timber is available at lower prices, but pose a disadvantage to private forest owners because the price of stumpage falls, forcing them to sell for less (e.g., Abt and Prestemon 2006, Adams and Latta 2005, Adams et al. 1996, Ince et al. 2011). Stumpage prices may rebound over time if private landowners reduce harvest levels in response to lower stumpage prices. Increased federal timber harvest might improve the well-being of local wood products producers and private forest landowners in situations in which all local milling capacity is in danger of closing, and the addition of federal timber supply helps to keep mills above the tipping point of having to close operations (e.g., Adams and Latta 2005); or where supply increases last for a long time (e.g., Abt and Prestemon. 2006). The potential increased timber supply from "ecological forestry," including variable-retention harvesting[6] (e.g., Franklin and Johnson 2012) in plantations, may well promote improved community well-being if the early seral vegetation created supported long-term timber production, especially in areas with a higher share of dry forest, and in communities that have, or can recreate, a forest products workforce. However, the wood products sector within the NWFP area would remain subject to market conditions and competition from other wood products manufacturers nationally and globally.

Because of the relatively high transport cost, species preference of mills, and supply from private forests, the majority of the wood processed in the NWFP area comes

[6] Franklin and Johnson (2012) identified the key elements of ecological forestry as (1) retaining structural and compositional elements of the preharvest stand during regeneration harvests, (2) using natural stand development principles and processes in manipulating established stands to restore or maintain desired structure and compositions, (3) using return intervals for silvicultural activities consistent with recovery of desired structures and processes, and (4) planning management activities at landscape scales. Variable-retention harvesting is clearcut harvesting that retains a portion (e.g., 10 to 15 percent) of the original forest in undisturbed patches or aggregates distributed across the harvest unit.

from within the region. Historically, there has been relatively little procurement of federal timber from outside the NWFP area by local mills. Under the Forest Resources Conservation and Shortage Relief Act of 1990 (as amended), federal timber in the NWFP area is barred from international export, and, in most cases, purchase by an entity that sells timber into the export market. With that export restriction, federal timber can be a source of wood supply for businesses that have difficulty purchasing logs when there are high prices in the log export market. Additionally, providing a consistent flow of federal timber could offer some certainty to wood processors that some wood volume would be accessible to domestic purchasers in the face of a strong log export market.

Following adoption of the NWFP, the limited social acceptability of harvesting large-diameter and old-growth trees from matrix land allocations on federal lands and of clearcutting (Charnley and Donoghue 2006a), has largely confined harvests west of the Cascades to existing plantations within matrix lands that have younger, smaller trees. Timber harvest prescriptions in these cases often apply commercial variable-density thinning (see chapter 3) to stands younger than 80 years. The focus on harvesting trees under 80 years old in the matrix is counter to the calculation of probable sale quantity (PSQ)[7] in the NWFP (Charnley 2006b), which relied substantially on volume produced from stands over 80 years of age within the timber-suitable base of matrix lands (Johnson 1994, Johnson et al. 1993). One modeling study undertaken in a large landscape in the Coast Range of Oregon estimated that continuing current federal forest management practices that were focused on thinning smaller, young trees in plantations under 80 years of age would ultimately result in a 71-percent decline in federal harvest levels by 2050 (Johnson et al. 2007). The reason for the decline was reduced availability of small- and medium-diameter stands on federal forest lands because thinning did not establish new young stands, and the existing plantations aged beyond 80 years.

[7] Probable sale quantity is an estimate of average annual timber sale levels likely to be achieved over a decade; it is a decadal average. The NWFP identified matrix lands and adaptive management areas as being suitable for producing a predictable and sustainable timber supply, thus only timber produced from these locations counts toward PSQ volume (Charnley 2006c).

Potential future declines in harvest volumes from federal forests would further reduce the contribution of federal timber supply to the traditional forest and wood products sectors of local economies within the NWFP area. As a consequence, the forest and wood products sectors would become more reliant on the supply of timber from private and state-owned forests. Increased use of ecological forestry (Franklin and Johnson 2012) to create early seral vegetation (Swanson et al. 2011) that has been reduced by fire exclusion (chapter 3) and other practices in moist and dry forests could be a way to maintain some level of timber harvest from plantations and other younger forests over the longer run. Challenges to expanded use of ecological forestry and regeneration harvests in the NWFP area include (1) lack of public trust of federal agencies, (2) the scale of restoration needed in dry forests, and (3) the legal and social obstacles to implementing regeneration harvests in moist forests (Franklin and Johnson 2012). In addition, it could be difficult to plan and schedule timber production from early-seral vegetation projects when landscape goals for these conditions can also be met by wildfire, which is unpredictable.

Trends in the number of wood-processing facilities— Reductions in demand for wood products, technology, and reduced log supply from federal forests during the 1980s and 1990s have led to declines in wood-processing infrastructure throughout the United States. Consistent with national trends, over the long term and under varying levels of federal timber supply, the number of operating timber mills and employees in the wood products sector has declined in Oregon, Washington, and California (Gale et al. 2012, Keegan et al. 2011, McIver et al. 2015); the case of Oregon is illustrative (figure 8-6). For example, Oregon had 405 lumber mills in 1980, 282 of which closed over the next three decades for a reduction of two-thirds (Chen and Weber 2012). Similarly, in 1980, 113 rural communities in Oregon had mills (roughly half of them), and by 2007 only 58 communities had mills. Direct job loss per mill closure averaged 100 jobs, a large impact on rural communities whose median population was 2,000 people or fewer (Chen and Weber 2012). It is unknown how many mills in the Pacific Northwest closed specifically because of the NWFP. A variety of factors (e.g., technological change, industry

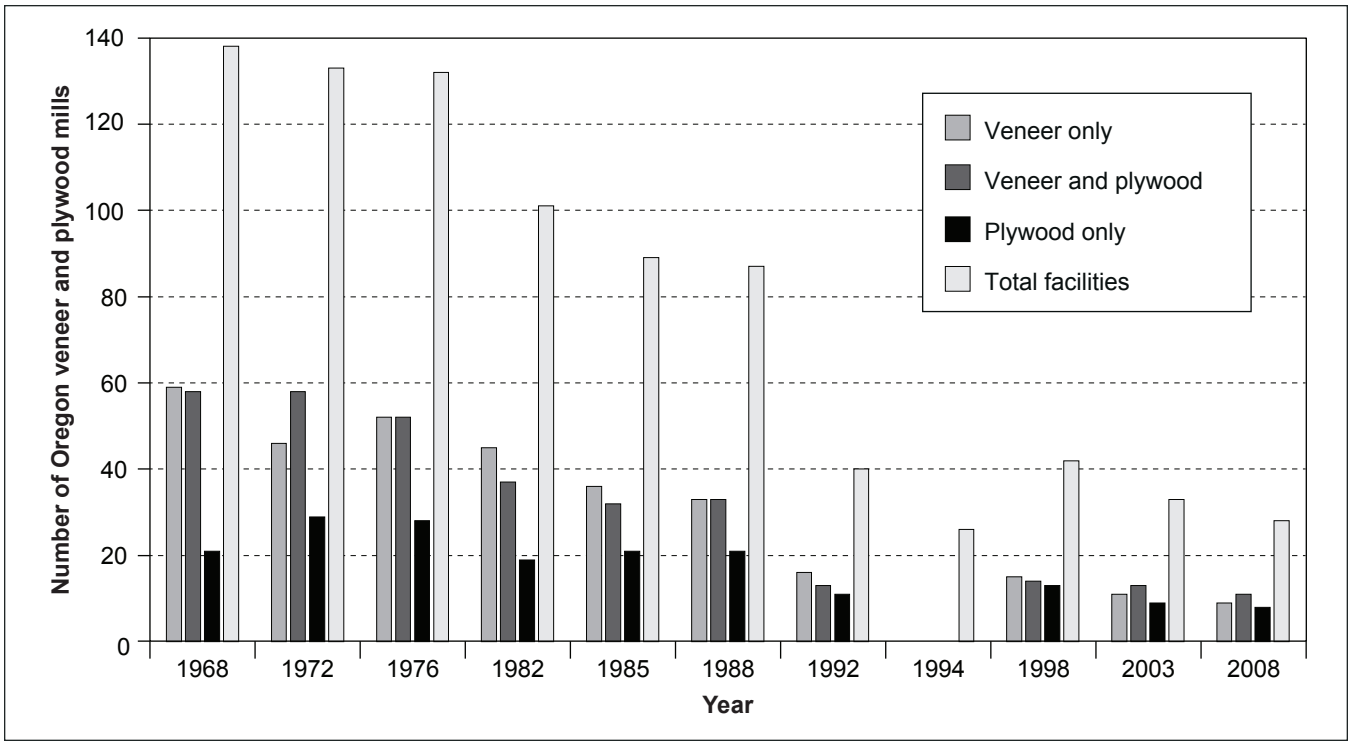

Figure 8-6—Number of veneer and plywood mills in Oregon, 1968–2008. Note that, for 1994, veneer and plywood mills were not counted separately. Adapted from Gale et al. 2012.

restructuring, and competition) have combined to precipitate mill closures in the region. For example, Helvoigt and Adams (2009) found that 38 percent of jobs lost in sawmills in Oregon and Washington between 1988 and 1994 were related to technology improvements in log processing. The remaining jobs losses were due to a variety of factors, including changes in log supply.

More recently, between 2000 and 2003, an estimated 142 wood products plants closed in the United States (Quesada and Gazo 2006). During that time, 20 plants closed in Oregon (the second most in the nation), 13 closed in Washington, and 5 closed in California (Quesada and Gazo 2006). Plant closures (when a cause could be determined) were most commonly attributed to general financial difficulty and reorganization; only 5 of 94 cases cited material shortages as a reason for plant closure (Quesada and Gazo 2006). Between 2005 and 2009, an additional 300 mills temporarily or permanently closed in the Western United States in response to the steep decline in demand for lumber in the housing sector, and competition from other mills (Keegan et al. 2011). The national pattern of mill closures in the 2000s was mirrored in Oregon, Washington, and California (McIver et al. 2015, WDNR 2014).

Mill capacity—

The capacity of operating mills (mill capacity) can be a better indicator of the size of the wood products industry and the potential use of, and demand for, timber harvested from public and private forest lands than the number of mills (Keegan et al. 2011). Because of technological improvements and loss of small mills, the number of mills and mill employees may decline while total aggregate mill capacity across states or regions declines more slowly, remains steady, or even increases. For example, although the number of sawmills in Washington declined from more than 200 in 1968 to 75 in 2002, aggregate mill capacity in the state increased during the period as mills adopted new technology and became larger (Helvoigt and Adams 2009). The average capacity of the mills in operation in 2002 in Washington was three times what it was in 1968 (Helvoigt and Adams 2009).

Historically and currently, the Pacific Coast states (Washington, Oregon, California, and Alaska) have accounted for the majority of the West's milling capacity (Keegan et al. 2006). The change in mill capacity across the West sets the context for considering changes in mill capacity within the NWFP area. Between the late 1980s and 2010, mill capacity in the Western United States declined from about 25 billion board feet to 13 billion board feet—a nearly 50-percent decline (Keegan et al. 2011). Mill capacity losses in the NWFP area during that time reflected, in part, conditions facing the industry elsewhere in the West. Between 1986 and 2003, the Pacific Coast states lost 35 percent of their mill capacity, but this decline was the smallest percentage decline in the West during that period. Post-2005, and influenced in large part by the Great Recession, milling capacity in the Pacific Coast states dropped another 10 percent to a little under 11 billion board feet by 2010. Although that loss was significant, the Pacific Coast region again had smaller percentage declines in mill capacity than elsewhere in the West during that period (Keegan et al. 2011). Within the Pacific Coast states, Oregon and Washington have typically fared better than California and Alaska in rates of change in the industry. For example, in Oregon, mill capacity in 2010 was roughly the same as it was in 1996 (Gale et al. 2012); and in Washington, aggregate milling capacity in 2002 was slightly greater than it was in 1968 (Helvoigt and Adams 2009).

The percentage of mill capacity in use gives an indication of how much additional timber could be processed in the short term with minimal infrastructure investment. Capacity utilization in the Western United States from the 1980s through 2005 (just prior to the Great Recession) remained steady at about 70 to 80 percent (Keegan et al. 2011). In the early 2000s, with high demand for lumber during the housing peak, capacity utilization in the Western United States peaked at a little over 80 percent before subsequently falling to about 56 percent at the height of the recession of the late 2000s (Keegan et al. 2011). After the Great Recession, in 2012, Oregon was utilizing 57 percent of its overall timber processing capacity and 61 percent of its sawmill capacity (Gale et al. 2012); California was using 72 percent of its sawmill capacity (McIver et al. 2015).

Employment in the wood products industry— The U.S. wood products manufacturing sectors have experienced consistent, long-term contraction in employment since the early to mid-1990s (Keegan et al. 2011, Quesada and Gazo 2006, Woodall et al. 2012). Employment in wood products manufacturing in the Pacific Northwest mirrors that pattern. For example, in Oregon, employment in wood products manufacturing has been in a general decline since the late 1970s (Lehner 2012). At various times during that period, contraction in employment has resulted from changes in the demand for lumber and paper products, plant closures, technological advances in manufacturing that led to lower labor requirements, closing of product lines, and consolidation of companies. Demand for softwood lumber closely tracks conditions in the U.S. housing market. Steep declines in demand for new housing and housing remodels in the late 2000s that occurred in association with the Great Recession led to sharp reductions in lumber production, to levels not seen since World War II (Woodall et al. 2012). As result of that decline, the U.S. wood products sector lost nearly 209,000 jobs between 2005 and 2009. This pattern mirrored that seen in other manufacturing sectors, such as the automotive industry, during the same time frame (Woodall et al. 2012).

In the Western United States specifically, employment in the wood products industries dropped by about 50,000, to about 250,000, between 2000 and 2010 (Keegan et al. 2011). Oregon and Washington each experienced wood products manufacturing employment in the 2000s that was below employment levels of the late 1990s (Eastin et al. 2007, Lehner 2012). Subsequent to 2010, there has been a recovery in this sector in Oregon, in line with an overall economic recovery (Rooney 2015). In California, employment remained flat through 2012. Comparable reporting is not available for Washington. Employment in the wood products sector in Oregon is cyclical over the long term, and often tracks in a pattern similar to overall nonfarm employment (although the swings in wood products employment are generally of higher magnitude) (Lehner 2012). Regardless, wood products manufacturing now requires fewer employees than in earlier decades (see Grinspoon et al. 2016), but recovery in recent years has been good relative to employment levels in the 1990s and early 2000s.

It is challenging to predict the complex interactive outcomes of changes in timber production, wood products markets, technologies, and other factors relevant to future timber economies as they interact with global climate trends. However, various climate change scenarios anticipate steady or increasing flows of forest products production worldwide (Alig 2010, Irland et al. 2001, Kirilenko and Sedjo 2007, Latta et al. 2010). Such outcomes could benefit those communities that contain infrastructure for harvesting and processing timber, though effects on wood products prices will influence the distribution of benefits (Alig 2010, Joyce 2007). Within the NWFP area specifically, gains in productivity may be offset by increased incidence of fire, disease, and insect outbreaks, especially in drier forest types within the region (Klopfenstein et al. 2009) and in areas that become more susceptible to other pathogens (Kliejunas et al. 2009).

Effects of the Northwest Forest Plan on timber production and timber industry jobs—
As noted at the start of this section, economic concerns over the impacts of the NWFP on forest communities in the Plan area stemmed mainly from cutbacks in federal timber harvesting. During the 1980s, the allowable sale quantity (ASQ) of timber from federal forests in the Plan area averaged 4.5 billion board feet (BBF) annually (Charnley 2006c). Under the Plan, the PSQ varied during the first decade but averaged 776 million board feet (MMBF) annually between 1995 and 2003. The total volume of timber offered for sale from Forest Service and BLM lands in the Plan area averaged 526 MMBF annually between 1995 and 2003. Of this volume, an estimated 80 percent was from adaptive management areas and matrix lands, and 20 percent from reserve lands. Under the NWFP, only timber offered for sale from adaptive management areas and matrix lands counts toward PSQ, meaning that an annual average of 421 MMBF of PSQ volume was offered for sale between 1995 and 2003 (Charnley 2006c). Reflecting this shift, the total contribution of federal timber to the regional supply dropped from roughly 25 percent in 1990 to under 5 percent in 2000 (Phillips 2006a). By 2003, the expected PSQ volume from federal forests in the Plan area was 805

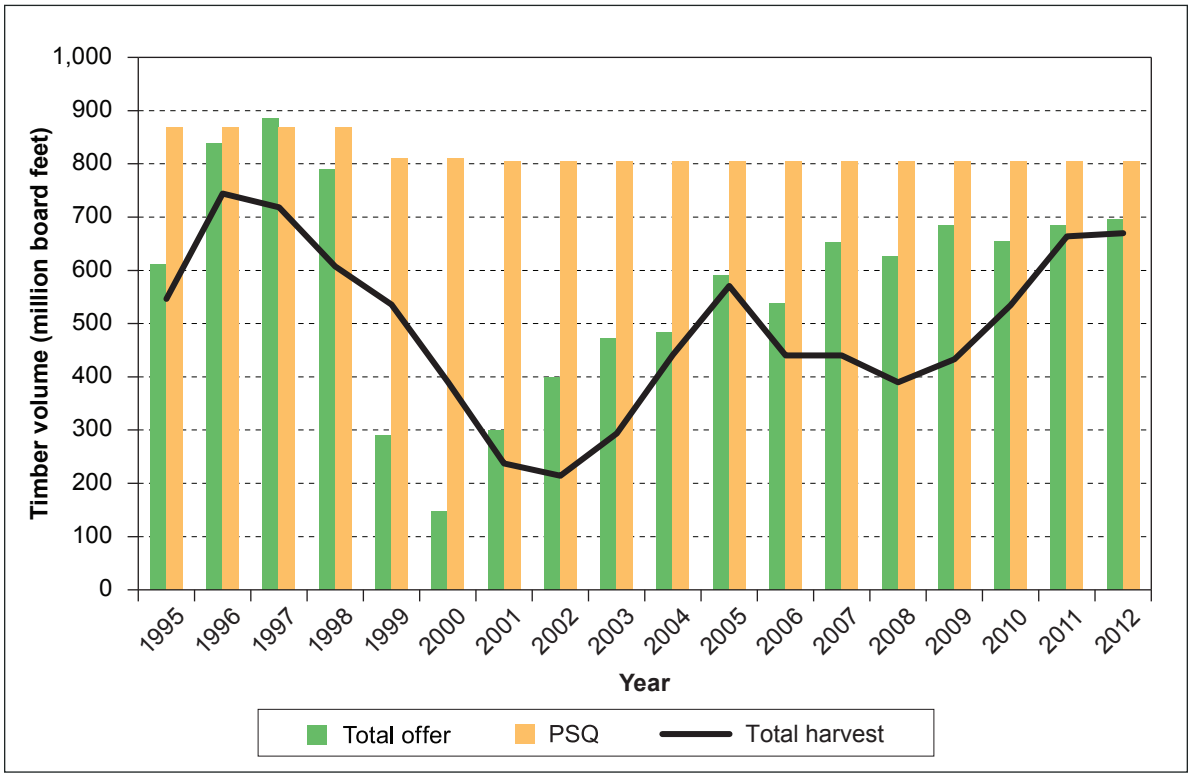

Figure 8-7—Timber offered for sale and harvested from federal forests in the NWFP area, in relation to the probable sale quantity (PSQ), 1995-2012. Source: Grinspoon et al. 2016.

MMBF. During the second decade of the Plan, the volume of timber offered for sale from Plan-area federal forests increased gradually and became more stable and predictable, but remained below the PSQ (fig. 8-7) (Grinspoon et al. 2016). By 2012, federal timber accounted for about 10 percent of the regional timber supply from all land ownerships (Grinspoon et al. 2016).

Regarding employment, jobs in primary wood products manufacturing declined in the NWFP area by 30,000, or 26 percent, between 1990 and 2000, and stood at roughly 85,000 in 2000 (Phillips 2006a). The bulk of the 30,000 job losses (all but 400 of them) occurred between 1990 and 1994, after injunctions on federal timber harvesting were put into place following the owl listing in 1990. An estimated 39 percent of these jobs were lost as a result of cutbacks in federal timber harvesting; the majority of the job loss (the remaining 61 percent) is attributable to technological changes in the industry (Phillips 2006a). In 2001, there were over 100,000 jobs in the NWFP area in the timber sector/forest products industries (logging, primary and secondary wood processing) associated with production from all forest ownerships; by 2012, there were 65,000, a drop of about 40 percent (Grinspoon et al. 2016). In 2001, 12 percent of the jobs in nonmetropolitan counties in the NWFP area were in the timber sector, and by 2012 only 3 percent were in the timber sector (Grinspoon et al. 2016). During this same period, the volume of federal timber sales within the NWFP area increased from about 150 MMBF in 2000, to about 650 MMBF in 2012, meaning that despite the overall job decline the number of industry jobs associated with timber harvesting from Forest Service and BLM lands increased (Grinspoon et al. 2016). In 2012, timber harvested from federal forests in the Plan area supported an estimated 2,300 direct jobs, and 2,500 indirect and induced jobs in the 72 NWFP-area counties (Grinspoon et al. 2016). Total employment in nonmetropolitan counties of the Plan area increased between 2001 and 2012, more than offsetting job losses in the wood products industries. Nevertheless, if people do not have the skills to take advantage of new job opportunities, they may still suffer unemployment.

Adding to the economic effects of changing timber harvest levels on employment in the private sector, additional economic losses resulted from the contraction of public sector agency jobs: the five BLM units in the NWFP area lost 13 percent of their full-time-equivalent positions between 1993 and 2002 (166 jobs), and 15 of the 17 national forests in the NWFP area (excluding the Lassen and Modoc) together lost 36 percent of their full-time-equivalent positions (3,066 jobs). These trends continued during the second decade of the NWFP, especially on Plan-area national forests in Oregon and Washington, which had about 5,700 full-time-equivalent employees in 1993, and 2,300 in 2012 (Grinspoon et al. 2016). Forest Service job loss during the first decade of the plan was associated with declining budgets. Despite growth in Forest Service and BLM budgets at the national scale during the decade (owing largely to increased appropriations for fire and fuel management), national forest budgets for the Plan area as a whole dropped 35 percent, even with increased allocations for fire and fuel management (Stuart 2006). Budget declines were tied to reduced timber harvest levels (Charnley et al. 2008b). BLM job loss was associated with reduced timber sales, but not with reduced budgets; BLM unit budgets rose overall during the first decade of the NWFP, mainly because of stable O&C funding appropriations and additional budget allocations for NWFP-related programs such as Jobs in the Woods and Survey and Manage (Charnley et al. 2008b, Stuart 2006).

Another way in which federal agencies create local community benefit is through procurement contracting, which can provide jobs for local businesses. Although BLM procurement contract spending remained constant during the first decade following NWFP implementation, Forest Service procurement contract spending declined from $103 million in 1991 to $33 million in 2002, meaning that the agency supported substantially fewer external jobs through contracts for services such as road maintenance, forest management, and professional services (Charnley et al. 2008b). Trends in Plan-area procurement contract spending were not analyzed during the second decade of the Plan.

Mitigation measures designed to offset the negative economic impacts of the NWFP included the Jobs in the Woods Program, the Northwest Economic Adjustment Initiative (NEAI), and changes in federal payments-to-counties formulas so that these payments were not tied to subsequent annual timber revenues from federal forest lands. Community economic assistance provided through

the NEAI was generally viewed as having some successes, but as being "too little, too late" overall (Dillingham 2006). Although changes in legislation related to payments to counties have been successful in mitigating the effects of declining timber receipts (Graham 2008, Phillips 2006b), ongoing uncertainty associated with Secure Rural Schools Act reauthorization makes the future uncertain.

Impacts of job loss on wood products workers— Job loss can have severe impacts on affected workers. Employees who lose their jobs in wood products manufacturing face the challenge of finding work in other sectors of the economy, either where they currently live or elsewhere, including perhaps in other states. Helvoigt et al. (2003) examined Oregon employment records to study employment transitions of those displaced from the wood products market in the early 1990s. In Oregon, about 51 percent of wood products sector employees who lost their jobs during industry downturns in the early 1990s found employment by 1998 in other industries within the state, primarily in the service sector, retail trade, manufacturing, and construction (Helvoigt et al. 2003). The remainder of those who lost their jobs either stayed unemployed, left the state, or became self-employed. Those who were able to find employment in another sector within Oregon had median annual wages that were about 1 percent lower than their former wages. However, that small change in median wage was buoyed by the high incomes of those former wood products manufacturing employees who found new jobs in the technology sectors. Many workers who lost their jobs were working in relatively low-paying service-sector jobs by 1998. Aside from changes in wages, there may have been additional losses in benefits coverage not reported in these figures. In southern and eastern Oregon, about one-third of those who lost their mill jobs moved elsewhere in the state for work (Helvoigt et al. 2003).

The impacts of job loss on wood products workers were not purely economic; they were also social. Existing literature finds that mill workers were concerned about economic stability, and have a strong attachment to their home communities (Lee et al. 1991). This finding implies that moving for a new job elsewhere would have strong social impacts. Loggers' sense of identity was closely tied to their occupation, which fostered independence, pride in their work, and the feeling of having a unique job (Carroll et al. 2005). They were also part of an "occupational community" that included other loggers, social interactions with whom strengthened their sense of identity (Carroll et al. 2005). This attachment to a logging way of life meant that many loggers were willing to move or migrate seasonally in order to pursue it (Carroll et al. 2000b). Thus, not only did job loss represent a loss of jobs and income; it also undermined loggers' sense of identity and personal empowerment, which were tied to working in the woods, making finding a substitute occupation difficult. Moreover, loggers and the timber industry were often vilified during the years of the so-called "owl wars," leading to occupational stigmatization, which had a negative social and psychological impact on loggers and their families (Carroll 1995, Carroll et al. 1999). A study of job loss among company loggers in Idaho (Carroll et al. 2000a) found that many loggers chose to stay in logging if they could, even if it meant lower wages and fewer benefits than they had previously enjoyed. Reasons included the relatively high income from logging, attachment to their local community and region, desire to maintain a rural way of life, and sense of identity tied to logging.

Northwest Forest Plan impacts on communities and counties— The impacts of reduced federal timber harvesting following the spotted owl listing and the NWFP on jobs, wood products workers, and communities in the NWFP area have been debated since the 1990s (e.g., Carroll et al. 1999, Freudenburg et al. 1998). Often, different findings emerge depending on the unit of analysis used to assess impacts (region, county, census tract, definition of community, individual or household), time considered, and datasets and indicators used to assess impacts. Thus, studies on the socioeconomic impacts of the NWFP on communities and counties find mixed results. Most studies evaluate NWFP socioeconomic impacts using secondary indicator data, rather than primary data gathered at the community scale from community residents.

The NWFP caused some 11.5 million ac (4.65 million ha) of federal land to be reallocated from commodity production to ecosystem management and conservation status (Chen et al. 2016, Eichman et al. 2010). A number of studies have looked at the effects of federal lands conservation policies and

protected areas generally on local counties and communities in the Western United States. Some have found these policies to undermine the local economic base associated with natural resource production, causing job loss, lower wages, and outmigration (e.g., Duffy-Deno 1998). Others have found that they can be good for communities because they may increase amenity migration and associated amenity-driven economic development (Holmes and Hecox 2004, Lorah and Southwick 2003, Power 2006, Rasker et al. 2013). And some analyses find no significant impacts on employment or wages from proximity to public lands that are protected from, or experience reduced levels of, resource extraction (Duffy-Deno 1997; Lewis et al. 2002, 2003; Pugliese et al. 2015; Rasker 2006). Eichman et al. (2010) pointed out that because the impacts of conservation policies can be both negative and positive, one must analyze their aggregate effects, including how the positive impacts mitigate the negative ones, to fully understand their effects.

Community-scale research conducted as part of NWFP socioeconomic monitoring during the first decade of the NWFP used a community socioeconomic well-being index derived from six U.S. Census variables[8] to evaluate change in 1,314 nonmetropolitan communities in the Plan area (Donoghue and Sutton 2006). Socioeconomic well-being was evaluated based on index scores that ranged from 0 to 100. The index was used to examine change in well-being for a number of parameters; those reported here are (a) number of communities regionwide whose socioeconomic well-being scores increased, decreased, or remained the same between 1990 and 2000; (b) change in socioeconomic well-being scores between 1990 and 2000 in communities based on their proximity to federal forest lands (<5 miles versus ≥5 miles away); and (c) number of communities having very low (0 to 48.72), low (48.73 to 61.07), medium (61.08 to 73.36), high (73.37 to 85.58), or very high (85.59 to 100) socioeconomic well-being scores in relation to proximity to federal forests. Donoghue and Sutton (2006) also looked at variation in the individual indicators comprising the socioeconomic well-being index between 1990 and 2000, and between communities within and greater than 5 miles of a federal forest, also reported here. The authors compared change in socioeconomic well-being in NWFP-area communities within 5 miles of a federal forest, with those 5 miles or more away, because they inferred that communities near federal forests have distinct connections to those forests that differ from those farther away.

The study found that, regionwide, 27 percent of NWFP-area communities experienced little change in socioeconomic well-being between 1990 and 2000 (scores in 2000 were within +3 to -3 points of the 1990 scores); 37 percent experienced a decrease in well-being (ranging from -51 to < -3 points), and 36 percent experienced an increase in well-being (ranging from >3 to 44 points) (Donoghue and Sutton 2006). When comparing means between 1990 and 2000 for each of the six indicators comprising the socioeconomic well-being index, they found that change in the means of five of these indicators were statistically significant at a regional scale ($p < 0.001$). At a regional scale, the percentage of the population in communities with a bachelor's degree or higher went up, the percentage of the population in poverty went down, employment diversity increased slightly, income inequality increased, and average commute time to work also increased during the decade. Change in unemployment between 1990 and 2000 at the regional scale was not statistically significant (Donoghue and Sutton 2006).

Among communities within 5 miles of a federal forest, 40 percent had socioeconomic well-being scores that decreased during the decade, compared with a 33 percent decrease in scores among communities 5 miles or farther from a federal forest. Moreover, most of the communities with very low or low socioeconomic well-being scores in 2000 (71 percent) were within 5 miles of a federal forest. However, 43 percent of the communities with high or very high socioeconomic well-being scores in 2000 were also within 5 miles. Thus, although some communities close to federal forest lands were doing well in 2000, in general, communities farther away had higher socioeconomic well-being scores. When disaggregating the index indicators and comparing their means for 1990 and 2000,

[8] The variables were diversity of employment by industry, percentage of population 25 years and older having a bachelor's degree or higher, percentage of the population unemployed, percentage of persons living below the poverty level, household income inequality, and average travel time to work.

Donoghue and Sutton (2006) found that, on average, communities farther from federal forests had a greater percentage of the population with a bachelor's degrees or higher, less poverty, less unemployment, and less income inequality during both time periods, and a higher diversity of employment by industry in 1990 (but not 2000). Communities farther away also had higher commute times, but there was a positive correlation between average travel time to work and median household income. There were no statistically significant correlations between community socioeconomic well-being scores and community population size or population change (Donoghue and Sutton 2006).

Another study examined how 2000 poverty and unemployment rates (indicators of community well-being) traced to prior high rates of timber industry employment, the share of minority populations, and other characteristics of communities on the Olympic Peninsula in the context of the establishment of the NWFP (Kirschner 2010). The study used panel regression with U.S. Census data from 1990 and 2000, and the census tract as the unit of analysis (which is larger than a community but smaller than a county). In the study region, the poverty rate in 1990, a high minority population in 2000 (primarily American Indians and Latinos), and the share of the population with college degrees were significant predictors of the poverty rate in 2000. The poverty rate in 1990 was believed to reflect the lingering impacts of timber industry restructuring that occurred in the 1980s. The presence of minorities was the only variable tested that was a statistically significant predictor of the unemployment rate in 2000. These findings likely reflect a history of prejudice and discrimination toward, and disadvantage among, these populations, influencing community socioeconomic well-being (Kirschner 2010). The level of reliance on the timber industry as a local employer (used as a proxy for the potential magnitude of the effect of the NWFP) was not found to be a statistically significant predictor of poverty or unemployment in 2000 on the Olympic Peninsula.

Eichman et al. (2010) studied the effects of the NWFP on employment growth rates and net migration rates during the first decade of the NWFP at the county scale for 73 counties that either contain NWFP reserved land (late-successional reserves, riparian reserves), or are adjacent to such counties. They were interested in how the economic effects of net migration might offset those associated with reduced timber production from the reserved lands. They found that in counties having land reserved by the NWFP, there was a negative effect on annual employment growth rates, reducing them by 0.2 percent for every 1 percent of land in a county that was reserved. Thus the presence of reserved lands (12 percent on average across the 73 counties studied) decreased the average annual employment growth rate from 1.75 to 1.52 percent The percentage of decline in annual employment growth was higher in nonmetropolitan counties than in metropolitan counties. This study also found that the NWFP had a slightly positive effect on net migration to the 73 counties, which the authors attribute to the natural features associated with reserved land that attract amenity migrants (e.g., retirees, telecommuters) or help retain residents. However, the positive economic effects of migration only slightly offset the negative impacts of reduced timber harvesting on employment growth rates (-0.019 [total effect] versus -0.021 [without net migration offset]).

Chen and Weber (2012) examined the impact of the NWFP on 234 rural communities (incorporated cities having less than 50,000 people) in Oregon whose economies were based in the wood products industry before NWFP implementation. The authors found complex relationships between community population change and wealth growth (measured by residential and commercial real estate value), mill closures, and proximity to NWFP-reserved land in the decades around establishment of the NWFP. They found that, during the 1990s, proximity to NWFP reserved land (i.e., within 10 miles of reserved land) had a statistically significant positive effect on community population growth and wealth growth compared to communities located farther away. They attributed this finding to positive amenity-related growth effects of the Plan on communities. This positive effect of proximity to reserved lands on population and wealth disappeared by the early 2000s; it was also not evident in the 1980s. In that decade, mill closures caused by the general downturn in the wood products sector and early reductions in federal timber harvest had a direct negative effect on community population, but no statistically significant effect on wealth change

in communities. In the 1990s, with the NWFP in place, mill closures had a direct negative effect on wealth and an indirect (through wealth loss) negative effect on population. That is, the mill closures did not directly influence population change, but the effect of mill closures reduced community wealth, which in turn led to population loss. Oftentimes these negative effects were not limited to communities close to NWFP reserved land because mills are often located away from the log source. By the early 2000s, the relationship between mill closures and wealth creation disappeared, and there was a direct positive relationship between communities with mill closures and communities with population growth. The authors postulated that relationships between mills closures and population and wealth found for the early 2000s may reflect the arrival of amenity migrants in mill towns (after they had already arrived in communities closest to reserved land), and the corresponding increase in residential housing value that offset (in real estate values community-wide) any continued loss in commercial property values.

Chen et al. (2016) extended this analysis by testing for any effect of proximity to NWFP reserved areas on population, income, and wealth through the late 2000s. The authors found that small communities (100 to 2,500 people) within 5 miles of protected NWFP land experienced positive increases in all three attributes relative to those that were farther away. They attribute the correlation between proximity to protected NWFP lands and income, population, and property value growth to the amenity values associated with conservation lands set aside by the NWFP, where land uses were restricted. Because a share of amenity migrants are often individuals with strong purchasing power who can purchase existing homes or build new ones, amenity migration can lead to increases in property values within a community without an associated increase in income in the community. In this study, the authors did find that property values in NWFP-proximate small communities grew more than median income, resulting in a decrease in real income in those communities. The authors found no effect of NWFP proximity for medium-size communities (2,500 to 20,000 residents).

It is difficult to generalize about the effects of the NWFP on rural communities and counties, and its role as a driver of change there, from quantitative studies based on secondary data because the body of research encompasses different periods, different geographic scales and locations, and different indicators. Moreover, although several studies find correlations between different social and economic indicators and lands protected by the NWFP, these correlations do not necessarily imply causation. For example, some studies attribute their findings to the NWFP when they may be the result of proximity to federal lands generally, instead of a specific forest management policy such as the NWFP (Charnley et al. 2008c). Nevertheless, to summarize the results of these studies: impacts attributed to the NWFP include population growth and population decline, both increases and decreases in socioeconomic well-being, and both increases and decreases in economic indicators. Some studies found no NWFP impact on population and economic indicators. Studies also found that NWFP impacts on communities differed at the community and county scales, and depended on local social, cultural, economic, and environmental contexts. In general, impacts (both positive and negative) were greater during the first decade of the NWFP than they were during the second decade. Impacts (both positive and negative) were also greater in communities located closer to national forests, or to reserved lands set aside by the NWFP; and in communities that had experienced a mill closure (not necessarily as a result of the Plan). Finally, impacts were greater at the community scale than at the county and regional scales; and were greater in nonmetropolitan counties than in metropolitan counties.

Qualitative accounts providing insight into causal relationships between the NWFP and socioeconomic conditions in rural communities are less common. Seventeen community case studies that included primary qualitative data collection were undertaken in communities surrounding federal forests in the NWFP area to evaluate its impacts on community well-being during the first decade (Buttolph et al. 2006, Charnley et al. 2008a, Dillingham et al. 2008, Kay et al. 2007, McLain et al. 2006). Charnley et al. (2008c) and Charnley and Donoghue (2006b) summarize the findings of these case studies.

They found that not all communities were affected in the same way, or to the same extent. The NWFP's impacts depended on the relative strength of the wood products industry as an economic sector around 1990; the extent to

which federal timber supported that sector; and the degree to which local residents depended on federal jobs (as agency employees or contractors). Communities that participated heavily in the wood products industry in the late 1980s and early 1990s, where loggers worked mainly on federal forest lands and local mills obtained most of their wood from federal forests, were heavily affected. Communities having a large number of Forest Service or BLM employees were also heavily affected. In communities where tribal or private forest lands were the main source of supply for the industry, the NWFP had a minor impact. Although timber workers and agency employees experienced impacts, at the community level, the effects of the NWFP also depended on economic activity in other sectors. In places where other industries were also in decline (e.g., the fishing industry in coastal communities), the NWFP added to these impacts. In places with more diversified local economies, its impacts were somewhat mitigated, although jobs in other sectors did not necessarily provide opportunities for those who experienced NWFP-related job loss. In communities where the timber industry had declined prior to the late 1980s, or was never prominent—as in some agriculturally oriented communities—the NWFP had little impact.

Effects of wildfire management on communities— Several of the studies reviewed here suggest that rural communities near federal forests are more affected by federal forest management policy than communities located farther away. Communities near federal forests—no matter what their economic orientation—are also likely to face greater risks from the heightened incidence of wildfires that occur there, and that are predicted to increase under a warming climate (see chapter 2). These risks will likely be greatest in areas of WUI expansion (Wimberly and Liu 2014) (fig. 8-8). Socially vulnerable WUI populations may be at

Susan Charnley

Figure 8-8—Home expansion into the wildland-urban interface increases the risk of losses from high-severity wildfire on federal forest lands.

even greater risk (Ojerio et al. 2011). Beyond the strictly economic impacts of wildfire, there are multiple social and health concerns associated with wildfires generally, and large wildfires specifically (Finlay et al. 2012). Recent large wildfires have resulted in injuries, property loss, and death among WUI residents. Wildfire smoke has been associated with increased risk of respiratory disease, and may also be associated with increased cardiovascular disease and mortality (Kochi et al. 2010, Liu et al. 2015, Moeltner et al. 2013, Mott et al. 2002).

Displacement of residents, stress, psychological trauma, and conflict have also been documented in communities affected by wildfires (Carroll et al. 2006, Finlay et al. 2012). The activities of federal fire managers during fires that threaten or damage the built environment can influence trust and relationships between community members and agency managers in the future (Carroll et al. 2006, 2011; Paveglio et al. 2015a). Management activities intended to alter fire behavior, restore forest conditions so they are more resilient to wildfire, or protect human values from fire are often warranted in various forest types throughout the NWFP area (see chapter 3 of this volume). Thus, eliminating fire from these systems is not possible, nor is it possible to eliminate smoke impacts, especially where prescribed fire is a needed forest restoration tool to increase forest resilience to wildfire.

Social and Economic Change in Rural Communities in the Northwest Forest Plan Area

Social science research from the Plan area that examines how communities have changed in the two decades since the NWFP was implemented forms part of a broader literature on rural restructuring in the American West that followed the decline in natural resource extraction as a prominent economic activity in rural communities. Following a brief overview of demographic change in the region, we discuss key findings of this body of research.

Demographic change—
Published accounts of demographic change in the 72 counties of the NWFP area as a whole since the Plan was implemented come from the Plan's socioeconomic monitoring reports. These are inconsistent in their data sources and

Summary—
The population of the NWFP area has been increasing at a faster rate than for the United States as a whole, with the majority of population growth occurring in metropolitan areas. Population trends in nonmetropolitan communities have been variable. Over the past two to three decades, many rural communities in the Plan area have undergone changes in demographic and economic conditions following declines in commodity production. One general trajectory is the "amenity" trajectory, in which communities that are relatively accessible and situated near natural amenities such as mountains and water bodies experience population growth owing to in-migration by people who are seeking an improved quality of life or are fleeing cities, telecommuting, becoming creative entrepreneurs, and living off of retirement or investment incomes. Amenity migration may drive local community development. A second trajectory is for communities to continue with traditional modes of production, albeit at lower levels, or to attract new forms of commodity production or service-oriented economic activity to bolster the local economy. These new businesses may be less desirable but provide jobs, at least in the short term; illegal (e.g., marijuana production on federal lands); or may seek to use natural resources in new and diverse ways through investments in sustainable agriculture and natural resource management. Many communities pursue a range of strategies, with diverse development pathways increasing their resilience. A third trajectory, however, is one in which communities find it difficult to recover from declines in commodity production, and therefore experience population and employment declines. Nevertheless, these communities have latent potential for development associated with the availability of labor, land, natural resources, or infrastructure that may become valuable in the future.

scale of analysis, making simple reporting of trends difficult. Socioeconomic monitoring of the NWFP area during the first decade (1994 to 2003) occurred at the community scale and used decennial U.S. Census data from 1990 and 2000 (Donoghue and Sutton 2006). Socioeconomic monitoring during the second decade (2004 to 2013) occurred at the county scale and used annual mid-year population estimates from the U.S. Census Bureau (reported by the Bureau of Labor Statistics and Bureau of Economic Analysis) for the years 1999 through 2012 (Grinspoon and Phillips 2011, Grinspoon et al. 2016). All of these reports distinguish between trends in metropolitan and nonmetropolitan areas. A metropolitan area is a core urban area with a population of 50,000 or more people, and can be composed of several counties.[9] The 10-year socioeconomic monitoring report identifies 10 metropolitan areas and 1,314 nonmetropolitan communities in the NWFP area (Donoghue and Sutton 2006), and identifies trends for these communities. The 15- and 20-year monitoring reports distinguish 32 metropolitan counties and 40 nonmetropolitan counties (Grinspoon and Phillips 2011, Grinspoon et al. 2016), and show population trends for these two groups of counties. General findings from the two reports are as follows:

1. Between 1990 and 2000, the total population of the NWFP area went from 8.57 million in 1990 to 10.26 million in 2000, a population increase of 19.8 percent (Donoghue and Sutton 2006). The population of the United States as a whole grew by 13.2 percent during this decade.[10] Population in the 1,314 nonmetropolitan communities went from 4.13 million in 1990 to 4.98 million in 2000, increasing by 20.6 percent. However, 21 percent of communities lost population during this period; these tended to be small (under 2,000 people). About 40 percent of communities grew at a slower rate than for the region as a whole, and about 40 percent grew more quickly. The fast-growing communities were typically bigger than the slow-growing communities (Donoghue and Sutton 2006).
2. Between 2000 and 2012, the total population of the NWFP area grew to 11.87 million, an increase of 15 percent since 2000 (Grinspoon et al. 2016). In comparison, the U.S. population grew by 11.6 percent during this period (based on 2012 population projections from the 2010 Census).[11]
3. The population of NWFP-area counties grew by 10 percent in California, 16 percent in Oregon, and 19 percent in Washington between 1999 and 2012. Population growth between 1999 and 2012 in metropolitan counties overall was twice what it was in nonmetropolitan counties, and accounted for nearly all of the population growth in the Plan area during this period. And, NWFP-area counties (both metropolitan and nonmetropolitan) grew faster than non-NWFP-area counties in the three states (Grinspoon et al. 2016), perhaps because they contain the largest metropolitan areas. These trends obscure changes occurring in individual counties and at the community scale.
4. Overall, people residing in nonmetropolitan communities and counties in the NWFP area are aging.

Changing socioeconomic conditions—

Over the past two to three decades, many rural communities in the NWFP area and elsewhere in the Western United States have undergone "rural restructuring"—changes in their demographic and economic conditions (Nelson 1997)—owing to declines in natural resource production and agriculture, which previously were the economic mainstays of these communities. Researchers investigating this phenomenon in rural forest communities in the United States and in the West have identified general trajectories of change in response, leading to different community/county types that have emerged today. This does not mean that communities were static prior to the 1980s, nor that they can be neatly categorized into one ideal type today. Nevertheless, researchers have distinguished several rural community development pathways, typically integrating

[9] http://www.census.gov/population/metro/.
[10] https://www.census.gov/prod/2001pubs/c2kbr01-2.pdf.
[11] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmkPl.

considerations of economic activities, "connectedness" to urban areas, population, and stocks of financial, social, or other forms of capital in doing so. These different development pathways can be used to characterize change in the NWFP area as well.

The degree of community economic dependence upon "traditional" resource use (e.g., logging, ranching, and mining) is one common variable used to differentiate rural Western communities. For example, so-called "old West" economic activities are typically contrasted with "new West" economic activities associated with the service industries, particularly tourism and real estate (Winkler et al. 2007). We apply three general trajectories of socioeconomic change documented in rural forest communities in the United States (based on Morzillo et al. 2015) to the Plan area because they are consistent with the literature from the region: (1) amenity-driven development, (2) development driven by new production strategies, and (3) economic decline. These are archetypes; communities following different trajectories can occur in the same county, and individual communities may pursue a combination of development strategies (fig. 8-9).

Gaps in the published literature prevent us from quantifying the number of communities in the NWFP area that have followed these different trajectories, and from identifying their geographic distribution. However, other researchers have developed typologies that classify counties according to variables that help to characterize socioeconomic conditions there. For example, the U.S. Department of Agriculture's Economic Research Service (ERS) developed nine different rural-to-urban continuum codes, which classify metropolitan counties based on the size of the population in their metropolitan area (three categories), and nonmetropolitan counties based on their

Susan Charnley

Figure 8-9—Weaverville in Trinity County, California, retains a sawmill and has also experienced amenity-driven development.

degree of urbanization and adjacency to a metropolitan area (six categories).[12] Rasker et al. (2009) developed a similar typology of urban connectivity for counties in the U.S. West that further differentiate nonmetropolitan counties. In that typology, counties are classified as metropolitan, connected, and isolated based on location within a metropolitan area or location within one hour of an airport with daily commercial passenger service. About 50 percent of the counties in the U.S. West were classified as "isolated;" 18 counties within the NWFP area (25 percent) were classified as "isolated."

The ERS has also typed counties based on several social and economic characteristics (not necessarily mutually exclusive).[13] Examples include economic dependence on recreation (fig. 8-10); economic dependence on manufacturing (fig. 8-11); retirement-destination counties (fig. 8-12); and low-employment counties (fig. 8-13). In the NWFP area, the majority of recreation-dependent counties are located along the Pacific Coast or on the east side of the Cascade Range, in areas commonly perceived as being rich in natural amenities. Manufacturing-dependent counties are rare, and are all metropolitan. Two of the manufacturing-dependent counties are focused on advanced manufacturing: Snohomish County, Washington, is a key manufacturing center for the aerospace industry, and Washington County, Oregon, is home to semiconductor and bioscience manufacturers. Retirement counties are sprinkled throughout the Plan area and are in a mix of metropolitan and nonmetropolitan locations. In general, the retirement counties tend to be associated with areas that are rich in natural amenities (e.g., Deschutes County, Oregon; Skagit County, Washington; and Shasta County, California) or that have a relatively low cost of land and housing (e.g., Douglas County, Oregon, and Lewis County, Washington). Low-employment counties are predominantly nonmetropolitan, and within the NWFP area are concentrated in northern California, southern Oregon, and the Olympic Peninsula of Washington. It is important to bear in mind that county-scale typologies do not necessarily reflect conditions at the community scale.

Amenity communities—

The most studied form of rural restructuring in forest communities nationwide, and in the Western United States, is the one that follows the commodity production → decline → amenity trajectory (Morzillo et al. 2015), in which rural communities or counties become places that attract people who wish to enjoy the natural amenities they offer, rather than because they are pursuing employment in natural resource production (Lawson et al. 2010, Morzillo et al. 2015). Natural amenities include water bodies, mountains, and public lands, and communities following this trajectory of change are typically located in or near places that offer nearby natural amenities and are relatively accessible from urban areas (McGranahan 1999, Rasker et al. 2009). Amenity communities are characterized by high population growth rates owing to in-migration by amenity migrants—people who seek an improved quality of life outside of cities, telecommute, are entrepreneurs, or who live on retirement or investment income (McGranahan and Wojan 2007, Winkler et al. 2007). For overviews of the phenomenon of amenity migration see Gosnell and Abrams (2011) and Waltert and Schläpfer (2010).

High-amenity communities and counties draw people and businesses, which in turn can drive economic development (Rasker et al. 2013). Waltert and Schläpfer (2010) identified five ways that natural amenities have been found to affect rural development: (1) new residents with flexible income sources move to the area to be closer to natural amenities; (2) new residents accept lower pay or higher costs of living in rural areas to be close to natural amenities; (3) entrepreneurs willing to accept lower profits move to rural areas to be closer to natural amenities; (4) natural amenities provide a basis for tourism, recreation and outdoor industries; and (5) amenities provide benefits from nature that improve the well-being of individual people or make businesses more profitable. In some cases, population change that provides a potential labor force with desirable skills may attract new businesses looking for workers (Waltert and Schläpfer 2010).

Research on amenity migration and amenity communities in the Northwest is relatively sparse compared to research on this topic from other parts of the American West. In the Northwest, amenity counties have been found

[12] http://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.aspx.
[13] http://www.ers.usda.gov/data-products/county-typology-codes.aspx.

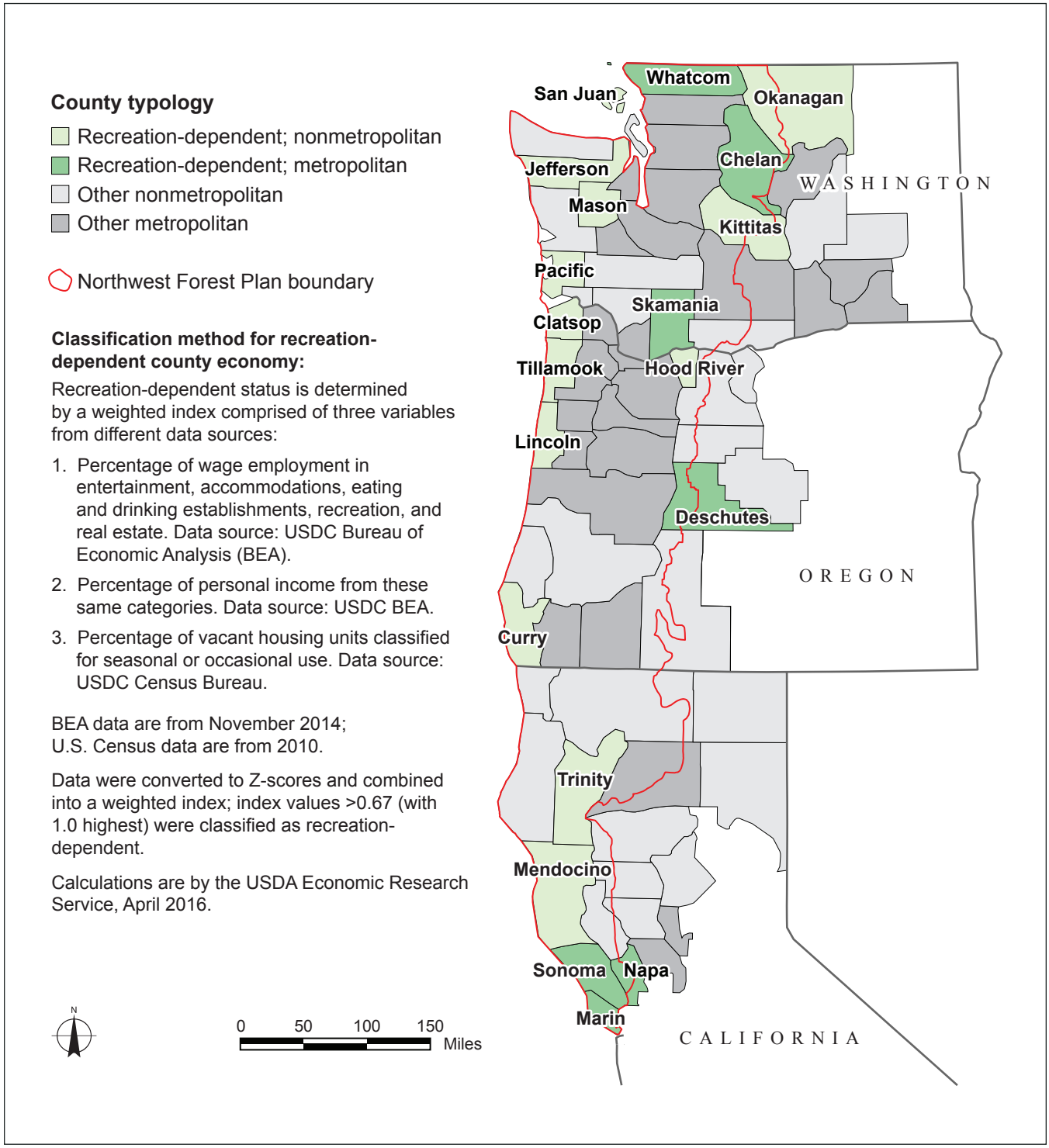

Figure 8-10—Recreation-dependent counties in the Northwest Forest Plan area. Source: U.S. Department of Agriculture, Economic Research Service.

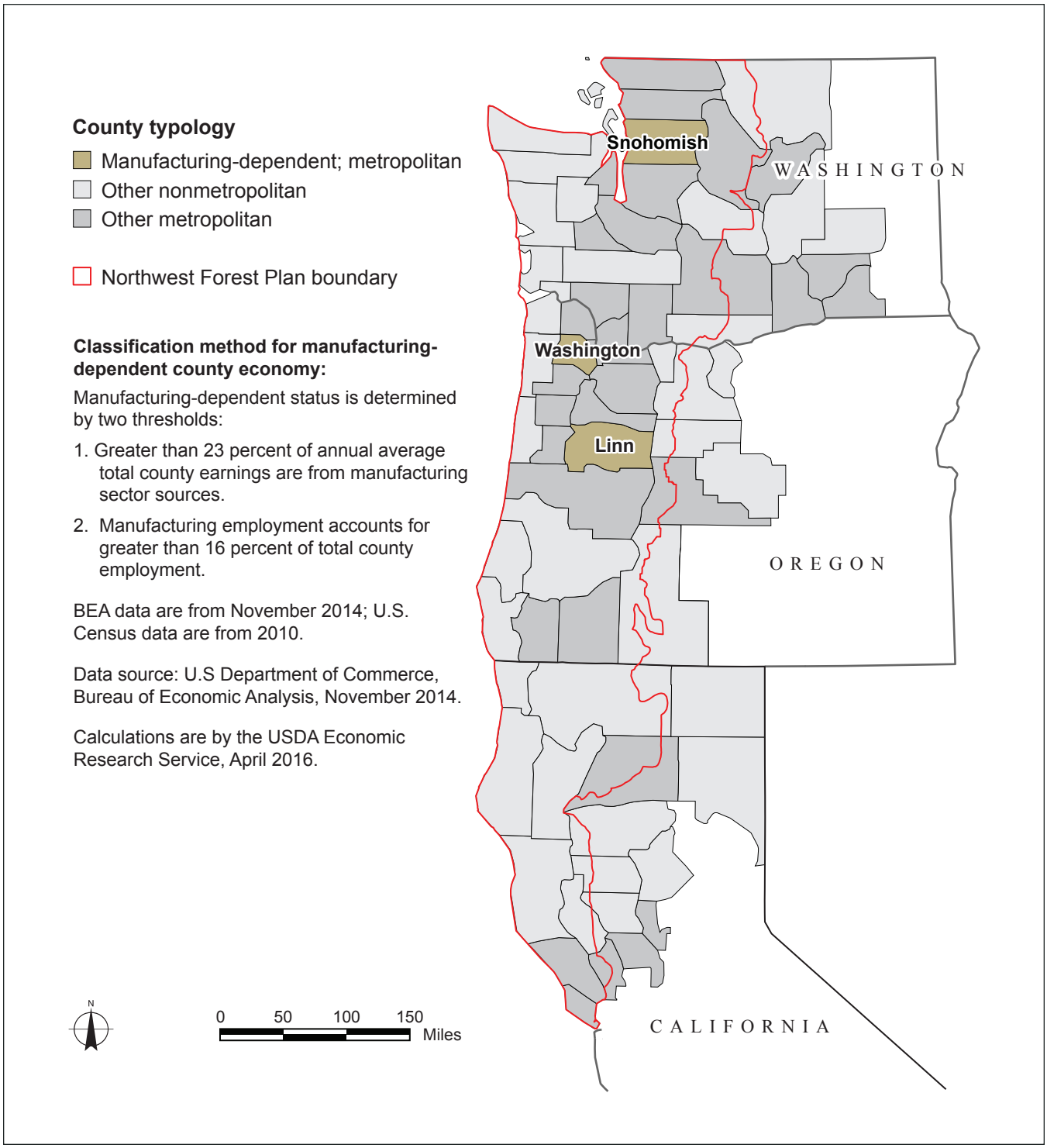

Figure 8-11—Manufacturing-dependent counties in the Northwest Forest Plan area. Source: U.S. Department of Agriculture, Economic Research Service.

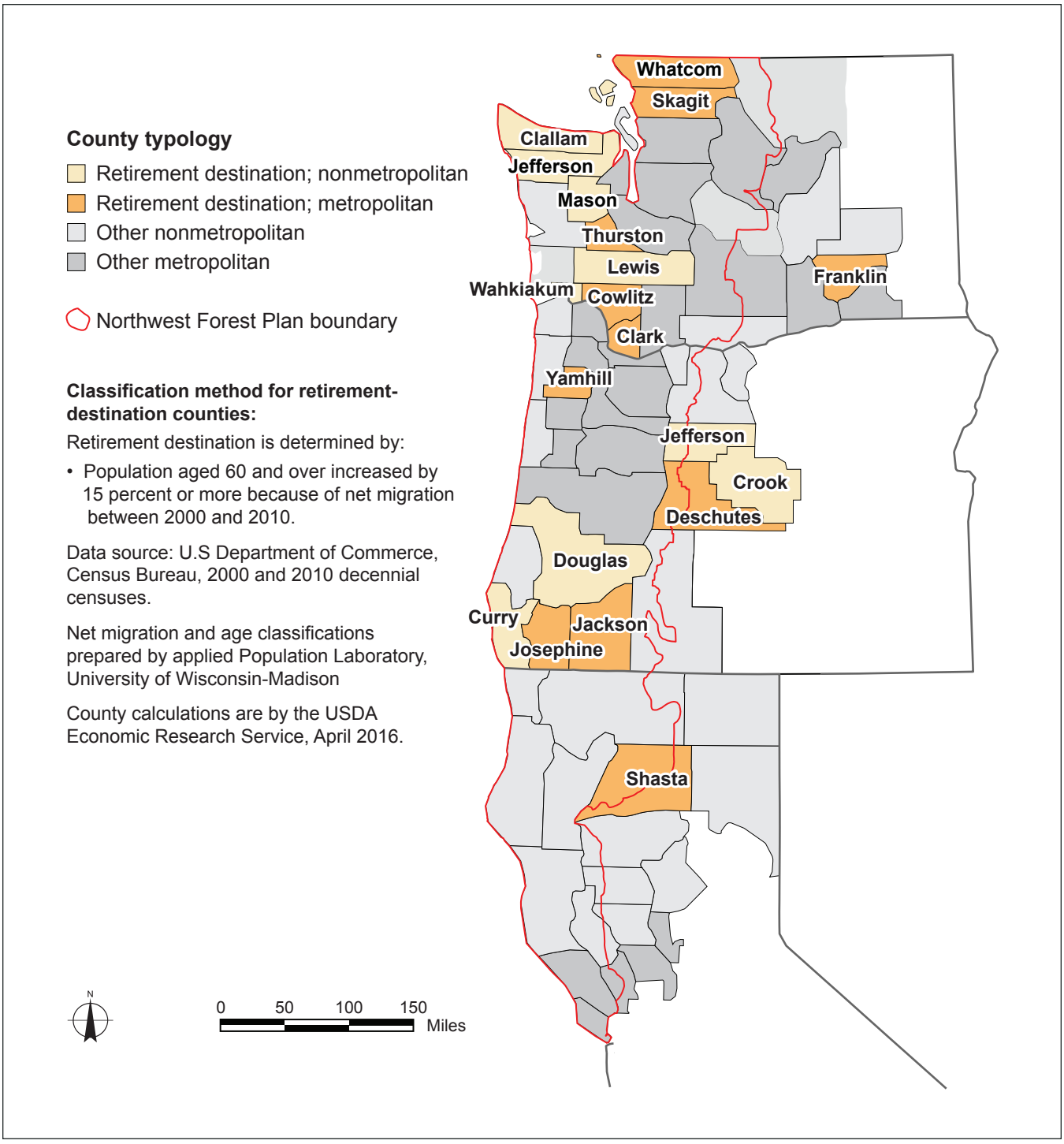

Figure 8-12—Retirement-destination counties in the Northwest Forest Plan area. Source: U.S. Department of Agriculture, Economic Research Service.

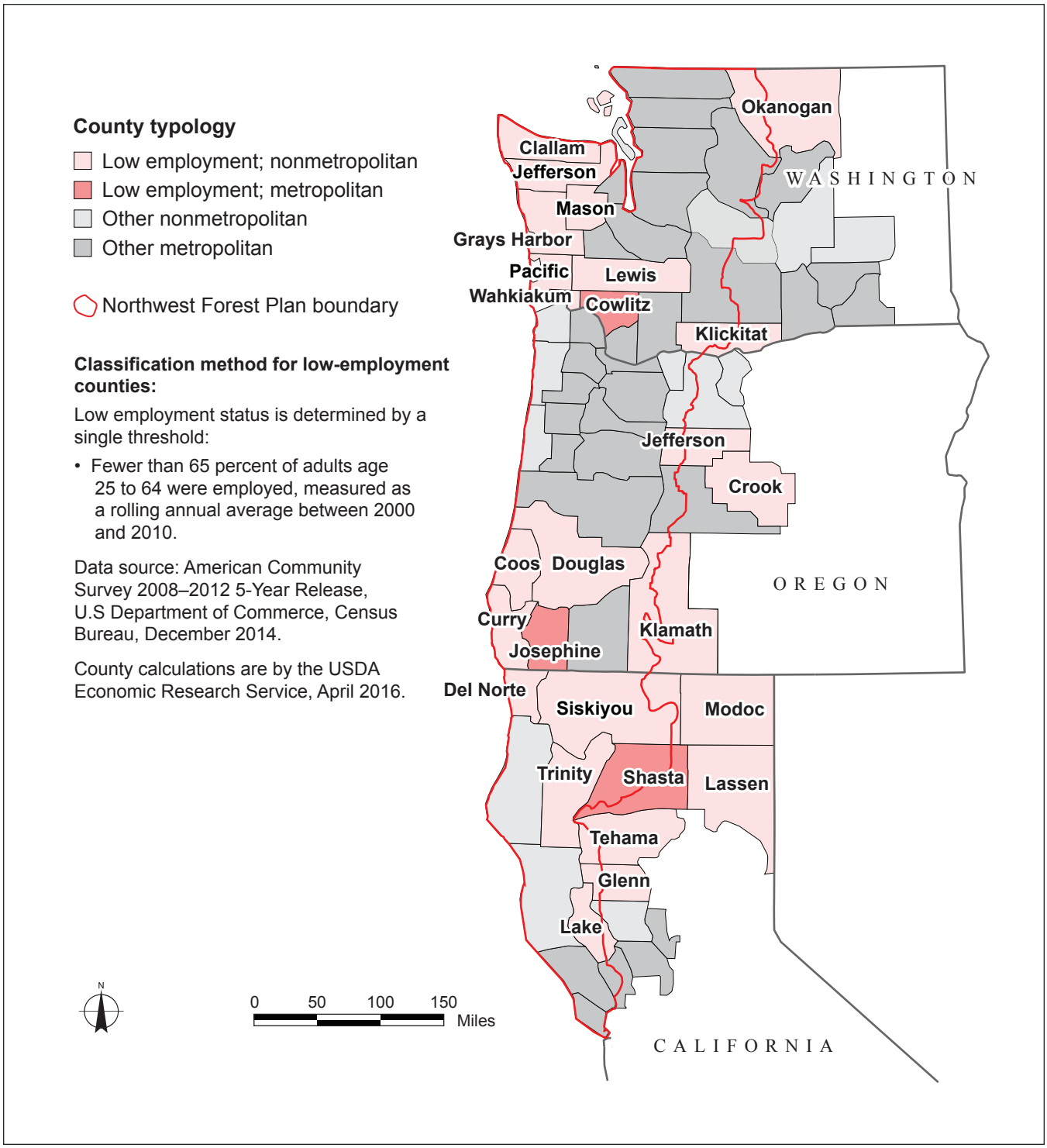

Figure 8-13—Low-employment counties in the Northwest Forest Plan area. Source: U.S. Department of Agriculture, Economic Research Service.

to attract investments in recreation and tourism, to draw middle- and high-income residents, and to be economically diversified relative to other rural counties (Lawson et al. 2010). Amenity counties also often have a high proportion of second homes; nonmetropolitan Washington counties had an average of 17 percent of their housing stock in second homes in 2010, with the number increasing rapidly (Kondo et al. 2012). Employment in the retail and services sectors in these areas is typically more important economically than employment in agriculture or natural resource extraction (Lawson et al. 2010) (fig. 8-14). Although poverty has been found to be relatively low in high-amenity counties in the Northwest compared to other nonmetropolitan counties (Lawson et al. 2010), these places are often characterized by high social and economic inequality, and by sociocultural divisions between long-time residents and newcomers (Kondo et al. 2012, Morzillo et al. 2015, Nelson 1997, Ohman 1999). In Oregon and Washington, high-amenity rural counties are concentrated along the Pacific Coast and the Cascade Range (Lawson et al. 2010). One example is Hood River County, Oregon (Pierce 2007).

The presence of public lands can be an important driver in attracting amenity migration; new arrivers often wish to live near public land boundaries. A study of housing growth within 50 km of designated wilderness areas, national parks, and national forests in the coterminous United States between 1940 and 2000 found that national forests experienced the highest absolute growth in number of housing units in their vicinity (from 484,000 to 1.8 million within 1 km of a national forest; and from 9.0 to

Susan Charnley

Figure 8-14—Services and retail are important economic sectors in amenity-based communities.

34.8 million within 50 km) (Radeloff et al. 2010). Population growth and associated housing and road development can lead to habitat fragmentation and threats to water quality and biodiversity on federal lands (Radeloff et al. 2010), and other patterns of ecological degradation (Abrams et al. 2012). For example, Radeloff et al. (2010) found that, between 1940 and 2000, 940,000 housing units were built on private inholdings within national forests nationwide. Housing growth and associated road development near these protected areas can make them ecologically isolated by causing habitat fragmentation around their boundaries, disrupting habitat corridors between them, increasing the spread of invasive species, and increasing predation by pets (Radeloff et al. 2010). The study does not provide comparable statistics for the Pacific Northwest.

The expansion of the WUI also poses challenges for fire managers (Hammer et al. 2007). During the 1990s, 61 percent of the new housing units built in Oregon, Washington, and California (combined) were built in the WUI, causing 18 percent growth in the number of WUI housing units in these states during the decade (Hammer et al. 2007). Most of this growth occurred in the intermix, where homes and forests intermingle, making fire management especially difficult. In 2000, about two-thirds of the WUI in these states occurred in places with a 35 to 100+-year fire-return interval, the vast majority of which had departed from its historical range of variability (Hammer et al. 2007). These past patterns may portend future trends in WUI development in the NWFP area.

Communities pursuing new production strategies— A second trajectory of change in rural forest communities in the United States has been characterized as commodity production → decline → (new) production (Morzillo et al. 2015). Places that follow this trajectory find ways to continue traditional forms of commodity production, albeit often reduced or altered, or they find new forms of commodity production or service-oriented economic activity to bolster the local economy (Morzillo et al. 2015). Research indicates that change along this trajectory has various outcomes.

On the one hand, it can lead to industrial recruitment (Lawson et al. 2010). Research from the Northwest characterizes such communities as being as remote or less attractive then amenity communities, and as having weak farming and natural resource production sectors. Thus, community leaders try to lure in new businesses such as hog farms, food processing plants, corporate dairies, or prisons in the hope that they will lead to job creation. To be competitive, they may loosen environmental, labor, and zoning standards, and provide economic incentives and cheap land. Although such industries may be deemed undesirable—providing low-wage jobs, paying low property taxes, having undesirable environmental consequences, or departing after a few years—they are pursued as a means to create large numbers of jobs in the short term to keep the local economy afloat (Crowe 2006, Lawson et al. 2010). In Washington state, local control over land and resources, physical space for expansion, and accessibility to markets were found to be important community characteristics associated with industrial recruitment. Well-developed social infrastructure (e.g., schools, health care services, active community organizations, and links to agencies or organizations in nearby communities or at the state or national levels) also positively influenced industrial recruitment (Crowe 2006).

An alternative to industrial recruitment is the emergence of new but illegal production economies, exemplified by the marijuana economy that has developed in the California portion of the NWFP area since the 1980s (Polson 2013). An estimated 60 to 70 percent of the marijuana consumed in the United States is produced in California (Carah et al. 2015). The collapse of the mining and timber industries in northern California, economic stagnation, and the rise of service-oriented industries—in which many jobs are low paying, temporary or seasonal, and lack benefits—created conditions of economic vulnerability (Keene 2015). This lack of economic opportunity led many people to experiment with marijuana production. Initially illegal, marijuana production increased substantially in the 1990s and 2000s as a result of local economic restructuring and legislative changes in California legalizing the use, cultivation, and possession of marijuana for medicinal purposes (although some illegal modes of production continued, e.g., growing on federal lands). Marijuana production now plays a significant role in sustaining rural

livelihoods in the region and in shaping land values there (Keene 2015, Polson 2013). This role may increase because California legalized marijuana for recreational use by adults in 2016. Large-scale production (hundreds to thousands of plants) on private lands funded by nonlocal residents for investment purposes can create conflict by driving up land prices, taking land out of food production, affecting water use, and failing to consider or contribute to local community interests (fig. 8-15). Washington and Oregon have also legalized marijuana for medicinal and recreational use, but we are not aware of any published literature on marijuana production in Oregon and Washington and its effects on local communities, economies, and the environment.

The environmental impacts of commercial-scale, outdoor marijuana cultivation in northern California's forested landscapes are beginning to be documented (Bauer et al. 2015, Carah et al. 2015, Gabriel et al. 2012). They include forest clearing, land terracing, and road construction; and diversion of large quantities of surface water for irrigation during summer when water flows are low, posing a threat to fish, amphibians, and other wildlife in watersheds important for their aquatic biodiversity. These impacts can occur on both public and private lands. Chemical pollution from heavy use of pesticides, herbicides, and fertilizers is another threat that has been documented on public lands, with these pollutants contaminating watersheds and

Susan Charnley

Figure 8-15—Large-scale marijuana production funded by nonlocal community members and its impacts on Karuk and Yurok ancestral lands in northern California is controversial.

entering local food chains, poisoning wildlife, including fishers (*Pekania pennanti*), recently considered for listing under the Endangered Species Act (Bauer et al. 2015, Carah et al. 2015, Gabriel et al. 2012). Whether these kinds of environmental impacts will decrease in response to recent legislation legalizing marijuana cultivation remains to be seen.

Another distinct development pathway for communities pursuing new production strategies is what Hibbard and Lurie (2013) refer to as the "new natural resources economy." This strategy entails using natural resources in new and diverse ways to help drive local economic development through investments in sustainable agriculture and natural resource management (fig. 8-16), including restoration. Such activities draw on the natural resource base of rural communities in ways that both diversify the local economy and promote socioeconomic well-being by producing new goods and services for export, generating new jobs and income-earning opportunities, and producing goods and services for local use rather than importing them, thereby increasing self-sufficiency. Examples of such activities in Oregon communities include (1) sustainable farming/ranching, forest products production, and alternative energy production (production related); (2) ecotourism and agritourism (consumption related); and (3) watershed restoration, wildlife habitat protection and restoration, forest restoration, and environmental education (protection related) (Hibbard and Lurie 2013).

Emily Jane Davis

Figure 8-16—Mount Adams Resource Stewards' small business incubator and log yard in Glenwood, Washington.

Examples of NWFP-area communities that are developing new natural resource economies are Hayfork, California, (Abrams et al. 2015) and Vernonia, Oregon (Hibbard and Lurie 2013). In Hayfork, a local community-based organization—the Watershed Research and Training Center—helped the community transition by developing workforce training and job opportunities associated with ecosystem management work and hazardous fuels reduction on national forests. It also invested in a small-log processing facility and a business incubator to encourage development and marketing of value-added forest products (Abrams et al. 2015). In Vernonia, some family forest owners engage in commercial nontimber forest products production from their lands, and there is a tourism economy developing in association with a recent rails-to-trails project. In addition, the community is reinventing itself as a "green" community, with rural development projects revolving around rebuilding schools according to Leadership in Energy and Environmental Design-certified standards and heat from locally produced biomass energy, and a new rural sustainability center promoting forest sustainability and clean energy (Hibbard and Lurie 2013). Hibbard and Lurie (2013) discussed barriers to the development of new natural resource economies, and suggested policies and programs that might help; none pertain directly to federal forest management.

Communities in decline—
A third general trajectory of change identified for rural forest communities in the United States experiencing dwindling commodity production is decline (Morzillo et al. 2015). Such communities are unable to recover from significant job losses associated with traditional modes of production, and therefore experience population and employment declines. They are often remote, may have undesirable environmental legacies from former extractive industries such as forestry or mining, and often have high and growing poverty rates (Lawson et al. 2010, Morzillo et al. 2015). These communities have not attracted investors or wealthy, educated immigrants; have limited development options; and are economically and politically marginalized. Not only have they failed to attract new investments; the viability of traditional economic activities such as forestry, ranching, farming, and mining continues to dwindle (Lawson et al. 2010, Nelson 1997). An example is Happy Camp, California, which was heavily affected by cutbacks in timber harvesting associated with the NWFP (Charnley et al. 2008a). Nevertheless, these communities have latent potential for development associated with the availability of labor, land, natural resources, or infrastructure that may become valuable in the future (Morzillo et al. 2015).

Adaptation to change—
A common theme that crosscuts the discussion above is community adaptation to change. Community capacity and community resilience are important to well-being in forest communities, making them more resilient to change and disturbances (such as wildfire, climate variability, and declines in the wood products industry) (Berkes and Ross 2013, Folke et al. 2010). The elements, mechanisms, and determinants of community resilience are not necessarily the same across community contexts, implying a need to consider the various development pathways of rural communities over time and their particular relationships with nearby public forest lands (Donoghue and Sturtevant 2008).

As noted, our discussion of rural community development pathways above identifies archetypes. Rural communities that have strongly "multifunctional" characteristics are more likely to be resilient to social, economic, and ecological changes associated with federal forest management, and to mitigate their negative impacts, making them more resilient (Wilson 2010). Multifunctional rural landscapes are those that have a mix of uses, including commodity production (e.g., forest products, agriculture); amenity-driven development (e.g., recreation, tourism, services); and natural resource protection (e.g., forest restoration, jobs with land management agencies). Multifunctionality helps communities diversify their rural economies and contributes to both environmental and economic health (Hibbard and Lurie 2013). Not all communities are able to develop multifunctional characteristics, and doing so depends on their natural and social assets.

Research on NWFP impacts conducted in 17 communities around federal forests in the NWFP area following the first decade of the Plan's implementation (Charnley et al. 2006b, 2008b) found that different communities experienced the different trajectories of change described above in pursuing (or not pursuing) new opportunities. Owing to

their proximity to natural amenities, several communities experienced an influx of retirees, commuters, mobile or self-employed workers, or second-home owners, and benefitted from being popular recreation or tourism destinations, although not all community residents viewed this as a positive change (Charnley et al. 2008c). Other communities reoriented around new forms of production such as agriculture; new industries or service sectors associated with proximity to a major transportation corridor in or near a regional center; or the growth of tribal businesses, administration, and services. And some were in decline—especially those that were remote, surrounded by federal lands, and previously highly dependent on the wood products industry. Regardless, all communities were making efforts to develop and diversify, which was easier for some than others, depending on community characteristics.

One study (Harrison et al. 2016) examined the role of social capital (defined as behavioral norms and social networks that facilitate collective action) in influencing the capacity of three Pacific Northwest communities affected by the decline of the wood products industry to adapt to change and take advantage of new opportunities. The study found that a community's ability to develop along new trajectories aligned with local goals was influenced by interactions between different forms of social capital (bonding, linking, bridging).[14] In particular, a combination of strong bridging and linking social capital was found to facilitate desirable community outcomes. This finding builds on earlier work from the 1990s that found social cohesion to be an important characteristic influencing rural community well-being (Beckley 1998, Doak and Kusel 1996, Harris et al. 2000). Local cultural context also plays an important role in influencing how communities respond and adapt to changes like mill closures (Lyon and Parkins 2013).

These observations suggest that there is no one pathway, or set of variables, that will make communities resilient in the face of change, ensure successful adaptation, or promote socioeconomic well-being. Individual communities draw on the assets and opportunities available to them, which differ depending on social, cultural, economic, and environmental conditions. Moreover, community well-being is based on a host of quality-of-life attributes, including health, safety, political participation, social equity, and access to social services as well as jobs and income. Federal forest management can contribute to socioeconomic well-being in multiple ways (Kusel 2001, Nadeau et al. 2003, Sturtevant and Donoghue 2008), but it is only one of many factors influencing community well-being.

How Goods, Services, and Opportunities from Federal Forests Contribute to Community Socioeconomic Well-Being

Federal forest management contributes to socioeconomic well-being in rural communities by providing timber and nontimber forest products, recreation opportunities, jobs, other ecosystem services, and backdrops for where people want to live and work. Charnley (2006c) and Grinspoon et al. (2016) detailed and quantified many of these contributions for NWFP-area national forests and BLM districts over the first 20 years of the Plan. Here we focus on jobs in forest restoration and firefighting, nontimber forest products (NTFPs), the economic effects of recreation on federal forests, and ecosystem services from federal forests. NTFPs are also addressed in chapters 10 and 11, and recreation is also addressed in chapter 9.

Summary—
Federal forest management contributes to socioeconomic well-being in rural communities in ways that go beyond providing timber and associated jobs in the wood products industries. This section discusses jobs in forest restoration and firefighting, biomass use, nontimber forest products (NTFP) gathering, the economic effects of recreation on federal forests, and other ecosystem services from federal forests.

Restoration of federal forest lands may benefit forest communities through associated economic

[14] Bonding social capital refers to relations between individuals within a community who have similar social and economic backgrounds. Bridging social capital refers to relations between individuals having different backgrounds. Linking social capital refers to relations between community members and people outside the community who have the ability to affect community outcomes (Harrison et al. 2016).

activities (e.g., in-woods work and processing of restoration byproducts) as well as by providing the ecosystem services associated with restored ecosystems. In the Pacific Northwest, the ability of local communities to compete for and obtain contracts for work on nearby federal forests, and to retain local dollars, is an important factor in the adaptive capacity of communities. The Pacific Northwest has a high concentration of both hand crew and equipment-based fire suppression contracting, many of which also engage in forest restoration contracting. In some regions of the Pacific Northwest, the restoration contracting industry has transitioned to lower skill jobs, and Forest Service contracting practices for such activities tend to favor mobile businesses that employ a high proportion of temporary and migrant laborers. Although in some places the type of forest-related contracting has changed, many nongovernmental organizations and private businesses still depend on these forest-based activities for economic and social benefits, and continue to build their business around meeting federal agency needs for forest activities. Biomass energy production presents one possible pathway for adding value to restoration byproducts; examples from across the West demonstrate its potential economic benefits and suggest its role in reconciling diverse interests in forest management.

Federal forests in the NWFP region are important sources of a wide variety of commercial and noncommercial nontimber forest products, such as moss, mushrooms, cones, grasses, and firewood. These products provide important safety net, buffering, and provisioning functions for rural and urban households, and activities surrounding their harvest, processing, and use often help build social capital and cultural identities, as well as strengthening human-nature connections. The retail value of NTFPs in the United States is estimated to be at least $1.4 billion, with much of that coming from the NWFP region. Studies that have measured NTFP employment in the Pacific Northwest have estimated that roughly 10,000 individuals work as harvesters, buyers, or processors in the floral greens/bough sector, and an equal number of people who earn income in the wild mushroom sector. State recreation surveys for Oregon and Washington suggest that the rate of participation in NTFP gathering and collecting activities (excluding hunting and fishing) exceeds that of many other outdoor activities. The 10- and 20-year socioeconomic assessments for the NWFP indicate that the Plan likely reduced physical access to NTFPs through road closures and restricted legal access to NTFPs owing to harvesting prohibitions in some late-successional and riparian reserves, and restrictions on the harvest of special-status plants. However, the most important impact of the NWFP on NTFP resources is likely to be the landscape-level changes in forest structure and composition brought about by the Plan's management provisions. Likely, these changes will bode well for NTFPs such as matsutake mushrooms and moss that do well in late-successional forests, but will lead to reduced supplies of NTFPs found in early-seral-stage forests, such as salal and boughs.

Recreation on federal forests supports economic activity in local forest communities as visitors spend money while on recreation trips, and federal agencies spend money maintaining recreation resources. In this synthesis we focus on the former. Recreation visitors to NWFP-area national forests spend about $612.6 million in the communities around those forests each year. That spending supports employees and proprietors of businesses that sell goods and services to recreationists, and generates additional economic activity through the multiplier effect. In general, the economic activity generated around federal forests from recreation visitor spending depends on (1) the amount of recreation use, (2) the types of trips (i.e., day or overnight, local or nonlocal) taken by recreationists, and (3) the size of the local economy. The activity of recreationists can influence some patterns in spending, but is less important than trip type. All else being equal, those visitors on overnight trips spend 5 to 8 times more in local federal forest communities than those on day trips.

In addition to providing the socioeconomic benefits identified above, federal forests also provide important ecosystem services both to local communities and more distant urban populations. These include fresh water, food and fiber, wildlife habitat, and outdoor recreation opportunities, among others. Federal agencies are beginning to develop methods and protocols for evaluating ecosystem services and how they are influenced by various federal actions. Within the NWFP area, efforts largely have focused on identifying and quantifying key ecosystem services produced on the region's national forests. Although these efforts have made significant progress in raising awareness and concern for these important forest benefits, formal methods for routinely including ecosystem services values into national forest management largely are still in development by the Forest Service.

Forest restoration and wildfire-suppression contracting— Despite the overall reduction in traditional timber management activity on national forest lands, in both the Forest Service and many rural communities there has been interest in and support for restoration and stewardship activities that generate both direct employment and byproducts of potential economic value (Nechodom et al. 2008). This opens the possibility for development of a "restoration economy" (Nielsen-Pincus and Moseley 2013) based on various activities, including "ecological forestry" (Franklin and Johnson 2012), associated with the restoration of structure or function to forest ecosystems. Such activities include stream rehabilitation, fish passage improvement, road decommissioning, riparian planting, forest fuel reduction treatments (designed to decrease fuel loads, break up fuel continuity, and reduce the risk of crown fire), and thinning projects designed to introduce structural heterogeneity to second-growth stands (fig. 8-16). All these activities entail employment in planning, implementation, oversight, monitoring, or other duties, and some of them produce byproducts that can be used for bioenergy, with associated economic benefits. Nielsen-Pincus and Moseley (2013) found that an average of 16.3 jobs, $589,000 in total wages, and $2.3 million in overall economic activity were associated with every $1 million of restoration grant spending in Oregon; and economic impacts were greater in rural counties than in metropolitan counties. Baker and Quinn-Davidson (2011) calculated that the restoration sector brought nearly $135 million into Humboldt County, California, between 1995 and 2007. Thus, restoration contracting now represents a potentially significant source of forest-based jobs in rural communities.

In the Pacific Northwest, restoration contracting includes a variety of forest-related management actions, such as reforestation, thinning, mastication and chipping, and other practices aimed at improving or restoring the health of the forest (see chapter 3). Forestry support work involves seasonal and labor-intensive activities including planting and maintaining tree seedlings, piling and burning brush, thinning trees, harvesting cones, and applying herbicides (Moseley 2006b) (fig. 8-17). These activities contribute to a variety of forest management goals, from forest and watershed restoration to timber management and wildfire mitigation (Moseley et al. 2014). Related wildland fire suppression work can include heavy-equipment operation and more manual tasks such as digging fire lines.

Relatively little scholarly research has focused on the forest management-related service-contracting sector. Past research suggests that these contractors operate in regional markets that involve working close to home as well as traveling relatively long distances, sometimes across state lines, to perform forest management services on federal lands (Nielsen-Pincus and Moseley 2013). Contractors are more likely to travel long distances if the work is manual and labor intensive, such as tree planting and hand thinning. Contractors that work on equipment-intensive activities such as stream restoration, road construction, and mechanical thinning tend to work closer to home (Moseley and Reyes 2008, Moseley and Shankle 2001, Moseley and Toth 2004).

Understanding where contractors are located has been an important component of the research on restoration contracting because it sheds light on where and how contracting

Susan Charmley

Figure 8-17—Thinning to restore forest resilience to wildland fire can be equipment-intensive.

businesses create local community benefit. An intended outcome of the NWFP was for the Forest Service and BLM to offset job loss in the timber production, harvesting, and processing markets through public land restoration, including the use of contracting (Moseley 2006b). Both the Forest Service and BLM have transitioned away from intensive forest management for timber (e.g., replanting clearcuts) to more restoration-focused work (Moseley 2006b). Moseley (2006b) found that significant declines in Forest Service contract spending subsequently decreased the amount of contracting money flowing to rural communities. These trends have continued, as an increasing amount of the Forest Service budget is allocated to wildfire suppression (Calkin et al. 2011, Gebert and Black 2012, North et al. 2015).

In some regions of the Pacific Northwest, the restoration contracting industry has transitioned to lower skill jobs. Changes in federal policy and practice, and a refocus on reducing wildfire risk in drier, fire-prone forests in the early 2000s, led to a need for low-skill, labor-intensive fuels reduction work in federal forests (e.g., thinning trees and clearing brush). Forest Service contracting practices for these kinds of activities tend to favor mobile businesses that employ a high proportion of temporary and migrant laborers (Moseley et al. 2014; Sarathy 2008, 2012). The implications of these transitions and of contracting for lowest bid Forest Service work are further detailed in chapter 10. In northern California, for example, the availability and structuring of restoration contracts have put many smaller businesses based in rural communities at a disadvantage relative to larger, more mobile urban-based contractors (Baker and Quinn-Davidson 2011), which led a local, community-based nonprofit organization to begin

training and hiring local residents to be able to contract with the Forest Service to perform this fuels-reduction work (Abrams et al. 2015). This example illustrates a shift by community organizations from other work into contracting, which is part of a growing trend in which organizations (nongovernmental and private businesses alike) are changing and adapting their roles to fit new or amplified needs emanating from changes in Forest Service forest restoration and fire-suppression contracting.

In the Pacific Northwest, the ability of local communities to compete for and obtain work contracts on federal forests, and retain local dollars, is an important factor in the adaptive capacity of communities. State or federal contracts for restoration or wildfire suppression services that are captured by local businesses can benefit local economies. In contrast, hiring contractors from outside local communities can reduce the amount of forest restoration dollars that circulate in the local economy.

Contracting for fire suppression purposes began in the 1970s, when loggers and other forest workers would fight fires as needed to protect their livelihoods—which were based on work in the forest. Fire suppression was conducted in the shoulder seasons for other forest work, or when forests were closed to forestry work in the hottest fire-prone months of the summer. Recent research exploring connections between restoration contracting capacity and fire suppression capacity found that the amount of money captured during a fire by community businesses located near the fire increases with the number of vendors involved in forest and watershed restoration prior to a fire, suggesting that local business restoration capacity might influence local fire suppression response (Moseley et al., n.d.). Similar to evidence about wildfire hazard mitigation (Moseley and Toth 2004), findings by Moseley et al. (n.d.) also suggest that counties containing more diversified urban economic centers may be more likely and prepared to capture wildfire suppression contracting work than smaller, less diversified, and moderately isolated counties.

Research on the effects of large wildfires in the Western United States by Nielsen-Pincus et al. (2013) found that wildfires generally improved county-level employment and wage growth while suppression efforts were active. However, following a wildfire, counties experienced increased economic volatility, though these effects differed by the type of county in which the wildfire occurred. Employment growth associated with fire-suppression spending suggests that developing community capacity could change how local economies experience wildfire, potentially facilitating more local community capacity to participate directly (fire crews or equipment), or indirectly (e.g., support services) in fire suppression, keeping wildfire suppression funds in the community longer (Nielsen-Pincus et al. 2013). Although these studies provide evidence of links between a community being engaged in forest management and restoration and local participation in fire suppression efforts, the lack of historical analysis of restoration and fire suppression contracting markets means that little is known about how these relationships have changed over time. However, recent related research on the location and diversity of fire suppression contractors and their equipment suggests that the two markets have become more complex as private wildfire contracting has become more nationalized and mobile (Huber-Stearns et al., n.d).

Changes in federal wildfire contracting policy, such as creating more nationalized dispatch systems, or the contracting award system, may unintentionally limit local contractors' ability to participate in local fire suppression efforts (Davis et al. 2014). In a time of increased focus on collaborative fire management and local workforce capacity development (e.g., the National Cohesive Wildland Fire Management Strategy), the finding that participation in federal contracting prior to a fire shapes suppression capacity can help focus policy and practice on these linkages.

The Pacific Northwest still has one of the highest concentrations in the United States of both hand crew and equipment-based fire suppression contracting (Huber-Stearns et al., n.d). In the past decade, fire-suppression contracting in the region has been experiencing a transition, as contracting processes have become more standardized, and more businesses have joined the industry. All the 48 regional and national hand crew businesses, and more than 600 of the 2,016 total equipment contractors active in

2015, were located in Oregon, Washington, and northern California (Moseley et al., n.d.).

Although many restoration businesses are still engaged in fire suppression contracting, there has been a shift in the past decade toward contracting companies entering the market primarily for fire contracting purposes (e.g., businesses purchasing equipment specialized for fire suppression, and hiring crews for fire suppression). This shift is in contrast to 20 years ago, when restoration contractors took on fire suppression work as needed and with the forestry equipment they had on hand (Moseley et al., n.d.). Recent research has also found that in several cases, these contracting companies come from other sectors, such as construction, heavy equipment, and services (e.g., portable showers, food, and housing units), and have now expanded their work into fire contracting. In many instances, restoration contracting is not the primary source of income for these businesses. Rather, it is fire suppression work, or the other sectors in which they operate during the rest of the year (e.g., construction) (Moseley et al., n.d.). As fire suppression needs differ year to year, some of the businesses that hire fire hand crews have faced critical challenges with employee retention, and looked to find other sources of income to extend the employment period for their seasonal hand crew employees. One option has been to enter the forest restoration contracting realm, using their fire suppression equipment and resources to conduct forest restoration work outside of fire season (Huber-Stearns et al., n.d).

As both Forest Service and BLM budgets and workforces decline, and are constricted further by a larger proportion of the budget going to wildfire suppression, agencies are contracting out an increasing amount of their land management work, which includes forest restoration and wildfire suppression (Moseley 2005). This suggests a continued (yet unpredictable) demand for forest-based restoration and fire contracting activities across the NWFP area. Although in some places the type of forest-related contracting has changed, many nongovernmental organizations and private businesses still depend on these forest-based activities for economic and social benefits, and continue to build their business around meeting federal agency needs for forest management and restoration work.

Biomass use—

In addition to the "in-woods" work associated with removing trees and other forest fuels, fuel reduction and thinning projects result in the production of restoration byproducts with potential economic benefit to forest communities. These include biomass materials such as tops, branches, and small-diameter trees as well as larger materials suitable for traditional commercial processing. The development of biomass-use infrastructure capable of adding value to otherwise unmarketable byproducts has been specifically supported through grant programs, targeted policies, and research efforts (Becker et al. 2009, 2011b). In particular, biomass energy production has been identified as a potential means of integrating forest restoration and rural community development while producing energy from renewable sources (Becker and Viers 2007, Hjerpe et al. 2009) (fig. 8-18).

It is extremely difficult for forest biomass energy production to be profitable as a stand-alone activity, owing to issues such as the dispersed nature of the raw material, long haul distances, the low energy density of wood, and low prices of other energy sources (Aguilar and Garrett 2009, Sundstrom et al. 2012). Development of forest biomass energy in areas with a large federal forest presence has been challenged by additional factors such as a lack of predictability in access to raw materials (Becker et al. 2011a, Stidham and Simon-Brown 2011). The cost of forest biomass harvesting is often greater than the value of resources removed (Evans and Finkral 2009); biomass treatments therefore tend to rely upon supportive public policies (e.g., direct subsidies, renewable energy mandates) to remain feasible. Biomass energy installations themselves can generate controversy regarding issues such as the possible effects of raw material demand on nearby forests (Stidham and Simon-Brown 2011). However, given appropriate public consultation and collaboration, the use of biomass can also represent an approach to reconciling diverse social, economic, and environmental restoration interests (Hjerpe et al. 2009).

The collection, transportation, and processing of biomass materials represents a potential economic opportunity

Susan Charnley

Figure 8-18—Forest restoration byproducts provide fuel for biomass energy production.

for forest communities. An analysis of 43 timber-producing counties in east Texas suggests that residue procurement and biomass energy production could collectively generate direct, indirect, and induced jobs equal to nearly one-third of current logging sector employment (Gan and Smith 2007). Using fiscal year 2005 data from five national forests in the Southwest, Hjerpe and Kim (2008) determined that fuel reduction expenditures (including prescribed fire) resulted in 337 direct full-time equivalent jobs and 151 indirect and induced jobs. Communities with installed biomass-use capacity may also benefit forests, as the presence of small-diameter processing facilities results in a greater ability to perform treatments on nearby forest land (Nielsen-Pincus et al. 2013). There is some evidence that development of local processing infrastructure can lower the per-acre cost of forest restoration activities, therefore allowing more area to be treated with a given level of funding (Becker et al. 2011a). Stakeholders in a number of communities have collaborated with one another and with Forest Service managers to design long-term, large-scale restoration projects capable of catalyzing this beneficial relationship between biomass-use capacity, forest restoration treatments, and associated economic benefits (Abrams 2011, Schultz et al. 2012). A key challenge in this context is aligning biomass-use infrastructure, state or federal policies regarding biomass utilization, and contracting mechanisms to stimulate investments that simultaneously support community economic development and forest restoration activities. An additional challenge is providing a long-term, reliable supply of biomass material from federal lands to incentivize infrastructure investments. Stewardship contracting is one mechanism the Forest Service and BLM can use to address this barrier (Nielsen-Pincus et al. 2013).

Nontimber forest products—

Nontimber forest products, or special forest products as they are known by the Forest Service and the BLM, include "bark, berries, boughs, bryophytes, bulbs, burls, Christmas trees, cones, epiphytes, fence material, ferns, firewood, forbs, fungi (including mushrooms), grasses, mine props,[15] mosses, nuts, pine straw, posts and poles, roots, sedge, seeds, shingles and shake bolts,[16] transplants, tree sap, rails, and wildflowers" (USDA FS 2001). These NTFPs are often grouped into broad functional categories, with common categories consisting of edibles, medicinals, arts and crafts, ornamental and decorative materials, fuel, transplants and other landscaping products, and construction materials (Alexander et al. 2011b). NTFP management and research are complicated by the extremely large number of species from which this broad array of products is derived. Vance et al.'s (2001) guide to commercial NTFPs in the Pacific Northwest describes products from 59 native species in detail, lists 60 additional native species that are commercially harvested, and emphasizes that many other species are bought and sold in markets. NTFP species harvested in the Pacific Northwest likely number in the hundreds (Jones and Lynch 2007). Table 8-1 lists some of the most common commercial NTFPs harvested in the Plan area. This chapter provides a broad overview of NTFP harvesting in the Plan area, whereas chapter 10 describes commercial NTFP harvesting by low-income and minority populations; and chapter 11 addresses the importance of specific NTFPs to American Indians.

It is difficult to characterize the contribution that NTFPs from federal forest lands in the Plan area make to community socioeconomic well-being because of the large number of products, variety of organism parts, and diversity of species that make up this category of forest products. No studies have systematically evaluated the relative importance of federal lands as a source of supply for NTFPs in the Plan area. Charnley (2006c) and Grinspoon et al. (2016) documented the quantities of special forest products sold from Plan-area Forest Service and BLM lands during the first two decades of the NWFP based on permits and contracts the agencies issue to members of the public. However, systems for tracking the quantities of NTFPs harvested on national forests and BLM lands are not structured in ways that would allow one to determine whether permittees have harvested more or less than the quantities indicated on their permits (Alexander et al. 2011b). And, no studies document the extent to which unauthorized NTFP harvesting takes place on federal lands in the NWFP region, although it is probable that a significant portion of NTFPs are harvested without authorization (Dobkins et al. 2016, McLain and Lynch 2010, Muir et al. 2006, NFWC 2015). Nevertheless, research suggests that federal forests are important sources of supply for a number of products, including wild mushrooms (McLain 2008, Pilz et al. 2007, Richards and Creasy 1996); beargrass (Charnley and Hummel 2011, Hummel et al. 2012); huckleberries (Kerns et al. 2004); firewood, Christmas trees, floral greens, limbs and boughs, moss, cones, and posts and poles (Charnley 2006c, Grinspoon et al. 2016) (fig. 8-19).

Table 8-1—Commonly harvested commercial nontimber forest product species in the Northwest Forest Plan area

Species	Scientific name
Floral greens:	
Salal	*Gaultheria shallon*
Evergreen huckleberry	*Vaccinium ovatum*
Beargrass	*Xerophyllum tenax*
Tall Oregon grape	*Berberis aquifolium*
Western redcedar	*Thuja plicata*
Noble fir boughs	*Abies procera*
Deer fern	*Blechnum spicant*
Western swordfern	*Polystichum munitum*
Mushrooms:	
Morel	*Morchella* spp.
Chanterelle	*Cantharellus cibarius*
Matsutake	*Tricholoma magnivelare*
Bolete	*Boletus* spp.

Sources: Blatner and Alexander 1998, Lynch and McLain 2003, Schlosser and Blatner 1995, Weigand 2002.

[15] Mine props are lengths of wood used to hold up a mine roof.
[16] Shake bolts are blocks of wood used for making shingles.

Rebecca McLain

Figure 8-19—Mushroom picking is an important commercial and recreational gathering activity on federal forest lands.

***Market context*—**Market demand for many NTFPs has increased over the past 20 years in response to growing consumer interest in wild-harvested and organically produced foods and medicines (Pilz et al. 2007, Smith et al. 2010) as well as shortages in supply in other parts of the world for products such as wild mushrooms that are traded primarily in international markets (McLain et al. 1998, Pilz et al. 2007). No reliable data exist for the amounts and values of NTFPs harvested in the United States or from the NWFP area. However, extrapolating from Forest Service and BLM permit and contract data, Alexander et al. (2011b) estimated that the retail value for NTFPs harvested from BLM and Forest Service lands in the United States in 2007 was at least $1.4 billion, with the majority attributable to NTFPs harvested in the Pacific Coast region. A similar analysis covering the years 2004 to 2013 found that the estimated retail value of NTFPs trended upward and was roughly $1.9 billion in 2013 (Chamberlain 2015). Nationwide, firewood, crafts and floral products, and Christmas trees—in that order—consistently had the highest total retail values (Alexander et al. 2011b, Chamberlain 2015). In both studies, the Pacific Coast region dominated in permitted harvest quantities (and therefore retail value) for arts, crafts, and floral products; edibles; grasses; nursery and landscape products; and regeneration and silviculture products. The region was second after the Rocky Mountain region in permitted harvest quantities of fuelwood and posts and poles. However, Alexander et al. (2011b) cautioned that it is unclear whether regional differences in permitted harvest quantities reflect differences in actual quantities harvested, or cross-regional differences

in agency permitting and enforcement capacity. A 2014 survey of Forest Service employees in the agency's Pacific Northwest Region (Oregon and Washington) found that respondents most commonly labeled the following products as being among the "five most important" products gathered on the national forest where they worked: firewood (53 percent of respondents); boughs (14 percent); mushrooms (10 percent); beargrass (10 percent); Christmas trees (10 percent); and floral greens (5 percent) (Crandall 2016).

The only NTFP industries in the Pacific Northwest for which annual wholesale values have been calculated are floral greens and wild mushrooms. Schlosser et al. (1991) estimated the wholesale value of floral greens and boughs harvested in western Washington, western Oregon, and southwestern British Columbia during 1989 at $128.5 million. The wholesale value of wild edible mushrooms harvested in Oregon, Washington, and Idaho during 1992 was estimated at $41.1 million. Unfortunately, more recent valuations of NTFP industries in the Pacific Northwest (or elsewhere in the United States) do not exist. Many NTFPs harvested in the Pacific Northwest are sold in global markets (Alexander et al. 2002, 2011b), making them susceptible to demand and price fluctuations linked to economic and environmental conditions elsewhere. Although floral greens (including holiday greens for wreaths and swags), wild mushrooms, and huckleberries are commonly identified as the most economically important NTFPs in the Plan area (Schlosser and Blatner 1997), the values extrapolated from NTFP permit and contract data suggest that firewood and posts and poles are equally important economically, if not more so. No studies of the socioeconomic dimensions of either firewood or post and poles harvesting for the region exist.

The number of persons who currently earn a full or partial livelihood from NTFPs is unknown. However, Schlosser et al. (1991) estimated that, in 1989, processors in western Washington, western Oregon, and southwestern British Columbia bought floral greens and boughs from roughly 10,000 harvesters. In a later study, Schlosser and Blatner (1995) estimated that the wild mushroom industry provided income-earning opportunities for roughly 10,400 harvesters in Oregon, Washington, and Idaho. Whether and how much overlap there is between the two industries is unknown. Most of the processing facilities for NTFPs harvested in the Pacific Northwest were located west of the Cascade Range (Schlosser and Blatner 1997), but the number employed in those facilities is unknown. The NTFP sector offers income-earning opportunities that are easily accessible with little capital investment, but as described in chapter 10, working conditions for harvesters are sometimes poor, and it is likely that the more lucrative opportunities are in processing and marketing (Schlosser and Blatner 1997). As currently structured, the NTFP sector is "one piece of a larger mosaic of rural development options" (Schlosser and Blatner 1997: 2) rather than an economic driver. The NTFP sector contributes to the well-being of individuals, households, and firms located in both rural and urban areas. More than half of the harvesters interviewed during a study of beargrass harvesting on the Gifford Pinchot National Forest lived in the cities of Tacoma and Aberdeen, Washington (NFWC 2015). Many wild mushroom harvesters on the Deschutes National Forest in central Oregon also live in cities located west of the Cascades or in northern California (McLain 2008, Tsing 2015). However, the extent to which urban residents rely on NTFP-related work and the impacts that the NWFP has had on urban residents have not been the subjects of scientific studies.

Nonmarket contributions of NTFPs to socioeconomic well-being—The NTFP sector differs from most other natural resource sectors (i.e., mining, wood products, livestock production), in that much economic activity linked to the harvesting, processing, and exchange of NTFPs remains strongly rooted in the informal sector. Informal economic activity is defined as "economic activity that takes place outside of governmental regulatory and reporting systems" (McLain et al. 2008: 1), and as numerous studies attest (Brown et al. 1998, Carroll et al. 2003, Emery 1998, Hinrichs 1998, Levitan and Feldman 1991, Love et al. 1998, Nelson 1999, Richards and Alexander 2006), such activities are both ubiquitous and important contributors to community and household well-being. Assessments of the contribution of NTFPs to community well-being must therefore account for contributions from activities taking place at the edges and outside of the formal sector, as well as those tracked within the formal sector. Practically, this means that one cannot rely solely on standard economic measures, such as number of jobs created or the value of products sold in formal markets, to assess the contribution that NTFPs make

to community well-being. In part this is because the number of jobs and market values associated with NTFPs are often not well captured in many of the standard economic activity accounting systems, such as the Harmonized Tariff Schedule that the U.S. government uses to track exports and imports (Alexander et al. 2011b), or the U.S. Census Bureau's County Business Patterns database, which tracks the number of businesses operating in each county, as well as how many people each business employs and the size of its payroll (Smith et al. 2010).

Ethnographic studies of NTFP harvesters and buyers indicate that NTFPs perform safety net, buffering, and provisioning functions for both rural and urban households (Emery 1998, Emery and Pierce 2005, Hinrichs 1998, Love et al. 1998, McLain et al. 2014, Poe et al. 2014). NTFP activities taking place outside of formal markets function as a type of "intergenerational and cultural glue," helping community members and families build and strengthen social ties and maintain cultural identities (Brown et al. 1998, Carroll et al. 2003, Love et al. 1998, McLain 2008, Richards and Alexander 2006, Poe et al. 2014). Unlike timber harvesting, which few people would categorize as a leisure activity, some commercial NTFP harvesting falls "somewhere in between" (Carroll et al. 2003, McLain 2008), with participants viewing harvesting as simultaneously work and leisure. A common theme among commercial and noncommercial harvesters alike is that NTFP harvesting is important to them in part because it provides an opportunity to strengthen their connections with the natural world and improve their physical and mental health (Emery and Ginger 2014, Love et al. 1998, McLain 2008, Poe et al. 2014, Tsing 2013).

Recent surveys of outdoor recreationists in Oregon and Washington show that "gathering/collecting things in a nature setting" is an activity practiced by a significant percentage of the population in the NWFP region. We are not aware of any comparable data for California. Washington state's Statewide Comprehensive Outdoor Recreation Plan (SCORP) survey results for 2012 analyzed the participation by residents from across Washington in four types of gathering/collecting activities (Responsive Management 2012). As indicated in table 8-2, slightly more than one-quarter of adult residents had participated in

Table 8-2—Percentage of Washington and Oregon SCORP survey respondents participating in specified outdoor activities during the 12 months preceding the survey

Outdoor activity	Washington respondents	Oregon respondents
	Percent	
Gathering/collecting things in nature setting:	27.2	21.9
Berries or mushrooms	14.9	—
Shells, rocks, vegetation	18.4	—
Firewood	6.7	—
Christmas trees	4.2	—
Selected outdoor activities:		
Bicycle riding (trails)	24.4	12.2
Camping (car/motorcyle with tent)	26.5	34.6[a]
Cross-country skiing	4.5	5
Downhill skiing	10.4	16.3
Hiking	53.9	48
Hunting (big game)	8.4	8.3
Off-roading (four-wheel drive)	9.5	9.8
Snowshoeing	6.7	8.5

SCORP = Statewide Comprehensive Outdoor Recreation Plan; — = No data.
[a] Car camping only.
Source: Responsive Management 2012 and Rosenberger and Lindberg 2012.

gathering or collecting in a nature setting in the previous 12 months, with participation rates in mushroom/berry picking and shell/rock/plant collecting being more than double the participation rates in harvesting firewood or Christmas trees. Table 8-2 shows that participation rates for gathering/collecting were greater than for many other outdoor activities, including downhill and cross-country skiing, hunting, off-road vehicle riding, and bicycling on forest or mountain trails. Residents of rural areas or small towns were somewhat more likely to participate in gathering or collecting than urban or suburban residents (29 percent and 24 percent of respondents, respectively). Table 8-3 shows that respondents gathered on diverse landownership types, with 18 percent gathering on national forests and only 1 percent on BLM lands. This difference is likely because very little BLM-managed land is located in Washington. Overall, the percentage of persons gathering or collecting on national forests or BLM-managed lands in Washington is relatively small compared with those who gather or collect on private or other types of public lands. However, these figures represent recreational gathering only; the bulk of commercial harvest likely takes place on federal and state forests and large private timber holdings.

Table 8-3—Percentage of Washington SCORP survey respondents who gather or collect things in nature settings on specified land ownerships

Land ownership category	Respondents
	Percent
National park or monument	8
State park	18
County/city/municipal park	8
National forest	18
State forest	8
National wildlife refuge	1
Bureau of Land Management land	1
Other public land	19
Own property	14
Someone else's private property	27

SCORP = Statewide Comprehensive Outdoor Recreation Plan.
Source: Responsive Management 2012.

The Oregon SCORP survey, which was also administered to residents statewide, collected data about gathering/collecting participation rates by Oregon residents during 2011, but did not break down the data by type of gathering activity (Rosenberger and Lindberg 2012). The percentage of Oregon residents who participated in gathering/collecting ranged from a low of 16.3 percent in the area around Portland to a high of 47 percent in northeastern Oregon, with an average of 22 percent for the entire state. Unfortunately, the authors lumped rock collecting in with plant, mushroom, and berry collecting, making it difficult to ascertain the percentage associated with NTFP gathering. The Oregon survey did not gather data about landownerships on which collecting took place. Table 8-2 shows how participation rates for gathering/collecting in Oregon compared with a selection of other activities.

A study by Starbuck et al. (2004) is the only example of research that has looked at the economic value of recreational NTFP harvesting in the Plan area. By using travel cost methods with 1996 permit data from the Gifford Pinchot National Forest, they estimated that one visitor day of berry and mushroom harvesting was worth $30.02 (in 1996 U.S. dollars). This compared with roughly $87/day for camping and $53/day for picnicking (Alexander et al. 2011a). More studies using the travel cost method or other forms of non-market valuation are needed to understand how much different types of recreational NTFP harvesting contribute to local economies.

***How the NWFP affects NTFP supplies from federal lands*—**Permitted harvest quantities are currently the best data available for analyzing trends in the demand for NTFPs on federal lands. However, two important caveats limit the utility of permit data as an indicator of NTFP demand. Both the Forest Service and BLM lack the capacity to track with any accuracy the quantities of NTFPs actually being harvested, and permit data merely reflect the maximum amount that the permit holder hopes to be able to harvest. Additionally, other factors, such as price shifts, weather conditions, and changes in consumer preferences can and do affect how many permits are issued in any given year (Charnley 2006c). The NWFP 10-year socioeconomic monitoring report described trends in permitted

quantities for BLM districts and national forests for the period 1994–2002 (Charnley 2006c); the NWFP 20-year socioeconomic monitoring report described these trends from 2004 through 2012 (Grinspoon et al. 2016). Table 8-4 shows the permit trends for NTFP products during these two periods. Unfortunately, the NTFP data in the 20-year report are presented in a format that does not permit a determination of the trends for a number of product categories. Nevertheless, the products for which a comparison across land ownerships and time is possible, some patterns do emerge. For both BLM lands and national forests, permitted harvest quantities of firewood initially declined and then increased, whereas greenery and foliage showed an upward trend for the entire period. Permitted harvest quantities for wild mushrooms increased on BLM lands through both periods, but on national forests they declined before trending upward between 2004 and 2012.

Based on interviews with specialists on three national forests and one BLM district, Charnley (2006c) identified several ways in which the Plan affected opportunities for the commercial harvest of NTFPs on national forests and BLM-managed lands between 1994 and 2006. Some provisions, such as road closures linked to the Plan's management guidelines, reduced the ability of harvesters to physically access resources. Other provisions, such as guidelines related to the management of late-successional reserves (LSRs) and riparian reserves, resulted in the closure of some areas to legally sanctioned commercial harvesting. Additionally, provisions prohibiting the harvest of special-status plants affected some commercially harvested species. The extent to which the standards and guidelines for LSRs and riparian reserves affected NTFP harvesting depended on how local Forest Service and BLM units interpreted them, and whether they were strictly applied. For example, some forests prohibited commercial harvesting of wild mushrooms in LSRs, while others did not (McLain 2000). Charnley (2006c) concluded that, during the first 10 years of implementation the Plan had the greatest negative impact on the harvesting of firewood and Christmas trees, both of which were previously closely linked to timber harvesting activities. Comparable interview data were not collected for the 20-year report, and consequently it is unclear what factors might account for the observed increases in permitted harvest quantities for firewood and stabilization in Christmas tree permits. Charnley (2006c) pointed out that, over the long term, the most important impact of the NWFP on NTFP resources is likely to be the landscape-scale

Table 8-4—Trends in permitted harvest quantities of nontimber forest products in the Northwest Forest Plan area (1994–2002 and 2004–2012)

	Bureau of Land Management districts		National forests	
Product	**1994–2002**	**2004–2012**	**1994–2002**	**2004–2012**
Fuelwood	-	+	-	+
Christmas trees	-	No data	-	Stable
Cones	-	No data	+	-
Moss	-	No data	Stable	-
Posts and poles	+	+	-	No data
Greenery and foliage	+	+	+	+
Boughs	+	-	Unclear	-
Mushrooms	+	+	-	+
Transplants	+	No data	-	No data

- = negative; + = positive.
Source: Charnley 2006c and Grinspoon et al. 2016.

changes it causes in forest structure and composition, changes that will affect the types, quantities, and qualities of NTFPs present in an area. Whether those impacts are negative or positive, however, depends on what changes in forest conditions have occurred in NTFP harvesting sites, as well as the types of products that are harvested there (Pilz and Molina 2002). The NWFP provisions and fire suppression are expected to encourage the development of older forest structure and processes, with a concomitant decrease in early-seral vegetation. Such conditions favor NTFPs such as matsutake mushrooms and moss, but will likely lead to reductions in the supply of products found in early-seral-stage forests, such as huckleberries, salal, and boughs (Charnley 2006c).

A promising avenue for enhancing the contribution of the NTFP sector to socioeconomic well-being is a forest management approach known as "compatible management" or "joint production." In this approach, forest stands are managed simultaneously for timber and one or more NTFPs (Alexander et al. 2002, 2011a). For example, in a study comparing three scenarios of timber management, one using a timber management strategy that increased matsutake production, another using a timber management approach with a neutral effect on matsutake productivity, and the third with no timber harvest, Pilz et al. (1999) found that the most lucrative approach was to manage the forest for both timber and matsutake. A joint production approach to federal forest management would have the additional advantage of supporting other goals of the NWFP, including enhancing structural and biological diversity.

Recreation—

The Forest Service and BLM provide opportunities for urban and rural residents to recreate in a wide variety of settings and to participate in a wide variety of recreation activities. Current annual estimates are that 20 million visits take place each year to federal forests in the NWFP area—with 5.3 million to BLM lands and 14.6 (± 5.3 percent) million to Forest Service lands (Grinspoon et al. 2016, USDA FS 2016). Other federal agencies, state and local governments, and private businesses and organizations also provide places to recreate for many of the same individuals. Relative to other providers, the recreation opportunities provided by the Forest Service and BLM are typically farther from population centers and less intensively developed. Chapter 9 includes a detailed description of the amount of recreation use on NWFP-area national forests and common activities of those recreating. This chapter focuses on the economic contributions of recreation activity on federal forests in the NWFP area to local communities.

Recreation on federal forests drives economic activity in local communities, states, and across the NWFP region when recreation visitors spend money on recreation trips, and the agencies and their partners spend money to manage recreation sites. Recreation visitors also support economic activity when they purchase equipment and other durable goods (e.g., boots, binoculars, off-highway vehicles, skis) that they need for particular recreation activities. This spending is not attributable solely to a single recreation opportunity provider (e.g., a single NWFP-area federal forest or all of them combined), and is not discussed here. This section focuses instead on the effects of visitor spending during recreation trips.

The amount of recreation use, the types of trips visitors take, their activities (to a lesser extent), and the size of the local economy all combine to influence how and to what degree recreation visitation leads to private sector employment and business activity (Stynes and White 2006, White and Stynes 2008). The amount of recreation use determines the potential number of visitors who can spend money in an area. All else being equal, a national forest with more recreation use supports more visitor spending in local communities. The type of recreation trip (day trip, overnight trip, near or far from the visitor's residence) is the key factor in determining recreation visitor spending (White and Stynes 2008). On average, spending by national forest recreation visitors nationwide ranges from $36 per party per trip for visitors on local day trips (trips within 50 miles of their residence), to $580 per party per trip for those on nonlocal (more than 50 miles between residence and destination) overnight trips where lodging is off the national forest (table 8-5). Average spending figures represent both those who spend money and those who do not spend money during the recreation trip. About 12 percent of visits to national forests involve no visitor spending; about 30 percent

Table 8-5—National forest visitor spending profiles for the United States by trip-type segment and spending category, dollars per party per trip[a]

Spending categories	Nonlocal			Local			Non primary	All visits[b]
	Day	OVN-NF	OVN	Day	OVN-NF	OVN		
	Dollars							
Motel	0	44.77	203.85	0	6.39	51.62	139.67	53.96
Camping	0	27.79	13.68	0	28.25	23.01	12.23	7.43
Restaurant	14.77	27.47	116.41	5.66	7.65	32.43	93.23	37.63
Groceries	10.67	55.09	72.52	6.62	71.54	59.62	49.85	29.68
Gas and oil	30.20	62.27	82.47	15.43	46.59	58.05	62.71	38.74
Other transportation	0.58	1.34	4.98	0.16	0.04	1.19	3.35	1.45
Entry fees	4.12	7.13	12.85	2.70	4.51	5.12	7.58	5.38
Recreation and entertainment	2.96	7.36	33.31	1.01	2.01	3.61	21.84	9.38
Sporting goods	3.15	10.77	13.75	3.83	11.78	9.48	7.91	6.62
Souvenirs and other expenses	1.93	7.73	25.87	0.60	1.10	11.48	23.74	8.62
Total	68.39	251.74	579.70	36.00	179.86	255.60	422.12	198.87
Sample size (unweighted)	2,112	3,600	2,289	9,225	1,388	295	3,955	22,864
Standard deviation of total	72	399	714	53	199	325	653	n/a

OVN = overnight, NF = national forest, n/a = not applicable.

[a] Outliers are excluded and exposure weights are applied in estimating spending averages. All figures are expressed in 2014 dollars. These averages exclude visitors who reported that their primary activity was downhill skiing/snowboarding. When completing analyses involving skiers/snowboarders, refer to subsequent tables. Local visitors are those who live within 50 miles of their recreation destination. Nonprimary visitors are those who were away from home to visit family, work, or recreate somewhere else. Their visit to the national forest was secondary to that other purpose.

[b] The all-visit averages are computed as a weighted average of the columns using the national trip segment shares for nondownhill skiing/nonsnowboarding as weights. Source: White 2017.

of visits involve spending of $20 or less. Because the spending averages include nonspenders and low spenders, some average values may appear low relative to typical costs.

Recreation activity has a secondary influence on visitor spending once trip type has been accounted for. For example, the spending of visitors who are downhill skiing or snowmobiling is systematically higher than average; and spending by visitors engaged in backcountry or primitive camping is lower than average (White and Stynes 2008). On average, spending by downhill skiers ranges from $60 per party per trip for local day trips (e.g., a couple who live in Bend, Oregon, and visit Mount Bachelor for morning skiing), to nearly $750 per party per trip for nonlocal overnight trips (table 8-6).

Following the processes outlined in White (2017), we calculate that, in total, recreation visitors to all the NWFP-area national forests combined spend roughly $612.6 million each year in the communities within about 50 miles of those national forests. About one quarter of that spending is generated by visitors engaged in downhill skiing and snowboarding ($156.8 million). Visitors who are hunting, fishing, or viewing wildlife on a national forest spend about $82.1 million in local communities; visitors engaged in other activities (excluding downhill skiing and snowboarding) spend about $374.8 million in local communities each year. Employees and proprietors of businesses that provide goods and services to recreationists receive direct benefits, in the form of income, from recreation visitor expenditures. The majority of expenditures by recreation visitors to NWFP-area forests are made for purchases of lodging and camping, food and beverages in grocery stores and restaurants, and fuel. The Mount Hood National Forest ($95 million), the Deschutes National Forest ($84 million), and the Siuslaw National Forest ($58 million) account for the greatest levels of spending at individual national forests. The presence of ski areas on the Mount Hood and

Table 8-6—Spending profiles of downhill skiers and snowboarders recreating on U.S. national forests, dollars per party per trip[a]

	Nonlocal segments		Local segments			
Spending category	Day	Overnight	Day	Overnight[b]	Nonprimary	All visits[c]
			Dollars			
Motel	0	193.53	0	88.83	146.10	95.76
Camping	0	0.43	0	0.20	4.23	0.37
Restaurant	20.53	158.80	9.83	72.89	129.36	85.48
Groceries	4.57	76.78	3.21	35.24	68.60	40.21
Gas and oil	24.43	64.96	13.44	29.82	55.28	40.73
Other transportation	0.28	1.89	0.24	0.87	9.78	1.39
Entry fees	37.68	90.73	17.93	41.65	107.20	58.39
Recreation and entertainment	18.62	107.74	11.13	49.45	52.21	58.79
Sporting goods	5.02	26.08	2.81	11.97	22.14	14.73
Souvenirs and other expenses	2.01	22.88	0.68	10.50	12.84	11.69
Total	113.15	743.81	59.26	341.41	607.74	407.54
Sample size (unweighted)	371	431	784	n/a	71	n/a
Standard deviation of total	96	825	81		772	n/a

n/a = not applicable.

[a] Outliers are excluded and exposure weights are applied in estimating spending averages. All figures are expressed in 2014 dollars. These averages are based on visitors who reported that their primary activity was downhill skiing or snowboarding. Analyses involving nonskier/nonsnowboarder visits should refer to previous tables on national forest visitor average spending. For downhill skiers and snowboarders, we have combined the overnight (OVN) national forest and OVN segments into a single OVN segment. Local visitors are those who live within 50 miles of their recreation destination. Nonprimary visitors were away from home to visit family, work, or recreate somewhere else. Their visit to the national forest was secondary to that other purpose.

[b] The sample size for local overnight visitors sampled at ski areas was insufficient, and here we calculate average spending as 46 percent of the nonlocal overnight average.

[c] The all-visit averages are computed as a weighted average of the columns using the national skier/snowboarder segment shares as weights.

Source: White 2017.

Deschutes National Forests helps explain the high levels of recreation expenditures there.

When a recreation visitor buys a good or service, economic activity that starts with the initial purchase spreads out to the broader economy in what is commonly referred to as the "multiplier effect" (e.g., Hjerpe et al. 2017). The size and diversity of other area businesses influence how that additional economic activity spreads within the local region, or leaves the area. Those areas with larger economies, such as Multnomah County near the Mount Hood National Forest or King County near the Mount Baker–Snoqualmie National Forest, will have greater multiplier effects from purchases by recreationists than places with smaller economies, such as Douglas County near the Umpqua National Forest or Skamania County near the Gifford Pinchot National Forest.

Recreation-related economic activity may be affected by climate change as wildfire and forest insect (e.g., bark beetle) activity are expected to increase with a warming climate, potentially leading to impacts on popular hiking and mountain biking areas (Hesseln et al. 2003, 2004; Loomis et al. 2001). Economic activity associated with forest recreation can be expected to decline when forests are closed because of high fire danger or active fire events (Starbuck et al. 2006), or trails or recreation sites are closed following fire events (Sánchez et al. 2016). Negative impacts on recreational quality can last for many years after a wildfire (Englin et al. 2001). However, research from southern California suggests that there can be positive economic effects when a fire creates opportunities for viewing postfire landscape processes (e.g., viewing flowers or new growth) (Sánchez et al. 2016).

Across mountainous regions of the world, alarm has also been expressed regarding possible climate change impacts on the ski industry and associated economic activity (Scott and McBoyle 2007). Potential concerns include a shortened ski season (Lal et al. 2011) as well as changes to avalanche conditions (Lazar and Williams 2008). Other recreational impacts may stem from heavy rainfall events that wash out access roads or otherwise result in flood-related damage (Sample et al. 2014). Climate change will affect multiple recreation-related variables, creating differential impacts depending on region, elevation, and other factors, with some areas potentially benefiting, for example, from longer snow-free seasons or fewer days of extreme cold (Irland et al. 2001, Richardson and Loomis 2004).

Ecosystem services—

In addition to providing the socioeconomic benefits previously discussed, federal forests also provide important ecosystem services both to local communities and more distant urban populations. These include contributions like fresh water, food and fiber, wildlife habitat, and outdoor recreation opportunities, to name a few (fig. 8-20). Della-Sala et al. (2011), for example, noted substantial economic and ecological benefits associated with clean water that originates from national forests of the Western United States, and in particular from roadless areas, where timber harvest is prohibited. The importance of national forests for supplying surface drinking water in the NWFP area has been mapped,[17] but the economic value of this contribution

[17] https://www.fs.fed.us/ecosystemservices/FS_Efforts/forests-2faucets.shtml.

Susan Charnley

Figure 8-20—Federal forests provide many ecosystem services, including clean water and fish and wildlife habitat.

has not been calculated. Brandt et al. (2014) identified several ecosystem services associated with Pacific Northwest forests, including timber harvesting, salmon populations, carbon storage in vegetation, soil organic matter, and landscape aesthetics. Many ecosystem services considered to be amenities (e.g., scenic views, recreation opportunities) contribute to rural residents' quality of life (e.g., Deller et al. 2001, Rudzitis and Johnson 2000), as well as attract inmigration of new residents (e.g., Gosnell and Abrams 2011, McGranahan 1999).

The past decade has seen significant and increasing effort among state and federal agencies, nongovernmental organizations, and others to identify and evaluate ecosystem services associated with various landscapes, including forests (e.g., Kline and Mazzotta 2012, Kline et al. 2013, Smith et al. 2011). There also has been increasing interest in developing and implementing policy instruments that provide monetary compensation to private forest landowners who produce particular ecosystem services, including direct payment programs, tax incentives, and ecosystem services markets, among others (e.g., Kline et al. 2000a, 2000b, 2009).

Within the Forest Service, the 2012 planning rule formally incorporated the concept of ecosystem services into national forest management and requires forest personnel to address ecosystem services as they prepare national forest plan revisions (USDA FS 2012). More recently, the Obama administration directed all federal agencies to consider ecosystem services values in federal planning and decisionmaking (Donovan et al. 2015), inducing agencies to develop methods and protocols for evaluating ecosystem services as outcomes of federal policies, programs, and agency performance. There also have been efforts to examine the potential for developing partnerships with nonfederal entities that may be willing to provide funding to assist in federal land management when it produces mutual benefits, such as restoration on federal lands that improve municipal watersheds (e.g., McCarthy 2014).

Within the NWFP area, federal efforts largely have focused on identifying and quantifying key ecosystem services produced from the region's national forests (e.g., Smith et al. 2011). In addition to characterizing biophysical ecosystem services such as water, habitat, food, and fiber, efforts also have included improving understanding of cultural ecosystem services associated with national forests and their importance to Pacific Northwest residents (e.g., Asah et al. 2012). Landscape modeling efforts have attempted to characterize tradeoffs among ecosystem services associated with alternative forest management regimes. For example, Kline et al. (2016) examined the potential for Pacific Northwest forests to store and sequester additional carbon, harvest timber, and retain/enhance habitat for seven focal wildlife species across an exhaustive array of management regimes for western Cascade Range forest landscapes. Results showed the levels of each ecosystem service produced under each management regime, as well as the tradeoffs among them from choosing one management regime over another. Northern spotted owl habitat was found to be complementary with stored carbon, with both generally increasing in older forests. Northern spotted owl habitat and timber harvest were found to range from largely competitive to neutral depending on the characteristics of the management regime examined. Joint production relationships involving northern spotted owl habitat and other wildlife species ranged from competitive for western bluebird to mostly neutral for Pacific marten, and complementary for the olive-sided flycatcher and red tree vole, depending on the differences or similarities in the forest conditions preferred by individual species (Kline et al. 2016).

Last, within the NWFP area there has been analysis of the willingness of nonindustrial private forest landowners to accept direct payments in return for agreeing to lengthen timber rotations to improve habitat for spotted owls (Kline et al. 2000b) and coho salmon (Kline et al. 2000a). Kline et al. (2000b), for example, suggested that many forest land owners would require little or no payment to forego harvest to improve habitat, while others would require a significant incentive.

Increasing recognition of ecosystem services by federal land management agencies can be viewed as an extension of the multiple-use approach toward more earnest

consideration of the diversity of uses and values derived from national forests, and to a broader coalition of public parties interested in federal land management (Kline et al. 2013). Although efforts to identify and quantify key ecosystem services have made significant progress in raising awareness and concern for these important forest benefits, formal methods for routinely including ecosystem services values into federal forest management are being developed by the Forest Service and BLM. Formally incorporating ecosystem services concepts into federal land management processes generally requires information about: (1) current landscape conditions and how they are changing; (2) how management activities likely will affect ecosystem services; and (3) what people value about the landscape, how much they value those things, and how their values might be changing (Kline and Mazzotta 2012). Meeting these informational requirements depends on addressing various methodological challenges involving the availability of ecological data and analytical models for describing the responses of ecosystem services to management, as well as adequate staffing for conducting such analysis (Kline et al. 2013). Federal directives (e.g., Donovan et al. 2015, USDA FS 2012) suggest that efforts to develop and improve methods for evaluating ecosystem services and including them in federal land management will continue as policymakers and the public increasingly recognize the importance of addressing these benefits in federal decisionmaking.

Summary—
Just as forest management can contribute to socioeconomic well-being in rural communities, so can rural communities contribute to federal forest management. Agency budgets have been reduced substantially since the NWFP was implemented, reducing agency capacity to accomplish forest management goals. In response, community-based groups and partner organizations have raised money and provided labor to help undertake forest work on federal lands. Wood processing infrastructure in communities has also declined throughout the Plan area since the 1980s, making timber sales less economical and creating a financial barrier to restoration. By working together, communities and federal land management agencies in the Plan area can develop strategies to support and maintain the business infrastructure needed for forest restoration while creating more local economic opportunities.

How Rural Communities Contribute to Federal Forest Management

The community forestry literature from the United States emphasizes the reciprocal relationship between healthy forests and healthy communities (Baker and Kusel 2003, Kelly and Bliss 2009, Kusel and Adler 2003). Just as federal forest management can contribute to community well-being, so can communities contribute to federal forest management. For example, many communities and national forest units have begun to plan over large spatial scales and long time frames to create the consistency of work needed to attract investments in processing and contracting capacity (Schultz et al. 2012). Doing so provides both a more predictable employment base in local communities and the business capacity required to accomplish forest restoration.

Agency budgets, and the number of agency employees and field offices, have dropped substantially since the NWFP was implemented, particularly for the Forest Service and especially in its Pacific Northwest Region (Grinspoon et al. 2016, Stuart 2006). These declines have reduced agency capacity to undertake forest restoration and other forest management work. One way in which the Forest Service has dealt with declines in budget and personnel is through outsourcing work to contractors, partners, or volunteers. For example, Seekamp et al. (2011) identified 35 different types of recreation partnerships that the Forest Service engages in to help accomplish recreation-related work on national forests nationwide. Partners range from individual volunteers to service organizations, commercial outfitters, and other government agencies (fig. 8-21). Community-based organizations, local business partners, environmental and recreation organizations, and other groups have helped raise money and provide labor to accomplish forest management goals

Susan Charmley

Figure 8-21—A partnership between the Six Rivers National Forest and the California Conservation Corps makes it possible to accomplish trail work on the national forest.

on federal lands in the face of declining agency capacity to do so, filling critical gaps. But communities must have an interest in and capacity to provide support, which is linked to their assets and overall community health and well-being.

There are several such examples from the NWFP area. On the Siuslaw National Forest in Oregon, local partner organizations formed the Siuslaw Stewardship Group in the early 2000s (Sundstrom and Sundstrum 2014). The group has worked with the Forest Service to facilitate forest restoration on private and public lands in the Siuslaw watershed by pooling resources, assisting with monitoring activities, and cooperating in work activities by using stewardship contracts and the Wyden Amendment Authority (which allows federal dollars to pay for work on private lands in shared watersheds to protect and restore resources or reduce natural disaster risk), while contributing to community economic health and avoiding legal conflict over treatments (Sundstrom and Sundstrom 2014). In California, the Trinity County Resource Conservation District has been managing a stewardship agreement on the "Weaverville Community Forest," comprised of 12,000 ac (4856.2 ha) of the Shasta-Trinity National Forest and 1,000 ac (404.7 ha) of the BLM's Redding Field Office lands (Frost 2014). Their objective is to develop and implement forest management activities that meet local objectives while addressing forest health concerns. The community plays a central management role, recruits skilled local workers to accomplish restoration activities, and contributes financial support by leveraging money from other federal and state partners to help fund new projects in the community forest (Frost 2014).

In another example on the Shasta-Trinity National Forest, the Watershed Resource and Training Center has filled a number of institutional voids to help accomplish

forest management activities while creating local jobs (Abrams et al. 2015). These include job training to create a skilled local workforce to engage in ecosystem management and forest restoration activities, running a work crew to accomplish fuels reduction on federal and private lands, monitoring of projects, developing new local wood processing infrastructure, helping the Shasta-Trinity to develop stewardship projects, developing a community wildfire protection plan, and leading interdisciplinary project planning teams. Despite the fact that some community-based organizations such as these have innovated to fill in the gaps left by declining federal agency capacity, there are legal and economic limits to what these organizations can accomplish, and they may also be limited by their own internal organizational capacity (Abrams et al. 2015). In all these examples, external organizations help provide funding and labor to accomplish work on federal forests that the agencies do not have sufficient budgets or staffing to undertake.

An important way in which economically healthy communities contribute to ecologically healthy forests is by having a skilled workforce and the business infrastructure needed to help federal agencies accomplish their management goals. As noted previously, declines in local wood processing infrastructure accompanied declines in timber production from federal lands in the NWFP area. Not only did this decline adversely affect some Plan-area communities, lack of local infrastructure for processing timber and small-diameter wood make timber sales and removal of small-diameter material that constitutes hazardous fuels less economical, creating a financial barrier to forest restoration. For example, Nielsen-Pincus et al. (2013) found that national forest ranger districts in Oregon and Washington that were within a 40-minute drive to a sawmill or biomass facility treated more overall hectares, and more hectares in the WUI, for hazardous fuels reduction than did ranger districts that were farther away. Ranger districts that were close to these facilities also incorporated more biomass into their treatments. These findings underscore some of the interdependencies between healthy forests and healthy communities in the NWFP area.

The Implications of Land Use and Ownership Changes for Forest Management

Summary—
Changes in land use and ownership, particularly those that involve conversions of forest land to low-density and urban development, are likely to remain a significant factor affecting the NWFP area owing to population growth in the region. Loss of forest land to development, associated fragmentation of the remaining forest land base, and accompanying changes in how remaining private forest lands are managed suggest that policymakers and managers cannot assume that the forest land surrounding federal lands will be the same in coming decades and available to contribute to NWFP objectives.

In addition to its significant area of federal and other public lands, the NWFP area includes a notable private land base. Nonfederal lands totaled more than 11 million ac (4.45 million ha) in 2009 in western Oregon, or about 57 percent of all land in the region (Lettman 2011). Sixty-five percent of nonfederal land in western Oregon was forest, with the remainder divided between mixed forest and agriculture, agriculture, and low-density and urban development (fig. 8-22). In western Washington, nonfederal lands totaled more than 10 million ac (4.05 million ha) in 2006, or about 65 percent of all land (Gray et al. 2013). Seventy percent was forest, with the remainder in mixed forest and agriculture, agriculture, and low-density and urban development (fig. 8-23). Significant private forest lands also exist in northern California (Waddell and Bassett 1996, 1997), with nonfederal lands comprising 48 percent of all forest land in NWFP-area counties in California (Christensen et al. 2015). Private forest lands, including both industry- and nonindustry-owned, often augment federal and other public lands in providing ecosystem services (Kline et al. 2004a), including habitat for at-risk wildlife species (Stein et al. 2010; see also chapters 5 and 7). However, private lands also often differ from federal and other public lands in their forest structural

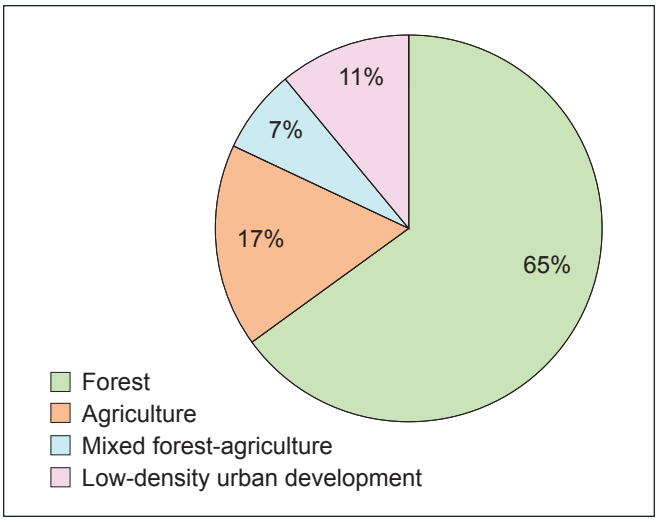

Figure 8-22—Land use of nonfederal lands in western Oregon (11 million ac [4.45 million ha]). Source: Lettman 2011.

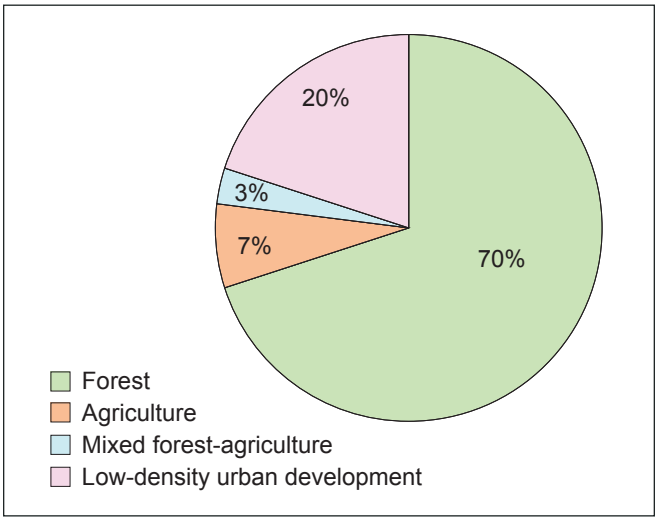

Figure 8-23—Land use of nonfederal lands in western Washington (more than 10 million ac [4.05 million ha]). Source: Gray et al. 2013.

attributes, with potential implications for habitat and other resource issues (Azuma et al. 2014). Although the public land area generally will remain constant for the foreseeable future, private forest lands are subject to possible conversions to other nonforest land uses, including agricultural, residential, commercial, and industrial development associated with population growth in the region. Federal and other public lands also can attract development on adjacent private lands, potentially leading to increased road densities, more human-caused wildfire ignitions, and greater demands for recreation, among other changes affecting federal lands (e.g., Azuma et al. 2013). The uneven distributions of ecosystems, ownerships and management activities across the NWFP area is one reason why it may be difficult to meet diverse biodiversity objectives on federal lands alone (Spies et al. 2007)

Forest land/agriculture conversions— Within the NWFP area, actual conversions of private forest land to agriculture (and vice versa) are limited. Forest land conversions to agriculture totaled 9,000 ac (3642 ha) from 1974 to 2009 in the entire state of Oregon, relative to a nonfederal land base of nearly 29 million ac (11.74 million ha), while conversions from agriculture to forest land totaled 3,000 ac (1214 ha) (Lettman 2011). Similarly, net conversions from forest land to agriculture totaled just 1,761 ac (713 ha) in western Washington between 1976 and 2006, out of a nonfederal land base of more than 10 million ac (4.05 million ha) (Gray et al. 2013). This stability between forest and agricultural land uses stems largely from the unsuitability of existing forest land for agriculture because of soils and topography, and the high income-earning capacity of lands currently in agricultural uses relative to forestry.

Conversion of private forest land to more developed uses— More prevalent are conversions of private forest land to residential, commercial, industrial, and other developed uses (fig. 8-24). Private forest land conversions to development in Oregon totaled 172,000 ac (69 606 ha) from 1974 to 2009, or about 2 percent of the nonfederal forest land statewide during this period, with 163,000 ac (65 964 ha) (95 percent of this total) involving conversions to low-density residential development, and the remaining 5 percent (9,000 ac) (3642 ha) involving urban development (Lettman 2011). These changes have been most prevalent in urbanizing regions along Oregon's Interstate 5 corridor (Lettman 2011).

Similarly, forest land development totaled 479,324 ac (193 976 ha) in western Washington between 1976 and 2006, or about 6 percent of the nonfederal forest land in western Washington. Of this total, 419,678 ac (169 838 ha) (88 percent) were converted to low-density residential development, and 59,646 ac (24 137 ha) (12 percent) to urban development (Gray et al. 2013). Population densities

Jeff Kline

Figure 8-24—Conversion of private forest land to residential development, Oregon.

have more than doubled in the Puget Sound region in recent decades, contributing to significant urban expansion onto forest land (Alig and White 2007). In some northwestern Washington counties, population increase owing to net domestic migration was more than double the natural increase in population during the 1990s, with associated increases in forest land development (White and Mazza 2008). Land use data suggest that development has been increasing on private lands adjacent to federal and other public lands, particularly in selected counties of western Washington and on the eastern slope of the Cascade Range in Deschutes County, Oregon (Azuma et al. 2013).

National-level projections based on expected population growth suggest continued loss of forest land to development through 2030 in northern California and the Pacific Northwest, largely following national patterns of development near existing urban areas (Stein et al. 2005, 2009). Regional projections of future low-density residential and urban development on forest land in western Oregon through 2024 are fairly modest largely owing to Oregon's land use planning program, with most conversions involving the transition of low-density developed forest land to urban uses (Kline 2005b). In eastern Oregon, forest land development also is projected to be fairly modest through 2025, with most conversions involving low-density to largely urban transitions (Kline et al. 2007). In western Washington, forest land was projected to decline by 8 percent from 1997 to 2027, with most converting to urban development (Alig and White 2007). However, projections in western Washington do not consider the potential conservation influence of Washington's land use planning program (implemented in 1990), which early analysis is suggesting may be beginning to have some effect on slowing development on both forest and agricultural lands (Kline et al. 2014). Development is expected to be most prevalent in valleys near urban areas, based on analyses conducted for western Oregon (Kline at al. 2003) and western Washington (Kline et al. 2009). Similar patterns also are reflected in analysis of western Oregon and western Washington combined, with greater loss of forest land expected through 2040 in the Puget lowlands and

Willamette Valley relative to the Coast Range and Cascades regions (Lewis and Alig 2014). We are unaware of regional-level land use projections for northern California.

Forest land development largely results from market forces. Population growth and inmigration, rising incomes, and economic growth over time combine to increase demands for land in developed uses (Kline et al. 2004a). Demands also increase with people's lifestyle choices when, for example, people relocate to rural areas or desire second homes in scenic forest settings. When demands for developed land uses increase, forest landowners may be able to earn more by selling their land than they can by maintaining it as forest (Kline et al. 2004a). When these market forces are at play, some loss of forest land to development is inevitable. Research also suggests that these trends can influence the degree to which forest landowners continue to perceive forestry and forest ownership as a worthwhile endeavor (Creighton et al. 2016). The combined influence of various socioeconomic factors on land use change largely has been confirmed in the Pacific Northwest from econometric land use modeling and analysis conducted at the county level (e.g., Parks and Murray 1994) and at finer spatial scales (Kline 2003; Kline and Alig 2001; Kline et al. 2001, 2003, 2007, 2009). Additionally, fine-scaled models, based on geocoded point data (e.g., Gray et al. 2013, Lettman 2011), suggest that location and natural amenity factors also play a role. Land use modeling for western Oregon, for example, found a positive correlation between development and the proximity of land to the Interstate 5 corridor and the Pacific Coast (Kline and Alig 2001, Kline et al. 2001). Analysis for the eastern slope of the Oregon Cascades found a positive correlation between development and the presence of scenic mountain views (Kline et al. 2007).

In general, conversions of forest land to development in both Oregon and Washington have been more common on private nonindustrial lands than on industry-owned lands (Lettman 2013). The area of timber industry-owned forest land has remained fairly constant in both Oregon and Washington since the mid-1970s, while the area of forest land in each state owned by nonindustrial owners has declined by 6 percent and 10 percent, respectively (Lettman 2013). We are unaware of studies addressing forest land development in northern California. Analysis and projection of future changes in forest land ownership has been hampered by a lack of data describing land ownership over time that spatially and temporally aligns with land use data sets developed for the region (e.g., Gray et al. 2013). Thus, knowledge of anticipated changes in land ownership tends to derive from predictions about which land ownerships are most likely to be involved in projected future land use changes (e.g., development), rather than predictions about potential future changes in ownership. For example, landscape-level modeling and projections for the Coast Range physiographic province of Oregon has suggested that forest land development could reduce industry-owned forest land by 6 percent, and nonindustry-owned forest land by 35 percent by 2096, with the greatest reductions near urbanizing Portland, Oregon (Johnson et al. 2007). Such reductions generally are not as likely to involve the most commercially productive industry-owned timber lands in the region, largely because of their relative geographic isolation from urbanizing locations where development will be prevalent owing to greater proximity to urban areas and transportation corridors (Kline and Alig 2005).

In addition to concern about the loss of forest land to development and its potential ecological impact, are concerns about how development often brings greater numbers of homes into dry, fire-prone forest types, expanding the WUI. In addition to the various land-use projection efforts previously mentioned (e.g., Kline et al. 2003, 2007, 2009), which can be used to anticipate future expansion of the WUI within the Plan area, are other regional and national efforts to define the current WUI and anticipate its future growth (e.g., Hammer et al. 2007). Such expansion likely will present future challenges to public land managers who will need to consider how to expend limited wildfire management funds to meet potentially competing objectives, including managing for ecological integrity and resilience to climate change, and habitat for species such as the northern spotted owl versus mitigating wildfire risk to homes.

Timber investment management organizations and real estate investment management trusts—
A growing interest nationally in recent years involves the seeming rise in forest land ownership of timber investment management organizations (TIMOs) and real estate

investment trusts (REITs), as they purchase forest parcels previously held by more traditional timber industry owners. Forest policymakers, for example, question whether TIMOs will continue to manage their holdings for long-term timber production versus eventual development (Lettman 2013). Whereas timber industry owners are perceived by policymakers as focused solely on securing an expected flow of timber revenue over the long term via active forest management, TIMOs and REITs are perceived as less committed to solely managing forests over the long term, and more amenable to other ways of generating income, including development (Lettman 2013). The NWFP area, however, has seen little research regarding how prevalent these forest land owners have become in recent years, their potential future trends, and whether and how their management of forest land holdings might change. Although TIMOs and REITs have been involved in several large acquisitions of previous industrial forest land in both Oregon and Washington (Lettman 2013), what this means for future management of such holdings as well as longer-term forest land ownership trends within the Plan area remains uncertain. Additionally, given that TIMOs and REITs typically do not own and operate wood processing facilities, it is conceivable that their increased forest land ownership in the Pacific Northwest could be accompanied by increases in log exports. Such changes potentially could increase the importance of federal timber harvests in supporting timber-related economic activity within the region.

Land use planning—
An additional and potentially significant influencing factor in both the pace and pattern of forest land development within the Plan area is land use planning, which restricts developed uses on private lands to promote efficient land use and secure various conservation benefits. Oregon's land use planning program—often cited as a national model for statewide planning (Kline and Alig 1999)—has provided a measurable degree of protection of forest and agricultural lands since its inception in 1973 (Gosnell et al. 2011), with an estimated 1.4 percent of the private forest land base saved from development by 1994 that otherwise would have been developed without land use planning in effect (Cathcart et al. 2007, Kline 2005a). Land use projections suggest that the Oregon land use planning program will continue to conserve forest land in the future, totaling 315,000 ac (127 476 ha) (4.4 percent) between 2004 and 2024 (Kline 2005b). Although less studied than Oregon's land use planning law, research suggests that Washington's land use planning program also has had some effect at reducing development of private forest land since its implementation in 1990 (Kline et al. 2014). To our knowledge, land-use planning effects on conserving forest land in California have not been examined. Additional public land use policies, including most notably preferential property tax assessment, also likely influence land use changes within the Plan area, but we are unaware of any studies addressing these.

Land use change and fragmented forests—
Secondary to the direct impact that development can have on reducing the total area of forest land is the role it plays in fragmenting remaining forest land. For example, as the area of forest land in western Washington has declined, it has become more fragmented, with greater edge to interior portions and smaller patch sizes (Gray 2013). Forest fragmentation can have implications for wildlife habitat and other ecosystem services, as well as influence how remaining forest lands are managed. For example, forest land development has been linked to loss of forest cover and associated declines in coho salmon populations in rivers feeding the northern Puget Sound (Bilby and Mollot 2008), as well as degradation of stream conditions and fisheries generally owing to declines in vegetation and increased area of impervious surfaces (Morley and Karr 2002). Azuma et al. (2014) suggested that even small amounts of development can lead to meaningful changes in forest conditions on both private lands and lands adjacent to federal and other public lands, including increases in invasive species.

Increased use of fine-scale spatial land use modeling (e.g., Kline et al. 2003) versus county-level models (e.g., Parks and Murray 1994) in recent years has enabled greater consideration of how future development is likely to affect specific ecosystems and habitats. For example, development in western Washington is expected to be more prevalent on level or moderately sloped lands and nearer to existing urban areas (Kline et al. 2009). Similar patterns are projected in western Oregon, with development expected

to have a greater impact on oak woodland habitat along the Willamette Valley perimeter than on the coniferous forests of the western Cascades and Coast Ranges (Kline and Alig 2005). In the Coast Range physiographic province of Oregon, development is expected to occur more frequently on gently sloping valley bottoms (Spies et al. 2007), including high intrinsic-potential coho salmon streams (Burnett et al. 2007). On the eastern slope of the Oregon Cascades, projected development is expected to adversely affect habitat connectivity for mule deer, potentially impeding animal movement for winter foraging (Kline et al. 2010). National-level analysis has identified significant numbers of at-risk species on corporate-owned lands in select watersheds in coastal areas of northern California, southern Oregon, and Washington (Stein et al. 2010).

Forest fragmentation resulting from development also has been found to be accompanied by changes in how remaining private forest lands are managed. Research from western Oregon found that increasing building densities on private forest land were associated with lower forest stocking rates as well as reduced precommercial thinning and tree planting following harvest (Kline et al. 2004b). This contrasts with similar research conducted for eastern Oregon, which suggested that development had not significantly influenced private forest management owing largely to the relatively lower rates of development, among other factors (Kline and Azuma 2007). Modest rates of forest land development throughout western Oregon are projected to lead to additional reductions in active forest management for commercial purposes at least through 2054 (Kline and Alig 2005). Such changes are thought to arise, in part, from forest fragmentation (or parcelization), which breaks up large forest parcels into smaller parcels for development, thereby increasing the cost of active forest management. Additional research suggests that private landowners of smaller forest land parcels tend to manage less for commercial timber production and more for recreation, aesthetics, and other passive-use values (Kline et al. 2000a, 2000b). There also is emerging evidence suggesting that private forest landowners may have different perspectives and approaches to managing wildfire risk than do federal land managers (e.g., Charnley et al. 2017). Such changes in private landowner objectives and perspectives potentially offer opportunities for enlisting private landowners in landscape-level conservation and wildfire management efforts, possibly through financial incentives, education, and technical assistance (Fischer et al. 2014; Kline et al. 2000a, 2000b).

Research Needs, Uncertainties, Information Gaps, and Limitations

The science synthesis presented in this chapter is necessarily limited by information gaps stemming from lack of available science to adequately answer the guiding questions. Here we identify research needs that could help fill some of these gaps.

The Wood Products Industry

There is increasing recognition that federal forest management, especially forest and watershed restoration, should be done at the landscape scale and across land ownerships to ensure better outcomes. Concurrently, there is recognition that forest management and the production of ecosystem services take place within complex social-ecological systems (chapter 12) in which management outcomes are influenced by both social and ecological conditions, which are linked and which interact to influence one another. Further, these social-ecological systems are characterized by complexities such as time-lagged effects, tipping points that yield dramatic changes over short periods of time, and spatial connectivity. Much of the landscape-level modeling conducted within the Plan area is now decades old or has not fully accounted for the linked social-ecological system dynamics that influence forest management. New research that recognizes and quantifies these dynamics, and that simulates landscape-level management over long time frames, is needed to better understand potential futures and tradeoffs in the production of ecosystem services under alternative management regimes within the Plan area. Such research could provide insight into whether the availability of federal timber for harvest will continue to change in coming decades, and how federal timber production might affect other values associated with federal forests.

Global competition, technological change, consumer demand, and other factors unrelated to federal timber supply all influence wood products manufacturers in the Plan area. In Oregon, there has been recent interest among policymakers and the business community in mass-timber buildings as a potential new market for wood products manufacturers. Mass-timber buildings (which are often multistory and use large panels and columns constructed from wood rather than concrete or steel) are proposed, or under construction, in Portland, Oregon, and an Oregon manufacturer has begun producing mass-timber panels. Additional research is needed to identify products for which wood products manufacturers in the Plan area may have a competitive advantage, given the realities of global markets for commodity wood products such as dimension lumber and structural panels.

Community Socioeconomic Well-Being

Land managers have expressed interest in how socioeconomic well-being in the Plan area has changed since the NWFP was implemented. In this chapter, we have described general trajectories of change in forest communities, characterizing these trajectories according to certain archetypes. We do not know how many communities in the Plan area fall into each type, the geographical distribution of different community types, or the extent and nature of hybrid types ("multifunctional") communities, although typologies have been developed and mapped at the county scale. Existing studies that rely on a small handful of indicators from secondary data sources, such as the U.S. Census, are insufficient for fully understanding change in the region, and how it may be linked to federal forest management as one driver of change. An assessment of community types in the Plan area could help managers better understand how communities have been changing, and how management actions could be tailored in different places to provide different types of local community benefits. Adding to this, NWFP socioeconomic monitoring during the first decade provided a rich characterization of the impacts of the Plan on rural communities, and how they were adapting to changes in federal forest management. NWFP socioeconomic monitoring during the second decade focused on change at the county scale, and relied solely on secondary data from existing sources. Community studies that include primary data gathering directly from community residents would provide a much richer understanding of how socioeconomic well-being in the Plan area has changed over time, and its links to federal forest management. Currently, there is a paucity of community-level studies from NWFP-area communities.

Forest Service Contracting

Climate change promises to further complicate the relationships among wildfire, federal spending, and community benefits. On the one hand, communities with higher levels of fire suppression contracting infrastructure may benefit economically from increases in fire frequency and extent, owing to increased economic activity associated with more fire suppression. On the other hand, increasingly nationalized and mobile fire suppression response means that local fire suppression capacity (e.g. trained crews and equipment) may be elsewhere when a fire strikes, and therefore unable to support local suppression efforts (thus requiring dispatch to call upon crews from outside the local area). Additionally, communities may experience economic challenges in the months following a wildfire despite an initial increase in economic activity associated with firefighting (Davis et al. 2014, Nielsen-Pincus et al. 2014). Forest-specific climate adaptation strategies for the region identify the need for active management to make forests more resilient to wildfire and climate-change effects, and undertake other stewardship activities (chapter 2) (Spies et al. 2010, Whitely Binder et al. 2010), all of which imply potential contracting opportunities for local communities. The lack of historical analysis of forest restoration and fire suppression contracting leads to many uncertainties in understanding the future of such contracting work, or the linkages between restoration and fire suppression contracting. Much of the research to date has focused either on very specific geographies and case studies, or on more regional data and trends. In addition, the challenges facing restoration contractors and fire suppression contractors differ, not only in the contracting and dispatching protocols, but also in the scale at which the work is conducted.

Additional research focused specifically on understanding the businesses that engage with federal agency contracting (restoration service, timber sales, and fire suppression) would provide a more comprehensive understanding of the overlap and linkages between these businesses, as well as the communities to which they are connected and their local impacts.

Within the confines of timber sale and contracting requirements, the Forest Service has a number of innovative tools available to enter into partnerships, agreements, and stewardship contracts with private businesses and nongovernmental organizations. These innovative tools can be used to accomplish a variety of natural resource projects, produce a range of ecosystem goods and services, and bolster the performance of both the agency and the cooperating entity. Much of the recent research on the use of innovative tools in the Pacific Northwest has taken place in dry forests, east of the Cascades. Additional research is needed within the NWFP area on how the connections between the Forest Service and local communities can be strengthened through the use of such tools. In addition, the Plan area has been a source for experimentation with new models of natural resource governance (Montgomery 2013), including models in which community-based organizations fill in for gaps in federal capacity (Abrams et al. 2015). It remains to be seen how the evolution of these new institutional arrangements will affect contracting activities and the spatial distribution of benefits from Forest Service contracting.

Biomass

Much is still unknown regarding the potential for biomass energy production and related ecosystem service work to support rural communities in the future. Doing so will depend on the details of renewable energy, climate change, and ecosystem service-oriented policies and markets. Various climate change mitigation or adaptation initiatives may provide incentives and support for forest biomass production and use. For example, programs to increase the production of energy from non-fossil-fuel sources could increase demand for forest-based biomass materials and outputs. However, uncertainties remain regarding the carbon benefits of forest biomass energy (Hudiburg et al. 2011, Nechodom et al. 2008, Ter-Mikaelian et al. 2015), raising the possibility that biomass may not continue to be favored as part of a low-carbon energy portfolio. Further, the feasibility of biomass as a complement to forest stewardship and as a contributor to rural development is challenged by current harvest, transportation, and processing costs and the low demand for biomass materials; this scenario could change with new markets, subsidies, or biomass-based products (Crandall et al. 2017). Research is needed to better understand the full suite of costs and benefits associated with biomass energy development under different market and public policy scenarios, and to understand where and under what conditions biomass harvesting may help to complement other forest management activities or contribute to a low-carbon energy matrix. Additional research could also help to clarify how the interactions of various energy and non-energy policies influence the development of biomass businesses (Abrams et al. 2017, Becker et al. 2011b).

Nontimber Forest Products

Nontimber forest products on federal forests support community and household well-being by providing income-earning opportunities in the formal and informal economic sectors, strengthening individual and community social capital, facilitating intergenerational ecological knowledge transfer, and enabling NTFP practitioners to develop stronger connections with nature and improve their mental and physical health. Research conducted in the previous two decades has begun to reveal some of the diverse and complex ways in which NTFPs contribute to human well-being, but there is much more to be learned (fig. 8-25). Specifically, we know very little about even some of the most basic social, economic, and ecological aspects of NTFPs, such as:

1. Who is harvesting NTFPs and what are their motivations for harvesting these products? To what extent do urban, as well as rural, residents participate in NTFP-related activities?
2. Where are harvesters getting NTFPs from and how much are they actually harvesting?
3. How does the spatial and temporal distribution of NTFP activities vary within and across seasons?

Rebecca McLain

Figure 8-25—Much remains to be learned about the harvesting of even the most important nontimber forest products in the Northwest Forest Plan area, such as wild mushrooms and firewood.

4. What are the cumulative impacts of agency regulations such as large-scale area closures, permit requirements, seasonal restrictions, etc. on NTFP livelihoods?
5. What are the ecological impacts (positive and negative) of NTFP harvesting? And what are the impacts of different vegetation management and restoration practices on NTFP species and livelihoods? What active management approaches can be adopted to enhance the productivity of different NTFPs, while also producing timber?
6. How is climate change likely to affect the location, quantities, and qualities of NTFP species? What adaptive measures can be taken to ensure the viability of NTFP livelihoods in the face of changing climatic conditions?
7. What do informal and formal NTFP value chains look like, and how are benefits distributed along those value chains? How do permit prices align with the costs incurred by harvesters?
8. What methods exist or could be developed for measuring the contribution to community well-being of NTFP activities taking place outside the market place, and how can these be adapted for research on NTFP activities in the Plan region? How can the recreational, cultural, and provisioning values of NTFPs best be assessed?

Additionally, most of the research on NTFPs in the Plan region has focused on the "big three"—floral and holiday greens, wild edible fungi, and huckleberries. No studies have been done of firewood, which provides the bulk of NTFP revenues on many national forests and serves as a heating source for many rural residents. Little is known about the native seed and transplant industries, which play a major role in restoration on both federal and private lands. Likewise, little is known about the social and economic aspects of medicinal plant gathering on federal forests in the NWFP region, yet the medicinal plant industry is one of the largest and fastest growing NTFP sectors.

The biggest gains in knowledge about NTFPs in the NWFP region and the people who rely upon them for their livelihoods, enjoyment, and cultural traditions were made between 1990 and 2010, thanks in large part to the Pacific Northwest Research Station's interdisciplinary applied research program focused on improving understanding of the social, economic, and ecological aspects of NTFPs. A key take-home message from that experience is that building and strengthening partnerships, both across academic disciplines and among scientists, managers, and NTFP harvesters/buyers, is likely the key to the development of a program of NTFP research that can enhance socioecological resiliency and community well-being in the NWFP region.

Recreation

Recreation opportunities on federal forests support the well-being of local communities by providing leisure opportunities for local residents and by attracting visitors who spend money in local communities during their recreational trips. Research is generally clear on what communities can do to promote greater visitor spending, such as providing lodging opportunities, restaurants, and recreation services. There is limited research within the Plan area on how federal forest resource conditions and management influence recreation use and recreation behavior of local residents and visitors. More research is needed to understand how management actions across the landscape, and at important resource destinations, influence how people use forests for recreation.

Ecosystem Services

Given the degree of contentious debate that motivated the NWFP and that has been inspired by it over the years, it is surprising that little analysis has addressed the potential net co-benefits associated with the Plan. Specifically, what has the NWFP meant in terms of water quality, outdoor recreation, and habitat for species other than the spotted owl? Quantifying these possible net co-benefits, even approximately, might offer additional information with which to more fully evaluate the long-term effects of the Plan. Future research could be directed toward characterizing how the NWFP has influenced various ecosystem services, building on case studies and approaches in development (e.g., Kline and Mazzotta 2012, Smith et al. 2011).

Additional research could be directed toward further evaluating the degree to which various policy instruments, including direct payments, tax incentives, and ecosystem services markets, could be used to provide incentives to private landowners to conduct actions that pursue NWFP goals on private lands, augmenting current efforts on federal lands. In the early 2000s, for example, there was significant excitement about the expected development of markets for nontimber ecosystem goods and services that are produced from forests (e.g., carbon storage, water quality improvements) (e.g., Kline et al. 2009). However, achieving these expectations has been spotty within the NWFP area, in part because to effectively implement them, such markets require new or tighter environmental regulations restricting actions that damage ecosystem goods and services, making such markets difficult to establish (Kline et al. 2009). Despite limited success thus far, the presence of a carbon market in California and other cases in Oregon and Washington provide some promise that such markets can provide additional revenue streams from private forests. But how, and if, public forests can contribute to carbon markets and other ecosystem service markets remains largely unknown. Use of other landowner compensation mechanisms, such as direct payments and tax incentives, to advance NWFP goals on private lands arguably have received less attention by environmental advocates, but offer similar promise. Key research needs regarding compensation mechanisms of any type include evaluating the degree of difficulty in their implementation, and evaluating the potential returns in terms of the net ecosystem services benefits gained.

There also are opportunities for improving knowledge concerning the use of nonfederal funding to finance forest restoration on federal lands. Existing research demonstrates examples of supporting forest restoration projects that lead to watershed improvements (e.g., McCarthy 2014). The Pacific Northwest accounts for the majority of high-biomass forests nationwide, and federal lands account for nearly half of the regional total (Krankina et al. 2014), suggesting possible opportunities related to protection and stewardship of sequestered carbon should carbon markets be developed in the region and be open to participation by federal lands. The development of these potential financing opportunities will depend upon, among other factors, supportive public policies and organizational capacity at multiple scales (Davis et al. 2015, Kline et al. 2013). Exactly how such financing approaches can operate on public forest lands, how much additional revenue such approaches could provide toward forest restoration on federal lands, and how the revenue derived from these approaches should be distributed to benefit both people and forests are areas in need of further research.

Land Use Change

Given the impact that housing and other development could have on the amount and condition of remaining private forest land, analysis of the implications that such development could have for whether NWFP goals can be met in the future would seem warranted. In many cases, private lands likely augment public lands in providing various types of habitat, depending in part on the degree of development present. Most analyses have treated land use as an "either-or" proposition—land is considered either forest or developed. Increasingly, however, we are likely to see growing fragmentation of privately owned forest lands, with housing and other development interspersed "among the trees." Such development can have a variety of effects on habitat and ecosystem services, including effects on spotted owls, depending on how private landowners choose to manage their lands—whether for timber or largely for environmental amenities such as aesthetics, recreation, and habitat. For these reasons, development and its influence on landowner decisions could be a significant social process influencing the Plan area in the future. We see value in maintaining a research program that examines land use change and its effects on habitat and other NWFP goals, and that analyzes the effects of various policies that can be used to influence land use change.

Conclusions and Management Considerations

This chapter discusses how the NWFP, among other social and economic factors operating at multiple scales, has affected rural communities in the Plan area, and how they have changed since the Plan was implemented. It also highlights many of the ways in which federal forest management contributes to community socioeconomic well-being, and vice versa. The chapter is based on a set of guiding questions, several of which federal forest managers in the Plan area identified as being of interest. Given the statutory and policy foundation for considering socioeconomic well-being in federal forest management, a number of relevant management considerations based on the literature synthesized in the chapter are identified here.

Management Considerations

Wood products production remains important. Increased use of alternative silvicultural methods and expanded restoration treatments could increase federal timber production to maintain local wood processing infrastructure and the forestry workforce and support investments in new wood products markets. Historically, timber production was the central way in which federal forests in the NWFP area contributed to community socioeconomic well-being. The supply of timber from federal forests has dramatically declined post-NWFP. That decline, coupled with broadscale changes in the wood products industry, has altered this important connection between federal forests and communities. How to meet the NWFP goal of producing a predictable and sustainable supply of timber in the future to contribute to community socioeconomic well-being remains an important and continuing management challenge. Federal forests contribute roughly 10 percent of the regional timber supply today, reflecting current social acceptability and management approaches. Efforts and plans to pursue alternate management strategies focused on increased use of alternative silvicultural methods, and expanded restoration treatments could increase the volume of federal timber produced compared to recent outputs. How any increased federal forest harvest volume would influence the wood products industry and private forest land in the region is complex, however, and also is heavily affected by market and industry conditions outside of local control. Increased federal timber supply may be especially important in locations in which it provides the means to maintain local wood processing infrastructure and a forestry workforce, where federal agencies are the primary owner of local timberlands, or where the local forest products industry is attempting to expand into new wood products markets or to produce niche products.

Most timber harvested in the Plan area comes from private lands. Understanding how social, economic, and environmental variables influence timber production from private forests is important because it supports the business infrastructure needed for timber sales and restoration treatments on federal lands. In many places

within the Plan area, the capacity to undertake forest restoration on federal lands depends on the presence of mills to buy timber products generated through restoration projects (which can help pay for restoration work through stewardship contracting), and the presence of a contract forestry workforce to do the work. The lack of mills to buy material is currently more of a challenge east of the Cascade Range, and the need to retain existing infrastructure west of the Cascades is critical for supporting forest restoration. With federal timber harvests declining in recent decades, forest managers and policymakers may want to consider the capacity of private forest lands to continue to supply the bulk of timber to mills within the NWFP area. Production from private forest lands is important because management of federal forests, in many cases, depends on having a market for logs to fund other restoration activities and on supporting the workforce to do that restoration. Challenges facing the productivity of private forest lands in some locations include reduced private investment in forestry, the potential for wildfire, insects, and disease, and the management goals and decisions of private forest owners. To what extent will private forest lands continue to be available for economically viable harvest in the future? Can private forest lands sustain current or increased timber harvest levels in a manner that is ecologically sustainable? Will the increasing number of more-urban-minded forest owners have any interest in harvesting? Answers to these questions will have implications for the ability of federal forests in the Plan area to meet their timber production and forest restoration goals.

Local communities could benefit more from jobs associated with forest restoration if the predictability and accessibility of restoration contracting opportunities improve and if stakeholders build social agreement on biomass harvesting and processing projects. Finding ways to create forest restoration jobs that local residents can capture will help build skills, capacity, and infrastructure needed to support management activities on federal forests, including fire suppression response, and will promote both healthy forests and healthy communities. The opportunities for local communities to benefit from forest management are strongly conditioned by factors such as the existing workforce, the processing capacity in the community, and the structure of work contracts. To promote more beneficial linkages between rural communities and their nearby public lands, agencies could consider structuring contracts in ways that make them more accessible to local communities. For example, they could consider the effect of restoration contract size and scope on local contracting capacity, and provide restoration contracts in a variety of sizes to support business diversity. Community capacity to participate in the restoration economy is not only a function of the structure of individual contracts but also of the consistency and predictability of contracts over time. Using a variety of tools may help build a predictable, sustainable program of restoration and biomass use work that will help support investments in contracting and processing capacity.

The harvesting and processing of biomass materials may also help deliver economic benefits from restoration work, but biomass production has often been controversial and economically challenging in the NWFP area. To improve the opportunities for positive outcomes, working closely with community members and other key stakeholders to build agreement on biomass harvesting and processing projects is important. Consideration of local benefits as a contributing factor to such projects may help build social agreement.

Forest management decisions affect access to and use of NTFPs and people's ability to benefit from harvesting them. Thus it is important to consider the social and ecological tradeoffs involved when making decisions that affect NTFP management. The key to supporting a robust and resilient NTFP sector in the Plan region is to recognize that many of the informal aspects of that sector enhance community and household well-being. By providing low-cost income-earning and provisioning opportunities, the NTFP sector can provide the flexibility that some individuals and households might need to survive times of crisis or improve their quality of life during better times. NTFP activities that take place outside the market also function as social-ecological glue, linking people to each other and strengthening human-nature connections. When developing forest management policies and regulatory frameworks, agencies may wish to consider how they will affect the informal economic activities associated with NTFPs, and weigh carefully how the ecological benefits of large-scale area closures for commercial NTFP harvesting and increased formalization stack up against the costs of decreased economic resiliency and a weakening of social connections.

Community economic benefits from federal forest-based recreation are greatest when visitors take overnight trips. Developing recreation opportunities that encourage overnight stays and align with visitors' desires will help local communities benefit from recreation spending. Recreation visitor spending is a significant driver of economic activity in many forest communities within the NWFP area. The key factor in explaining how much recreation visitors spend in local communities during their trip is whether the visitor spends the night (either in a public campground or private lodging). Visitors who spend the night away from home spend an average of 5 to 8 times as much as visitors who are in the area for the day only. Communities seeking to generate the greatest amounts of visitor spending locally would do well to focus on efforts that (1) increase the likelihood visitors will spend the night there, and (2) support businesses that supply the types of services, goods, and experiences that recreation visitors desire.

Policies and programs are needed to incentivize private forest landowners to produce desired ecosystem services and to help them benefit from doing so. Local communities, including private landowners, may stand to benefit from emerging markets in ecosystem services. Similarly to forestry and restoration work, however, the nature of these benefits will depend upon how market access is structured. To promote these benefits, managers and policymakers could consider local community needs in the development of ecosystem service markets, and provide opportunities for local businesses and landowners to benefit from restoration, carbon sequestration, and other stewardship activities. For example, habitat improvements on private forest lands likely could be enhanced by targeting incentive programs or technical assistance toward forest landowners whose own objectives include habitat protection.

Development of private forest land raises questions about society's ability to benefit from forests, and will affect ecological conditions and processes across land ownerships. Anticipating its implications is important for federal forest management decisionmaking. Private forest land development and accompanying changes in forest management are an inevitable outcome of social and economic forces. Forest land development raises three main concerns: (1) how does it affect our ability as a nation to produce sufficient forest commodities, (2) how does it affect the many ecological values (e.g., biodiversity) and ecosystem services we desire from forests as open space, and (3) how does it affect our capability to reduce wildfire risk in the WUI? Potential ecosystem services impacts from development are less certain. Low-density and urban development of forest lands undoubtedly have some adverse ecological consequences as forest lands are converted to residential and other developed uses. However, less intensive management of remaining private forest lands also could alter ecological characteristics in unanticipated ways, adversely affecting habitat for some species while improving habitat for others. Evaluating net ecosystem services impacts resulting from increasing development of forest landscapes will require anticipating how resulting changes in private forestry are likely to affect ecological conditions and processes, and their associated ecosystem services. Such studies have been fairly limited in the Pacific Northwest.

When developing communication and outreach strategies to help communities adapt to fire-prone landscapes, tailor them to community type; different community types will have different opportunities and challenges associated with wildfire adaptation. Timber harvesting is no longer the only focal federal forest management concern from a socioeconomic standpoint, as it was when the NWFP was developed. Two decades later, wildfire management has risen to become another important management concern for communities located near federal forests. A number of social scientists have conducted research about what factors drive community adaptation to fire-prone landscapes, and how to build community capacity to address wildfire risk (see McCaffrey et al. 2013). Paveglio et al. (2015b) suggested that strategies to build community capacity to address wildfire risk will depend on community type. They develop a four-part typology of WUI communities that includes formalized suburban communities, high-amenity/high-resource communities, rural lifestyle communities (these last two are consistent with the amenity trajectory), and working landscape/resource-dependent communities (consistent with the production trajectory). They suggest that communities sharing similar characteristics

are likely to encounter similar challenges and opportunities in adapting to wildfire risk. Thus, agencies and others seeking to assist WUI communities become more resilient to wildfire could develop communication and outreach strategies tailored to each community type. Paveglio et al. (2015b) detailed what some of these might be.

When possible, drawing on local community resources to help fight wildfires (e.g., equipment, labor) could improve fire suppression response and help communities capture fire suppression dollars. Regarding fire-related jobs, given the erratic nature and small windows of demand for wildfire contracting, most businesses and workers need to perform other activities when they are not working on fire crews. As a consequence, local contracting capacity for fire suppression may be concentrated in particular regions, at least in part because there is other work for businesses to do when they are not fighting fires. This means that local capacity for fire suppression may be unequally distributed across the region, and concentrated in pockets where restoration work has historically existed. Related to this, the mobile and national nature of fire suppression means that local businesses trained in fire suppression will often be dispatched to fires outside their local community. Consequently, the ability of communities to capture fire suppression dollars locally may be reduced because firefighters (and fire camp support services) spend money on lodging, food, gas, and other supplies in the locale where they are fighting the fire. No matter where a fire occurs, firefighters will bring some of the income they earn back to their home areas. But, with such a necessarily mobile workforce, some firefighter earnings will be spent while on deployment to fires. This finding suggests that when fire resource needs and dispatch procedures allow for it, linking local fire suppression response capacity to less mobile resources (e.g., local fire districts, other fire suppression resources not signed up for national or regional deployment) might improve both local response and economic capture.

Working with communities to help mitigate negative climate change impacts will contribute to community well-being. Adaptation to climate change is another key concern for community socioeconomic well-being. This is not a purely technical exercise; it entails consideration of a multitude of social values and economic activities. Working with local community members to identify forest resources and economic activities potentially at risk from a changing climate, and considering management approaches that address these impacts, are ways that agency managers may help mitigate the impacts of climate change on communities.

Conclusions

Rural communities are not all alike, forest management policies and practices affect different communities differently, and the social and economic bases of many traditionally forest-dependent communities have changed in the years since the start of the NWFP. Better understanding and consideration of the economic development trajectories of different communities will help identify forest management activities that best contribute to their well-being. Providing a diverse set of benefits from federal forests may support communities in their efforts to diversify economically, and help build community resilience to future change.

Additionally, local relationships are important. Building constructive relationships with place-based nongovernmental organizations and other entities that are working to help communities become more resilient to external stressors can contribute to community resilience, for example by helping communities capture the economic benefits from forest management activities. The stressors affecting communities include changes in federal forest management policy, markets for forest products, development, wildland fire, and climate change. These same organizations may also be able to contribute resources and capacity to help address unmet needs on National Forest System lands, including (but not limited to) maintaining trails and other recreational infrastructure, filling gaps in planning capacity, building local business capacity to undertake forest restoration, raising funds to pay for forest management work, and leading collaborative forest planning efforts. Healthy forests and healthy communities are linked; thus it is in the interest of federal forest management agencies to contribute to community socioeconomic well-being, and it is in the interest of local communities to contribute to the capacity of agency managers to accomplish forest management work.

References

Abrams, J. 2011. The policy context of the White Mountain stewardship contract. In: Egan, D.; Hjerpe, E.; Abrams, J., eds. Human dimensions of ecological restoration. Washington, DC: Island Press/Center for Resource Economics: 163–176.

Abrams, J.; Becker, D.; Kudrna, J.; Moseley, C. 2017. Does policy matter? The role of policy systems in forest bioenergy development in the United States. Forest Policy and Economics. 75: 41–48.

Abrams, J.; Davis, E.J.; Moseley, C. 2015. Community-based organizations and institutional work in the remote rural west. Review of Policy Research. 32(6): 675–698.

Abrams, J.; Gill, N.; Gosnell, H.; Klepeis, P. 2012. Re-creating the rural, reconstructing nature: an international literature review of the environmental implications of amenity migration. Conservation and Society. 10(3): 270.

Abt, K.L.; Prestemon, J.P. 2006. Timber markets and fuel treatments in the western U.S. Natural Resource Modeling. 19(1): 15–43.

Adams, D.M.; Alig, R.J.; McCarl, B.A.; Callaway, J.M.; Winnett, S.M. 1996. An analysis of the impacts of public timber harvest policies on private forest management in the United States. Forest Science. 42(3): 343–358.

Adams, D.M.; Latta, G.S. 2005. Costs and regional impacts of restoration thinning programs on the national forests in eastern Oregon. Canadian Journal of Forest Research. 35(6): 1319–1330.

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Washington, DC: Island Press. 505 p.

Aguilar, F.; Garrett, H.E. 2009. Perspectives of woody biomass for energy: survey of state foresters, state energy biomass contacts, and National Council of Forestry Association executives. Journal of Forestry. 107(6): 297–306.

Alexander, S.J.; Fight, R.D. 2003. Managing access to nontimber forest products. In: Monserud, R.A.; Haynes, R.W.; Johnson, A.C., eds. Compatible forest management. Dordrecht, Netherlands: Kluwer Academic Publishers: 383–400.

Alexander, S.J.; McLain, R.J.; Jones, E.T.; Oswalt, S.N. 2011a. Challenges and approaches to assessing the market value of wild fungi. In: Cunningham, A.B.; Yang, X., eds. Mushrooms in forests and woodlands: resource management, values and local livelihoods. London: Earthscan Ltd.: 87–106.

Alexander, S.J.; Oswalt, S.N.; Emery, M.R. 2011b. Nontimber forest products in the United States: Montreal Process indicators as measures of current conditions and sustainability. Gen. Tech. Rep. PNW-GTR-851. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 36 p.

Alexander, S.J.; Weigand, J.F.; Blatner, B.A. 2002. Nontimber forest product commerce. In: Jones, E.T.; McLain, R.J.; Weigand, J.F., eds. Nontimber forest products in the United States. Lawrence, KS: University Press of Kansas: 115–150.

Alig, R.; White, E. 2007. Projections of forest land and developed land areas in western Washington. Western Journal of Applied Forestry. 22(1): 29–35.

Alig, R.J. 2010. Economic modeling of effects of climate change on the forest sector and mitigation options: a compendium of briefing papers. Gen. Tech. Rep. PNW-GTR-833. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 169 p.

Anderson, M.; Kerkvliet, J. 2011. The Northwest Forest Plan has been good for the region's environment and economy. Northwest Science. 85(3): 506–508.

Asah, S.T.; Blahna, D.J.; Ryan, C.M. 2012. Involving forest communities in identifying and constructing ecosystem services: Millennium Assessment and place specificity. Journal of Forestry. 110(3): 149–156.

Azuma, D.; Thompson, J.; Weyermann, D. 2013. Changes in development near public forest lands in Oregon and Washington, 1974–2005: implications for management. Res. Pap. PNW-RP-596. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 21 p.

Azuma, D.L.; Eskelson, B.N.I.; Thompson, J.L. 2014. Effects of rural residential development on forest communities in Oregon and Washington, USA. Forest Ecology and Management. 330: 183–191.

Baker, J.M.; Quinn-Davidson, L.N. 2011. Jobs and community in Humboldt County, California. In: Egan, D.; Hjerpe, E.E.; Abrams, J., eds. Human dimensions of ecological restoration: integrating science, nature, and culture. Washington, DC: Island Press/Center for Resource Economics: 221–237.

Baker, M.; Kusel, J. 2003. Community forestry in the United States: learning from the past, crafting the future. Washington, DC: Island Press. 247 p.

Bauer, S.; Olson, J.; Cockrill, A.; Van Hattem, M.; Miller, L.; Tauzer, M.; Leppig, G. 2015. Impacts of surface water diversions for marijuana cultivation on aquatic habitat in four northwestern California watersheds. PLoS ONE. 10(3): e0120016.

Becker, D.R.; McCaffrey, S.M.; Abbas, D.; Halvorsen, K.E.; Jakes, P.; Moseley, C. 2011a. Conventional wisdoms of woody biomass utilization on federal public lands. Journal of Forestry. 109(4): 208–218.

Becker, D.R.; Moseley, C.; Lee, C. 2011b. A supply chain analysis framework for assessing state-level forest biomass utilization policies in the United States. Biomass and Bioenergy. 35(4): 1429–1439.

Becker, D.R.; Nechodom, M.; Barnett, A.; Mason, T.; Lowell, E.C.; Shelly, J.; Graham, D. 2009. Assessing the role of federal community assistance programs to develop biomass utilization capacity in the western United States. Forest Policy and Economics. 11(2): 141–148.

Becker, D.R.; Viers, J. 2007. Matching the utilization of forest fuel reduction by-products to community development opportunities. In: Daniel, T.C.; Carroll, M.S.; Moseley, C.; Raish, C., eds. People, fire, and forests: a synthesis of wildfire social science. Corvallis, OR: Oregon State University Press: 157–175.

Beckley, T.M. 1998. The nestedness of forest dependence: a conceptual framework and empirical exploration. Society & Natural Resources. 11(2): 101–120.

Bennett, D.; Davis, E.J.; White, E.M.; Ellison, A. 2015. Economic impacts from the Malheur 10-year stewardship contract. Fact sheet 5. Eugene, OR: University of Oregon, Ecosystem Workforce Program. 2 p.

Berkes, F.; Ross, H. 2013. Community resilience: toward an integrated approach. Society & Natural Resources. 26(1): 5–20.

Bilby, R.E.; Mollot, L.A. 2008. Effect of changing land use patterns on the distribution of coho salmon (*Oncorhynchus kisutch*) in the Puget Sound region. Canadian Journal of Fisheries and Aquatic Sciences. 65(10): 2138–2148.

Blatner, K.A.; Alexander, S. 1998. Recent price trends for nontimber forest products in the Pacific Northwest. Forest Products Journal. 48: 28–34.

Brandt, P.; Abson, D.J.; Dellasala, D.A.; Feller, R.; Von Wehrden, H. 2014. Multifunctionality and biodiversity: ecosystem services in temperate rainforests of the Pacific Northwest, USA. Biological Conservation. 169: 362–371.

Breslow, S.J.; Sojka, B.; Barnea, R.; Basurto, X.; Carothers, C.; Charnley, S.; Coulthard, S.; Dolšak, N.; Donatuto, J.; García-Quijano, C.; Hicks, C.C.; Levine, A.; Mascia, M.B.; Norman, K.; Poe, M.; Satterfield, T.; Martin, K.S.; Levin, P.S. 2016. Conceptualizing and operationalizing human wellbeing for ecosystem assessment and management. Environmental Science & Policy. 66: 250–259.

Brown, R.B.; Xu, X.; Toth Jr, J.F. 1998. Lifestyle options and economic strategies: subsistence activities in the Mississippi Delta. Rural Sociology. 63(4): 599–623.

Burnett, K.M.; Reeves, G.H.; Miller, D.J.; Clarke, S.; Vance-Borland, K.; Christiansen, K. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Ecological Applications. 17(1): 66–80.

Buttolph, L.P.; Kay, W.; Charnley, S.; Moseley, C.; Donoghue, E.M. 2006. Northwest Forest Plan—the first 10 years: socioeconomic monitoring of the Olympic National Forest and three local communities. Gen. Tech. Rep. PNW-GTR-679. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 84 p.

Calkin, D.C.; Finney, M.A.; Ager, A.A.; Thompson, M.P.; Gebert, K.M. 2011. Progress towards and barriers to implementation of a risk framework for US federal wildland fire policy and decision making. Forest Policy and Economics. 13(5): 378–389.

Calkin, D.E.; Thompson, M.P.; Finney, M.A. 2015. Negative consequences of positive feedbacks in US wildfire management. Forest Ecosystems. 2: 9.

Carah, J.K.; Howard, J.K.; Thompson, S.E.; Short Gianotti, A.G.; Bauer, S.D.; Carlson, S.M.; Dralle, D.N.; Gabriel, M.W.; Hulette, L.L.; Johnson, B.J.; Knight, C.A.; Kupferberg, S.J.; Martin, S.L.; Naylor, R.L.; Power, M.E. 2015. High time for conservation: adding the environment to the debate on marijuana liberalization. BioScience. 65(8): 822–829.

Carroll, M.S. 1995. Community and the northwestern logger: continuities and changes in the era of the spotted owl. Boulder, CO: Westview Press. 192 p.

Carroll, M.S.; Blatner, K.A.; Alt, F.J.; Schuster, E.G.; Findley, A.J. 2000a. Adaptation strategies of displaced Idaho woods workers: results of a longitudinal panel study. Society & Natural Resources. 13(2): 95–113.

Carroll, M.S.; Blatner, K.A.; Cohn, P.J. 2003. Somewhere between: social embeddedness and the spectrum of wild edible huckleberry harvest and use. Rural Sociology. 68(3): 319–342.

Carroll, M.S.; Blatner, K.A.; Cohn, P.J.; Morgan, T. 2007. Managing fire danger in the forests of the US Inland Northwest: a classic "wicked problem" in public land policy. Journal of Forestry. 105(5): 239–244.

Carroll, M.S.; Daniels, S.E.; Kusel, J. 2000b. Employment and displacement among northwestern forest products workers. Society & Natural Resources. 13(2): 151–156.

Carroll, M.S.; Higgins, L.L.; Cohn, P.J.; Burchfield, J. 2006. Community wildfire events as a source of social conflict. Rural Sociology. 71(2): 261–280.

Carroll, M.S.; Lee, R.G.; McLain, R.J. 2005. Occupational community and forest work: three cases from the Pacific Northwest. In: Lee, R.G.; Field, D.R., eds. Communities and forests: where people meet the land. Corvallis, OR: Oregon State University Press: 159–175.

Carroll, M.S.; McKetta, C.W.; Blatner, K.A.; Schallau, C. 1999. A response to "forty years of spotted owls? A longitudinal analysis of logging industry job losses". Sociological Perspectives. 42(2): 325–333.

Carroll, M.S.; Paveglio, T.; Jakes, P.J.; Higgins, L.L. 2011. Nontribal community recovery from wildfire five years later: the case of the Rodeo-Chediski fire. Society & Natural Resources. 24(7): 672–687.

Cathcart, J.F.; Kline, J.D.; Delaney, M.; Tilton, M. 2007. Carbon storage and Oregon's land-use planning program. Journal of Forestry. 105(4): 167–172.

Chamberlain, J. 2015. The volumes and value of non-timber forest products harvested in the United States. In: Stanton, S.M.; Christensen, G.A., eds. Pushing boundaries: new directions in inventory techniques and applications: forest inventory and analysis. Forest Inventory and Analysis (FIA) symposium. Gen. Tech. Rep. PNW-GTR-931. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 323–327.

Charnley, S., ed. 2006a. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 vol.

Charnley, S. 2006b. The Northwest Forest Plan as a model for broad-scale ecosystem management: a social perspective. Conservation Biology. 20(2): 330–340.

Charnley, S. 2006c. Volume II: timber and nontimber resources. In: Charnley, S., ed. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 74 p.

Charnley, S.; Dillingham, C.; Stuart, C.; Moseley, C.; Donoghue, E. 2008a. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring of the Klamath National Forest and three local communities. Gen. Tech. Rep. PNW-GTR-764. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 111 p.

Charnley, S.; Donoghue, E.M. 2006a. Volume V: Public values and forest management. In: Charnley, S., ed. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 23 p.

Charnley, S.; Donoghue, E.M. 2006b. The effects of the Northwest Forest Plan on forest-based communities. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L., eds. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: Rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 105–153. Chapter 8.

Charnley, S.; Donoghue, E.M.; Moseley, C. 2008b. Forest management policy and community well-being in the Pacific Northwest. Journal of Forestry. 106(8): 440–447.

Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L. 2006a. Volume 1: Key findings. In: Charnley, S., ed. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Charnley, S.; Hummel, S. 2011. People, plants, and pollinators: the conservation of beargrass ecosystem diversity in the western United States. In: Pujol, J.L., ed. The importance of biological interactions in the study of biodiversity. Rijeka, Croatia: InTech: 127–154.

Charnley, S.; McLain, R.J.; Donoghue, E.M. 2008c. Forest management policy, amenity migration, and community well-being in the American west: reflections from the Northwest Forest Plan. Human Ecology. 36(5): 743–761.

Charnley, S.; Spies, T.A.; Barros, A.M.G.; White, E.M.; Olsen, K.A. 2017b. Diversity in forest management to reduce wildfire losses: implications for resilience. Ecology and Society. 22(1): 22.

Chen, Y.; Lewis, D.J.; Weber, B. 2016. Conservation land amenities and regional economies: a postmatching difference-in-differences analysis of the Northwest Forest Plan. Journal of Regional Science. 56(3): 373–394.

Chen, Y.; Weber, B. 2012. Federal policy, rural community growth, and wealth creation: the impact of the federal forest policy and rural development spending in the Pacific Northwest. American Journal of Agricultural Economics. 94(2): 542–548.

Christensen, G.A.; Waddell, K.L.; Stanton, S.M.; Kuegler, O., eds. 2015. California's forest resources: forest inventory and analysis, 2001–2010. Gen. Tech. Rep. PNW-GTR-913. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 293 p.

Cook, A.K. 1995. Increasing poverty in timber-dependent areas in western Washington. Society & Natural Resources. 8(2): 97–109.

Crandall, M.S.; Adams, D.M.; Montgomery, C.A.; Smith, D. 2017. The potential rural development impacts of utilizing non-merchantable forest biomass. Forest Policy and Economics. 74: 20–29.

Crandall, S.G. 2016. Fungal ecology and ecosystem-based management of special forest products. Santa Cruz, CA: University of California at Santa Cruz. 136 p. Ph.D. dissertation.

Creighton, J.; Blatner, K.A.; Carroll, M.S. 2016. For the love of the land: generational land transfer and the future of family forests in western Washington State, USA. Small-Scale Forestry. 15(1): 1–15.

Crowe, J.A. 2006. Community economic development strategies in rural Washington: toward a synthesis of natural and social capital. Rural Sociology. 71(4): 573–596.

Dana, S.T. 1918. Forestry and community development. Washington, DC: U.S. Department of Agriculture. 35 p.

Daniel, T.C.; Carroll, M.S.; Moseley, C.; Raish, C. 2007. People, fire and forests: a synthesis of wildfire social science. Corvallis, OR: Oregon State University Press. 240 p.

Davis, C. 2001. The west in flames: the intergovernmental politics of wildfire suppression and prevention. Publius: The Journal of Federalism. 31(3): 97–110.

Davis, E.J.; Gwin, L.; Moseley, C.; Gosnell, H.; Burright, H. 2015. Beer, beef, and boards: the role of intermediaries in payment for ecosystem services arrangements in northwestern Montana. Journal of Environmental Planning and Management. 58(9): 1562–1576.

Davis, E.J.; Moseley, C.; Nielsen-Pincus, M.; Jakes, P.J. 2014. The community economic impacts of large wildfires: a case study from Trinity County, California. Society & Natural Resources. 27(9): 983–993.

DellaSala, D.A.; Karr, J.R.; Olson, D.M. 2011. Roadless areas and clean water. Journal of Soil and Water Conservation. 66(3): 78A–84A.

Deller, S.C.; Tsung-Hsiu, T.; Marcouiller, D.W.; English, D.B. 2001. The role of amenities and quality of life in rural economic growth. American Journal of Agricultural Economics. 83(2): 352–365.

Dillingham, C. 2006. Community economic assistance programs. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 89–100. Chapter 6.

Dillingham, C.; Poe, M.R.; Grinspoon, E.; Stuart, C.; Moseley, C.; Mazza, R.; Charnley, S.; Meierotto, L.; Donoghue, E.; Toth, N. 2008. Northwest Forest Plan—the first 10 years (1994-2003): socioeconomic monitoring of the Okanogan-Wenatchee National Forest and five local communities. Gen. Tech. Rep. PNW-GTR-761. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 109 p.

Doak, S.C.; Kusel, J. 1996. Well-being in forest-dependent communities, part II: a social assessment focus. In: Millar, C.I., ed. Sierra Nevada Ecosystem Project final report to Congress, volume II: assessments and scientific basis for management options. Wildland Resources Center Report. No. 37. Davis, CA: University of California, Centers for Water and Wildland Resources: 375–402.

Dobkins, R.; Lewis, C.; Hummel, S.; Dickey, E. 2016. Cultural plant harvests on federal lands: perspectives from members of the Northwest Native American Basketweavers Association. Res. Pap. PNW-RP-608. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 34 p.

Donoghue, E.M.; Sturtevant, V.E. 2008. Taking stock of community and forest connections. In: Forest community connections: implications for research, management, and governance. Washington, DC: Resources for the Future Press: 263–274.

Donoghue, E.M.; Sutton, N.L. 2006. Socioeconomic conditions and trends for communities in the Northwest Forest Plan region, 1990 to 2000. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L., eds. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 7–36. Chapter 2.

Donovan, S.; Goldfuss, C.; Holdren, J. 2015. Incorporating ecosystem services into federal decision making. Memorandum for Executive Departments and Agencies. M-16-01. Washington, DC: Executive Office of the President of the United States.

Duffy-Deno, K.T. 1997. Economic effect of endangered species preservation in the non-metropolitan west. Growth and Change. 28(3): 263–288.

Duffy-Deno, K.T. 1998. The effect of federal wilderness on county growth in the intermountain western United States. Journal of Regional Science. 38(1): 109–136.

Eastin, I.; Ganguly, I.; Sasatani, D.; Lippke, B. 2007. Study 3: economic contribution. In: Edmonds, R.; Boyle, B., eds. The future of Washington's forests and forestry industries. Seattle, WA: University of Washington, College of Forest Resources: 154–237.

Eichman, H.; Hunt, G.L.; Kerkvliet, J.; Plantinga, A.J. 2010. Local employment growth, migration, and public land policy: evidence from the Northwest Forest Plan. Journal of Agricultural and Resource Economics. 316–333.

Emery, M.R. 1998. Invisible livelihoods: non-timber forest products in Michigan's Upper Peninsula. New Brunswick, NJ: Rutgers University. Ph.D. dissertation.

Emery, M.R.; Ginger, C. 2014. Special forest products on the Green Mountain and Finger Lakes National Forests: a research-based approach to management. Gen. Tech. Rep. NRS-GTR-131. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 51 p.

Emery, M.R.; Pierce, A.R. 2005. Interrupting the telos: locating subsistence in contemporary US forests. Environment and Planning A. 37(6): 981–993.

Englin, J.; Loomis, J.; González-Cabán, A. 2001. The dynamic path of recreational values following a forest fire: a comparative analysis of states in the intermountain west. Canadian Journal of Forest Research. 31(10): 1837–1844.

Evans, A.M.; Finkral, A.J. 2009. From renewable energy to fire risk reduction: a synthesis of biomass harvesting and utilization case studies in US forests. GCB Bioenergy. 1(3): 211–219.

Finlay, S.E.; Moffat, A.; Gazzard, R.; Baker, D.; Murray, V. 2012. Health impacts of wildfires. PLoS Currents Disasters. Nov 2. http://currents.plos.org/disasters/article/health-impacts-of-wildfires/. (22 December 2017).

Fischer, A.P.; Kline, J.D.; Ager, A.A.; Charnley, S.; Olsen, K.A. 2014. Objective and perceived wildfire risk and its influence on private forest landowners' fuel reduction activities in Oregon's (USA) ponderosa pine ecoregion. International Journal of Wildland Fire. 23(1): 143–153.

Fischer, A.P.; Spies, T.A.; Steelman, T.A.; Moseley, C.; Johnson, B.R.; Bailey, J.D.; Ager, A.A.; Bourgeron, P.; Charnley, S.; Collins, B.M. 2016. Wildfire risk as a socioecological pathology. Frontiers in Ecology and the Environment. 14(5): 276–284.

Folke, C. 2006. Resilience: the emergence of a perspective for social-ecological systems analyses. Global Environmental Change. 16(3): 253–267.

Folke, C.; Carpenter, S.R.; Walker, B.; Scheffer, M.; Chapin, T.; Rockström, J. 2010. Resilience thinking: integrating resilience, adaptability and transformability. Ecology and Society. 15(4): 20.

Force, J.E.; Machlis, G.E.; Zhang, L.; Kearney, A. 1993. The relationship between timber production, local historical events, and community social change: a quantitative case study. Forest Science. 39(4): 722–742.

Forest Ecosystem Management Assessment Team [FEMAT]. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Portland, OR: U.S. Department of Agriculture; U.S. Department of the Interior [and others]. [Irregular pagination].

Franklin, J.F.; Johnson, K.N. 2012. A restoration framework for federal forests in the Pacific Northwest. Journal of Forestry. 110(8): 429–439.

Freudenburg, W.R.; Wilson, L.J.; O'Leary, D.J. 1998. Forty years of spotted owls? A longitudinal analysis of logging industry job losses. Sociological Perspectives. 41(1): 1–26.

Frost, P. 2014. Stewardship agreements: the Weaverville Community Forest, California. In: Stitching the west back together: conservation of working landscapes. Chicago, IL: University of Chicago Press: 177–180.

Gabriel, M.W.; Woods, L.W.; Poppenga, R.; Sweitzer, R.A.; Thompson, C.; Matthews, S.M.; Higley, J.M.; Keller, S.M.; Purcell, K.; Barrett, R.H.; Wengert, G.M.; Sacks, B.N.; Clifford, D.L. 2012. Anticoagulant rodenticides on our public and community lands: spatial distribution of exposure and poisoning of a rare forest carnivore. PLoS ONE. 7(7): e40163.

Gale, C.B.; Keegan, C.E.; Berg, E.C.; Daniels, J.; Christensen, G.A.; Sorenson, C.B.; Morgan, T.A.; Polzin, P. 2012. Oregon's forest products industry and timber harvest, 2008: industry trends and impacts of the great recession through 2010. Gen. Tech. Rep. PNW-GTR-868. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 55 p.

Gan, J.; Smith, C.T. 2007. Co-benefits of utilizing logging residues for bioenergy production: the case for east Texas, USA. Biomass and Bioenergy. 31(9): 623–630.

Gebert, K.M.; Black, A.E. 2012. Effect of suppression strategies on federal wildland fire expenditures. Journal of Forestry. 110(2): 65–73.

Gosnell, H.; Abrams, J. 2011. Amenity migration: diverse conceptualizations of drivers, socioeconomic dimensions, and emerging challenges. GeoJournal. 76(4): 303–322.

Gosnell, H.; Kline, J.D.; Chrostek, G.; Duncan, J. 2011. Is Oregon's land use planning program conserving forest and farm land? A review of the evidence. Land Use Policy. 28(1): 185–192.

Graham, N.D. 2008. Advocacy groups plead with Congress to reauthorize the Secure Rural Schools and Community Self-Determination Act. Public Interest Law Reporter. 13(2): 194–199.

Gray, A. 2013. Changes in fragmentation of western Washington forest land (Project WC-EM-08-01). In: Potter, K.M.; Conkling, B.L., eds. Forest Health Monitoring: national status, trends, and analysis 2010. Gen. Tech. Rep. SRS-GTR-176. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station: 111–115.

Gray, A.N.; Azuma, D.L.; Lettman, G.J.; Thompson, J.L.; McKay, N. 2013. Changes in land use and housing on resource lands in Washington state, 1976–2006. Gen. Tech. Rep. PNW-GTR-881. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 51 p.

Grinspoon, E.; Jaworski, D.; Phillips, R. 2016. Northwest Forest Plan—the first 20 years (1994–2013): social and economic status and trends. Report FS/R6/PNW/2015/0006. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 80 p.

Grinspoon, E.; Phillips, R. 2011. Northwest Forest Plan—the first 15 years (1994–2008): socioeconomic status and trends. Tech. Paper R6-RPM-TP-02-2011. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 68 p.

Hammer, R.B.; Radeloff, V.C.; Fried, J.S.; Stewart, S.I. 2007. Wildland-urban interface housing growth during the 1990s in California, Oregon, and Washington. International Journal of Wildland Fire. 16(3): 255.

Harris, C.C.; McLaughlin, W.; Brown, G.; Becker, D.R. 2000. Rural communities in the Inland Northwest: an assessment of small rural communities in the interior and upper Columbia River basins. Gen. Tech. Rep. PNW-GTR-477. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 120 p.

Harrison, J.L.; Montgomery, C.A.; Bliss, J.C. 2016. Beyond the monolith: the role of bonding, bridging, and linking social capital in the cycle of adaptive capacity. Society & Natural Resources. 29(5): 525–539.

Helvoigt, T.L.; Adams, D.M. 2009. A stochastic frontier analysis of technical progress, efficiency change and productivity growth in the Pacific Northwest sawmill industry. Forest Policy and Economics. 11(4): 280–287.

Helvoigt, T.L.; Adams, D.M.; Ayre, A.L. 2003. Employment transitions in Oregon's wood products sector during the 1990s. Journal of Forestry. 101(4): 42–46.

Hesseln, H.; Loomis, J.B.; González-Cabán, A. 2004. Comparing the economic effects of fire on hiking demand in Montana and Colorado. Journal of Forest Economics. 10(1): 21–35.

Hesseln, H.; Loomis, J.B.; González-Cabán, A.; Alexander, S. 2003. Wildfire effects on hiking and biking demand in New Mexico: a travel cost study. Journal of Environmental Management. 69(4): 359–368.

Hibbard, M. 1999. Organic regionalism, corporate liberalism, and federal land management: creating Pacific Northwest timber towns. Journal of Planning Education and Research. 19(2): 144–150.

Hibbard, M.; Lurie, S. 2013. The new natural resource economy: environment and economy in transitional rural communities. Society & Natural Resources. 26(7): 827–844.

Hinrichs, C.C. 1998. Sideline and lifeline: the cultural economy of maple syrup production. Rural Sociology. 63(4): 507–532.

Hjerpe, E.; Abrams, J.; Becker, D.R. 2009. Socioeconomic barriers and the role of biomass utilization in southwestern ponderosa pine restoration. Ecological Restoration. 27(2): 169–177.

Hjerpe, E.; Holmes, T.; White, E. 2017. National and community market contributions of wilderness. Society & Natural Resources. 30(3): 265–280.

Hjerpe, E.E.; Kim, Y.-S. 2008. Economic impacts of southwestern national forest fuels reductions. Journal of Forestry. 106(6): 311–316.

Holmes, F.P.; Hecox, W.E. 2004. Does wilderness impoverish rural regions? International Journal of Wilderness. 10(3): 34–39.

Hoover, K. 2015. Reauthorizing the Secure Rural Schools and Community Self-Determination Act of 2000. Report R41303. Washington, DC: Congressional Research Service. 25 p. http://nationalaglawcenter.org/wp-content/uploads/assets/crs/R41303.pdf. (22 December 2017).

Huber-Stearns, H.; Moseley, C.; Bone, C.; Mosurinjohn, N. [N.d.] Contracted wildfire response capacity in the American West. Manuscript in review. On file with: Heidi Huber-Stearns, Ecosystem Workforce Program, Institute for a Sustainable Environment, University of Oregon, hhuber@uoregon.edu.

Hudiburg, T.W.; Law, B.E.; Wirth, C.; Luyssaert, S. 2011. Regional carbon dioxide implications of forest bioenergy production. Nature Climate Change. 1(8): 419–423.

Hummel, S.; Foltz-Jordan, S.; Polasky, S. 2012. Natural and cultural history of beargrass (*Xerophyllum tenax*). Gen. Tech. Rep. PNW-GTR-864. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 80 p.

Ince, P.; Schuler, A.; Spelter, H.; Luppold, W. 2007. Globalization and structural change in the U.S. forest sector: an evolving context for sustainable forest management. Gen. Tech. Rep. FPL-GTR-170. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 62 p.

Ince, P.J.; Kramp, A.D.; Skog, K.E.; Spelter, H.N.; Wear, D.N. 2011. U.S. forest products module: a technical document supporting the Forest Service 2010 RPA assessment. Res. Pap. FPL-RP-662. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 61 p.

Irland, L.C.; Adams, D.; Alig, R.; Betz, C.J.; Chen, C.-C.; Hutchins, M.; McCarl, B.A.; Skog, K.; Sohngen, B.L. 2001. Assessing socioeconomic impacts of climate change on US forests, wood-product markets, and forest recreation. BioScience. 51(9): 753–764.

Johnson, K.N. 1994. Sustainable harvest levels and short-term sales. Journal of Forestry. 92(4): 41–43.

Johnson, K.N.; Bettinger, P.; Kline, J.D.; Spies, T.A.; Lennette, M.; Lettman, G.; Garber-Yonts, B.; Larsen, T. 2007. Simulating forest structure, timber production, and socioeconomic effects in a multi-owner province. Ecological Applications. 17(1): 34–47.

Johnson, K.N.; Crim, S.; Barber, K.; Howell, M.; Cadwell, C. 1993. Sustainable harvest levels and short-term timber sales for options considered in the report of the Forest Ecosystem Management Assessment Teams: methods, results, and interpretations. Corvallis, OR: Oregon State University. 96 p.

Jones, E.T.; Lynch, K.A. 2007. Nontimber forest products and biodiversity management in the Pacific Northwest. Forest Ecology and Management. 246(1): 29–37.

Joyce, L.A. 2007. The impacts of climate change on forestry. In: Adams, D.M.; Haynes, R.W., eds. Resource and market projections for forest policy development: twenty-five years of experience with the US RPA timber assessment. Dordrecht, Netherlands: Springer Netherlands: 449–488.

Kaufman, H.F.; Kaufman, L.C. 1946. Toward the stabilization and enrichment of a forest community. In: Lee, R.G.; Field, D.R., eds. Communities and forests: where people meet the land. Corvallis, OR: Oregon State University Press: 96–112.

Kay, W.M.; Donoghue, E.M.; Charnley, S.; Moseley, C. 2007. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring of the Mount Hood National Forest and three local communities. Gen. Tech. Rep. PNW-GTR-701. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 97 p.

Keegan, C.E.; Morgan, T.A.; Gebert, K.M.; Brandt, J.P.; Blatner, K.A.; Spoelma, T.P. 2006. Timber-processing capacity and capabilities in the western United States. Journal of Forestry. 104(5): 262–268.

Keegan, C.E.; Sorenson, C.B.; Morgan, T.A.; Hayes, S.W.; Daniels, J.M. 2011. Impact of the great recession and housing collapse on the forest products industry in the western United States. Forest Products Journal. 61(8): 625–634.

Keene, S. 2015. Marijuana and the limits of knowledge: implications for economic vulnerability and resilience in northern California. Resilience. 4(1): 44–58.

Kelly, E.C.; Bliss, J.C. 2009. Healthy forests, healthy communities: an emerging paradigm for natural resource-dependent communities? Society & Natural Resources. 22(6): 519–537.

Kerns, B.K.; Alexander, S.J.; Bailey, J.D. 2004. Huckleberry abundance, stand conditions, and use in western Oregon: evaluating the role of forest management. Economic Botany. 58(4): 668–678.

Kirilenko, A.P.; Sedjo, R.A. 2007. Climate change impacts on forestry. Proceedings of the National Academy of Sciences of the United States of America. 104(50): 19697–19702.

Kirschner, A.R. 2010. Understanding poverty and unemployment on the Olympic Peninsula after the spotted owl. The Social Science Journal. 47(2): 344–358.

Kitzhaber, J. 1998. Governor's letter to U.S. Forest Service Regional Forester Bob Williams and BLM State Director Elaine Zielinski. Salem, OR: State of Oregon, Governor's Office.

Kliejunas, J.T.; Geils, B.W.; Glaeser, J.M.; Goheen, E.M.; Hennon, P.; Kim, M.-S.; Kope, H.; Stone, J.; Sturrock, R.; Frankel, S.J. 2009. Review of literature on climate change and forest diseases of Western North America. Gen. Tech. Rep. PSW-GTR-225. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 54 p.

Kline, J.D. 2003. Characterizing land use change in multidisciplinary landscape-level analyses. Agricultural and Resource Economics Review. 32(01): 103–115.

Kline, J.D. 2005a. Forest and farmland conservation effects of Oregon's (USA) land-use planning program. Environmental Management. 35(4): 368–380.

Kline, J.D. 2005b. Predicted future forest- and farmland development in western Oregon with and without land use zoning in effect. Res. Note PNW-RN-548. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 p.

Kline, J.D.; Alig, R.J. 1999. Does land use planning slow the conversion of forest and farmlands? Growth and Change. 30(1): 3–22.

Kline, J.D.; Alig, R.J. 2001. A spatial model of land use change for western Oregon and western Washington. Res. Pap. PNW-RP-528. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 24 p.

Kline, J.D.; Alig, R.J. 2005. Forestland development and private forestry with examples from Oregon (USA). Forest Policy and Economics. 7(5): 709–720.

Kline, J.D.; Alig, R.J.; Garber-Yonts, B. 2004a. Forest land social values and open space preservation. Journal of Forestry. 102(8): 39–45.

Kline, J.D.; Alig, R.J.; Johnson, R.L. 2000a. Forest owner incentives to protect riparian habitat. Ecological Economics. 33(1): 29–43.

Kline, J.D.; Alig, R.J.; Johnson, R.L. 2000b. Fostering the production of nontimber services among forest owners with heterogeneous objectives. Forest Science. 46(2): 302–311.

Kline, J.D.; Azuma, D.L. 2007. Evaluating forest land development effects on private forestry in eastern Oregon. Res. Pap. PNW-RP-572. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 18 p.

Kline, J.D.; Azuma, D.L.; Alig, R.J. 2004b. Population growth, urban expansion, and private forestry in western Oregon. Forest Science. 50(1): 33–43.

Kline, J.D.; Azuma, D.L.; Moses, A. 2003. Modeling the spatially dynamic distribution of humans in the Oregon (USA) Coast Range. Landscape Ecology. 18(4): 347–361.

Kline, J.D.; Harmon, M.E.; Spies, T.A.; Morzillo, A.T.; Pabst, R.J.; McComb, B.C.; Schnekenburger, F.; Olsen, K.A.; Csuti, B.; Vogeler, J.C. 2016. Evaluating carbon storage, timber harvest, and habitat possibilities for a western Cascades (USA) forest landscape. Ecological Applications. 26(7): 2044–2059.

Kline, J.D.; Mazzotta, M.J. 2012. Evaluating tradeoffs among ecosystem services in the management of public lands. Gen. Tech. Rep. PNW-GTR-865. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p.

Kline, J.D.; Mazzotta, M.J.; Patterson, T.M. 2009a. Toward a rational exuberance for ecosystem services markets. Journal of Forestry. 107(4): 204–212.

Kline, J.D.; Mazzotta, M.J.; Spies, T.A.; Harmon, M.E. 2013. Applying the ecosystem services concept to public land management. Agricultural and Resource Economics Review. 42(1): 139–158.

Kline, J.D.; Moses, A.; Alig, R.J. 2001. Integrating urbanization into landscape-level ecological assessments. Ecosystems. 4(1): 3–18.

Kline, J.D.; Moses, A.; Azuma, D.; Gray, A. 2009b. Evaluating satellite imagery-based land use data for describing forest land development in western Washington. Western Journal of Applied Forestry. 24(4): 214–222.

Kline, J.D.; Moses, A.; Burcsu, T. 2010. Anticipating forest and range land development in central Oregon (USA) for landscape analysis, with an example application involving mule deer. Environmental Management. 45(5): 974–984.

Kline, J.D.; Moses, A.; Lettman, G.J.; Azuma, D.L. 2007. Modeling forest and range land development in rural locations, with examples from eastern Oregon. Landscape and Urban Planning. 80(3): 320–332.

Kline, J.D.; Thiers, P.; Ozawa, C.P.; Yeakley, A.J.; Gordon, S.N. 2014. How well has land-use planning worked under different governance regimes? A case study in the Portland, OR-Vancouver, WA metropolitan area, USA. Landscape and Urban Planning. 131: 51–63.

Klopfenstein, N.B.; Kim, M.-S.; Hanna, J.W.; Richardson, B.A.; Lundquist, J.E. 2009. Approaches to predicting potential impacts of climate change on forest disease: an example with Armillaria root disease. Res. Pap. RMRS-RP-76. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 10 p.

Kochi, I.; Donovan, G.H.; Champ, P.A.; Loomis, J.B. 2010. The economic cost of adverse health effects from wildfire-smoke exposure: a review. International Journal of Wildland Fire. 19(7): 803–817.

Kondo, M.C.; Rivera, R.; Rullman, S. 2012. Protecting the idyll but not the environment: second homes, amenity migration and rural exclusion in Washington state. Landscape and Urban Planning. 106(2): 174–182.

Krankina, O.N.; Dellasala, D.A.; Leonard, J.; Yatskov, M. 2014. High-biomass forests of the Pacific Northwest: who manages them and how much is protected? Environmental Management. 54(1): 112–121.

Kruger, L.E.; Mazza, R.; Stiefel, M. 2008. Amenity migration, rural communities, and public land. In: Donoghue, E.M.; Sturtevant, V.E., eds. Forest community connections: implications for research, management, and governance. Washington, DC: Resources for the Future: 127–142.

Kusel, J. 2001. Assessing well-being in forest dependent communities. Journal of Sustainable Forestry. 13(1–2): 359–384.

Kusel, J.; Adler, E., eds. 2003. Forest communities, community forests Lanham, MD: Rowman & Littlefield Publishers, Inc. 301 p.

Lal, P.; Alavalapati, J.; Mercer, D.E.; Alig, R.J.; Mercer, E. 2011. Socioeconomic impacts of climate change on rural communities in the United States. In: Alig, R.J.; Mercer, D.E., eds. Effects of climate change on natural resources and communities: a compendium of briefing papers. Gen. Tech. Rep. PNW-GTR-837. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 73–118.

Latta, G.; Temesgen, H.; Adams, D.; Barrett, T. 2010. Analysis of potential impacts of climate change on forests of the United States Pacific Northwest. Forest Ecology and Management. 259(4): 720–729.

Lawson, V.; Jarosz, L.; Bonds, A. 2010. Articulations of place, poverty, and race: dumping grounds and unseen grounds in the rural American Northwest. Annals of the Association of American Geographers. 100(3): 655–677.

Lazar, B.; Williams, M. 2008. Climate change in western ski areas: potential changes in the timing of wet avalanches and snow quality for the Aspen ski area in the years 2030 and 2100. Cold Regions Science and Technology. 51(2–3): 219–228.

Le Master, D.C.; Beuter, J.H. 1989. Community stability in forest-based economies: proceedings of a conference in Portland, Oregon. Portland, OR: Timber Press. 191 p.

Lee, R.G.; Carroll, M.S.; Warren, K.K. 1991. The social impact of timber harvest reductions in Washington State. In: Sommers, P.; Birss, H., eds. Revitalizing the timber dependent regions of Washington, eds. Seattle, WA: Northwest Policy Center, University of Washington: 3–19.

Lee, R.G.; Field, D.R.; Burch, W.R. 1990. Community and forestry: continuities in the sociology of natural resources. Boulder, CO: Westview Press. 301 p.

Lehner, J. 2012. Historical look at Oregon's wood product industry. Salem, OR: Oregon Office of Economic Analysis. https://oregoneconomicanalysis.com/2012/01/23/historical-look-at-oregons-wood-product-industry/. (15 December 2017).

Lettman, G.J. 2011. Land use change on non-federal land in Oregon, 1974–2009. Salem, OR: Oregon Department of Forestry. 69 p.

Lettman, G.J. 2013. Land use change on non-federal land in Oregon and Washington. Salem, OR: Oregon Department of Forestry. 17 p.

Levitan, L.; Feldman, S. 1991. For love or money: nonmonetary economic arrangements among rural households in central New York. Research in Rural Sociology and Development (USA). 5: 149–172.

Lewis, D.J.; Alig, R.J. 2014. A spatial econometric analysis of land-use change with land cover trends data: an application to the Pacific Northwest. Res. Pap. PNW-RP-600. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 44 p.

Lewis, D.J.; Hunt, G.L.; Plantinga, A.J. 2002. Public conservation land and employment growth in the northern forest region. Land Economics. 78(2): 245–259.

Liu, J.C.; Pereira, G.; Uhl, S.A.; Bravo, M.A.; Bell, M.L. 2015. A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. Environmental Research. 136: 120–132.

Loomis, J.; González-Cabán, A.; Englin, J. 2001. Testing for differential effects of forest fires on hiking and mountain biking demand and benefits. Journal of Agricultural and Resource Economics. 26(2): 508–522.

Lorah, P.; Southwick, R. 2003. Environmental protection, population change, and economic development in the rural western United States. Population and Environment. 24(3): 255–272.

Love, T.; Jones, E.; Liegel, L. 1998. Valuing the temperate rainforest: wild mushrooming on the Olympic Peninsula Biosphere Reserve. Ambio. (Special Report No. 9): 16–25.

Lynch, K.A.; McLain, R. 2003. Access, labor, and wild floral greens management in western Washington's forests. Gen. Tech. Rep. PNW-GTR-585. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 61 p.

Lynn, K.; Mackendrick, K.; Donoghue, E.M. 2011. Social vulnerability and climate change: synthesis of literature. Gen. Tech. Rep. PNW-GTR-838. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

Lyon, C.; Parkins, J.R. 2013. Toward a social theory of resilience: social systems, cultural systems, and collective action in transitioning forest-based communities. Rural Sociology. 78(4): 528–549.

Magis, K. 2010. Community resilience: an indicator of social sustainability. Society & Natural Resources. 23(5): 401–416.

McCaffrey, S.; Toman, E.; Stidham, M.; Shindler, B. 2013. Social science research related to wildfire management: an overview of recent findings and future research needs. International Journal of Wildland Fire. 22(1): 15.

McCarthy, L.F. 2014. Water source protection funds as a tool to address climate adaptation and resiliency in southwestern forests. In: Sample, V.A.; Bixler, R.P., eds. Forest conservation in the Anthropocene: conference proceedings. RMRS-P-71. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 329–343. https://www.fs.fed.us/rm/pubs/rmrs_p071/rmrs_p071_329_343.pdf. (22 December 2017).

McGee, T.K. 2011. Public engagement in neighbourhood level wildfire mitigation and preparedness: case studies from Canada, the US and Australia. Journal of Environmental Management. 92(10): 2524–2532.

McGranahan, D.; Wojan, T. 2007. Recasting the creative class to examine growth processes in rural and urban counties. Regional Studies. 41(2): 197–216.

McGranahan, D.A. 1999. Natural amenities drive rural population change. No. 33955. Washington, DC: U.S. Department of Agriculture, Economic Research Service. 24 p. https://www.ers.usda.gov/webdocs/publications/41047/13201_aer781.pdf?v=42061. (22 December 2017).

McIver, C.P.; Meek, J.P.; Scudder, M.G.; Sorenson, C.B.; Morgan, T.A.; Christensen, G.A. 2015. California's forest products industry and timber harvest, 2012. Gen. Tech. Rep. PNW-GTR-908. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 49 p.

McLain, R.J. 2000. Controlling the forest understory: wild mushroom politics in central Oregon. Seattle, WA: University of Washington. 331 p. Ph.D. dissertation.

McLain, R.J. 2008. Constructing a wild mushroom panopticon: the extension of nation-state control over the forest understory in Oregon, USA. Economic Botany. 62(3): 343–355.

McLain, R.J.; Alexander, S.J.; Jones, E.T. 2008. Incorporating understanding of informal economic activity in natural resource and economic development policy. Gen. Tech. Rep. PNW-GTR-755. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 53 p.

McLain, R.J.; Christensen, H.H.; Shannon, M.A. 1998. When amateurs are the experts: amateur mycologists and wild mushroom politics in the Pacific Northwest, USA. Society & Natural Resources. 11(6): 615–626. doi:10.1080/08941929809381106.

McLain, R.J.; Hurley, P.T.; Emery, M.R.; Poe, M.R. 2014. Gathering "wild" food in the city: rethinking the role of foraging in urban ecosystem planning and management. Local Environment. 19(2): 220–240.

McLain, R.J.; Lynch, K. 2010. Managing floral greens in a globalized economy: resource tenure, labour relations, and immigration policy in the Pacific Northwest, USA. In: Laird, S.A.; McLain, R.J.; Wynberg, R.P., eds. Wild product governance: finding policies that work for non-timber forest products. London: Earthscan: 265–286.

McLain, R.J.; Tobe, L.; Charnley, S.; Donoghue, E.M.; Moseley, C. 2006. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring of Coos Bay district and three local communities. Gen. Tech. Rep. PNW-GTR-675. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 144 p.

Moeltner, K.; Kim, M.K.; Zhu, E.; Yang, W. 2013. Wildfire smoke and health impacts: a closer look at fire attributes and their marginal effects. Journal of Environmental Economics and Management. 66(3): 476–496.

Montgomery, C.A. 2013. Institutional environments and arrangements for managing complex aquatic ecosystems in forested landscapes. Forest Policy and Economics. 35: 50–56.

Morley, S.A.; Karr, J.R. 2002. Assessing and restoring the health of urban streams in the Puget Sound basin. Conservation Biology. 16(6): 1498–1509.

Morzillo, A.T.; Colocousis, C.R.; Munroe, D.K.; Bell, K.P.; Martinuzzi, S.; Van Berkel, D.B.; Lechowicz, M.J.; Rayfield, B.; McGill, B. 2015. "Communities in the middle": interactions between drivers of change and place-based characteristics in rural forest-based communities. Journal of Rural Studies. 42: 79–90.

Moseley, C. 2006a. Ethnic differences in job quality among contract forest workers on six national forests. Policy Sciences. 39(2): 113–133.

Moseley, C. 2006b. Procurement contracting in the affected counties of the Northwest Forest Plan: 12 years of change. Gen. Tech. Rep. PNW-GTR-661. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 36 p.

Moseley, C. [N.d.]. Business strategies in a managed market: fire suppression equipment contracting in the Northwest. Document in preparation. On file with: Cassandra Moseley, Institute for a Sustainable Environment, University of Oregon, cmoseley@uoregon.edu.

Moseley, C.; Charnley, S. 2014. Understanding micro-processes of institutionalization: stewardship contracting and national forest management. Policy Sciences. 47(1): 69–98.

Moseley, C.; Reyes, Y.E. 2008. Forest restoration and forest communities: have local communities benefited from Forest Service contracting of ecosystem management? Environmental Management. 42(2): 327–343.

Moseley, C.; Sandoval, G.; Davis, E.J. 2014. Comparing conditions of labor-intensive forestry and fire suppression workers. Society & Natural Resources. 27(5): 540–556.

Moseley, C.; Shankle, S. 2001. Who gets the work? National forest contracting in the Pacific Northwest. Journal of Forestry. 99(9): 32–37.

Moseley, C.; Toth, N.A. 2004. Fire hazard reduction and economic opportunity: how are the benefits of the national fire plan distributed? Society & Natural Resources. 17(8): 701–716.

Mott, J.A. 2002. Wildland forest fire smoke: health effects and intervention evaluation, Hoopa, California, 1999. Western Journal of Medicine. 176(3): 157–162.

Muir, P.S.; Norman, K.N.; Sikes, K.G. 2006. Quantity and value of commercial moss harvest from forests of the Pacific Northwest and Appalachian regions of the U.S. The Bryologist. 109(2): 197–214.

Nadeau, S.; Shindler, B.A.; Kakoyannis, C. 2003. Beyond the economic model: assessing sustainability in forest communities. In: Shindler, B.A.; Beckley, T.M.; Finley, M.C., eds. Two paths toward sustainable forests: public values in Canada and the United States. Corvallis, OR: Oregon State University Press: 60–74.

Nechodom, M.; Becker, D.R.; Haynes, R.W. 2008. Evolving interdependencies of community and forest health. In: Donoghue, E.M.; Sturtevant, V.E., eds. Forest community connections: implications for research, management, and governance. Washington, DC: Resources for the Future: 91–108.

Nelson, M.K. 1999. Economic restructuring, gender, and informal work: a case study of a rural county. Rural Sociology. 64(1): 18–43.

Nelson, P.B. 1997. Migration, sources of income, and community change in the nonmetropolitan Northwest. The Professional Geographer. 49(4): 418–430.

Nelson, T.C. 1979. Fire management policy in the national forests—a new era. Journal of Forestry. 77(11): 723–725.

Nielsen-Pincus, M.; Charnley, S.; Moseley, C. 2013. The influence of market proximity on national forest hazardous fuels treatments. Forest Science. 59(5): 566–577.

Nielsen-Pincus, M.; Moseley, C. 2013. The economic and employment impacts of forest and watershed restoration. Restoration Ecology. 21(2): 207–214.

Nielsen-Pincus, M.; Moseley, C.; Gebert, K. 2014. Job growth and loss across sectors and time in the western US: the impact of large wildfires. Forest Policy and Economics. 38: 199–206.

North, M.P.; Stephens, S.L.; Collins, B.M.; Agee, J.K.; Aplet, G.; Franklin, J.F.; Fule, P.Z. 2015. Reform forest fire management: agency incentives undermine policy effectiveness. Science. 349(6254): 1280–1281.

Northwest Forest Worker Center [NFWC]. 2015. Gifford Pinchot National Forest beargrass harvest program monitoring final report. Albany, CA: Northwest Forest Worker Center. 18 p.

Ohman, D. 1999. Restructuring and well-being in the non-metropolitan Pacific Northwest. Growth and Change. 30(2): 161–183.

Ojerio, R.; Moseley, C.; Lynn, K.; Bania, N. 2011. Limited involvement of socially vulnerable populations in federal programs to mitigate wildfire risk in Arizona. Natural Hazards Review. 12(1): 28–36.

Oswalt, S.N.; Smith, W.B.; Miles, P.D.; Pugh, S.A. 2014. Forest resources of the United States, 2012: a technical document supporting the Forest Service 2010 update of the RPA assessment. Gen. Tech. Rep. WO-GTR-91. Washington, DC: U.S. Department of Agriculture, Forest Service. 218 p.

Parks, P.J.; Murray, B.C. 1994. Land attributes and land allocation: nonindustrial forest use in the Pacific Northwest. Forest Science. 40(3): 558–575.

Paveglio, T.B.; Carroll, M.S.; Hall, T.E.; Brenkert-Smith, H. 2015a. 'Put the wet stuff on the hot stuff': the legacy and drivers of conflict surrounding wildfire suppression. Journal of Rural Studies. 41: 72–81.

Paveglio, T.B.; Jakes, P.J.; Carroll, M.S.; Williams, D.R. 2009. Understanding social complexity within the wildland-urban interface: a new species of human habitation? Environmental Management. 43(6): 1085–1095.

Paveglio, T.B.; Moseley, C.; Carroll, M.S.; Williams, D.R.; Davis, E.J.; Fischer, A.P. 2015b. Categorizing the social context of the wildland urban interface: adaptive capacity for wildfire and community "archetypes." Forest Science. 61(2): 298–310.

Phillips, R. 2006a. Jobs and income associated with resource and recreation outputs. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 37–51. Chapter 3.

Phillips, R. 2006b. Payments to county governments. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 101–104. Chapter 7.

Pierce, J. 2007. The winds of change: the decline of extractive industries and the rise of tourism in Hood River County, OR. Oregon Historical Quarterly. 108(3): 410–431.

Pilz, D.; McLain, R.; Alexander, S.; Villarreal-Ruiz, L.; Berch, S.; Wurtz, T.L.; Parks, C.G.; McFarlane, E.; Baker, B.; Molina, R.; Smith, J.E. 2007. Ecology and management of morels harvested from the forests of western North America. Gen. Tech. Rep. PNW-GTR-710. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 161 p.

Pilz, D.; Molina, R. 2002. Commercial harvests of edible mushrooms from the forests of the Pacific Northwest United States: issues, management, and monitoring for sustainability. Forest Ecology and Management. 155(1–3): 3–16.

Pilz, D.; Smith, J.; Amaranthus, M.P.; Alexander, S.; Molina, R.; Luoma, D. 1999. Mushrooms and timber: managing commercial harvesting in the Oregon Cascades. Journal of Forestry. 97(3): 4–11.

Poe, M.R.; Lecompte, J.; McLain, R.; Hurley, P. 2014. Urban foraging and the relational ecologies of belonging. Social & Cultural Geography. 15(8): 901–919.

Polson, M. 2013. Land and law in marijuana country: clean capital, dirty money, and the drug war's rentier nexus. PoLAR: Political and Legal Anthropology Review. 36(2): 215–230.

Power, T.M. 2006. Public timber supply, market adjustments, and local economies: economic assumptions of the Northwest Forest Plan. Conservation Biology. 20(2): 341–350.

Pugliese, A.; McCann, L.; Artz, G. 2015. Impacts of national forests in the west on county population and employment. Forest Policy and Economics. 50: 62–69.

Pyne, S.J. 1981. Fire policy and fire research in the U.S. Forest Service. Forest & Conservation History. 25(2): 64–77.

Quesada, H.J.; Gazo, R. 2006. Mass layoffs and plant closures in the US wood products and furniture manufacturing industries. Forest Products Journal. 56(10): 101–106.

Quirke, J.D.; Moseley, C.; Abrams, J. 2017. Between community stability and the 'greatest good:' legal obligations of the U.S. Forest Service toward rural communities, 1891–2016. Journal of Environmental Law and Litigation. 32(2): 169–187.

Radeloff, V.C.; Stewart, S.I.; Hawbaker, T.J.; Gimmi, U.; Pidgeon, A.M.; Flather, C.H.; Hammer, R.B.; Helmers, D.P. 2010. Housing growth in and near United States protected areas limits their conservation value. Proceedings of the National Academy of Sciences of the United States of America. 107(2): 940–945.

Rasker, R. 2006. An exploration into the economic impact of industrial development versus conservation on western public lands. Society & Natural Resources. 19(3): 191–207.

Rasker, R.; Gude, P.H.; Delorey, M. 2013. The effect of protected federal lands on economic prosperity in the non-metropolitan west. Journal of Regional Analysis & Policy. 43(2): 110–122.

Rasker, R.; Gude, P.H.; Gude, J.A.; Van Den Noort, J. 2009. The economic importance of air travel in high-amenity rural areas. Journal of Rural Studies. 25(3): 343–353.

Reilly, M.J.; Dunn, C.J.; Meigs, G.W.; Spies, T.A.; Kennedy, R.E.; Bailey, J.D.; Briggs, K. 2017. Contemporary patterns of fire extent and severity in forests of the Pacific Northwest, USA (1985–2010). Ecosphere. 8(3): e01695.

Responsive Management. 2012. Results of general population survey in support of the development of the Washington State Comprehensive Outdoor Recreation Plan. Harrisonburg, VA: Responsive Management National Office. 324 p. https://www.rco.wa.gov/documents/rec_trends/WA_SCORP_ResidentSurvey.pdf. (22 December 2017).

Richards, R.T.; Alexander, S.J. 2006. A social history of wild huckleberry harvesting in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-657. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 113 p.

Richards, R.T.; Creasy, M. 1996. Ethnic diversity, resource values, and ecosystem management: matsutake mushroom harvesting in the Klamath bioregion. Society & Natural Resources. 9(4): 359–374.

Richardson, E. 1980. BLM's billion-dollar checkerboard: managing the O&C lands. Santa Cruz, CA: Forest History Society. 200 p.

Richardson, R.B.; Loomis, J.B. 2004. Adaptive recreation planning and climate change: a contingent visitation approach. Ecological Economics. 50(1–2): 83–99.

Rooney, B. 2015. A comprehensive estimate of Oregon's forest sector employment. Salem, OR: Oregon Employment Department, Workforce and Economic Research Division.

Rosenberger, R.; Lindberg, K. 2012. Oregon Statewide Comprehensive Outdoor Recreation Plan supporting documentation. Corvallis, OR: Oregon State University.

Rudzitis, G; Johnson, R. 2000. The impact of wilderness and other wildlands on local economies and regional development trends. In: McCool, S.F.; Cole, D.N.; Borrie, W.T.; O'Loughlin, J., comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 14–26.

Sample, V.A.; Halofsky, J.E.; Peterson, D.L. 2014. US strategy for forest management adaptation to climate change: building a framework for decision making. Annals of Forest Science. 71(2): 125–130.

Sánchez, J.J.; Baerenklau, K.; González-Cabán, A. 2016. Valuing hypothetical wildfire impacts with a Kuhn-Tucker model of recreation demand. Forest Policy and Economics. 71: 63–70.

Sarathy, B. 2008. The marginalization of pineros in the Pacific Northwest. Society and Natural Resources. 21(8): 671–686.

Sarathy, B. 2012. Pineros: Latino labour and the changing face of forestry in the Pacific Northwest. Vancouver, BC: UBC Press. 208 p.

Satterfield, T. 2007. Anatomy of a conflict: identity, knowledge, and emotion in old-growth forests. Vancouver, BC: UBC Press. 198 p.

Schlosser, W.E.; Blatner, K.A. 1995. The wild edible mushroom industry of Washington, Oregon and Idaho: a 1992 survey. Journal of Forestry. 93: 31–36.

Schlosser, W.E.; Blatner, K.A. 1997. Special forest products: an east-side perspective. Gen. Tech. Rep. PNW-GTR-380. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p.

Schlosser, W.E.; Blatner, K.A.; Chapman, R.C. 1991. Economic and marketing implications of special forest products harvest in the coastal Pacific Northwest. Western Journal of Applied Forestry. 6(3): 67–72.

Schultz, C.A.; Jedd, T.; Beam, R.D. 2012. The Collaborative Forest Landscape Restoration Program: a history and overview of the first projects. Journal of Forestry. 110(7): 381–391.

Schultz, C.A.; Sisk, T.D.; Noon, B.R.; Nie, M.A. 2013. Wildlife conservation planning under the United States Forest Service's 2012 planning rule. The Journal of Wildlife Management. 77: 428–444.

Scott, D.; McBoyle, G. 2007. Climate change adaptation in the ski industry. Mitigation and Adaptation Strategies for Global Change. 12(8): 1411–1431.

Seekamp, E.; Cerveny, L.K.; McCreary, A. 2011. Institutional, individual, and socio-cultural domains of partnerships: a typology of USDA Forest Service recreation partners. Environmental Management. 48(3): 615–630.

Skog, K.E.; McKeever, D.B.; Ince, P.J.; Howard, J.L.; Spelter, H.N.; Schuler, A.T. 2012. Status and trends for the U.S. forest products sector: a technical document supporting the Forest Service 2010 RPA assessment. Gen. Tech. Rep. FPL-GTR-207. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 35 p.

Smith, J.; Crone, L.K.; Alexander, S.J. 2010. A U.S. Forest Service special forest products appraisal system: background, methods, and assessment. Gen. Tech. Rep. PNW-GTR-822. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p.

Smith, N.; Deal, R.; Kline, J.; Blahna, D.; Patterson, T.; Spies, T.A.; Bennett, K. 2011. Ecosystem services as a framework for forest stewardship: Deschutes National Forest overview. Gen. Tech. Rep. PNW-GTR-852. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p.

Spencer, C. 1999. Linking forest employment and forest ecosystem objectives in the Pacific Northwest. Community Development Journal. 34(1): 47–57.

Spies, T.A.; Giesen, T.W.; Swanson, F.J.; Franklin, J.F.; Lach, D.; Johnson, K.N. 2010. Climate change adaptation strategies for federal forests of the Pacific Northwest, USA: ecological, policy, and socio-economic perspectives. Landscape Ecology. 25(8): 1185–1199.

Spies, T.A.; Johnson, K.N.; Burnett, K.M.; Ohmann, J.L.; McComb, B.C.; Reeves, G.H.; Bettinger, P.; Kline, J.D.; Garber-Yonts, B. 2007. Cumulative ecological and socioeconomic effects of forest policies in coastal Oregon. Ecological Applications. 17(1): 5–17.

Starbuck, C.; Alexander, S.; Berrens, R.; Bohara, A. 2004. Valuing special forest products harvesting: a two-step travel cost recreation demand analysis. Journal of Forest Economics. 10(1): 37–53.

Starbuck, C.M.; Berrens, R.P.; McKee, M. 2006. Simulating changes in forest recreation demand and associated economic impacts due to fire and fuels management activities. Forest Policy and Economics. 8(1): 52–66.

Steelman, T.A.; Burke, C.A. 2007. Is wildfire policy in the United States sustainable? Journal of Forestry. 105(2): 67–72.

Stein, S.M.; McRoberts, R.E.; Alig, R.J.; Nelson, M.D.; Theobald, D.M.; Eley, M.; Dechter, M.; Carr, M. 2005. Forests on the edge: housing development on America's private forests. Gen. Tech. Rep. PNW-GTR-636. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 p.

Stein, S.M.; McRoberts, R.E.; Mahal, L.G.; Carr, M.A.; Alig, R.J.; Comas, S.J.; Theobald, D.M.; Cundiff, A. 2009. Private forests, public benefits: increased housing density and other pressures on private forest contributions. Gen. Tech. Rep. PNW-GTR-795. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 74 p.

Stein, S.M.; McRoberts, R.E.; Nelson, M.D.; Mahal, L.; Flather, C.H.; Alig, R.J.; Comas, S. 2010. Private forest habitat for at-risk species: where is it and where might it be changing? Journal of Forestry. 108(2): 61–70.

Stidham, M.; Simon-Brown, V. 2011. Stakeholder perspectives on converting forest biomass to energy in Oregon, USA. Biomass and Bioenergy. 35(1): 203–213.

Stuart, C. 2006. Agency jobs, unit reorganizations, and budgets. In: Charnley, S.; Donoghue, E.M.; Stuart, C.; Dillingham, C.; Buttolph, L.P.; Kay, W.; McLain, R.J.; Moseley, C.; Phillips, R.H.; Tobe, L. Northwest Forest Plan—the first 10 years (1994–2003): socioeconomic monitoring results. Volume III: rural communities and economies. Gen. Tech. Rep. PNW-GTR-649. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 53–75. Chapter 4.

Stynes, D.J.; White, E.M. 2006. Reflections on measuring recreation and travel spending. Journal of Travel Research. 45(1): 8–16.

Sundstrom, S.; Nielsen-Pincus, M.; Moseley, C.; McCaffery, S. 2012. Woody biomass use trends, barriers, and strategies: perspectives of US Forest Service managers. Journal of Forestry. 110(1): 16–24.

Sundstrom, S.; Sundstrom, J. 2014. Stewardship contracting in the Siuslaw National Forest. In: Charnley, S.; Sheridan, T.E.; Nabhan, G.P., eds. Stitching the West back together: conservation of working landscapes. University of Chicago Press: 159–176.

Swan, L. 2012. Eastern Oregon primary wood products processing facilities and operations (final working draft). Portland, OR: U.S. Department of Agriculture, Forest Service, Region 6, State and Private Forestry. 19 p.

Swanson, M.E.; Franklin, J.F.; Beschta, R.L.; Crisafulli, C.M.; Dellasala, D.A.; Hutto, R.L.; Lindenmayer, D.B.; Swanson, F.J. 2011. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Frontiers in Ecology and the Environment. 9(2): 117–125.

Ter-Mikaelian, M.T.; Colombo, S.J.; Chen, J. 2015. The burning question: does forest bioenergy reduce carbon emissions? A review of common misconceptions about forest carbon accounting. Journal of Forestry. 113(1): 57–68.

Thomas, J.W. 1996. Forest Service perspective on ecosystem management. Ecological Applications. 6(3): 703–705.

Thomas, J.W.; Franklin, J.F.; Gordon, J.; Johnson, K.N. 2006. The Northwest Forest Plan: origins, components, implementation experience, and suggestions for change. Conservation Biology. 20(2): 277–287.

Tsing, A. 2013. Dancing the mushroom forest. PAN: Philosophy, Activism, Nature. 10: 1–6.

Tsing, A.L. 2015. The mushroom at the end of the world: on the possibility of life in capitalist ruins. Princeton, NJ: Princeton University Press. 352 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2001. National strategy for special forest products. Publication. FS-713. Washington, DC. 15 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2012. National forest system land management planning. 36 C.F.R. Part 219. Federal Register. 77: 21260–21276.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2016. National visitor use monitoring results. Washington, DC.

U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management [USDA and USDI]. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. [Place of publication unknown]. 74 p. [plus attachment A: standards and guidelines].

Vance, N.C.; Borsting, M.; Pilz, D.; Freed, J. 2001. Special forest products: species information guide for the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-513. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 169 p.

Vaughn, J.S.; Cortner, H. 2005. George W. Bush's healthy forests: reframing the environmental debate. Boulder, CO: University of Colorado Press. 231 p.

Waddell, K.L.; Bassett, P.M. 1996. Timber resource statistics for the North Coast resource area of California 1994. Res. Bull. PNW-RB-214. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 50 p.

Waddell, K.L.; Bassett, P.M. 1997. Timber resource statistics for the North Interior resource area of California. Res. Bull. PNW-RB-222. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 49 p.

Walker, B.; Salt, D. 2006. Resilience thinking. Washington, DC: Island Press. 192 p.

Waltert, F.; Schläpfer, F. 2010. Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. Ecological Economics. 70(2): 141–152.

Washington Department of Natural Resources [WDNR]. 2014. Washington mill survey, 2012. Olympia, WA. 43 p.

Weigand, J. 2002. Overview of cultural traditions, economic trends, and key species in nontimber forest products of the Pacific Northwest. In: Jones, E.T.; McLain, R.J.; Weigand, J., eds. Nontimber forest products in the United States. Lawrence, KS: University of Kansas Press: 57–64.

White, E.; Mazza, R. 2008. A closer look at forests on the edge: future development on private forests in three states. Gen. Tech. Rep. PNW-GTR-758. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 20 p.

White, E.M. 2017. Spending patterns of outdoor recreation visitors to national forests. Gen. Tech. Rep. PNW-GTR-961. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 70 p.

White, E.M.; Davis, E.J.; Bennett, D.E.; Moseley, C. 2015. Monitoring of outcomes from Oregon's Federal Forest Health Program. Working Paper 57. Eugene, OR: University of Oregon, Ecosystem Workforce Program. 40 p. http://www.oregon.gov/ODF/Board/Documents/BOF/20160309/BOFATTCH_20160309_04_01.pdf. (22 December 2017).

White, E.M.; Stynes, D.J. 2008. National forest visitor spending averages and the influence of trip-type and recreation activity. Journal of Forestry. 106(1): 17–24.

Whitely Binder, L.C.; Krencicki Barcelos, J.; Booth, D.B.; Darzen, M.; McGuire Elsner, M.; Fenske, R.; Graham, T.F.; Hamlet, A.F.; Hodges-Howell, J.; Jackson, J.E.; Karr, C.; Keys, P.W.; Littell, J.S.; Mantua, N.; Marlow, J.; McKenzie, D.; Robinson-Dorn, M.; Rosenberg, E.A.; Stöckle, C.O.; Vano, J.A. 2010. Preparing for climate change in Washington state. Climatic Change. 102(1–2): 351–376.

Wilkinson, C.F.; Anderson, H.M. 1987. Land and resource planning in the national forests. Covelo, CA: Island Press. 400 p.

Wilson, G. 2010. Multifunctional 'quality' and rural community resilience. Transactions of the Institute of British Geographers. 35(3): 364–381.

Wimberly, M.C.; Liu, Z. 2014. Interactions of climate, fire, and management in future forests of the Pacific Northwest. Forest Ecology and Management. 327: 270–279.

Winkler, R.; Field, D.R.; Luloff, A.E.; Krannich, R.S.; Williams, T. 2007. Social landscapes of the inter-mountain West: a comparison of "Old West" and "New West" communities. Rural Sociology. 72(3): 478–501.

Woodall, C.W.; Ince, P.J.; Skog, K.E.; Aguilar, F.X.; Keegan, C.E.; Sorenson, C.B.; Hodges, D.G.; Smith, W.B. 2012. An overview of the forest products sector downturn in the United States. Forest Products Journal. 61(8): 595–603.

Participants map their favorite destinations in the Mount Baker–Snoqualmie National Forest, Washington, during a human ecological mapping workshop.
Photo by Lee Cerveny.