SUMMITS

ENVIRONMENTAL SCIENCE, LAW, AND POLICY

A series edited by Marc Miller,
Jonathan Overpeck,
and Barbara Morehouse

STITCHING THE WEST BACK TOGETHER

Conservation of Working Landscapes

EDITED BY SUSAN CHARNLEY,
THOMAS E. SHERIDAN, AND
GARY P. NABHAN

The University of Chicago Press
Chicago and London

2

STATUS AND TRENDS OF WESTERN WORKING LANDSCAPES

Susan Charnley, Thomas E. Sheridan, and Nathan F. Sayre

IN BRIEF

- Although western forests supply almost half the nation's softwood lumber in addition to other wood products, timber harvest has dropped by roughly one-half since 1990, with most of the decrease occurring on federal lands.
- Even though permitted livestock use on federal lands has decreased over the past two decades, western rangelands still support about one-fifth of the cattle and half of the sheep in the United States.
- Rural land in the West is being converted to development at an average rate of 2.32 percent annually as human population growth there far exceeds the national average.
- Private nonindustrial forestlands are shrinking as the number of owners is increasing, leading to parcelization (fragmented ownerships of small parcels) and forest fragmentation; meanwhile private industrial forestlands are being sold and managed as investment properties, making their future conservation and land-use status uncertain.

This book is about the conservation of working landscapes in the West today. In order to provide context for saving these wide open spaces, it is helpful to look at where they occur, their current status, what has been happening to them over the past few decades, and how this has affected the people who depend on them for their livelihoods. Toward that end, we provide, in this chapter, an overview of the status and trends in the West's working forests and rangelands on both public and private lands.

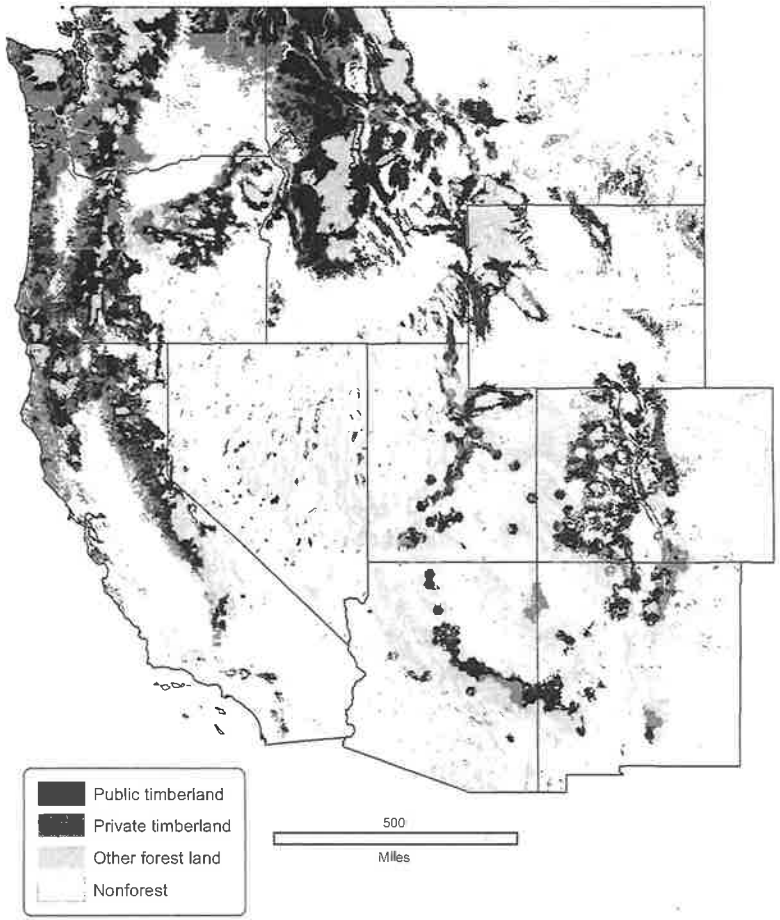

Figure 2.1. Extent and ownership of western U.S. timberlands. Map authored by John M. Chase, 2013 (U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR). Data sources analyzed in the creation of the map: "Protected Areas Database of the US, PAD-US (CBI Edition)," version 2, Conservation Biology Institute, June 2009–October 2012, http://consbio.org/products/projects/pad-us-cbi-edition; Mark D. Nelson, Greg C. Liknes, and Brett J. Butler, 2010. "Forest Ownership in the Conterminous United States: ForestOwn_v1 Geospatial Dataset" (U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA); USDA Forest Service 2007, "Unproductive Timberland of the Conterminous United States Summarized across the US Environmental Protection Agency Environmental Monitoring and Assessment Program Hexagon Sampling Framework," RPA2007_UnproductiveForest geospatial dataset, part of 2007 updates to Resource Planning Act Assessment of 2000 (U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA). Methodological references: two nondataset references speak to the methodology behind the Forest Service's Forest Inventory and Analysis ownership dataset and its unproductive timberland dataset—W. Brad Smith, Patrick D. Miles, Charles H. Perry, and Scott A. Pugh, *Forest Resources of the United States, 2007*, General Technical Report WO-78 (Washington, D.C.: Washington Office, Forest Service, U.S. Dept. of Agriculture, 2009); and D. White, A. J. Kimerling, and W. S. Overton, "Cartographic and Geometric Components of a Global Sampling Design for Environmental Monitoring," *Cartography and Geographic Information Systems*. 19 (1992): 5–22.

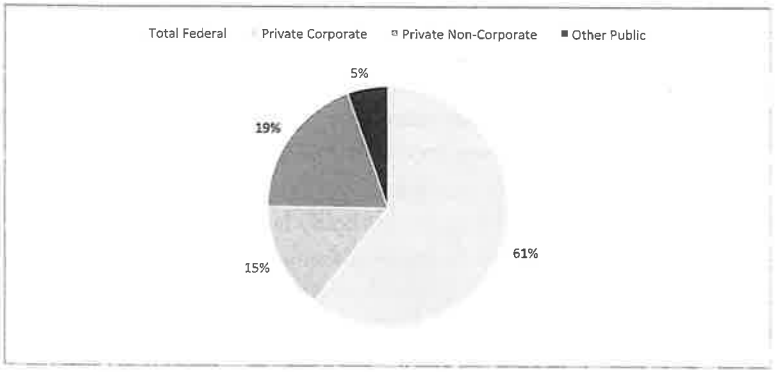

Figure 2.2. Division of ownership of western timberlands in 2007. Source: W. B. Smith, P. D. Miles, C. H. Perry, and S. A. Pugh, *Forest Resources of the United States, 2007: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report WO-78 (Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office, 2009). Figure created in 2013.

FORESTLANDS: CURRENT STATUS

The West's working forests from which wood products are produced lie primarily in the timberlands located in the Northwest, California, and the Rocky Mountains (fig. 2.1).[1] Nearly two-thirds of these timberlands are in public ownership (with 57 percent of the total on national forestlands); the rest are privately held by corporate owners (forest industry, forest management companies, timber investment management organizations, and other companies) or by noncorporate owners such as individuals, families, trusts, nongovernmental organizations, and other unincorporated groups (fig. 2.2).[2] Western timberlands comprise just over half of the region's forestlands (56 percent) and cover about 128.3 million acres.[3]

From an economic standpoint, the working forests of the West supplied roughly 45 percent of the nation's softwood lumber in 2011 (11.9 billion board feet).[4] The majority of this production came from Oregon and Washington. In addition, Northwestern states supplied about 16 percent of the nation's plywood and other structural panel board in 2011 (3,031 million sq. ft., based on 3/8-inch thickness).[5] In 2011, employment in the forest products industries was estimated at 137,200 people in Oregon, Washington, California, Montana, and Idaho, where these industries are concentrated.[6] Although these jobs comprise a small part of total employment in these states, they are nonetheless important. Unemployment in rural western counties is typically higher than in urban areas, and jobs in the wood products industry tend to be higher paying than jobs in the services sector, the major employment sector in many rural western counties.[7]

Working forests are also a source of nontimber forest products such as

mushrooms, berries, and floral greens that support a multimillion dollar industry in the Pacific Northwest and provide a host of additional products that are valued for food, medicine, basketry, decoration, and other cultural uses.[8] Harvesting of commercial nontimber forest products can be an important source of supplemental income for rural community residents, as well as recent immigrants, and offers economic diversification opportunities in rural communities.[9] In addition, these forests hold a large supply of biomass that is increasingly being utilized as a domestic source of renewable energy and for manufacturing wood products for niche markets, creating economic development opportunities in forest communities.

RANGELANDS: CURRENT STATUS

There are an estimated 426.7 million acres classified as rangelands in the U.S. West (fig. 2.3).[10] Of these rangelands, about 205 million acres (48 percent) occur on federal lands (primarily Forest Service and Bureau of Land Management), and the remainder are found on nonfederal lands (mostly private). Arizona, New Mexico, Montana, Nevada, Wyoming, and California are the western states with the largest acreages of rangelands (fig. 2.4). Grazing, of course, does not necessarily occur across all of these rangelands, but no one has quantified the extent of grazing lands in the West in a reliable way.[11] Grazing can also occur on pasturelands (land used primarily for the purpose of producing introduced forage grasses for livestock) and forestlands (in the understory).[12] Because grazing takes place on deserts, grasslands, and forestlands, parts of the West support both ranching and the timber industry.

Despite their aridity and rugged terrain, the rangelands of the eleven western states support about one-fifth of the cattle and half of the sheep in the United States, with California having the greatest numbers of both (table 2.1). In 2012, according to the USDA National Agricultural Statistics Service, the West supported 20.2 million cattle including calves, 21.8 percent of the national total (92.7 million; table 2.1). The West's proportion of sheep including lambs is more than twice as high: 2.7 million, or 51.5 percent of the total (5.3 million) in 2012 (table 2.1). The number of cattle in the West has remained fairly stable over the past two decades, while the number of sheep has dropped by almost half. Below, we look more closely at trends in forestry and ranching on public and private working lands in the West.

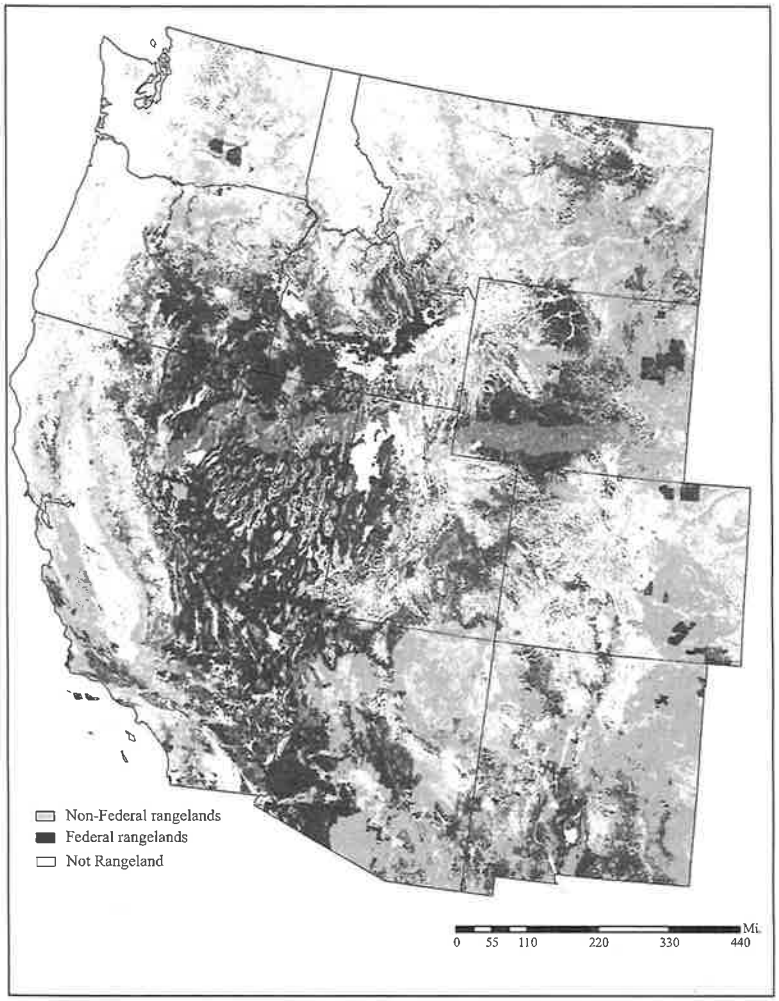

Figure 2.3. Rangelands in the western United States, by ownership. Credit: Matthew C. Reeves, U.S. Forest Service, Rocky Mountain Research Station. Data source: M. C. Reeves and J. E. Mitchell, "Extent of Conterminous US Rangelands: Quantifying Implications of Differing Agency Perspectives," *Rangeland Ecology and Management* 64, no. 6 (2011): 585–97. Figure created in 2013.

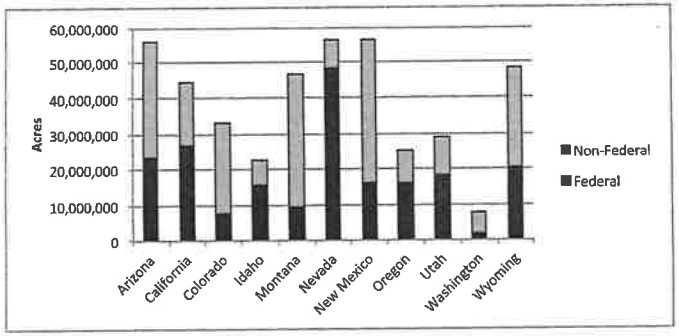

Figure 2.4. Acres of federal and nonfederal rangelands in the western states. Source: Nonfederal—National Resources Inventory Data, 2007; Federal—2001 data derived from M. C. Reeves and J. E. Mitchell, *A Synoptic Review of U.S. Rangelands: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report RMRS-GTR-288 (Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 2012). Figure created in 2013.

TABLE 2.1. Cattle and Sheep in the 11 Western States, 2012

State	*Cattle including Calves (Per 1,000 head)*	*Sheep including Lambs (Per 1,000 head)*
Arizona	920	140
California	5,350	570
Colorado	2,750	460
Idaho	2,220	240
Montana	2,500	225
Nevada	470	70
New Mexico	1,390	100
Oregon	1,300	200
Utah	800	305
Washington	1,110	52
Wyoming	1,360	370
Total West	20,170	2,732
West as percent of U.S. total	21.8	51.5
U.S. Total	92,700	5,300

Source: USDA National Agricultural Statistics Service (for cattle: http://usda01.library.cornell.edu/usda/current/Catt/Catt-02-01-2013.pdf; for sheep: http://usda01.library.cornell.edu/usda/current/SheeGoat/SheeGoat-02-01-2013.pdf). 2013.

FEDERAL LANDS AS WORKING LANDS

About 48 percent of all western lands are in federal ownership, ranging from nearly 85 percent in Nevada, to about 27 percent in Washington:

Nevada	84.6
Utah	63.1
Idaho	62.7
Oregon	50.3
California	45.9
Wyoming	45.9
Arizona	41.7
Colorado	35.7
New Mexico	33.9
Montana	28.8
Washington	27.1[13]

These figures do not include Native American reservations, where tribes and the Department of the Interior's Bureau of Indian Affairs are engaged in complex, ongoing negotiations to determine where federal oversight ends and tribal sovereignty begins. Historically, most federal lands, including Indian reservations, were managed as working forests and rangelands, as described in chapter 1. They have been, in fact, critical to the ranching and timber industries of the West, and continue to be so today, in part because they are protected from residential development.

Multiple uses, such as timber harvesting, grazing, mining, or off-highway vehicle use, are allowed on roughly 69 percent of federal lands in the western states.[14] However, since the 1990s, the focus of federal land management has shifted to recreation, biodiversity conservation, and ecological restoration in response to changing public values and to comply with the National Environmental Policy Act, Endangered Species Act, Healthy Forests Restoration Act, and other federal environmental laws, particularly where lawsuits brought by environmentalists have forced the issue.[15]

As a result, the pendulum has swung in the other direction. Timber harvest from western timberlands (fig. 2.5) and employment in the forest products industries (fig. 2.6) have dropped by 50 percent and 48 percent, respectively, since 1990. Most of this harvest decrease occurred on federal lands. Permitted livestock use on federal lands has also decreased, from about 10 to 7.9 million animal unit months over the past two decades on Bureau of

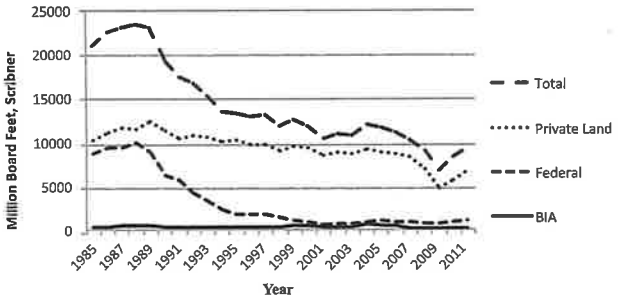

Figure 2.5. Total timber harvested in Washington, Oregon, California, Montana, and Idaho, by ownership, 1985–2011. Timber harvests from state and other public lands are not broken out from the total. Annual harvests under one million board feet from an individual ownership are not included in the totals.Sources: D. D. Warren, *Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 2000*, Research bulletin PNW-RB-236 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2002); X. Zhou and D. D. Warren, *Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 2011*, Research Bulletin PNW-RB-264 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2012). Figure created in 2013.

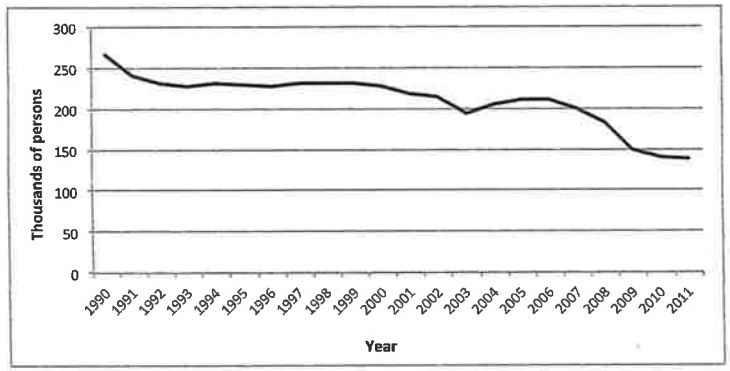

Figure 2.6. Total employment in the forest products industries in Washington, Oregon, California, Montana, and Idaho, 1990–2011. Sources: D. D. Warren, *Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 2000*, Research bulletin PNW-RB-236 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2002); X. Zhou and D. D. Warren, *Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 2011*, Research Bulletin PNW-RB-264 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2012). Figure created in 2013.

Land Management (BLM) lands, and from about 9.5 to 8.3 million animal unit months on Forest Service lands in the last decade.[16] At the same time, the majority of outdoor recreation activities in the West take place on public lands. Recreational use of federal lands nationwide has been stable or increasing (with the exception of Forest Service lands), even as traditional hunting

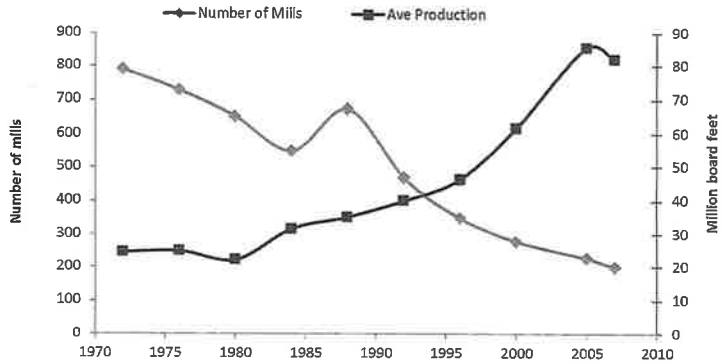

Figure 2.7. Change in number of mills and their average production, 1971–2009. Source: R. W. Haynes and T. M. Quigley, "The Western Forest Products Industry: Status, Issues, and Implications for the Future" (report prepared by Management and Engineering Technologies International, El Paso, TX, for the Western Forestry Leadership Coalition, 2009). Figure created in 2013.

and fishing uses are flat or in decline.[17] Mechanized recreation in particular has increased nationwide: between 1995 and 2006, retail sales of off-highway vehicles in the United States nearly tripled, from 368,600 to more than one million. The number of off-highway vehicle operators climbed from about 27.3 million in 1994–95 to more than 40 million in 2007.[18] Such recreation can potentially degrade federal watersheds and wildlife habitat.

Reductions in timber production and grazing on federal lands have been detrimental for many residents of nearby communities who have historically made a living from ranching and forestry on federal and state lands. The dramatic drop in timber production on federal lands that has occurred since the late 1980s (fig. 2.5) has been a major contributor to the drop in timber-based employment, though reductions in federal timber harvests are only one of several factors contributing to these employment trends. Other factors include technological changes in the wood products manufacturing industry that have increased efficiency (see fig. 2.7) and changes in market demand for wood products.[19] Reduced federal timber harvesting affected forest communities differently, depending on local characteristics and relations to national forests. Communities located close to federal forestlands, and whose economies were highly dependent on those lands, experienced greater employment declines and exhibited lower socioeconomic well-being rankings following the declines (in 2000) than communities farther away.[20]

The loss of mill infrastructure throughout the West to support forest products manufacturing (fig. 2.7) has important implications for the ability of federal agencies to produce forest products in a cost-effective manner because

mills constitute markets for those products. Fewer mills mean less competition and lower stumpage prices for logs. And, the farther the haul distance from the harvest site to the processing facility, the higher the transport costs and the less economical the timber sale. In the absence of nearby infrastructure, sawlogs, small-diameter trees, and biomass lose commercial value and become expensive to remove, making it harder for agencies to produce timber, accomplish forest restoration goals such as fire risk reduction, and support jobs in the wood products industries.[21] Mill infrastructure is not only important for federal land management; it also provides a market for wood products harvested on private and tribal lands, which is also less economical in the absence of local processing infrastructure. If the economic value of private lands for timber production drops relative to their value for other land uses, they are more likely to be sold and converted to agricultural uses or to development.[22] The remaining mill infrastructure in the West is concentrated along major interstate highways in western Washington, western Oregon, California, western Montana, and northern Idaho (fig. 2.8). Because the West's working forests are highly dependent on this remaining infrastructure, it is important to maintain what is left of it.

Ranchers are also highly dependent on public lands.[23] The way in which ranching developed in the West means that today, many ranches consist of a core of private land, and grazing allotment(s) or leases on federal and/or state lands.[24] Such ranches are mosaics of private and public land tenure, but they are managed together as a ranch unit.[25] National forest grazing allotments provide important summer pasture, while BLM and state trust lands, generally found at lower elevations, are often grazed year-round. Rangeland health on BLM lands is good and for the most part stable; the Forest Service does not monitor rangeland health consistently.[26]

The Forest Service and BLM are mandated to manage public lands for multiple uses. The power of other stakeholders like environmental groups and recreation interests has grown in recent decades, often at the expense of ranchers and foresters. As mentioned in chapter 1, grazing on public lands is controversial, and a host of environmental regulations constrain grazing activities and demand more attention and expense from ranchers. These factors together create a state of uncertainty around public lands grazing and threaten ranching in the West because ranching on private lands is often highly dependent on the public lands component: without secure access to grazing leases or allotments, many ranchers would not be able to maintain viable operations.

One alternative to public lands grazing for these ranchers is leasing private range. However, the cost of leasing private rangelands to supplement grazing on their deeded lands can be prohibitive, especially where competing land uses, such as farming or real-estate development, create a shortage of range.[27] The predominance of public rangelands in many rural western counties, and in states like Nevada and California, means leasing private range may not be an option. Ranching is a difficult way to make a living under the best of circumstances. Frequent and prolonged droughts, and meat prices that rise more slowly than the price of fuel, feed, and other inputs, shave profit margins down to the bone. The loss or reduction of animal unit months on federal grazing allotments could drive many ranchers out of busi-

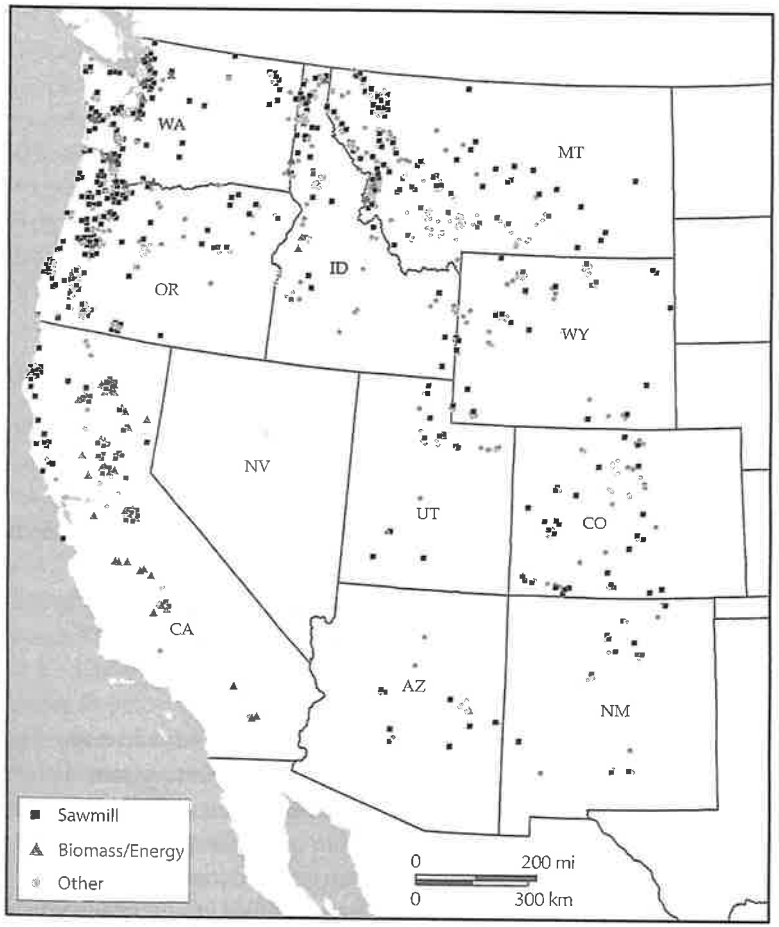

Figure 2.8. Location of mills in the western United States, as of 2006–8 (date varies by state). Source: Data come from the University of Montana, Bureau of Business and Economic Research. Credit: GIS map produced by Jean Daniels, U.S. Forest Service, Pacific Northwest Research Station; presentation modified by Darin Jensen and Syd Wayman in 2013.

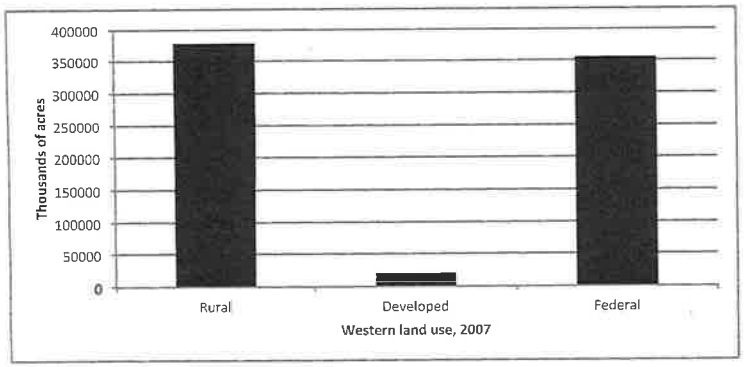

Figure 2.9. Use of western land in 2007. Source: 2007 National Resources Inventory data (U.S. Department of Agriculture, *Summary Report: 2007 National Resources Inventory* (Washington, DC: Natural Resources Conservation Service; Ames, IA: Center for Survey Statistics and Methodology, Iowa State University, 2009). Figure created in 2013.

ness and force them to sell their private lands to developers or to develop it themselves.

PRIVATE LANDS AS WORKING LANDS

The majority of nonfederal land in the West remains rural and undeveloped (fig. 2.9).[28] Nevertheless, between 1982 and 2007, the amount of land converted to development in the western states increased at an average rate of 2.32 percent annually, effectively removing it from natural resource–related uses.[29] Population growth is one driver of development: between 1990 and 2010, the population of the western states increased 37 percent, from 51.1 million to 69.9 million people (the national average was 24 percent).[30] Nationwide, land conversion to development occurs primarily as a result of the conversion of cropland and forestland, with forests being the largest source of land conversion to developed uses.[31]

Private forestlands can be divided into two categories: corporate and noncorporate. Family forestlands are a subset of noncorporate private forestlands and are owned by families, individuals, trusts, estates, family partnerships, and other unincorporated groups of individuals.[32] The conversion of forestland to development occurs primarily on family forest (as opposed to timber industry) land.[33] However, rapidly changing industrial timberland ownership trends have meant increasing sales of these lands for development in some places where their value as real estate exceeds their value for timber production.[34] Timber production from private forestlands in the West has been more

stable than from federal lands, though harvest levels have declined in recent years in response to the economic downturn (fig. 2.5).

As shown in figure 2.2, 20 percent of the timberlands in the West are owned by private noncorporate owners (most of whom are family forest owners), who own forestland for a variety of reasons. Not all family forest owners in the West are economically dependent on commercial timber production, though it does provide a supplementary source of income for many. Nearly half of the family forest owners in the West have harvested timber from their lands, and about 18 percent have engaged in commercial timber harvests from their lands (of sawlogs, veneer logs, or pulpwood).[35] There is a strong relationship between ownership size and management for timber: the larger the ownership, the more likely a family forest owner is to manage for timber production.[36]

The private noncorporate ownership category has been declining. For example, the amount of timberland owned by private noncorporate owners in the Pacific Northwest dropped by 4.4 million acres (34 percent) between 1953 and 2002, and by 1.5 million acres in California during this same period (25 percent).[37] At the same time, the number of private noncorporate owners has been increasing, implying increasing fragmentation and parcelization of the landscape.[38] Parcelization results from a reduction in average forest parcel size and an increase in the number of forest landowners.[39] In the eleven western states, 65 percent of the family forest owners owned parcels between one and nine acres in size in 2006 (fig. 2.10), though this accounted for only 6.6 percent of family forestland in the region. Most family forestland consists of tracts over 200 acres in size, owned by a minority of the owners (fig. 2.10). The number of owners of several size classes of forestland under 500 acres in size has been increasing, however—an indicator of parcelization.[40]

Parcelization and low-density rural home development have a number of negative environmental impacts. These include forest fragmentation and associated habitat loss or alteration, changes to ecosystem processes and biotic interactions, higher likelihood of invasion by exotic species, and increased human disturbance.[41] Parcelization does not necessarily lead to forest fragmentation, depending on how individual forest owners manage their lands.[42] But it becomes increasingly difficult to maintain continuous habitat when the number of owners proliferate because each additional owner brings her or his own needs, management preferences, and levels of knowledge to the landscape. Robles et al. found that several coastal watersheds in the West have high numbers and densities of at-risk species associated with private forestlands, as well as private forestlands that are predicted to experience increasing housing densities in the coming decades.[43] These trends suggest a need

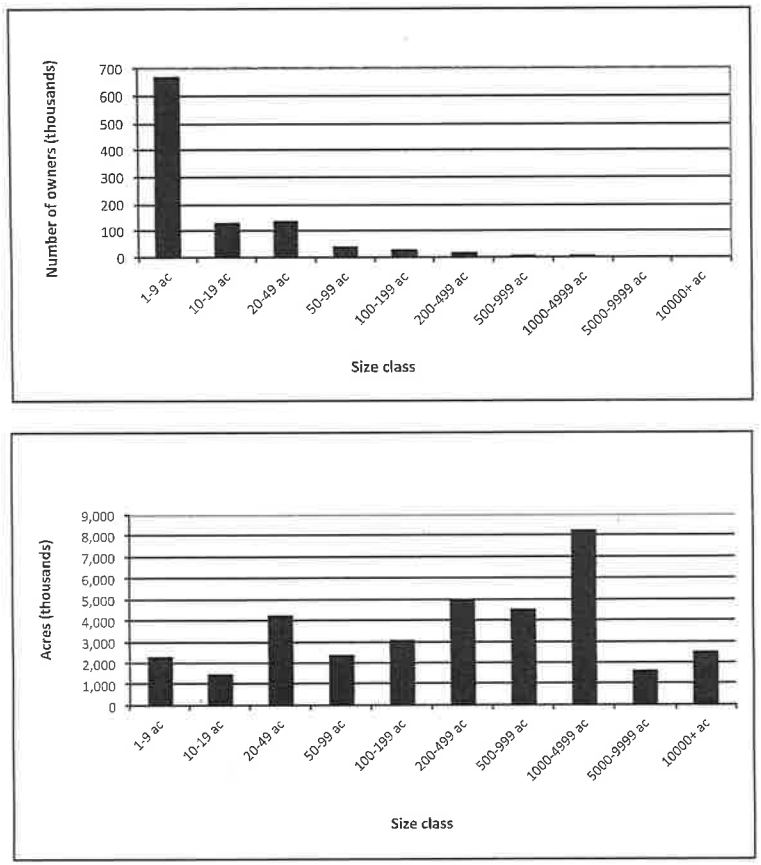

Figure 2.10. Number of owners (*top*) and acres owned (*bottom*) by family forest owners according to size class in the 11 western states, 2006. Source: 2006 data from "National Woodland Owner Survey," Forest Inventory and Analysis National Program, U.S. Department of Agriculture Forest Service, http://www.fia.fs.fed.us/nwos/. Figure created in 2013.

for targeting private forestlands and timberlands with conservation efforts using the kinds of strategies discussed in this book.

Private corporate timberlands are also an important component of the West's working forests. Historically, forest products companies were vertically integrated, owning timberlands to have control over the supply of timber to their manufacturing facilities. In the mid-1990s, however, many forest products companies began selling off their timberlands for economic reasons to timber investment management organizations (TIMOs) and real-estate investment trusts (REITs), as well as to individual private owners.[44] Timber investment management organizations buy, manage, and sell forestland and timber on behalf of institutional investors; they do not typically own forestland. In contrast, REITs do own land; many are former forest products companies that have restructured for tax purposes to separate legal ownership and control of their forestland and timber from that of their manufacturing facilities, with the land and timber being acquired by the REIT. Such trusts buy, manage, and sell real estate and related assets on behalf of private investors.

In 1992 there were approximately 28.5 million ha of industrial timberland in the United States.[45] Between 1996 and 2007, timberland sale transactions for sales over 10,000 acres in size (4,047 ha) totaled nearly 24 million ha (some parcels were sold more than once). Forest industry offered nearly 76 percent of the total sales, while TIMOS, REITs, and private buyers purchased 77 percent of these sales. Though much of this shift in timberland ownership from forest industry to TIMOs and REITs is taking place in the southern and northeastern United States, it is also occurring in the Northwest.[46]

This trend is of concern for working landscape conservation because it creates uncertainty around the future ownership and management of large blocks of timberland. Organizations like TIMOs and REITs manage their lands as investments. Limited evidence suggests that TIMOs and REITs manage these lands more intensively than private industry, are less concerned with long-term management horizons, sell land in parcels that are smaller than what they acquired, and convert timberlands to developed uses if they deem this to be the most profitable use of the land.[47] Nevertheless, as the authors of chapter 7 of this volume demonstrate, there can also be positive conservation outcomes from forest industry divestitures of working forestlands.

Rangelands

Although the extent of federal rangeland nationwide has remained fairly constant over time and is not expected to change much in the future, the extent of nonfederal rangeland declined at an average rate of 350,000 acres annually between 1982 and 2007 as a result of conversion to cropland and developed land uses and is projected to continue to decline slowly in the future.[48] In the West, the greatest decreases occurred in New Mexico, Montana, and California.[49] Rangeland fragmentation is also occurring as a result of agricultural uses, subdivision, and urbanization.

The loss of rangeland has occurred primarily as a result of conversion to crop production rather than to residential development, though the dynamics of land-use changes vary by place.[50] Residential development is projected

to contribute to future rangeland conversion, particularly in California, followed by Arizona and Colorado. Ranchlands are also undergoing a process of parcelization and fragmentation owing to development and, in some cases, because of estate tax demands (see spotlight 13.1). Much of this parcelization occurs near major urban centers such as Denver, Boulder, and Fort Collins, in Colorado, Salt Lake City and the Wasatch Front in Utah, and the greater Phoenix and Tucson areas of Arizona (see chap. 13).[51] The conversion of ranchlands to real-estate development also occurs in areas of the West having high amenity values. For example, in the Madison Valley of Montana, part of the greater Yellowstone ecosystem, the average price per acre rose from $563 to $1,251 during the 1990s, triple the agricultural value of the land (see spotlight 11.1).[52] Much of this land was subdivided into "ranchettes." Some large ranches, like large tracts of private forest near more developed resort destinations, have not been carved up. Nonetheless, the new owners may be less interested in livestock production and more drawn by the amenity and investment values of the ranch, taking it out of production.[53]

A rangeland health inventory system developed in the early 2000s for nonfederal rangelands examined 17 different rangeland health indicators pertaining to soil and site stability, hydrologic function, and biotic integrity to assess their degree of departure from reference conditions representing healthy rangelands. Arizona and New Mexico contained the largest percentage of nonfederal rangeland acres that had departed from reference conditions for all three attributes, indicating the most severe degradation.[54] Nonnative species and invasive native species (such as juniper and mesquite) are also widespread on western rangelands, though the degree to which they pose a problem for grazing is variable.[55] These findings underscore the need for collaborative conservation efforts to restore rangeland health.

SUMMARY

In sum, western working forests and rangelands are threatened on both public and private lands, for different reasons but with the same outcome: it has become increasingly difficult for rural ranchers and foresters to maintain natural resource-based livelihoods. And, although biodiversity conservation and ecological restoration have become a central focus of federal land management over the past two decades, trends on private lands have often worked against these goals. These trends make it challenging to stitch the West back together, especially in places having checkerboard ownership

patterns or in watersheds having mixed ownerships. Nevertheless, doing so is important for maintaining and restoring the integrity of working forests and rangelands, as well as the biodiversity and rural communities they support.

NOTES

1. For purposes of the statistics reported here, "timberland" is defined as forestland that is capable of producing at least 20 cubic feet per acre per year of industrial wood from natural stands and that is not withdrawn from timber utilization by statute or administrative regulation. "Forestland" is defined as land that is at least 120 feet wide and one acre in size and that has at least 10 percent live tree cover, including land that had such tree cover in the past that will be regenerated. W. B. Smith, P. D. Miles, C. H. Perry, and S. A. Pugh, *Forest Resources of the United States, 2007: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report WO-78 (Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office, 2009).
2. Ibid.
3. Ibid.
4. X. Zhou and D. D. Warren, *Production, Prices, Employment, and Trade in Northwest Forest Industries, All Quarters 2011*, Resource Bulletin PNW-RB-264 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2012), 1, 6.
5. Zhou and Warren, *Production, Prices, Employment*, 10.
6. Ibid., 24, 27, 28.
7. Susan Charnley, Rebecca J. McLain, and Ellen M. Donoghue, "Forest Management Policy, Amenity Migration, and Community Well-Being in the American West: Reflections from the Northwest Forest Plan," *Human Ecology* 36, no.5 (2008): 743–61.
8. E. T. Jones, R. J. McLain, and J. Weigand, eds., *Nontimber Forest Products in the United States* (Lawrence: University of Kansas Press, 2002), xvii–xviii.
9. R. Hansis, "A Political Ecology of Picking: Non-timber Forest Products in the Pacific Northwest," *Human Ecology* 26, no. 1 (1998): 67–86; E. T. Jones and K. A. Lynch, "Integrating Commercial Nontimber Forest Product Harvesters into Forest Management," in *Forest Community Connections: Implications for Research, Management, and Governance*, ed. E. M. Donoghue and V. E. Sturtevant (Washington, DC: Resources for the Future Press, 2008), 143–61.
10. The Natural Resources Conservation Service's *National Resource Inventory* defines "rangeland" as land on which native grasses, grasslike plants, and forbs or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland, make up the climax or potential plant cover (U.S. Department of Agriculture [USDA], *Summary Report: 2007 National Resources Inventory* [Washington, DC: Natural Resources Conservation Service and Center for Survey Statistics and Methodology, Iowa State University, 2009], http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1041379.pdf). This is the definition adopted for purposes of the statistics reported in this chapter; M. C. Reeves and J. E. Mitchell, *A Synoptic Review of U.S. Rangelands: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report RMRS-GTR-288 (Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 2012).

11. M. C. Reeves and J. E. Mitchell, "Extent of Conterminous US Rangelands: Quantifying Implications of Differing Agency Perspectives," *Rangeland Ecology and Management* 64, no. 6 (2011):585–97.
12. U.S. Department of Agriculture, *RCA Appraisal: Soil and Water Resources Conservation Act* (Washington, DC: U.S. Department of Agriculture, 2011).
13. The source for these figures is USDA, *Summary Report: 2007 National Resources Inventory.*
14. Multiple-use percentages were calculated from raw data found at National Gap Analysis (GAP), U.S. Geological Survey, http://gapanalysis.usgs.gov/data/.
15. Regarding the federal land management's shift in focus in response to changing public values, see B. A. Shindler, T. M. Beckley, and M. C. Finley, *Two Paths toward Sustainable Forests: Public Values in Canada and the United States* (Corvallis: Oregon State University Press, 2003).
16. An animal unit month is the amount of forage it takes to sustain one cow and calf, one horse, or five sheep or goats for one month. Permitted use is the maximum number of animal unit months that can be used on U.S. Forest Service or Bureau of Land Management lands in a given year under a permit document. This number is generally higher than the number of animal unit months that are actually authorized for grazing use in a given year; Reeves and Mitchell, *A Synoptic Review of U.S. Rangelands.*
17. H. K. Cordell, *Outdoor Recreation Trends and Futures: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report SRS-150 (Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 2012); K. Calvert, C. H. Vincent, and R. W. Gorte, *Recreation on Federal Lands*, CRS Report for Congress RL33525 (Washington, DC: Congressional Research Service, 2010).
18. H. K. Cordell, C. J. Betz, G. T. Green, and B. Stephens, *Off-Highway Vehicle Recreation in the United States and Its Regions and States: A National Report from the National Survey on Recreation and the Environment (NSRE)*, USDA Forest Service RECSTATS Research Report in the Internet Research Information Series, ([Athens, GA: Southern Research Station?], 2008), http://www.fs.fed.us/recreation/programs/ohv/IrisRecrpt.pdf.
19. T. M. Power, "Public Timber Supply, Market Adjustments, and Local Economies: Economic Assumptions of the Northwest Forest Plan," *Conservation Biology* 20, no. 2 (2006): 341–50.
20. S. Charnley, E. M. Donoghue, and C. Moseley, "Forest Management Policy and Community Well-Being in the Pacific Northwest," *Journal of Forestry* 106, no. 8 (2008): 440–47.
21. M. Nielsen-Pincus, S. Charnley, and C. Moseley, "The Influence of Proximity to Sawmills and Biomass Facilities on National Forest Hazardous Fuels Treatments," *Forest Science* 59, no. 5 (2013): 566–77.
22. R. J. Alig, "A United States View on Changes in Land Use and Land Values Affecting Sustainable Forest Management," *Journal of Sustainable Forestry* 24, nos. 2–3 (2007): 209–27.
23. J. M. Fowler, "Historic Range Livestock Industry in New Mexico," in *Livestock Management in the American Southwest*, ed. R. Jemison and C. Raish (Amsterdam: Elsevier, 2000); G. B. Ruyle, R. Tronstad, D. W. Hadley, P. Heilman, and D. A. King, "Commercial Livestock Operations in Arizona," in *Livestock Management*, ed. Jemison and Raish; A. Sulak and L. Huntsinger, "Public Land Grazing in California: Untapped Potential for Private Lands?" *Rangelands* 29, no. 3 (2007): 9–12.
24. For an overview of how ranching developed in the West, see P. F. Starrs, *Let the Cowboy Ride: Cattle Ranching in the American West* (Baltimore, MD: Johns Hopkins University Press, 1998).

25. L. Huntsinger, L. C. Forero, and A. Sulak, "Transhumance and Pastoralist Resilience in the Western United States," *Pastoralism* 1, no.1 (2010): 9–36.
26. U.S. Department of Agriculture, Forest Service, *Future of America's Forests and Rangelands: 2010 Resources Planning Act Assessment* (Washington, DC: USDA Forest Service, 2012).
27. B. J. Gentner and J. A. Tanaka, "Classifying Federal Public Land Grazing Permittees," *Journal of Range Management*, 55, no.1 (2002): 2–11; Sulak and Huntsinger, "Public Land Grazing."
28. For purposes of the data reported here, developed land consists of a combination of large urban and built-up areas, small built-up areas, and rural transportation land. Rural land is land that does not fall into one of the three preceding categories. Definitions from USDA, *Summary Report: 2007 National Resources Inventory* (n. 10 above, this chap.).
29. Data from ibid.
30. Population figures based on data found at U.S. Census Bureau, U.S. Department of Commerce, http://www.census.gov/prod/2001pubs/c2kbr01-2.pdf, and http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf
31. R. J. Alig, A. J. Plantinga, S. Ahn, and J. D. Kline, *Land Use Changes Involving Forestry in the United States: 1952 to 1997, with Projections to 2050—a Technical Document Supporting the 2000 USDA Forest Service RPA Assessment*, General Technical Report PNW-GTR-587 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2003).
32. B. J. Butler, *Forest Ownership*. In W. B. Smith, P. D. Miles, C. H. Perry, and S. A. Pugh, *Forest Resources of the United States, 2007: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, General Technical Report WO-78 (Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office, 2009), 19–21.
33. J. D. Kline and R. J. Alig, "Forestland Development and Private Forestry with Examples from Oregon (USA)," *Forest Policy and Economics* 7 (2005): 709–20.
34. J. C. Bliss, E. C. Kelly, J. Abrams, C. Bailey, and J. Dyer, "Disintegration of the U.S. Industrial Forest Estate: Dynamics, Trajectories, and Questions," *Small-Scale Forestry* 9 (2010): 53–66.
35. The data, which are from 2006, are from the National Woodland Owner Survey: http://www.fia.fs.fed.us/nwos/.
36. Butler, *Family Forest Owners*, 23.
37. R. W. Haynes, D. M. Adams, R. J. Alig, P. J. Ince, J. R. Mills, and X. Zhou, *The 2005 RPA Timber Assessment Update: A Technical Document Supporting the USDA Forest Service Interim Update of the 2000 RPA Assessment*, General Technical Report PNW-GTR-699 (Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 2007), 22. Note that this publication uses the term "private nonindustrial" instead of "noncorporate"; we use the latter for consistency of terminology in the chapter. Since the time of this publication, the categorization of private forest lands has changed (see Butler, *Forest Ownership*). However, the categories "private nonindustrial" and "private noncorporate" are analogous.
38. Ibid.; B. J. Butler, J. J. Swenson, and R. J. Alig, "Forest Fragmentation in the Pacific Northwest: Quantification and Correlations," *Forest Ecology and Management* 189, nos. 1–3 (2004): 363–73; B. J. Butler and E. C. Leatherberry, "America's Family Forest Owners," *Journal of Forestry* 102, no. 7 (October–November 2004): 4–9.

39. S. R. Mehmood, and D. Zhang, "Forest Parcelization in the United States: A Study of Contributing Factors," *Journal of Forestry* 99, no. 4 (2001): 30–34.
40. Butler and Leatherberry, "America's Family Forest Owners," 6.
41. A. J. Hansen, R. L. Knight, J. M. Marzluff, S. Powell, K. Brown, P. H. Gude, and K. Jones, "Effects of Exurban Development on Biodiversity: Patterns, Mechanisms, and Research Needs," *Ecological Applications* 15, no. 6 (2005): 1893–1905; G. E. Heilman Jr., J. R. Strittholt, N. C. Slosser, and D. A. Dellasala, "Forest Fragmentation of the Conterminous United States: Assessing Forest Intactness through Road Density and Spatial Characteristics," *BioScience* 52, no. 5 (2002): 411–22.
42. Y. Zhang, D. Zhang, and J. Schelhas, "Small-Scale Non-industrial Private Forest Ownership in the United States: Rationale and Implications for Forest Management," *Silva Fennica* 39, no. 3 (2005): 443–54.
43. M. D. Robles, C. H. Flather, S. M. Stein, M. D. Nelson, and A. Cutko, "The Geography of Private Forests That Support At-Risk Species in the Conterminous United States," *Frontiers in Ecology and the Environment* 6, no. 6 (2008): 301–7.
44. Bliss et al., "Disintegration of the U.S. Industrial Forest Estate."
45. Ibid.
46. N. E. Block and V. A. Sample, *Industrial Timberland Divestitures and Investments: Opportunities and Challenges in Forestland Conservation* (Washington, DC: Pinchot Institute for Conservation, 2001).
47. Bliss et al., "Disintegration of the U.S. Industrial Forest Estate."
48. Reeves and Mitchell, *A Synoptic Review of U.S. Rangelands* (n. 10 above, this chapter), 14–16, 33–35, http://www.fs.fed.us/rm/pubs/rmrs_gtr288.html
49. Data from USDA, *Summary Report: 2007 National Resources Inventory* (n. 10 above, this chap.), 32–41, table 2: "Land Cover/Use of Non-Federal Rural Land, by State and Year."
50. On the sources of rangeland loss, see Reeves and Mitchell, *A Synoptic Review of U.S. Rangelands*, 24–27.
51. Robert E. Lang, Andrea Sarzynski, and Mark Muro, *Mountain Megas: America's Newest Metropolitan Places and a Federal Partnership to Help Them Prosper* (Washington, DC: Brookings Institution, 2008).
52. A. B. Pearce, "Uncommon Properties: Ranching, Recreation, and Cooperation in a Mountain Valley" (PhD thesis, Stanford University, 2004).
53. H. Gosnell and W. R. Travis, "Ranchland Ownership Dynamics in the Rocky Mountain West," *Rangeland Ecology and Management* 55, no. 1 (2005): 2–11.
54. J. E. Herrick, V. C. Lessard, K. E. Spaeth, P. L. Shaver, R. S. Dayton, D. A. Pyke, L. Jolley, and J. J. Goebel, "National Ecosystem Assessments Supported by Scientific and Local Knowledge," *Frontiers in Ecology and the Environment* 8, no. 8 (2010): 403–8; USDA, *RCA Appraisal* (n. 12 above, this chapter).
55. Regarding nonnative and invasive species on rangeland, see Herrick et al., "National Ecosystem Assessments." Concerning the degree to which such species are problematic, see USDA, *RCA Appraisal*.

3

THE BIODIVERSITY THAT PROTECTED AREAS CAN'T CAPTURE

How Private Ranch, Forest, and Tribal Lands Sustain Biodiversity

Gary P. Nabhan, Richard L. Knight, and Susan Charnley

IN BRIEF

- Formally designated protected areas in the western United States are not large enough, diverse enough, or located strategically enough to support viable populations of many area-sensitive species, endemic species, or endangered species; a broader, landscape-scale focus is needed to incorporate conservation on adjacent private and tribal lands as well.
- Many working tribal and private lands provide an ecological buffer zone between adjacent public lands and encroaching exurban development; their lower elevation relative to many protected public lands offers better soils, more water features, and often a significant component of the biodiversity in a region.
- The conversion of working lands to exurban development will cause a decline in human-sensitive species, in turn increasing the number of these species on the federal threatened and endangered species list and placing a greater burden on public-policy makers and land managers who must act to protect them.
- Working landscapes on private and tribal lands are core conservation areas in the West that deserve protection using tools such as zoning restrictions, tax incentives for establishing conservation easements, and market rewards for maintaining their ecological goods and services.