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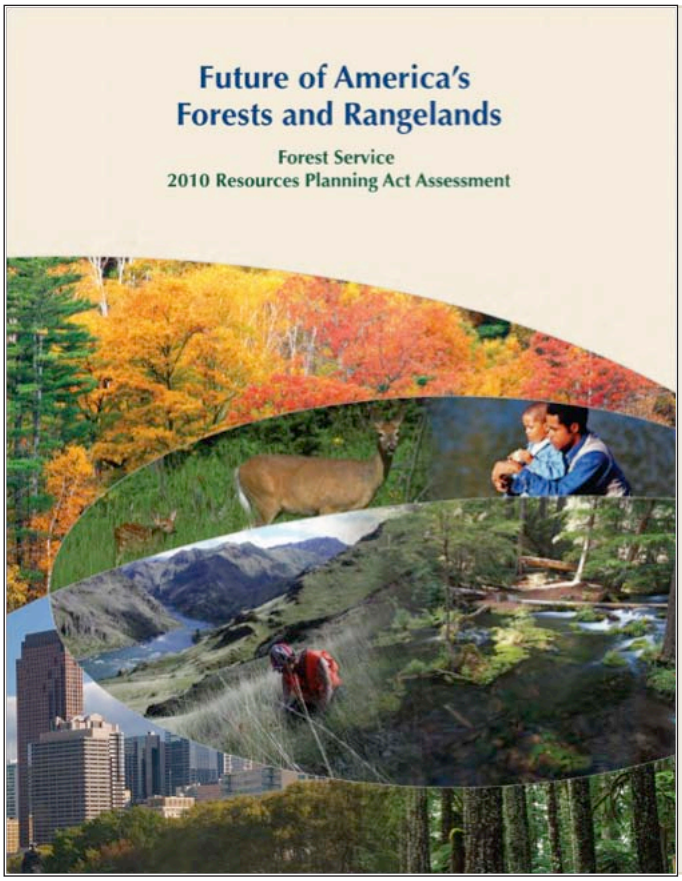
Coming to a Landscape Near You: Natural Resource Changes in the Interior West



The 2010 RPA Assessment uses scenario-based socioeconomic and climatic projections to analyze complex drivers of change and their impacts on important natural resources.

SUMMARY

In the coming decades, population growth, economic growth, and associated land-use changes—in concert with climate change—will influence forests and rangelands in the Interior West. Society's demand for ecosystem goods and services continues to increase as human and biophysical change alter the productive capacity of these lands. The 2010 RPA Assessment uses scenario-based socioeconomic and climatic projections to analyze these natural resource trends. Geographic variation throughout the Interior West will determine local trends, but regional trends project population growth around existing urban centers and the likelihood of water shortages, primarily in the Southwest. Projected population growth will increase demands for water, agricultural-to-residential land-use changes, and habitat fragmentation. Projected climatic change will further complicate the picture of the region's future, as water availability decreases, outdoor recreation opportunities shift, and increasing temperatures alter habitat. The RPA Assessment gives a policy-neutral projection of the range of future conditions. Land managers and policy makers can use its results to develop effective plans and policies for climate adaptation and an expanding population. The choices that land managers and policy makers make in the near-term will help to shape the future of natural resources in the Interior West.

A notable coming attraction to the Interior West is more than a summer blockbuster—it's a series of climatic and demographic changes that will alter natural resources in the region. A changing climate and growing population will present new and complex challenges to U.S. land managers and citizens. Many natural resources—especially water—will experience a dual pressure from increasing demand and decreasing availability, and the communities that rely on these resources will be confronted with difficult tradeoffs. Understanding these pressures, and how they affect the current status and future trends of ecosystems and resources, can help resource managers, policy makers, and communities effectively plan for the future of this region.

Where does information on ecosystem and resource status and trends come from? In 1974, the U.S. Congress passed the Forest and Rangeland Renewable Resource Planning Act (RPA), which requires the U.S. Forest Service to conduct in-depth assessments of both current status and future uses and trends of all the nation's forest and rangeland resources, whether public or private. In 1990, Congress amended the RPA legislation to require that the assessment consider the effects of climate change. As a result of this Act, U.S. Forest Service Research and Development publishes a new "RPA Assessment" every ten years. The RPA Assessment provides scientifically robust trends and outlook information that can help land managers, policy makers, and the public understand what's "coming to a landscape near you." In completing the most recent assessment, scientists analyzed the outlook for forests, rangelands, water, wildlife and fish, outdoor recreation, and urban forests to 2060. The resulting synthesis forms the foundation for rigorous, science-based management of our public lands and the nation's natural resources. The RPA Assessment provides information for the entire nation, but this edition of the Science You Can Use Bulletin focuses on findings of particular relevance and importance for land and resource managers in the Interior West, which is expected to see the highest rate of population growth of any region, resulting in shifts in demand for many natural resources.

"Ecosystem services" is a term commonly used to refer to the benefits that people obtain from nature. The RPA assessment analyzes a number of critical ecosystem services: provisioning services such as timber, wood fuel, forage for livestock, water, and wildlife; and cultural services such as recreation. The RPA Assessment projects that growing populations will result in an increased demand for these ecosystem services just as projected urban expansion and land-use change are likely to act in tandem to decrease their supply. Impacts related to population growth will be further exacerbated by climate change. According to projections in the RPA Assessment, coupled population growth and climate change trends will increase the vulnerability of the water supply in the Southwest and, if current land-use development trends continue, cause habitat loss and fragmentation both near the metropolitan areas of Colorado and Utah and across the region's forests and rangelands. Actions by policy makers, urban developers, and land managers can change the trajectory of these trends. "What the RPA Assessment really is doing is showing where adaptation is needed and how badly it is needed," says economist Tom Brown, one of several Rocky Mountain Research Station scientists involved in the production of the Assessment.

NATURAL RESOURCE TRENDSETTERS

The most recent assessment, published in 2012 and titled *Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment*, represents the combined efforts of a team of scientists from four research stations of U.S. Forest Service Research and Development branch. The scientific team includes Rocky Mountain Research Station research scientists Drs. Tom Brown, Curt Flather, Linda Joyce, Miranda Mockrin, and Matt Reeves. Many other university collaborators and scientists at other research stations also contributed to the RPA report. A full list of lead researchers from all US Forest Service Research Stations is contained in the acknowledgements section of this Bulletin.

The 2010 RPA Assessment used a scenario-based approach to provide the foundation for projections. Scenarios provide a tool to help address the uncertainty of future conditions by combining information about a variety of future climatic and socio-economic trends that can be used to analyze their future effects on humans and natural resources. Quantitative ecologist Linda Joyce remarks, "This RPA assessment cycle really was the first time that three primary drivers of change—climate change, population, and economic growth—were combined in a consistent manner to analyze future natural resource trends on the nation's forest and rangeland resources." In analyzing the future of different resource areas, scientists looked at three different socioeconomic scenarios and three different climate scenarios. These result in nine different future projections, or scenarios.

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While the idea of nine scenarios may initially sound overwhelming, managers may use the range of projections to begin to think about the context for their district, forest, or region. It is important to note that each of the three factors—climate change, population growth, and economic growth—that informs the scenarios will affect forests and rangelands in the Interior West. However, the factors may influence change at different rates or spatial scales, and they may act independently or inter-dependently, depending upon specific location and circumstances.

For example, in some areas of the Interior West, population growth and the associated land use change will result in near-term changes to forest and rangelands that exceed any impact from climate change. In other areas of the region, changes in precipitation and temperature may have greater effects in the short term through extreme events—such as drought—or changes in disturbance regimes—such as insect outbreaks and wildfire. And in other areas, these three forces will interact with fragmentation of habitat and the expansion of invasive species. Given their local knowledge and experience, managers at the local level may be well-suited to understand which factors are likely to be most influential within the local geography in the near to mid-term, and may pair this knowledge with the scenarios to inform planning on the local or regional scale.

Theodore Roosevelt said that "In utilizing and conserving the natural resources of the Nation, the one characteristic more essential than any other is foresight." Dr. Dave Cleaves, Climate Change Advisor for the Chief of the Forest Service, notes that the RPA Assessment contributes to our foresight by helping us better understand key uncertainties, identify emerging issues, and anticipate unintended consequences. "The RPA posits critical questions for the reader, the manager, the policymaker, and the citizen. Do you see different futures? What is driving them? What the risks and the opportunities they present? What can we do about them? These are important questions, especially in the critical tension zones - urban interfaces, edges of increasingly unstable habitat ranges, critical reproductive phases or severe microclimates, or concentrations of demand for fragile ecosystem services."

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GROWING OUT WEST

The Interior West region is one of four main RPA regions (Figure 1). It defines the Rocky Mountain region (referred to as the "Interior West" in this Bulletin) as Idaho, Montana, North Dakota, South Dakota, Wyoming, Colorado, Utah, Arizona, New Mexico, Nebraska, and Kansas. This region encompasses the driest areas (Southwest) and some of the coldest areas (high-elevation Rocky Mountains) of the United States. Many of these states have large areas of National Forests, National Parks and Monuments, and Wildlife Refuges. Within the Interior West region, 20% of the land is forestland; and of this forestland, 75% is public—either federal, state, or local.

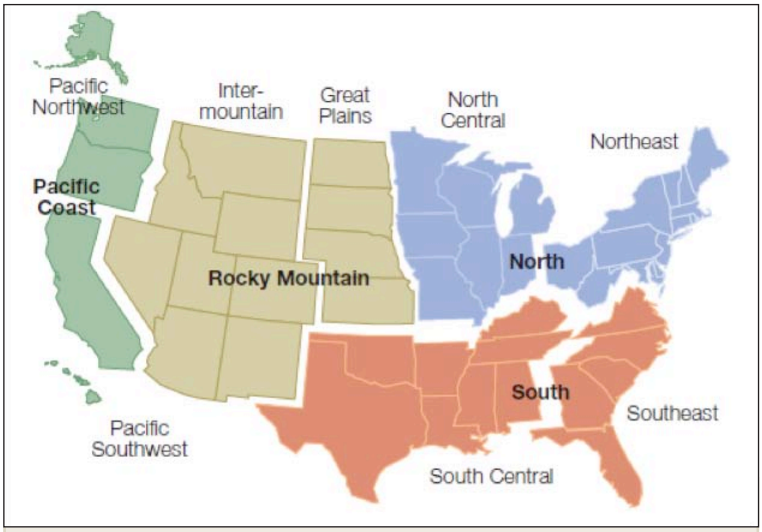


Figure 1. RPA Assessment regions and subregions.

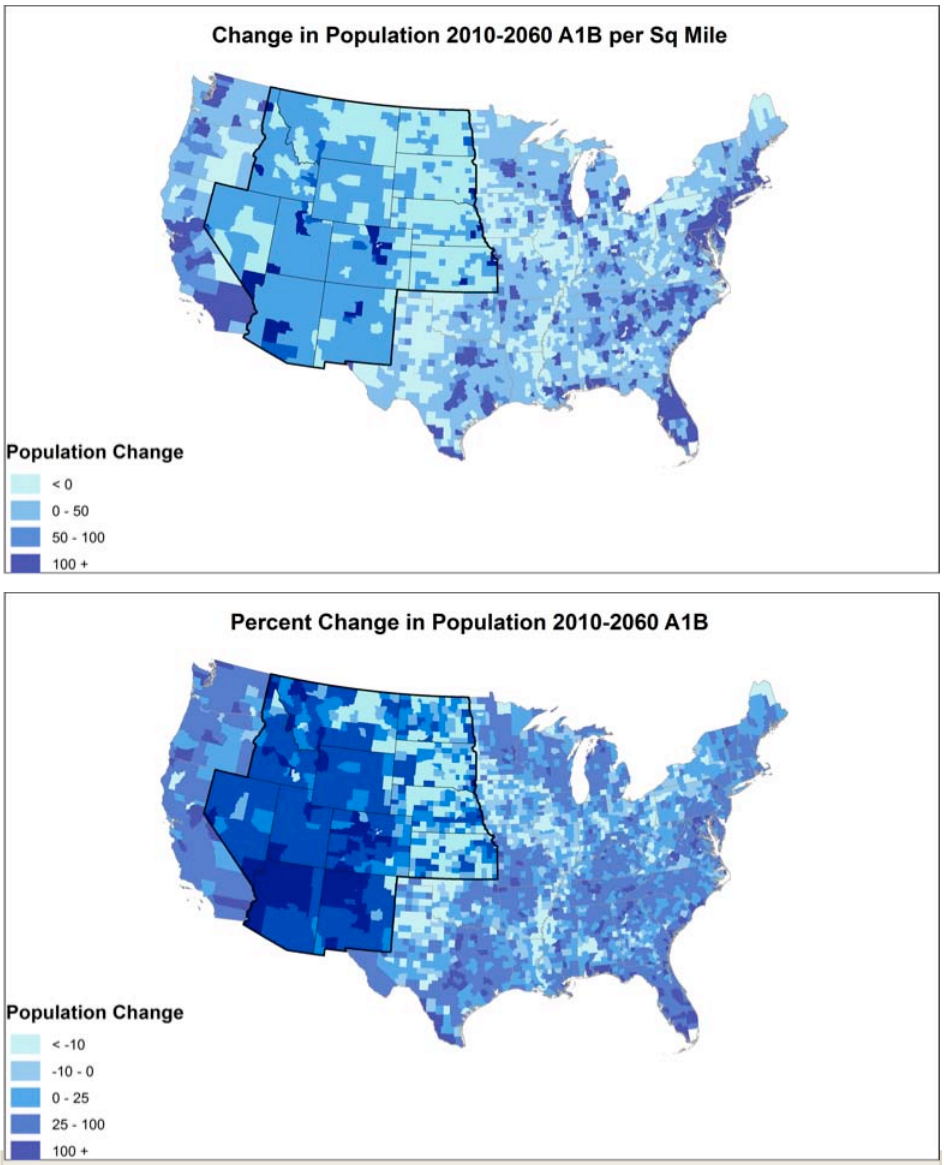
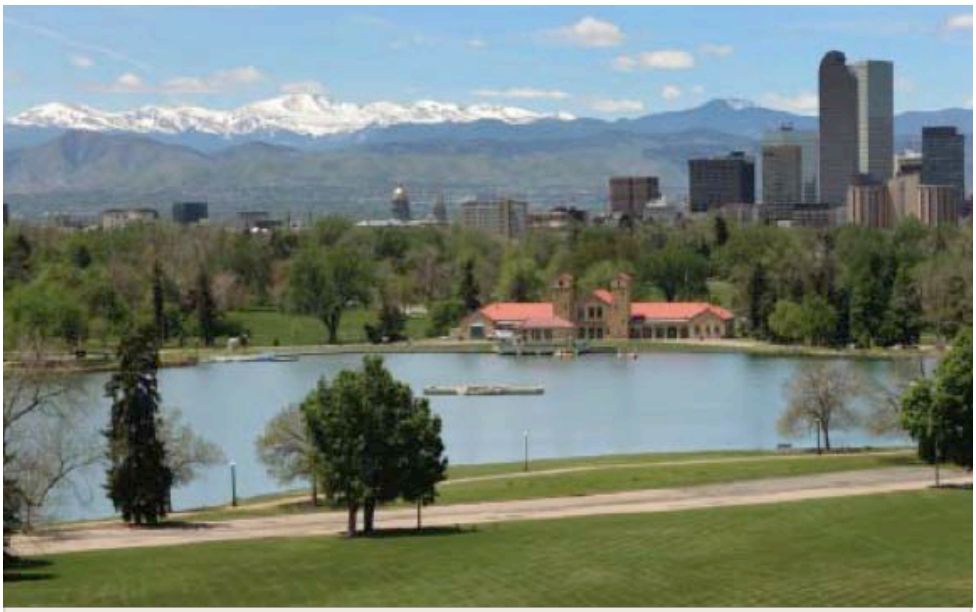


Figure 2. Absolute (top) and relative (bottom) change in population, under scenario RPA A1B, 2010-2060. The RPA A1B scenario represents medium US GDP and population growth and is based upon the Intergovernmental Panel on Climate Change's (IPCC) A1B scenario, but with some specific adjustments which are described in Chapter 5 of the RPA Assessment. Absolute change (top) represents the change in population density (change in number of people per square mile) by 2060, compared to the 2010 population. Relative change (bottom) represents population growth rate (percent population change) by 2060, compared to the 2010 population. A sizeable increase in population may not sizably alter the percent population change for a high-density/urban county. On the other hand, a relatively small increase in a low-density/rural county could dramatically increase percent population change for that county.

The Interior West region is projected to have the highest rate of population growth and the highest rate of urban area growth to 2060 (Figure 2). The rugged topography of the region will concentrate the growth around existing urban centers such as Phoenix, Denver, and Las Vegas. As these cities grow, the amount of rangeland and forests will decline. In the past, development pressures have been particularly evident on lands with high natural amenity values—lands that often occur in proximity to public lands in general and to national forests in particular. Between 1940 and 2000, nearly 26 million homes were built near national forests across the United States While the pattern of housing growth varied geographically, the relative rate of housing growth by the year 2000 was the greatest in the West, including parts of Idaho, Colorado, Wyoming, Utah, Arizona and New Mexico. The attraction to these natural settings surrounding the expansive public land in the Interior West is likely to continue in the future, adding another stress to future rangeland and forest areas.

Loss of habitat and connectivity in forests and rangelands will affect the many wildlife species in the region. Over the next 50 years, the country will lose about 6 to 9 million acres of rangeland, with about half of that occurring in the Interior West. Agricultural expansion will be the primary driver of rangeland loss in the Plains states, but development and urban expansion will also drive the loss, especially in Arizona and New Mexico. Imperiled species located proximate to growing cities will be most heavily impacted. "The urbanization effect in the Interior West tends to be more localized, with population growth around existing urban centers and irrigated agriculture occurring where there's water," says landscape ecologist Kurt Riitters. This pattern, which differs from the East where abundant water creates the potential for agriculture almost anywhere, still only gives a partial picture of habitat change in the region. Further rangeland-related habitat change is driven by encroachment of woody growth and invasive species.



In recent decades, the relative rate of housing growth was the greatest in the West, including near cities like Denver, Colorado, above. Photo credit: istockphoto.com/David Parsons

HABITAT HOT SPOT

Whereas urbanization typically chips away at the edge of forests and rangelands, other factors can result in habitat fragmentation. Within forested communities, many species depend on what is known as "interior forest" for predator evasion, migration, or other aspects of survival. Fragmentation both eliminates interior forest and increases edge forest. Edge forest in turn creates openings for the spread of invasive plants and animals resulting in more fragmented habitat that leads to species population declines similar to loss of a habitat through land-use change. These factors can combine with agricultural and energy developments to result in the loss of even more interior forest and a further changed landscape across the Interior West.

"The Interior West supports one of the biodiversity hot spots of at-risk species," says research ecologist Curt Flather. Figure 3 shows the concentration of at-risk species by county throughout the country based on NatureServe rankings, demonstrating the clear need for an emphasis on at-risk species in the Intermountain West. "So how we manage public lands and National Forest System lands in particular will have an important impact on maintaining the persistence of those species in the biota." Further, the studies on the rapid housing growth in the Rocky Mountain region indicate that policies and management to buffer ecosystems from the expanding footprint of human development could help protect these species.

Birds are considered good indicators of landscape change due to the sensitivity of both abundance and diversity of bird species in an area as habitat changes. Over the long-term, most bird species in the Intermountain West have shown stable or increasing populations. Unlike woodland breeding species which saw only 16% of the species with declining trends, nearly 1/3 of all grassland species showed evidence of declines since the mid-1960s. "Those grassland systems are inherently more disturbed by human land use conversion than are forested systems in this region," adds Curt Flather. "Given that the Interior West has the highest amount of National Grasslands, there is a real opportunity for managers to contribute to conserving not just bird populations, but the rich variety of wildlife in this region."

NOTHING BUT THE WATER

The Southwest is forecast to have the most severe impacts from climate change, through both an increase in temperature and a decrease in precipitation. In addition, there is the human side of the equation—related to the demand for these water resources. "The water assessment really was all about the combined effects of changing population and climate stressors," remarks economist Tom Brown. "At the same time as population growth will increase the total demand for and consumptive use of water, climate change is likely to reduce available water supplies. In the Interior West, where water is already scarce and often transported across long distances to be used, these effects will be profound."

After water falls to the earth as precipitation, a certain amount of it returns to the atmosphere through the process of evapotranspiration. Temperature drives this process, with higher temperatures creating greater evapotranspiration. The water that remains after this evapotranspiration is

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called water yield, which forms the supply side of the water vulnerability equation. "Both population increase and climate change will increase water demands. Climate change will also decrease water yield and therefore water supply, especially in parts of the Interior West" says Tom Brown. "The combination of these two changes, increasing demand and decreasing supply, will lead to increasing water shortages, especially in the Southwest."

The 2010 RPA Assessment evaluates water vulnerability, or the possibility of water shortage, across 98 assessment subregions (ASRs) in the country by totaling all the reservoir storage, water supply, and demand within each ASR. Rather than looking at counties, the borders of the ASRs are defined by river systems and watersheds. About 80% of the ASRs in the Interior West are already considered vulnerable. Future projected conditions will push this percentage higher and increase the vulnerability of these areas to water shortages.

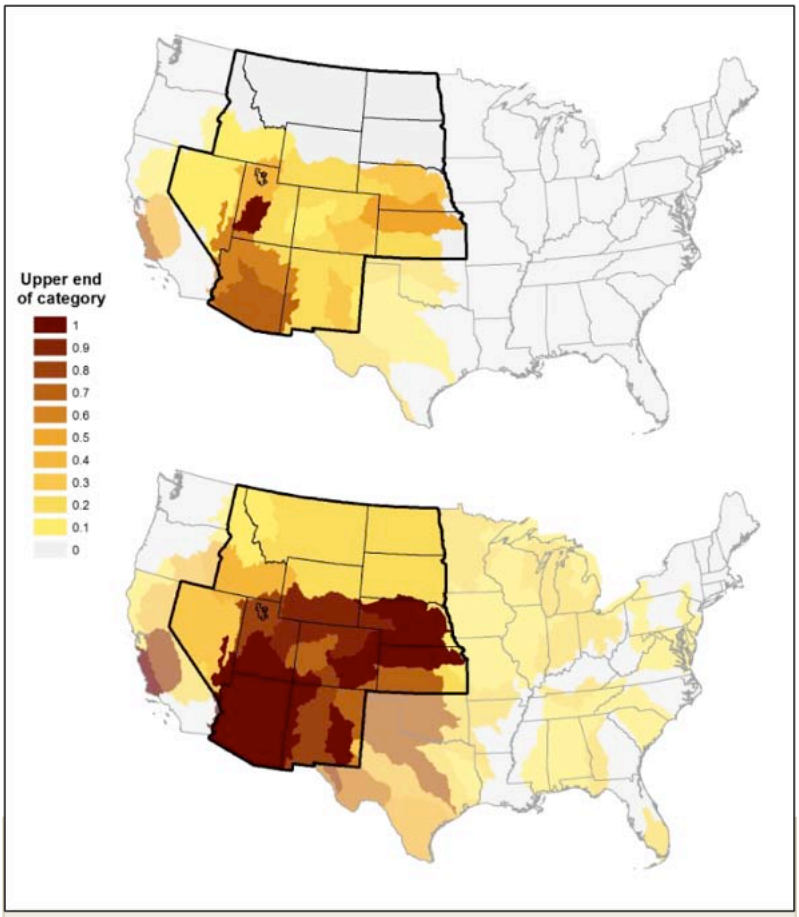

Figure 4. Composite maps of minimum (top) and maximum (bottom) water supply vulnerability (probability of shortage) in 2060 by Assessment Subregion (ASR) across nine alternative futures. The highest levels of vulnerability are projected to occur in the Southwest and central Great Plains, but as demonstrated by the spread between the minimums and maximums; in many ASRs the level of vulnerability to be addressed remains quite uncertain.

In the face of increased water vulnerability, especially in the Southwest, land managers and communities will be faced with daunting challenges. "What we have done is project what happens if we don't do major things to adapt," notes Tom Brown. One adaptation action related to water shortages that is already occurring is an increase in water-use efficiency for domestic and industrial use and for irrigated agriculture. While the RPA Assessment projects continued increases in efficiencies and conservation on a per-capita or per-acre basis, these advancements will only be able to ameliorate the effects of the population growth in the region as aggregate demand for water continues to rise. Greater demand for scarce water resources will also drive up its price per unit. Higher prices may incentivize the sale of the rights to water that would have historically been used for agriculture to thirsty cities that are willing to place higher bids on the resource. That shift of water-use patterns, along with land-use change from expanding suburban development, is projected to result in a decrease in irrigated agricultural lands in the region from 46 million acres to 42 million acres. With increasing urban water use as the driver, the decrease in irrigated lands is a reaction to increased population and water supply vulnerability that shifts water from one sector to another, rather than a planned adaptation to the changing climate.

Another challenge for adaptation measures regarding water vulnerability in the Southwest is that additions to the storage capacities of large downstream reservoirs will not solve the problem. The ASRs along the Colorado River including Lake Powell and Lake Mead, for example, are projected—in the absence of major adaptations—to drop to storage levels of zero and never fully recover. "If they are projected to go dry, making large

Increased water vulnerability in the Interior West may create a demand for more reservoirs further upstream where water is still relatively abundant—at higher elevations with cooler temperatures. These higher elevation sites are more likely to exist within the borders of National Forests. Photo credit: RMRS Library.

reservoirs bigger won't really help," says Tom Brown. "That doesn't mean that in specific locations in the ASRs, typically upstream, that building smaller reservoirs wouldn't help meet more local needs." Potential sites for new reservoirs or diversions would occur where water is still relatively more abundant—at higher elevations with cooler temperatures and therefore less evaporation of stored water. These higher elevation sites are more likely to exist within the borders of National Forests. These water projects would then decrease the in-stream flow available for other uses downstream, creating tradeoffs between management priorities that must be balanced in deciding permits and selecting locations.

Decreased in-stream flow will also combine with higher water temperatures from climate change to worsen the habitat available to fish and other aquatic species. "Concentrations of at-risk aquatic species often correspond with some of the most water vulnerable areas in the arid Southwest," according to research ecologist Curt Flather. "This sets up a potential conflict between an increasing need for water for human use that directly conflicts with the need to keep the in-stream flows that support imperiled species."

In fact, as the RPA Assessment reports, taxonomic groups associated with aquatic habitats have higher proportions of imperiled species than other taxonomic groups. Nationwide, 41% of amphibians, 37% of freshwater fishes, 58% of mollusks, and 53% of crustaceans are of conservation concern. Figure 5 shows the distribution of at-risk species associated with aquatic habitats, with emphasis on the Interior West.

While the RPA Assessment does not include direct recommendations, managers may be able to use the

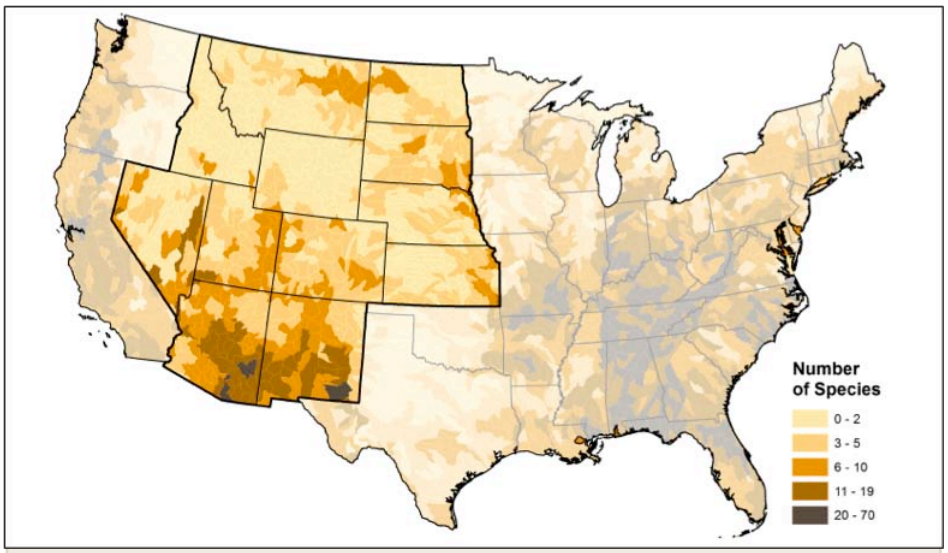

Figure 5. The geographic distribution of species associated with aquatic habitats (at the eight digit hydrologic unit level) that are assessed to be at-risk of extinction (G1 – critically imperiled, G2 – imperiled, G3 – vulnerable), 2010.

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implications of the RPA Assessment's findings to draw reasonable inferences about decisions and tradeoffs they may need to consider. Because such a large proportion of the freshwater resources in the Interior West originates on public lands, managers may find that planning and management for water resources vis-à-vis multiple uses increasingly involves considerations around threatened and imperiled aquatic species. For example, managers may have to consider the cumulative ecological impacts of new reservoirs, the projections for water yield in the geographic area, and the pressures of demand from growing populations when evaluating new water projects for planning and approval on public lands.

RE-CREATE YOUR RECREATION

A changing climate will also shake up recreation on public lands. Increased temperatures will result in shorter seasons for snow-based recreation, and decreased water levels in reservoirs and in-stream flows in rivers will lessen the potential for water-based recreation and also negatively affect the quality of recreation experiences. These influences could reduce recreation participation. Demographic shifts and technological advancements will also alter people's selection of recreation opportunities. Wildlife hunting participation rates have consistently declined across the US and the Interior West, although this region remains a stronghold of hunting participation, particularly for big game hunting. Wildlife viewing has also declined but has proven more stable than hunting participation, with nearly four times as many participants in the Interior West than hunting. The only snow-based recreation not to show a recent decline in participation days is snowboarding, an activity favored by a younger audience. Technological advances have also contributed to increased participation in kayaking, rafting, and canoeing over the past decade. New sturdier and lightweight boats have expanded the possibilities for paddlers taking on flat-water lakes and whitewater rivers, although these possibilities may be stymied by lower water levels in the future.

As the population grows, the total number of participants in outdoor recreation is also projected to increase over the next 50 years. These wilderness-seekers, backpackers anglers, boaters, hunters, and day-hikers may turn to public lands to find recreation opportunities. Although the number of participants is projected to increase, the base of public land in the country will most likely remain relatively fixed. In the Interior West, the large amount of expansive public lands can help absorb many potential impacts from greater use. However, projected development pressure around public lands in the front ranges and foothills of the Interior West and in the arid Southwest would generate more concentrated use on public lands near those areas. Public land managers will be challenged to maintain facilities and infrastructure to meet increasing demands. However, the proximity of these urban residents to public lands presents opportunities to connect people with nature and also provide opportunities to enhance physical fitness. The dual interest in improving the populace's connection with nature and in improving physical fitness might present new research and management opportunities.

URBAN OUTFITTERS

As more people migrate to the cities of the Interior West, urban areas will play a more prominent role in supplying ecosystem services. People expect certain natural amenities in the region, such as fresh air and high-quality clean water, and as development pressure expands into areas that have historically provided these benefits, urban planners will need to develop innovative plans to ensure their continued provision. However, as already large cities get larger, tree canopy cover may not keep up with urban expansion, and percent urban tree cover may decline.

The amount of tree canopy cover in urban areas tends to be greatest in the eastern United States. In the Interior West, the availability of water often limits the amount of tree canopy cover possible in urban areas. However, in some areas of the Interior West—and in grassland areas in particular—urban expansion often leads to an increase in urban tree canopy, as trees in these areas are intentionally planted and watered.

Planting drought-tolerant trees may help to sequester carbon and provide additional ecosystem services in urban areas of the Interior West. Photo credit: iStockphoto.com/Scott Leigh.

In fact, canopy cover is an important indicator of ecosystem services in urban areas. In a city, trees provide aesthetic ecosystem services by improving the quality of life of residents. They also provide provisioning ecosystem services including clean air, especially valuable in congested areas. Urban forests also provide the regulating ecosystem service of carbon storage. However, urban forests also face multiple management challenges—insects and disease, ice storms and wind, air pollution, and changes in temperature and precipitation patterns related to climate change all potentially threaten urban forests. Monitoring the health of urban forests will be important to track these changes and plan for the future. How people manage urban forests will determine not only the local conditions of cities but also influence the global system—managing for urban forest resilience can contribute to climate change adaptation in communities throughout the Interior West.

A NEW FRONTIER

Insight from the RPA Assessment will help managers both understand the history of forests throughout the Interior West and anticipate where they may be headed. Throughout the primary document and the many supporting technical documents, the RPA Assessment provides more scientific information on natural resource trends in richer detail. Its framework allows managers to explore analysis by topic area or region, giving them the tools they need to effectively plan for the future. In fact, the RPA Assessment is one of the resources that should be considered in the assessment phase of the 2012 Planning Rule for the National Forest System.

Several challenges and opportunities emerge in the RPA Assessment that have specific relevance to the Interior West. While the region will bear the brunt of water vulnerability issues over the next 50 years, one opportunity to address this difficulty is to improve water use efficiency across the board from domestic use to irrigated agriculture. Doing so may require a reexamination of western water law, a complex and thorny topic; however, innovative and emerging options such as water leasing schemes, if adopted by policymakers, may provide some opportunities to improve efficiency. Another option is to establish water pricing structures which encourage conservation in areas with high vulnerability. Finally, managers can engage local water utilities and communities in partnerships to help develop and fund water supply projects on National Forests and other public lands. Tom Brown notes that "public lands will continue to provide most of the water and the highest quality water." Partnerships can help facilitate watershed-health projects necessary to maintain this important ecosystem service.

Regarding the challenge of protecting habitat in the face of an ever-expanding population, collaborative efforts can help maintain the populations of at-risk species. Managers may draw from the scientific information presented in the Assessment to develop potential options for habitat conservation. Such ideas

"Although many of the trends are humbling and even overwhelming, understanding their causes and possible remedies can give us cautious confidence to take action, experiment, and innovate," notes Cleaves.

might include conservation easements, exploring market-based instruments to reward landowners for biodiversity protection, developing resource certifications that include biodiversity conservation standards, and training both public managers and private landowners in best management practices for forestry and water quality standards.

Many of the changes facing the Interior West over the next 50 years are already underway. The RPA Assessment gives projections and detailed analyses of many of these changes. While land and resource managers may lament the fact that they lack a "crystal ball" to see into the future, they may find comfort in the fact that the RPA Assessment can provide a valuable tool with which to understand how the factors of climate change, population growth, and economic growth may influence US forest and rangeland resources in the decades to come. Climate Change Advisor Dr. Dave Cleaves notes that "although many of the trends are humbling and even overwhelming, understanding their causes and possible remedies can give us cautious confidence to take action, experiment, and innovate." It is the hope of Linda Joyce and the other RPA team members that the RPA Assessment might be a tool that is used to inform the development of plans and policies that facilitate effective adaptation in the face of a changing climate.

KEY FINDINGS

- The Interior West region is projected to see the highest rate of population growth and the highest rate of urban area growth from now until 2060; this will reduce areas of forests and rangeland, particularly near the urban growth areas of Phoenix, Denver, and Las Vegas.
- Preferences for natural amenities are likely to change with future demographic trends while climate change will affect the availability of and participation in recreation opportunities.
- Expansion of the human footprint is occurring over the same geographic areas of the Interior West that support particularly high concentrations of imperiled species.
- Water supply in the Southwest is currently vulnerable. Over the next 50 years, that vulnerability increases as a function of both socioeconomic changes that increase the demand for water and climate change that results in lower water yield.
- Climate change will alter natural ecosystems and affect their ability to provide goods and services within the Interior West. Climate change influences forest growth, wildlife habitat, and participation in various recreation activities.

FURTHER READING

A limited selection of further reading is captured below. Please refer to the RPA website for a more comprehensive list; the website features the latest assessment and all supporting documents: http://www.fs.fed.us/research/rpa/

Bowker, J.M., A. E. Askew, H.K. Cordell, C.J. Betz, S.J. Zarnoch, L. Seymour. 2012. Outdoor Recreation Participation in the United States. – Projections to 2060: A technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-160. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 36 p.

Cordell, H. Ken. 2012. Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station, 167 p.

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Foti, Romano; Ramirez, Jorge A.; Brown, Thomas C. 2012. Vulnerability of U.S. water supply to shortage: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. RMRS-GTR-295. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 147 p.

Loftus, Andrew J.; Flather, Curtis H. 2012. Fish and other aquatic resource trends in the United States: A technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. RMRS-GTR-283. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 81 p.

Mockrin, Miranda H.; Aiken, Richard A.; Flather, Curtis H. 2012. Wildlife-associated recreation trends in the United States: A technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. RMRS-GTR-293. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 34 p.

Reeves, Matthew Clark; Mitchell, John E. 2012. A synoptic review of U.S. rangelands: a technical document supporting the Forest Service 2010 RPA Assessment. Gen. Tech. Rep. RMRS-GTR-288. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 128 p.

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U.S. Department of Agriculture, Forest Service. 2012b. Future of America's Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment. Gen. Tech. Rep. WO-87. Washington, DC. 198 p.

MANAGEMENT IMPLICATIONS

- Areas within the Interior West most likely to experience population gains can use this information in planning infrastructure for the new residents and in designing policies to manage land and water resources in an environmentally sustainable manner.
- Public land will serve a growing role in the conservation of imperiled species, as habitat on privately owned land becomes more fragmented and faces increasing development pressure.
- Public land managers are likely to face compounding pressure to meet multiple resource demands from a more heavily impacted public land base.
- Challenges for urban managers include maximizing the ecosystem services from a small natural resource base within the urban area and sustaining ecosystems services from a diminishing base outside the urban zone.

ACKNOWLEDGEMENTS

The Resources Planning Act (RPA) Assessment is the product of a program of research carried out by a team of Forest Service scientists. Richard Guldin, Linda Langner, and Margaret Connelly, in the USFS Washington Office, Research & Development, manage this research. Scientists from various research stations have taken lead roles in conducting assessment research. The full list of these scientists, their affiliation, and their respective lead subject area, is listed below:

- **J. Michael Bowker,** Southern Research Station, Outdoor Recreation
- **Thomas C. Brown,** Rocky Mountain Research Station, Water
- **H. Ken Cordell,** Southern Research Station, Outdoor Recreation and Wilderness
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