PNW
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Research Station

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FINDINGS

INSIDE

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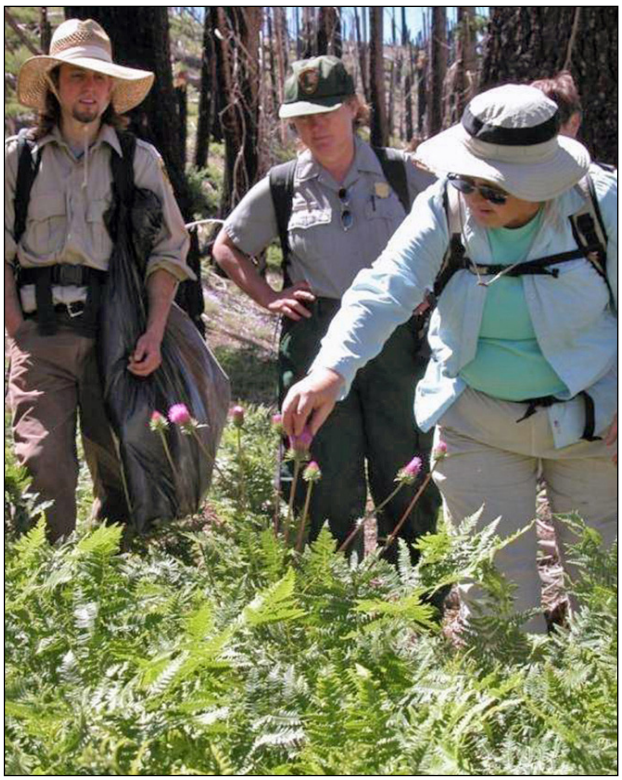
"Science affects the way we think together."
Lewis Thomas

Adaptation: Planning for Climate Change and Its Effects on Federal Lands

"As the climate continues to change—and in most mainstream scientific studies, change is expected to accelerate substantially during the twenty-first century—we can expect natural systems to become highly stressed."
—Stephen H. Schneider



National Park Service

Early detection—rapid response focuses on identifying and treating invasive species before they gain a foothold on the landscape. It is one method for improving the resilience of native vegetation to climate changes by removing competition from invasive weeds.

Arguments about the reality and causes of global climate change began to take center stage in the media in the late 1980s. Meanwhile, U.S. Forest Service scientists and university researchers documented the effects of climate change in many ecosystems. Their efforts, combined with findings from other scientists around the world, have documented that the Earth's weather patterns are changing and that this phenomenon is affecting ecosystem function in our national forests and parks.

Recent warming trends already are playing a role in heat waves, increased area burned by wildfire, increased insect outbreaks, increased flooding, proliferation of invasive plants, and reduced snowpack. And if climate change models are accurate, things are just getting started.

In July 2010, Forest Service Chief Thomas Tidwell directed all national forests and grasslands to consider climate change in management. Each management unit is required to report its progress using a 10-point *Climate Change Performance Scorecard* that addresses organizational capacity, engagement, adaptation, and mitigation. At least seven of the 10 items on the scorecard must be completed by 2015, and thereafter units will report yearly on their progress.

At first glance, such a bold step may seem like a tall order, given the broad scope and unpredictability of climate change. Land managers already deal with the stress of

IN SUMMARY

National forest managers are charged with tackling the effects of climate change on the natural resources under their care. The Forest Service National Roadmap for Responding to Climate Change *and the* Climate Change Performance Scorecard *require managers to make significant progress in addressing climate change by 2015.*

To help land managers meet this challenge, Forest Service scientists conducted three case studies on national forests and adjacent national parks and documented a wide range of scientific issues and solutions. They summarized the scientific foundation for climate change adaptation and made the information accessible to land managers by creating a climate change adaptation guidebook and web portal. Case study teams discovered that collaboration among scientists and land managers is crucial to adaptation planning, as are management plans targeted to the particular ecosystem conditions and management priorities of each region.

Many current management practices are consistent with climate change adaptation goals. Because timely implementation is critical, strategies are in development at the national level to speed the implementation of science-based climate change adaptation processes in national forests throughout the country.

tackling substantial natural resource issues with reduced staffing. Juggling these daily demands, while keeping up with the latest climate change scientific findings and trying to interpret how the findings apply to specific landscapes under their charge, is a daunting task.

Fortunately, keeping all the balls in the air at once may be easier than it looks.

David Peterson, a research biologist with the Pacific Northwest (PNW) Research Station, has spent the past few years spearheading climate change communication efforts within the Forest Service, helping managers put scientific findings into perspective as they apply to individual ecosystems. He and his colleagues have produced key reports that address climate change vulnerability assessment and adaptation planning in national forests. Their contributions include a guidebook, several case studies, short courses, and a Web portal that makes the available science easily accessible. Collectively, these tools systematize a process for conducting vulnerability assessments across large landscapes and are meant to lead land managers through a process to quickly and accurately make decisions related to resource priorities and adaptation options.

KEY FINDINGS

- Adaptation to climate change can be accomplished with minimal impact on national forest staff.
- Adaptation is a critical component of sustainable resource management because climate change will alter ecological systems and ecosystem services.
- Addressing climate change is inherently place-based.

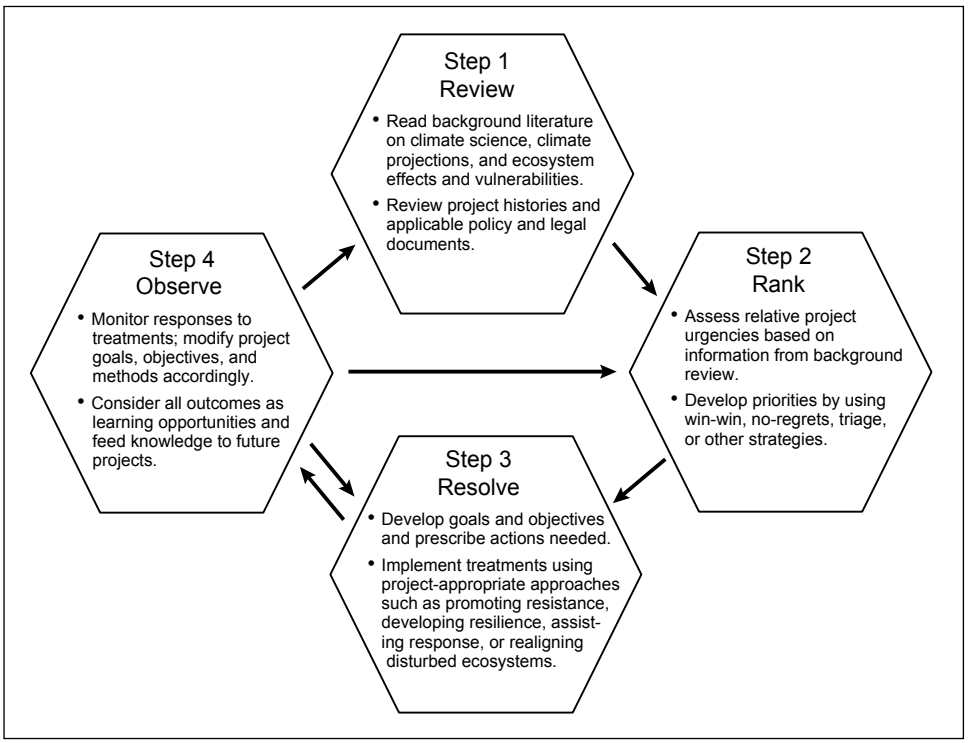
PLANNING FOR UNCERTAINTY

Preparing science-based management plans that address observed and projected changes in climate (long term) and weather (short term) patterns will vary among management units. Plans must account for the unique aspects of each ecosystem and its management priorities. "What's important and the strategies you would use, in a place like Olympic National Forest, which is in a very wet corner of the world, are different from what you would do in the drier Deschutes National Forest on the east side of Oregon," says Peterson.

For that reason, the Forest Service began the task of codifying climate change preparedness by establishing three case studies in climatically diverse regions of the United States. "We just wanted to see what would work," says Peterson. "How do we put this kind of scientific conceptual notion about climate change on the ground so that land managers can incorporate it into their normal management practices?"

After synthesizing input from several pioneering work groups, Peterson and his colleagues recommended an adaptation sequence that involves educating staff, assessing resource vulnerability, and developing and implementing adaptation options. The education component ensures that all national forest management personnel understand the basics of climate change. Once that knowledge base has been established, each unit is expected to assess various natural resources, such as water, wildlife, and vegetation, to determine each resource's vulnerability to changing weather patterns.

"The main objective is to get science in the hands of managers so that they have the basic information but also have access to the documentation they need to do their jobs," says Peterson. "There's always going to be uncertainty, just like there is for any topic. But we've got more than 20 years of climate change science behind us, and we have enough information to move forward."



Steps for developing and implementing climate adaptation options.

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USDA United States Department of Agriculture

Forest Service

Using the information gleaned from the vulnerability assessment, management teams develop adaptation options to address the natural resources under their care. The collaborative process enables work groups to frame larger initiatives—improving ecosystem resiliency to fire damage, for example—in terms of specific actions. "For instance, if we anticipate that climate change is going to cause a longer fire season and more severe fires, we may want to accelerate our fuel treatments to try to mitigate that severity, or we may want to expand our treatments across a broader landscape," says Peterson.

The good news for managers is that implementation may not be as onerous as it appears at first glance. Michael Furniss, a hydrologist with the PNW Research Station, worked with Peterson to develop the climate change guidebook and Web site for the Forest Service. He points out that although climate change "raises the stakes and the stressors on everything," adding it to the management equation doesn't require completely rewriting the management plan or creating something totally new. "What's new is figuring out the places that are vulnerable and deciding on which techniques to use," he says.

Tahoe National Forest

Thinning and other fuel reduction treatments increase the vigor of the remaining trees, thus making them more resilient to low soil moisture, insects, and fungal pathogens.

Peterson agrees. "I think at least 80 percent of what we currently do is already compatible with adapting to climate change," he says. "If we are doing sustainable resource management, if we're managing for the continued production and flow of resources and the ecosystem services that people want from federal lands, we're probably already doing most of what is necessary to adapt to climate change."

A CASE STUDY ON THE OLYMPIC PENINSULA

Climate ignores human-made boundaries. Adjacent lands usually face similar weather-related issues, which is why the three pilot studies paired a national forest with a neighboring landscape managed by the National Park Service. The studies paired Shoshone National Forest with Yellowstone National Park in Wyoming, Inyo National Forest with Devils Postpile National Monument in California, and Olympic National Forest with Olympic National Park in Washington state.

The first study was launched in the Olympic region, where Peterson worked closely with Jessica Halofsky, a research ecologist with the University of Washington, and other scientists. They started 4 years ago by inviting scientists from various disciplines, such as water resources, fisheries, and forest ecology, to participate in eight different workshops as a first step toward educating forest and park personnel about climate change issues. "I think the audience was in kind of a 'wait and see' mode—maybe even a little bit skeptical—but they became very engaged with it," says Peterson about the first workshops. "The workshops included lots of dialog to make sure we were not only getting the information correct, but providing it in a format that was useful to them."

Over the next 2 years, scientists and managers worked together to develop a plan of action for the Olympic region. Not surprisingly,

Olympic National Forest

Fall and winter flooding has increased in western Washington over the past decade. Culvert capacity can be quickly exceeded during these events, leading to road failures and heavy erosion.

establishing these communication links became the foundation for the Olympic study's success; this proved true in the other studies as well. "We have not found a better system than the science-management partnership," says Peterson.

Although the scientists took the lead on conducting the vulnerability assessments in the Olympic study, land managers led the charge when the team was developing the adaptation options. "It wasn't the scientists telling the land managers what to do; it was the scientists asking them 'what would you do?'" says Peterson. "We found that if we asked questions and presented them with future scenarios, they could quickly assess the issue and then find solutions and options. I was impressed at how effectively that process worked."

Halofsky says the workshops helped reduce the sense of helplessness many managers felt when faced with climate change. "I think this process got them past the point of 'we can't do anything about this.' It helped them to realize that they know a lot about their systems and if they know a little bit about climate impacts, they can come up with proactive ways to limit the negative impacts of climate change," she says.

Kathy O'Halloran

The Olympic National Forest is promoting resilience to heavy rains, erosion, and runoff by reinforcing roads at stream crossings.

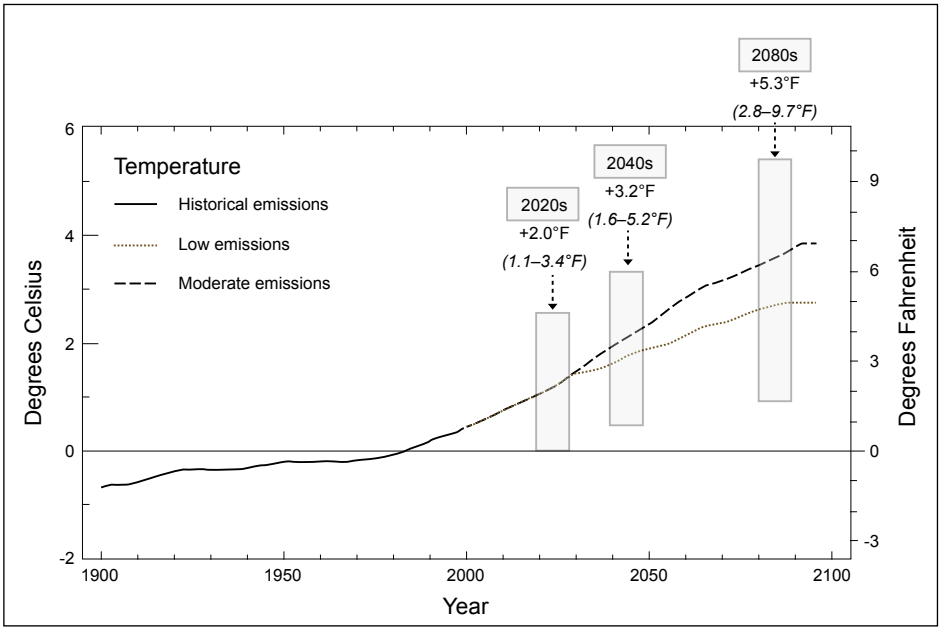
One outcome of the Olympic study included taking measures to address increased flooding and the effect it will continue to have on infrastructure and fish habitat. "Over the last decade, west-side Washington in general has had a tremendous amount of flooding," says Peterson. "We're having more rain and less snow, which means that the fall-winter floods tend to be higher and the summer flows of the rivers tend to be lower. The fall flooding is a negative thing for roads and infrastructure, and the lower flows in summer are typically a negative thing for fisheries. We anticipate that this will only get worse in the future—probably much worse in some cases—if snowpack continues to decline." Adaptation strategies for these issues include increasing culvert size to handle the larger flows and decommissioning certain streamside roads.

STEP ONE: EDUCATION

After synthesizing the learning from each of the pilot studies, Peterson, Furniss, Halofsky, and their colleagues wrote an adaptation guidebook to help national forest personnel integrate science-based climate change measures into their management plans. Peterson describes the guidebook as a "toolkit" rather than a prescription that can be applied universally throughout the Forest Service. "I'll admit, I went into this with the idea that we would develop a template and then we could apply this template everywhere, but that was a mistake—each place has its own context," he says. However, certain processes consistently produced good results in all three studies, and these processes are detailed in the guidebook.

Furniss took the lead on creating the Climate Change Resource Center, a Web portal at www.fs.fed.us/ccrc/ that gives federal land managers access to everything from a primer on climate change basics to carefully selected, peer-reviewed summaries of specific subjects. "We wanted to have a place where they could find information that was accessible to those who make decisions and conduct land management across the federal agencies," says Peterson. The Web site was launched in 2008 and attracts about 2,000 users each week from all over the world, although most users are based in the United States.

The Web site includes easily accessible, original content targeted to users who manage federal lands. Included are peer-reviewed video presentations by leading scientists that were carefully developed into short courses on various topics. New content is continually in the development process. "We've just started scratching the surface," says Furniss.



UW Climate Impacts Group

Projected temperature change for the Pacific Northwest based global climate models. The black curve is the weighted average of all models during the 20th century. The dotted and dashed curves are the weighted average of all models assuming a low emissions scenario or a moderate emissions scenario for the 21st century. The bars indicate the potential range of projected temperatures. All changes are relative to 1970–1999 averages.

A SENSE OF URGENCY

Peterson and Furniss expressed a sense of urgency in addressing the issues surrounding climate change. For example, in summer 2012, the East Coast and the Midwest dealt with weeks of triple-digit temperatures. By the end of August, about 55 percent of the contiguous Unites States had experienced moderate to severe drought, the National Climatic Data Center reported.

The 2012 Colorado fire season had devastating effects with hundreds of people losing their homes. Smoke from wildfires in eastern Washington produced such hazardous air conditions, county health departments and the Red Cross distributed thousands of respirators to residents. "The projected increase in fires is pretty scary and will make a big difference for the Forest Service," says Furniss. "We're looking at maybe two or three times as much area burned by mid-century—and the same with insect infestation."

About 160 national forests have yet to go through the process that the three pilot study teams have completed, which has Peterson and his colleagues wondering how they can hasten the adaptation planning process. "That's the discussion now at the national level: how can we accelerate the pace of implementing adaptation across the entire country?" he says.

LAND MANAGEMENT IMPLICATIONS

- Principles and processes included in the guidebook *Responding to Climate Change in National Forests* provide land managers with the tools they need to follow the *Forest Service National Roadmap for Responding to Climate Change* and complete most of the target actions on the national *Climate Change Performance Scorecard* by 2015.
- Processes were developed for addressing climate change with active collaboration among scientists, land managers, adjacent landowners, and other stakeholders. Scientists led the education and vulnerability assessment steps, and land managers led the development of adaptation options across large landscapes.
- Managing national forests within the context of climate change can be done by continuing the practice of sustainable resource management and including climate change among existing management considerations.

Because education is the first step, managers can begin the process any time by taking advantage of the foundation laid by Peterson and his team. "The most important thing is just having the employees go through the process, do these workshops, and incorporate this in their thinking," says Peterson. "Twenty-five years ago, we had this new thing called 'ecosystem management.' It was considered crazy. Now it's just how we do business. It's hard to express how big of a change that was, and that was a much bigger transformation than what is needed now with climate change."

"All is connected … no one thing can change by itself."
—Paul Hawken

FOR FURTHER READING

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MICHAEL J. FURNISS is a hydrologist with the Pacific Northwest Research Station and is based in Arcata, California. He leads a team of 18 scientists and specialists in a pilot project in which national forests across the United States have assessed the vulnerability of water and watershed resources to climate change. He has consulted and given lectures on climate change adaptation throughout the world and is a member of the Joint U.S.-Vietnam Climate Change Working Group. Software and technologies he developed to improve fish passage and low-impact transportation in forest wildland management have been applied worldwide.

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