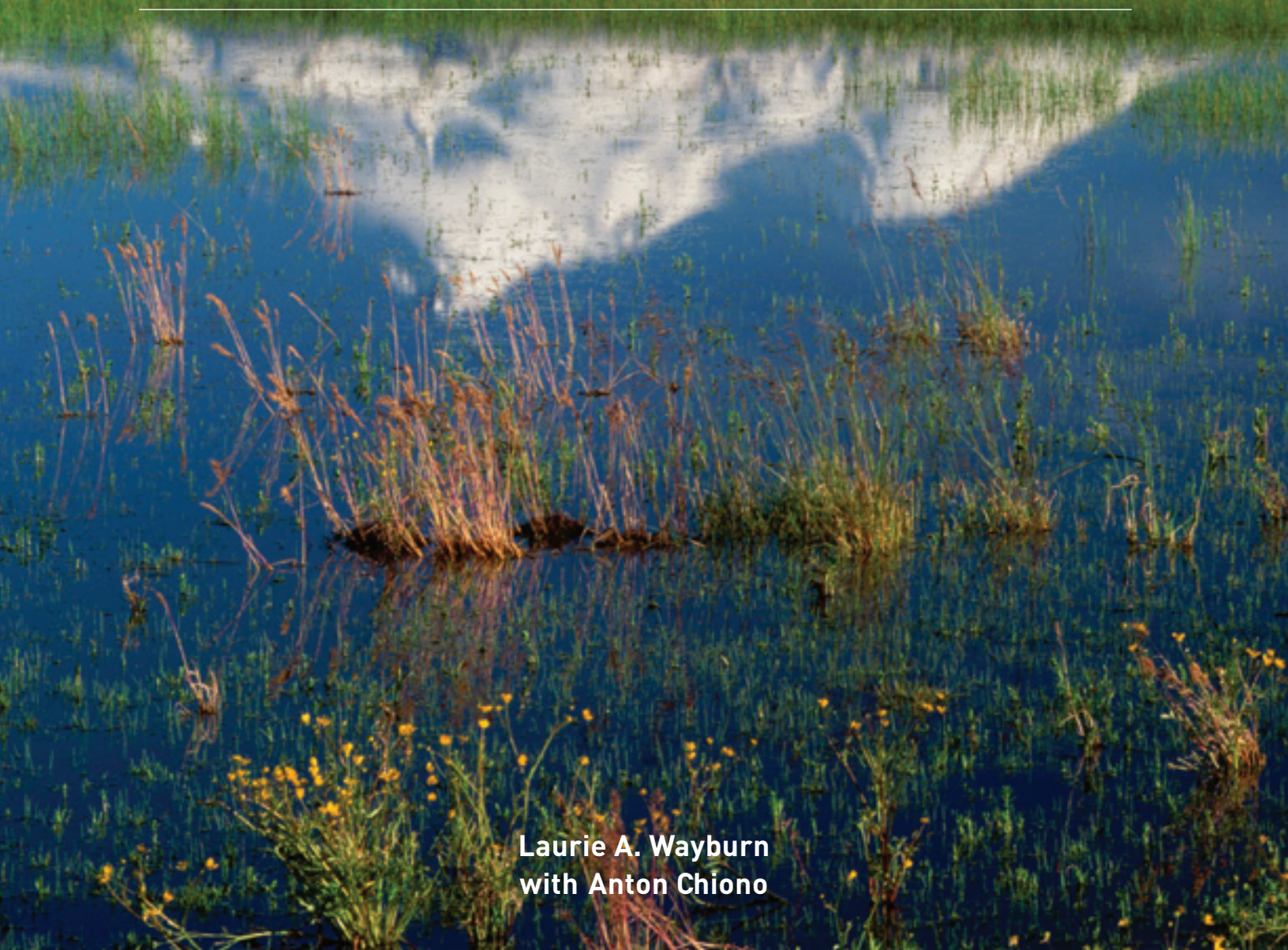




THE KLAMATH-CASCADE: CALIFORNIA'S WATERSHED IN THE BALANCE



Laurie A. Wayburn
with Anton Chiono

INTRODUCTION

SUSTAINING CALIFORNIA'S WATER SUPPLY

Ensuring the future of the Klamath-Cascade forest watersheds to sustain a vital, rich, and resilient economy, ecology and people.

Mounts Shasta and Lassen are iconic, defining features of California, towering skyward from one of the state's most productive and beautiful regions: the Klamath-Cascade. Spanning almost 10 million acres, this is amongst California's most valuable natural resource regions. Klamath-Cascade forests provide the vast majority of the state's water. They are also the most diverse conifer forests globally and form California's historic "timber-basket."

Now, the Region is at a crossroads. Global competition, sprawling development, and a depressed economy have the Region's traditional, timber-based communities struggling to survive. By proxy, that timber economy paid for keeping a working forest landscape with all its resources intact, from water to wildlife to recreation. Effective from the 1850s through most of the 1900s, this proxy approach is no longer sufficient in the 21st century. With its cities growing from 300-600% in the last 2 ½ decades, the Region's vital forest infrastructure is fragmenting and under attack. A new resource economy is needed to secure this broad base of forest services—water, timber, wood-based renewable energy, recreation, and climate stabilization—that all Californians rely on.

Ruggedly beautiful, globally renowned, essential to the state's vibrant economy and highly threatened—the future of the Klamath-Cascade is in our hands.





FOREST

The Klamath-Cascade landscape is the most productive, diverse conifer forest on earth. **pg 9**



WATER

From mountain tops to farms and taps, the Region's watersheds serve millions of Californians. **pg 14**



BIOLOGICAL DIVERSITY

Globally outstanding, this mosaic of different habitat types supports more than 600 species. **pg 19**



CLIMATE CHANGE

Vast carbon stores and growing glaciers are increasingly important with climate change. **pg 24**



PEOPLE

Those who depend on this Region for life and livelihood are in a position to shape its future. **pg 27**

EXECUTIVE SUMMARY

A LANDSCAPE AT THE CROSSROADS

A hidden treasure, the Klamath-Cascade is the primary source of California's most critical natural resource: water.

Most Californians don't realize this region provides the vast majority of the state's water. But it does, and this role will be increasingly important with climate change.

The Klamath-Cascade is ruggedly beautiful, resource-rich, globally renowned for outdoor recreation, and still relatively low in population. Such places often are loved to death or driven to steep declines as resources are depleted, commodity markets shift, and unplanned sprawl destroys the very fount of their wealth and culture. Already, the Klamath-Cascade is being pressured by some of the Region's fastest growing communities in Redding, Ashland and Reno. Signs of this are evident with significant growth in ranchettes and sprawl. The Klamath-Cascade's fiercely independent rural culture is caught within a web of urban influences, remote federal politics, and global economies.

But the people who live in and love "the KC" have the opportunity to chart a different path. The full value and potential of its natural resources are just beginning to emerge. A vibrant alternative future is emerging, built on a forest economy as diversified as the Region's resources and people, grounded in conserving the Region's natural infrastructure, and focused on producing the broad suite of goods and services it naturally provides.

During the 1800s and 1900s, a "gold rush" on the Region's forests depleted its tremendous wealth of grand old growth. In the 21st century, we recognize a more essential liquid gold pouring from the woods: water. The Klamath-Cascade is the "top of the tap"

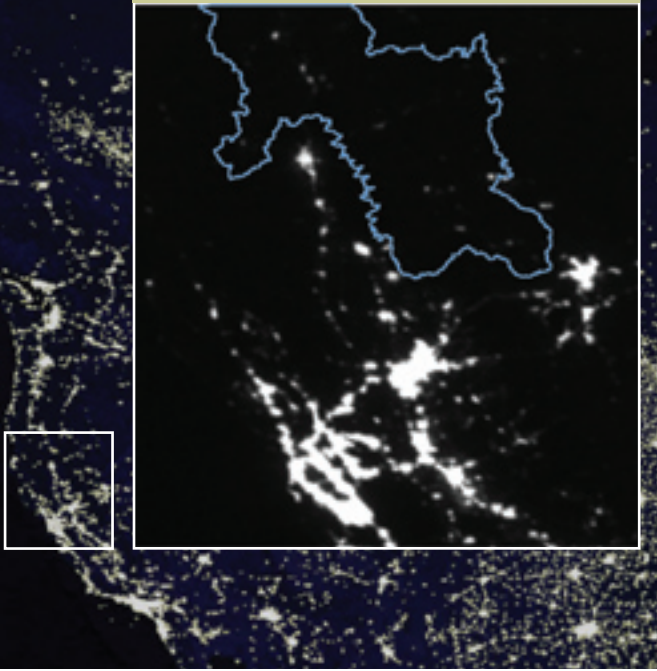
for California's water supply. These forest watersheds collect, store, clean and transport more water than anywhere else in the state. With climate change, this region's watersheds are predicted to accumulate even more snow pack, essential for the state's summer water. Mount Shasta's glaciers are growing, unlike those of the Sierra. Conservation, restoration and sustainable management of the Region's forested watersheds are essential to the state's continued water supply and its economic vitality.

Water from this region underwrites a \$37 billion dollar agricultural economy annually — almost a third of the state's total. The Klamath-Cascade also supplies drinking water to almost 25 million Californians. Water demand is expected to increase by a whopping 33% over the next 20 years. Having to replace water from the Klamath-Cascade, were it to decline, would be exorbitantly expensive.



(Right) Redding, the Region's principal city, has grown over 600% since the 1970s, now covering over 345 square miles. (Photo by USDA, 2005)

Klamath-Cascade Region



Though encircled by development and threatened with increasing fragmentation, the 10 million acre Klamath-Cascade Region still remains relatively intact. This “lights at night” image illustrates the development pressures encroaching on the Region: Reno to the east; Interstate 5 bisecting the center; the San Francisco/Sacramento axis to the south; and Ashland to the north. However, with willing partners, we now have a historic opportunity for landscape-level conservation in this globally recognized Region so essential to California’s water supply. (Photo by NASA, 2001)

Policies from the 19th and 20th centuries promoted timber production and the forest products industry, and a number of state and federal policies continue to do so. Yet, though water supplies are certainly as important as timber for the state, there are no focused policies to ensure the Region’s continued watershed health. Policies promoting timber production alone are insufficient to prevent conversion of this land for development—a primary cause of watershed degradation—or to ensure high quality watershed function. In fact, these forests have become increasingly fragmented and degraded over the past 50 years, even as water has become more valuable.

The historic economic model won’t support 21st century economies *or* watersheds. Policies for the past, more rural, less populous world cannot be relied upon to provide for the needs of our urbanized and globalized society. Existing policies and incentives are not aligned with maintaining and restoring California’s forest watersheds. But they need to be.

Watershed integrity declines if less than 85% of it is forested. What must we do to hedge against this risk of watershed degradation? Establish policy to conserve and restore watersheds. Working with

willing partners—landowners and federal agencies—to conserve and restore well-managed forests, we could eliminate this risk to the Klamath-Cascade watershed. What would it cost? In today’s dollars, managing that risk might cost \$2.5-3 billion—the capital cost of two desalinization plants, providing only a small fraction, less than 3%, of the water the Sacramento River provides. Conservation is the most cost-effective approach, by far, to ensure this water supply.

Paradoxically, the current economic collapse also brings the opportunity to diversify and strengthen a broad, forest-centered economy. By reversing the trend of forest loss and fragmentation, we build the foundation of a new forest economy that integrates the legacy of timber products into a future of forest products. By focusing on watershed protection and restoration as management goals, sustainable timber harvest can continue. Restoration activities will increase renewable energy supplies while decreasing fire suppression costs. The Region’s unique biodiversity can be conserved. These forests, so managed, will also be more reliable carbon sinks, providing invaluable mitigation for increasing emissions of carbon dioxide. Investments in forest conservation and stewardship create more jobs per dollar than in any other sector. Thus, partnering with landowners to conserve and restore this most important water fountain of the state will underpin an economy as diversified as the Region’s forests, products and people.

Today, we are at the crossroads. Down one path, the Region continues to fragment and develop, watershed function declines, and the traditional resource economy continues to falter. Pockmarked with sprawl, watersheds will be conserved in islands of federally owned forests—which are increasingly degraded.

Down the other path, we shift our focus from single, siloed economies of timber and development to an integrated, diversified forest economy. We invest, at a fraction of the cost of other solutions, in conserving this water source. We diversify economic investment policies to promote restoration and maintenance of natural watershed infrastructure. We develop appropriately scaled, sustainable biomass energy while restoring watersheds and decreasing fire-fighting costs. We promote climate services in forests here at home. We build a new resource economy for the 21st century in the Klamath-Cascade grounded in conservation and sustained into the future.

Which path we choose will make all the difference.



OVERVIEW

ONE FOREST, ONE FUTURE

The Klamath-Cascade’s forests are an essential, intact ecological and economic natural infrastructure for California.

The Klamath-Cascade Region comprises a vast arc of almost 10 million acres, from Mount Lassen and the headwaters of the Feather River across northern California to Mount Shasta and the Klamath River Basin down through the Trinity Mountains. Encompassing the forested mountains of the Klamath, Cascade, and Northern Sierra Ranges, the Region’s eastern edge is defined by the high deserts of the Modoc Plateau. The Sacramento River has its headwaters here, and its tributaries run through most of the Klamath-Cascade landscape before joining together to flow into the Sacramento Delta. Defined by watershed boundaries at the sub-basin level, this is the most water-rich landscape of the state, providing drinking water for more than two-thirds of Californians as well as much of its agricultural water.

Klamath-Cascade forests are the most diverse conifer forests in the world, and one of the most productive. The Region’s globally recognized forest biodiversity supports over 600 species. Ninety-four of these are currently imperiled. Nonetheless, Klamath-Cascade forests remain an example of intact ecological and economic natural infrastructure. Its vast landscape is held in large chunks, sometimes checkerboarded, across 4.5 million acres of private and 5.3 million acres of public ownership. A coherent “all lands” approach —managing this as the one great forest it naturally is—both makes sense and is essential if we wish to maintain the vital water services these forests provide.

However, with steep declines in the Region’s timber economy, there is little incentive to retain and maintain its forests, private or public. A host of factors promote forest conversion, neglect and degradation: from globalization to climate change and invasive species, to the economic crisis, changing demographics and ownerships. We need to act swiftly to ensure the continued health of the Klamath-Cascade’s intact, forested watersheds that are so critical to the state’s economic health.

Over the next two decades, we have an historic opportunity to achieve landscape scale conservation and restoration of this vast and vital resource. Investing in the Klamath-Cascade’s watershed and ecosystem health will ensure key water supplies for the state. Managing and conserving this region as the one great forest it naturally is—rather than as a fragmented, incoherent landscape—promotes watershed and climate services, adaptation and habitat function, reduces fire risks and supplies renewable energy. It is the fundamental basis for transforming a declining *timber* economy into a sustainable *forest* economy.

White Deer Lake,
Siskiyou County.
(Photo by Mike Hupp.)

*Pull open to read the
executive summary.*

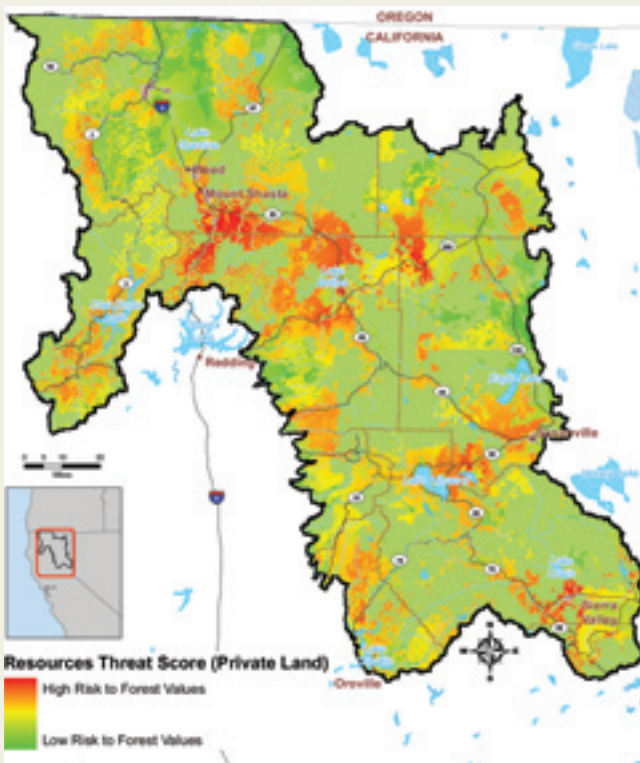
RECOMMENDATIONS

A GREENPRINT FOR THE KLAMATH-CASCADE

1. MANAGE THE KLAMATH-CASCADE FOR WATERSHED SERVICES:

- Conserve 85% of watersheds as well-managed forest across ownerships;
- Establish a collaborative state-federal partnership to achieve watershed conservation goals;
- Expand incentives for working forest conservation easements (WFCEs);
- Increase management of federal forests to restore and maintain adaptive, resilient watersheds.

PRIVATE FOREST RISK ASSESSMENT IN THE KLAMATH-CASCADE



This analysis illustrates the intensity of threats to key watersheds in the Region, using a color scale from red to green, red denoting the highest degree of threat to the highest value resources. The area around Mt. Shasta, with its invaluable water sources, high development demand, easy access from Interstate 5, and a declining forest industry infrastructure, ranks as most highly threatened and critical to conserve.

2. DEDICATE A PERCENTAGE OF ANNUAL FUNDING FROM STATE AND FEDERAL WATER PROJECTS TO WATERSHED CONSERVATION AND RESTORATION:

- Prioritize support for acquisition of WFCEs until conservation goals are largely achieved;
- Focus watershed restoration funding on conserved lands.

3. INVEST IN RESTORATION FOREST MANAGEMENT:

- Restore resilient, adaptive, native forest types;
- Promote restoration to maintain complex, diverse natural habitats;
- Coordinate federal and private management efforts for landscape outcomes;
- Provide reliable cost-share support for sub-basin level restoration management.

4. INVEST IN PROACTIVE FUELS MANAGEMENT:

- Transition a portion of fire suppression and insurance programs to fund fuels reduction, beginning with federal forests;
- Institute greater state support for insurance of private lands prescribed fire;
- Reassess air pollution control requirements where catastrophic fires can be reduced/prevented.

5. DEDICATE A PORTION OF FEDERAL AND STATE RENEWABLE ENERGY AND FUEL SUBSIDIES TO WOODY BIOMASS ENERGY/ FUEL FACILITIES:

- Support small scale, community-to-county level biomass facilities up to 15 megawatts;
- Collaborate with willing counties for local energy independence;
- Prioritize co-generation (CHP) facilities;
- Obtain woody biomass fuel from restoration and maintenance management.



Mount Shasta, Siskiyou County, from the southeast



FOREST A WEALTH OF DIVERSITY

The Klamath-Cascade, with its uniquely intact, large and still-natural forests, presents a rare opportunity in the United States for coherent landscape management of globally outstanding resources across public and private ownerships.

With 30 conifer species, seven of which are endemic, the Klamath-Cascade Region hosts the most diverse temperate conifer forests on earth. Encompassing the Klamath, Cascade, Trinity and Sierra mountain ranges in interior northern California, four distinct ecoregions are represented. The KC also occurs at the confluence of several major biotic communities. This complex interaction of climate, terrain, geology, and biogeography has created an array of ecological communities and floristic diversity of nearly unparalleled richness worldwide.

The Region's vast forests range from Douglas fir-dominated lands in the west to Ponderosa pine and mixed conifer forests in the east. These landscapes were shaped by frequent, low- to moderate-intensity fires both natural and human-caused. Often used

by Native Americans to manage habitats for food and hunting, fires were the most significant and widespread form of pre-European disturbance in the KC. These fires created and maintained a mosaic of habitat types — from forests to open meadows, aspen stands, and riparian hardwood communities — which support a vast array of life. Also key to the region's biological richness are its older forests (over 200 years) and habitats at the forest edge, both of which provide the complex habitat features and functions so vital to supporting biodiversity.

KC forests also are highly productive, ranking amongst the most productive forest types in the United States and yielding 50-60% of the state's timber products annually. Managed primarily for dimensional lumber products, timber has been the historic foundation of the Region's economy, dominating both employment and economic return into the 1980s.

A CHANGED LANDSCAPE

This resource-rich region attracted European settlers from the 1700s on who transformed the area's natural capital into financial capital. The Klamath-Cascade is California's historic wood basket, with private landowners settling the lower elevation, moister forests and the higher elevation lands largely becoming federal lands managed by the U.S. Forest

Service. With the historic emphasis on timber harvest as the focus of forest management, the majority of the Region's old-growth forests were harvested by the mid-1900s. Most forests on private lands have been in regular management for more than 150 years, and are relatively young; on average well less than 100 years old.

Old-growth conditions, vital to the Region's biodiversity, currently characterize less than 8% of public forests in small, discrete patches, located largely in federal forests. The accelerated harvest cycles that dominate modern production forestry have yielded generally young, often over-crowded stands. Combined with the widespread suppression of wildfire across the landscape and the significant reduction in forest management on public forests over the last 20 years, these factors have led to many dense, even-aged forests composed of less fire-resistant species. This is particularly true in a number of federal forests.

These forest conditions have increased the frequency of catastrophic, stand-replacing fires that reduce watershed stability, degrade water resources, and reduce the ability of forests to moderate water flows from snow melt and storm run-off. Private forests, though less characterized by the dense, young stand conditions of public forests, are shaped by accelerating harvest cycles, increasing fragmentation from low-density development, and also are impacted by changes in fire frequency and intensity.

The Klamath-Cascade's forests have a history of intensive forest management, cattle production and conversion for agriculture, but large forest holdings, both public and private, still dominate the landscape. Over 6,000,000 acres of the KC are forested; comprising almost 85% of all vegetation. Such intact, large and relatively natural landscapes are rare in the U.S., especially outside of Alaska. The KC presents an exceptional opportunity for coherent landscape management of the Region's globally outstanding resources across public and private ownerships.

However, over the past 50 years, significant conversion pressure for development has emerged as a primary threat to the Region's forests. The very climatic forces that make this highly productive forest hospitable to a vast and diverse array of animals and plants — good water, soils and temperate weather — attract people in high numbers as well. Global competition, combined with declining domestic markets for timber, render these forests increasingly vulnerable to development and the accompanying fragmentation that reshapes natural landscapes. The lack of historic, frequent, low-intensity fires — to which the forests of this region are adapted — is difficult or impossible to restore in areas where wildlands interface with development. The suppression and elimination of low intensity fire from these forests has reduced the extent of many unique habitats, including natural early seral forests, threatening diversity and diminishing ecosystem function.

Adaptive Watershed Management

Keep Continuous Forest: Reduce fragmentation; maintain 85% cover

Keep it Cool: Restore and maintain canopy cover over streams

Keep it Clean: Reduce sediment; increase buffers and upslope retention; decrease catastrophic fire

Decrease Flooding: Reduce "rain-on-snow" events through greater retention, slow flow down with natural channels and wet meadows

Increase Summer Release: Promote retention of big, dead down logs; reduce thick small tree stands; retain winter snow longer

Techniques:

- Thin stands to mimic more natural open spacing
- Patch cuts in "snakes and blobs" across landscape
- Keep significant "biological legacies" post harvest: standing dead trees, downed wood, and patches of unharvested trees
- Leave trees and groups of trees to develop late seral characteristics.
- Habitat corridors between forest patches and across landscapes
- Native hardwoods retained for food and habitat
- Species composition mimics native conifer diversity
- Natural structure: Mimic diverse complex structure



AN EVOLVING FOREST MANAGEMENT PARADIGM

Forest management in the Klamath-Cascade has focused on generating timber products. All the other things people receive from forests — water, wildlife, inspiration and recreation amongst them — were not seen traditionally as forest products, but rather as forest “by-products.” Many of these so-called by-products also form the bulk of “public trust resources.” The public relies on having these resources available and benefits from them, but there is no market to pay for them. Not specifically managed for, such public trust resources can be damaged in harvest, but were thought to largely recover during long rotations over 65 years or more. As the nature of the timber resource changed from very large, old-growth trees harvested at 200–600 years to medium size trees of 80 years to today’s harvest of many smaller trees at ages 40–50 years, the ability of the forest to also provide these many public benefits has been greatly diminished.

As the population has increased, the demand for these public resources, especially water, also has increased. Conflicts over the fate of those public trust resources has increased dramatically, as well. Further, new markets for “ecosystem services” — such as climate benefits — combined with additional regulatory requirements, are changing the incentives, goals and limits for forest management.

In response, new approaches to forestry are developing, focused on restoring and sustaining all forest resources as well as the timber resource. In many ways, these approaches seek to mimic natural disturbance regimes and produce the same kinds of outcomes of clean water and diverse wildlife in conjunction with timber products. This enables productive economic use of the forest while restoring ecosystem function for the benefit of both people and wildlife. Both watershed management and adaptation management meet these goals. These result in, and maintain, more complex forest stands of different ages, sizes, and densities distributed across the landscape. An additional benefit is that such forests are more resilient to disturbance. Such approaches to forest management benefit overall forest ecological communities and underpin sustainable economic return in human communities.

(Left) Managed, adaptive Ponderosa Pine forest on the Campstool Ranch, CA.



WAYNE STEFFES

Klamath-Cascade Tree Diversity

CONIFERS:

Alaska Cedar
Arizona Cypress
Baker’s Cypress
Bishop Pine
California Red Fir
California Torrey
Douglas-Fir
Engelmann Spruce

Foxtail Pine*

Ghost Pine
Giant Sequoia
Grand Fir
Incense Cedar

Jeffrey Pine*

Juniper*

Knobcone Pine*

Limber Pine
Lodgepole Pine
Modoc Cypress
Monterey Cypress
Monterey Pine
Mountain Hemlock
Noble Fir
One-Needle Pinyon Pine
Pacific Silver Fir
Pacific Yew
Pitch Pine
Poderosa Pine

Port Orford Cedar*

Redwood
Sub-Alpine Fir
Sugar Pine
Washoe Pine

Weeping Spruce*

Western Hemlock
Western Juniper

Western Red Cedar
Western White Pine
White Fir
Whitebark Pine

HARDWOODS:

Big Leaf Maple
Black Cottonwood
Black Oak
Blue Oak
Box Elder
California Buckeye
California Laurel
Canyon Live Oak
Coast Live Oak
Fremont Cottonwood
Gooding’s Black Willow
Gray Willow
Madrone
Miner’s Dogwood
Northern California
Black Walnut
Oregon Ash
Oregon White Oak
Quaking Aspen
Red Willow
Scrub Oak
Southern California
Walnut
Valley Oak
Velvet Ash
Western Sycamore
White Alder
Willow
Yellow Willow

*Regional Endemic



FIRE

WILDFIRES, BIODIVERSITY AND BIOMASS ENERGY

Despite the wholesome look of Smokey Bear, decades of fire suppression have led to some dire consequences. Declining biodiversity, disappearance of alpine wet meadows, and an increase in high-intensity, catastrophic wildfires are among them. The lack of fire also is linked with the rise of many pests and pathogens, such as mistletoe, that fire often serves to reduce or eliminate.

In the Klamath-Cascade, fire was the primary agent creating the Region's current mosaic of forest and meadow, and was a determinant factor in the stand age and structure so necessary for biodiversity. Its absence causes problems.

However, reintroducing fire has many complications. Air quality and liability concerns significantly limit the use of controlled burns. Timber harvest designed to simulate the impacts of low-intensity fires is an alternative. When focused on the removal of small-diameter materials to restore forest conditions and health, timber harvest can be a highly useful restoration tool — one key for adaptation to climate change.

In turn, this small diameter material can have another fire-related use: as renewable fuel for energy. Biomass already provides California with almost 20% of its renewable energy, but that is only about 2.3% of the state's current overall energy supply. There are both need and demand for significantly increased biomass utilization from restoration forestry. It is also essential



Biomass material from fuels reduction management piled for collection and transport.



Ladder fuels in unthinned forest lead to crown fires.

to help meet the state's goal of having 33% of its energy from renewable sources by 2020 and 75% by 2050. Woody biomass energy development is an opportunity for the Region's people to again use fire to shape and restore the landscape — only this time burning within facilities to generate energy. It is also a promising source of both new revenue and employment.

Currently, there are 12 biomass generation facilities with outputs ranging from between 4 and 54 megawatts in the Region. These facilities primarily employ cogeneration to produce both steam used for kiln-drying lumber, and electricity, which may be used either on-site or sold back to the grid through Pacific Gas & Electric Co. However, there is a lack of well-dispersed facilities to affordably accept biomass materials throughout the Region. This limits landowners' — both public and private — incentive and capacity to harvest biomass materials. Investment in increasing smaller capacity (under 15 megawatts) biomass facilities located across the Region and co-located with small mills would have a significant beneficial payoff for the state's renewable energy and employment goals. Additionally, these small facilities could help move these counties to energy independence, relieving demand from the grid itself. Renewable energy investment in biomass utilization is one way to help pay for watershed health.



This controlled burn in Siskiyou County mimics the low-intensity burning managed by Native Americans. (© Mark E. Gibson/CORBIS)



SHAPING THE FOREST

NATIVE AMERICANS IN THE KLAMATH-CASCADE

The Klamath-Cascade Region is home to a number of diverse Native American groups, including the Shasta, Modoc, Achomawi, Atsugewi, Wintu, and Maidu. Their traditional lifestyles, diets, and legends were greatly influenced by the biological and geological world around them, which varied throughout the Region. Some groups depended more on rivers for fish while others relied more on hunting large game species. As a massive landscape feature that could be seen throughout a large part of the northern Klamath-Cascade, Mount Shasta held cultural significance for five of the Native American groups within the Region.

Even as the Native Americans were influenced by their environment, their resource management influenced the environment around them. Their management shaped the ecology, and especially the plant and animal diversity, of the Region. The most important management tool was fire. Fire was used to clear brush, improve deer browse, maintain open

grasslands and meadows, manage for plants used in basket weaving, maintain low fuel levels, and modify the understory species in the forests. The Native American use of fire continuously introduced small disturbances into the ecosystem, which created diversity in plants and helped maintain a vertically complex and open forest structure, leading to more drought, fire, and insect-resistant forests.

After decades of fire suppression policy, there is a growing awareness that this is a key factor in the declining biodiversity in the United States. Fire suppression is also the determinant factor in the disappearance of alpine wet meadows. Changing the fire regime managed by Native Americans has also contributed to the increases in catastrophic wildfires as these fires regularly reduced overall fuel loads in the forests. What is often defined as the “natural and historic” ecosystem conditions in the Klamath-Cascade were largely influenced by the Native American’s stewardship and land use.



The meadow-forest mosaic below Mount Lassen is a result of fire influences. (Photo by Tupper Ansel Blake.)



McCloud River Middle Falls.
[Photo by Mike Hupp.]



WATER

FROM MOUNTAIN TOPS TO FARMS AND TAPS

The economic value of the immense water flows from the Klamath-Cascade far exceeds that of any other forest resource, but no market supports forest management for watershed health.

The abundant water flowing from the forests of the Klamath-Cascade is California's lifeblood. While these forests sustain a variety of important resources, and are economically valued for both timber and development, the value of the water that these forests provide far exceeds the economic value of any other forest resource. Forests are the most desirable cover type for the protection of watersheds in temperate ecoregions. The forests of the Klamath-Cascade Region are the most abundant source of California's invaluable water supply. They receive 75% of the state's precipitation. The Klamath-Cascade encompasses the state's two largest rivers, the Sacramento and the Klamath, which together drain almost 30% of California's surface area. The Sacramento watershed alone accounts for nearly one-third of California's total annual runoff — enough to cover the entire state of Indiana under a foot of water.

Sacramento, the state's capital, is dependent upon its namesake river for up to 90% of its water. The Sacramento-San Joaquin Delta receives between 80–85% of its annual inflow from the Sacramento, and is the central hub of California's state and federal water projects. The Delta provides one-quarter of all of California's drinking water. Two-thirds of the state's population, nearly 25 million people, receive drinking water from the Delta. The largest water project in California, the Central Valley Project, derives almost half of its 2.3 trillion gallons of annual deliveries from the Delta.

Water from the Klamath-Cascade sustains California's people and diverse economies. Integral to the state's thriving agricultural sector, the continued health of the Sacramento watershed is essential to California's status as the nation's leading agricultural producer, with receipts in excess of \$37 billion in 2007. Obtaining more water from other states (which composes only 3% of water used in California currently) is nigh impossible; witness the intense struggles over simply maintaining water delivery from the Colorado River. Desalinization, another option, is quite costly. One plant to provide 300,000 acre-feet per year costs \$1.5–2 billion to build, with a limited lifetime of 20–30 years.

By contrast, the natural forests of the Klamath-Cascade provide 21 million acre-feet of water annually and can continue to do so for centuries if they are maintained. To ensure continued healthy watershed function requires that 85% of the watershed remains intact as relatively natural forest. Once more than even 10% of a forest watershed is converted for development or fragmented, watershed health is compromised, with sediment and temperature increases, flows altered, and storage reduced.

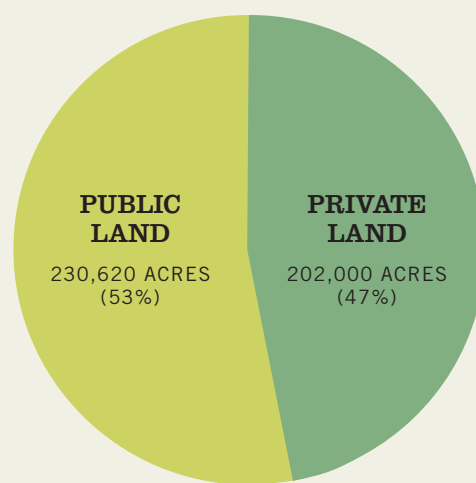
With over half of the Region’s forests already protected by the U.S. Forest Service, we have an extraordinary opportunity to ensure the continued supply of cool, clean water by working with willing landowners to conserve their privately owned forests. Conserving at least half of these ownerships would meet the threshold to keep forests productive for both water and a range of other forest products. Sustainably managed, these forests will generate a wide array of goods and services with little environmental disturbance. This would require an investment in 2011 dollars of up to \$3 billion, the same as the cost of just two desalinization plants providing 600 thousand acre-feet per year — a fraction, 2.9% — of the water naturally provided, and for only 20-30 years, as opposed to the unending supply from the Klamath-Cascade’s forests.



The McCloud River basin, encompassing 432,620 acres draining the eastern flanks of Mount Shasta, illustrates the interwoven federal-private ownership pattern of the Klamath-Cascade watersheds.

COLLABORATIVE, COST-EFFECTIVE SOLUTIONS IN THE MCCLOUD RIVER BASIN

The McCloud River is California’s most renowned trout fishery, and a key tributary to the Sacramento. It provides an estimated 560,000–580,000 acre-feet of annual flow to the Sacramento. Its ownership mirrors that of the Region as a whole: a near-even split between the Forest Service and private landowners. To protect watershed function, just over half of the private lands would need to be conserved as well-managed forest. To bring this into perspective, private owners of almost 25% of the basin have already committed to doing just that, at a projected cost of roughly \$40,000,000. Completing that watershed protection would require an investment estimated at less than \$160,000,000 — providing double the water deliveries of a desalinization plant at a fraction of the cost.



Conserving and stewarding the McCloud forest watershed is the least-cost and most effective approach to guaranteeing almost 10% of the flows to the Sacramento River, ensuring not only water quantity and quality but irreplaceable habitat and recreational benefits, as well. Over 20 years, an investment in ensuring 570,000 acre feet annually from the McCloud is 100 times less costly than investing in desalinization using a 2% discount rate.



WATERSHED INVESTMENT

NEW YORK CITY

Investing in natural infrastructure through forest conservation saved New York City between \$6 billion and \$8 billion over 10 years.

New York City's water supply demonstrates the economic efficiency of using land conservation to ensure water quality and quantity. Two upstate watersheds, the Catskill and Delaware, provide New York City with 90% of its needs, or about 1.3 billion gallons per day. This provides water for more than 10 million people annually.

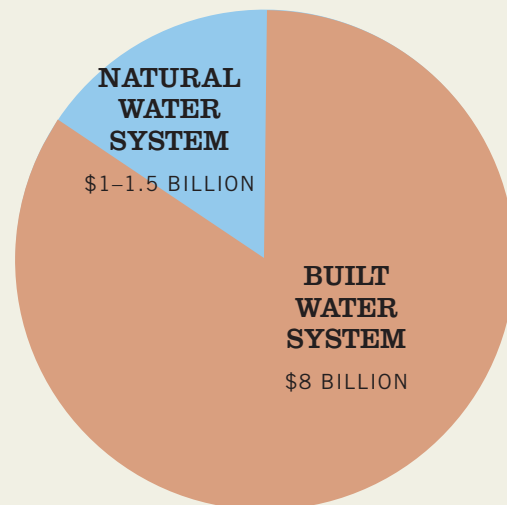
With the vast majority of lands in the Catskill and Delaware watersheds in private ownership, land use trends towards fragmentation and development posed serious implications for New York City's water supply. Short-term financial pressures discouraged long-term investments in forest health, and exacerbated conversion trends. Development increases peak runoff levels, leading to erosion, stream bank instability and increased pollution—all of which degrade water quality.

In 1989, New York City was faced with the requirement that all surface drinking water sources undergo filtration unless human activities could be controlled within source watersheds. The city could construct new filtration facilities—at an estimated \$8 billion in construction costs, and \$300 million annually in operational costs. Alternately, it could reduce development activities and increase restoration within upstate watersheds at a cost of \$1-1.5 billion. The city chose to invest in the conservation of lands in the Catskill and Delaware watersheds. The decision to invest in natural infrastructure—land conservation—rather than filtration facilities saved New York City between \$6 billion and \$8 billion over 10 years while preserving myriad other benefits associated with functioning ecosystems, such as biodiversity and carbon sequestration. Proactive watershed conservation

efforts have allowed New York City to maintain a water supply largely free of the need for costly artificial filtration. Additionally, EPA provided a waiver of filtration requirements.

Only lands from willing sellers have been purchased. The agreement also included almost \$300 million for a partnership program with local communities to help repair local infrastructure and encourage sustainable development compatible with water quality.

COST COMPARISON: NEW YORK CITY



Ensuring reliable and adequate supplies of cool, clean water for New York City's over 10 million users through conservation and stewardship rather than new filtration and storage systems was an effective, efficient, least-cost approach.



WATERSHED INVESTMENT

DENVER

Denver residents are investing just over \$0.14/month on their water bills to save millions over the next decade in fire fighting, damage and restoration costs.

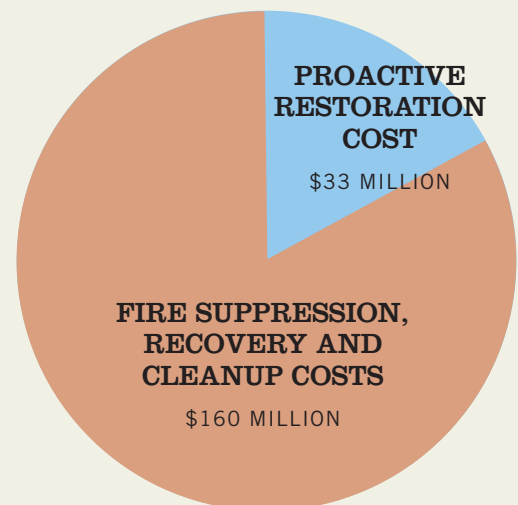
Forest restoration also is an efficient investment in water quality. In 2002, the Hayman Fire—the largest in Colorado’s history—burned more than 138,000 acres of national forest in Denver’s watersheds. This followed the 1996 Buffalo Creek Fire that burned nearly 12,000 acres in the same area. Severe rainstorms followed both of these fires, causing extreme erosion and the accumulation of more than 1 million cubic yards of sediment in the Strontia Springs Reservoir, a primary water storage facility for the city of Denver. More than \$40 million in damage was caused.

In the wake of these catastrophic events, federal taxpayers and Denver Water ratepayers were left to foot the bill of almost \$120 million for poor forest health. State and federal fire-fighting costs exceeded \$42 million. Insured private property losses were estimated at \$38.7 million, and subsequent restoration and stabilization efforts by the U.S. Forest Service already have totaled \$37 million. The total cost of dealing with these fires’ impacts on the watershed exceeds \$160 million.

As a result, Denver Water, the supplier for the city, has developed a keen interest in avoiding such fires in the future and promoting resilient, healthy forests. Denver Water has partnered with the U.S. Forest Service to invest in proactive forest restoration and watershed improvements. They have developed a joint campaign to restore forest health and protect water resources. Each is investing \$16.5 million over five years in forest restoration and watershed protection on more than 38,000 acres of priority watersheds critical to Denver’s water supply.

These restoration treatments—thinning, removing roads, re-contouring the land, and controlled burns—will help forests become more naturally resistant to insects and disease, reducing wildfire risk and preventing further damage to Denver’s municipal water supplies in the future. The average residential household will pay an additional \$1.65 a year. For only a few cents on each ratepayer’s monthly bill, this proactive approach will save millions for Denver water consumers.

COST COMPARISON: DENVER



The lack of restoration management for fire resilient forests in Denver’s watershed required the public to spend five times more to clean up after fire than what it would have cost to avoid the problems fire caused.



WET MEADOWS

THEIR WATERSHED ROLE

Conserving and restoring wet meadows in the Klamath-Cascade could increase groundwater storage by hundreds of thousands of acre-feet annually.

Wet meadows are an important component of water resources and the habitat mosaic of the Klamath-Cascade. Some of California's greatest plant diversity is found in the high alpine meadows of the Region, and these ecosystems provide critical habitat for numerous birds, mammals, fish, and amphibians—including imperiled species like mountain yellow-legged frogs (*Rana spp.*). These same high alpine meadows help give rise to the state's largest rivers and their tributaries, and are integral to the overall health of the waterways flowing from them. The Region contains more wet meadows than any other region of the state. Natural "sponges," meadow ecosystems soak up water during the wet season and then slowly release it over the dry, summer months when water demands are highest. By filtering sediment, storing water and regulating stream flow, wet meadows help ensure a continuous, high-quality supply of water for plants, wildlife, and Californians downstream.

Many of the same activities threatening the Region's forests—road construction, fire suppression, conversion and development, as well as grazing—have compromised these fragile ecosystems and the services they provide. Stream channelization that results from meadow degradation dramatically increases flow velocities, intensifying erosion and diminishing sediment filtration. Higher stream velocities also reduce groundwater saturation, which diminishes overall water storage capacity and filtration to aquifers. The channelization process compromises meadows' ability to maintain base flows throughout the dry season or regulate peak flows during the winter. It increases both summer drought and downstream flood risks.

Channelization also eliminates habitat for fish and macroinvertebrates. And, in a negative feedback loop, it leads to the encroachment of less water-tolerant tree and shrub species, further diminishing natural wet meadows.

Restoring these systems to absorb and store water they naturally can—several hundred million acre-feet/year—will help relieve drought and flood risk. With both drought and precipitation events expected to intensify with climate change, protecting and restoring wet meadows within their forest ecosystems is central to California's ability to adapt to a changing climate.



Restoration of wet meadows yields increased water supplies as well as material for biomass benefits for multiple at-risk species.



The fate of California’s iconic chinook salmon, as well as California’s water supply, depends on the health of the Sacramento River and its tributaries. [© Bridget Besaw/Aurora Open/Corbis]



BIOLOGICAL DIVERSITY

A VAST, VARIED, AND VITAL TREASURE

Conserving the Klamath-Cascade’s working forests is an historic opportunity to protect a globally important natural resource at the landscape scale.

The Klamath-Cascade is within the California Floristic Province, one of only 33 biodiversity “hotspots” named by Conservation International globally. It stands out as an important biological resource within a state that also is the most biologically diverse in the United States. More than 600 species, in addition to humans, call the Region home.

The Klamath-Cascade includes the Klamath-Siskiyou eco-region—one of seven IUCN “Areas of Global

Botanical Significance” in North America, as well as a proposed UNESCO Biosphere Reserve—at its northwestern bounds. Additionally, its southern end is defined by the Sierra Valley, the largest alpine meadow in the United States.

The Region is a mosaic of different habitat types ranging from open meadows and grasslands to riparian zones and aspen stands to late seral forests of extraordinary diversity in and of themselves. This variety of habitats supports a treasure trove of more than 600 species, including 94 special status plant and animal species. Listed species range from those formally protected under the federal or state Endangered Species Acts to candidate and vulnerable species. Listed species include: the Northern Spotted Owl, Northern Goshawk, Pacific fisher, Willow Flycatcher (pictured below), Sandhill Crane, redband trout, and chinook salmon.



Gentner’s Fritillary. (Photo by Derek Severson via Flickr CC.)



Restoration of wet meadows and riparian forest are essential for Willow Flycatcher. (Photo by Idaho Department of Fish and Game.)

Endangered, Threatened and Rare Species in the Klamath-Cascade Region

~ Fauna ~

American Peregrine Falcon
 American White Pelican
 Bald Eagle
 Bank Swallow
 Black Swift
 Black Tern
 Burrowing Owl
 California Black Rail
 California Gull
 Cooper's Hawk
 Double-crested Cormorant
 Golden Eagle
 Great Gray Owl
 Greater Sage-Grouse
 Greater Sandhill Crane
 Loggerhead Shrike
 Long-eared Owl
 Merlin
 Northern Goshawk
 Northern Harrier
 Northern Spotted Owl
 Osprey
 Prairie Falcon
 Purple Martin
 Short-eared Owl
 Swainson's Hawk
 Tricolored Blackbird
 Western Snowy Plover
 Western Yellow-billed Cuckoo
 White-faced Ibis
 White-tailed Kite
 Willow Flycatcher
 Yellow-breasted Chat
 Yellow-headed Blackbird
 Yellow Warbler
 California Red-legged Frog
 Cascades Frog
 Foothill Yellow-legged Frog
 Northern Leopard Frog



Oregon Spotted Frog
 Pacific Tailed Frog
 Sierra Nevada Yellow-legged Frog
 Western Spadefoot
 Coast Horned Lizard
 California Tiger Salamander
 Del Norte Salamander
 Mount Lyell Salamander
 Scott Bar Salamander
 Shasta Salamander
 Siskiyou Mountains Salamander
 Southern Torrent Salamander
 Giant Garter Snake
 American Badger
 California Wolverine
 Humboldt Marten
 Oregon Snowshoe Hare
 Pacific Fisher
 Pallid Bat
 Pygmy Rabbit
 Sierra Nevada Bighorn Sheep
 Sierra Nevada Red Fox
 Sierra Nevada Snowshoe Hare
 Sonoma Tree Vole
 Spotted Bat
 Townsend's Big-eared Bat
 Western Mastiff Bat
 Western Red Bat
 Western White-tailed Jackrabbit
 Carson Wandering Skipper
 Mardon Skipper
 Valley Elderberry Longhorn Beetle
 Conservancy Fairy Shrimp
 Vernal Pool Fairy Shrimp
 Vernal Pool Tadpole Shrimp
 Shasta Crayfish
 Trinity Bristle Snail
 Western Pond Turtle
 Bigeye Marbled Sculpin
 Blue Chub



Bull Trout
 Chinook Salmon
 Coho Salmon
 Cow Head Tui Chub
 Eagle Lake Rainbow Trout
 Eagle Lake Tui Chub
 Goose Lake Lamprey
 Goose Lake Redband Trout
 Goose Lake Sucker
 Goose Lake Tui Chub
 Hardhead
 High Rock Spring Tui Chub
 Klamath Largescale Sucker
 Lahontan Cutthroat Trout
 Lost River Sucker
 McCloud River Redband Trout
 Modoc Sucker
 Pit Roach
 Rough Sculpin
 Shortnose Sucker
 Steelhead



~ Flora ~

Ashland Thistle
 Black Rock Potentilla
 Boggs Lake Hedge-Hyssop
 Butte County Meadowfoam
 Gentner's Fritillary
 Greene's Tuctoria
 Hairy Orcutt Grass
 Hoover's Spurge
 Indian Valley Brodiaea
 Layne's Ragwort
 McDonald's Rock-Cress
 Siskiyou Mariposa-Lily
 Slender Orcutt Grass
 Trinity Buckwheat
 Webber's Ivesia
 Yreka Phlox



Source: California Natural Diversity Database (www.dfg.ca.gov/biogeodata/cnddb). Photos: Bull Trout, Tricolored Blackbird, Western Pond Turtle by U.S. Fish and Wildlife Service. "Ram, Lundy, 2009" by California Department of Fish and Game via Flickr CC. Pacific Tailed Frog by Kenneth P. Wray. Meadowfoam by Eric Hunt.

Indeed, the Klamath-Cascade Region hosts the greatest richness in wide-ranging mammals in California. These "charismatic megafauna,"—larger mammals with home ranges requiring thousands of acres of contiguous habitat to survive (e.g., black bear, mule deer, Pacific fisher, wolverine)—further highlight the critical importance of a landscape-scale conservation approach in the Region.

More commonly known wildlife species, such as the Rocky Mountain elk and mule deer, also are key species, not only for biodiversity but also as important parts of a hunting and recreation community. Wildlife viewing, especially for birds, is a major economic contributor, as well.

Conserving biological diversity is not limited to conserving biological "hotspots" in and of themselves. These hotspots exist, and indeed only survive, within a matrix of other ecosystem features across the landscape. It is essential to maintain the connections between biodiversity hotspots for the hotspots themselves to persist. Conserving the surrounding and connecting landscape can be as important as conserving the hotspots per se, as without this context, individual conservation efforts may not succeed. A relatively intact natural region, the Klamath-Cascade provides an historic opportunity in our lifetimes to connect multiple, biologically diverse habitat types at the landscape scale, thus conserving one of the most important regions for diversity globally.



PACIFIC FISHER

LISTING WARRANTED, RECOVERY WAITING

Ensuring the future of Klamath Cascade forests is essential to ensuring the survival of the Pacific fisher in California.

The Pacific fisher (*Martes pennanti*) is the second largest member of the North American terrestrial mustelid, or weasel, family. Though once abundant throughout North American forests, hunting, trapping and habitat loss have vastly reduced the fishers' historic range. In California, fishers have been extirpated from the northern Sierra Nevada. A candidate for listing under the Endangered Species Act, isolated populations still persist in the Klamath-Cascade.

Fishers are omnivores, feeding primarily upon small mammals, birds, carrion, and fruit. They are dependent upon large areas of unfragmented, intact forest—an adult home range is estimated between 10 and 800 km². Territories are generally exclusive. Both early successional and older forests may be used, but contiguous, older, interior forests are preferred. Some 8.5 million acres of fisher habitat were lost between 1953 and 1997 in the Pacific Region. Forest loss is projected to continue through 2050, resulting in a further reduction of fisher habitat, and threatening the species' viability in this region.

Fishers need complex, natural habitats typically found in mature to old growth forest. These forests provide varied and abundant prey as well as good den sites and protection from predators. Large hollow trees, snags, and rock crevices are important den sites for fishers. While forest management has historically removed much fisher habitat, new approaches in forestry designed to promote watershed function and climate adaptation are more compatible with restoring fisher habitat.

While the Klamath-Cascade fisher populations are the most robust in the state, even these are small, isolated and highly vulnerable to local extirpation, complicating overall recovery. If the fisher is to survive in California, conservation of Klamath-Cascade forests is essential.



The Pacific fisher was determined to warrant protection under the Endangered Species Act in 2004. In an effort to avoid listing, landowners are seeking new ways to protect and restore fisher habitat and populations. (© DLILLC/Corbis)



NORTHERN GOSHAWK

SPECIES OF SPECIAL CONCERN

Recovery of the Goshawk requires landscape-level management.

The Northern Goshawk (*Accipiter gentilis*) is a fairly large, forest-dwelling hawk occurring throughout the Klamath-Cascade Region. Uncommon nationally, the species is considered vulnerable to extirpation in California due to a restricted range, isolated populations, and habitat loss. Generally a permanent resident, Goshawks are threatened when their home territories are disturbed. They have a varied diet of small forest mammals, birds, and insects, and forage in both heavily forested and relatively open forest meadows.

Goshawks nest in a wide variety of forest types, including deciduous, coniferous, and mixed forests. Mature or old-growth forests are typically used, with the birds preferring larger areas of contiguous, older forest. Nests preferences are for the largest

trees of mature or old-growth stands with sparse groundcover and high canopy closure. The Klamath-Cascade is unique in providing these requirements at the landscape scale.

Timber harvest and high-severity fire pose the greatest risks to breeding populations. Harvest activities have long-term impacts on breeding habitat, reducing stand density and canopy cover, and sometimes causing nest failure due to abandonment. However, forest management that encourages Goshawk habitat—restoring a more open forest with larger, relatively well-spaced trees, with some younger stands—is quite compatible with watershed restoration and fuels reduction.

Goshawk recovery requires landscape-level management. Habitat connectivity at scale, combined with the wide variety of forest conditions still present in the Region, is essential to support Northern Goshawks and their prey species.

Twice proposed for listing under the Endangered Species Act, the magnificent Goshawk depends on the sweep and variety of habitats the Klamath-Cascade holds.





MCCLLOUD RIVER REDBAND TROUT

A CANDIDATE FOR LISTING

Conservation of riparian and upland forest cover is key to the continued health of these unique, endemic trout.

The McCloud River redband trout (*Oncorhynchus mykiss stonei*) is a distinct population of redband trout. Barrier falls separating the headwaters of the McCloud drainage have allowed for the genetic

this ancient population from extinction. Due to their extremely limited range, rarity, and relative lack of hybridization, the Sheepheaven and other McCloud strains are particularly vulnerable to extirpation, and are considered imperiled by the State of California.

Redband depend upon on cold, clear, spring-fed streams, uninterrupted surface flow, and ample riparian cover. Loss of riparian shade or increases in sediment pollution are the greatest threats to redband, as well as hybridization with hatchery



The McCloud Redband was listed as a candidate species under the Endangered Species Act in 1996. To avoid further restrictions under the Act, private and public landowners and managers are collaborating to conserve and restore habitat. With the proposed re-introduction of chinook salmon in the upper McCloud, such efforts are even more essential. (Photo by Sam Rizza.)

isolation of some of the most distinctive redband trout strains in the northern Sacramento basin, preventing contact and hybridization with coastal rainbow populations to the south. Fishermen on the McCloud River prize the opportunity to catch, and release, redband.

One of these, the Sheepheaven Creek redband trout, occurs only in an isolated portion of the upper McCloud drainage. Arising from a series of springs, Sheepheaven Creek flows only a little over a mile before disappearing again into the streambed. The isolation of this tributary from the greater McCloud drainage and its freedom from hatchery stocking have allowed the ancestral Sheepheaven strain to remain free of hybridization with other redband trout, saving

rainbow trout. The most important actions to ensure redband survival are to conserve their streams and riparian corridors as well as reduce sediment input to those streams from associated uplands.

Redband refugia were designated in 1998 for special management requirements to reduce forest management that threatens aquatic habitat quality. Trout Unlimited, the U.S. Forest Service, and California Department of Fish and Game also have initiated projects to improve stream habitat within the broader watershed. Continued conservation of riparian corridors and upland forest cover is key to the protection of these unique, endemic trout of the Klamath-Cascade.



CLIMATE CHANGE BLESSING OR CURSE?

With climate change, conserving Klamath-Cascade forests is even more important to California's water supply for people, agriculture and wildlife, as well as safeguarding its growing, resilient and adaptive carbon bank.

Forests are potent tools for mitigating and reducing the impact of climate change. They are an essential means for adaptation to be successful on many fronts, from water to biodiversity to fire reduction. This is nowhere more vividly illustrated than in the forests of the Klamath-Cascade. The Region's forests hold two keys to helping California mitigate risks and adapt to climate change. First, the Klamath-Cascade contains the state's only glaciers that are increasing, rather than decreasing. The importance of watersheds linked to Mount Shasta is ever more important in this thirsty state. Second, the Klamath-Cascade is composed of California's mixed-conifer forests, which, in total, store more carbon than any other forest in the West, and serve as the

most significant carbon "bank" in the state. The Region's forests account for over half of total state sequestration annually. How well these forests fare as both watersheds and carbon storehouses under a changing climate will be a major determinant in how well this state fares overall under climate change.

More than 80% of California's water demand derives from the southern two-thirds of the state, while 75% of its available water originates from the Klamath-Cascade and the Sacramento River. Well over half of the state's annual CO₂ emissions — 700,000,000 tons in 2007 — also derive from the southern portion of the state, while the region's forests sequester 460,800,000 tons. With a compelling need for both the Region's water and carbon sequestration, Southern California has a strong self-interest in ensuring the Klamath-Cascade's forests persist and thrive. Decisions about the future of these forests will either ensure the stability of California's largest watershed and carbon bank or exacerbate both the pace and intensity of climate change. Well-managed and conserved, this region will be an essential blessing for water and carbon stores. With continued degradation, it will be a further curse with climate change.

(Above) With a warming of the atmosphere, Sierran glaciers have retreated by 55% since the early 1900s, as this comparison of the Maclure Glacier from 1917–2003 demonstrates. (F.E. Matthes 1917; Hassan Basagic 2003)

WATERSHEDS AND CLIMATE CHANGE

Climate change is increasing the frequency and intensity of weather events once thought of as extreme and rare in California, as elsewhere. But, while climate change results in increased storm intensity and extreme winter weather, it also means less water for most of the state overall. Mean annual temperatures are projected to continue to increase by 2 to 11.5 degrees Fahrenheit by the end of the century. As a result, more precipitation will fall on average across the state as rain rather than snow in higher elevations. This both intensifies peak winter runoff and reduces the amount of snowmelt available throughout the dry, summer season.

Decreases in total spring melt from the Sierra are already occurring. It has decreased by nearly 10% since the early 1900s. Changes to surface runoff from climate change also affect groundwater supplies. Regional groundwater aquifers dependent upon alpine snowpack for recharge also are declining. Sierran glaciers overall have experienced enormous reductions, losing over 55% of their extent in the last 100 years (see left). If current trends continue, up to 90% of current Sierran snowpack may be lost by 2100 — within the lifetime of many of our children.

In contrast, however, the glaciers of Mount Shasta are growing. Mt. Shasta's precipitation has increased by 17% since 1900, despite a 1.8-degree Fahrenheit increase in temperature in the same time period. This further increases the state's already great dependency on water from the Klamath-Cascade, reinforcing the critical importance of conserving watershed health and function in the Region.

CARBON SEQUESTRATION AND CLIMATE CHANGE

It is common to portray climate change as a significant potential threat to forests, and Klamath-Cascade forests may suffer enormously from climate change if current trends continue. Equally, we may reverse that course and manage these forests to help ensure the impacts from climate change are greatly mitigated. The largest carbon bank in the state, these forests have the capacity to double and even triple their current carbon stores. Forests in this region, especially on private lands, have many younger stands that hold less carbon on average than do older forests. Federal forests, while slightly older and generally holding more carbon than do private forests, also can be managed to both increase these stores and make them more adaptive and resilient. Further, focusing management on climate change

adaptation is consonant with enhancing watershed function. This approach has multiple and synergistic benefits. It helps reduce fire intensity, yields older forests that are also more fire resistant, and restores and maintains essential habitat in more natural, carbon-rich forests. Additionally, byproducts of such management can serve as biomass energy stocks.

Without successful adaptation management, carbon stocks in Klamath-Cascade forests will be subject to greater destabilization from increased fire intensity and frequency, pests, and disease. This would lead to the significant release of carbon dioxide emissions from current stores and the sacrifice of future sequestration. Both would significantly hamper the state's ability to meet its goals mandated under the state's Global Warming Solutions Act, AB 32. By contrast, conserving well-managed forests in the Region would stabilize existing stocks — increasing both the amount and resiliency of those stocks and reducing future emissions.



Warmer winters have enabled the pernicious bark beetles to survive over winter and expand their extent many-fold. Without ongoing stewardship, many managed forests have become vastly more prone to catastrophic fires as a result of major infestations. As climate change continues, this twinned threat of dying trees and catastrophic fire will only intensify. (Photo by vsmoothe via Flickr CC.)



FIRE AND CLIMATE

BENEFITS OF FUELS REDUCTION

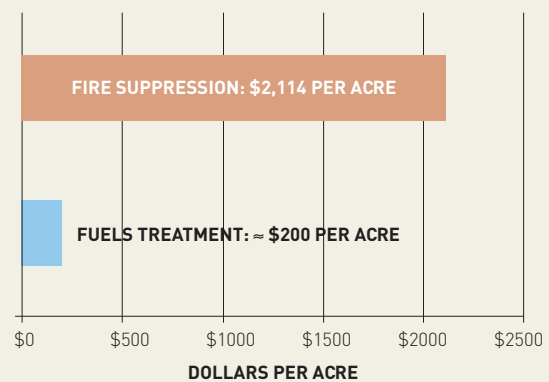
Proactive fuels reductions result in major cost efficiencies and improved watershed health.

Increased frequency and intensity of wildfire promises to be one of the most significant climate impacts in California. Fire occurrence could increase by more than 100% in Klamath-Cascade forests by 2085. Fire seasons already are starting sooner, lasting longer and burning more acres. As wildfires increase in size, they may also result in more stand-replacing burns that are too large to be reforested via natural regeneration — requiring post-fire investment in forest and watershed restoration, as well as in repairing damage to homes and property.

In 2007, total fire fighting costs alone were \$1.2 billion, with California’s Department of Forestry and Fire Protection, CalFire, spending over \$500 million and federal costs spiking at \$700 million. In 2008, half of the entire U.S. Forest Service fire suppression costs were for California. This does not count costs of

damages to homes and structures, post-fire recovery efforts, timber damage, and negative impacts on water supplies, recreation and tourism. The federal budget for wildland fire management in California — both in absolute terms and as a portion of total costs for the state — increased substantially during 2003–2008, and these costs are expected to increase with climate change.

FIRE SUPPRESSION VS. TREATMENT COSTS IN CALIFORNIA



Treating fire prone forests proactively is far more cost effective than fire suppression to control fires after the fact, and results in greater, sustainable rural employment, as well. (Source: Gebert et al. 2007; Finney et al. 2002.)

TOP 10 ECONOMIC SECTORS IN THE KLAMATH-CASCADE, BY EMPLOYMENT, 1977–2008

Rank	Sector (1977)	Employment	Sector (2008)	Employment
1	Lumber and Wood Products	9,426	Health Care and Social Assistance	28,061
2	Eating and Drinking Places	6,181	Retail Trade	26,142
3	Health Services	6,021	Accommodation and Food Services	17,598
4	Automotive Dealers and Service Stations	3,382	Manufacturing	10,220
			Wood Product Manufacturing	3,639
5	Food Stores	2,978	Construction	8,311
6	Miscellaneous Retail	2,709	Administrative, Support, Waste Mgmt., and Remediation Services	6,774
7	Special Trade Contractors	2,227	Other Services (Repair, Maintenance, Personal & Religious Services)	6,378
8	Wholesale Trade, Durable Goods	2,128	Finance and Insurance	5,819
9	General Merchandise Stores	1,973	Professional, Scientific, and Technical Services	5,659
10	Wholesale Trade, Nondurable Goods	1,802	Transportation and Warehousing	5,034

Once the dominant employer of the Region, forest products are now ranked as 21st, folded into the overall diversified manufacturing sector.

Klamath-Cascade forest watersheds benefit Californians across generations and cultures.



PEOPLE A FORCE OF NATURE

People hold the future of the Klamath-Cascade in their hands. With policies supporting a new economy built on forest products—water, energy, wildlife, recreation, and wood—the people who shape and steward the Region can ensure it thrives, benefiting all Californians.

Over the last 10 to 15,000 years our decisions have shaped this region. Be it with fire, fragmentation, conversion or stewardship, people’s choices have determined what thrived or disappeared here. What has changed fundamentally in the last 150 years is the intensity, variety, rate and scale of our impact. Prior to the 1800s, forests were primarily managed by frequent, low-intensity, relatively small-scale indigenous burning. This shaped the forests, renewed grasses and other forage crops. Today, our impacts are much greater: fragmentation, logging, roads, pollution, erosion, conversion and development among them. Now, catastrophic fires are far more frequent, whereas low-intensity fires are rare. Our impacts are sweeping and enduring, not short and small-scale. Some, such as species extinction, are irrevocable.

The pace of change is incessant and rapid.

Ownerships turn over and break up within a decade on average. This trend leads to an irreversible change from forest to sprawl. The reason for this is clear. The near-term, cash value of these forests is far greater for development and rapid timber delivery than for long-term forest use. We have significant and immediately available economic return from these “forest products.” The taxable value of real estate in Shasta County from 1961 to 2010 has increased by more than 5,000%—even with the major dampening effects of Proposition 13, which froze many property taxes at 1978 levels. Urban interfaces to the south, north, and east are ever encroaching on the Region. Redding’s population has increased by 600% in this time period; Ashland grew by 130% and Reno by 315%. What was once a rugged, remote region of abundant resources has become all too accessible and vulnerable.

Bisected, bounded and easily accessed by Interstates 5 and 80, blessed with relatively temperate weather and great beauty, the Klamath-Cascade is the focus of ever increasing development pressure for baby-boomers seeking to retire in the less populated, less hectic, more appealing environs. Timber, a source of great wealth historically, is now only a tiny fraction of California’s total gross domestic product—only 0.547%—even as forests occupy over one-third of the state’s land mass. Timber and milling are globalized

industries, with the state importing up to 80% of its timber used. Mills, once the backbone of the region's economy and its top employer into the 1980s, now rank as the 21st. The economy is vastly diversified from the focus on timber products it had just 25 years ago. Relying on timber to pay the bills for the conservation of the Region's forests — keeping forests as forests with all their values — is not realistic. It is gambling with the future health of California's watershed.

The factors we once relied upon to keep this region's wealth of resources, especially its water, safe for the future — its remoteness, scale and ruggedness — are no longer sufficient to protect them. There are multiple indicators that the Region's natural infrastructure is fraying.

Despite the threats, these are still early warnings of a reversible trend. Klamath-Cascade forests remain remarkably intact. The majority of private forest in the region is owned in relatively large chunks, bounded or checker-boarded with federal lands. Viewed from the sky, rather than with property boundaries on a map, an expanse of forest covers the landscape. We have the opportunity to keep it that way through conservation and new, forest-based economies that recognize the value of all forest products, not just timber. This approach will pay the cost of keeping these forests healthy and whole.

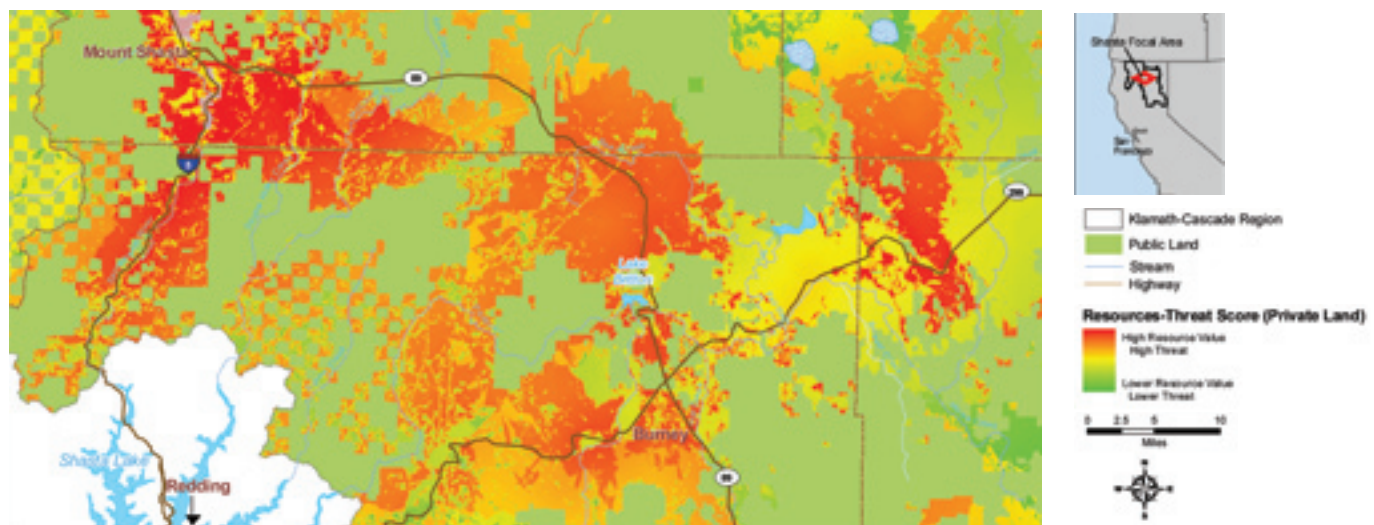
There is a special breed of people in this Region who value this land for the long term. Many of these are families who have been there for 150 years or more. From the Sierra Valley to Lake Almanor to Mount Shasta and the Castle Crags, these

owners have stepped forward to create a legacy for all of us. The Collins family, of Collins Pine Forest — and its associated mill and biomass plant near Lake Almanor — has set a national standard for stewardship and corporate responsibility. The Ford family of Roseburg Resources is another such pioneer and steward. These and many others, large and small, are looking to a forest future for seven generations and more. They are the foundation which resists a tide of fragmentation and development.

Partners are emerging to work with them. The state has increasingly recognized the value of conserving this region, launching a new agency in 2007, the Sierra Nevada Conservancy. There is also increasing recognition that conserving the Region's watershed infrastructure is an urgent area of state and federal investment. As rate and surcharge increases for both federal and state water projects are being discussed, investment of some of those proceeds in this key area is also being proposed. The state's mandates for renewable energy could provide a strong stimulus for investment in small, rural biomass generation facilities, further strengthening the Region's economy.

The Region is characterized by rugged pioneers, proud of their ability to earn a living from the rich land and deliver products to the state and globe. Despite this tradition, the decline in traditional economies has caused unemployment here to rank among the highest in the country. With a change in investment policies to support a new economy based on today's forest products — water, energy, wildlife, recreation and wood — the Region, and the people who are its stewards, will thrive in the future.

AT HIGHEST RISK: MOUNT SHASTA HEADWATERS





WORKING FOREST CONSERVATION EASEMENTS

ENSURING THE FUTURE

Robust tools, working forest conservation easements meet private owners' economic and management goals while protecting vital public trust resources.

Working Forest Conservation Easements (WFCEs) are a powerful tool enabling landowners to keep their working forests as forests, continue their stewardship, and maintain forestry as the backbone of a sustained local economy. With WFCEs, the land stays in private ownership and on the county tax rolls. Landowners continue active forestry while gaining additional value from not developing the land. They also maintain and restore key conservation values of their lands, such as habitat, watershed, recreational and scientific values. WFCEs are increasingly recognized as the best existing means of compensation for ecosystem services, such as for climate and biodiversity.

The state's first major WFCE with an "industrial" owner, one with over 5,000 acres who manages primarily for economic return, was completed in the Klamath-Cascade on 9,200 acres. This WFCE ensured that a key portion of the McCloud watershed, including eight miles of the McCloud River, would be well managed forever. Completed with one owner, Bascom Pacific, the land has since been sold to another forest management entity, The Campbell

Group, which continues to manage the forest in accordance with its easement.

Sales of working forests conserved with easements have become an increasingly common practice, reflecting that these tools are not an encumbrance to doing business. It also shows that easements are robust, enduring tools, able to meet the requirements of new owners over time. Additionally, WFCEs enable the consistent, long-term management required to achieve goals that can only be accomplished over time, such as watershed restoration.

When forests ownership changes rapidly, as the growing majority of forestlands do, differing economic objectives of each owner make it challenging to provide a sustainable model for forest management. Having conserved, working forests enables long-term sustainable management, as well as the efficient use of public tax dollars invested in restoration. WFCEs enable restoration goals to be fully realized over time, rather than potentially abandoned with new owners.

In the McCloud watershed, many partners are invested in watershed restoration. With the proposed reintroduction of chinook salmon (*Onchyrhynchus tshawytscha*) in the McCloud, ensuring that this watershed is restored, healthy and conserved is even more important. Owners of over 25% of the private forests in the McCloud basin are now either committed to, or exploring, WFCEs as a complement to timber operations. Such conservation is essential to the future of a thriving McCloud River and all that depend upon it.

(Right) Sierra Valley wet meadow and forest.

(Left) The forests surrounding Mt. Shasta are caught in a cultural, economic, and natural shift that threatens both the traditional timber economy and the essential infrastructure — human and physical — that supports it. This area ranks as highest priority for conservation with the highest potential for successful management at the landscape scale. Mill closures; rising haul costs, a declining work force of trained loggers, and global competition are among the human and economic threats; climate change is the primary natural threat. The relatively intact forest base with willing landowner and community partnerships create a high likelihood for successfully mitigating these risks.





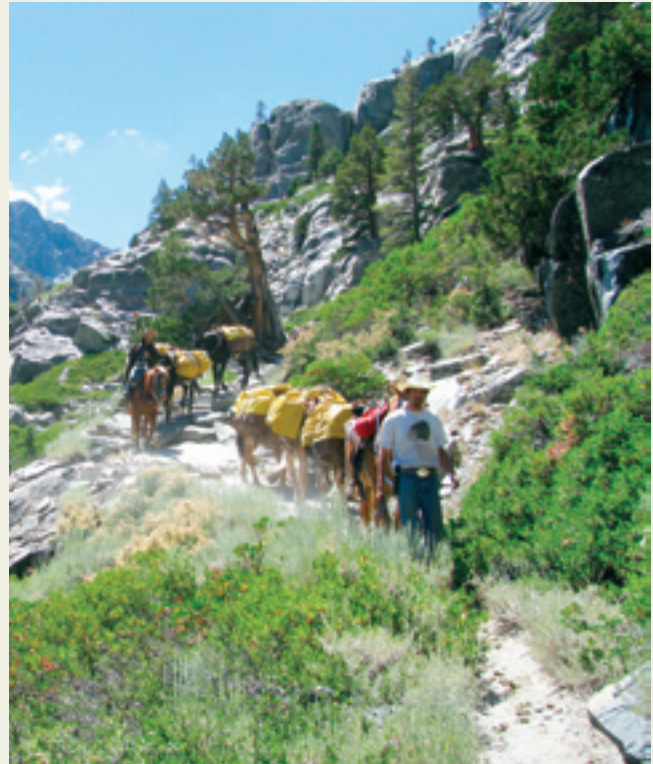
RECREATION

A GROWING REGIONAL ECONOMY

Outdoor recreation is an area of economic growth for the Klamath-Cascade.

Californians are among the most active outdoor enthusiasts in the nation. Their passion for the outdoors translates into significant economic returns — outdoor recreation in this most populous state in the Union generates more than \$46 billion dollars annually. Hiking is the most popular form of outdoor recreation, with bird watching, camping, and fishing running close behind. With an abundance of natural resources, recreational opportunities, and easy access the Klamath-Cascade Region is a major destination for outdoor recreation.

Mount Shasta Wilderness, Lassen National Park, and Castle Crags State Park have hundreds of thousands of visitors annually from around the world. The five million acres of public lands in the Region with six major National Forests: the Trinity, Klamath, Shasta, Lassen, Modoc and Plumas are favorite camping areas for generations of Californians. The McCloud, Sacramento, Trinity, Feather and Klamath Rivers, offer varied and spectacular river recreation. Lake Almanor is an increasingly popular alternative to Lake Tahoe. The Pacific Crest Trail, one of the country's most popular through-trails, covers more than 400 miles in the Region, and countless trails in nearby parks and forests lure hundreds of thousands of hikers and walkers annually. The McCloud River is a premier fishing destination in the state, acclaimed both nationally and internationally.



Recreation-related industries are the third largest employer in the KC region, and demand for outdoor recreation is increasing. Per-capita days of outdoor recreation increased by 16% between 2000 and 2007 nationally, and revenues increased as well. Recreational demand in California is also moving north from southern and central California, with the Redding and Mount Shasta areas are the focus of significantly increased recreational use. Recognition of the significant physical and mental health benefits of outdoor recreation has grown significantly in the past decade, with multiple studies from many countries affirming this. As the state's population continues to grow, demand for recreational opportunities on both public and private lands in the Region will only increase. Compatible with watershed conservation and restoration, increased outdoor recreation is a major additional benefit from conserving the Region's watersheds.

(Above) With thousands of miles of trails to offer, visitor days in Klamath-Cascade national forests are increasing. (Photo: www.pcta.org)
(Left) Bird watching, as for this rare Sandhill Crane in the wetlands of the Sierra Valley, is a major driver in the outdoor recreation economy.

CONCLUSION

THE ROAD WE CHOOSE MAKES ALL THE DIFFERENCE

Occasionally, the opportunity to fundamentally improve the future presents itself. We are at such a time and have such a choice today. The benefits of conserving the working watersheds of the Klamath-Cascade Region are many and manifest. In fact, they are more than benefits—they are necessities. Water fuels California. These forests are California’s largest water source. The expense of obtaining replacement water would be prohibitive, if even possible.

Conserving and managing this region as resilient, adaptive forest watersheds offers significant economic opportunity, saves money and creates economic efficiencies. The risks we face will only increase over the next decades as climate change and populations increase. With a ready contingent of engaged partners, now is the time to set a new course, transforming this region’s economy.

Yet, even with the clarity of compelling benefits, a significant barrier to action remains: where might catalytic money come from, especially in times of fiscal constraint? Herein lie the choices we must address. We cannot afford to *not* conserve this region — we rely on its water. Realigning public policy to sustain the overall forest resource, not solely its timber products, is one key step. Realigning investments in built infrastructure for water (e.g. dams, canals, treatment facilities) to also maintain the essential natural infrastructure (e.g. watersheds) on which it relies, is another. The same willingness to pay for dams, canals and other physical infrastructure benefitting the public must also recognize the public benefit of ensuring that natural infrastructure, watersheds, can deliver flows to those dams.

Subsidies that are a major component of supporting our highly centralized energy system must also be invested in invigorating renewable and sustainable energy industry at the small, decentralized scale. County-level, dispersed biomass facilities diversify rural economies, reduce energy losses and leverage fuel reduction treatments from watershed restoration.

Public and private funding supports massive fire-fighting campaigns annually, and insurance companies pay hundreds of millions to billions of dollars for fire damages. Proactively investing a small portion of these funds towards forest watershed restoration and risk mitigation is good economic policy.

Creating focused, coordinated, public-private partnerships to fund the conservation and restoration of the Klamath-Cascade watershed is an efficient, effective risk mitigation strategy to ensure the future of California’s water supply. Complementary benefits flowing from this will catalyze a rural renaissance in this resource-rich region, creating a sustainable economy to carry it through and beyond the 21st century. We can make this the future. Or, we can wait and see what happens, hoping that current trends of irreversible forest loss, watershed fragmentation and degradation will go away.

The choice is ours.

BIBLIOGRAPHY

- Agee, J.K. (1993). *Fire Ecology of Pacific Northwest Forests*. Washington, DC: Island Press.
- Agee, J.K. (2007). *Steward's Fork: A Sustainable Future for the Klamath Mountains*. Berkeley, CA: University of California Press.
- Alig, R.J., Plantinga, A.J., Ahn, S., & Kline, J.D. (2003). Land use changes involving forestry in the United States: 1952 to 1997, with projections to 2050 [General Technical Report PNW-GTR-587]. Portland, OR: USDA Forest Service, Pacific Northwest Research Station.
- Anderson, M.K., & Moratto, M.J. (1996). Native American Land Use Practices and Ecological Impacts. In *Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Assessments and Scientific Basis for Management Options* (Ch. 9, pp. 187-206). University of California, Davis, CA: Centers for Wildlife and Water Resources.
- Aubry, K.B., & Lewis, J.C. (2003). Extirpation and reintroduction of fishers (*Martes pennanti*) in Oregon: Implications for their conservation in the Pacific states. *Biological Conservation* 114(1), 79-90.
- Basagic, H.J., IV. (2008). Quantifying Twentieth Century Glacier Change in the Sierra Nevada, California. [Master's thesis, Portland State University, 2008]. Retrieved from <http://www.glaciers.pdx.edu/Thesis/Basagic/snglac.html>.
- Behnke, R.J., & Tomelleri, J.R. (2002). *Trout and Salmon of North America*. New York, NY: The Free Press.
- Boal, C.W., & Mannan, R.W. (1994). Northern goshawk diets in ponderosa pine forests on the Kaibab Plateau. *Studies in Avian Biology* 16, 97-102.
- Bonan, G.B. (2008). Forests and climate change: forcings, feedbacks, and the climate benefits of forests. *Science*, 320, 1444-1449.
- Bosakowski, T., & Speiser, R. (1994). Macrohabitat selection by nesting northern goshawks: Implications for managing eastern forests. *Studies in Avian Biology* 16, 46-49.
- Bull, E.L. & Hohmann, J.E. (1994). Breeding biology of northern goshawks in northeastern Oregon. *Studies in Avian Biology* 16, 103-105.
- Calflora. (2011) The Calflora Database [web application]. Retrieved from <http://www.calflora.org/>.
- California Air Resources Board. (2008, December). *Climate Change Scoping Plan: A Framework for Change*. Sacramento, CA: Air Resources Board.
- California Biomass Energy Alliance. (2009). *Biomass Facilities by County*. Retrieved from <http://www.calbiomass.org/county.htm>.
- California Department of Finance, Financial and Economic Data. (2007). *County Profiles* [Data file]. Retrieved from http://www.dof.ca.gov/HTML/FS_DATA/profiles/pf_home.php.
- California Department of Finance. (2009). 2008 California Statistical Abstract. Retrieved from www.dof.ca.gov/HTML/FS_DATA/.../CaliforniaStatisticalAbstract2008.pdf.
- California Department of Fish & Game. (2003). *Atlas of the Biodiversity of California*. Sacramento, CA: Department of Fish & Game.
- California Department of Fish & Game. (2007). *California Wildlife: Conservation Challenges* [Comprehensive Wildlife Conservation Strategy]. Retrieved from <http://www.dfg.ca.gov/wildlife/WAP/>
- California Department of Fish & Game. (2011). *California Natural Diversity Database* [Data file]. Retrieved from www.dfg.ca.gov/biogeodata/cnddb/.
- California Department of Water Resources, and California Department of Food & Agriculture. (2008, October 10). *Current Water Use Efficiency Policy and Programs and Estimate of Agricultural and Urban Water Use*. Retrieved from http://deltavision.ca.gov/BlueRibbonTaskForce/.../DWR_CDFR_Response.pdf.
- California Department of Water Resources. (2009). *Resource Management Strategies: Desalination* (Vol. 2, Ch. 9). In *California Water Plan, Update 2009* (Bulletin 160-09). Sacramento, CA: Department of Water Resources.
- California Department of Water Resources. (2009). *Resource Management Strategies: Forest Management* (Vol. 2, Ch. 23). In *California Water Plan, Update 2009* (Bulletin 160-09). Sacramento, CA: Department of Water Resources.
- California Department of Water Resources. (2009). *Regional Reports: North Coast Integrated Water Management* (Vol. 3, Ch. NC). In *California Water Plan, Update 2009* (Bulletin 160-09). Sacramento, CA: Department of Water Resources.
- California Department of Water Resources. (2009). *Regional Reports: Sacramento River Integrated Water Management* (Vol. 3, Ch. SR). In *California Water Plan, Update 2009* (Bulletin 160-09). Sacramento, CA: Department of Water Resources.
- California Department of Water Resources. (2009, December). *The State Water Project Delivery Reliability Report 2009 Draft*. Sacramento, CA: Department of Water Resources.
- California Executive Order No. S-06-06. (2006, April 25). Retrieved from <http://www.dot.ca.gov/hq/energy/Exec%20Order%20S-06-06.pdf>.
- California Natural Resources Agency. (2009). *2009 California Climate Adaptation Strategy*. Sacramento, CA: Natural Resources Agency.
- California State Parks. (2009). *California Outdoor Recreation Plan 2008*. Sacramento, CA: California State Parks.
- Chichilinsky, G. & Heal, G. (1998). Economic returns from the biosphere. *Nature*, 391, 629-630.
- Coleman, R.G., & Kruckeberg, A.R. (1999). Geology and plant life of the Klamath-Siskiyou Mountain Region. *Natural Areas Journal* 19(4): 320-340.
- Conservation International. (2007). *Biodiversity Hotspots, California Floristic Province*. Retrieved from http://www.biodiversityhotspots.org/xp/hotspots/california_floristic/Pages/default.aspx.
- Cordell, H.K. (2008). The latest on trends in nature-based outdoor recreation. *Forest History Today*, Spring, 4-10.
- Covington, W.W. & Moore, M.M. (1994). Southwestern ponderosa forest structure. *Journal of Forestry* 92(11), 39-47.
- Denver Water. (2011). *From Forests to Faucets: U.S. Forest Service and Denver Water Watershed Management Partnership*. Retrieved from <http://www.denverwater.org/SupplyPlanning/WaterSupply/PartnershipUSFS/>.
- Fiedler, C.E., Keegan, C.E., III, Woodall, C.W., & Morgan, T.A. (2004). *A Strategic Assessment of Fire Hazard in Montana: Potential Effectiveness and Costs of Hazard Reduction Treatments* [General Technical Report PNW-GTR-622]. Portland, OR: USDA Forest Service, Pacific Northwest Research Station.
- Finney, M.A., Sapsis, D.B., & Bahro, B. (2002). Use of FARSITE for Simulating Fire Suppression and Analyzing Fuel Treatment Economics. *Proceedings from CAFE Conference: Fire in California Ecosystems: Integrating Ecology, Prevention, and Management*.
- Franklin, J.F., & Fites-Kaufman, J.A. (1996). Assessment of Late-Successional Forests of the Sierra Nevada. In *Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Assessments and Scientific Basis for Management Options* (Ch. 21, pp. 627-657). University of California, Davis, CA: Centers for Wildlife and Water Resources.
- Gebert, K.M., Calkin, D.E., & Yoder, J. (2007). Estimated suppression expenditures for individual large wildland fires. *Western Journal of Applied Forestry* 22(3), 188-196.
- Grant Deed of Conservation Easement—Bear Creek Tract (Shasta County, CA). July 18, 2006. The Pacific Forest Trust.
- Hanak, E., Lund, J., Dinar, A., Gray, B., Howitt, R., Mount, J., Moyle, P., & Thompson, B. (2011). *Managing California's Water: From Conflict to Reconciliation*. San Francisco, CA: Public Policy Institute of California.
- Hassett, J.M., Endreny, T.A., Wolosoff, S., Adam, M., & Mitchell, M.J. (2003). Effect of suburban development and landscape position on water quality in three small watersheds within the Croton system, New York. *Eos Transactions AGU, Fall Meet. Suppl., Abstract H51C-1066*.
- Hayward, G.D., & Escano, R.E. (1989). Goshawk nest-site characteristics in western Montana and northern Idaho. *Condor* 91, 476-479.

- Hessburg, P.F., Mitchell, R.G., & Filip, G.M. (1994). Historical and current roles of insects and pathogens in Eastern Oregon and Washington forested landscapes (General Technical Report PNW-GTR-327). Portland, OR: USDA Forest Service, Pacific Northwest Research Station.
- Hoffman, J. (2005). Economic Stratification and Environmental Management: A Case Study of the New York City Catskill/Delaware Watershed. *Environmental Values*, 14, 447-70.
- Howat I.M., Tulaczyk, S., Rhodes, P., Israel, K., & Snyder, M. (2007). A precipitation-dominated, mid-latitude glacier system: Mount Shasta, California. *Climate Dynamics*, 28, 85-98.
- Hudiburg, T., Law, B., Turner, D.P., Campbell, J., Donato, D., & Duane, M. (2009). Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. *Ecological Applications* 19(1), 163-180.
- Hurowitz, G. (2010, February 3). The jobs are in the trees. *Grist*. Retrieved from <http://www.grist.org/article/2010-02-01-the-jobs-are-in-the-trees>.
- Intergovernmental Panel on Climate Change. (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Solomon, S., Qin, D., & Manning, M. (Eds.). Cambridge, United Kingdom and New York, NY: Cambridge University Press.
- Jules, E.S., Frost, E.J., Mills, L.S., & Tallmon, D.A. (1999). Ecological consequences of forest fragmentation in the Klamath Region. *Natural Areas Journal* 19(4), 368-378.
- Kuchler, A.W. (1976). *Potential Natural Vegetation of California* (Map 1:1,000,000). New York, NY: American Geographical Society.
- Land Trust Alliance. (2006). *The 2005 National Land Trust Census Report*. Retrieved from <http://www.landtrustalliance.org/land-trusts/land-trust-census/2005-national-land-trust-census>.
- LaPierre, S. & Germain, R.H. (2005). Forest Parcelization in the New York City Watershed. *Journal of Forestry*, April/May, 139-145.
- Legislative Analyst's Office. (2007). *California Department of Forestry and Fire Protection: State's Wildland Firefighting Costs Continue to Escalate*. Retrieved from http://www.lao.ca.gov/analysis_2007/resources/res_08_3540_an07.aspx.
- Mann, R. (2007, June 18). *Delta Vision Context Memorandum: Local and State Economics*. Retrieved from http://deltavision.ca.gov/Context_Memos/Context_Memo_LASE.shtml.
- Moser, S., Franco, G., Pittiglio, S., Chou, W., & Cayan, D. (2009). *The Future is Now: An Update on Climate Change Science Impacts and Response Options for California*. California Energy Commission, PIER Energy-Related Environmental Research Program (CEC-500-2008-071). Retrieved from http://www.climatechange.ca.gov/publications/biennial_reports/index.html.
- National Academy of Sciences. (2000). *Watershed Management for Potable Water Supply: Assessing the New York City Strategy*. Washington, DC: National Academy Press.
- National Commission on Science for Sustainable Forestry. (2007). *Conserving Biodiversity Through Sustainable Forestry*. Washington, DC: National Council for Science and the Environment.
- National Park Service. (2011). *NPS Stats: Lassen Volcanic NP, Annual Park Visitation [All Years] [Data file]*. Retrieved from <http://www.nature.nps.gov/stats>.
- National Research Council. (1998). *Forested Landscapes in Perspective: Prospects and Opportunities for Sustainable Management for America's Non-Federal Forests*. Washington, DC: National Academy Press.
- NatureServe. (2010). *NatureServe Explorer: An Online Encyclopedia of Life*. Retrieved from <http://www.natureserve.org/explorer/>.
- Odion, D.C. (2004). Patterns of fire severity and forest conditions in the western Klamath Mountains, California. *Conservation Biology* 18(4), 927-936.
- California Energy Commission. (2009). *Total System Power*. Retrieved from http://energyalmanac.ca.gov/electricity/total_system_power.html.
- Office of Shasta County Assessor-Recorder. (2011). *County of Shasta, California. Annual Report 2010-2011*. Retrieved from http://www.co.shasta.ca.us/ShastaCountyInternet/index/assessor_index/annual_report.aspx.
- Outdoor Industry Foundation. (2006). *The Active Outdoor Recreation Economy: California*. Retrieved from www.outdoorindustryfoundation.org.
- Pacific Gas & Electric. (2008). *Technical Memorandum 37 (TM-37), Regional Recreation Demand Assessment (RL-S1)*.
- Reynolds, R.T., Graham, R.T., Reiser, M.H., Bassett, R.L., Kennedy, P.L., Boyce, D.A., Jr., Goodwin, G., Smith, R. & Fisher, E.L. (1992). *Management recommendations for the Northern Goshawk in the southwestern United States*. (General Technical Report RM-GTR-217). Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest Range Experimental Station.
- Ricketts, T.H., E. Dinerstein, D.M. Olson, and C.J. Louks. (1999). *Terrestrial Ecoregions of North America, A Conservation Assessment*. Washington, DC: Island Press.
- Romme, W.H., Everham, E.H., Frelich, L.E., Moritz, M.A., & Sparks, R.E. (1998). Are large, infrequent disturbances qualitatively different from small, frequent disturbances? *Ecosystems* 1, 524-534.
- Sierra Valley Resource Conservation District. (2005, April). *Sierra Valley Watershed Assessment*. Retrieval from <http://www.sierravalleyrcd.org/nodes/aboutwatershed/reports/>.
- Squires, J. R., & R. T. Reynolds. (1997). Northern Goshawk (*Accipiter gentilis*). In A. Poole and F. Gill (Eds.), *The Birds of North America* (No. 298). Philadelphia, PA: The Academy of Natural Sciences. Washington, DC: The American Ornithologists' Union.
- Stein, S.M., McRoberts, R.E., Mahal, L.G., Carr, M.A., Alig, R.J., Comas, S.J., Theobald, D.M., and Cundiff, A. (2009). *Private Forests, Public Benefits: Increased Housing Density and Other Pressures on Private Forest Contributions* (General Technical Report PNW-GTR-795). Portland, OR: USDA Forest Service, Pacific Northwest Research Station.
- Thomas, J. W., Raphael, M.G., Anthony, R.G., Forsman, E.D., Gunderson, A.G., Holthausen, R.S., Marcot, B.G., Reeves, G.H., Sedell, J.R., & Solis, D.M. (1993). *Viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest*. The report of The Scientific Analysis Team. Portland, OR: USDA Forest Service.
- U.S. Department of Agriculture, Forest Service. (2009). *Fiscal Year 2010 President's Budget, Budget Justification*. Retrieved from <http://www.fs.fed.us/aboutus/budget/>.
- U.S. Department of Commerce, Bureau of the Census. (1963). *U.S. Census of Population: 1960, Vol. I. Characteristics of the Population, Part 6, California*. U.S. Washington, DC: U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. (1963). *U.S. Census of Population: 1960, Vol. I. Characteristics of the Population, Part 30, Nevada*. U.S. Washington, DC: U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. (2009). *2005-2009 Community Survey Census Fact Sheet, Redding, CA*. Retrieved from http://factfinder.census.gov/home/saff/main.html?_lang=en.
- U.S. Department of Commerce, Bureau of the Census. (2009). *2005-2009 Community Survey Census Fact Sheet, Reno, NV*. Retrieved from http://factfinder.census.gov/home/saff/main.html?_lang=en.
- U.S. Department of Commerce, Bureau of the Census, Data User Services. (2011). *County Business Patterns, 2008*. Retrieved from <http://www.census.gov/econ/cbp/index.html>.
- U.S. Department of the Interior, Fish & Wildlife Service. (2004, April 8). *Twelve-Month Finding for a Petition to List the West Coast Distinct Population Segment of the Fisher (Martes pennanti), Proposed Rule*. 69 Fed. Reg. 18769-18792.
- U.S. Department of the Interior, U.S. Fish & Wildlife Service, U.S. Department of Commerce, and U.S. Census Bureau. (2007, December). *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHW/06-CA)*. Washington, DC: U.S. Government Printing Office.
- U.S. Geological Survey. (2009). *Water-Data Report 2009, 11368000 McCloud River above Shasta Lake, CA [Data file]*. Retrieved from <http://wdr.water.usgs.gov/>.
- University of California, Davis, Natural Heritage Institute, U.S. Forest Service, & California Department of Fish & Game. (2007, June 19). *Final Report: Sierra Meadows: Historical Impacts, Current Status and Trend, and Data Gaps (CD96911501)*. Retrieved from <http://watershed.ucdavis.edu/research/sierra.html>.
- University of Virginia, Geospatial and Statistical Data Center. (2003). *County Business Patterns, 1977 [Data file]*. Retrieved from the <http://fisher.lib.virginia.edu/collections/stats/cbp/>.
- Wang, L., Lyons, J., Kanehl, P., & Gatti, R. (1997). Influences of watershed land use on habitat quality and biotic stream integrity in Wisconsin streams. *Fisheries*, 22(6), 6-12.
- World Wildlife Fund. 2001. *Terrestrial Ecoregions, Klamath-Siskiyou forests (NA0516)*. Retrieved from http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na0516_full.html.



Castle Crags from Castle Creek. (Photo by Mike Hupp)

On the cover: Mount Shasta reflected in a pond. (© David Muench/CORBIS)

About the Pacific Forest Trust

Founded in 1993, the Pacific Forest Trust (PFT) is dedicated to conserving and sustaining America's vital, productive forest landscapes. Working with forest owners, we focus on conserving privately owned working forests for all the benefits they provide, including clean water, sustainably harvested wood, green jobs, renewable, sustainable energy, fish and wildlife habitat and a livable climate. With an array of stakeholder partners, we advance innovative, incentive-based strategies to safeguard our nation's diverse forest landscapes and the communities they support. In so doing, we're ensuring forests continue to provide people everywhere — from rural communities to urban centers — with a wealth of forest benefits.

Acknowledgements

This publication would not be possible without the early support of this vision to conserve the Klamath-Cascade from the Collins Family. I gratefully acknowledge the investments of the Bella Vista, S.J. Bechtel, and National Fish and Wildlife Foundations and the Mary A. Crocker Trust, all of which provided timely and essential support. California Department of Fish and Game provided critical insight and feedback, as did Norman L. Christensen Jr., Ph.D. and Dean Urban, Ph.D. Many PFT staff were invaluable in analyses and research as well: Jon Remucal, our GIS wizard, Megan Wargo, Jesse Leddick, and Connie Best. Cari McLaughlin and Chris Harrison provided great teamwork, problem solving and more.



PACIFIC FOREST TRUST

THE PRESIDIO

1001-A O'Reilly Avenue, San Francisco, CA 94129

TEL 415.561.0700 | FAX 415.561.9559

www.pacificforest.org