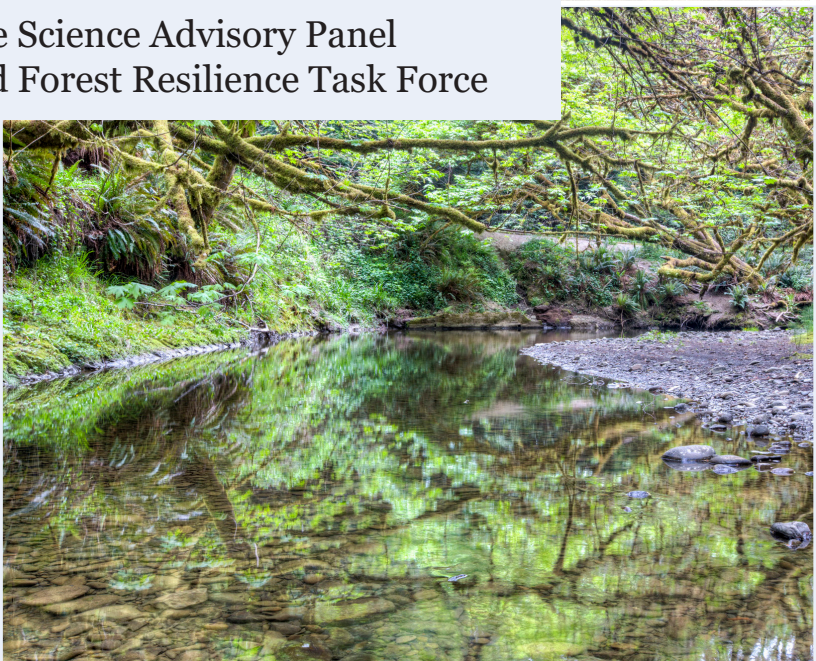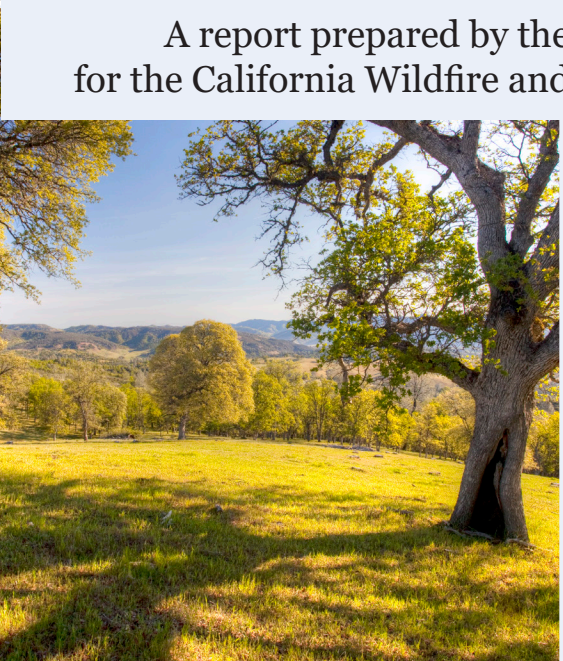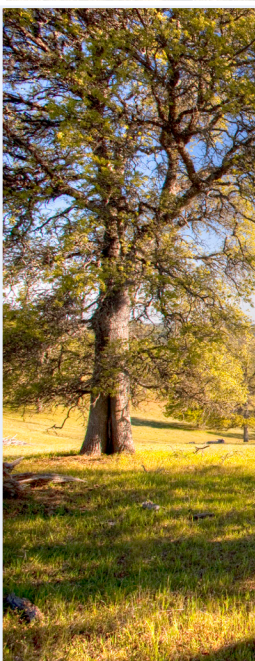# Northern California Regional Profile

November 2023

A report prepared by the Science Advisory Panel
for the California Wildfire and Forest Resilience Task Force

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Cover photos:

Top: View of rangelands and mountains near the town of Canby in Modoc County; Sheila Sund. *Left:* Oak woodlands and grasslands in Cache Creek Natural Area provide valuable habitat and recreation opportunities in Lake County; Bob Wick, BLM. *Right:* Headwaters Forest Reserve in Humboldt County protects old-growth redwood forests and critical stream habitat for endangered salmonids; Bob Wick, BLM. *Bottom:* Fog and low cloud cover rises from the ocean to the mountains at King Range National Conservation Area in Humboldt County; Bob Wick, BLM.

Contents

Northern California Regional Profile

The State of California, U.S. Forest Service, and regional partners are collaborating to respond to the wildfire and climate crises that have significantly impacted, and are projected to continue to impact, California's natural and human communities. The primary goal of this response is to identify the scale and types of management needed by 2025 to meet these interrelated crises and restore resilience to California's diverse ecosystems. The expected outcomes are to reduce the risk of catastrophic wildfire and enhance community resilience. To achieve this goal, capacity to plan and implement socially acceptable land management activities at ecologically meaningful scales must increase. This will require state, federal, regional, and local partners working across jurisdictional boundaries to develop integrated plans that are consistent with local objectives, projects, and strategies. Regional Profiles, such as this report, have been developed as one of the resources to assist with this effort.

The Science Advisory Panel of the California Wildfire and Forest Resilience Task Force (WFRTF) developed the Regional Profile series in order to provide insight, both social and ecological, for community and ecosystem resilience to wildfire in each of the state's four diverse regions (see Figure 1). The content of each Regional Profile is informed by the best available scientific information, as well as the experience and perspectives of diverse stakeholders from the region. Each Regional Profile also showcases products of the Regional Resource Kit (RRK), which provides publicly available mapped data. The RRK is another resource being developed for the WFRTF by an interagency collaboration to support state and regional planning efforts to achieve socio-ecological resilience.

The Regional Profile and RRK build upon the Pillars

Figure 1. Boundaries of the four state regions, as delineated by the Task Force, and the boundaries of the 15 counties partially or fully included in the Northern California region.

of Resilience Framework, which resulted from a collaborative stakeholder process organized through the Tahoe-Central Sierra Initiative. The Framework is structured around ten desired outcomes, termed 'Pillars of Resilience', that reflect key social and ecological values. Each pillar is characterized by regionally-specific metrics, which can be used to assess, plan for, measure and monitor progress toward achieving objectives on a landscape. In this way, the Framework provides a common platform for tracking progress towards statewide goals while meeting regionally-specific needs.

PC: harminder dhosi

Actions that benefit one pillar may also benefit other pillars or may result in tradeoffs. For example, fuel treatments that reduce wildfire hazard to communities ("Resilient and Fire-Safe Communities") may also protect water resources ("Water Security") or may negatively impact wildlife habitat ("Biodiversity Conservation"). Additionally, management needs and priorities likely vary at both the regional and sub-regional scales. To navigate this complexity, it is important that decision-makers understand the priorities and values of local communities and stakeholders. Each Regional Profile includes stakeholder input gathered via an anonymous survey about priority areas of investment for achieving resilience, as well as focused interviews with regional experts and leaders about key issues, barriers, and opportunities for increasing resilience to wildfire. To assess how community members' experiences and perspectives varied across the region, survey respondents were asked to identify the primary county where they live or work (Fig. 1).

For the purposes of the Regional Profile stakeholder survey, we modified the ten Pillars of Resilience to eight categories: Healthy and resilient forests, Healthy and resilient shrublands and grasslands, Resilient and fire-safe communities, Air quality, Water security, Biodiversity conservation, Carbon storage, and Economically robust communities (Fig. 2). The following sections provide a Northern California-specific overview of how each of these categories are affected by the interrelated crises of wildfire and climate change, as well as opportunities for increasing resilience. Each section also includes highlights from the 345 survey responses and the 46 interviews, and finally, example assessments of current resource conditions. Our intention is to provide foundational background information for the Northern California region; share findings that summarize stakeholder perspectives on the region's key issues; and describe select metrics being used to assess each pillar, to help land managers and decision-makers understand how data and metrics provided in the Regional Resource Kit can be applied to achieve desired outcomes.
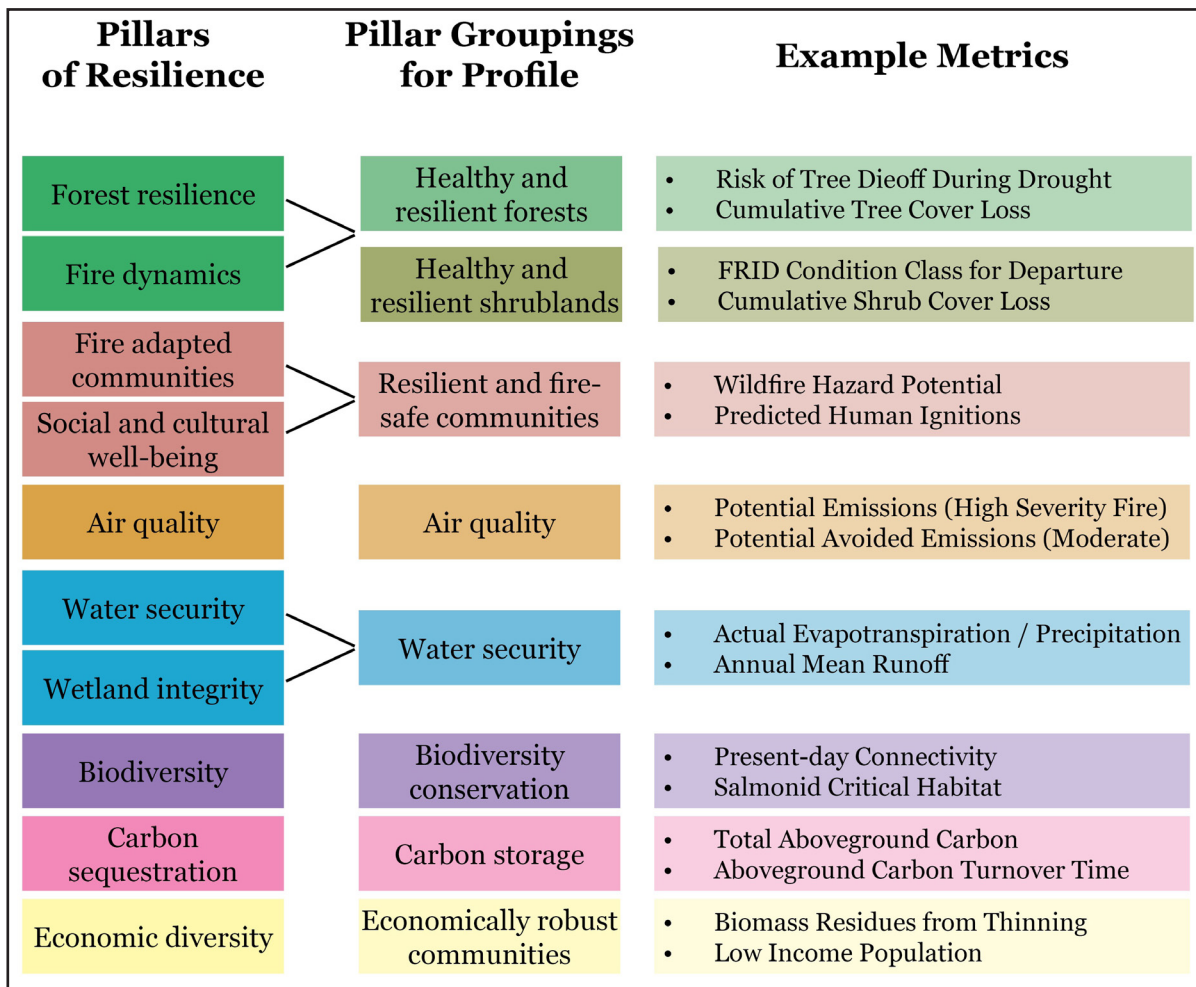
Pillars of Resilience	Pillar Groupings for Profile	Example Metrics
Forest resilience	Healthy and resilient forests	• Risk of Tree Dieoff During Drought • Cumulative Tree Cover Loss
Fire dynamics	Healthy and resilient shrublands	• FRID Condition Class for Departure • Cumulative Shrub Cover Loss
Fire adapted communities Social and cultural well-being	Resilient and fire-safe communities	• Wildfire Hazard Potential • Predicted Human Ignitions
Air quality	Air quality	• Potential Emissions (High Severity Fire) • Potential Avoided Emissions (Moderate)
Water security Wetland integrity	Water security	• Actual Evapotranspiration / Precipitation • Annual Mean Runoff
Biodiversity	Biodiversity conservation	• Present-day Connectivity • Salmonid Critical Habitat
Carbon sequestration	Carbon storage	• Total Aboveground Carbon • Aboveground Carbon Turnover Time
Economic diversity	Economically robust communities	• Biomass Residues from Thinning • Low Income Population

Figure 2. The original ten pillars of resilience were modified into eight pillar groupings to gather stakeholder input via surveys and interviews. These eight groupings form the organizational basis for this document. Each pillar includes metrics for assessing current resource conditions. The metrics listed here are examples showcased in this profile, but additional metrics and data are provided in the Regional Resource Kit.

Northern California Region

The Northern California region stretches from the rugged coastline of the North Coast in the west with its remnants of ancient forests to the northern Sacramento Valley in the east with its valuable agricultural resources. It is home to nearly two million people that are spread over 15 primarily rural counties (Fig. 1). Land in the northernmost counties is sparsely populated with remote communities and large areas managed by federal agencies, while forest parcels in the southern counties are owned by many small private landowners and face some of the same development pressures of the San Francisco Bay Area that these counties border. The region is also home to over thirty federally-recognized Tribes. This vast area encompasses significant ecological diversity shaped by topography coupled with a coastal climatic gradient, as well as by a long history of human land use.

Ecosystems across the region evolved to be adapted to fire from both lightning ignitions and over 13,000 years of cultural burning by Indigenous peoples. However, over a century of fire suppression and other land use changes have altered natural disturbance regimes. This is now being compounded by climate change and other novel disturbances, such as invasive species and pathogens, which are leading ecosystems to shift to new states and habitat types. This has also increased the threat of catastrophic wildfire across the region.

Many stakeholders in Northern California believe that there is a common misconception that their area is not as vulnerable to wildfire as other parts of the state. In fact, almost 70% of Lake County has burned since 2015. Trinity County is one of the highest fire risk counties in the state, and every community in the county has been evacuated at least once in the last five years. More populated areas, such as Sonoma County, have also been affected. In 2017, the Tubbs Fire took nine lives and destroyed over 3,000 homes in the city of Santa Rosa alone. Some other counties in the drier interior of the region have similarly been disproportionately affected relative to other parts of the state, while moister coastal areas are also beginning to experience more severe fire events (Fig. 3).

The rural nature of Northern California means that many regional economies, such as timber, ranching, agriculture, and tourism, depend on land and natural resources that are increasingly threatened by wildfire. However, there is also a strong tradition of land stewardship and self-reliance in the region. These cultural values and place-based knowledge have made community-based initiatives to respond to increasing wildfire danger particularly effective in many parts of the region.

One challenge is bridging the diverse land stewardship perspectives that coexist in the region. There are many families in the region who have stewarded land for generations for ranching and timber production. Beginning in the 1960s, a countercultural back-to-the-land movement led to an influx of new residents building homesteads in remote areas and bringing with them an ethos of environmental preservation. These two traditions of land stewardship have historically been at odds, most notably during the 'timber wars' of the 1980s and 90s when loggers and conservationists bitterly conflicted over the management of Pacific Northwest forests. This legacy has contributed to persistent distrust of forest management in the Northern California region. Also, Tribal communities
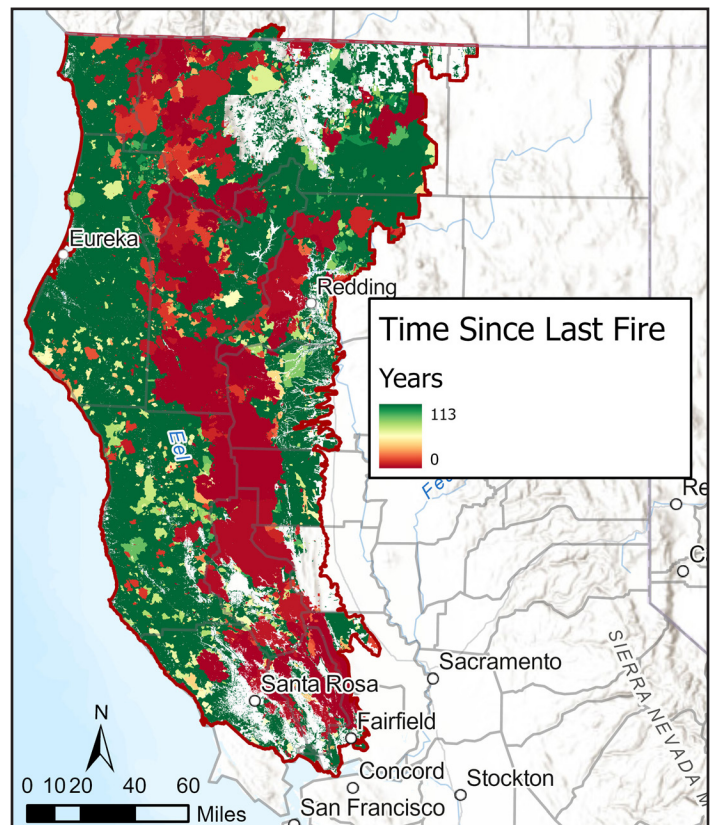

Figure 3. Huge sections of the interior of the region, from Santa Rosa all the way to the Oregon border, have burned in the last 1-5 years. Implementing post-fire responses to such large footprints all in need of management at once is an enormously resource intensive task. In contrast, nearly all of the coastal counties (Humboldt, Del Norte and most of Mendocino) have not burned in more than 50 years. Managers may need to prioritize treatments to mitigate wildfire hazard in these areas as well, in order to reduce dangerously accumulated fuels. Data credit: Fire History (2022), CAL FIRE.

in the region are endeavoring to restore traditional land management practices that were suppressed by 19th century Euro-American settlement and 20th century fire suppression policies. These practices are embedded in a worldview of humans as kin with the natural world, which can be difficult to reconcile with the anthropocentric worldview that dominates land management work for fuels reduction.
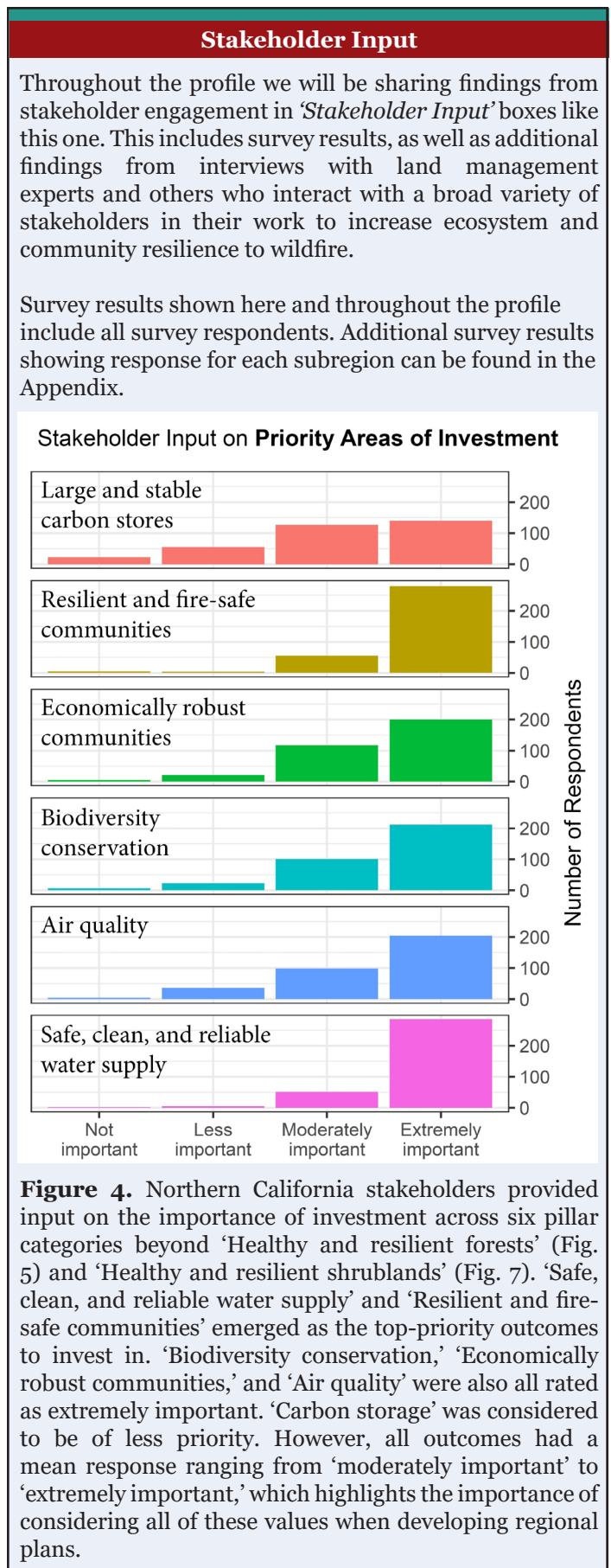
Given this varied cultural context, it is unsurprising that one topic that was frequently raised by interviewees participating in this Northern California Regional Profile project was 'social license.' Whether or not vegetation treatments and other wildfire resilience-related projects had the support of local community members and other stakeholders has critically influenced whether planned projects are successful in this region. Despite these challenges, there are also many examples across the region of individuals and groups that have been highly effective in bridging historic divides to build new, stronger collaborations. New organizations, such as fire safe councils and prescribed burn associations, as well as larger landscape-scale collaboratives are forming across the region. There are also a growing number of partnerships between Tribal communities and public and private organizations that are creating more opportunities for integrating Indigenous stewardship practices into land management. In some cases, the mounting threat of wildfire has provided momentum to build consensus between diverse stakeholders and motivated community members to take an active role in increasing ecological and community resilience to wildfire.

Healthy and Resilient Forests

Forests and woodlands cover approximately 60% of the Northern California landscape (Fig. 5) and provide vital ecosystem services, including protecting the health of key water sources, sequestering and storing carbon, and offering recreational opportunities. Managers are challenged to respond to multiple threats to these ecosystems, including climate change, invasive species, novel pathogens, development of natural lands, and changing wildfire regimes. Threats and management priorities vary by forest type.

Coast Redwood Forests

Coast redwood forests are an iconic ecosystem of Northern California and have long played an integral role in the regional economies of timber and tourism for the North Coast counties. The coast redwood ecosystem exists in a narrow band from Monterey

Stakeholder Input

Throughout the profile we will be sharing findings from stakeholder engagement in *'Stakeholder Input'* boxes like this one. This includes survey results, as well as additional findings from interviews with land management experts and others who interact with a broad variety of stakeholders in their work to increase ecosystem and community resilience to wildfire.

Survey results shown here and throughout the profile include all survey respondents. Additional survey results showing response for each subregion can be found in the Appendix.

Stakeholder Input on **Priority Areas of Investment**

Figure 4. Northern California stakeholders provided input on the importance of investment across six pillar categories beyond 'Healthy and resilient forests' (Fig. 5) and 'Healthy and resilient shrublands' (Fig. 7). 'Safe, clean, and reliable water supply' and 'Resilient and fire-safe communities' emerged as the top-priority outcomes to invest in. 'Biodiversity conservation,' 'Economically robust communities,' and 'Air quality' were also all rated as extremely important. 'Carbon storage' was considered to be of less priority. However, all outcomes had a mean response ranging from 'moderately important' to 'extremely important,' which highlights the importance of considering all of these values when developing regional plans.

County in the Central Coast in the south to California's border with Oregon in the north. This area is known

as the fog belt, and these forests are only able to persist because of the critical summertime moisture provided by fog that sustains them through the dry summer season. Both redwood trees and many of the understory plants are specially adapted to absorb fog water through their leaves. If fog frequency declines in the future due to climate change, redwood forests may be increasingly drought stressed. A related concern is that thinning in some coast redwood forests could create forest structures that are too open, thereby diminishing the forest's ability to capture moisture from fog.

Coast redwood trees are adapted to both low- and high-intensity fire. Their thick bark protects living tissue, and they have the capacity to resprout from their trunk even after wildfire consumes their crowns. Studies estimate that the natural fire regime in redwoods was every 25-30 years due to both lightning ignitions and cultural burning by Indigenous people. These trees can live for over 2,000 years and grow over 320 ft tall, making them the tallest trees in the world. However, few of these ancient trees still exist because redwood is one of the most valuable trees for timber.

The redwood ecosystem, including both the North Coast and the more southern range along the Central Coast, has experienced a long history of intensive logging. Of the 1.6 million acres of remaining coast redwood forest, 93% has been logged at least once, leaving relic old-growth patches scattered across a highly fragmented landscape. Visitors to the region typically experience redwood trees in state, national and regional parks, but 35% of redwood forests is managed by commercial timber companies, while an additional 37% is owned by small private landowners and also considered unprotected. This has resulted in a fragmented ecosystem under a mosaic of different ownerships, which complicates efforts to increase forest resilience to wildfire.

Historically, there has been little catastrophic fire in redwood forests, but this has started to change for the Northern California region in the last 15 years. Furthermore, the CZU Lightning Complex fire that burned across 86,509 acres of forest lands in the Central Coast in August 2020 at much higher severity than previously occurred has changed perception about how mature redwood forests could burn as a result of climate change and other changing disturbance regimes. One emerging threat is the prevalence of sudden oak death, an infectious disease caused by an
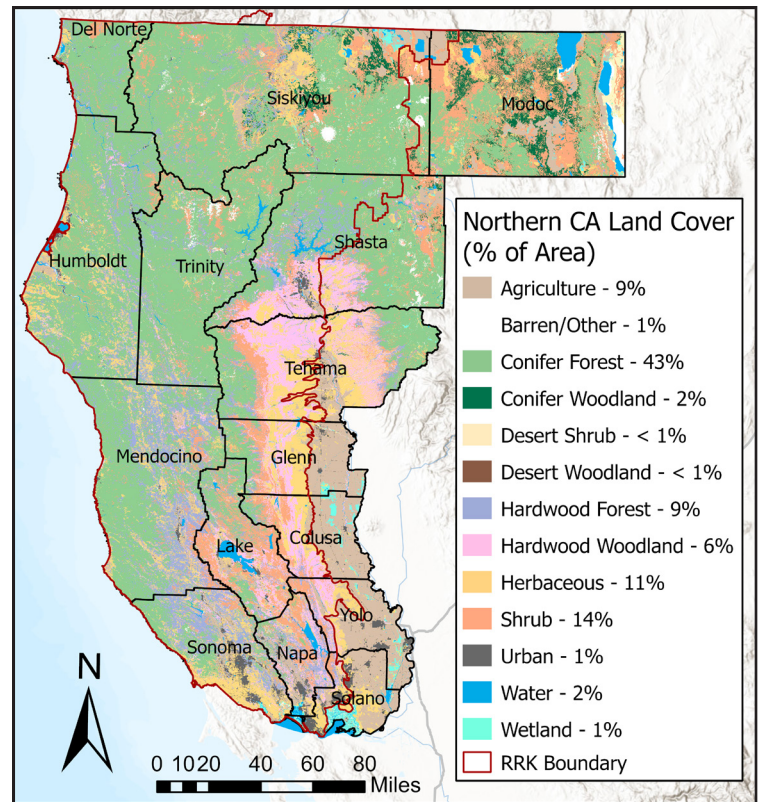

Figure 5. Map uses 2015 FVEG data (CALFIRE-FRAP) to show the distribution of land cover types across the 15 counties that are part of the Northern California region. The Northern California Regional Resource Kit provides spatial data for the area shown in the red boundary; it excludes agricultural land and county areas that were included in the Sierra Nevada Regional Resource Kit.

exotic invasive water mold *Phytophthora ramorum*. Although coast redwood trees are not susceptible to the pathogen, they frequently co-occur with tanoak trees which have suffered as high as 90-100% mortality in some impacted areas. Dead tanoak trees alter fuel loads and can increase the risk of higher-severity fire because fire can move from the surface to the canopy by using the standing dead trees as a ladder.

Mixed Conifer Forests

Moving inland from the coast and to higher elevations, mixed conifer forests dominate the forested landscape, with notable tree species including Douglas-fir, tanoak, California bay laurel, Pacific madrone, and a variety of pine and oak species. Similar to the redwoods, these forests are adapted to frequent, low-severity fire. In the eastern Klamath ecoregion, forests evolved with a fire return interval of less than 25 years, and this interval could be significantly less in areas due to Indigenous land management.

Much of this forested land is now federally-managed, including four large national forests: Klamath,

Mendocino, Six Rivers, and Shasta-Trinity. For most of the 20th century, federal forest management in this region was governed by principles of providing sustained timber yield. In 1994, the implementation of the Northwest Forest Plan (NWFP) shifted federal land management practices for 17 national forests, including the four in this region, in an effort to better protect public values that forests provide. A primary focus of the revised land management plan was protecting remaining old-growth forests and the endangered species, such as the northern spotted owl and marbled murrelet, which depend on this habitat, as well as protecting sensitive aquatic habitats. As a result, NWFP significantly restricted timber harvesting on federal lands in the region.

Although NWFP was highly effective in preventing clear-cutting of old-growth forest, biodiversity in these forests has continued to decline due to other threats. In particular, warming climate and denser forests due to the legacy of plantation-style timber management and fire suppression have led to both drought- and fire-driven tree mortality. Furthermore, the planned goal to maintain a viable timber industry to sustain rural communities and economies was not realized under the original plan. In July 2023, the U.S. Department of Agriculture appointed a new Federal Advisory Committee to

Figure 6. Survey respondents were asked how important various potential areas of investment were for achieving healthy and resilient forests in their area of Northern California. The vast majority of stakeholders rated reducing fuel loads as extremely important for achieving this objective. Other top priorities for investment were applying prescribed fire, adapting management for climate change, and increasing forest management workforce. Many other areas of investment were also considered to be on average at least moderately important. Developing a robust timber economy, developing wood products infrastructure, and developing biochar production capacity were considered on average to be less important. However, the related topic of developing economic solutions, such as new infrastructure and markets, to better deal with biomass from forest treatments was a topic commonly mentioned as a high priority during expert interviews.

provide recommendations on updating the NWFP to better respond to current management needs, including climate change and other novel disturbances. The plan will be updated to incorporate traditional ecological knowledge as well as the latest science. One planned revision is requiring a landscape-based approach that provides more flexibility for managing biodiversity conservation than the historic plan which emphasized strict habitat designations and single species management.

Another challenge facing regional forest management is tree mortality associated with drought and insect pest outbreaks. Similar to the Sierra Nevada region, there are species of pine, such as Ponderosa pine and sugar pine, in Northern California that are especially susceptible. Bark beetles, such as the mountain pine beetle and western pine beetle, naturally occur
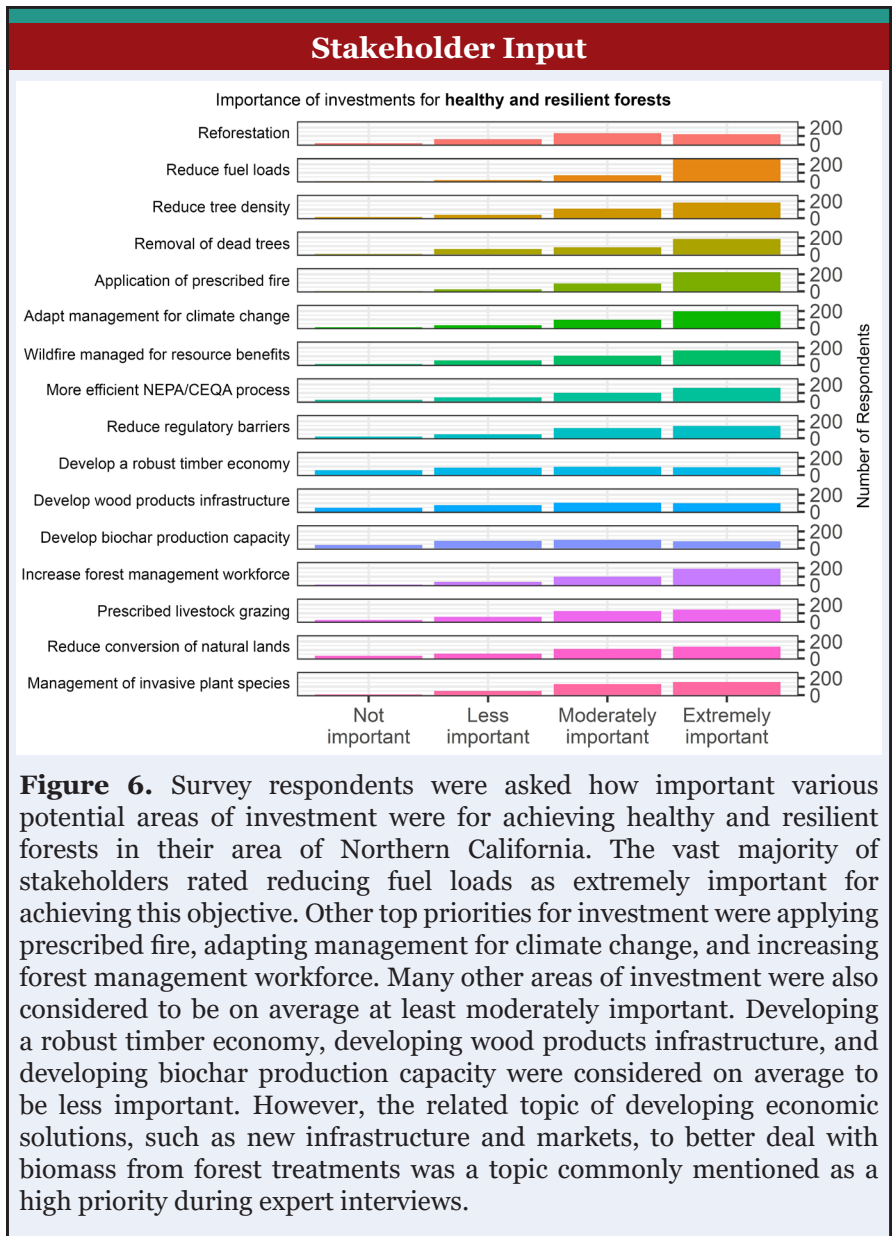
in the region and under normal conditions create smaller patches of tree mortality that benefit forest structure diversity. However, under the recent drought conditions and poor forest health, bark beetle populations have surged in many forests of California and led to widespread tree mortality. This mortality can result in larger and more severe wildfires due to increased dead fuels on the landscape. Forest stands that had previously been treated by prescribed fire and mechanical thinning have been found to experience lower mortality because fewer trees meant less competition for water resources. Additionally, research indicates that low-severity fire can spur sap production in surviving pines for a decade or more, bolstering defenses against bark beetles. Thus, forest treatments that reduce the probability of severe wildfire can also make forests more resilient to drought and bark beetle infestations.
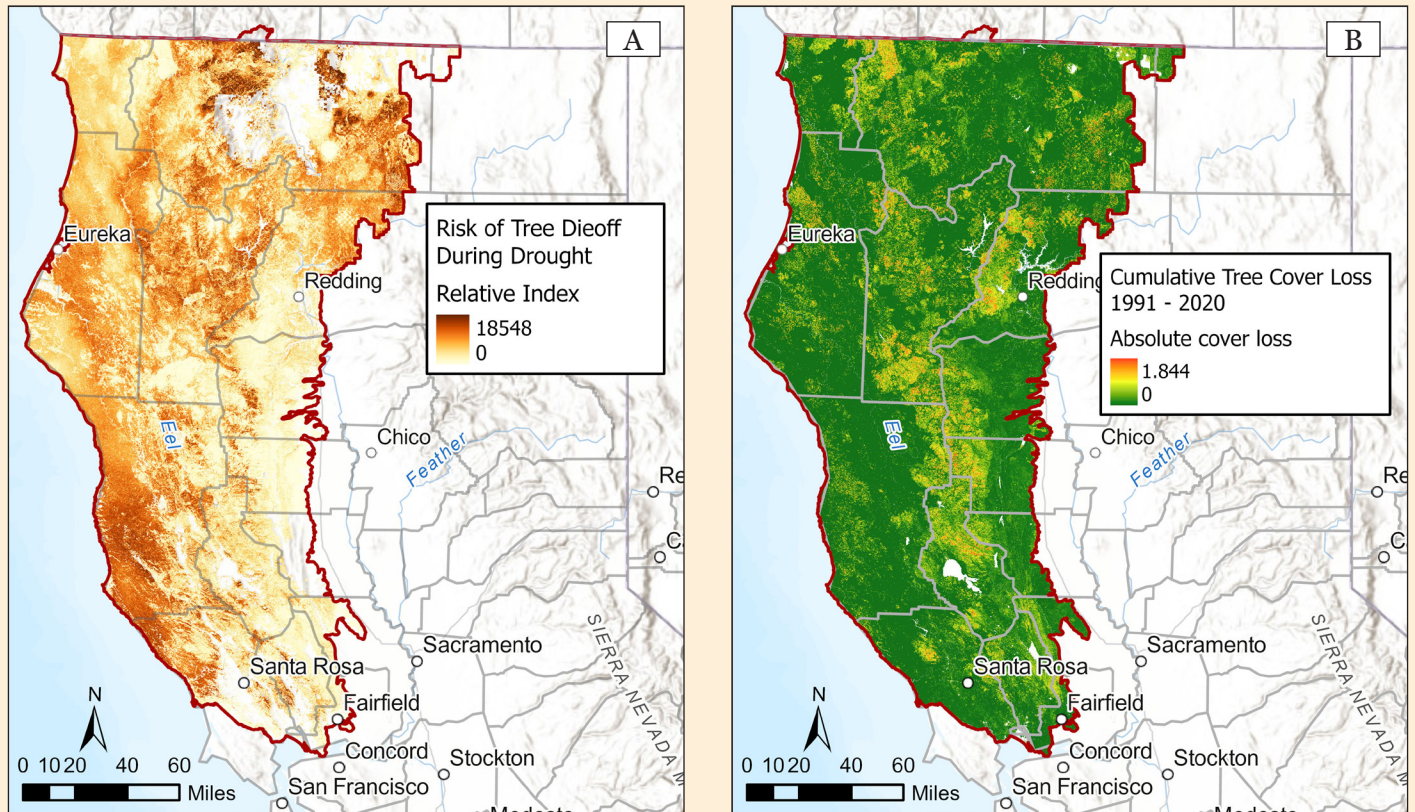
Figure 7. The risk of trees dying during drought metric (A) is an index based on the ratio of local moisture balance and tree density. Low values can indicate minimal risk because moisture balance is sufficient to support the surrounding trees, or simply because there are few trees present. However, high values indicate significant risk of tree dieoff during a drought. Managers may use this metric to prioritize areas for thinning treatments, in the hopes that less competition for available water will reduce the risk of tree dieoff. In Northern California, risk of dieoff is significant along the Mendocino County coast, and much of the Shasta-Trinity National Forest. The Regional Resource Kit also includes data on cumulative tree cover loss (B) quantified by remote sensing and including loss resulting from all types of disturbances, including logging. This metric is measured as an absolute value, ranging from 0 to 1; though values can exceed 1 if multiple disturbances occurred. In Northern California, much of the tree cover loss is concentrated in a band running from northern Lake County to southern Trinity County, with additional areas of high tree cover loss in western Shasta and Siskiyou Counties.

There is a need for more monitoring and research to understand how to make redwood forests and mixed conifer forests in the region more resilient to fire because fire dynamics in these ecosystems are less-studied than, for example, forests in the Sierra Nevada region. Many stakeholders in the region are interested in improving forest health by restoring fire to the landscape through prescribed burning and cultural burning. However, in many areas fuels need to be reduced by other means first before it is considered safe or ecologically effective to do controlled burning. One concern is that forests in the coastal region are highly productive and regrowth happens quickly after vegetation treatments, which means that fuels reaccumulate quickly, too. In general though, there is consensus that encouraging the growth of larger trees and reducing forest density is important for making Northern California forests more fire-resistant.

Oak Woodlands

Oak woodlands are an ecologically and culturally important ecosystem that can be found in lower-elevation areas throughout the Northern California region. The distribution of oak species varies across the region. Commonly found oak species in the North Coast include Oregon white oak, tanoak, canyon live oak and California black oak. In the northern interior region, there is a mixture of blue oak, California black oak, canyon live oak, and Oregon white oak. In the Sacramento region, as well as more southern areas of the Central Valley, there are significant valley oak and blue oak woodlands.

The majority of oak woodlands in the region are located on private property, which places this habitat at high risk of land development, especially in more urban areas such as the Sacramento region. For

The Indian Valley/Walker Ridge Recreation Area on the eastern edge of Lake County features chaparral covered hills dotted with oak and pine that provides wildlife habitat and recreational opportunities. Photo credit: Jesse Pluim, BLM

example, Napa County has already lost an estimated 90% of historic oak woodlands since the early 1880s. Oak woodlands are also vulnerable to habitat type conversion due to encroachment by Douglas-fir trees and invasive grasses, which is being largely driven by the suppression of the fire regimes to which oaks were adapted. Similarly to other regions of the state, Northern California oak woodlands are also threatened by emerging diseases. Sudden oak death has killed millions of tanoaks and oak trees in coastal California forests since the late 1990s. Recently, extreme drought has also killed many oak trees and is a heightening concern under climate change.

Tree mortality increases surface fuel loads and numbers of standing dead trees (snags) on the landscape. Management actions that restore low-severity fire back into these systems, reduce fuel loads, and remove invasive species will increase the resilience of oak woodlands to future climate change, invasive species, and novel pathogens. Organizations such as resource conservation districts are also leading efforts in the region to plant acorns and restore oak trees.

Healthy and Resilient Grasslands and Shrublands

Grassland and shrubland ecosystems are also an important component of the Northern California landscape, especially in the interior Northern Sacramento Valley region where ranching and agriculture are primary industries. However, as a result of agriculture and other human activities, a lot of grasslands have been reduced to a few invasive species, such as medusahead, yellow starthistle, and goatgrass. These invasive plants provide little nutritional value for livestock and grazing wildlife. Controlled burning is one of the most efficient and ecologically-beneficial ways to eliminate these invasive annual species and encourage the growth of native grass species. However, to be effective, burns must be carefully timed to occur after combustible fuel loads are sufficient and prior to seeds maturing and dispersing. This typically happens in late spring, but most prescribed burning is restricted to winter and early spring due to fire hazard and air quality regulations, resulting in limited opportunities to restore native grasslands.

Chaparral is another important ecosystem in Northern California that provides habitat for many species of wildlife and other ecosystem services, including reducing soil erosion and sequestering and storing carbon. The importance of chaparral ecosystems

Figure 8. Stakeholders responded that the top priority areas of investment for achieving healthy and resilient shrublands were roadside ignition prevention and utility hardening/undergrounding. Increasing land management workforce and actions that restored disturbed or degraded habitat, including managing invasive plant species, were also considered important. Survey respondents rated planting trees to create ember screens and restricting public activities during peak fire weather to be less important than other potential areas of investment for their region.

Importance of investments for **healthy and resilient shrublands**
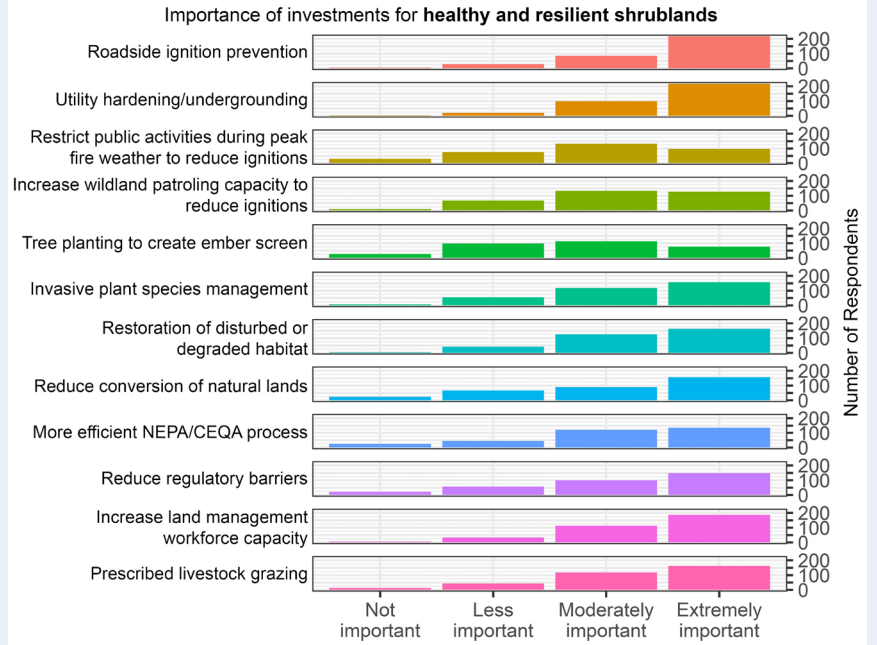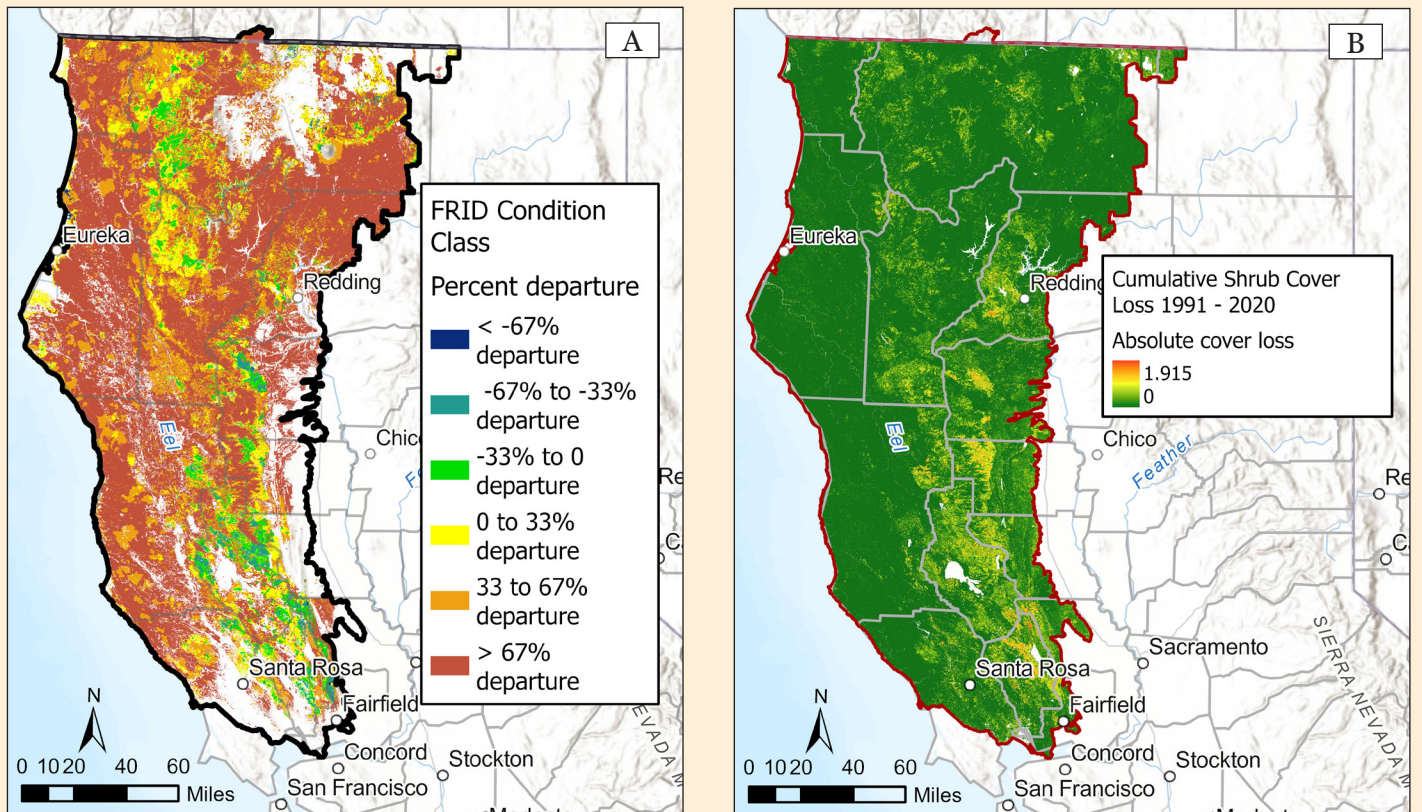
Current Conditions

Figure 9. Fire Return Interval Departure (FRID) condition class (A) reflects the magnitude and direction of departure of contemporary fires (data from 1908-2022) from the historical fire return interval on the landscape. A positive FRID value indicates fires are burning less frequently than historical regimes, while negative values indicate fires are burning more frequently than historical regimes. The greater the condition class value, the greater the departure from an area's historical fire return interval. Much of this region is in a fire deficit, meaning fires are burning less frequently than historical regimes. Cumulative shrub cover loss (B) from fires, management, and dieoff is measured as an absolute value. These values range from 0 to 1; values can exceed 1 if multiple disturbances occurred. Significant shrub cover has been lost in areas that have experienced fire in the last 5 years, such as Lake and Napa Counties (see Fig. 2 'Time Since Last Fire').

Tribal EcoRestoration Alliance (TERA) Crew Lead Stoney Timmons lights up tule thatch near the shore of Clear Lake. Cultural burning of tule has been a practice of Pomo people since time immemorial, and is a critical component of maintaining healthy lakeshore wetland habitat for the endangered Clear Lake hitch. Photo Credit: Sashwa Burrous

is often overlooked because they do not provide merchantable resources to humans as forests do. Since Euro-American settlement of California, there has been a misconception that chaparral represents degraded forest, and it has often been cleared for human development. Many communities and remote homes have been built in chaparral in Northern California, which poses a threat to public safety because this vegetation is highly flammable and burns at high-intensity.

To mitigate wildfire hazard to these communities, it is necessary to create defensible space, which often requires clearing chaparral habitat. Other approaches that are used to reduce fuels and restore ecological health to forests and grasslands, such as mechanical treatments and controlled burning, are also harmful for chaparral habitat. However, management actions that may impair ecological resilience on the treatment site (e.g., strategic fuel breaks), may increase the ecological resilience of the larger landscape by reducing the risk of fire entering the neighboring undisturbed areas and human communities. When managing grasslands and shrublands it is also important to avoid creating gaps and soil disturbance that increase susceptibility to invasion by nonnative annual plants because this can increase wildfire hazard.

Resilient and Fire-Safe Communities

As the Northern California region prepares for a future of increasing fire risk, communities are working to mitigate fire hazard and increase emergency preparedness. One challenge to adapting is that areas that did not experience high fire risk tend to have limited public awareness about how to live with fire and less capacity to increase fire preparedness than areas which have historically contended with wildfire. Furthermore, many rural communities in the region are socioeconomically disadvantaged and have aging populations, which makes it harder to do proactive work to mitigate wildfire hazard or to recover after disasters occur. Home hardening is critically needed in many areas, but many residents cannot afford costly home retrofitting. Although there are low-cost strategies for mitigating wildfire risk, such as modifying landscaping, placing screens on ventilations, and keeping flammable materials away from homes, many residents are not aware of these recommended practices. One solution for this is increasing public education around both home hardening and defensible space recommendations. There is also a need to increase public awareness on preventing human ignitions, as accidental ignitions have been the cause of some recent destructive wildfires in the region.

Safety during wildfires and other emergencies is a concern for many communities across the region, especially in remote areas where there are limited roads for ingress and egress. Efforts are being made to develop evacuation plans and to increase secondary route access through private road agreements between neighbors, but in many areas limited financial resources or topographical challenges make building additional road infrastructure infeasible. Similar to other regions in California, there has been continued development in the wildland-urban interface where there is high fire hazard. Certain counties, especially in the southern part of the region and near Redding in Shasta County, have been especially susceptible to this. This is a concern because development in the wildland-urban interface increases the probability of human ignitions in densely vegetated areas and increases the risk of danger to communities if natural- or human-caused wildfire does occur.

One aspect of emergency preparedness that is particularly challenging for the Northern California region is communication to remote communities. Many communities do not have access to broadband internet and have limited cell reception. As a result, it can be hard for residents to access information or receive emergency notifications. Many communities rely on local radio stations as the primary alert system, though in some remote areas, it is even hard for radio signals to get through. Areas that normally have functioning communication networks that depend on websites and social media also need to have a back-up plan prepared for communities to know how to respond in emergencies when electricity is lost.

In order to be resilient to wildfire, communities also need to be capable of recovering after disaster occurs. One interviewee described how in their experience there has been tremendous emergency response to suppress fire, but afterward there are limited resources, technical expertise, and other support for communities that need to rebuild. Recovery is becoming increasingly challenging as many homeowners across the region have lost access to fire insurance due to policies being dropped or rates becoming unaffordable. As a result, when disaster occurs, many residents are unable to rebuild and end up leaving the area. This displacement has put greater strain on limited housing resources
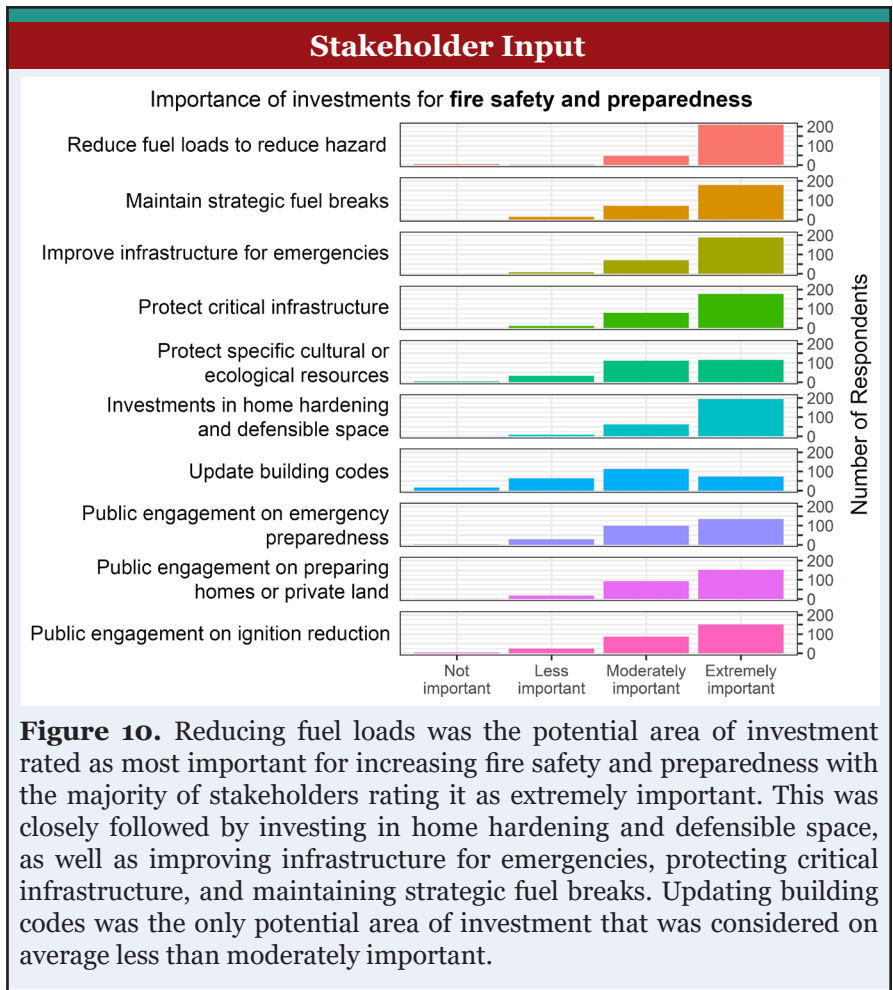

Figure 10. Reducing fuel loads was the potential area of investment rated as most important for increasing fire safety and preparedness with the majority of stakeholders rating it as extremely important. This was closely followed by investing in home hardening and defensible space, as well as improving infrastructure for emergencies, protecting critical infrastructure, and maintaining strategic fuel breaks. Updating building codes was the only potential area of investment that was considered on average less than moderately important.
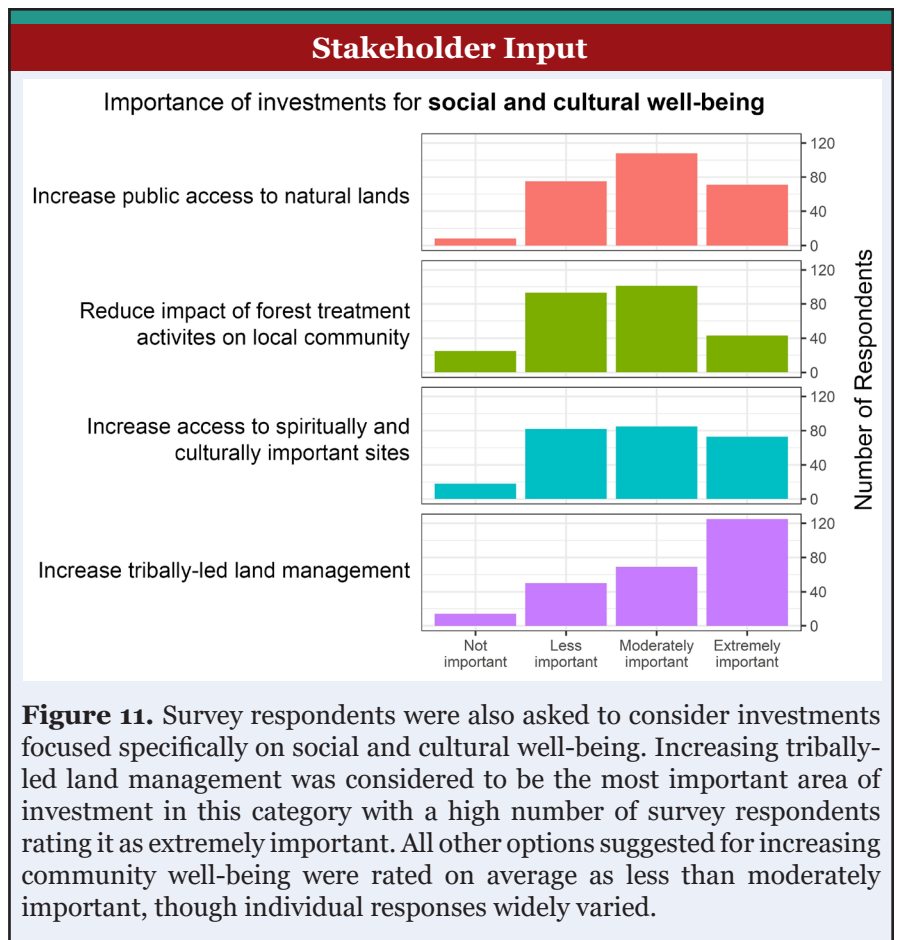
in other areas and also impacts the recovery of the community that remains. Several interviewees noted that there is also a need for community resilience efforts to address mental health because many people in the region have experienced trauma from recent wildfire events.

Despite these challenges, there are many new initiatives led by both public and private organizations that are effectively increasing community resilience across the region. These organizations are empowering communities by providing technical expertise, public education, and increased access to resources, including grant opportunities. New fire safe councils and prescribed burn associations are forming across the region. Many neighborhoods are also working toward achieving Firewise Community designation to increase the safety of their community and to access insurance discounts. However, interviewees expressed concerns that many positions and projects are dependent on temporary funding from legislation or grants, and the long-term work that needs to be done to respond to the growing wildfire crisis requires more permanent funding support. Interviewees also expressed concern that entities with greater existing capacity are often more successful in competing for grants and forming

partnerships, whereas counties and individual organizations that have less capacity continue to struggle to access resources.

Some regional organizations are investing in building community capacity that can then be self-sustaining. For example, the Watershed Research and Training Center provides family-friendly community-based training in implementing prescribed fire. This has been effective in developing local workforce capacity, as well as providing broad public education around living with fire. One interviewee noted that it can be challenging to do community engagement work because this work is often not recognized as something that needs funding and is worth investing in. Also, funding and metrics for success tend to be tied to quantifiable outcomes like acres of vegetation treated, and it can be harder to quantify the return on investment that comes from empowering communities. However, some public agencies and other land management organizations have recently staffed more public affairs and community outreach positions.

In some cases, community resilience and recovery efforts have been notably led by people who were personally impacted by recent fire events. For example, after the 2015 Valley Fire devastated Lake County, took four lives, destroyed nearly 1,281

Figure 11. Survey respondents were also asked to consider investments focused specifically on social and cultural well-being. Increasing tribally-led land management was considered to be the most important area of investment in this category with a high number of survey respondents rating it as extremely important. All other options suggested for increasing community well-being were rated on average as less than moderately important, though individual responses widely varied.

homes, and caused an estimated $1.5 billion in losses, a community member who lost their house was motivated to start a non-profit called the Seigler Springs Community Redevelopment Association that has since grown in capacity and continued to provide disaster care management, economic grant development, and community development with a particular focus on wildfire adaptation. Such examples of disaster leading to stronger regrowth demonstrate the capacity for resilience that exists in the region.

CAL FIRE fire fighters work to suppress the 2021 Dixie Fire which burned across nearly 1 million acres in the Northern California and Sierra Nevada regions, making it the largest single wildfire to occur in California history. Photo credit: CAL FIRE
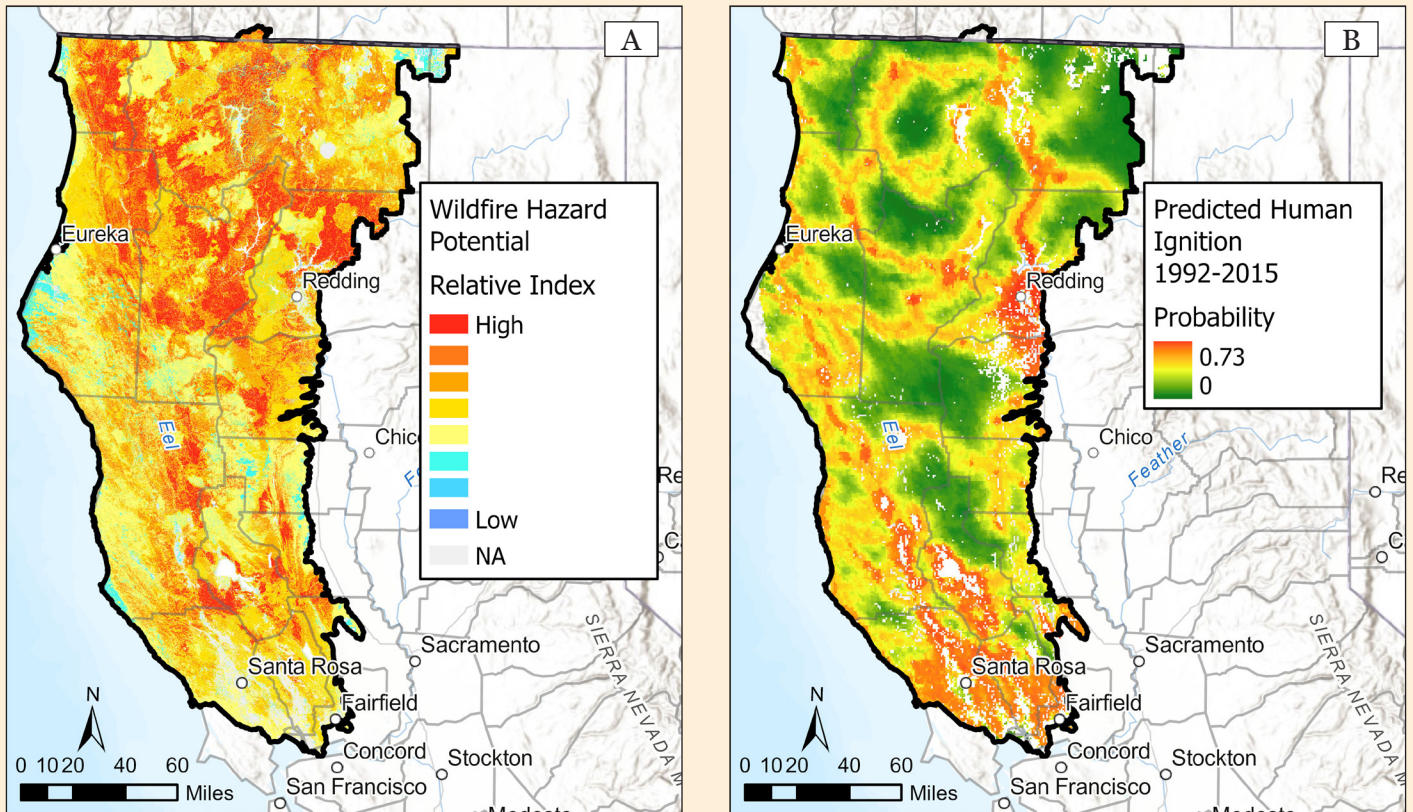
Figure 12. Measuring wildfire hazard potential (A) can help prioritize locations of fuel treatments. In the Regional Resource Kit, this metric focuses specifically on potential for fires that may be difficult for suppression operations to control based on models of how fire will behave. High potential for wildfire hazard exists in all of Northern California's counties. Hazard potential is especially high and concentrated in Del Norte County, northeastern Humboldt County, eastern Trinity and northern Shasta Counties. The Regional Resource Kit ignition probability metrics reference a model that used recent (1992-2015) ignition records and environmental data, including human settlement, climate, fuels, and topographical variables, to predict human-caused ignition probability (B). Because population density is low across most of Northern California, human-caused ignitions are most likely to occur along major roads and near population centers, such as Redding and Santa Rosa.

Prescribed burning, such as this treatment in the Shasta-Trinity National Forest, involves intentionally applying fire under controlled conditions and can mitigate the risk of higher-severity wildfire occuring. Photo credit: Liz Young, USFS

Air Quality

In addition to the direct dangers that wildfire poses to communities, smoke from wildfires can also impact the health of people hundreds of miles away. For many communities in the Northern California region, persistent poor air quality has become an unwelcome new fixture of the summer season. Some communities located in valleys are especially burdened by smoke due to smoke from distant fires being trapped by the topography. Catastrophic wildfires in the region's wildland urban interface emit acutely toxic pollutants by burning building structures, household materials, and vehicles, and thus pose more severe public health issues compared with wildfires in more remote and less populated areas.

Inhalable fine particulate matter (PM2.5) and other pollutants in smoke can exacerbate a range of respiratory and cardiovascular issues and even cause premature death. Black carbon (soot) produced by wildfires may be especially unhealthy; in addition to cardiovascular and respiratory diseases, evidence has linked it to increased risk of cancer, and potentially, birth defects. Certain populations are especially vulnerable to smoke, including outdoor workers, seniors, people with asthma, and children because they have a lower tolerance for elevated toxin concentrations. These are public health issues that disproportionately affect

households that lack indoor air filtration systems or sufficient insulation to protect from toxins. Also, many socioeconomically disadvantaged communities in the region lack resources to improve air quality in public spaces, such as schools or community centers.

Expanding prescribed fire, as well as cultural burning, has been proposed as a strategy for reducing the risk of higher toxins from uncontrolled wildfires. Fires that burn at lower intensity over smaller areas emit fewer pollutants than large, high-severity wildfires. Fires that only burn vegetation also do not release the hazardous chemical emissions of fires that burn structures and vehicles. Additionally, prescribed burn organizers and local air districts can collaborate to minimize air quality impacts by planning burns to occur during optimal weather conditions and limit the duration communities may be exposed to smoke. They can also provide advanced public notice of planned burns so that nearby residents can take precautions to reduce smoke exposure and work with public health officials to notify and protect more susceptible individuals.

Some interviewees observed that many communities that have been exposed to the greater dangers of wildfire have become more enthusiastic about prescribed burning in their area. There is already a long tradition of private landowners burning for agricultural purposes in the region, which also has

facilitated support for controlled burning as a solution for increasing resilience to wildfire. However, some communities that are burdened with persistent wildfire smoke do not want additional smoke from prescribed burning, and it can be difficult to build public hope that fuels reduction through prescribed burning can make a positive difference. Public education on the benefits of prescribed burning, as well as increasing capacity to alert communities when planned burns are occurring can help to grow public support.

Even when the public is supportive of prescribed burning and cultural burning, regulatory and logistical barriers may still impede planned burns from being implemented. Some stakeholders in the region feel that cultural burning should be exempt from air quality regulations and instead considered part of baseline air pollution and that there should be fewer air quality constraints on the use of prescribed burning, too. Similar to other regions, many stakeholders interviewed for this regional profile project expressed concern that regulations that are intended to protect the public from air pollution can paradoxically cause more harm by barring controlled burning but being unable to prevent catastrophic wildfires from igniting.
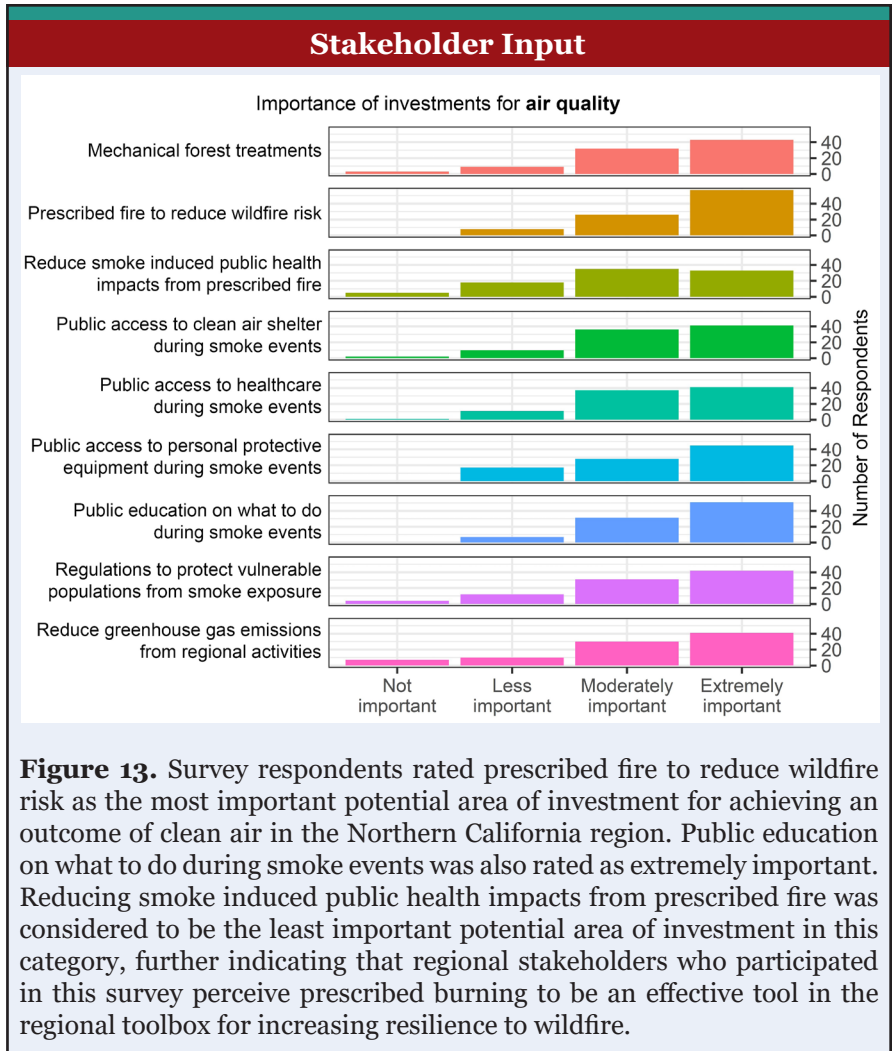

Figure 13. Survey respondents rated prescribed fire to reduce wildfire risk as the most important potential area of investment for achieving an outcome of clean air in the Northern California region. Public education on what to do during smoke events was also rated as extremely important. Reducing smoke induced public health impacts from prescribed fire was considered to be the least important potential area of investment in this category, further indicating that regional stakeholders who participated in this survey perceive prescribed burning to be an effective tool in the regional toolbox for increasing resilience to wildfire.
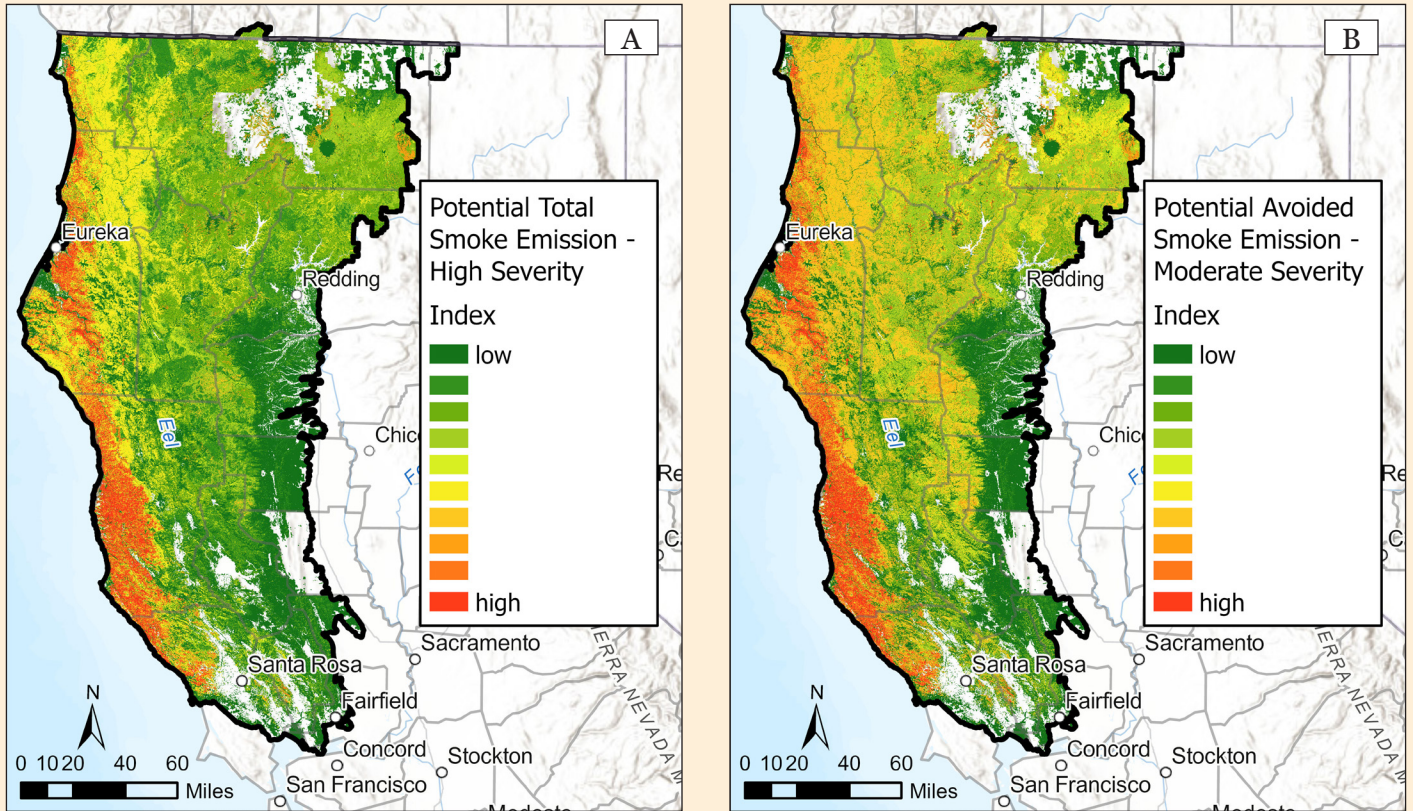
Current Conditions

Figure 14. The Regional Resource Kit includes data on potential smoke emissions under high severity fire (A). This index is based on the fuel loads and fuel moisture of 30-meter areas, and it can be used to identify where within a region smoke emissions may be especially high during a high severity wildfire. Much of the Mendocino coast and northern Humboldt coast are predicted to have the highest smoke emissions during a high severity fire. The potential avoided smoke emission metric (B) estimates how much less smoke would be produced from a location burning at moderate, rather than high, severity. This index can indicate locations where it might be advantageous to allow fire to burn at lower severities, e.g., via prescribed burning, rather than risking a future wildfire burning under extreme conditions.

Stakeholder Input

Figure 15. Survey respondents rated securing water supply for residential use as the highest priority area of investment for achieving this outcome. Actions that increased watershed health, including ecosystem restoration, addressing water pollution impacts to humans and ecosystems, and reducing soil erosion, were also considered to be highly important. Reducing regulatory barriers was considered to be less important for water security. Public survey responses ranged widely regarding the importance of securing water supply for economic use and addressing constraints related to water rights, though interviewees indicated that these were key issues in the region that are being exacerbated by climate change and increasing wildfire hazard.

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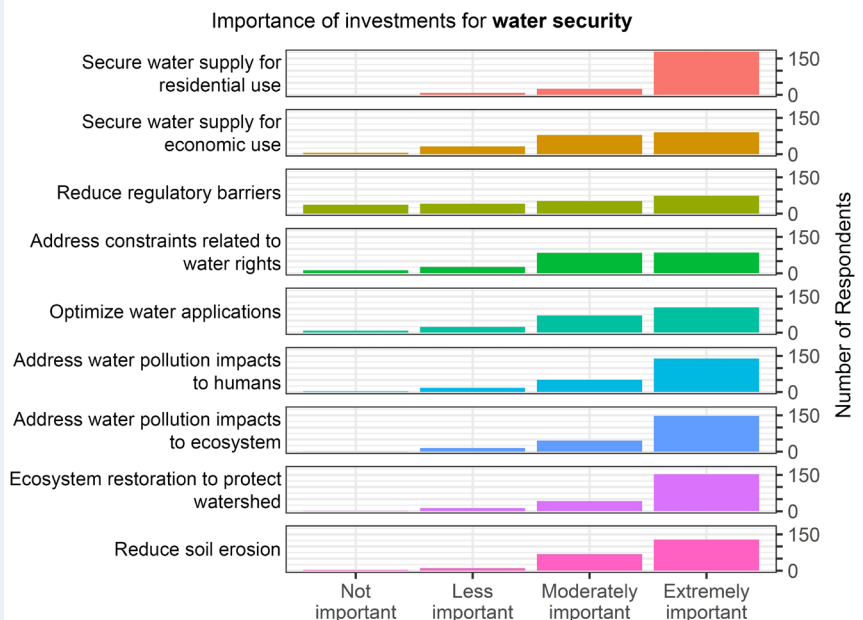
Type 1 firefighting helicopters such as the one shown here, which is being used to suppressed the 2021 Dixie Fire, can carry up to 700 gallons of water and can use snorkel capabilities to refill from open water sources. Photo credit: CAL FIRE

Water Security

In addition to increasing wildfire hazard, the warmer and drier conditions associated with climate change are also exacerbating long-standing water security issues for the Northern California region. Much of the region depends on small local surface water and groundwater systems for community and agricultural water use. Recently, severe droughts have led to extensive tree mortality, reduced forage production for grazing animals, and limited freshwater resources for people and wildlife.

Conflict over water use rights is a long-standing issue in the region. Historically, agricultural water demands have been pitted against water for wildlife because regulations require that tributaries release specified amounts of water to sustain endangered fish and other aquatic wildlife, thus diminishing water supplies available to irrigate crops and livestock. This historic conflict has not been resolved, and now many Northern California communities are additionally concerned about the allocation of water resources for fire protection. Because wildfires in the region generally occur during the dry summer season when water resources are scarce, regional stakeholders perceive an increasing need to increase local water storage capacity and recharge groundwater reservoirs to have water resources available for fire fighting.

Despite these challenges, many organizations and collaborations across the regions are working toward solutions that increase community resilience to wildfire while also restoring the ecological health of watersheds. The health of the region's fisheries have evolved to be tied to having healthy fire on the landscape, and Indigenous people helped to cultivate this balance. For example, smoke from cultural burning was understood to benefit cold-water adapted fish, such as salmon and steelhead, by cooling river and stream temperatures during the summer. A recent study provides modern evidence of this phenomenon occurring by showing that wildfire smoke significantly reduced both maximum and mean water temperature in the Klamath River Basin.

Many other forest management practices that mitigate wildfire hazard can also benefit watershed health. For example, thinning overly-dense forests can promote the health of the remaining plants by reducing competition for limited water resources. This has also been observed to result in more water in streams that previously ran dry. By reducing fuels and soil moisture deficit, these practices also mitigate the risk of high-severity fire burning soil and causing significant canopy cover loss, thus preventing erosion-caused sedimentation and warmer water temperatures that are detrimental to fish populations.
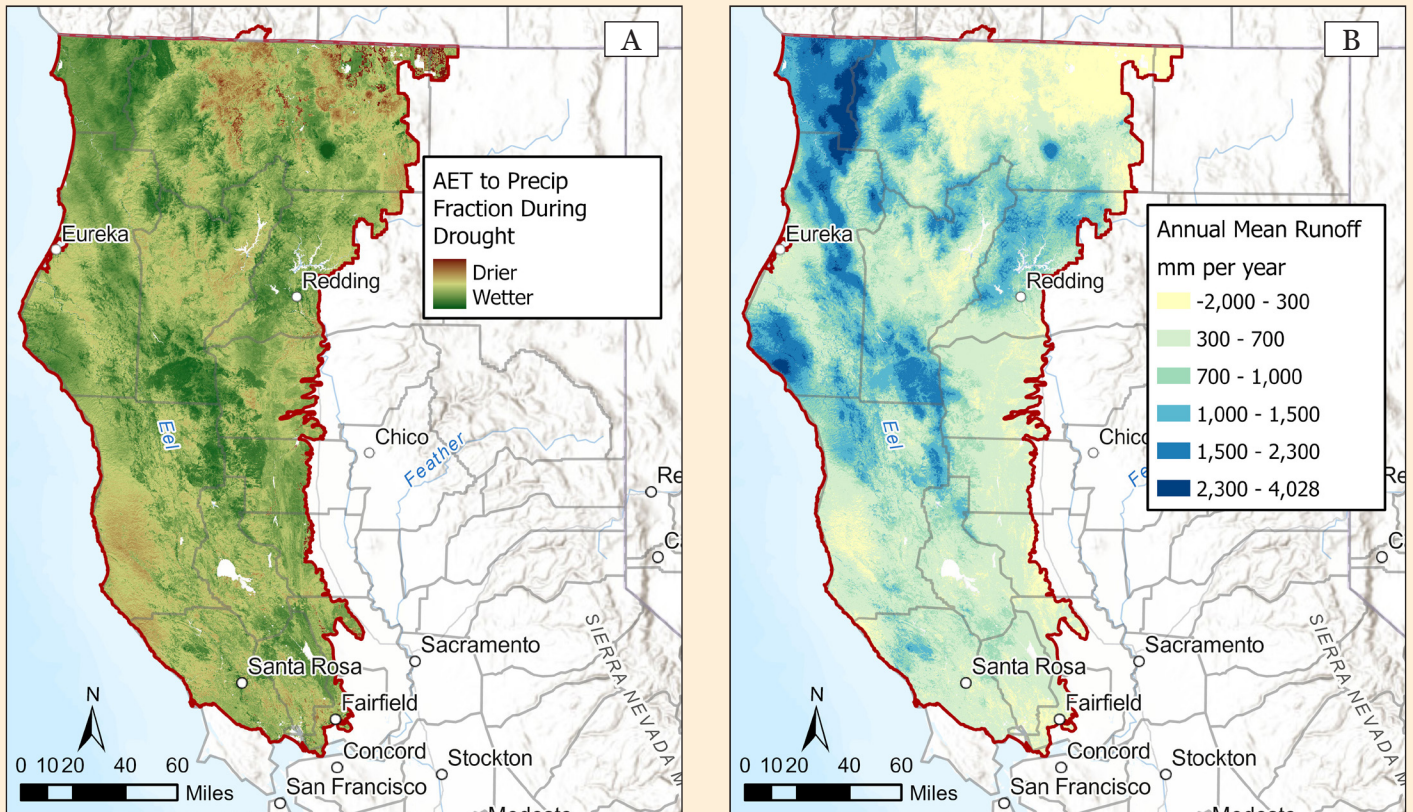
Figure 16. Water security can be assessed in terms of actual evapotranspiration/precipitation (AET Fraction) (A) and annual mean runoff (B). Actual evapotranspiration is the combined amount of water that evaporates from the land surface in addition to the water that is lost as vapor from plants. AET Fraction represents the percentage of water needed by plants that is met by precipitation during a severe 4-year drought. This metric is important for water security because it estimates the moisture stress that would be experienced by the vegetation during drought. Values > 1 indicate moisture stress driven by shortfalls in precipitation relative to plant needs. Values < 1 indicate no water stress. Both vegetation management and disturbances like wildfire can affect AET Fraction by reducing the amount of vegetation at a site and thereby lowering the amount of water needed by plants. Annual mean runoff is the surplus water discharged from a location in the form of surface or groundwater flows. This metric is important for water security because it estimates the amount of surplus water for downstream use. Vegetation management and disturbances like wildfire can affect runoff in part by changing the vegetation conditions at a site. For example, forest treatments that thin trees in moisture-stressed areas may increase runoff and provide more water availability downstream.

A biologist releases a salmon into Butte Creek, one of only three Central Valley streams that continue to harbor a self-sustaining population of spring-run Chinook salmon. Salmon are an ecologically and culturally resource that are protected in their critical habitat in Northern California. Photo credit: Harry Morse, California Department of Fish and Wildlife

Biodiversity Conservation

The varied ecosystems of the Northern California region support a high diversity of plant and animal species. Some of the rarer species have become well-known for their outsized role in shaping forest management in the region [see 'Healthy and Resilient Forests']. For example, old-growth forest is heavily protected to help conserve endangered species, such as northern spotted owl, marbled murrelet, and Humboldt marten, that depend on this habitat. These regulations have been extremely controversial for the region, in large part because of the new restrictions that they imposed on the timber industry that was the economic lifeblood of many North Coast communities. More recently, these regulations have also come under scrutiny from additional stakeholder groups that are finding that historic conservation efforts have not been effective because the species that they were intended to protect are still declining. There is increasing concern that historic management regulations that targeted single species do not allow land managers to respond to the current challenges posed by climate change and altered disturbance regimes, and revised approaches that allow for more holistic ecosystem management are currently being considered as land management plans are updated [see "Healthy and Resilient Forests'].
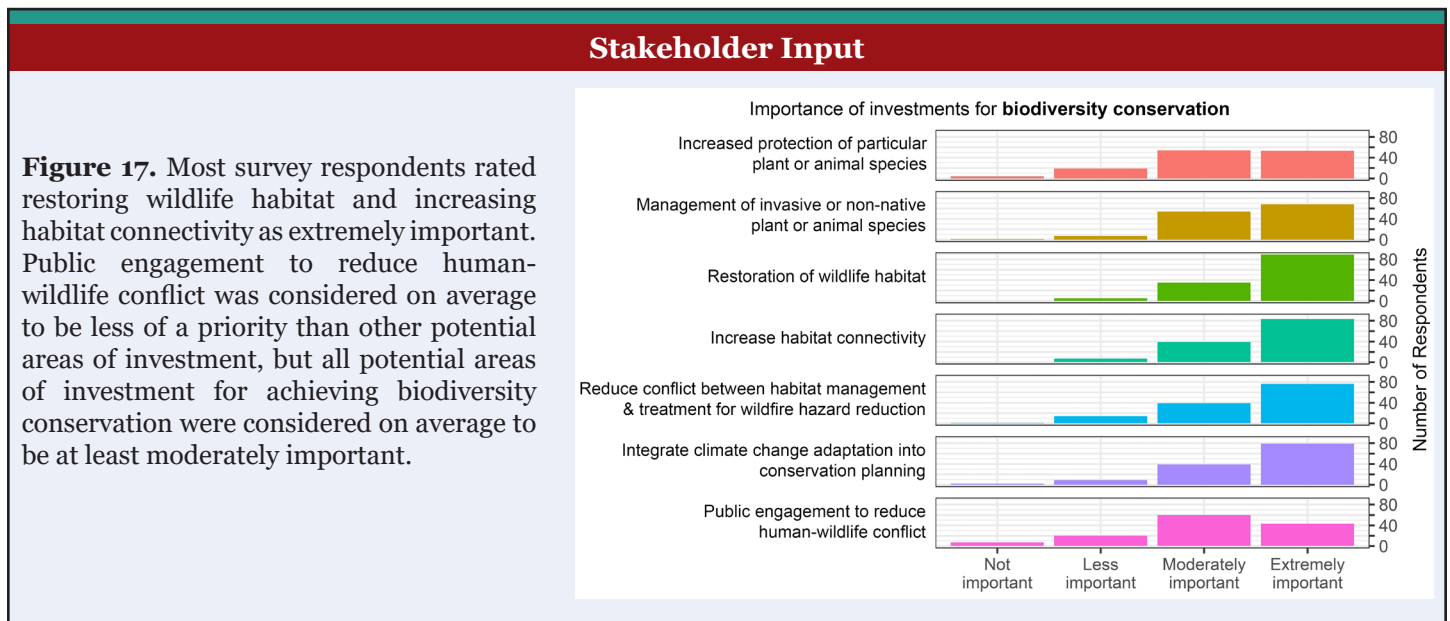
In addition to its special terrestrial wildlife, the region is also home to significant populations of anadromous fish, including Chinook salmon, Coho salmon and steelhead trout. Much of the region's historic fish populations has been lost as a result of farming, ranching, timber harvesting, mining, overfishing, dams, and climate change. However, there are strong efforts to conserve remaining populations. One notable effort that has made recent headway is the Klamath River dam removal. This demolition of four hydroelectric dams is the largest dam removal project in United States history and is expected to reopen more than 400 miles of habitat for endangered fish. Breaking ground on this project represents the culmination of decades of advocacy by regional Tribes, including the Karuk, Yurok, Hoopa, and others, whose cultural identity and food security has traditionally been tied to the Klamath River, and was achieved through partnership with conservationists, agencies, scientists, and other stakeholders. This is a monumental conservation achievement; however, fish populations in the region are also threatened by wildfire-related hazards and water rights conflicts [see 'Water Security'].

Similar to other regions of California, many Northern California stakeholders are concerned that laws and regulations that are intended to protect sensitive

species can conversely have the negative effect of impeding management activities that would increase ecosystem health and make habitat more resilient to disturbance. Environmental compliance can require extensive wildlife monitoring that imposes higher costs and longer timelines on projects. This can lead to projects becoming too expensive to pursue, and in some cases, wildfire has impacted project areas before planned vegetation treatments could be implemented. Laws protecting endangered species from harm by human actions can be a barrier to implementing vegetation treatments that could critically benefit the species habitat.

Relatedly, a significant number of watercourses in the Northern California region have been designated Wild and Scenic Rivers, including the Eel, Klamath, and Trinity River Systems. This designation carries additional regulations intended to protect these rivers and the ecosystem services that they provide. However, it can also make it difficult to do fuels reduction treatments in the riparian area that are needed to mitigate wildfire hazard for both the ecosystem and nearby communities.

In general, stakeholders in the region perceive that there is a need to balance conservation approaches that focus on single species or a specific part of a landscape with more holistic ecosystem management. It is also becoming increasingly important to ameliorate regulatory barriers to increase the pace and scale of ecologically-beneficial projects in response to the current wildfire crisis. In many cases, it will continue to be necessary to reconcile biodiversity conservation interests with other regional priorities because some actions that increase the safety of human communities, such as implementing fuel breaks, may be detrimental to wildlife habitat. However, many of the actions that increase community resilience can also help to increase ecosystem health by preventing higher severity fires than the ecosystem was adapted for or providing other ecological benefits [see 'Water Security'].

Stakeholder Input

Figure 17. Most survey respondents rated restoring wildlife habitat and increasing habitat connectivity as extremely important. Public engagement to reduce human-wildlife conflict was considered on average to be less of a priority than other potential areas of investment, but all potential areas of investment for achieving biodiversity conservation were considered on average to be at least moderately important.

Importance of investments for **biodiversity conservation**

20

Current Conditions

A

B

Present-day Connectivity
- Land use may limit movement
- Permeable lands that contribute little to regional connectivity
- Impeded
- Diffuse - Med
- Diffuse - High
- Intensified - Low
- Intensified - Med
- Intensified - High
- Channelized - Low
- Channelized - Med
- Channelized - High

Salmonid Critical Habitat

Common Name
- Salmon, Chinook
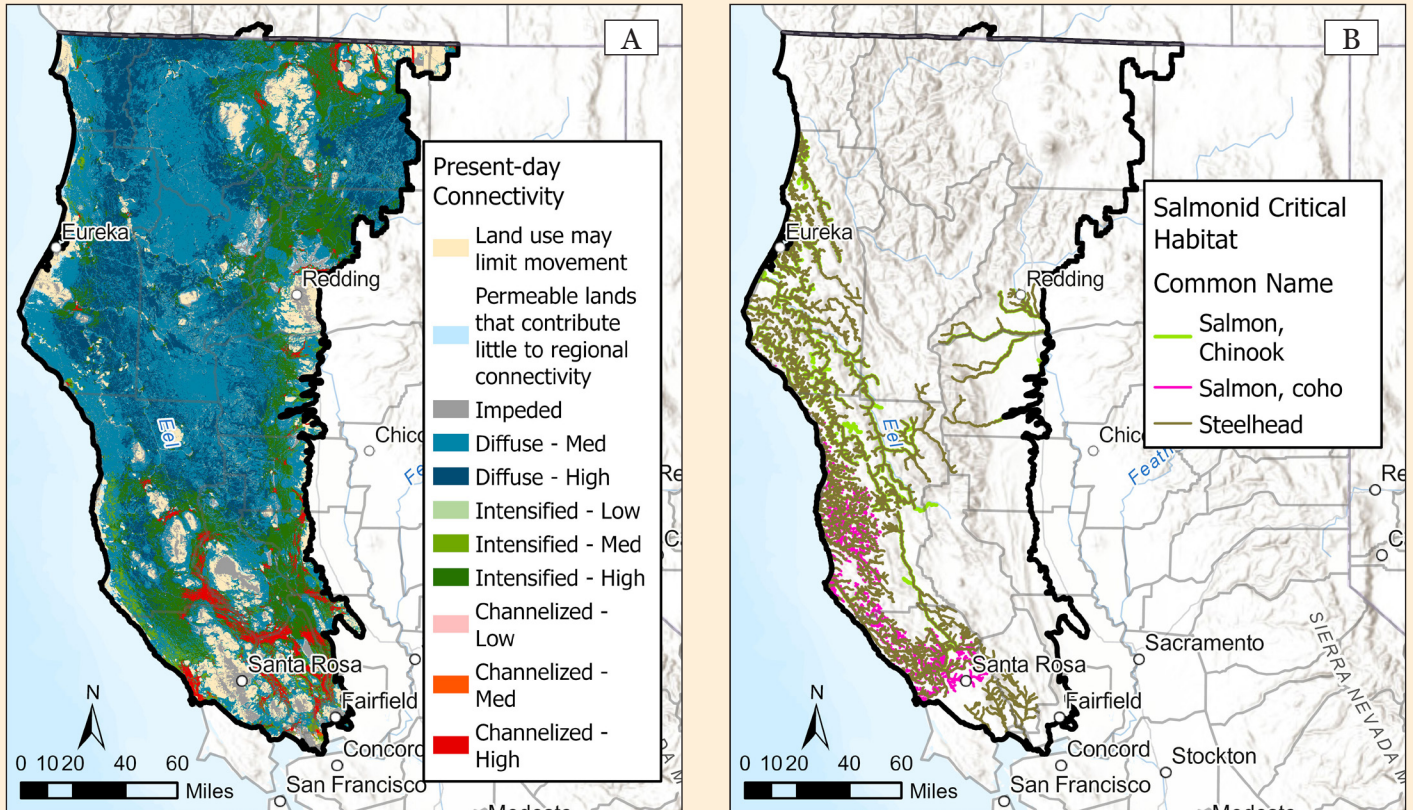- Salmon, coho
- Steelhead

Figure 18. The present day connectivity metric (A) characterizes the potential for species' movement across the landscape based on the presence of impediments like development and agricultural land use. The metrics are classified by magnitude (high, medium and low) as well as categories that indicate whether the flow of movement is less or greater than would be expected in the absence of land use barriers. "Diffuse" connectivity areas are broadly permeable to animal movement. "Channelized" and "intensified" categories indicate areas where animal movement is restricted by surrounding land uses and thus the movement pathways that remain available experience higher use. Channelized pathways provide particularly critical linkages across the landscape. Considering the rural nature of Northern California, it is not surprising that much of the region provides diffuse connectivity, though there is a lot of habitat along the eastern part of the region where connectivity is intensified, most likely due to agriculture. In contrast, there are some highly channelized areas in the southern part of the region where human population density is higher. Chinook salmon, Coho salmon, and populations of steelhead trout in Northern California are all listed as threatened. Critical habitat (B) is the area within a species' geographic range that includes the features most essential to species conservation. Critical habitat can be used to identify locations in particular need of special management or protection; its designation triggers additional environmental regulation intended to protect damage or destruction. In Northern California, steelhead trout critical habitat segments run nearly to the northern border; coho salmon segments are primarily found in Mendocino and Sonoma Counties, while Chinook salmon critical habitat is found primarily in Humboldt and Mendocino Counties.

Old-growth coast redwood trees, such as this stand located in Armstrong Redwoods State Natural Reserve in Sonoma County, store large amounts of carbon. When the 2020 Walbridge fire burned through this forest in August 2020, mature trees proved largely-resistant to the burn, but there are concerns as to how ancient forests will continue to respond to changing fire regimes. Photo credit: Emma Steigerwald

Carbon Storage

Managing natural and working lands to increase sequestration and storage of carbon is considered to be a relatively cost-effective strategy to help mitigate climate change and essential to California's efforts to achieve carbon neutrality. Forest and shrublands comprise approximately 85 percent of California aboveground and belowground carbon stocks. Wildfire threatens these carbon stocks because when vegetation burns, not only is some carbon immediately released via combustion, but also live pools of carbon can rapidly convert to less stable dead pools. As vegetation decays, stored carbon is released into the atmosphere. Regrowth sequesters carbons by turning it into new plant material and is critical to future carbon storage potential.

Northern California's redwood forests are particularly important pieces in California's climate strategy. Redwood trees capture more carbon dioxide than any other species on Earth due to their ability to live for over 2,000 years and grow to enormous heights. Old-growth redwood forests can store up to 890 metric tons of aboveground carbon per acre (roughly the equivalent of carbon emitted by a vehicle driving 8.3 million miles). Mature second-growth coast redwood forests, with trees as young as 150 years old, can also store carbon at a higher rate than nearly all other forest types (339 metric tons of carbon per acre). However, these forests are increasingly vulnerable to climate change which is also compounding with other novel disturbances to result in higher-severity wildfire events than the redwood ecosystem was evolutionarily adapted. Land managers, conservation groups, scientists, and other stakeholders are monitoring the impact of recent wildfire events and considering management actions that can make redwood forests more resilient to future fire and climate change.

Vegetation treatments can help mitigate the risk of high-severity fire burning large carbon stocks and encourage the growth of larger trees, but there are limited opportunities for mitigating the loss of stored carbon from these treatments, such as by converting removed vegetation into wood chips or biofuel. Residual biomass generally cannot be left on site or it will contribute to fuel accumulation. However, there are limited local markets or infrastructure for processing this vegetation material in the Northern California region, so it must be trucked longer distances, contributing to greenhouse gas emissions. In many cases, transporting the material off-site is infeasible, so it is burned in piles instead. Technology such as air curtain burners is being experimented with as one way to dispose of biomass that reduces

smoke emissions and can store carbon in the form of biochar, but interviewees did not seem to view this as a solution due to insufficient current market for biochar and the scale of the challenges of dealing with biomass in the Northern California region.
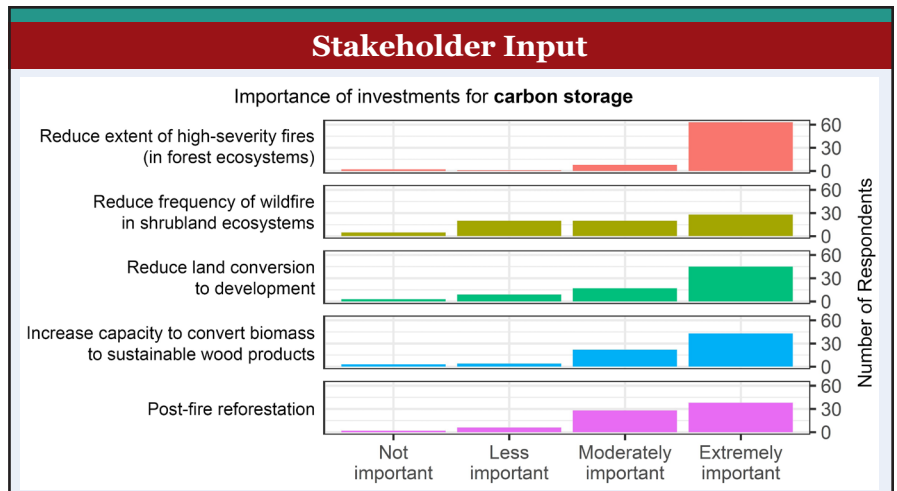

Figure 19. Nearly all survey respondents rated reducing the extent of high-severity fires in forest ecosystems as extremely important for achieving large and stable carbon stores. Most other potential areas of investment were considered to be on average at least moderately, except for reducing the frequency of wildfire in shrubland ecosystems which was considered to be less important than other potential areas of investment.
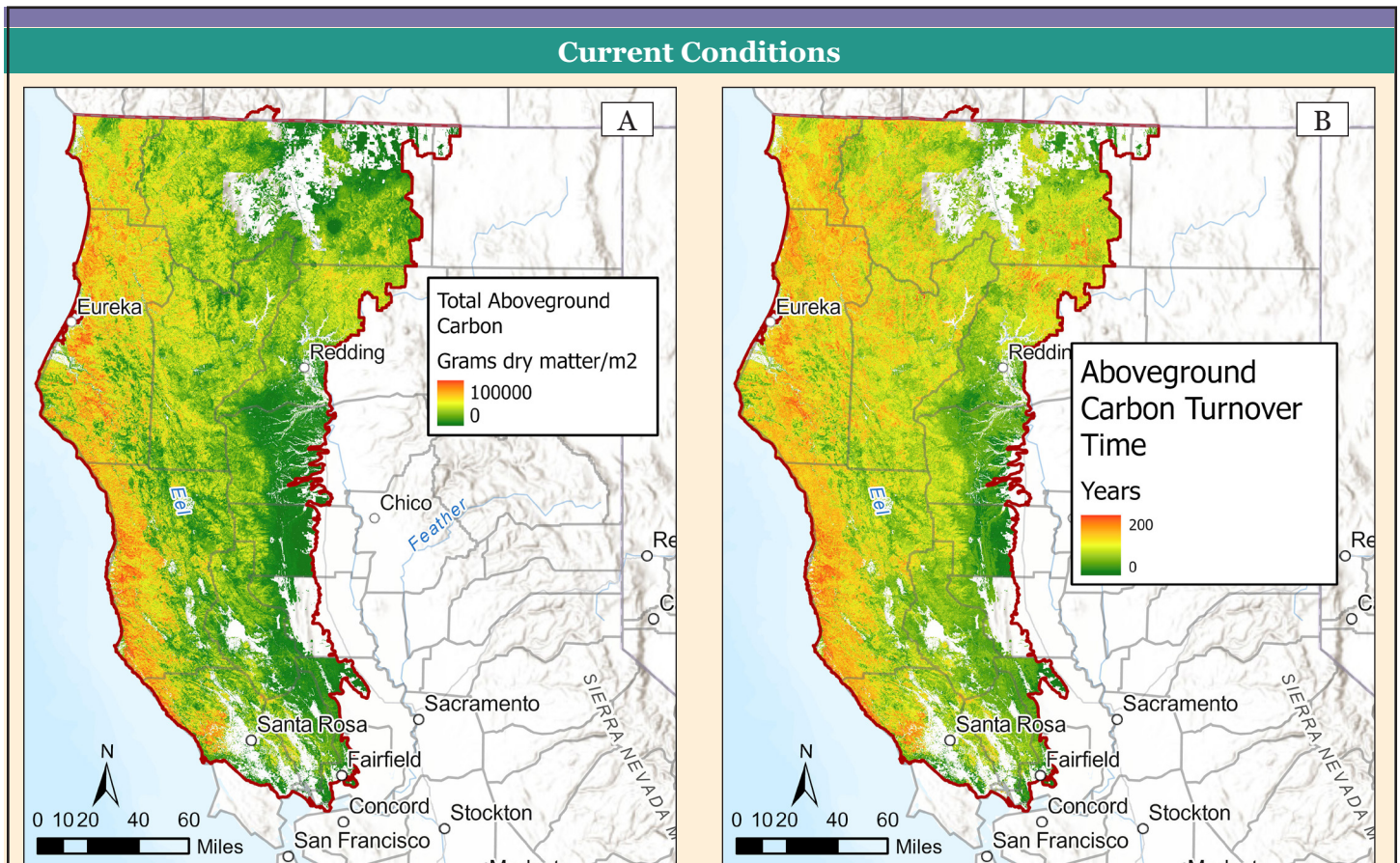

Figure 20. Carbon storage on the landscape can be assessed via total aboveground carbon (A) and carbon residency time (B). The total aboveground carbon is the amount of carbon present in all live and dead trees, shrubs, herbaceous vegetation, and dead material on the ground. Preserving carbon stored in natural systems is important for mitigating climate change. When live or dead vegetation material burns, this carbon may be released as greenhouse gas emissions. Carbon residency time is the average number of years both aboveground live and dead carbon persists. Locations with longer residency times have more stable carbon stores, often in large trees; areas with shorter residency times may have carbon stored in forms such as grasses and leaves. The presence of coast redwood forests and other large trees in North Coast counties is reflected in the large total carbon stores and over 200-year average residency time of these areas.

Staff at the Western Shasta Resource Conservation District participate in forestry survey training so that they can support private landowners in developing forest management plans. Photo credit: Sarah Seiler, Western Shasta RCD

Economically Robust Communities

Wildfire directly and indirectly impacts the economic health of the Northern California region. Fire threatens valuable resources like agricultural crops, livestock, and timber. Smoke taints wine grapes and disrupts tourism. In areas where large landscapes have burned at high-severity, such as the Mendocino National Forest, recreation has declined, making it challenging to get outside tourist attention to support rebuilding. Wildfires in Northern California have shut down segments of Interstate 5 on several recent occasions, disrupting statewide commerce. The destruction of homes and entire communities has also put further pressure on limited housing resources and led to the loss of fire insurance for numerous homeowners and ranchers.

Despite these significant challenges, there is the potential to respond to the wildfire crisis in ways that create new jobs and economic opportunities for communities across the region. Some approaches to increasing regional resilience to wildfire involve tapping into and reimagining traditional industries. The North Coast timber industry has already learned to adapt to changing regulations and public values as it has evolved from plantation management approaches of producing lumber to incorporating
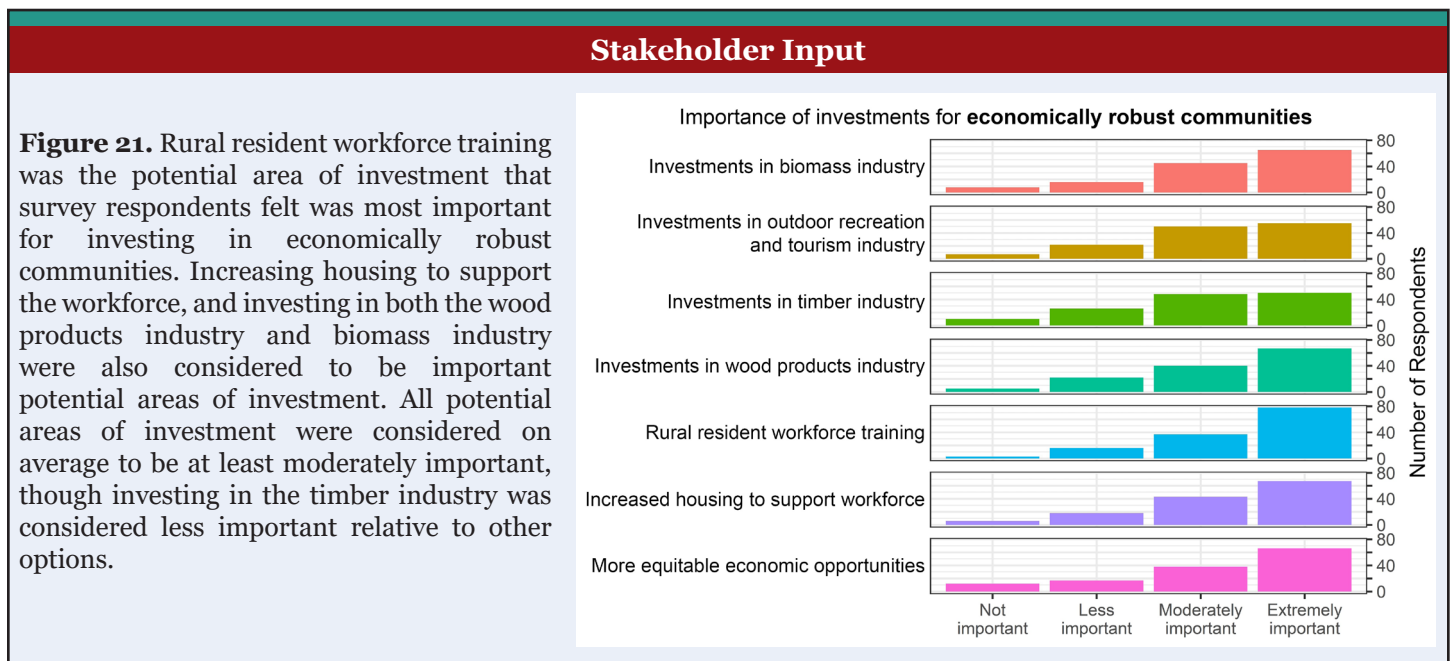
silvicultural techniques that promote other ecosystem services, such as biodiversity conservation, carbon sequestration, and watershed health. This workforce is increasingly being contracted to do wildfire resilience-related forest management work, and the technical knowledge of this industry is now being applied to reduce fire hazard and promote post-fire recovery of forests.

There is also a lot of interest across the region in building new biomass plants, sawmills and other wood processing facilities, as well as renovating old facilities that closed 10-20 years ago, in order to develop localized solutions for dealing with biomass from fuels reduction treatments. Stakeholders believe that this could provide additional economic development opportunities for rural communities. However, many interviewees were pessimistic of these solutions being realized due to myriad challenges which included public opposition to having biomass plants in their local communities due to air pollution concerns, regulatory challenges, opposition from California's Public Utilities Commission, need for more technological innovation around biomass energy, and need for government subsidies or significant private sector investments to develop this infrastructure and market.

Increased state and federal funding for land management work can help build rural economies by providing additional high-quality jobs in both public and private sectors. However, one challenge that Northern California is experiencing is that capacity to do land management work is unevenly distributed across the region. Areas that retained a timber industry tend to have more technical expertise and resources. In other areas, a lack of existing skilled workforce, as well as a shortage of housing for new workers, has limited capacity to get land management work done even when funding is available. Recruiting and retaining workers can be especially challenging for remote areas. Also, many recently-opened jobs have depended on grants or other temporary funding sources and are not permanent positions.

One significant change that is occurring is that new players are entering into land management work as a result of new challenges and opportunities, and they are contributing additional capacity and expertise.

For example, both public and private organizations are staffing new fire ecologist and fire advisor positions. Local governments and water agencies are taking a new interest in forest management to increase the safety of the communities that they serve. Additionally, many organizations throughout the region, such as Resource Conservation Districts and non-governmental organizations, are developing new workforce training programs, some of which specifically engage Tribes and other communities that were historically excluded or underrepresented in the natural resource management field. Academic institutions, such as Shasta Community College, are also developing forest management career programs intended to fill critical workforce gaps and prepare new professionals for success in a changing industry.

Stakeholder Input

Figure 21. Rural resident workforce training was the potential area of investment that survey respondents felt was most important for investing in economically robust communities. Increasing housing to support the workforce, and investing in both the wood products industry and biomass industry were also considered to be important potential areas of investment. All potential areas of investment were considered on average to be at least moderately important, though investing in the timber industry was considered less important relative to other options.

Importance of investments for **economically robust communities**

Investments in biomass industry
Investments in outdoor recreation and tourism industry
Investments in timber industry
Investments in wood products industry
Rural resident workforce training
Increased housing to support workforce
More equitable economic opportunities

Number of Respondents

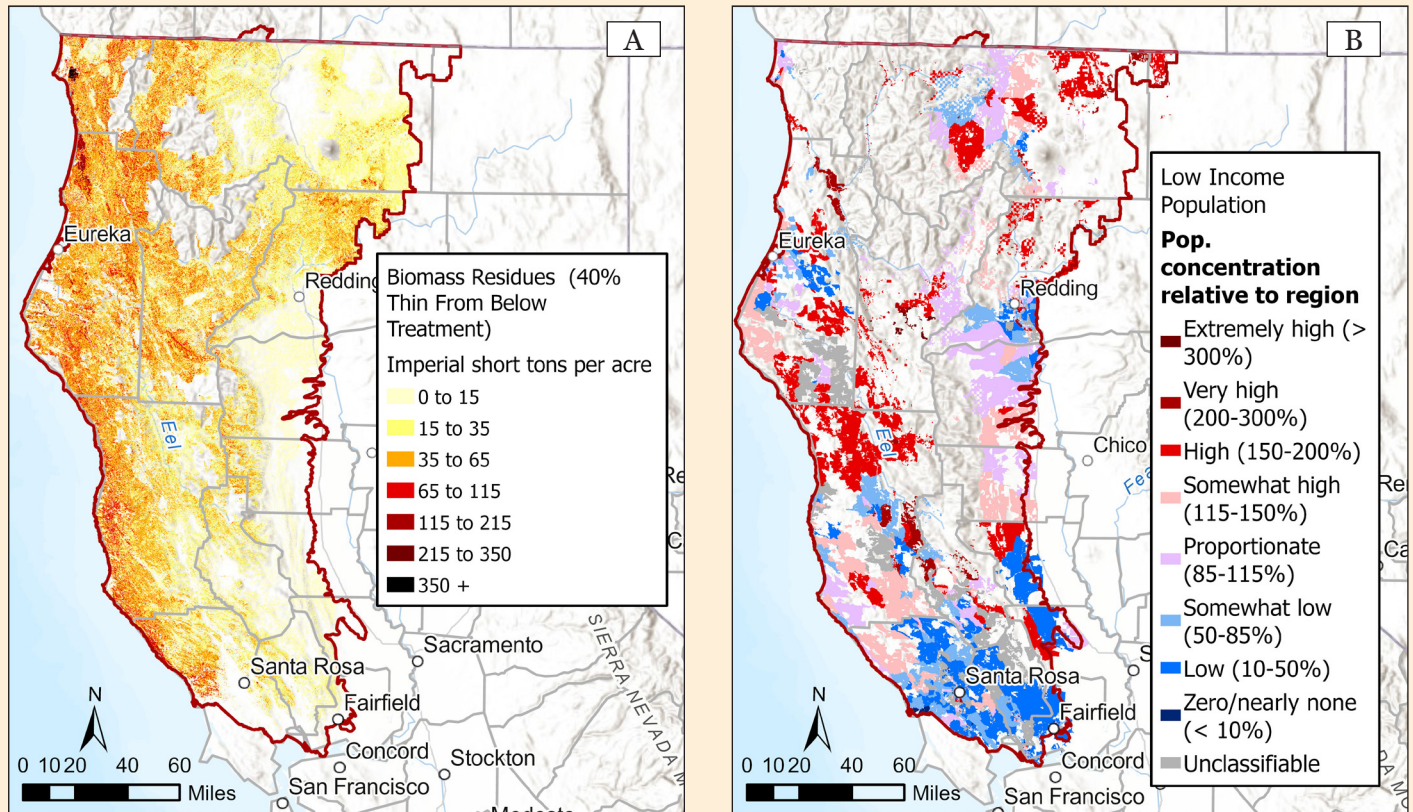Not important | Less important | Moderately important | Extremely important

Figure 22. Biomass Residues (40% Thin from Below Treatment) (A) measures the amount of biomass that would be left behind on the landscape after removing 40% of the basal area by thinning small-diameter trees. This information can help managers assess the viability and trade-offs of removing biomass from the forest for utilization versus leaving it in place or pile burning. Low Income Population (B) can be used to identify where communities in the Northern California region might be socioeconomically disadvantaged. Households burdened by poverty are more likely to experience negative impacts from air pollution and other public health threats and may have less capacity to mitigate wildfire hazard or recover from disaster.

Concluding Recommendations from Interviews

When interviewing experts who work on Northern California land management related to wildfire resilience, we asked participants if they had recommendations for increasing community and ecological resilience to wildfire. In addition to the findings already shared pertaining to specific pillars of resilience, some key big picture themes emerged from interviews. We conclude by highlighting a few of those recommendations.

1) Invest in Tribal communities and empower them to reclaim traditional stewardship practices. Many interviewees described growing efforts to incorporate Tribal perspective and Traditional Ecological Knowledge into land management strategies. These partnerships have created new opportunities for cultural burning on public and private lands. However, it is important that these collaborations are building capacity for Tribes to have the skill, knowledge, and ability to steward their ancestral lands and work with their neighbors, rather than to expect Tribal leaders to teach non-indigenous organizations how to integrate traditional ecological knowledge. As many Tribal communities endeavor to reclaim traditional practices and grow capacity, it should also be recognized that many of these communities are also actively engaged in broader communities and collaborations, and they are already valuably contributing to regional resilience.

2) Engage broader communities to build capacity and gain social license. In addition to Tribal communities, many other communities also have local knowledge and expertise that can critically contribute to increasing ecological and community resilience. This potential is evident in the many grassroots efforts that have flourished across the region, such as volunteer fire departments, fire safe councils, prescribed burn associations, and other community-based organizations. However, there are many areas in which local communities have not yet been engaged in this work. Furthermore, long-standing political and ideological divides have historically barred consensus over land management in the Northern California region and can make it difficult to gain public support for projects. Bridging these divides can give rise to new collaborations and increase capacity to address current challenges.

3) Support bold public leadership. Many interviewees described how public agency leaders have played an important role in championing partnership agreements and helping local organizations to navigate complex regulatory systems. Bold leaders who are willing to advocate for prescribed burning and other vegetation treatment projects despite the risk of public criticism or litigation from stakeholder groups that oppose these actions have been instrumental in accomplishing work that benefits ecological and community resilience in the region. Interviewees believed that it was thus important to support this leadership.

PC: keppet

List of Interview Participants

Stakeholder input was gathered during 46 individual, semi-structured interviews that focused on the key issues related to ecosystem and community resilience in the Northern California region, and the barriers, possible solutions, and recommendations for addressing these issues. Interviewees have extensive knowledge of and experience in both the ecological and social and cultural aspects of land management in the Northern California region.

Alison Blodorn, Principal Program Manager, Forestry, Napa RCD

Alli Permann, Outreach Coordinator, Yolo County RCD

Becky Roe, Director of Forest Health, Shasta College

Bob Schneider, FireScape Mendocino Co-Lead and Tuleyome Co-Founder

Brita Goldstein, past-Chair, The Buckeye

Brittany Jensen, Executive Director, Gold Ridge RCD

Chad Roberts, Independent Conservation Ecologist

Che Casul, Executive Director, Sonoma RCD

Chris Carlson, Sonoma Valley Stewardship Program Manager, Sonoma Land Trust

Chris Rose, Executive Director, Solano RCD

Christie Moore, Executive Director, The Buckeye

Dan Blessing, Forester, Shasta Valley RCD

Dawn Pedersen, Unit Forester, CAL FIRE Tehama-Glenn Unit

Eduardo Blancas-Alcantara, Project Coordinator, Colusa County RCD

Elicia Goldsworthy, Forest Policy and Communications Manager, Green Diamond Resource Company

Eric Knapp, PSW Forestry researcher, USFS Pacific Southwest Research Station

Erin Rentz, Collaborative Program Manager-Western Klamath Restoration Partnership, Six Rivers National Forest

Greg Conant, Forest Health Program Specialist, Glenn County RCD

Jessica Pyska, Supervisor, Lake County

Jim Richardson, Park Superintendent, Lassen Volcanic National Park

John Andersen, Director of Forest Policy, Mendocino Redwood Company

Jon Barrett, District Manager, RCD of Tehama County

Josh Davy, Livestock and Natural Resources Advisor, University of California Cooperative Extension

Kai Ostrow, Southern Humboldt Prescribed Fire Liaison, Humboldt County Prescribed Burn Association

Karen Gaffney, NCRP Director of Strategic Planning and Communications, North Coast Resource Partnership

Karin Young, Conservation Project Manager, Solano RCD

Kelly Sheen, Director, Trinity County RCD

Kevin Conway, State Forests Program Manager, CAL FIRE

Kyle Farmer, Co-Founder, Mendocino County Prescribed Burn Association

Laura Snell, Livestock and Natural Resources Advisor, University of California Cooperative Extension

Lindsay Dailey, Executive Director, Tribal EcoRestoration Alliance

Lisa Micheli, Executive Director, Pepperwood Preserve

Liz Harper, Executive Director, Colusa County RCD

Magdalena Valderrama, Program Director, Seigler Springs Community Redevelopment Association

Margo Robbins, Executive Director and Co-Founder, Yurok Tribe/Cultural Fire Management Council

Matt Greene, Board of Directors member, Forest Landowners of California

Maureen Teubert, District Manager, Western Shasta RCD

Mike Jones, Extension Forester, University of California Cooperative Extension

Miller Bailey, Co-Director, WRTC Fire program, Watershed Research and Training Center

Nick Goulette, Executive Director, The Watershed Research and Training Center

Rachel Birkey, Forest Supervisor, Shasta-Trinity National Forest

Scott Cratty, Executive Director, Mendocino Fire Safe Council

Tanya Meyer, Senior Program Manager, Yolo County RCD

Ted McArthur, Forest Supervisor, Six Rivers National Forest

Terre Logsdon, Chief Climate Resiliency Officer/Tribal Liaison Lake County

Will Harling, Director, Mid Klamath Watershed Council

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