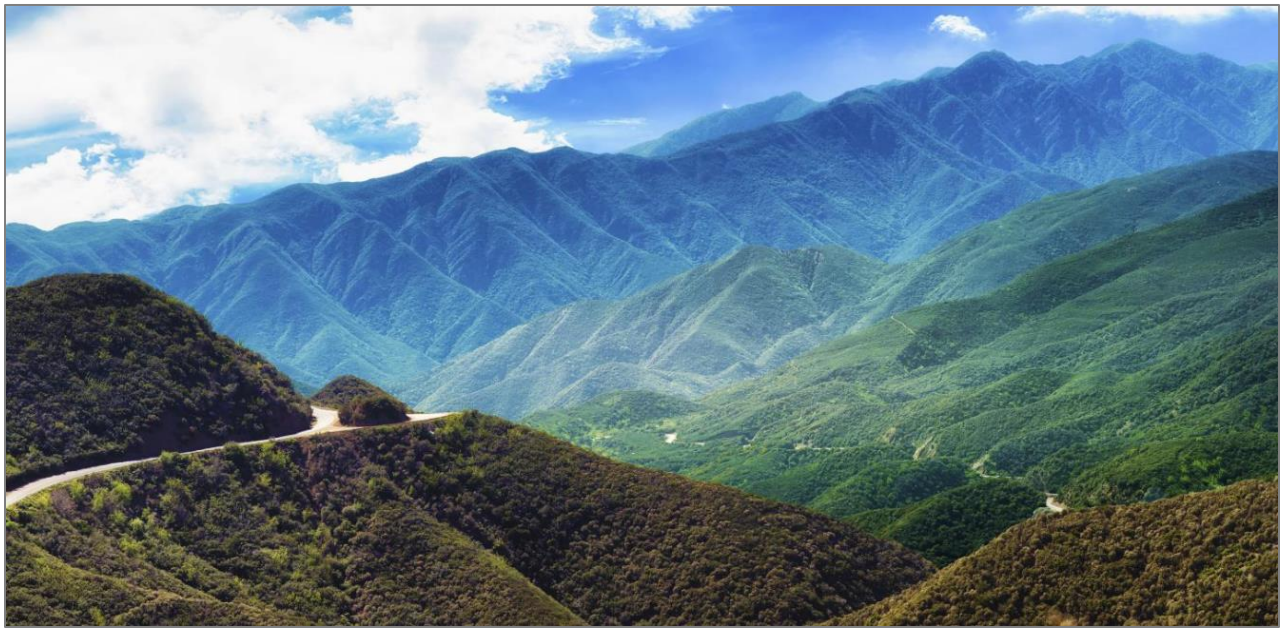

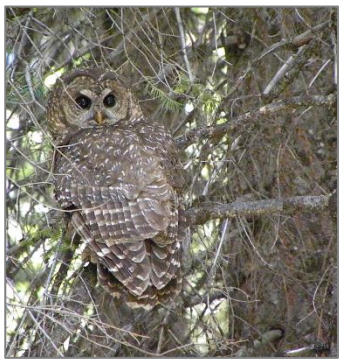

National Fish and Wildlife Foundation

California Forests and Watersheds Business Plan

November 2021

Purpose of a Business Plan

The purpose of a NFWF business plan is to provide a concise blueprint of the strategies and resources required to achieve the desired conservation outcomes. The strategies discussed in this plan do not represent solely the foundation's view of the actions necessary to achieve the identified conservation goals, but also reflects the majority view of federal, state, academic, and organizational experts consulted during plan development. This plan is not meant to duplicate ongoing efforts, but rather to invest in areas where gaps might exist so as to support the efforts of the larger conservation community.

Acknowledgements

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About NFWF

The National Fish and Wildlife Foundation protects and restores our nation's wildlife and habitats. Chartered by Congress in 1984, NFWF directs public conservation dollars to the most pressing environmental needs and matches those investments with private contributions. NFWF works with government, nonprofit and corporate partners to find solutions for the most complex conservation challenges. Over the last three decades, NFWF has funded more than 5,000 organizations and committed more than $6.8 billion to conservation projects. Learn more at *www.nfwf.org*.

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Conservation Need

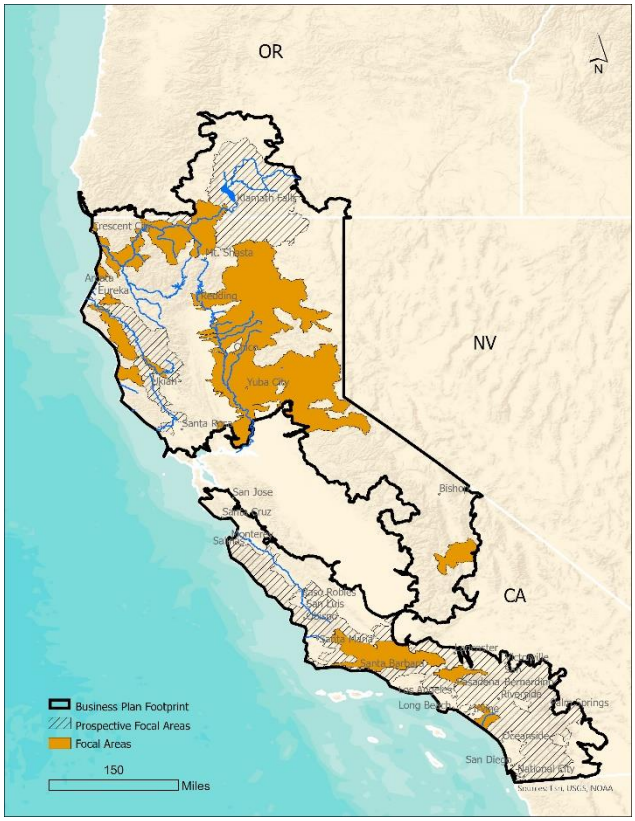
California in Context

California is an enormous landscape, comprising an incredible diversity of ecosystems, habitats, and species. From high meadows in the Sierra Nevada to the redwood stands along the North Coast; from hot, dry deserts to fog-shrouded rugged coastlines; from expansive coniferous forests, to rolling oak savannah, to steep and sprawling chaparral, California represents some of the most stunning environments in the world. California is home to more species of plants and animals than any other state, and of the estimated 5,500 plant species found in California, 40 percent are found nowhere else on the planet (California Natural Resources Agency 2021).

In and around these dramatic environments, California has built itself into the world's fifth largest economic engine, which sustains nearly 40 million residents in cities, towns, and agricultural areas that are as diverse and unique as its landscape. One out of every eight U.S. residents lives in California, making it the nation's most populous state. California is expected to add another five million residents by 2050, which will further intensify the demand for natural resources, particularly water (Johnson et al. 2021).

Given the complexity of California both in terms of biodiversity and human communities, NFWF plans to target its limited funds to areas where it has the best chance of meaningful, long-term outcomes (Figure 1). Although NFWF develops business plans with stretch goals in mind, the foundation recognizes there are still ecosystems within the state that deserve greater attention yet cannot be included in this plan at the present time (e.g., deserts, marine ecosystems). Forests and freshwater ecosystems are at the core of this plan.

Figure 1. Business Plan footprint



Forest Health and Landscape Resilience

California forests and woodlands are vast (over 38 million acres) and scrub habitats like chaparral and sage cover a similarly large area (over 41 million acres). These California ecosystems contain a range of superlatives with the tallest trees (redwoods), the largest trees (sequoias), and the oldest stand-alone trees (bristlecone pines) on Earth.

In recent decades, California forests, along with species and human communities, have suffered from devastating wildfire. The fine-scale heterogeneity that characterized California forests historically has

been replaced over the last 100 years by relatively homogenous, overly dense forest patches with a dearth of large, old growth trees (North et al. 2009, McIntyre et al. 2015). This change in forest structure has reduced the resilience of these systems which is characterized by its resistance to disturbance and the ability to quickly return to a desired condition following a disturbance event (North et al. 2009).

Although fire has always been a natural factor in maintaining the health of California forests, a century of fire suppression, urbanization, timber harvest practices, unintentional consequences of species protection (Collins et al. 2010) and climate change has altered the natural state of forests, leaving them increasingly vulnerable to more frequent, large-scale, high-severity disturbance events like catastrophic fire, drought and bark beetle outbreaks. 2020 was another record setting year—nearly 10,000 fires burned over 4.2 million acres, almost 4% of the state.

The significant departure from natural disturbance regimes and the heterogeneous forest conditions they create has led to the decline of many forest-associated wildlife species like spotted owls (northern and California) and a suite of migratory songbirds. Rosenberg et al. (2019) highlighted the continental loss of more than 3 billion birds from North America since 1970: western forests lost an estimated 30% of their bird populations during this period primarily due to habitat loss and degradation. California spotted owl populations throughout the Sierras have declined significantly over the last 30 years, with some populations experiencing as much as a 50% reduction in abundance (Tempel et al. 2014). Today, thoughtful and strategic actions are required to recover these landscapes, reintroduce more natural fire regimes, and restore resilience to California's forests and woodlands.

Freshwater Ecosystems

Meadow Ecosystems

Wet meadows of the Sierra Nevada are important for a number of species in California, particularly birds and amphibians. Meadow systems provide water and stream-shading during the dry season, promote lower summer stream temperatures, higher plant productivity, increased insect prey availability, and special vegetation structures such as willow thickets (Graber 1996). Streams that flow through these systems are also important habitat for native trout, and several federally threatened and endangered as well as sensitive fishes protected by California, are dependent upon these streams. Moreover, these ecologically rich oases often occur along riparian corridors, linking meadow to meadow and creating movement pathways across the broader landscape. Amphibian species like the mountain-yellow legged frog rely on perennial water sources that meadows provide to successfully breed and provide habitat to sustain tadpoles. In addition to serving as key habitat for wildlife, wet meadows provide critical ecosystem services—such as filtering of pollutants, carbon sequestration, and groundwater recharge—which support downstream habitats and human communities.

Over-grazing in the late 1800s through 1930s, road building, mining, logging, urbanization and catastrophic wildfire over the past 150 years have resulted in widespread deterioration of meadows in the Sierra Nevada. An estimated 50%, or approximately 90,000 acres, of all meadows throughout the Sierras are thought to be degraded due to anthropogenic causes (Drew et al. 2016). The cumulative watershed impacts on meadows include gullying, desiccation, shrub encroachment, and changes in plant species composition. Restoring the critical function of meadow systems is key in sustaining wildlife and human communities that depend on them.

Rivers and Streams

Much of California's biodiversity is reliant on its riverine ecosystems. Hundreds of distinct rivers flow across the state and are managed by thousands of separate entities based on precipitation and evolving human and environmental needs. Annual precipitation is highly variable, from 100 million acre-feet in a dry year to more than 250 million acre-feet during a wet year. Approximately 60% of precipitation is naturally lost to evaporation or used by vegetation in places like forested watersheds. Of the remaining water, about 50% naturally remains in rivers and streams, where it supports critical riparian habitat, fish and wildlife. While most of this water flows through large rivers on the North Coast that are some of the last remaining strongholds for certain species (California Department of Water Resources 2020), southern California rivers also provide critical in-stream and riparian habitat for a suite of protected species.

Anadromous salmon and trout illustrate the inter-connectedness of ecosystems across California. Their complex lifecycle relies on the complete river system—from hatching in headwaters, to passage through mainstems, tributaries, and estuaries, and finally the open ocean, and then back again as spawning adults. The state's geology, climate and productive ocean have resulted in the evolution of many distinct Pacific salmon populations, characterized by geographic, genetic and life history patterns. Currently, more than thirty salmon and trout taxa are recognized in the state. Twenty-five of these support—or once supported—commercial and recreational fisheries (Howard et al. 2013).

Historically, an estimated 5.5 million salmon returned to California's rivers. However, variable climate trends and a history of altered hydrology have created major challenges for native fish populations and other species reliant on the state's rivers, streams, lakes and wetlands. Today, California coho salmon, Chinook salmon and steelhead are only able to access approximately 65% of their historical spawning range. Many of these populations are either federally listed as endangered or threatened or considered sensitive species.

Decades of conservation efforts have highlighted the opportunities as well as difficulties in balancing human and wildlife water needs. As legal and beneficial consumptive water demand rises, suitable instream habitat for anadromous fish declines, and in some cases disappears altogether. Low flow issues are compounded by barriers to fish passage.

Historical and current land use also plays a role in freshwater ecosystem health. Increased sediment and nutrient loads from forest roads and farms diminish water quality. Urbanization and other forms of development have limited watershed function by degrading and fragmenting riparian and instream habitat. Human activities throughout California's history have contributed to the spread of invasive species that threaten diversity and abundance of native species through competition, disease, hybridization and predation.

Finally, drought cannot be ignored. Over the past twenty years, dry years have outnumbered wet years by a factor of three to one. Above average temperatures compound the impacts of drought, and the result is a steady increase in wildfire risk—with 2020 the worst year on record (Hanak et al. 2020). In its 2021 staff report titled *Recommendations for an Effective Water Rights Response to Climate Change*, California's Water Resources Control Board warned that climate change will bring more frequent and intense atmospheric rivers, heat waves, floods, and rising sea levels.

Wetlands

California as a whole has lost the majority of its wetlands, which are of critical importance to waterfowl, shorebirds and fish (California Water Monitoring Council 2016). The Central Valley of California once consisted of a mosaic of wetlands, riparian forests, and upland habitats. Estimates suggest that as much as 90% of the wetlands have been lost over the last century to conversion to agriculture, river channelization and urban development (CVJV 2020). Despite the loss of wetlands, the Central Valley continues to provide critical habitat to one of the largest concentrations of migratory birds in North America; 60% of Pacific flyway waterfowl and more than 500,000 shorebirds utilize these habitats annually (CVJV 2020).

Background

NFWF has a long history of investments in California. Over the past 10 years, NFWF has engaged in a wide variety of locally focused funding partnerships, multi-agency regional conservation programs, and targeted business plan investments. Through NFWF's 2009-2020 Russian River Coho Business Plan, the Russian River Coho Water Resources Partnership—a highly coordinated collaboration of five local organizations—prioritized water management planning and water storage projects that allowed people to meet water needs, and improve stream conditions and help restore a viable population of coho to the Russian River. NFWF's 2009-2017 Sierra Nevada Meadow Restoration Business Plan focused on creating the momentum to restore and protect thousands of acres of meadow in the Sierra Nevada, and it demonstrated the ability of meadow restoration to increase and sustain summer water flows. These programs have laid the groundwork for NFWF's expansive water-focused efforts and salmon and trout conservation work throughout California, including notoriously intractable places like the Klamath and Sacramento River watersheds.

NFWF has also been a leader on forest health and resilience issues in California. Through a partnership with the Los Padres National Forest in 2015 to develop and manage wildfire recovery programs, the Los Padres National Forest Business Plan provided the first step in developing an array of integrated landscape-scale strategies to help improve California's forested environments. The success with this business plan provided the base for a strong partnership with the U.S. Forest Service (USFS) in their Southwestern Region (USFS Region 5), which led to expanded programs dedicated to forest fuels management, endangered species monitoring, improving forest road infrastructure and aquatic organism passage. NFWF's role in landscape-scale conservation in California continues to grow as we engage in regional shared-stewardship cross-boundary collaborative efforts with our federal, state, and private partners to improve coordination and increase the pace and scale of forest recovery activity throughout the state. Through these partnerships, NFWF has funded a wide variety of projects that supported species such as steelhead, California condor, California spotted owl, and big-cone Douglas fir, developed state-of-the-art planning and assessment tools for land managers, restored ecosystems, and improved information and access to public lands.

These past NFWF investments laid the foundation for an integrated headwaters-to-coast California Forests and Watersheds Business Plan by demonstrating proof of concept for the strategies outlined in this document, including mountain meadow restoration, post-wildfire recovery, forest health improvements via fuels management, riparian and off-channel habitat construction, freshwater flow enhancement. The past investments in California have also highlighted the appropriate geographic focus for NFWF to ensure a sustained, long-term impact to benefit fish and wildlife species across this diverse landscape.

Current Conservation Context

California has a rich history in conservation. California's modern conservation movement was rooted in a partnership between John Muir and President Theodore Roosevelt. That partnership helped the creation of our National Forest System, National Parks and a spirit of conservation that was both proactive and reactive in response to significant disasters such as the 1969 oil spill off the Santa Barbara coastline which sprouted the creation of several environmental groups and state agencies.

Over the past 50 years, California's population has grown exponentially, presenting additional pressures on the state's precious fish and wildlife habitat which have been exacerbated by the impacts of drought, climate change and high intensity wildfire.

Up until recently, much of the conservation focus was aimed at specific species and watersheds. In California's current conservation context, there is more of an effort to collaborate across jurisdictions and to institute a landscape scale approach to conservation. For example, the State of California has instituted a "30 by 30" initiative to coordinate within existing state agencies to conserve 30% of the state's land and water by 2030. In addition, NFWF has a partnership with the U.S. Forest Service (USFS) and the California Department of Forestry and Fire Protection (CAL FIRE) to increase the footprint of forest health and fuels management projects. Specifically, the partnership is aimed at mobilizing several watershed groups to package grant proposals on a larger landscape scale to the State of California, NFWF and others.

What is becoming more apparent across these state, federal, private and NGO constituencies is the need to collect data from implementation projects to track species and habitat response. A good example of this process is a Memorandum of Understanding between NFWF, USFS, CAL FIRE, the U.S. Fish and Wildlife Service (FWS) and Sierra Pacific Industries aimed specifically at monitoring species impacts of fuels management and forest health projects to ensure these activities continue to protect sensitive species such as the California spotted owl.

The conservation constituencies are also paying close attention to the benefit these nature-based solutions have on climate and water resource resilience. Several agencies and NGOs are working with outside consultants to monitor the resource impact of conservation initiatives including how much carbon these projects sequester and the water volumetric offset quantity.

The confluence of all these efforts helps elucidate the benefit of having a statewide NFWF business plan to continue to focus on initiatives across jurisdictions, with public and private partners and in a "headwaters down" fashion to link conservation projects into a true landscape scale approach. NFWF is primed to facilitate this landscape-scale effort that integrates forest and freshwater conservation strategies build a more resilient California for fish, wildlife, and people.

Conservation Outcomes

The vision of the California Forests and Watersheds Business Plan is to **protect and restore California's forests and watersheds from the headwaters to the coast to advance species conservation and landscape resilience to future fire, drought, and other stressors.** Building on NFWF's experience and investments in this landscape, this plan outlines focal species and habitat goals for forest and freshwater systems that it aims to achieve over the next 10 years (Tables 1 and 2).

To be selected as a business plan focal species, a species must meet multiple criteria. One key criterion is that the species is either threatened or endangered, of conservation concern (i.e., declining population) and/or is an indicator of habitat quality. All focal species in the California Forests and Watersheds Business Plan are either listed or otherwise of conservation concern, and several (e.g., northern and California spotted owls, mountain yellow-legged frogs, and long-billed dowitcher) are also considered good indicators for the habitat improvements targeted in this plan.

Another criterion for a species to be considered focal is that the geographic footprint of the business plan plays a key role in part of the species lifecycle. The geographic footprint of this business plan encompasses major geographies in Northern California/Klamath Basin, the Central Valley, and Southern California (Figures 2 and 3). Focal areas within these geographies were identified where conservation investments could have the greatest impact for one or more business plan focal species.

Additional criteria used in the selection of focal species are: necessary management strategies are understood and can be successfully implemented, the species will measurably respond to those actions, and species outcomes are likely to be sustained beyond the period of investment. This business plan also identifies prospective species and sites that will be subject to further examination (Table 3). Additional business plan investments may be made within prospective focal areas (see hatched areas in figures), particularly as prospective species and habitats are included in the business plan.

Forest Ecosystems

Forest Health

NFWF plans to invest in improving forest resiliency through fuels management and restoration projects that restore natural disturbance regimes to reduce the risk and impacts of extreme disturbance events such as large, high-severity wildfire, drought-related tree mortality and bark beetle outbreaks. NFWF will also invest in actions that facilitate recovery (e.g., tree planting) following large scale disturbance events that degrade forest resilience. In the absence of a comprehensive metric to adequately assess changes in forest resilience (see prospective strategies below), NFWF will track interim measures of improvement as forest structure is returned to a more natural state.

Once forest stands are under improved management (increased heterogeneity), stands are better able to withstand future stressors, also referred to as forest "resistance." Resistance can be measured as the ability of an improved, heterogeneous forest stand to remain unchanged by disturbance events and implies minimal changes to stand structure and species composition following these events (Bryant et al. 2019). Mixed-conifer forests dominate middle-elevation slopes of the Sierra Nevada and Transverse ranges in California and are inhabited by spotted owl and a suite of forest songbirds (Allen 2005), so restoring resistance to severe disturbance is key in mitigating wildlife population declines by retaining more biomass in large diameter trees that will reduce tree mortality.

Due to long-standing fire suppression and management practices, many mixed-conifer forest stands are over-stocked—leading to homogenous, fire-prone forest conditions. One measure of improved resistance to large-scale disturbance in improved mixed-conifer forests is Stand Density Index (SDI) which incorporates both tree density and size. Forest stands that are stocked beyond appropriate SDI thresholds are more vulnerable to severe stress events. Reducing the SDI of a forest creates sufficient growing space and less competition for resources among trees, thus improving their capacity to withstand disturbance events. Resistance is a near-term measure of forest condition improvement that will ultimately contribute to a more comprehensive metric of forest resilience.

Spotted Owls

Two subspecies of spotted owl occur in California: northern spotted owl (NSO; *Strix occidentalis caurina*) and California spotted owl (CSO; *S. o. occidentalis*). Spotted owl territories usually comprise older, structurally complex forests that can include variably aged stands but generally feature large trees and high canopy cover. Spotted owl prey habitat includes open, early successional patches and forest edges where woodrat is the preferred prey, as well as larger trees with moderate to high cover where flying squirrels are the preferred prey. Northern spotted owl is federally listed as threatened and both it and California spotted owl are in decline (Diller et al. 2016, Gutierrez et al. 2017). Primary threats for spotted owls include human population growth and development, illegal marijuana cultivation, timber harvest and forest management, large-scale disturbance events, and non-native barred owls (*Strix varia*).

Declines of NSO have been linked to expanding barred owl populations in Washington, Oregon and California, and removal of barred owl has resulted in a positive response of NSO (Diller et al. 2016, Weins et al. 2021). Through this business plan NFWF will support strategic removal of barred owls in Mendocino County where NSO occupancy and site extirpation rates are increasing. Barred owl occupancy is lower south of Mendocino County thus a removal strategy targeting barred owl along the front line of the invasion will convey protection to additional NSO territorial pairs south of this line (Peery, pers. comm.). NFWF will also fund barred owl removal for California spotted owl as necessary, although proactive management of barred owl populations have mitigated much of their impacts to date.

To improve available CSO habitat and stabilize long-standing population declines in priority areas, where there are as few as 32 territorial birds, NFWF will support fuels reduction treatments to reduce local wildfire effects and forest management practices that improve forest resistance to persistent threats and work towards improving habitat structure and heterogeneity (see forest health above).

Table 1. Business Plan Goals for Forest Ecosystems

Focal Targets	10-yr Business Plan Goals
Forest health	Improve mixed-conifer forest stand resistance to extreme disturbance events by managing Stand Density Index (SDI) ≤50% of maximum on mesic sites and ≤35% of maximum on xeric sites.
Northern spotted owl	Increase northern spotted owl territorial occupancy rate from 0.25 to 0.68 in Jackson State Demonstration Forest, Mendocino Co, and surrounding state parks by removing barred owl.
California spotted owl	Maintain an annual occupancy rate of at least 30% in the Eldorado Demographic Study Area (EDSA) to slow the long-term decline of this species.[1]

[1] Relative to 2020 baseline CSO territories surveyed within the EDSA.

Freshwater Ecosystems

Mountain yellow-legged frogs

The mountain yellow-legged frog (MYLF) is represented by two distinct, but closely related, species: mountain yellow-legged frog (*Rana mucosa*) endemic to southern Sierra Nevada and Transverse Ranges, and Sierra yellow-legged frog (*Rana sierrae*), endemic to northern and central Sierra Nevada (Vredenburg et al. 2007). Once abundant throughout their range, it is estimated that they have been extirpated from 93% of their historical distribution (Vredenburg et al. 2007) and more than 55% of surveyed occupied sites contained fewer than 10 adult frogs (Brown et al. 2014). Steep population declines resulted in a federal listing of endangered for both species citing habitat destruction, non-native fish stocking, and disease as primary threats. These frogs are highly aquatic, and breeding habitat requires water that does not dry during the summer and is sufficiently deep to prevent freezing in the winter. Historically, frogs often occupied high-alpine meadow systems throughout the Sierras, but intensive land use of these areas has resulted in heavily incised channels that have lowered streambeds and groundwater tables and caused a conversion of the vegetation community from mesic to xeric plant communities. This business plan aims to invest in strategies to restore degraded meadows through process- and form-based approaches including beaver dam analogs (BDAs), pond-and-plug techniques and stream bank stabilization to improve the water storage capacity that provide longer periods of inundation during dry periods. These improvements will expand frog breeding habitat and support a diverse suite of meadow-associated wildlife.

Central Valley and Sacramento River Chinook Evolutionary Significant Units (ESUs)

Three ESUs of Chinook (*Oncorhynchus tshawytscha*) naturally occur in the Central Valley of California (Sacramento River winter-run, Central Valley spring-run, and Central Valley fall-run) with distribution limited to California. The winter-run Chinook salmon is a NOAA Species in the Spotlight and both it and spring-run Chinook salmon are federally listed species (endangered and threatened, respectively). Both runs estimate less than 180,000 fish (California Trout 2019). The fall-run Chinook salmon is not federally or state listed but is of high concern due to fluctuating population numbers. Threats include but are not limited to: fish passage barriers, development, declining stream flow, estuary alteration and habitat condition and availability (Katz et al. 2013). More than 95% of pre-development floodplains have been disconnected and unavailable for salmonids as floodplains have been leveed and drained (Katz et al. 2017). These Central Valley inundated floodplains were important for juvenile growth in midwinter and early spring (Katz et al. 2017). This business plan aims to invest in strategies to reactivate floodplains for juvenile Chinook parr to access prime habitat. The strategy is to make off-channel habitats available to parr, enabling juvenile Chinook to grow robust enough to complete their migration to the ocean.

Southern Oregon/Northern California Coast (SONCC) Coho Salmon

SONCC coho are an ESU of salmon that spawn in rivers and streams of southern Oregon and northern California in both coastal and interior ranges. The ESU is federally listed as threatened due to impacts of dams, hatcheries, fish harvest, and land use. Populations for SONCC coho are estimated to be less than 5,000 fish (California Trout 2019). Agency partners and experts have identified numerous opportunities to assist in SONCC coho recovery at all life stages. NFWF will work from the headwaters down to increase habitat availability for coho, including fish passage projects, stream and off-channel habitat enhancement, and floodplain connectivity projects to restore watershed function, which will increase the number of juvenile coho that can be supported in critical geographies across the state. SONCC coho were the focus of NFWF's Russian River Coho Business Plan, which closed in 2020. NFWF aims to build

on lessons learned from the Russian River experience and expand collaborative conservation efforts, drawing on regular monitoring data and a deep bench of skilled restoration practitioners to target our efforts.

Southern California Native Rainbow Trout

Two forms of the salmonid *Oncorhynchus mykiss* (*O. mykiss*) naturally occur in the mountains of Southern California: rainbow trout (the resident, non-migratory form) and steelhead (the anadromous form). The two forms interbred historically and those expressing genes for migratory behavior were considered steelhead. Currently, most rainbow trout populations are confined to headwaters that are cutoff from the ocean by barriers such as dams. The rainbow trout populations are isolated from one another and in danger of negative effects of inbreeding as well as losing the remaining genes that could allow for migratory behavior. In addition, different populations of rainbow trout are impacted by fires and low water flows/droughts.

Steelhead, meanwhile, are federally listed as an endangered Distinct Population Segment. Population numbers cannot be accurately estimated due to rare observations and detectability. Steelhead are blocked from most spawning grounds by dams and impacted by invasive species in the lower reaches of river systems that remain accessible. New approaches to the conservation of *O. mykiss* in Southern California are needed if the species is to survive. NFWF aims to invest in a pilot to increase rainbow trout diversity within the headwaters to support the expression of the anadromous gene in advance of the restoration of ocean access. The plan will also aim to prepare the landscape for the eventual return of steelhead runs in the future via habitat improvements.

Long-billed Dowitcher (Shorebirds)

Many once-abundant bird species are now reduced to small populations or are entirely gone from the Central Valley due to wetland loss. Despite this trend, the region still hosts one of the largest concentrations of migratory birds in North America and is recognized as a location of international significance for shorebirds by the Pacific Americas Shorebird Conservation Strategy (Senner et al. 2016) and by the Western Hemisphere Shorebird Reserve Network. Although most of the historical wetlands have been permanently lost, a network of restored and managed wetlands and postharvest-flooded fields of rice, corn, and other crops currently provide substantial habitat for non-breeding shorebirds (CVJV 2020). California's Bid4Birds program is working with local rice growers to provide flooded agricultural habitat during fall and spring migration; more than 45 waterbird species have been recorded using seasonally flooded rice fields on enrolled lands.

Shallow flooded rice fields are important for a suite of migratory shorebirds including long-billed dowitcher (*Limnodromus scolopaceus*), which is a good indicator of appropriate habitat for several priority shorebird species identified in the Pacific Americas Shorebird Conservation Strategy. Between 10-20% of the non-breeding North American population of long-billed dowitchers rely on high quality habitat in the Sacramento Valley. Investments to expand the number of acres enrolled in seasonally flooded rice fields will provide additional habitat for this species and other migratory shorebirds.

Table 2. Business Plan Goals for Freshwater Ecosystems

Focal Species	10-yr Business Plan Goals
Mountain yellow-legged frogs	Increase site-level MYLF population abundance by 30% at priority meadows with existing populations.
Central Valley Chinook ESUs	Improve resilience of juvenile chinook by supporting an average of 2,000 fish per acre within reactivated floodplains.
SONCC Coho	Improve capacity of the habitat to support an additional 40,000 juvenile parr coho in restored floodplains.
Southern California rainbow trout	Improve genetic diversity of *O. mykiss* at the target site to yield at least 100 genetically viable *O. mykiss*.
Long-billed dowitcher	Increase annually flooded rice agriculture habitat in the Sacramento Valley by 3,500 acres to support an additional 122,500 long-billed dowitchers each year.

Prospective Forest and Freshwater Species and Habitats

The following prospective focal species and sites require additional information and/or investment before NFWF can include them as species with measurable conservation goals in the business plan. Further information on these species can be found in Appendix A.

Table 3. Planned Actions for Prospective Forest and Freshwater Species and Habitats

Prospective Species & Habitats	Planned Actions
Sierra Nevada forest bird Index	Develop an index for Sierra Nevada birds across a defined gradient of forest condition. Utilize existing bird data (including point count and acoustic data from across the Sierra) and analyses to populate a bird index of occurrence. Utilize existing point count vegetation data combined with remote sensing data to build a gradient of forest conditions from overstocked, fuel loaded forests to a system characterized by large trees, open forest, and reduced fuels with regular fire (General Technical Report [GTR] 220). Expected completion 1-3 years.
Forest Resilience	NFWF will provide resources to convene expert reviewers and stakeholders to identify appropriate ecological and socio-economic resilience metrics to determine efficacy of forest treatments and wildlife response (like forest birds). Forest models will need to incorporate remotely sensed and field survey data to assess changes in forest conditions over space and time. A number of federal, state, tribal groups and private entities are working to better understand how to manage for more resilience forests and NFWF plans to leverage and build upon existing efforts.
Least Bell's vireo	The goal of the Collaborative Wildlife Protection and Recovery Initiative (CWPRI) partnership is to coalesce, identify and centralize information in support of a species status assessment, a 5-year recovery update and listing review, for this endangered sub-species. NFWF is supporting discovery surveys on state, private and federal lands to define current distribution and threats and hiring a coordinator to serve as a clearing house for information across this multi-agency stakeholder group. Expected completion 2-4 years.

Klamath suckers	Conduct a feasibility analysis of undertaking conservation actions related to stream flows, enhanced habitat, fish passage improvements, and water quality improvements for the Lost River sucker and the shortnose sucker from Upper Klamath Lake and canals to Klamath River. The feasibility analysis will include the likelihood of measurable species responses to conservation actions. NFWF intends to work with established monitoring and recovery efforts for Klamath suckers to determine focal species feasibility and goal setting.

Figure 2. Map of forest and freshwater priority areas in the Southern California focal geography.

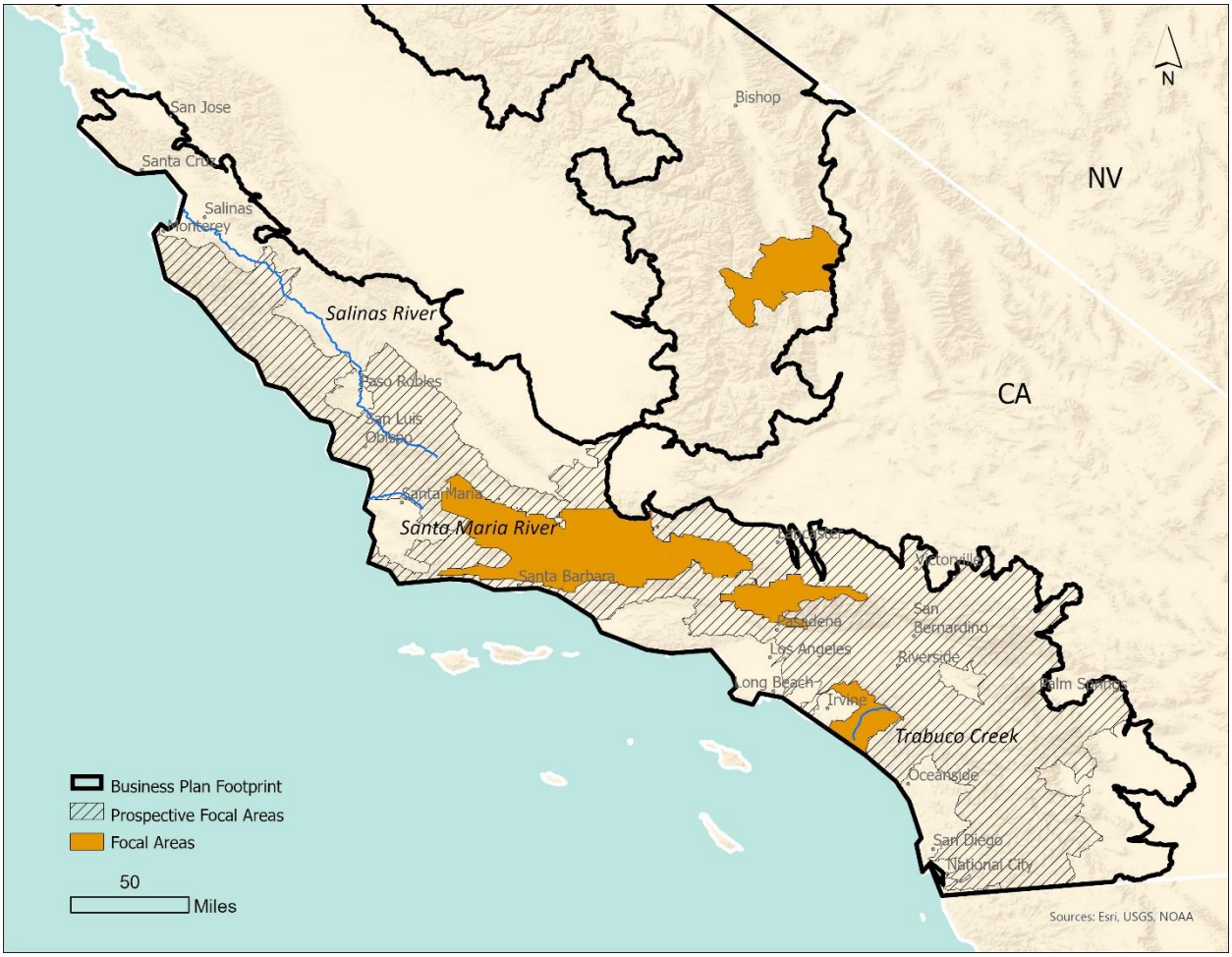


Figure 3. Map of forest and freshwater priority areas in the Northern California/Klamath Basin focal geography.

Implementation Plan

Through this business plan, NFWF intends to fund a diverse array of strategies to support the goal of protecting and restoring California's unique fire-adapted ecosystems and watersheds. These strategies have been identified to advance a holistic watershed-scale approach that considers conservation from the headwaters to the sea. Although the results chains depict the collective strategies that are broadly considered to contribute specifically to forest ecosystem outcomes (Figure 4) and freshwater ecosystem outcomes (Figure 5), many of the strategies will benefit both. For example, forest thinning and fuels management is intended to improve forest health and resilience, as well as restore properly functioning hydrology and reduce future sediment or other pollutant runoff to streams and lakes. Similarly, removal of invasive riparian vegetation is intended to improve in-stream habitat and flow conditions, as well as strengthen the resilience of riparian areas to wildfire, which in turn may serve as a natural firebreak that limits the spread of fire across the landscape.

Forest Strategies

Strategy 1. Fuels Management and Forest Restoration to restore heterogeneity and variable age class/structure

1.1. Thinning: Forest thinning refers to the selective removal of trees and other forest vegetation to reduce forest stand densities and gain a more diverse composition of forest age class and structure. In this context, forest thinning refers to any management strategies utilizing mechanical or hand treatments to remove and process selected vegetation from the landscape. Forest thinning is conducted to improve overall forest health, increase resistance to severe wildfire and other environmental stressors, and helps increase recovery and persistence of ecosystems when fire, drought, or other disruptive events do occur.

1.2. Prescribed fire: Prescribed fire is a specific forest management practice that utilizes the deliberate introduction of fire to the landscape in a strategic and highly managed approach. Prescribed fire intentionally uses fire to reduce the build-up of fuels and reintroduce fire as part of the natural processes in fire-adapted ecosystems. Prescribed fire helps reduce the intensity and severity of future fires and improves the health and resilience of the forest environment.

1.3. Shaded fuel breaks: A shaded fuel break is a forest management strategy designed to mitigate the threat of wildfire in areas where natural fire regimes have been suppressed and the risks of intense or severe fires to ecosystems, communities, or critical infrastructure is high. Shaded fuel breaks provide defensible space and increase the probability of successful protective actions during fire events, while including considerations for ecological function and integrity beyond that which would be provided by standard fuel break lines.

1.4. Hazard tree removal: Hazard tree removal is the selective removal of dead or dying trees from the landscape to improve safety in and around roads, trails, campgrounds, active management areas, and other features where people may congregate or utilize. Removal of hazard trees may also help to reduce additional forest fuels. Hazard trees are those that pose a particular risk to people due to the likelihood that they are likely to fall soon and may cause injury or block ingress/egress along transportation corridors. In post-fire environments, hazard tree removal across broad areas may be required to prepare sites before any restoration activity can occur.

1.5. Invasive vegetation removal: Invasive vegetation removal is the management and attempted eradication of (often) non-native vegetation that displays a propensity to outcompete native vegetation. As invasive vegetation becomes established, it can modify the ecological function and integrity of the systems that have adapted to the local conditions over time. Invasive vegetation can affect and alter critical habitat for wildlife, impact local hydrology and water availability, convert ecosystem types, destabilize hillsides and alter soil conditions, and increase the amount of fuel on the landscape. Invasive vegetation is often more prone to fire, and can increase the risk, severity, and frequency of fire—all factors which reduce the capacity for the landscape to recover to its natural fire-adapted state after a wildfire event.

1.6. Workforce capacity building: Effective fuels management and forest restoration requires specific skills, training, equipment, and experience in order to be effective. Changes in western forest management through time have created a present-day need that far exceeds the current capacity of the forestry related workforces in California to meet. NFWF will consider supporting the development of increased capacity, both in training to support qualified labor to conduct the variety of fuels treatment actions, and ways to responsibly process and utilize the fuel material post-treatments.

Strategy 2. Fire Recovery

2.1. Reforestation/planting: Replanting native trees, shrubs, and other plant species to restore ecological function and recover areas that may not otherwise recover naturally without intervention. Reforestation in this context is focused on post-fire recovery but could also be applied to other natural disturbances such as drought, disease, or flood events. Areas for reforestation should be thoughtfully considered, and conducted where natural recovery is unlikely, or where certain conditions exist that demand a faster and more certain outcome (e.g., to ensure invasive vegetation does not establish), and where/as appropriate in the face of climate change. Reforestation includes all aspects of site recovery—from seed collection and plant propagation, to site preparation, to planting, to post-planting watering (if necessary) and maintenance until the restored plants are established.

2.2. Invasive vegetation management: Invasive vegetation removal is the management and attempted eradication of non-native vegetation that displays a propensity to outcompete native vegetation. Invasive vegetation management is particularly important in post-fire conditions because some non-native invasive vegetation can quickly colonize and establish in burned landscapes, limiting or prohibiting the native plants from recovering. The establishment of these non-native plant communities then drives transformation in ecosystem composition and structure and can negatively alter the natural fire cycles on the landscape.

2.3. Trail/access repair and management: Under post-fire conditions, the restoration of safe trail conditions is particularly important on public lands. Wildfire events often damage or degrade trails, exacerbate erosion, and make access unsafe. The repair or relocation of trails, off-highway vehicle routes, and other access corridors is important to support additional landscape restoration activities, protect habitat and ecosystems by keeping access to designated areas, reduce pollutants and sediment from entering streams, and limit the introduction of invasive vegetation. In addition, where appropriate, educational and interpretive signage may be integrated into trail management actions as an opportunity to build public awareness around species protection, fire ecology, and responsible stewardship of public lands.

2.4. Erosion management/hillslope stabilization: Erosion management and hillslope stabilization refers to actions, either natural or engineered, that explicitly mitigate the potential of landslide or hillslope mass wasting events. Erosion from wind, rain, and snow can be common after wildfire as a result of the loss of vegetation and degradation of soil integrity. Erosion management and hillslope stabilization target areas and where the probability of erosion and the scale of potential erosion requires intervention to protect natural or human resources.

2.5. Riparian Restoration: Riparian restoration is the recovery of natural, native stream- or river-side vegetation. Healthy native riparian corridors provide habitat for birds, aquatic species, and other wildlife; shade streams and reduce water temperatures, buffer sediment and other pollutants from entering waterways, and in fire-prone areas, create natural firebreaks that help limit the spread of fire and provide refuge for wildlife during a fire event. NFWF-funded riparian restoration may include the removal of non-native invasive aquatic or riparian vegetation, the replanting of native riparian vegetation, and the stabilization of streambanks and reconnection of floodplains to restore geomorphology and hydrologic function.

Strategy 3. Research and Monitoring

3.1. Research and Monitoring: Investment in project effectiveness monitoring is important to chronicle success and develop adaptive management strategies to respond to a variety of dynamic conditions. The diversity in ecosystem types, climate, and biological communities across California inherently requires thoughtful consideration for what strategies are appropriate where, when, and under what conditions. There is a particular need to strengthen the understanding of fire and forest/fuels management effects on spotted owl and avian communities. As such, active data collection, analysis, and evaluation are critical to aid in effective decision making and strategic planning.

Strategy 4. Species-Specific Strategies

4.1. Barred owl removal: Remove territorial barred owls from northern spotted habitat and California spotted owl where they compete with and displace spotted owls.

Freshwater Strategies

Strategy 5: Mountain Meadow Restoration

5.1. Meadow restoration: Meadows are a critical component of watershed hydrology because they act as natural reservoirs, regulating stream flow through storage and release of snowmelt and rainfall runoff. NFWF will fund a variety of innovative meadow restoration methods including pond and plug and beaver dam analogs (BDAs), as well as native planting and invasive plant removal.

5.2. Hydrological monitoring: Monitoring meadow restoration projects to quantify hydrological benefits through changes in streamflow volume and groundwater storage helps to inform future projects as well as species benefits.

5.3. Fire scar repair: Targeted meadow restoration projects that complement and/or amplify restoration of fire scars on National Forests can provide additional benefits to watershed health.

Strategy 6: Aquatic Organism Passage

6.1. Channel maintenance: Maintain and improve access to existing channels and habitat. Examples of projects undertaken to maintain and improve fish access would include invasive weed management, riparian restoration, modification of tributary mouths, including removal of swimmer dams, gradient barriers, log jams, and other types of impediments.

6.2. Improve watershed infrastructure: Improvements in watershed infrastructure—such as roads, bridges, and drainage features—benefit watershed restoration and recovery by improving hydrologic connectivity and natural stream flow, reducing pollutant inputs and erosion, reconnecting in-stream habitat, and ensuring environmentally sound road networks to allow proper access for other conservation work. Projects may include:

a) Maintenance, replacement, and/or improvement to roads, bridges, culverts, barriers and drainage features, including installation of new drainage dips.
b) Decommissioning transportation infrastructure that has a deleterious impact on watershed health and/or human health and safety
c) Implementing strategic restoration projects in response to, and in anticipation of, extreme weather and storm events
d) Maintenance and improvements of existing transportation infrastructure to increase accessibility to fuels reduction and native vegetation projects

Strategy 7: Coldwater Refugia Habitat Restoration

7.1. Improve connectivity: Expand habitat cover and complexity or maintain habitat cover and complexity (if already suitable) at coldwater refugia sites (floodplains) to increase the amount of connected floodplain habitat. This aquatic habitat is essential to juvenile rearing of anadromous fish species.

7.2. Enhance rearing habitat in key rearing sites: Projects to improve or maintain cover and its complexity in refugia can include riparian planting and placements of boulders, large wood, and brush bundles. Projects to increase the extent and/or duration of refugia sites can include improving connection of flow from tributaries that feed refugia and adding natural structures or deepening refugia sites to increase the duration and extent of the coldwater plume.

Strategy 8: Instream and Off-Channel Habitat Restoration and Protection

8.1. Connectivity improvement: Conduct in-channel enhancements and improvements to eliminate flow and thermal barriers (e.g., removal or functional upgrades of diversion structures or screens, channel modifications or impediment removal to improve flow and access). Projects to enhance rearing habitat in tributaries include: channel reconstruction; floodplain connection; off-channel habitat creation and connection to increase available habitats provided by tributary channels; and side channels, alcoves, and ponds.

8.2. Riparian habitat restoration: Riparian fencing and planting and instream structure placement (e.g., large wood features, beaver dam analogs, post assisted wood structures) as well as riparian leasing and conservation easements or acquisitions to protect riparian areas and streambanks along reaches that provide important summer rearing habitat.

Strategy 9: Water Transactions and Conservation

9.1. Instream flow restoration: Projects that help prevent seasonal and temporary flow-related fish passage barriers and improve water quality and temperature in key rearing and spawning areas. Water transaction projects include water rights purchase or lease to provide flow augmentation in reaches used for spawning and juvenile rearing. Projects can also include seasonal flow releases.

9.2. Water conservation: Water conservation activities may include instream leasing and irrigation forbearance agreements, tailwater reduction projects, water storage tanks, piping of ditches, and other irrigation efficiency measures that ensure protection of the enhanced flow using tools such as petitions for instream flow dedications as described in Section 1707 of the California Water Code. Water conservation activities rely on landowner outreach to build trust over time and ensure long-term sustainability of enhanced instream flow.

9.3. Flow monitoring: Strengthen flow monitoring and accounting programs so that flow augmentation projects targeting focal species and critical ecosystems include compliance monitoring for water transaction projects and flow gaging of transferred water instream.

Strategy 10: Species-Specific Strategies

10.1. Rice agriculture flooding: Provide shallow flooded rice field habitat during the shoulder seasons (August/September; March to May) in key locations through an incentive program (Bid4Birds) that subsidizes producers to flood fields during critical late summer and early spring periods for migratory shorebirds.

10.2. Reactivating floodplains on rice fields for Chinook: Inundate off-channels and increase fish passage to quality habitat. Inundation will reactivate floodplains on rice fields during the late fall and winter for juvenile parr to access habitat, food, and refugia from predators. The timing of the inundation will allow for continued farming.

10.3. Embryonic translocation for Southern California native rainbow trout: Translocate Southern California rainbow trout (*Oncorhynchus mykiss*) embryos to suitable habitat for survivorship. The translocation site is anticipated to regain access to the ocean during the period of the business plan. The embryonic translocations will expand *O. mykiss* into historical locations and improve the genetic diversity and health of the species. The approach will allow for the possibility of the anadromous gene to be expressed in a portion of viable adults within the business plan timeframe. Habitat restoration will be undertaken in other areas to prepare sites for possible translocation (see Strategies 7.2 and 8.2).

Strategy 11: Capacity building

11.1. Capacity building: All aquatic conservation strategies rely on capable partners on the ground to build trust with landowners and water users, design sound projects, complete environmental compliance and permitting, and implement projects. Multi-year, sustained funding, along with regular compliance checks and site visits where appropriate, can increase and expand capacity of conservation partners. NFWF can also make available scientific tools such as the Flow Restoration Accounting Framework, Carbon Calculator, and Water Volumetric Equivalent Calculator to assist grantees in monitoring and tracking the impact of their efforts to improve project effectiveness and inform future project design and implementation.

Figure 4. Results chain depicting the relationship of various strategies (yellow hexagons) within the business plan to each other, to the intermediate results (blue boxes) and ultimately to the target forest species (green ovals).

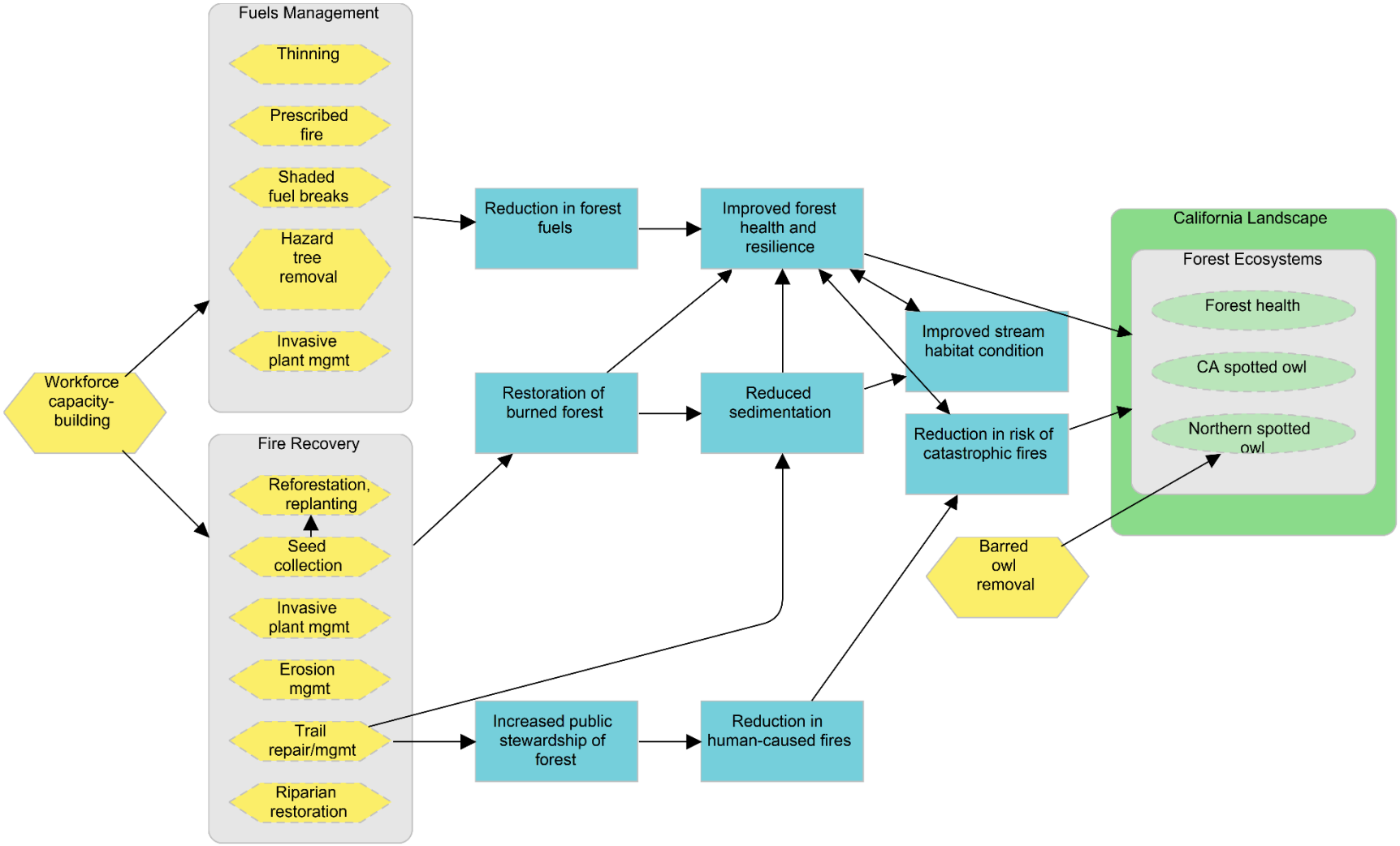
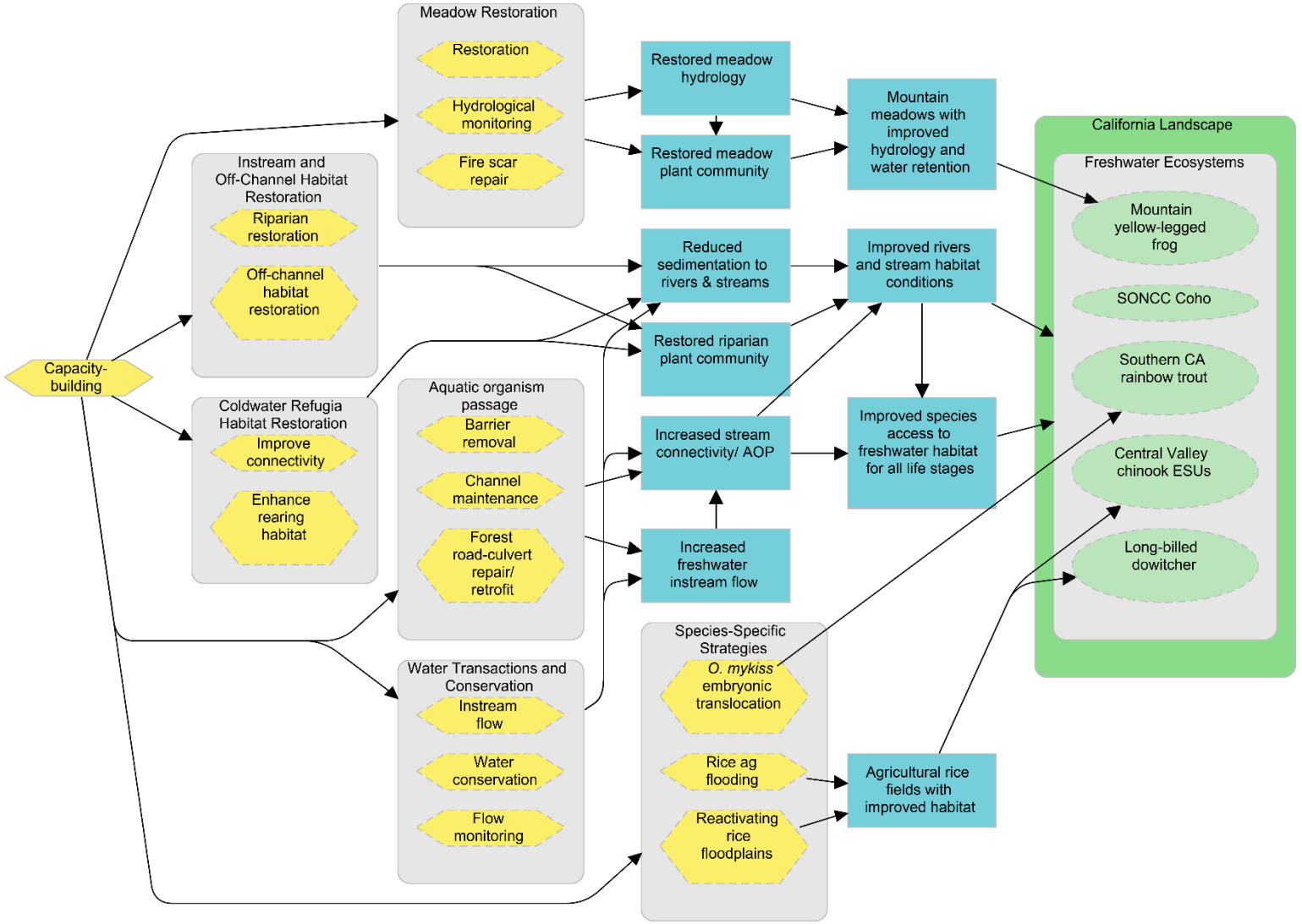


Figure 5. Results chain depicting the relationship of various strategies (yellow hexagons) within the business plan to each other, to the intermediate results (blue boxes) and ultimately to the target freshwater species (green ovals).



Risk Assessment

Risk is an uncertain event or condition which, if it occurs, could negatively affect a plan's outcomes. We assessed seven risk categories to determine the extent to which they could impede progress towards our business plan strategies and goals over the next 10 years. Below, we identify primary risks to success to the forest and freshwater goals and describe strategies to minimize or avoid those risks, where applicable.

NFWF also considers how these risks might affect the long-term sustainability of the outcomes achieved (i.e., up to 10 years after closure of the business plan). In particular, funding for continued maintenance and monitoring can be challenging to raise. In addition, environmental risks will likely intensify and impact the sustainability of restoration projects. To support long-term sustainability, NFWF will engage in the following best practices:

- RFP: Any Request for Proposals in support of the business plan will include language notifying applicants that projects may be subject to post-implementation monitoring by NFWF contractors. The RFPs will also list long-term sustainability in the evaluation criteria section.
- Outreach to Landowners: Support conservation projects that engage directly with landowners and major water users to build sustained support for implementation and maintenance.
- Long-term Maintenance and Monitoring: Prioritize projects that are tied to legally binding maintenance agreements such as a water forbearance agreement or a multi-year monitoring requirement.

Table 4: California Forests and Watersheds Business Plan Risk Assessment.

RISK CATEGORY	RATING	RISK DESCRIPTION	MITIGATING STRATEGIES
Economic Risks	Moderate	Lack of market for wood, workforce, and restrictions on purchase of equipment can hinder fuels management. Costs of materials for restoration projects have risen sharply.	NFWF will invest in capacity building to increase workforce available as well as ensure future agreements allow for investment in equipment (e.g., wood chippers) needed to process wood.
Environ-mental Risks	High	Multiple environmental risks, many associated with climate change, will impact habitats, species, and access to project sites, including fire, disease and insect infestation, monsoon storms, changing ocean conditions, and severe drought.	Business plan goals take environmental risks into consideration.
Financial Risks	Moderate	Inability to meet match requirements is a significant risk to soliciting forest management and species-specific grants. High and fluctuating flow restoration costs can lead to under or overestimate of required budget. 12% of the business plan budget has been secured at this time.	NFWF will consider adjusting program match expectations. New shared stewardship advisors will assist connecting applicants with match. NFWF will include water valuation reports as part of the water acquisition review and approval.

RISK CATEGORY	RATING	RISK DESCRIPTION	MITIGATING STRATEGIES
Institu-tional Risks	Moderate	Local partner capacity is limited which poses a risk to effectively deploying funds in a timely manner.	NFWF should build capacity of smaller organizations to implement larger projects and sustain investments (particularly in rural areas) over multiple years to ensure capacity for project completion. NFWF staff engagement or external support is needed to successfully build partnerships.
Regulatory Risks	Moderate	NEPA and CEQA[1] required for certain on-the-ground forest and freshwater activities, which can significantly delay implementation, depending on project scale and agency capacity.	NFWF will support NEPA contractors to expedite process, will consider potential for categorical exclusions, and will develop pipeline of design to implementation projects to help minimize impact of permitting delays.
Scientific Risks	Low	Limited scientific data on the impact of fuels management projects at a broad scale, and water conservation projects on aquatic species.	NFWF will support monitoring and the coalitions and tools to synthesize and disseminate these data.
Social Risks	Moderate	Negative public perception of prescribed fire can limit a cost- effective approach to fuels treatment. Tension and distrust surrounding use of water among users can impact partners agency offices and activities, as well as project sites.	Outreach to landowners will be embedded in grants. NFWF will maintain a role as a neutral convenor and will prioritize grants to those with strong local landowner relationships.

[1] National Environmental Policy Act and California Environmental Quality Act.

Monitoring & Evaluating Performance

Performance of this business plan will be assessed at both project and program scales. At the project scale, individual grants will be required to track relevant metrics from Tables 5 and 6 for demonstrating progress on project activities and outputs in their interim and final programmatic reports. At the program scale, broader habitat and species outcomes will be monitored through targeted grants, existing external data sources, and/or aggregated data from relevant grant projects, as appropriate. In addition, NFWF will conduct an internal assessment at a future stage of the plan to determine outcomes and adaptively manage. In some cases, course corrections that require increased investment may be warranted. However, it is also possible that NFWF would reduce or eliminate support if periodic assessment indicates that further investments are unlikely to achieve intended outcomes.

Monitoring Forest Outcomes

Table 5. Metrics for measuring progress towards forest conservation goals.

Focal Species	Outcomes	Metrics	Baseline (2021)	Goal (2031)	Data source(s)
Northern Spotted Owl	Increase the # of acres of NSO habitat in Mendocino County free of territory holding invasive barred owls	# acres under improved management for northern spotted owl (barred owl removal)	0	100,000	Grantee
	Decrease the # of occupied barred owl territories	# occupied territories	16	0	Grantee
	Increase NSO occupancy rate	% occupied territories	25%	68%	Grantee
California Spotted Owl	Maintain annual CSO occupancy of at least 30% to reduce population decline	% occupied territories [1]	35%	≥30%	Grantee/ contractor
	Improve forest condition by increasing heterogeneity and resistance to disturbance events	# acres under improved management[2]	0	63,000	Grantee
Forest Health	Manage mixed-conifer forests at or below 50% of max SDI on mesic sites	Stand Density Index (SDI)	Variable	≤50%	Grantee
	Manage mixed-conifer forests at or below 35% of max SDI on xeric sites	Stand Density Index (SDI)	Variable	≤35%	Grantee
	Reforestation for post-fire recovery	Acres of trees planted	0	14,750	Grantee

[1] Relative to 2020 baseline of 49 total CSO territories surveyed within the EDSA.

[2] A subset of these acres will occur in and around the EDSA; the remainder will occur throughout forest focal geographies.

Monitoring Freshwater Outcomes

Table 6. Metrics for measuring progress towards freshwater conservation goals.

Focal Species	Outcomes	Metrics	Baseline (2021)	Goal (2031)	Data source(s)
Mountain yellow-legged frog	Increase site-level abundance by 30%	Increase in abundance over baseline	Variable	30%	Grantee/ contractor
	Restore hydrologic function to degraded meadows	# of wetland/meadow acres restored	0	1,500	Grantee
Central Valley Chinook	Increase resilience in 3 populations by sustaining 2,000 juveniles per acre within reactivated floodplains	# of floodplain acres with a density of >2,000 juveniles/acre	0	250	Grantee/ contractor
	Reactivate floodplains for juvenile habitat	Acres of restored floodplain	0	250	Grantee
SONCC Coho	Restore access to floodplain habitat	Acres of restored floodplain	0	8	Grantee
	Increase juvenile capacity of juvenile parr coho	# of juvenile coho in restored areas	0	40,000	Model (2RH02D or variation) & Grantee/ contractor
Southern California Rainbow Trout	Contribute at least 100 viable rainbow trout per translocation site	# of rainbow trout per translocation site	0	100	Grantee/ contractor
	Complete embryonic translocations in 1 key area to increase genetic diversity of *O. mykiss.*	# of translocations	0	1	Grantee
	Sustainable survival rate of translocated embryos	Survival Rate	No data	70%	Grantee/ contractor
	Restore habitat to improve habitat availability and potential translocation sites	# of riparian acres restored	0	300	Grantee
Long-billed dowitcher	Increase available habitat supporting migratory shorebirds during fall/spring period	# rice agriculture acres under improved management (flooded annually to a depth of <4 inches)	0	3,500	Grantee
	Increase the density of long-billed dowitcher using rice agricultural fields during migration	# birds/acre	0	35	Grantee
	Increase the density of shorebirds utilizing rice agricultural fields during migration	# birds/acre	0	115	Grantee
Aquatic Habitat	Increase aquatic organism passage	Miles of stream re-opened	0	75	Grantee
	Increase aquatic organism passage	# of fish passage barriers rectified	0	15	Grantee
	Improve instream habitat	Miles restored instream	0	50	Grantee

Budget

The following budget shows the estimated costs to implement the business plan activities that NFWF intends to invest in through annual Request for Proposals. NFWF will have to raise funds to meet these costs; therefore, this budget reflects NFWF's anticipated engagement over the plan's period of performance and it is *not* an annual or even cumulative commitment by NFWF to invest. This budget assumes that current activities funded by others will, at a minimum, continue; however, only NFWF funds are shown in the budget below.

BUDGET CATEGORY	Years 1-5	Years 6-10	Total
Forest Conservation			
Strategy 1. Fuels Management	$10,000,000	$15,000,000	$25,000,000
Strategy 2. Fire Recovery	$15,000,000	$10,000,000	$25,000,000
Strategy 3. Research and Monitoring	$1,500,000	$1,500,000	$3,000,000
Strategy 4. Species-Specific Strategies	$500,000	$500,000	$1,000,000
Forest Conservation Sub-Total:	**$27,000,000**	**$27,000,000**	**$54,000,000**
Freshwater Conservation			
Strategy 5. Mountain Meadow Restoration	$2,500,000	$2,500,000	$5,000,000
Strategy 6. Aquatic Organism Passage	$4,500,000	$4,500,000	$9,000,000
Strategy 7. Coldwater Refugia Habitat Restoration	$5,000,000	$5,000,000	$10,000,000
Strategy 8. Instream and Off-Channel Habitat Restoration and Protection	$5,000,000	$5,000,000	$10,000,000
Strategy 9. Water Transactions and Conservation	$2,500,000	$2,500,000	$5,000,000
Strategy 10. Species-Specific Strategies	$4,750,000	$4,750,000	$9,500,000
Strategy 11. Capacity Building	$500,000	$500,000	$1,000,000
Freshwater Conservation Sub-Total:	$24,750,000	$24,750,000	$49,500,000
TOTAL BUDGET	**$51,750,000**	**$51,750,000**	**$103,500,000**

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Appendix A. Prospective Species and Habitats

Sierra Nevada forest birds

The Forest Service selects Management Indicator Species (MIS) as one of the required elements to address National Forest Management Act (NFMA) standards related to biodiversity. Species are selected as MIS due to the potential to link population changes to management activities. The current suite of indicators for the Sierra includes thirteen species (nine birds, three mammals, one amphibian) and aquatic macro invertebrates as indicators for lakes, rivers and streams. It is unclear how well MIS reflect management; some suggest that a community level index may be a better indicator of assessing efficacy of management for wildlife. Important components of a potential community index include overlap of management and monitoring and clear species-habitat relationships. Point Blue's Sierra Nevada Bioregional Monitoring project aims to conduct distribution population monitoring targeted towards the habitats of MIS to track changes in distributions at scale. Leveraging these data, which include more than 200,000 detections of 190 species across more than 2,900-point count locations, the objective is to construct a community level bird index to reflect forest resilience and management.

Forest Resilience

Resilience is often defined as characteristics of a system that demonstrate resistance to disturbance and the speed of return to an equilibrium. A growing body of research emphasizes the need to restore more natural disturbance regimes to forests that create structurally diverse stands with more large fire-resistant trees to enhance the resiliency of these systems. However, due to the complexity of these processes, the ability to quantify resilience and monitoring progress towards outlined objectives on a large geographic scale is limited. Environmental data are needed from multiple sources to characterize natural and anthropogenic factors known to affect conditions that promote large-scale, high-severity disturbance events such as climate data, land cover, elevation, soil conditions, slope and management types. To more effectively apply forest treatments to restore resiliency, there is a pressing need to identify key indicators of forest resilience that are measurable, consistently collected and responsive to scale within an adaptive, cost-effective modeling framework. Additionally, such tools should also be able to project future treatment scenarios to identify priority areas for management that can contribute most effectively to the ability of the forests to respond large-scale, severe disturbance events.

Least Bell's vireo

The least Bell's vireo (*Vireo bellii pusillus*) is a U.S. endangered species listed in 1986 and currently restricted to southern California and northern Mexico (USFWS 1998). Least Bell's vireo is an obligate riparian species during the breeding season, typically nesting in structurally complex habitat adjacent to and within southern California watersheds. Breeding habitat loss and degradation, water availability and brood parasitism by the non-native brown-headed cowbird (*Molothrus ater*) resulted in range-wide contraction and population decline. Current management, including habitat control and riparian habitat restoration, has resulted in increased populations. However, historical portions of the range remain unoccupied, and a species status assessment update needs to be completed by the USFWS towards a planned listing review. A multiagency, multi stakeholder effort is underway to address data needs and to coalesce existing vireo and riparian habitat data. NFWF is working in support of this partnership to ensure the best information is available to the USFWS for the SSA, a 5-year recovery update and a subsequent listing review. Ongoing status review efforts will inform next steps for the species.

Klamath suckers (Lost River sucker and shortnose sucker)

The Klamath Basin contains four sucker species, three of which are endemic to the basin and two are listed as endangered under the Endangered Species Act. The NFWF prospective species are the listed Klamath suckers – the Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*). Both fish are long lived and were federally listed in 1988. The suckers face a number of threats, including predation and poor water quality, potentially contributing to adult mortality and limited juvenile survival past one year (Bart et. al, 2020 and USFWS, 2013 and 2021). In addition, suckers lack sufficient natural recruitment for continued spawning (Bart et. al, 2020 and USFWS, 2013), the cause of which remains uncertain. Currently, reproduction (and the survival of both species) depends in large part upon a breeding facility in the basin (e.g., the Klamath Basin Sucker Rearing Program) (Rasmussen & Childress 2018). NFWF invests in monitoring and research related to the recovery of suckers in the Klamath. NFWF will work with partners to assess the feasibility of the actions most likely to improve the conservation status of the fish species.