Assessment of Restoration Projects Funded from 2004 to 2018 Supporting Coho Salmon Recovery in Four Focus Areas Along California's North Coast

California Department of Fish and Wildlife

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Acronyms

AIC	Akaike's Information Criterion
BACI	Before-after control impact
CCC	Central California Coast
CDFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game, CDFG)
CMP	Coastal Monitoring Program
DCFH	Don Clausen Fish Hatchery
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FRGP	Fisheries Restoration Grant Program
GRRCD	Gold Ridge Resource Conservation District
HAS	Hydrologic subarea
HUC	Hydrologic Unit Code
LWD	Large woody debris
MESHR	Monitoring and Evaluation of Salmonid Habitat Restoration
MMWD	Marin Municipal Water District
NCRWQCB	North Coast Regional Water Quality Control Board
NCSP	North Coast Salmon Project
NFWF	National Fish and Wildlife Foundation
NGO	Non-government organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PACT	Priority Action Coho Team
PSMFC	Pacific States Marine Fisheries Commission
PSN	Proposal Solicitation Notice
PWA	Pacific Watershed Associates
RCD	Resource Conservation District
RFFI	Redwood Forest Foundation, Inc.
RRCSCBP	Russian River Coho Salmon Captive Broodstock Program
RRCWRP	Russian River Coho Water Resources Partnership
SFER	South Fork Eel River
SIP	Streamflow Improvement Plan
SONCC	Southern Oregon-Northern California Coast
SMCA	State Marine Conservation Area
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TWG	Technical Working Group
USACE	United Sates Army Corps of Engineers
USGS	United States Geological Survey
WCB	Wildlife Conservation Board

Executive Summary

In 2018 the California Department of Fish and Wildlife (CDFW) formed the North Coast Salmon Project (NCSP) team to assess and better integrate all CDFW efforts to recover Coho Salmon and establish permanent collaborations with local communities to achieve this recovery. The overarching goal of the NCSP is to identify and implement actions to accelerate Coho Salmon recovery and focus its efforts in four watersheds. The NCSP is focused on Coho Salmon recovery in Lagunitas Creek in Marin County, the Russian River (four tributaries: Dutch Bill, Green Valley, Willow, and Mill creeks) in Sonoma County, the Mendocino Coast (Garcia, Navarro, Noyo, Pudding, and Ten Mile sub-watersheds), and the South Fork Eel River in Humboldt County. The NCSP intends to establish improvements in salmon recovery and local collaboration to apply statewide.

To determine if there are opportunities to improve efficiency and effectiveness of restoration in this region, the NCSP team performed a comprehensive assessment of restoration efforts funded through the Fisheries Restoration Grant Program (FRGP), which represents the best source of salmon and steelhead habitat restoration project data both in number of projects and years of projects. This review of FRGP projects broadly summarizes grants awarded to improve habitat within the range of both the Southern Oregon Northern California Coast (SONCC) and the Central California Coast (CCC) Evolutionary Significant Units (ESUs) and focuses on how funding has been distributed within each focal watershed. This report also evaluates efforts to implement recovery tasks from the Recovery Strategy for California Coho Salmon (Recovery Strategy), the Priority Action Coho Team (PACT) recommendations, and recommendations from watershed-specific plans through FRGP. The NCSP will use this evaluation to make recommendations on how FRGP may be adapted to serve habitat restoration goals, and broader goals of species recovery. Specific objectives of this report include the following:

1. Summarize FRGP projects in the watersheds selected for the NCSP.
2. Compare implemented projects with the recommended actions in Recovery Strategy, PACT Report, and other documents that pertain to specific watersheds.
3. Where possible, make recommendations on how FRGP, and thus also other CDFW restoration grant programs, in these focus watersheds could be made more efficient and effective in addressing habitat restoration to achieve Coho Salmon recovery.

Between 2004 and 2018, there have been 1,420 projects funded through FRGP on the North Coast that were considered to benefit Coho Salmon recovery. Instream habitat and watershed restoration (upslope) made up the greatest proportion of projects funded, accounting for 17.2% and 14.9%, respectively. Approximately $239 million were awarded, of which $46.4 million remain to be spent in on-going projects. The median amount of FRGP funds spent per project was $67,785, but

there was significant variation in cost, with several large projects spending more than $1 million. There was also spatial variation in the number of projects and the amount of spending in the four initial watersheds.

Lagunitas Creek, the Lower Russian River, and the Lower South Fork Eel River experienced some of the highest concentrations of funding with over 50 projects funded between 2004 and 2018 in each watershed. For both the Russian and South Fork Eel rivers, the lower watersheds received more funding and projects than upper portions of the watershed. This spatial concentration of projects, and specific project objectives, is an important consideration when analyzing factors limiting Coho Salmon recovery in specific watersheds.

FRGP projects have typically resulted in well-functioning on-the-ground habitat features. The vast majority of FRGP project features monitored by the Monitoring and Evaluation of Salmonid Habitat Restoration (MESHR) team received a "Fair" effectiveness rating or greater with some variation through time and by project type. Of the 1,796 features monitored, approximately 92.5% of features received a ranking of "Fair" or better, 76.8% received a ranking of "Good" or "Excellent" and fewer than 1.9% of features received a ranking of "Failed". Observations of FRGP grant managers suggested methods and implementation techniques used in restoration projects have improved through time, likely in response to lessons learned from previous projects (C. Ramsey and S. Monday, CDFW, pers. comm., 10 August 2019).

Lagunitas Creek has experienced some of the most concentrated restoration efforts through FRGP, with 51 projects funded between 2004 and 2018. Instream habitat restoration and planning projects were the most funded projects by number (16 total). The greatest amount of funding sought to address fish passage issues. Monitoring has also been a significant focus of FRGP funding in Lagunitas Creek. CDFW began monitoring salmonids in Lagunitas Creek in 1970 and seven FRGP grants have funded status and trends population monitoring projects for a total amount of $1.2 million since 2004. These efforts have provided one of the longest time series of Coho Salmon redd data along the North Coast.

Most of the recovery tasks described for Lagunitas Creek have been addressed to some degree by FRGP projects. Since publication of the Recovery Strategy, five projects in Lagunitas Creek have directly addressed sediment erosion, preventing an estimated 3,273 cubic yards of sediment from entering the stream. FRGP has also been well aligned with the PACT recommendations since 2013 with nearly all funding focused on the highest priority actions identified.

While restoration in this watershed has been responsive to the latest recommendations, the absence of a clear trend in habitat improvement and Coho Salmon abundance could suggest that restoration has not been able to keep up with other environmental impacts (including ocean conditions), or that more

restoration resources and time are needed to see responses. With mixed results in the habitat quality in Lagunitas Creek, it would likely take further concentration of resources in restoration to expect a measurable response in Coho Salmon.

The Russian River watershed received close to $19 million in FRGP awards from 2004 to 2018 for 106 projects. Project types receiving the most funding were status/trends monitoring, upslope watershed restoration, fish passage/barriers, and instream habitat restoration projects. FRGP funded more instream habitat restoration projects than any other project type. A little over $5 million has been awarded for instream monitoring that collects data to estimate the status and trend of Coho in the Russian River watershed. Basin-wide monitoring is essential to the success of the hatchery program and Coho Salmon recovery, and directly addressed Recovery Strategy tasks for the Russian River Hydrologic Unit.

Since publication of the Recovery Strategy, FRGP has awarded grants within lower Russian River tributaries, Green Valley, Dutch Bill, and Willow Creeks, to projects contributing to fish passage, either through planning, design, or implementation. These efforts supported two recovery tasks within the Russian River Hydrologic Unit and successfully added or improved passage to available habitat for Coho Salmon and other aquatic species. In addition, three tasks described in the Warm Springs Hydrologic Sub Area focused on treating sediment sources and increasing habitat complexity with wood and boulder structures were also addressed. FRGP funded projects also addressed PACT recommendations regarding fish passage and instream habitat improvements. Two recommendations focused on captive rearing and rescue were or currently are being addressed with FRGP funding — instream enhancement projects for broodstock release streams and CMP (PACT 2019).

From 2004-2018 FRGP funding contributed significantly to restoring instream habitat in the Russian River. Although there are other factors contributing to watershed dysfunction, lack of sufficient summer streamflow has emerged as a leading factor limiting Coho Salmon production and survival in the four focus Russian River tributaries, especially in Green Valley Creek, Dutch Bill Creek, and Mill Creek where agricultural land use is heavily impacted. This has become more pronounced during the recent drought in California. Restoration projects designed around streamflow protection and water conservation strategies, as well as an increase in large wood are likely to play an important role in Coho Salmon recovery in these sub-watersheds and the Russian River basin.

Among the Mendocino coast watersheds considered in this evaluation, almost 75% of the roughly $12.7 million allocated through FRGP since 2004 were instream habitat restoration or watershed restoration projects. These projects focused primarily on habitat enhancement, large woody debris (LWD) placement, sediment reduction/control, and road improvement/decommissioning. Fish passage projects accounted for less than five percent of total FRGP funds spent on the Mendocino Coast. While over 84% of the FRGP grants awarded support priority actions

identified in the Recovery Strategy only 25 of 49 actions have been addressed thus far.

The PACT recommendations for the Mendocino Coast include the addition of LWD, reducing sedimentation and water temperature, fish passage barriers, and monitoring. Since 2004, winter habitat restoration and LWD augmentation were the primary focus of FRGP funded projects in Ten Mile Creek. The majority of FRGP funding awarded in Pudding Creek has been for LWD projects as well as the continued operation of a life cycle monitoring station. Projects reducing the adverse effects of sedimentation on Coho Salmon were primarily addressed in the Garcia and Navarro. The PACT document listed 12 priority projects in the Garcia River watershed for fish passage at road crossings, but since 2004 no fish passage projects have been funded by FRGP in the Garcia River watershed. However, two fish passage projects were funded in the Navarro River watershed since 2004 as well as a project design grant for a substantial barrier removal project. An additional three fish passage projects were awarded in the Noyo watershed resulting in the removal of three barriers, two of which were associated with the California Western Railroad.

A lack of consistent data and the impacts of drought years make it difficult to produce a complete history of Coho Salmon abundance on the Mendocino Coast. However, CMP has provided statistically robust escapement estimates for some streams beginning in 2009. Some areas, like the Garcia River, have recently seen increases in returning adults. Whether or not these results can be attributed FRGP funded projects, restoration in general, or natural conditions is difficult to discern, but it is an encouraging trend. Density dependence in freshwater, and paucity of winter habitat, likely limit Coho Salmon production in some coastal California streams (Gallagher et al. 2012). Creating additional, and restoring existing, winter habitat on the Mendocino Coast could elicit positive responses in population trends.

In the South Fork Eel River watershed, FRGP has funded 112 projects intended to improve conditions for salmonids since the development of the Recovery Strategy. Between 2004 and 2018, a total of $14,024,144 has been awarded to 18 different organizations. The majority of this funding (69.8%) was awarded to three FRGP project types: upslope watershed restoration, instream habitat restoration, and fish passage at stream crossings.

FRGP funding has supported restoration projects that addressed many of the threats and high priority actions identified in the Recovery Strategy for the South Fork Eel River. Upslope watershed restoration, instream habitat restoration, fish passage at stream crossings, watershed evaluation, assessment, and planning, and instream barrier modification for fish passage FRGP project types supported 20 of the 23 tasks identified in the Recovery Strategy for the South Fork Eel River and 10 of the 11 highest priority tasks. These project types also account for over 83% of the grants awarded in the watershed.

Despite indications that some aspects of fish habitat and distribution are improving, Coho Salmon adult returns do not yet reflect a growing population in the South Fork Eel River. Considering the relatively small scale of the restoration work discussed in this analysis with respect to the size of the South Fork Eel River watershed, it may not be reasonable to expect a fish population response yet. Of the 275 miles of tributaries, 21.6 miles, or 7.9%, were treated to improve instream complexity between 2004 and 2018 and 59.5 miles of stream have been made accessible to fish. Of the 687 miles^2 (439,680 acres) of watershed, over 150 acres (<1%) of upland habitat have been restored, 27.5 miles of road have been decommissioned or improved, and 155,275.1 cubic yards of sediment were prevented from entering waterways. While these are commendable achievements, this scale of restoration is not likely to result in landscape and population level responses. The Recovery Strategy estimates that there are over 26,600 miles of roads in the entire Eel River watershed that require treatment or decommissioning, which means that less than one percent have been addressed through FRGP in 15 years. However, by estimates reported to FRGP, sediment savings could account for over 34% of the anthropogenic sediment sources in the South Fork Eel River.

This analysis of the NCSP watersheds highlights the variation in how FRGP funding has been applied across different regions. The initial watersheds have been the focus of many projects and the vast majority of those were successfully implemented and function as intended. However, the difference in spatial scale among watersheds, as exemplified by Lagunitas Creek and the South Fork Eel, is important when considering the expected outcomes based on the resources allocated. The relatively large South Fork Eel watershed (689 miles^2) received \$20,736/mile^2 compared to \$88,065/mile^2 in Lagunitas Creek (103 miles^2), which likely reflects both the different concentrations of restoration efforts and the regional differences in project implementation costs. However, the concentration of funding alone cannot guarantee the growth of a fish population.

FRGP was designed to fund relatively small projects that can fit under a programmatic permit, that are implemented over a relatively short timeframe, and funds are spread out over the entire range of both Coho Salmon and steelhead. This approach may have mitigated some of the most pressing threats to Coho Salmon by addressing habitat dysfunction and degradation in many watersheds simultaneously. However, this approach may also limit success in reversing population trajectories overall and within individual watersheds. While many of the restoration actions funded by FRGP seek to address watershed processes (fish passage improvements, riparian planting, floodplain activation, etc.), the scale of the FRGP projects alone may limit its ability to restore processes to a level that benefits fish populations.

Through this analysis, we have highlighted how the Recovery Strategy and other guiding documents have been supported by FRGP funding. This effort was particularly challenging and labor intensive as recovery tasks are not well tracked

through a grant's execution and determination of whether specific recovery tasks have been addressed relies on the professional opinion of regional experts. Many of the Recovery Strategy's task are not defined in a measurable way making it especially challenging to assess whether tasks have been completed or sufficiently addressed.

The analysis performed for this report revealed that some monitoring data sets were either unavailable or formatted in ways that do not facilitate assessment of restoration. Most habitat restoration and habitat monitoring are conducted in an opportunistic fashion resulting in data that have limited alignment and thus a limited scope of inference. To be able to make robust conclusions on the effects of restoration, implementation and monitoring should be conducted in a design-based approach. MESHR has gathered over 15 years of data on project effectiveness but there has been little to no analysis of this data due in part to its inaccessibility. Quantitative metrics specific to each project type are gathered and stored in multiple data bases that are unrelatable. Similarly, habitat monitoring data is stored in individual databases for every stream and year, making quantitative analysis across space and time extremely cumbersome. Moreover, tasks outlined in the Recovery Strategy and included in the grant application process as justification for the project are not carried over into the FRGP database, which prevents a direct comparison of each FRGP project to a relevant state or federal recovery task. This limits our ability to track progress on recovery tasks, making it difficult to adjust priorities for future projects. Additionally, with over 1,000 tasks to choose from in state and federal plans when applying for funding, it is questionable if this breadth of choices focuses projects on high priority restoration needs.

This report has attempted to draw connections between restoration histories and monitoring data where sufficient data has been available or accessible. However, many of the status and trends population monitoring programs were not designed to validate the success of individual restoration projects and none or the focal streams discussed in this report have reached a level of restoration effort that would likely result in detectable changes of fish populations (Roni et al. 2010). The following are recommendations for how FRGP and monitoring efforts can adapt to be mutually beneficial and support the recovery of Coho Salmon:

Recommendations

1. Improve the reporting and tracking of restoration to facilitate understanding of progress on recovery tasks. It is difficult to determine which recovery tasks are being supported by restoration and to what degree those tasks are accomplished. Recovery tasks cited in grant applications are not tracked through implementation and only grants with Department oversight are being tracked in a labor intensive and sporadic manner. Recovery task from a grant application should be carried forward in the database of funded

grants. Many tasks are not easily quantifiable, which requires a great deal of interpretation to determine whether they are addressed in a sufficient manner.

2. Provide higher resolution plans and more specific quantifiable restoration tasks based on updated science, monitoring, and collaborative efforts and consider limiting future Proposal Solicitation Notices to the recovery tasks prioritized through these processes. More specific watershed plans and high-priority actions facilitate a structured approach to restoring watersheds and move restoration away from opportunistic projects. Focusing grant funds on areas with specific plans and pathways to recovery could increase the likelihood of seeing significant habitat and population responses. While FRGP requires citing a National Oceanic and Atmospheric Administration recovery task, in watersheds with high priority actions established through collaborative planning efforts, grants should consider limiting funding opportunities to these specific and limited tasks.
3. Conduct a more robust analysis of MESHR data to investigate project failures and successes and provide feedback to practitioners on how to improve implementation practices. While summarized data on project effectiveness was broadly available and analyzed in this report, a wealth of data remains un-analyzed that would likely inform future restoration practices. Based on communications with MESHR staff, detailed data for each project type are collected, but only analyzed to a limited extent to assess individual project effectiveness. Furthermore, complications with data organization has limited the accessibility of this data for broader analysis and multiple data bases will need to be made relatable before this analysis can be completed. NCSP is actively participating in an ongoing MESHR review to ensure these data are used to promote effective restoration.
4. Apply restoration in a complementary manner to existing monitoring efforts so projects can be assessed in a more robust experimental design to detect changes in habitat and population parameters. Projects should be designed in ways that leverage existing data so that questions regarding the biological and habitat outcomes of projects can be answered.

Introduction

In 2018 the California Department of Fish and Wildlife (CDFW) formed the North Coast Salmon Project (NCSP) team to assess and better integrate all CDFW efforts to recover Coho Salmon and establish permanent collaborations with local communities to achieve this recovery. The overarching goal of the NCSP is to identify and implement actions to accelerate Coho Salmon recovery and focus its efforts in four watersheds. The NCSP is focused on Coho Salmon recovery in Lagunitas Creek in Marin County, the Russian River (four tributaries: Dutch Bill, Green Valley, Willow, and Mill creeks) in Sonoma County, Mendocino Coast (Garcia, Navarro, Noyo, Pudding, and Ten Mile sub-watersheds), and the South Fork Eel River in Humboldt County. CDFW intends to use the NCSP to establish improvements in salmon recovery and local collaboration and to apply these tactics statewide.

To determine if there are opportunities to improve efficiency and effectiveness of restoration in this region, the team performed a comprehensive assessment of restoration efforts funded through the Fisheries Restoration Grant Program (FRGP). FRGP was selected for this analysis because it is the best source of salmon and steelhead habitat restoration project data, both in number of grant projects and years of projects. FRGP has a dedicated database with more than twenty years of information, covering over 1500 projects. The NCSP team intends to analyze newer CDFW habitat restoration grant programs in these watersheds, including Propositions 1 and 68, when the relevant data are at an appropriate stage.

There are two Evolutionarily Significant Units (ESUs) of Coho Salmon along the North Coast defined by the National Oceanic and Atmospheric Association (NOAA) (Figure 1). The Southern Oregon-Northern California Coast (SONCC) ESU was listed as Threatened in 1997 under the Endangered Species Act (ESA). The Central California Coast (CCC) Coho Salmon ESU was first listed as Threatened in 1996 and then listed as Endangered in 2005.

In 2004, CDFW released the Recovery Strategy for California Coho Salmon (Recovery Strategy). This Recovery Strategy outlined actions that should be taken to recover CCC and SONCC Coho Salmon that were both listed as threatened at the time. The predominant way CDFW aimed to address financial needs of recovery at the time was with grant funding through FRGP. In 1981, State Assembly Bill 951 created FRGP with the mission: "To protect and restore coastal salmon and steelhead trout habitat, while collaborating with many stakeholders to provide the greatest environmental, cultural and economic benefit to the State of California". In 2016, the geographic extent of the program was expanded to include the Central Valley and listed winter-run and spring-run Chinook Salmon and Central Valley steelhead.

At the time of FRGP's creation, California Coho Salmon and steelhead trout were not listed as either 'Threatened' or 'Endangered' under the California Endangered Species Act or ESA. The initial focus of FRGP was habitat restoration to improve coastal fisheries. Since the release of the Recovery Strategy, FRGP has changed its focus to supporting species recovery and accommodated their respective protected status as either 'Endangered' (CCC Coho Salmon) or 'Threatened' (SONCC Coho Salmon and Northern California/Central California Coast steelhead trout Distinct Population Segments). To be eligible for funding, any project submitted to FRGP is required to address and cite a specific recovery task from any of the approved species recovery plans, and proposals are evaluated in part by their ability and effectiveness in implementing the cited recovery task. Consequently, FRGP has developed into a grant program that aims not only to restore habitat, but to do so in a focused manner that benefits species recovery. This aim is partially guided by NOAA priorities as much of the funding for FRGP comes from the Pacific Coast Salmon Recovery Fund.

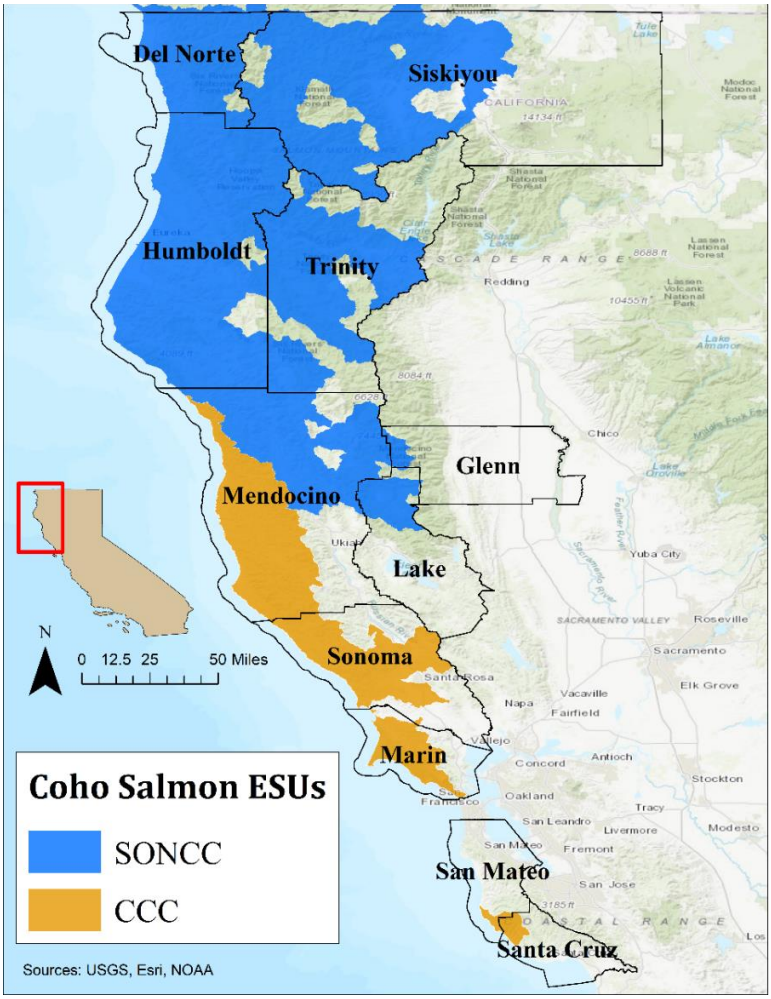

Figure 1. Map of California's North Coast showing county boundaries and the two Evolutionarily Significant Units for Coho Salmon: Central California Coast (CCC) and Southern Oregon-Northern California Coast (SONCC)

This distinction between habitat restoration and species recovery is significant in this context. The effectiveness of habitat restoration can be evaluated through proper oversight during the active phase of a project (implementation monitoring) and subsequently through monitoring of the effects of the project on the habitat (effectiveness monitoring). Both types of monitoring are routinely done in FRGP, the former as part of routine grant management, and the latter through a systematic post-implementation effectiveness monitoring program (at least ten percent of each implementation project type in each United States Army Corps of Engineers (USACE) subregion is randomly selected). In contrast, evaluating the effectiveness of projects funded through FRGP in providing a measurable biological response in the target species as indicated by increased abundance or distribution (status and trends population validation monitoring) is more challenging, particularly as many of the factors contributing to habitat degradation have continued.

This report summarizes and evaluates restoration efforts implemented through FRGP that have targeted Coho Salmon recovery. Although considerable efforts have been made to restore Coho Salmon in California since publication of the Recovery Strategy, CCC and SONCC Coho Salmon populations thus far have not shown significant improvements in abundance and distribution. At the same time, many of the anthropogenic factors contributing to habitat loss and degradation are ongoing. By analyzing four initial watersheds along the North Coast, this report evaluates efforts to implement recovery tasks from the Recovery Strategy and recommendations from watershed-specific plans that have been developed since 2004. The NCSP will use this evaluation to make recommendations on how FRGP may be adapted to serve both habitat restoration goals and broader goals of species recovery. This assessment of FRGP is a single part in a broader suite of deliverables that the NCSP will undertake regarding other aspects of species recovery.

Report Objectives

1. Summarize FRGP projects in the watersheds selected for the NCSP.
2. Compare implemented projects with the recommended actions in the Recovery Strategy, Priority Action Coho Team (PACT) Report, and other documents that pertain to specific watersheds.
3. Where possible, make recommendations on how FRGP, and thus also other CDFW restoration grant programs, in these focus watersheds could be made more efficient and effective in addressing habitat restoration to achieve Coho Salmon recovery.

Methods

Study Area

Four areas were selected as focal points for this study: Lagunitas Creek, the Russian River, Mendocino Coast, and the South Fork Eel River (Figure 2). Selected in collaboration with project partners, the four watersheds are representative of several different spatial and social factors impacting Coho Salmon recovery along the North Coast. The South Fork Eel and Russian rivers each have defined United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 8 watersheds, and Lagunitas Creek is a defined HUC 10 watershed. For in-depth analysis of the Russian River, four tributaries were selected within the Russian River watershed: Green Valley Creek, Dutch Bill Creek, Willow Creek and Mill Creek. The sub-watersheds selected along the Mendocino Coast for this project are composed of five HUC 10 watersheds: Pudding Creek-Frontal Pacific Ocean, Noyo River, Ten Mile River, Navarro River, and Garcia River.

Lagunitas Creek

The Lagunitas Creek watershed is the largest watershed in Marin County (103 miles^2). Lagunitas Creek has four major tributaries: San Geronimo, Devils Gulch, Olema, and Nicasio creeks. Several dams restrict salmonid access to half of the watershed, and populations have fluctuated significantly since 1970 (Ettlinger 2019). Roughly half of the watershed is privately owned, with the remaining area owned by the federal government (Golden Gate National Recreation Area), state government (Samuel P. Taylor State Park), Marin County, and other municipalities. This is the smallest and southern-most of the watersheds selected for the NCSP.

Like many of the watersheds that support Coho Salmon in California, historic and contemporary anthropogenic factors have negatively impacted salmonid habitat and populations. During the mid-1800's European settlers began farming, ranching, and harvesting timber in the Lagunitas watershed. In the 20th and 21st centuries a shift from crop cultivation towards grazing and a growing population increased the human water demand (Stillwater Sciences 2007). Increased demand for water for the growing population and agricultural needs, along with infrastructure like roads along stream corridors, has in certain areas of the watershed led to a simplification of habitat, incision, and less quality habitat available to salmonids.

Figure 2. Map of the focus areas for the North Coast Salmon Project and the HUC 8 and HUC 10 watersheds considered in those focus watersheds. Note: three of the four Russian River focus streams are part of the Lower Russian River HUC 10 depicted here for reference. Mill Creek is part of the Dry Creek HUC 10 and not shown here.

Lagunitas Creek Coho Salmon are considered an independent population by the National Marine Fisheries Service (NMFS). The watershed is one of the few in the southern range of CCC Coho Salmon that is not supplemented by a conservation hatchery. This watershed is also home to the largest persistent population of CCC Coho south of the Noyo River (Ketcham et al. 2004). Many of the watersheds with CCC Coho Salmon have experienced decreases in population abundance, and the

resiliency of Lagunitas Creek has largely been attributed to the concerted efforts of local stakeholders, non-governmental organizations (NGOs), state, and federal agencies (NMFS 2012).

Russian River

The Russian River basin covers an area of about 1,485 miles² and the river flows 110 miles from Laughlin Range near Willits to the Pacific Ocean near the town of Jenner (MCRCD 2012). The watershed consists of a series of valleys surrounded by two mountainous coastal ranges, the Mayacamas Mountains to the east and the Mendocino Highlands to the west. Annual precipitation across the watershed ranges from 30-80 inches, with more rain generally in the north and west. Over 90% of the watershed is private land, and dominant land uses are rural residential, urban, agriculture, ranching, and gravel mining (NMFS 2012).

The Russian River Coho Salmon population is one of twelve populations within the CCC ESU designated as functionally independent (McElhany et al. 2000; NMFS 2012). Geographically, the Russian River is the largest watershed inhabited by Coho Salmon in the CCC ESU, with historical estimates of approximately 20,000 returning adults, but by the year 2000 that number had dwindled to six individuals (NMFS 2012). In their 2011 status review, the Southwest Fisheries Science Center Technical Recovery Team determined the Russian River population to be at high risk of extinction (Spence and Williams 2011).

Much of the upper-basin Russian River does not, and probably never did, support Coho Salmon. The estimated total size of all watersheds in the lower-basin Russian River that currently support Coho Salmon is approximately 907 miles² (A. Bartshire, Sea Grant, pers. comm., 21 February 2020). This area is commonly referred to as the "Coho Universe" by local scientists and restorationists. The four tributaries to the Russian River selected by the NCSP and described in this report, Green Valley Creek, Dutch Bill Creek, Willow Creek and Mill Creek, represent a portion of the lower-basin Russian River with a combined area of approximately 81 miles² or 8.9% of the "Coho Universe" estimate. These four tributaries were identified as core priority areas for protection and restoration within the federal recovery plan (NMFS 2012). In addition, all four tributaries are intensively monitored by California Sea Grant and Sonoma Water as part of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) and the Coastal Monitoring Program (CMP) in the Russian River.

The four Russian River tributaries described here differ fundamentally from the other streams evaluated in this report in that they are part of a conservation hatchery effort. The RRCSCBP was initiated in 2001 to prevent the extirpation of Coho Salmon in the Russian River. From 2001 to 2003, some of the remaining natural-origin juvenile Coho Salmon were collected by biologists from lower-basin Russian River tributaries (primarily Green Valley and Dutch Bill creeks) and

brought to the Don Clausen Fish Hatchery (DCFH) on Dry Creek, a tributary to the Russian River. As the RRCSCBP expanded, out-of-basin Coho were added from Lagunitas Creek and Olema Creek in Marin County to provide additional genetic diversity. This program is currently funded and implemented by the USACE, the owners of the dam and hatchery.

The hatchery program now operates at its maximum capacity with plans to expand as funding becomes available, producing about 200,000 juvenile Coho Salmon annually for release into a suite of Russian River tributaries. In addition, surplus adults are released in Walker and Salmon creeks. A Technical Advisory Committee meets bi-annually to discuss monitoring, planning and release strategies. The number of returning adults has increased to over 700 in recent years but remains far below the federal delisting target of 10,100 adult Coho each year (NMFS 2012). Adult escapement to the basin in 2019/20 is estimated to be approximately 547 (Figure 3).

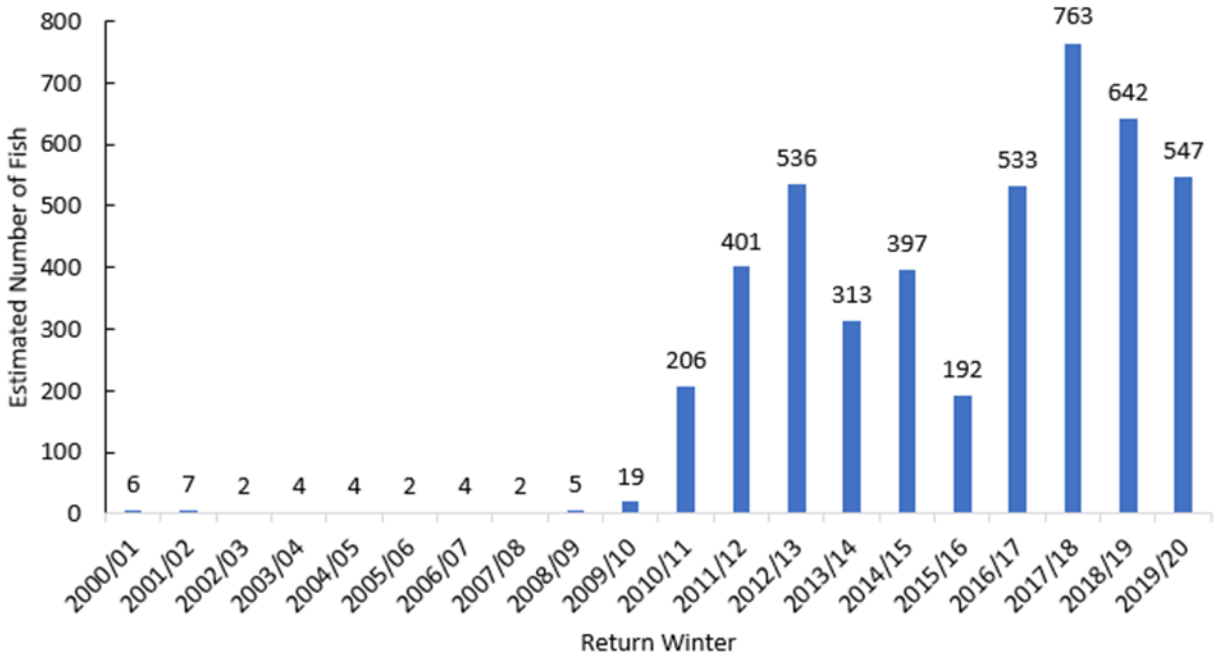

Figure 3. Estimated adult Coho Salmon returns to the Russian River, 2000/01 to 2019/20. The first cohort released from the broodstock program was in 2004. Methods for counting/estimating the number of returning adult Coho were not consistent among years; prior to 2009/10, spawner surveys were the primary method, from 2009/10-2011/12 methods included spawner surveys, video monitoring and PIT tag detection systems, and beginning in 2012/13, with the installation of the Duncans Mills antenna array, PIT tag detection systems were the primary method used (California Sea Grant 2020).

Green Valley Creek

Green Valley Creek and its tributaries (Atascadero, Purrington, and Jonive creeks) encompass an area of approximately 38 miles². The primary land use in Upper Green Valley Creek is rural residential (45%). Approximately 22% of the Upper Green Valley Creek and 40% of Purrington Creek lands are agricultural lands (GRRCD 2013).

Land use practices in Green Valley Creek have seriously impacted anadromous fish habitat. Legacy effects due to intense timber harvest, land conversion, and the development of road networks have increased sediment inputs to streams. In addition, lack of instream habitat, increased summer temperatures, and decreases in summer flows have affected juvenile fish survival. Although habitat conditions have declined over the years, CDFW identified Green Valley Creek as optimal Coho Salmon spawning and rearing habitat and the area produces some of the largest smolts within the lower-basin Russian River (RRCWRP 2019).

Dutch Bill Creek

The Dutch Bill Creek watershed is nearly 12 miles² and the creek flows through rural west Sonoma County, from the town of Occidental to Monte Rio where it joins the Russian River. The Dutch Bill Creek watershed was clear-cut during the "red gold" era beginning in the mid-1800's and again after the 1906 earthquake. A narrow-gage railroad ran the length of the watershed and was used to transport logs on their way to Sausalito.

The Sonoma County General Plan designated Dutch Bill Creek and its tributaries as "riparian corridors" and as "scenic landscape" (PWA 2003). Principal land uses within the Dutch Bill Creek watershed include timber, youth camps, conference centers, and rural residential, with vineyards concentrated in the eastern portion of the watershed and "other" agricultural activities concentrated in western portion (RRCWRP 2017).

The most critical limiting factor for anadromous fish survival is lack of summer rearing habitat caused by many small diversions and adjacent shallow aquifers that reduce summer flows (RRCWRP 2017).

Willow Creek

The Willow Creek watershed drains an area of about 8.6 miles². The watershed is unique in that nearly all is owned and managed by California State Parks as part of the Sonoma Coast State Park and the Mendocino Redwood Company. The lower Willow Creek watershed contains significant, undeveloped tidal wetland and riparian habitats. The upper watershed is primarily forested land that encloses high-gradient, step-pool channels, with intermixed grasslands (PCI 2005). Like Dutch Bill and Green Valley creeks, Willow Creek was heavily impacted by logging during the "red rush" and beyond. In the 20th century, the most intense logging in the upper watershed occurred between 1953 and the early 1970's. Large tracts of

forest within the inner gorge of Willow Creek were clear-cut and tractor yarded, leaving massive skid trails. Narrow-bed trains were reported to have been built within the creek-bed itself (PCI 2005).

The legacy effects left by timber harvest, road construction, and cattle grazing, as well as channel modification made in the 1950's, caused Willow Creek to heavily aggrade in the lower reaches, affecting fish passage. Large fine sediment loads caused by gullying, landslides, and other road related issues has greatly affected the quality of anadromous fish habitat by filling in rearing pools and embedding spawning gravels (PCI 2005). In addition, lack of shelter and large wood affects summer rearing opportunities for juveniles (CDFG 2000e).

Mill Creek

The Mill Creek watershed and its main tributaries, Felta, Wallace, Palmer, and Angel creeks, drain approximately 22.5 miles² into Dry Creek near its confluence with the Russian River. In 1841, the area was included in a land grant named Rancho Sotoyome, after the local Southern Pomo tribe. Rancho activity included livestock grazing, farming, fruit orchards, and vineyards (SRCD 2015). In addition, most of the watershed was logged within the last 150 years, leaving a legacy of poorly draining roads and skid trails, which continue to contribute large amounts of sediment to the stream (SRCD 2015). Today, the Mill Creek watershed is entirely under private ownership consisting of many relatively small parcels. Land uses include viticulture, other forms of agriculture, and livestock production. The narrowing of the channel associated with Mill Creek Road that runs adjacent to the stream has caused an increase in stream velocity and channel incision (CDFW 2000d).

Limiting factors to fish survival include embeddedness of gravels in fine sediment, high summer water temperatures, and impacts caused by diminishing flows (CDFG 2000d; RRCWRP 2015).

Mendocino Coast

The Mendocino Coast is the upper extent of the CCC ESU of Coho Salmon. The area is composed of multiple coastal streams, rivers, and creeks which flow west into the Pacific Ocean and provide valuable habitat to Coho Salmon, California Coastal Chinook Salmon, and steelhead. The area experiences a Mediterranean climate and averages approximately 43 inches of rain annually.

Five HUC 10 watersheds were selected as focus watersheds for the NCSP in the Mendocino Coast. From south to north they are the: Garcia River, Navarro River, Noyo River, Pudding Creek, and Ten Mile River. They were chosen based on professional opinion for their geographic distribution across the Mendocino Coast, varying sizes, presence of Coho Salmon populations, relevancy in recovery plans and pertinent literature, and recent or active restoration projects.

Historic and current land and water uses have affected the quality and quantity of Coho Salmon habitat within Mendocino coastal rivers and estuaries. Like other areas in CCC Coho Salmon ESU, populations along the Mendocino coast have shown a steady decline over the past few decades (NMFS 2012). Altered watershed processes or factors including accelerated delivery of sediment to streams, removal and reduced recruitment of wood to rivers, reduced river or estuary corridor and floodplain access, altered riparian shading, and water use have limited Coho Salmon habitat and populations. The application of California's FRGP for Mendocino Coho Salmon population recovery has focused on construction of fish habitat, river and floodplain fish passage connectivity, manipulation of watershed processes and factors, and planning or design of these activities to benefit Coho habitat.

The primary land use along the Mendocino Coast is timber production, although livestock grazing, irrigated agriculture (cannabis, orchards, and vineyards), parks, rural subdivisions, and urban areas also occupy smaller portions of the area (CDFG 2004). There are many anthropogenic impacts which adversely affect Coho Salmon populations along the Mendocino Coast. An increase in the percent of other land use categories (e.g., rural, agriculture, urban) at the reach and watershed scales was negatively correlated with adult Coho Salmon abundance (Pess et al. 2002).

Agencies, landowners, and NGOs have operated individually and collaboratively to implement salmonid habitat restoration along the 1,590 square mile Mendocino Coast. A majority of Mendocino coastal land is held in large tract timberland, agricultural, and public ownerships, and Coho Salmon habitat restorationists have benefited from partnership with and access provided by these large-scale landowners. The efforts taken by these groups to recover Coho Salmon on the Mendocino Coast are guided by recommendations made in the Recovery Strategy and PACT.

Garcia River

The Garcia River watershed, which spans 114 $miles^2$ in southwestern Mendocino County, is 80% privately owned and provides recreational, agricultural, and industrial water supply for the community of Point Arena. The Garcia River is one of the most impacted systems on the Mendocino Coast. Escapement numbers for Coho Salmon in the Garcia River watershed have fallen to alarmingly low levels in the last ten years. There have been several years when less than ten fish were observed since 2010, and in 2012 no fish were observed. However, recent escapement numbers have been more encouraging, with 240 and 585 fish in 2017 and 2018, respectively. The Garcia River watershed is greatly impacted by excessive sedimentation. The acceleration of sedimentation in the Garcia River watershed due to land management activities has reduced the availability of pool habitat necessary for salmonid rearing and resulted in the loss or degradation of potential spawning gravel (CRWQCB 2000).

Navarro River

The Navarro River is the largest and most diverse basin on the Mendocino Coast (CDFG 2004). The 28.2-mile-long river flows northwest through the coastal range and the Anderson Valley before reaching the Pacific Ocean. The watershed encompasses approximately 315 miles^2 and is composed of four HUC 12 sub-watersheds: North Fork of the Navarro River, Indian Creek, Anderson Creek, and Rancheria Creek. Forestland (70%), rangeland (25%), and agriculture (5%) make up the land-uses in the watershed. As recently as 1985, the Navarro River was considered to have the most anadromous habitat of any of coastal stream in Mendocino County.

Noyo River

The Noyo River is a coastal tributary which flows west to the Pacific Ocean at Noyo Harbor. The 180 miles^2 Noyo River watershed provides drinking water for the town of Fort Bragg and the land use is primarily timber production. Mendocino Redwood Company, Lyme Redwood Company, and the Jackson Demonstration Forest jointly own approximately 70% of the watershed. The California Western Railroad, also known as the Skunk Train, runs along the mainstem of the Noyo River for 40 miles requiring 31 bridges and trestles.

Pudding Creek

Pudding Creek is a small, second order, coastal tributary which includes 14 miles of fish-bearing stream reaches. Most of the watershed is managed for timber production, and over 70% of the watershed is owned by the Lyme Redwood Forest Company. Following intensive logging, road building, and instream disturbance (Burns 1971, 1972), Pudding Creek experienced large wood removal during the 1970's and 1980's. The Pudding Creek watershed includes a dam and an associated impoundment located 0.4 miles upstream of the confluence with the ocean, which was historically a water supply for the now defunct Georgia Pacific mill site. (Wright et al. 2012).

Ten Mile River

Ten Mile River is a 120 miles^2 watershed that is named for its proximity to the Noyo River, ten miles to the south. Ten Mile River has three main forks; North Fork, Middle Fork, and South Fork – all of which generally flow east to west. The watershed is primarily private timberland and has been actively logged for over 100 years, resulting in high sediment and siltation issues. Restoration efforts to address sediment related issues in the Ten Mile watershed focused on: restoring roads, installing drainage aids, and replacing failing bridges and culverts.

Although most of the interior of the watershed is privately owned, the estuary is under state protection. The Marine Life Protection Act designated the Ten Mile Estuary as a State Marine Conservation Area (SMCA) in 2012. Concurrently, Ten Mile Beach SMCA and Ten Mile State Marine Reserve were established creating a Marine Protected Area.

South Fork Eel River

The South Fork Eel River (SFER), a tributary to the Eel River, is a sub-basin with abundant natural resources including productive timberlands and relatively abundant Coho Salmon, Chinook Salmon, and steelhead populations despite historic and contemporary impacts to anadromous fish habitat. Draining approximately 687 miles^2 of land in Humboldt and Mendocino Counties, the SFER has 450 tributaries totaling over 966 miles of stream with approximately 275 miles of stream supporting native Coho Salmon. The SFER watershed supports productive forests prized for their stands of coastal redwoods and Douglas-fir. As post-European settlers colonized the Humboldt Bay region in the 1850's, smaller settlements were constructed throughout the SFER to raise livestock, extract oak tannins for leather making, and harvest the innumerable old growth redwoods. The growth of the post-WWII work force and the arrival of new mechanized harvest methods ushered in the logging boom of the north coast in the mid-1900's. The annual timber harvest rate in Humboldt and Del Norte Counties jumped from 53 million board feet in 1946 to over 300 million board feet in 1953 (Bearss 1969). The poorly regulated timber harvest practices of this era were a scourge to the landscape of the SFER; in addition to removing the canopy cover which shaded streams and provided a source of large wood, vast networks of roads were carved into steep, erodible hillsides, and numerous stream crossings were built, many of which blocked fish passage (CDFW 2014).

These impacts contributed to long term chronic sedimentation and habitat degradation, and they also left the watershed prone to natural disturbance. When the watershed was struck by two devasting floods in 1955 and 1964, the damaged landscape released sediment at a rate approximately three times greater than has been observed in the geologic record (Sommerfield et al. 2002). Though logging practices have improved, habitat in the SFER continues to be affected by these legacy impacts, as well as contemporary impacts from water diversion, unimproved roads, and poorly designed stream crossings.

Despite these anthropogenic impacts to the watershed, the SFER remains a stronghold for SONCC Coho Salmon. The Coho Salmon population in the SFER has drastically decreased over the last century, but its population has remained relatively stable over the last decade with an average of approximately 1,200 redds observed per year (Table 1). Agencies and restoration practitioners have been working to improve salmonid habitat since the 1950's and funding sources such as FRGP have been invaluable to perpetuating that work.

Table 1. Annual estimated Coho Salmon redd counts from the focus watersheds collected from California Coastal Monitoring Program. For areas with estimates at multiple location, abundance estimates were summed at the watershed level reported here.

Watershed	2010	2011	2012	2013	2014	2015	2016	2017	2018
South Fork Eel	1284	1873	1340	939	2069	416	465	1633	990
Ten Mile River	143	540	87	3	931	95	127	607	587
Pudding Creek	68	146	105	0	312	73	252	146	N/A
Noyo River	149	109	155	886	1296	2014	622	832	674
Navarro River	152	117	70	0	238	70	14	181	N/A
Garcia River	33	0	42	3	92	67	30	213	N/A
Lagunitas Creek	122	148	280	253	157	363	189	125	369
Russian River	N/A	N/A	N/A	N/A	98	148	185	82	127

Available Data

The FRGP, one of CDFW's longstanding grant programs, was established in 1981 and has been a substantial contributor to habitat restoration in the NCSP's focus watersheds. Data relating to the projects funded through FRGP are managed by CDFW and provide a robust foundation to assess the focus of restoration. The long time-series and geographic scale of these data allow us to assess how the FRGP process has addressed recommendations in specific areas since publication of the Recovery Strategy. This review of FRGP projects broadly summarizes grants award to improve habitat within the range of both the SONCC and the CCC ESU's and focuses on how funding has been distributed within each focal watershed described above.

Several components related to individual grants are contained within this data set. These include the amount of money granted and money spent, as well as the watershed (HUC 8 and HUC 10) that the grant is designated for. The project type of each grant is also recorded (see Table 2 for list of project types). Each grant

also has performance metrics reported by grantees that are unique to the project type.

Table 2. FRGP Project Types

AC	AmeriCorps Program Only
ED	Public School Watershed and Fishery Conservation Education Projects
EF	Enforcement and Protection
FP	Fish Passage at Stream Crossings
HB	Instream Barrier Modification for Fish Passage
HI	Instream Habitat Restoration
HR	Riparian Restoration
HS	Instream Bank Stabilization
HU	Watershed Restoration (Upslope)
MD	Monitoring Status and Trends
MO	Monitoring Watershed Restoration
OR	Watershed Regional Organization
PD	Project Design
PI	Public Involvement and Capacity Building
PL	Watershed Evaluation Assessment, and Planning
TE	Private Sector Technical Training and Education
WC	Water Conservation Measures
WD	Water Measuring Devices (Instream and Water Diversions)

Some data are also available pertaining to the effectiveness of grant-funded projects. The Pacific States Marine Fisheries Commission (PSMFC) Monitoring and Evaluation of Salmonid Habitat Restoration (MESHR) team conducts effectiveness monitoring of on-the-ground FRGP projects. The MESHR team selects at least ten percent of FRGP projects each year for monitoring using a random sampling scheme stratified by project type and region. While some years, including 2010, 2011, and 2014, had an expanded range for project selection, most of the monitoring is conducted between San Francisco Bay and the Oregon border. Only data pertaining to projects within the range of Coho Salmon were used in this analysis.

During effectiveness monitoring, MESHR team members conduct a thorough survey of each selected project using a protocol developed for each project type. Effectiveness ratings are based on an assessment of the structural integrity and function of individual features. Each feature, such as an individual large wood structure or fish passage barrier, is categorically rated as "Excellent", "Good", "Fair", "Poor", or "Fail" based on the definitions in Table 3 and survey results associated each respective ranking protocol. These individual ratings are then used to evaluate overall project success. The MESHR team conducts pre-treatment monitoring, followed by post-treatment monitoring within the first three years after implementation. Typically, post-treatment monitoring is conducted approximately one year after project completion. Monitoring is often deferred two to three years

for projects involving revegetation or other project types that may take several seasons to show results.

Data Processing

The initial phase of reviewing FRGP grants filtered available data to a subset of information relevant to this project. Projects were selected that occurred within the geographic range of the CCC and SONCC ESUs. In 2004, CDFW released the Recovery Strategy. The Recovery Strategy outlined actions that may lead to recovery of the species. Since this project aims to describe the work since the publication of the Recovery Strategy, projects were filtered to include only those that received funding between fiscal years 2003/2004 and 2017/2018. Finally, projects were examined to ensure they sought to benefit Coho Salmon. Some projects were beneficial to multiple species of interest (e.g., instream habitat projects that help Coho Salmon, steelhead, and coastal Chinook Salmon), while others were removed from consideration if they would likely only benefit other salmonids (e.g., steelhead genetics analysis).

The remaining data were sorted spatially based on the USGS HUC 8 and HUC 10 that each grant is assigned in the FRGP database. USGS HUCs range in scale, with additional digits (i.e. 10 vs 8) representing a finer scale watershed. There was one important exception to the filtering of data for this report. Roughly five percent of the total projects considered, 76 in total, were entered into the database with more than one assigned watershed. Where information in this document is summarized by individual watershed, these projects are excluded since counting a project, the amount of funds allocated, and the results from that project were not possible to parse out into specific watersheds. The decision was made to not double-count single projects in multiple watersheds, and to avoid assigning a project that took place across multiple watersheds to a single watershed. This does not impact the range-wide summary of the data presented here.

Effectiveness monitoring ratings produced by the MESHR team were summarized to reveal patterns in the functionality of restoration projects across time, space, and project type. Individual feature ratings from 2005 to 2018 MESHR monitoring reports were used to summarize feature effectiveness by FRGP project type (Figure 4), year (Figure 5), and HUC 8 (Figure 6). We excluded MESHR data from prior to 2005 to align with the FRGP data reviewed in this analysis since effectiveness monitoring is typically conducted one year after implementation. All features monitored are included in this summary, and while most of the features monitored are within the range of Coho Salmon, some fall outside of the species' range.

Table 3. MESHR post-construction effectiveness monitoring feature rating definitions.

RATING	GOALS	TARGETS	UNINTENDED EFFECTS	STRUCTURAL CONDITION
Excellent	Achieved all stated goals.	Met or exceeded targeted values.	No negative unintended effects. Unintended positive effects may outweigh failure to achieve a targeted value.	Excellent to Good
Good	Achieved most stated goals.	Did not quite meet targeted values. If no targets were specified, maximum rating is GOOD.	No negative unintended effects.	Excellent to Fair
Fair	Partially achieved most goals, or goals not achieved were outside the control of the feature.	Did not meet targeted values, but the feature still has some functional value.	May have minor unintended negative effects that partially offset goals.	Excellent to Fair
Poor	Achieved at least one goal; goals not achieved were the fault of the feature.	Did not meet targeted values, feature has little functional value.	May have minor or major unintended negative effects that offsets or negates a targeted gain.	Excellent to Poor
Fail	Achieved no goals; feature has no functional value.	Did not meet targeted values.	May have unintended negative effects that are degrading the habitat and outweigh achieved goals.	Excellent to Fail (may be completely gone)

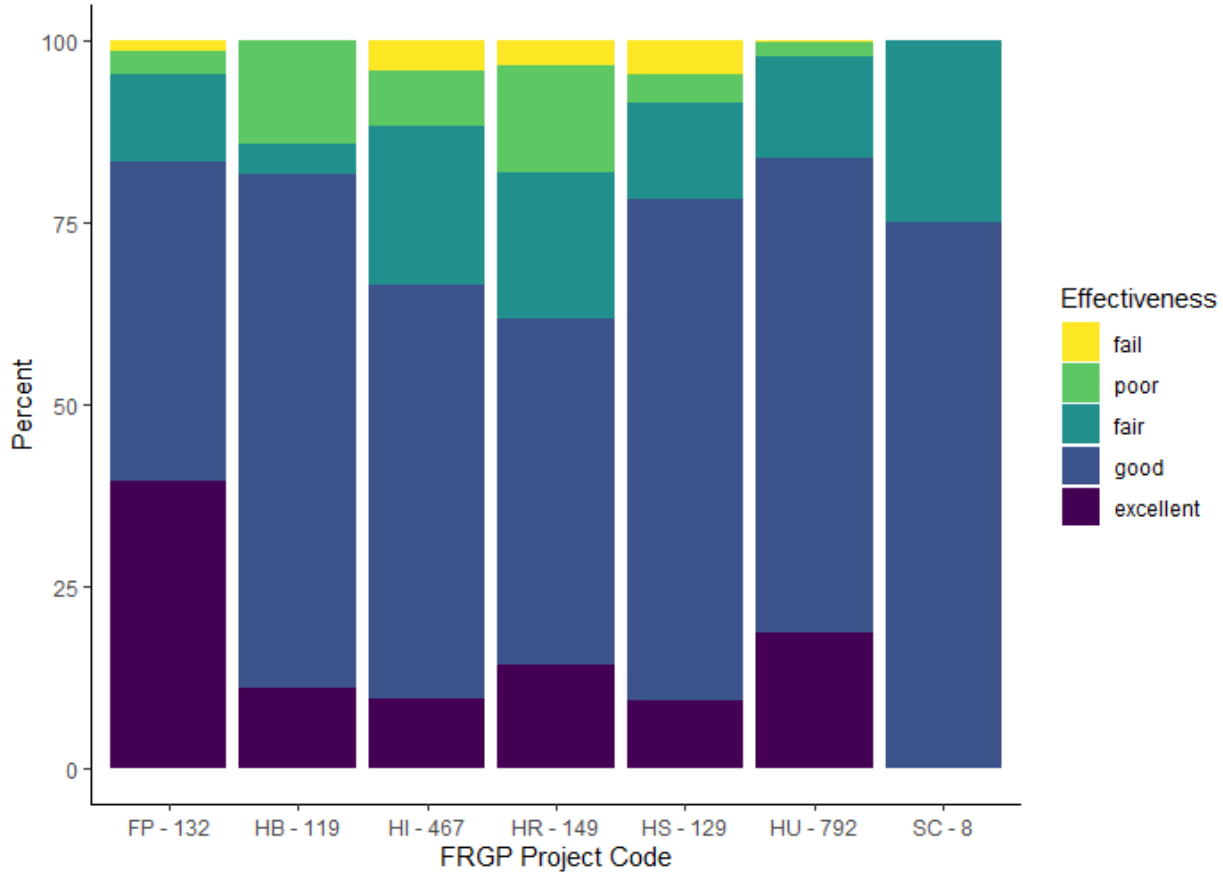

Figure 4. Feature effectiveness as reported by the MESHR team summarized by FRGP Project Codes. All features monitored from 2005 to 2018 are included and the count of features monitored are labeled next to each two-letter code.

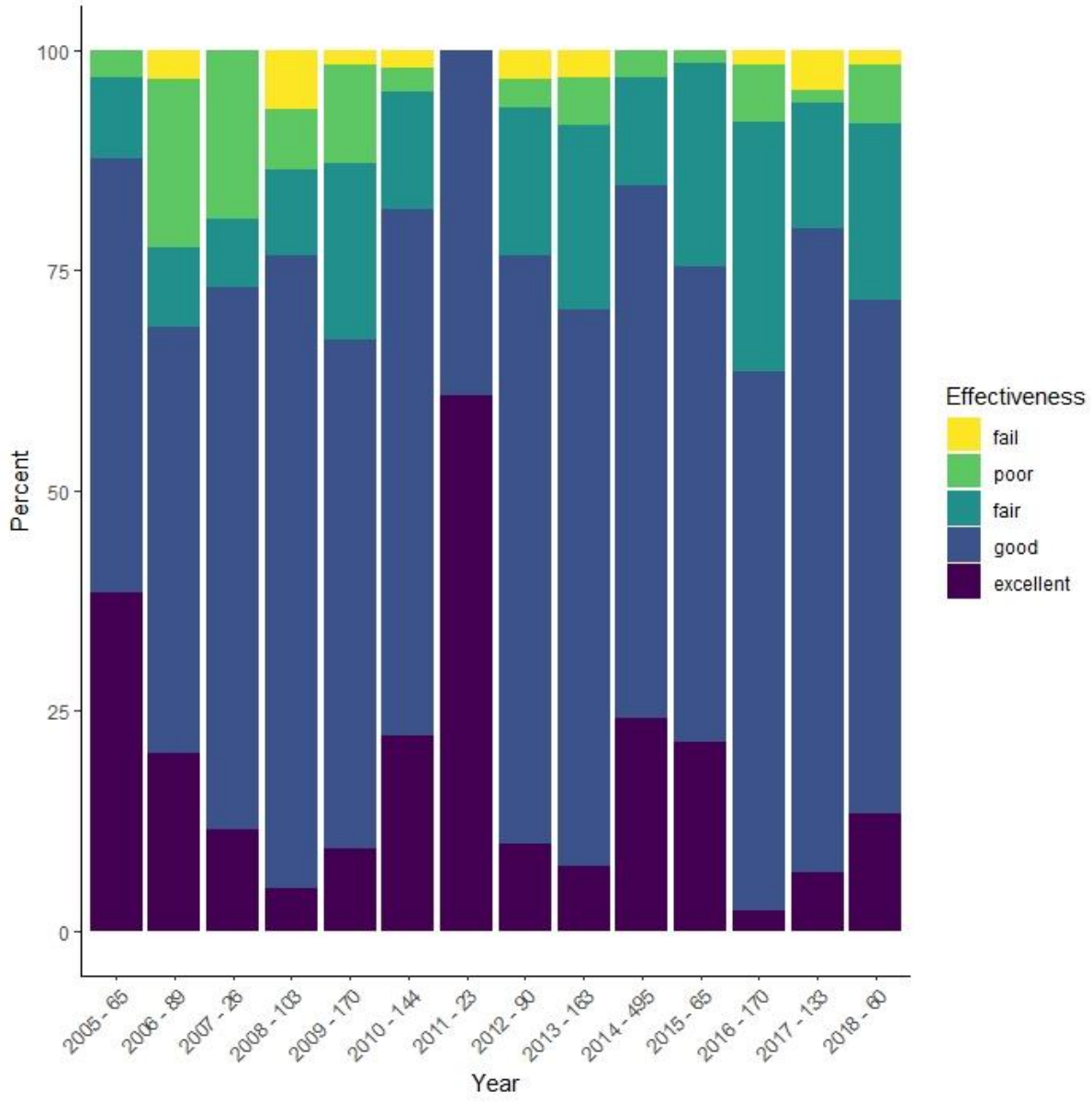

Figure 5. Feature effectiveness as reported by the MESHR team summarized by monitoring year. All features monitored from 2005 to 2018 are included and the count of features monitored are labeled next to each monitoring year.

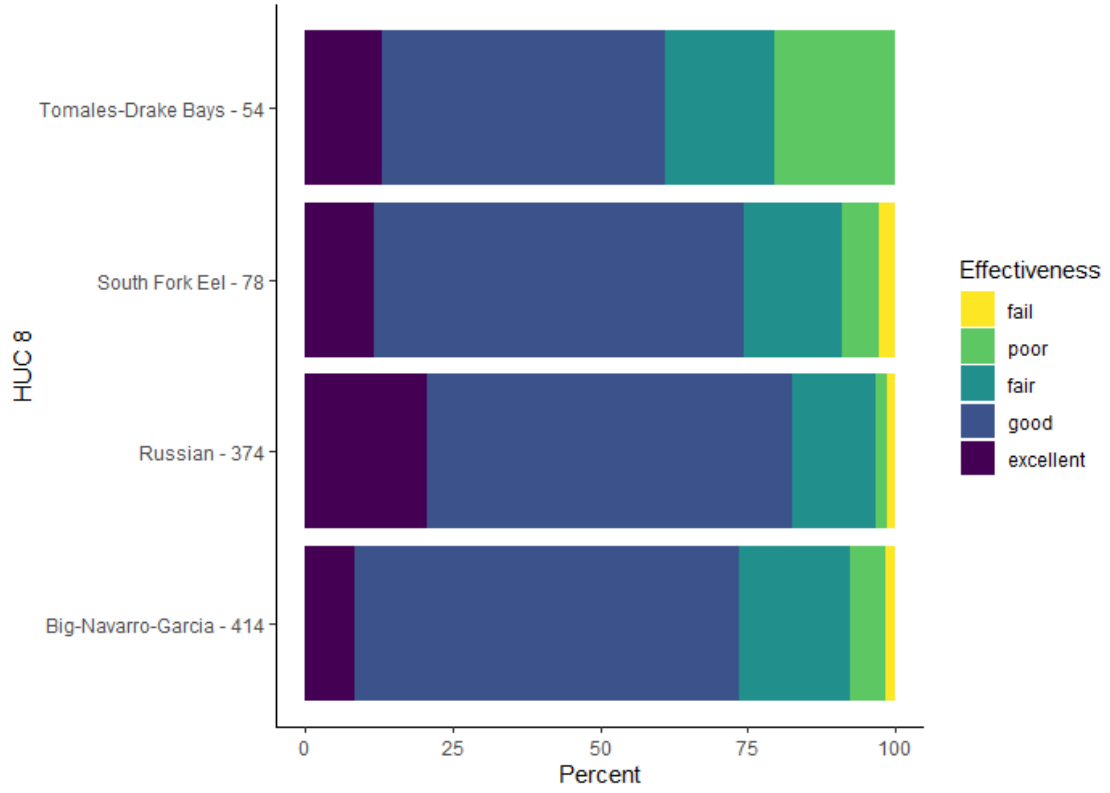

Figure 6. Feature effectiveness as reported by the MESHR team summarized by the focal area regions (HUC 8). All features monitored from 2005 to 2018 within each focal area are included. The count of features monitored are labeled next to each region.

Analysis

These FRGP projects were analyzed in the context of two important documents that guide restoration efforts, the Recovery Strategy, and the PACT Report. The Recovery Strategy has recommendations for all the initial focus watersheds and was relied on to determine if projects addressed the restoration actions outlined in that document. The Recovery Strategy describes range-wide and watershed-specific recommendations that were compared to the projects funded through FRGP. These recommendations have different levels (E, D, and C)[1] that reflect their relative urgency and priority to recover Coho Salmon. More details about these levels can be found in the Recovery Strategy (CDFG 2004).

PACT, a joint effort between CDFW and NOAA's NMFS, was initiated in 2011. As part of PACT, six Technical Working Groups (TWGs) were assembled to focus on

[1] Task Level E is the highest importance level and includes tasks that should be executed quickly because they are essential to Coho Salmon recovery. Task Level D indicates tasks that apply directly to specified recovery criteria or goals and are necessary for those criteria or goals to be achieved. Task Level C indicates tasks that apply directly to specified recovery criteria or goals and if not executed will hinder recovery.

specific topics, including habitat restoration, water conservation, captive rearing, and permitting. The habitat restoration TWG selected 150 priority actions to prevent extirpation of CCC Coho, pulling from the Recovery Strategy, Federal Recovery Plans, and partner solicitation. Additional recommendations were formulated by the Water TWG, Captive Rearing TWG and Permitting TWG. PACT only focuses on CCC Coho, and therefore was not considered for the SFER watershed.

Another focus of the analysis relates to planning projects. FRGP has historically funded watershed evaluation and planning projects. Watershed evaluation is an assessment of watershed-wide conditions and typically produces recommendations for actions that would help address those conditions. Watershed plans can provide guidance for future 'project design' projects or 'implementation' projects such as instream habitat or riparian restoration. Ideally, a project proponent would refer to the watershed plan document or a completed design project (or both) when applying for implementation funding through FRGP, in addition to the recovery task chosen from the Recovery Strategy or Federal Plan. This report seeks to answer whether watershed-level evaluation and planning projects are subsequently used as the basis of on-the-ground restoration efforts funded by FRGP, or whether they become 'orphaned plans' that are not followed by subsequent project proposals and do not lead to actual restoration.

In addition to understanding how project funding is directed, we also sought to understand the on-the-ground impacts of restoration projects. Where monitoring data were available, we attempted to draw connections between restoration projects and changes in habitat conditions or fish population parameters at a watershed or sub-watershed scale. The availability of these data, and the level of specificity vary considerably across the initial watersheds considered here. Additionally, we summarized MESHR project effectiveness ratings for restoration project effectiveness monitoring to evaluate whether projects are physically affecting the environment as they were designed to do.

To statistically investigate trends in MESHR ratings, multiple linear regression was used to model trends in project effectiveness. Simple additive models were built to predict the percent of features which received a rating of either "Poor" or "Fail" based on the year a project was monitored, the project type (see Table 2 for Project Types), and the region (HUC 8). All model combinations of the three predictor variables were compared using Akaike's Information Criterion (AIC) and the model with the lowest AIC score was used to evaluate variation in FRGP project effectiveness rating.

Findings

Between 2004 and 2018, there have been 1,420 projects funded through FRGP in the North Coast that were considered to benefit Coho Salmon recovery. Instream

habitat and watershed restoration (upslope) make up the greatest proportion of projects funded, accounting for 17.2% and 14.9%, respectively (Figure 7). Between 2004 and 2018 approximately $239 million were awarded, of which $46.4 million remain to be spent in on-going projects. The median amount of FRGP funds spent per project was $67,785, but there was significant variation in cost, with several large projects spending more than $1 million.

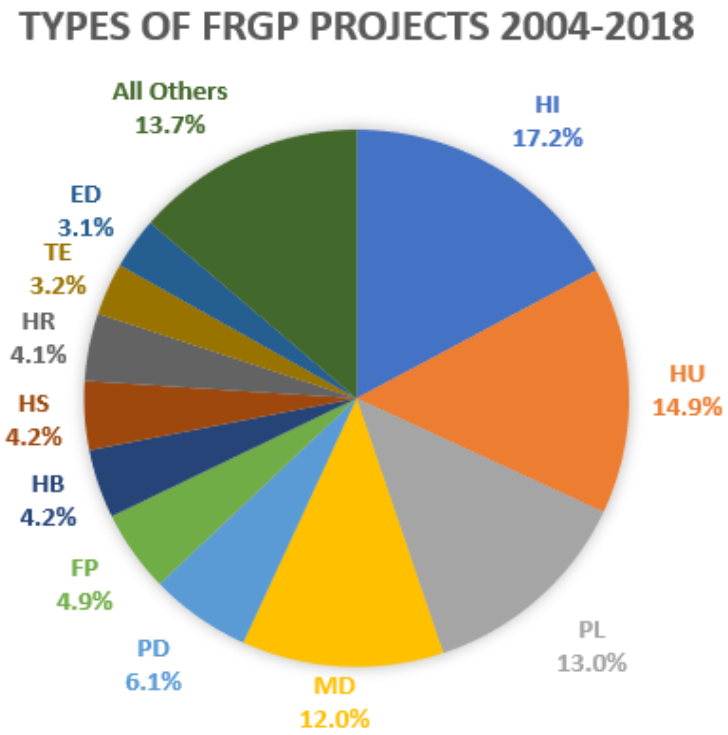

Figure 7. Figure representing the proportion of different types of projects funded by FRGP in the North Coast between 2004-2018 (n = 1420, types OR, PI, MO, WC, RE, SC, AC, PM, ALL, HA, WD, EF, WP, CC, FL, and TW each accounted for less than 3% of all projects and are included in "All Others" category. See FRGP project types in Table 2. for an explanation of project codes.

There was also spatial variation in the number of projects and the amount of spending in the four initial watersheds. Mapping the grants (see Figure 8, 9, 10, and 11) illustrates how funding is distributed across north coast watersheds at both HUC 8 and HUC 10 resolutions. The four initial watersheds were never in the lowest quartile for number of projects or amount spent.

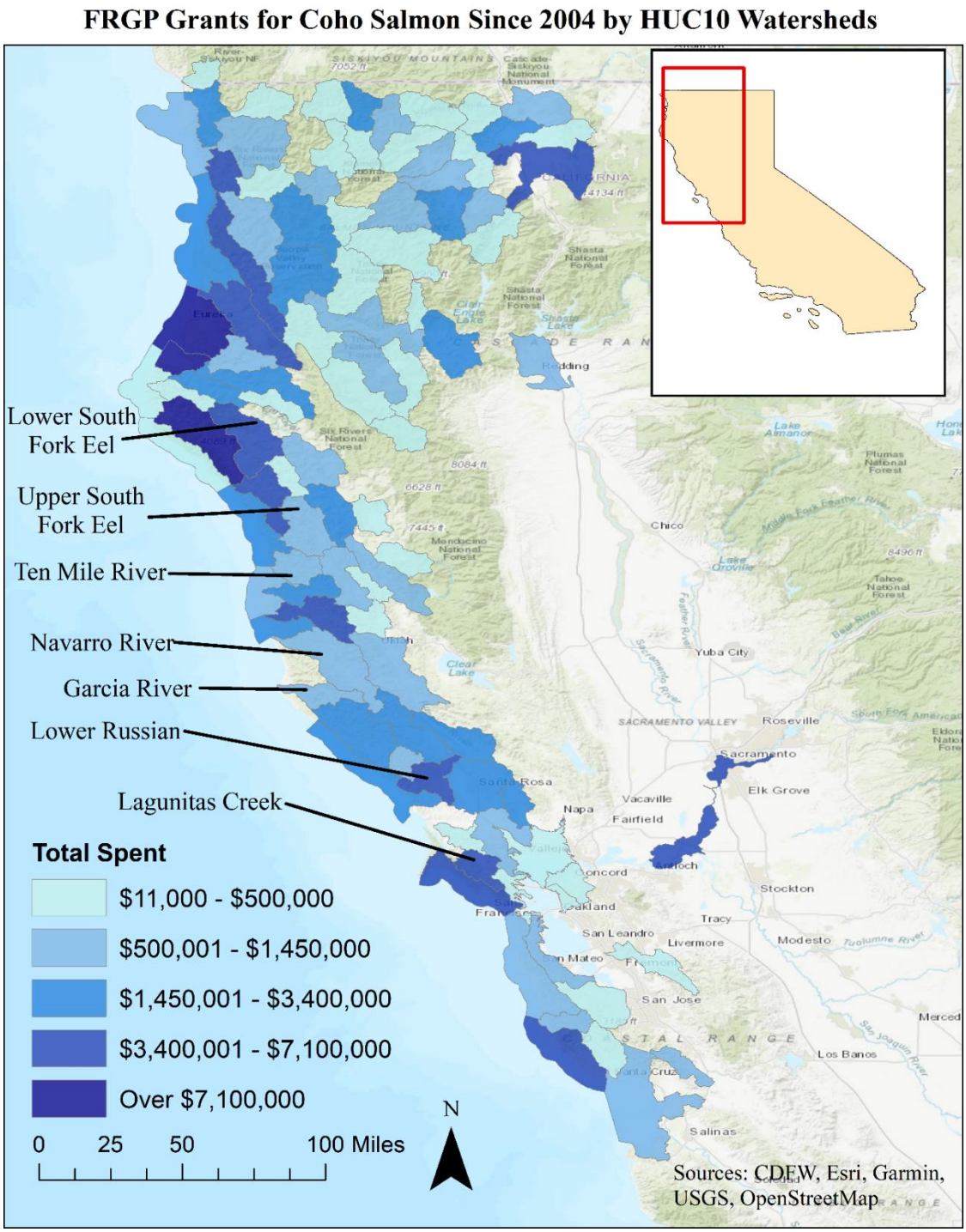

Figure 8. Map depicting the amount of money spent through FRGP grants between the 2003–2004 FY and 2017–2018 FY, summed at the HUC10 watershed level. This summary includes all project types throughout the North Coast. Some projects that are planning, outreach, or analysis based, are assigned watersheds not typically associated with Coho Salmon (Central Valley) but were kept in this analysis to accurately represent the available data on FRGP grants.

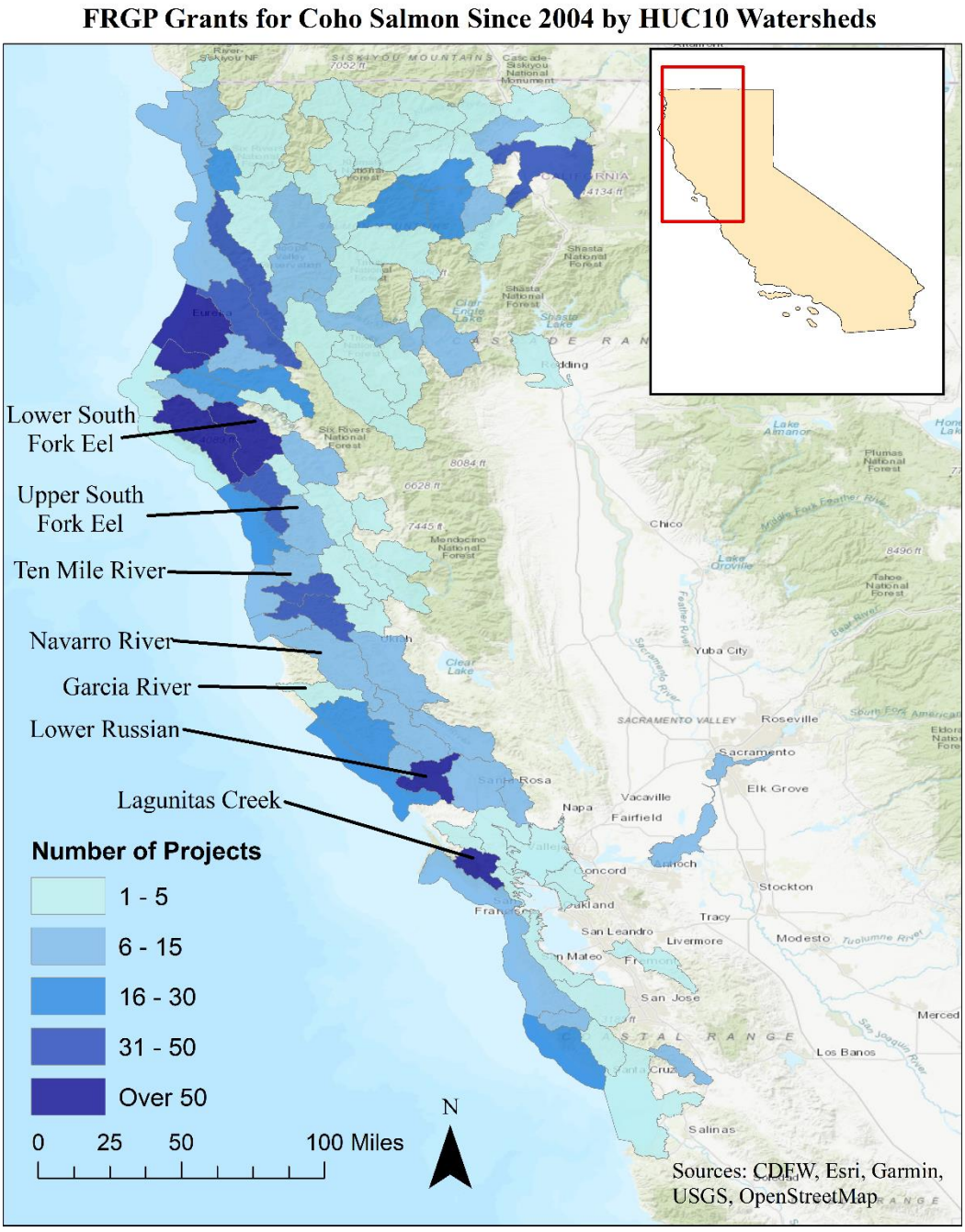

Figure 9. Map depicting the number of projects funded by FRGP between the 2003–2004 FY and 2017–2018 FY. Number of projects are summed at the HUC10 watershed level. Several HUC10 watersheds of particular interest to this project are labeled. Some projects that are planning, outreach, or analysis based, are assigned watersheds not typically associated with Coho Salmon (Central Valley) but were kept in this analysis to accurately represent the available data on FRGP grants.

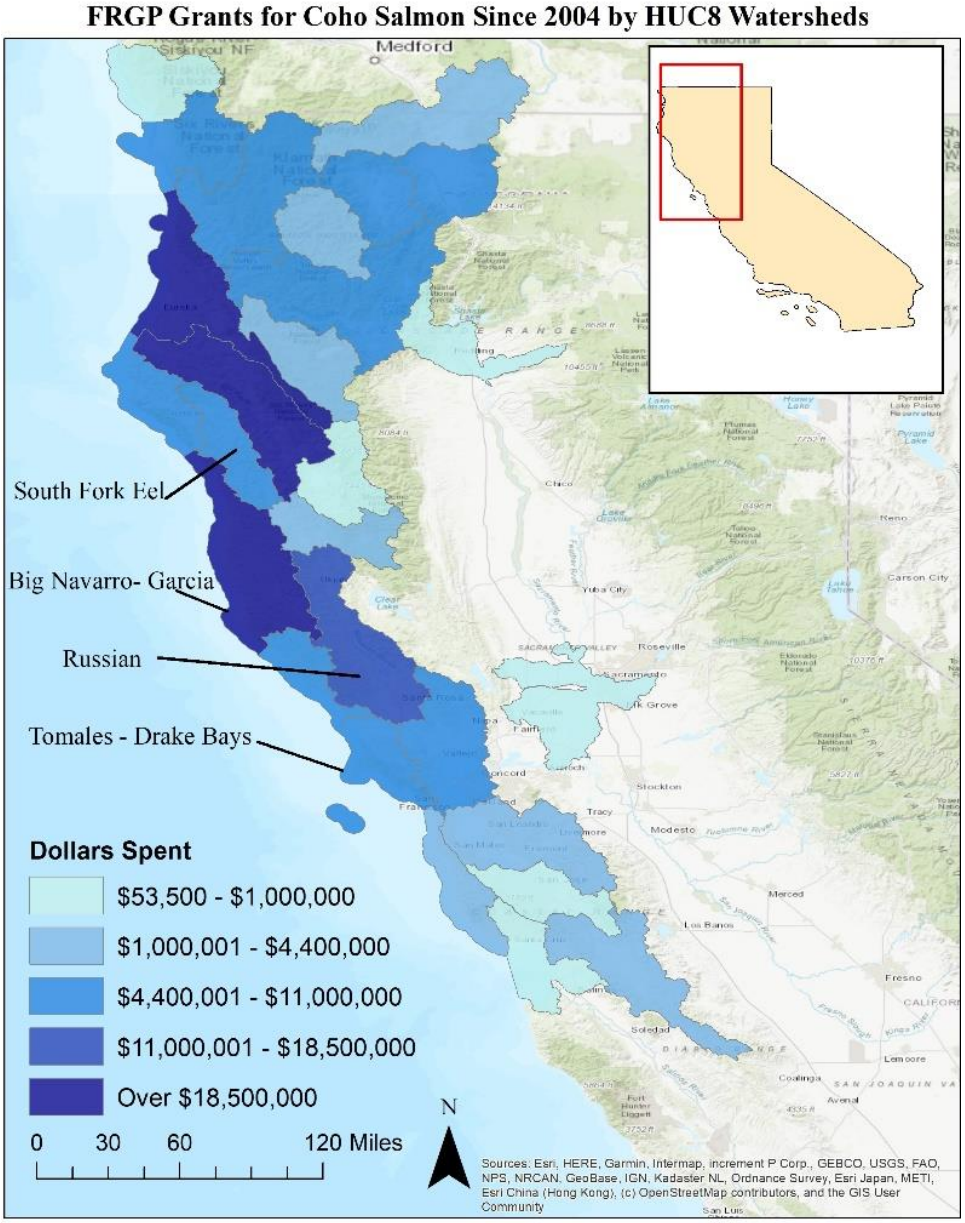

Figure 10. Map depicting the amount of money spent through FRGP grants between the 2003–2004 FY and 2017–2018 FY, summed at the HUC8 watershed level. The four watersheds identified contain our four initial watersheds selected for this project. This summary includes all project types throughout the North Coast. Some projects that are planning, outreach, or analysis based, are assigned watersheds not typically associated with Coho Salmon (Central Valley) but were kept in this analysis to accurately represent the available data on FRGP grants.

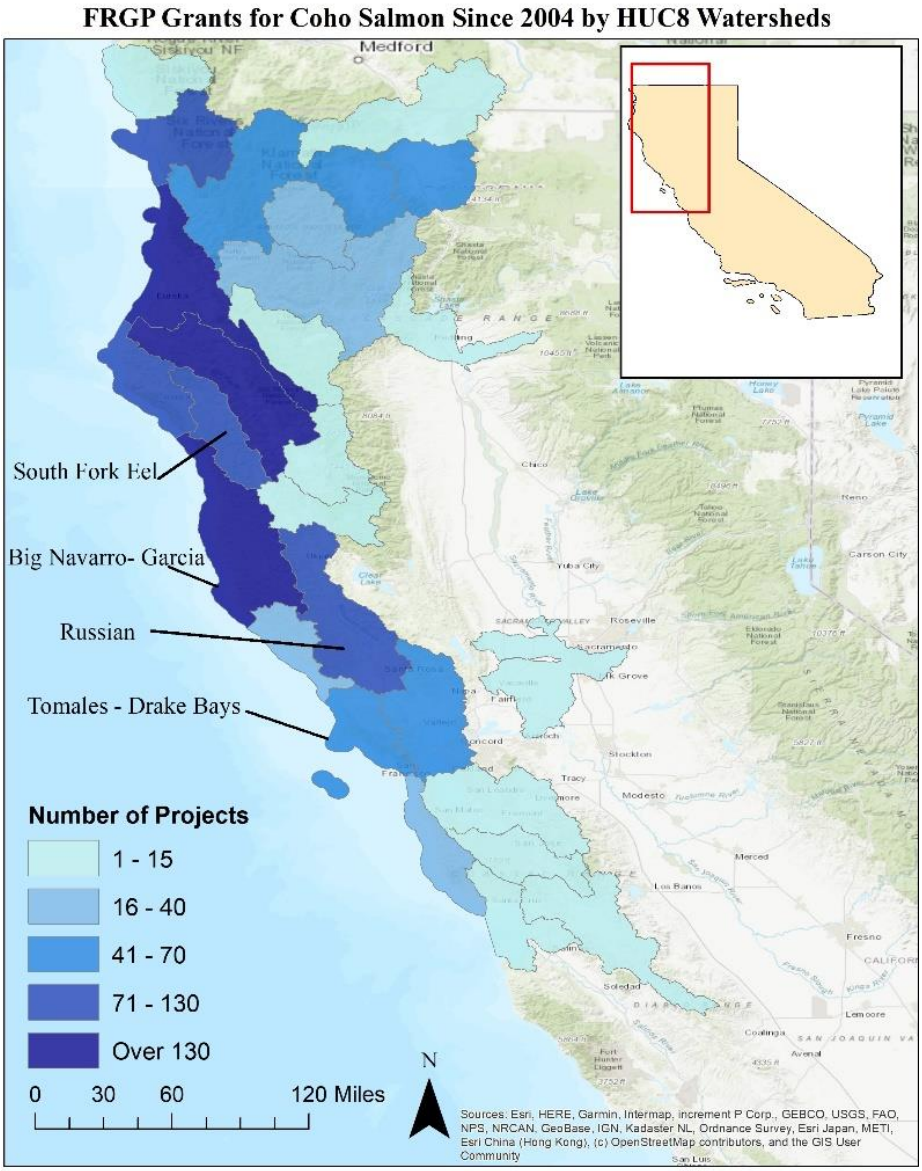

Figure 11. Map depicting the number of projects funded by FRGP between the 2003–2004 FY and 2017–2018 FY. Number of projects are summed at the HUC8 watershed level. Several HUC8 watersheds of particular interest to this project are labeled.

When looking at the HUC 10 level, Lagunitas Creek, the Lower Russian River, and the Lower South Fork Eel River experienced some of the highest concentration of funding with over 50 projects funded between 2004 and 2018 in each watershed. For both the Russian and South Fork Eel rivers, the lower watersheds received more funding and projects than upper portions of the watershed. For the Russian River in particular, this aligns with the fact that Coho Salmon are distributed throughout the lower basin with limited access to suitable habitat higher up in the system. This spatial concentration of projects, and specific project objectives, is an

important consideration when analyzing factors limiting Coho Salmon recovery in specific watersheds.

FRGP projects have typically resulted in well-functioning on-the-ground habitat features. The vast majority of FRGP project features monitored by the MESHR team received a "Fair" effectiveness rating or greater with some variation through time and by project type. Of the 1,796 features monitored, approximately 92.5% of features received a ranking of "Fair" or better, 76.8% received a ranking of "Good" or "Excellent" and fewer than 1.9% of features received a ranking of "Failed".

Observations from FRGP grant managers suggested methods and implementation techniques used in restoration projects have improved through time, likely in response to lessons learned from previous projects (C. Ramsey and S. Monday, CDFW, pers. comm., 10 August 2019). The results of linear regression support these observations. The model with the most support included both year and FRGP project type (Table 4) and this model indicates there is a negative trend in the percent of features that receive a rating of "Poor" or "Fail" through time. This suggests implementation methods and planning processes may have improved through the years modeled, leading to improved success rates. If this hypothesis is valid, continuing to investigate what leads to successful projects and provide feedback to restoration practitioners should continue to improve project effectiveness. It is important to note that the most supported model only explains 6.4% of the variance in the data, suggesting that this model would perform poorly in a predictive manner. Rather than interpreting this model directly (i.e., project effectiveness will continue to improve through time), we suggest that these results should inspire further investigations into the root cause of poorly functioning projects in order to inform future implementation. The MESHR program has a wealth of quantitative data pertaining to each project type collected over the last 15 years. Thorough analysis of these data would likely reveal patterns related to feature success and failure that could be used to improve project implementation. This will continue supporting adaptive approaches to restoration implementation ensuring higher quality results for all projects.

The linear model with the best fit also suggests project types addressing instream barrier modifications, instream habitat (HI), and riparian habitat (HR) are more likely to receive a "Poor" or "Fail" rating. Of all the project types that received effectiveness monitoring in the years analyzed, modeling results indicate that instream barrier modification (HB), instream habitat restoration, and riparian restoration projects are associated with an average increase in the percent of "Fail" and "Poor" project ratings. Reviewing some of the instream barrier modification, instream habitat restoration, and riparian restoration project features that received a "Fail" or "Poor" rating highlights some reasons these project features may be prone to receiving poor ratings and explain some of the variability in success. Many of these projects failed due to environmental stochasticity, such as large

flood events (T. Lucas, PSMFC, pers. comm., 27 August 2019). In the case of HB projects, 10 of the 17 features rated as "poor" were from a single fish passage project that was severely damaged by a large storm in 2005.

Table 4. The results of model selection for predicting the failure rate of project features from the project activity (FRGP Code), region (HUC 8), and monitoring year (Year). The degrees of freedom (df), log likelihood (logLik), Akiaki's Information Criterion corrected for small sample sizes (AICc), Delta AICc and model weight (weight) are list for each model. The model with the most support and used interpret the data is bolded.

Intercept	FRGP Code	HUC8	Year	df	logLik	AICc	Delta AICc	weight
1558.25	**+**		**-0.77**	**9**	**-1421.75**	**2862.08**	**0**	**0.841**
4.23	+			8	-1424.49	2865.45	3.37	0.156
1316.06			-0.65	3	-1433.99	2874.05	11.97	0.002
7.44				2	-1435.91	2875.85	13.77	0.001
1726.94	+	+	-0.86	31	-1410.90	2890.69	28.60	0.000
0.07	+	+		30	-1413.83	2894.09	32.00	0.000
1387.85		+	-0.69	25	-1423.93	2902.28	40.19	0.000
4.67		+		24	-1425.79	2903.64	41.56	0.000

Improvements to approaches and recommendations for instream barrier projects have also likely improved the success of these projects since 2003. The Fish Passage Evaluation at Stream Crossings Part IX of the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds 2004) was completed in February 2003, just after the submission of the HB project described above that accounted for over half of the features rated as "poor". Additionally, in April 2009, Part XII Fish Passage Design and Implementation was added to provide further detailed guidance about how to design and construct fish passage projects. For instream habitat restoration projects, features seem to have lower fail rates in dry years such as the extended drought from 2013 to 2015 (Figure 12).

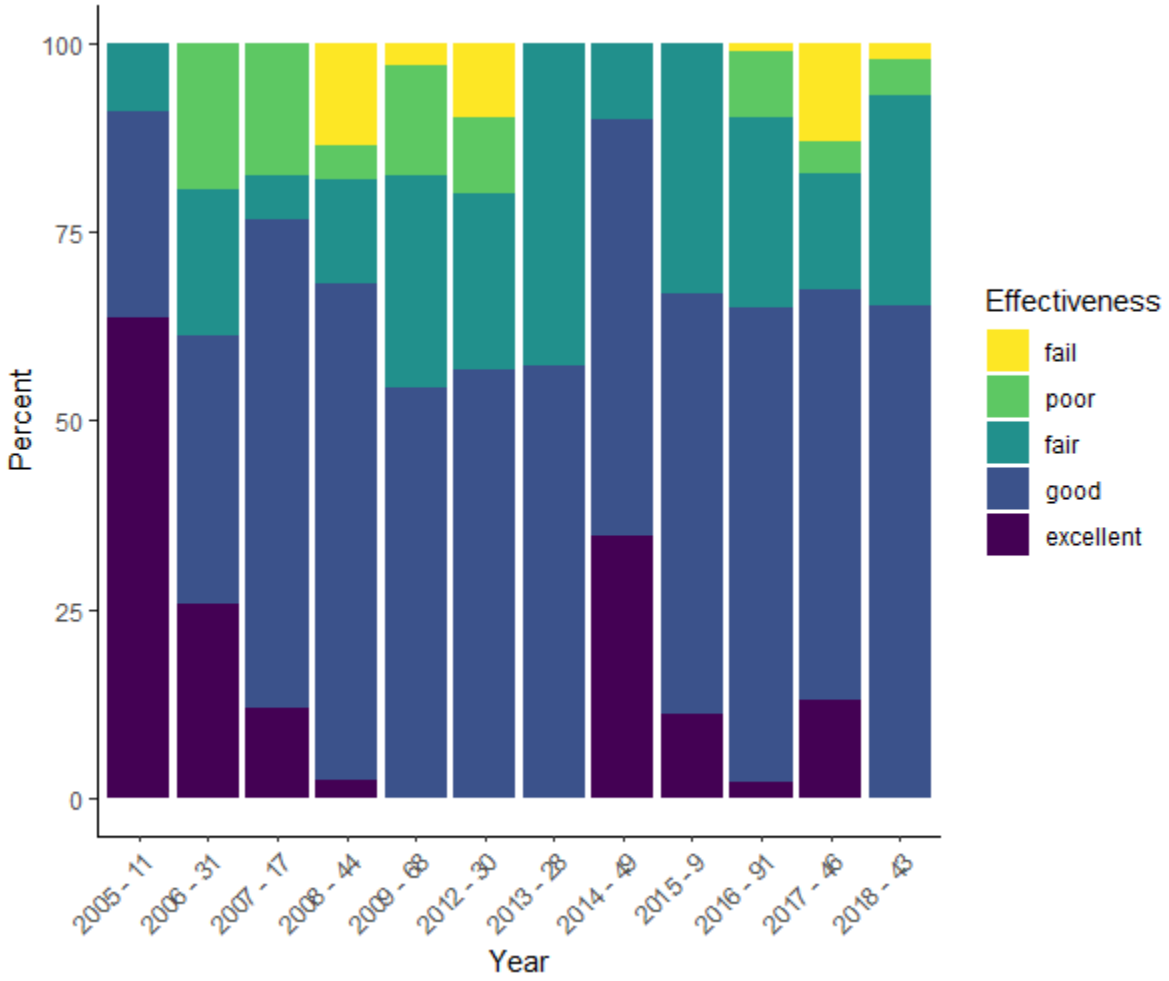

Figure 12. Effectiveness ratings for Instream Habitat (HI) features as reported by the MESHR team. All HI features monitored between 2005 and 2018 are included and the number of features monitored are labeled next to the respective monitoring year.

Riparian restoration projects typically fail when plantings die. Many of the failed riparian habitat features reported by the MESHR team came from a single large-scale riparian planting project in the Mattole River basin, where almost 28,000 conifer seedlings were planted across 65 acres of riparian vegetation (McGee 2010). Due to the scale of the project, intensive care and watering of plantings was not feasible, and seedlings were subject to the same environmental stressors, and associated mortality, as their wild counterparts. As a result, many of the seedlings which were planted in soils with relatively little soil moisture did not survive (McGee 2010). The grantees of this project speculated that the high-volume opportunistic approach to planting likely contributed to the high overall mortality rate; a limited selection of plant species inevitably results in seedlings being transplanted into unsuitable locations. They suggested that a focus on higher species diversity and site-specific planting locations should improve survival and overall success of revegetation efforts. This sentiment is reflected in the changes

made to the FRGP PSN beginning in 2010; riparian restoration projects now require site-specific planting designs to be submitted with project proposals. MESHR staff also reflected that it is difficult to characterize the success of riparian projects in a short time frame as riparian vegetation may take years to decades to mature and function as intended (T. Lucas, PSMFC, pers. comm., 27 August 2019).

In the four initial watersheds, availability of specific watershed-level data drove analysis. As mentioned above, all initial watersheds had high levels of funding through FRGP. However, the focus of these efforts varied considerably across watersheds, which is expected based on the unique environmental needs. The availability of watershed plans and limiting factors analyses also provided useful benchmarks to assess how supportive and adaptive FRGP was in each watershed to the best available scientific information.

Lagunitas Creek

Grant History

Lagunitas Creek has experienced some of the most concentrated restoration efforts through FRGP, with 51 projects funded between 2004 and 2018. Instream habitat restoration and planning projects were the most funded projects by number (eight each), followed by status and trends population monitoring (seven). In Lagunitas Creek, the greatest amount of funding sought to address fish passage through two project types: fish passage (FP) and instream barrier modification for fish passage (HB). There were five fish passage and one instream barrier modification projects funded between 2004 and 2018 for a total of nearly three million dollars (Table 5, Figure 13). The focus on funding fish passage through FRGP has been mirrored by efforts of local partners outside of FRGP, specifically the efforts of the Marin Municipal Water District (MMWD). MMWD has completed eight passage projects since 2005 and had an additional four in design and funding phases as of 2014 (MMWD 2014). For context, the Recovery Strategy estimated the total cost of complete barrier assessment and treatment in the Marin Coastal Hydrologic Unit (which Lagunitas Creek is a significant portion) would cost $13.8 million (CDFG 2004).

Monitoring has also been a significant focus of FRGP funding in Lagunitas Creek. CDFW began monitoring salmonids in Lagunitas Creek in 1970 and seven FRGP grants have funded status and trends population monitoring (MD) projects for a total amount of $1.2 million since 2004. These efforts have included a variety of methods: out-migrant trapping, DIDSON monitoring, Life Cycle Monitoring, and CMP. Other partners like the Salmon Protection and Watershed Network and the National Park Service (NPS) also perform important salmonid monitoring in the watershed. These efforts have provided one of the longest time series of Coho Salmon redd data along the North Coast.

Table 5. Summary of FRGP grants awarded in the Lagunitas Creek Watershed between 2004–2018. Total funding for projects was $9,371,932.

Project Type	Count	Total Approved	Average Cost	Percent of Total Approved in Basin
HI	8	2,322,892	290361.5	24.8
PL	8	549,711	68713.9	5.9
MD	7	1,176,144	168020.6	12.5
HU	6	1,097,997	182999.5	11.7
FP	5	854,083	170816.6	9.1
PD	5	722,700	144540	7.7
HS	4	126,709	31677.2	1.4
HR	3	206,591	68863.7	2.2
HA	1	10,000	10000	0.1
HB	1	2,141,484	2141484	22.8
PI	1	138,794	138794	1.5
WC	1	24,827	24827	0.3

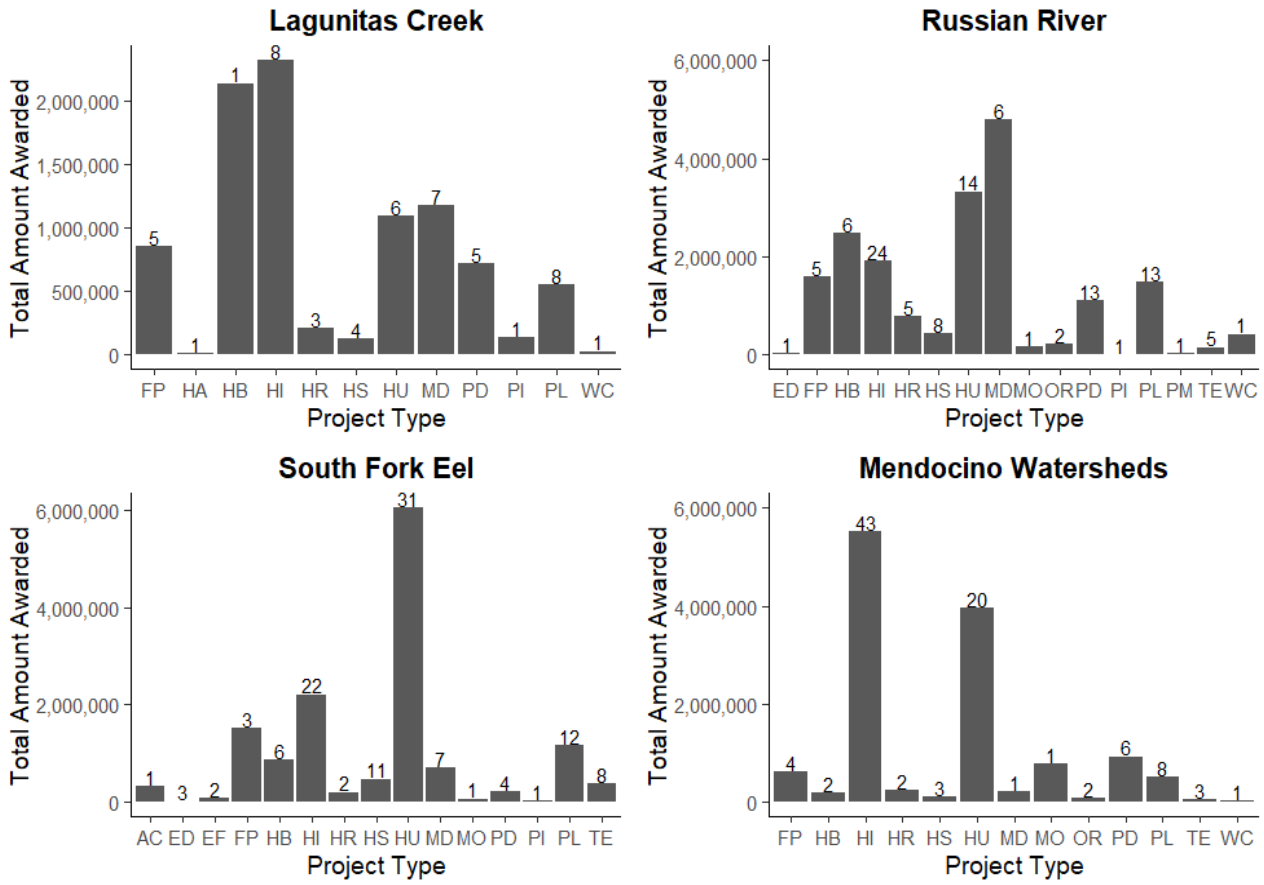

Figure 13. Figure showing the dollar amount awarded for each project type (represented by the bars) and the number of projects funded by type (text above the bars) by FRGP grants for initial watersheds between 2004–2018. Watersheds are defined as Lagunitas Creek (HUC 10), Russian River (HUC 8), South Fork Eel (HUC 8) and Mendocino (five HUC 10s defined in Methods). The Russian River graph includes projects other than the 42 projects implemented in the four focus watersheds.

Alignment with the Recovery Strategy and PACT

The 2004 Recovery Strategy outlines many broad tasks for the entire range of CCC Coho Salmon, several tasks for the Bodega Marin Coastal hydrologic unit, and 21 tasks specifically for Lagunitas Creek. Most of the tasks described for Lagunitas Creek have been addressed to some degree directly by FRGP projects. Since publication of the Recovery Strategy, five projects in Lagunitas Creek have directly addressed sediment erosion, preventing an estimated 3,273 cubic yards of sediment from entering the streams. These efforts contributed to addressing two tasks specifically defined for Lagunitas Creek (BM-LA-01 and BM-LA-06), and another (BM-HU-03) for the Bodega Marin Coastal hydrologic unit more generally. Nearly 60 educational and outreach documents have been produced through FRGP, with 178 documented participants contributing to several tasks focused on

increasing outreach and education in the watershed regarding protection of Coho Salmon. Over 1,500 native plants have been planted in the watershed, and as mentioned above, several fish passage projects have been implemented (see Appendix 1 for Performance Metrics). A recently funded project will address the need to engage and support private landowners in promoting restoration, a particularly important facet of restoration in this area where private landowners own a significant portion of the watershed. This planning project for private landowners is part of continued effort by the Marin Resource Conservation District (RCD) and directly addressed BM-LA-12 in the Recovery Strategy.

Other tasks, such as BM-LA-19, which recommended working with landowners to manage livestock to reduce sediment runoff, have been addressed minimally through FRGP, with only 0.2 miles of fencing installed for excluding livestock from riparian areas. Task BM-LA-19 has been the focus of non-FRGP work through the Marin RCD and the NPS. Other tasks have not been focuses of FRGP projects, such as removing non-native fish from stock ponds. See Appendix 2 for a complete list of Recovery Tasks addressed through FRGP in Lagunitas Creek.

The PACT, initiated in 2011, is another point of comparison that is useful when assessing how FRGP has operated in Lagunitas Creek. The Habitat Restoration and Protection TWG selected 15 high priority actions in 2013 for Lagunitas Creek (selected from State and Federal recovery plans and from additional stakeholder input) to prevent the decline and potential extirpation of Coho Salmon in the watershed. Of the 15 FRGP grants funded since their prioritization, 13 projects have directly addressed these priorities, one project was a planning project for a priority action (the two remaining projects were status and trends population monitoring projects). FRGP has been well aligned with the PACT recommendations since 2013 with nearly all funding focused on the highest priority actions.

Watershed Specific Documents

In 2008, Stillwater Sciences (contracted by Marin RCD) published a Limiting Factors Analysis of Lagunitas Creek. By analyzing Coho Salmon abundance data at different life stages, as well as environmental data, this study concluded that high spring flows and a lack of available winter habitat likely constrain the population in Lagunitas Creek (Stillwater Sciences 2008). Since these findings were published 38% of FRGP projects in Lagunitas have addressed winter habitat, with $1.1 million spent. When considering projects funded in 2018 that have yet to spend their funds, projects aimed at increasing winter habitat availability have accounted for roughly 55% of funds allocated. Most of these projects cite the need for winter refugia or this study as the motivation for their restoration project. The effort to address winter habitat in Lagunitas Creek demonstrates FRGP's responsiveness to science-based needs in a watershed.

The efforts in the Lagunitas watershed to address the most pressing limiting factors have not resulted in a clear environmental response. Three out of four reaches surveyed for habitat in Lagunitas Creek meet primary pool targets, and one of three reaches in San Geronimo Creek and Devils Gulch meet the targets set forth by the North Coast Regional Water Quality Control Board in 2006 (Ettlinger 2017; NCRWQCB 2006). For primary pool extent and primary pool frequency, a 'stable/fluctuating' or 'worsening' trend has been observed since 1995 (Ettlinger 2017). However, wood volume met established targets in 2016 (as set by the California Regional Water Quality Control Board in 2014), and other metrics suggested positive outlooks for habitat in the watershed. Overall, there have been mixed results for habitat quality in Lagunitas Creek and Devils Gulch, and a general decline in quality in San Geronimo Creek (Ettlinger 2017). As more work is done, particularly with two FRGP projects addressing instream habitat in San Geronimo Creek funded in 2018, it will be important to analyze whether FRGP grants can impact these trends in habitat.

Russian River

The Russian River watershed (HUC 8) received close to $19 million in FRGP awards from 2004 to 2018 for 106 projects (Table 6). Project types receiving the most funding were: monitoring status/trends, upslope watershed restoration, fish passage/barriers, and instream habitat restoration (Figure 13). FRGP funded more instream habitat restoration (HI) projects than any other project type. Coho Salmon utilize the lower tributaries of the watershed where most of the restoration spending occurred. Steelhead utilize the entire watershed, and coastal Chinook Salmon spawn mostly in the mainstem throughout the system.

Looking more closely within the region dubbed the "Coho universe," three of the four focus streams, Green Valley, Dutch Bill, and Willow creeks, and their tributaries, make up about half of the Lower Russian River HUC 10 watershed and Mill Creek lies along the southernmost boundary of the Dry Creek HUC 10 watershed (Figure 14). From 2004 to 2018, FRGP awarded $5.2 million toward 38 projects within Green Valley, Dutch Bill, and Willow creeks. During the same period, Mill Creek received $1.1 million for four projects. Together, the four focus streams received $6.3 million for 42 projects. Projects receiving the most funding included: upslope watershed restoration, fish passage, and instream habitat restoration (Figure 15).

Table 6. Summary of FRGP grants awarded in the Russian River watershed (HUC 8) between 2004-2018. A total of $18,847,069 has been allocated in this watershed for 106 projects.

Project Type	Count	Total Approved	Average Cost	Percent of Total Approved in Basin
HI	24	1,908,282	79511.8	10.1
HU	14	3,323,628	237402.0	17.6
PD	13	1,102,783	84829.5	5.9
PL	13	1,471,680	113206.2	7.8
HS	8	422,131	52766.4	2.2
HB	6	2,477,100	412850.0	13.1
MD	6	4,795,228	799204.7	25.4
FP	5	1,581,906	316381.2	8.4
HR	5	778,246	155649.2	4.1
TE	5	146,580	29316.0	0.8
OR	2	214,493	107246.5	1.1
ED	1	29,993	29993.0	0.2
MO	1	152,162	152162.0	0.8
PI	1	4,000	4000.0	0.0
PM	1	20,418	20418.3	0.1
WC	1	418,438	418438.0	2.2

The Recovery Strategy outlines many broad tasks for the entire range of CCC Coho Salmon including 42 tasks for the Russian River Hydrologic Unit, 10 tasks for the Guerneville hydrologic subarea (HSA) (contains Green Valley, Dutch Bill, and Willow creeks), and 11 tasks for the Warm Spring HSA (contains Mill Creek) (CDFG 2004).

All four focus streams have been part of the hatchery broodstock and monitoring programs since their inception. FRGP was a substantial supporter of the RRCSCBP instream monitoring program managed by University of California Sea Grant (Sea Grant) from about 2004 to 2011, awarding a little over $1 million. Sonoma Water and Sea Grant conduct Life Cycle Monitoring on these four streams as part of the CMP for Coho Salmon population estimates. Since 2012, FRGP has awarded more than $4 million to Sonoma Water for CMP implementation. (Note: these totals were not included in the analysis of the four focus streams since these programs cover the whole Russian River watershed). Basin-wide monitoring is essential to the success of the hatchery program and Coho Salmon recovery, and directly addressed Recovery Strategy tasks for the Russian River Hydrologic Unit (RR-HU-12, 13, 14, 15).

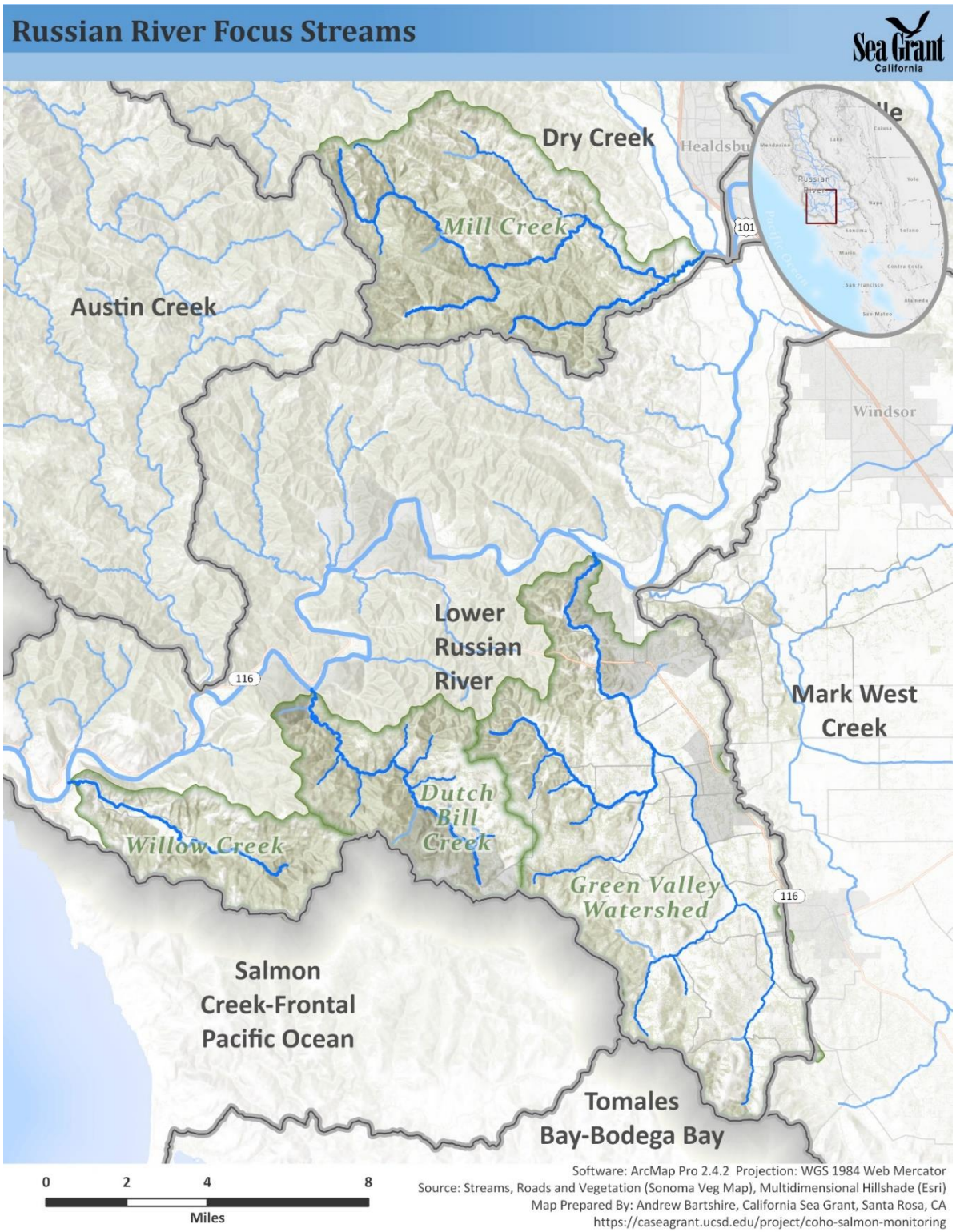

Figure 14. HUC 10 watershed names and boundaries of the Russian River. Green Valley, Dutch Bill and Willow creeks are within the Lower Russian River HUC 10 watershed and Mill Creek lies within the Dry Creek HUC 10 watershed (Sea Grant 2020).

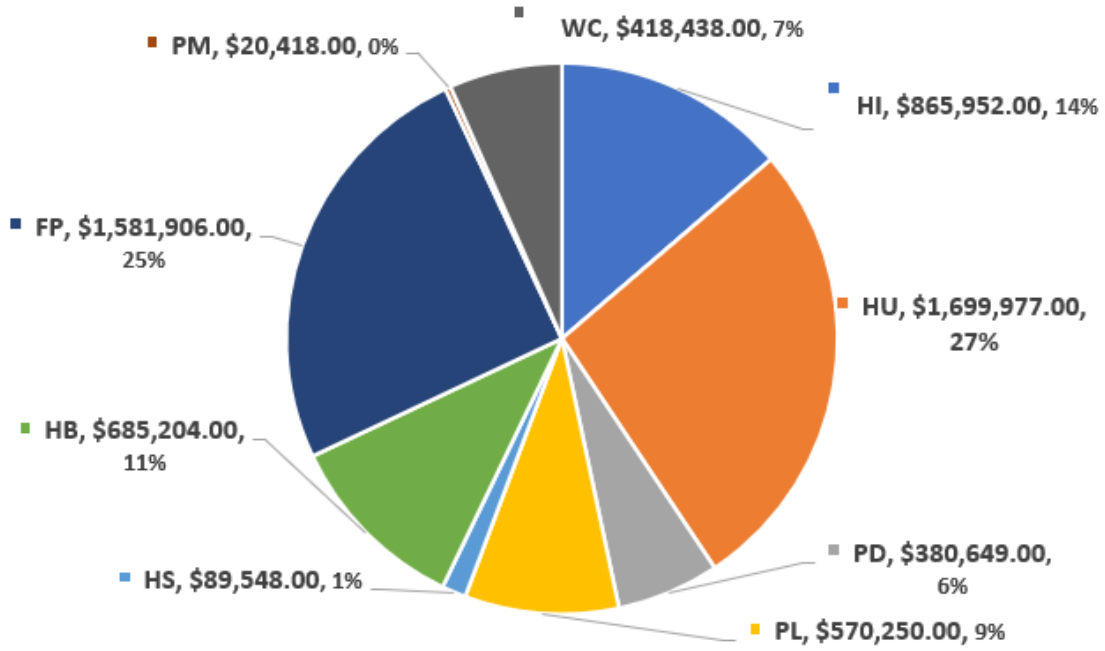

Figure 15. FRGP funded project types and dollars allotted from 2004 to 2018 within the four focus Russian River streams, Green Valley, Dutch Bill, Willow and Mill creeks. Total number of projects = 42, Total funds allotted: $6,312,342. See Table 2 for project codes.

The need for instream flow to protect all life stages of salmonids has been the focus of the RRCWRP that began working in 2009 to produce Streamflow Improvement Plans (SIP) for selected Coho Salmon streams. This effort was part of the Russian River Keystone Initiative funded by National Fish and Wildlife Foundation (NFWF) and Sonoma Water. SIPs were completed for three of the four focus streams: Green Valley, Dutch Bill, and Mill creeks. As their name implies, they focus on developing strategies to protect streamflow during the dry season for the benefit of salmonids and other aquatic resources while also ensuring water availability for water users.

Green Valley Creek

Grant History

From 2004 to 2018, FRGP awarded nearly $2.5 million to 21 projects in Green Valley Creek that addressed fish passage, upslope erosion and sediment, instream habitat for fish, and bank stabilization (Table 7). Fish passage received about half of this funding ($1.3 million). This amount included three passage design projects, three fish passage at crossings, and one barrier modification project that together opened another 40 miles of habitat for anadromous fishes.

Table 7. Number of projects, project type, restoration outcome derived from performance measures, and amount of award from 2004 to 2018, Green Valley Creek, Sonoma County, CA. See Table 3 for project codes.

Green Valley Creek			
# of Projects	**Type**	**Restoration Outcome**	**Amount ($)**
		Instream Habitat Restoration	
4	HI	25 LWs over 0.33 stream miles, 10 features, off-channel habitat .35 acres, 1,295 native riparian plants.	271,985
2	PL	Plan 1: Seven project designs, 18.7 stream miles assessed. Plan 2: Instream-flow model completed for Green Valley and Dutch Bill creeks, 137.8 miles needing restoration.	345,356
1	PD	Designed two projects to restore 2,000 stream feet of stream, 218 LiDAR points evaluated. One barrier observed and assessed.	18,180
		Upslope Watershed Restoration	
1	PL	Assessed 11 miles of road and 88 crossings and created a restoration plan.	69,002
1	PD	Created gully erosion control design.	6,515
2	HU	Treated 8.8 miles of roads, 225 acres of upland area treated, 19 features, 5,308 yds³ sediment savings.	278,415
		Fish Passage	
3	FP	Treated 5 barriers, 3.91 miles of stream made accessible.	1,039,084
3	PD	Prepared one assessment, 0.75 acres, revised previous design report, and developed 100% design for another.	143,881
1	HB	Removed flashboard dam, 4 LWs installed, 35.9 miles of stream made accessible.	171,865
		Bank Stabilization	
3	HS	Installed 15 instream structures, treated 35 feet of bank and 0.047 miles of stream, repaired one bank failure site.	89,548
Total			2,433,831

Upslope roads and erosion projects, including planning and design, received over $300,000 in FRGP funding. The planning and design assessments recommended

and outlined 127 features and 10.41 miles for erosion control treatments. Two subsequent FRGP funded upslope watershed restoration projects partially addressed these recommendations by treating 55 features and 6.25 miles of road. It is estimated these two projects prevented an estimated 10,000 yds³ of sediment from entering the stream.

Seven projects that contributed to the improvement of instream habitat in Green Valley Creek received $635,521 in FRGP funding—two projects to assess and plan, one project design and four instream habitat restoration projects. The design project was followed up with an instream habitat restoration grant in 2014, creating off-channel habitat and needed velocity refugia for juveniles during high winter flows.

Alignment with the Recovery Strategy and PACT

Since publication of the Recovery Strategy, FRGP has awarded grants to seven projects contributing to fish passage, either through planning, design, or implementation within Green Valley Creek watershed. These efforts supported two tasks within the Russian River Hydrologic Unit (RR-HU-04 and 05) and successfully added or improved passage to available habitat for Coho Salmon and other aquatic species.

The Recovery Strategy's Guerneville HSA tasks focused on sediment problems, water diversion, water use, and the broodstock program fish re-introductions. Sediment and road related assessments recommended and outlined 127 features and 10.41 miles for erosion control treatments. Two subsequent FRGP funded upslope watershed restoration projects partially addressed these recommendations by treating 55 features and 6.25 miles of road. These efforts addressed two Guerneville HSA tasks (RR-GU-03 and 04) and two Russian River Hydrologic Unit tasks (RR-HU-38 and 39). FRGP was a major contributor to addressing the legacy effects from logging and excess roads through these projects, but more work is needed.

As mentioned, Green Valley Creek has been an integral part of the broodstock program since it was initiated. In addition to the Russian River Hydrologic Unit tasks pointed out above, one task within the Guerneville HSA (RR-GU-05) was also addressed.

Multiple tasks were identified regarding water diversion, water use, and instream flow in the Russian River Hydrologic Unit (RR-HU-02, 03, 41, 42) and the Guerneville HSA (RR-GU-07, 08, 09, 10). These tasks call out the need to look closely at diversions, water use, ways to increase instream flow, and participation in regional water management planning. FRGP funding did not support any Water Conservation projects in Green Valley Creek from 2004 to 2018. However, FRGP did fund the "Integrated Surface and Groundwater Modeling and Flow Availability

Analysis for Restoration Prioritization" project. Completed in 2017, the goal of this project was to develop and calibrate a model that will simulate all major hydrologic processes responsible for streamflow generation and quantify the spatial and temporal variability of streamflow conditions in the Green Valley and Dutch Bill watersheds to guide restoration priorities. This model has been useful in project planning and design for summer and winter habitat restoration study and design.

Most water related tasks are currently being addressed by alternate funding. For example, the Gold Ridge Resource Conservation District (GRRCD) received funding in 2020 from Wildlife Conservation Board (WCB) Proposition 1 program for Mt. Gilead Water Conservation and Flow Improvement Design project. FRGP may be a cost share in the implementation phase. This project will introduce a suite of conservation measures for irrigation and provide rainwater to replace alluvial well extraction as an irrigation source. The WCB Proposition 1 program is part of a 10-year bond that is coming to an end. Complicated water use projects are a good fit for this program that has proven to be very beneficial for getting tough water projects completed throughout the state.

The PACT Instream Flow and Conservation TWG also emphasized the need for enhanced summer flows to provide suitable summer rearing habitat. The TWG provided eight region-wide and six specific Green Valley Creek recommendations. The flow monitoring project completed in 2017 addressed one of these region-wide recommendations by identifying diversions (RW-SF-15). None of the Green Valley Creek recommendations were implemented with FRGP funding.

Ten FRGP funded projects in Green Valley Creek addressed three recommendations made by the PACT Habitat Restoration and Protection TWG regarding fish passage and instream habitat improvements. Two recommendations made by the Captive Rearing and Rescue TWG were, or currently are, being addressed with FRGP funding—instream enhancement projects for broodstock release streams and CMP (PACT 2019).

See Appendix 2 for complete lists of Recovery Tasks for the Russian River Hydrologic Unit and the Guerneville HSA.

Watershed Specific Documents

The CDFG Stream Inventory Report rated shelter or cover for fish as the number one priority for Green Valley Creek followed by gravel quality and pools (CDFG 2000c). Projects addressing these priorities are on-going and have been partially implemented to date, with three large instream projects that included large wood. In addition, passage projects often include instream work to add complexity to the newly opened reach. For example, a recent FRGP funded barrier removal project in Green Valley Creek included placement of several large pieces of redwood anchored strategically into the site.

Although implemented prior to our analysis period, in 2003 FRGP funded the Russian River Stream Crossing Inventory and Fish Passage Evaluation (Taylor et al. 2003). This report detailed and prioritized fish passage issues at stream crossings in the watershed and served as a restoration guide for projects in subsequent years. Three culvert replacement projects opened an additional four miles of stream in Green Valley Creek watershed. The Purrington Creek project ranked 16th in Taylor's report. It would be useful to re-visit this report with partners to update the inventory and prioritize any crossings that may still be an issue.

An analysis of sediment sources and impacts reported in Green Valley Creek Watershed Management Plan Phase II showed that channel incision, surface erosion, and gullying are factors in sedimentation in Green Valley Creek watershed (GRRCD 2013) that aggregates in the lower reaches. Sediment-related recommendations presented in the plan include: (1) expand assessment of erosion and sediment sources especially on agricultural lands; and (2) develop a program to arrest channel incision, bank failure, gravel retention and channel complexity in Purrington Creek, where channel incision is greatly impacting stream health (GRRCD 2013). New assessments are warranted to examine current sediment sources and the effects on stream habitat conditions. The combination of increased aggradation with lower summer baseflows, and an increase in water demand, has resulted in extensive reaches where streams go dry. Aggradation can be desirable as it can lead to flood plain activation but diminishing summer flows and disconnected pools affect summer growth and survival (RRCWRP 2019).

The Upper Green Valley Creek Streamflow Improvement Plan was developed in 2019 by the Russian River Coho Water Resources Partnership. The main purpose of the plan is to "identify specific measures to moderate the impact of dry season water demand and improve instream flow for Coho Salmon and ecosystem function in the Green Valley Creek watershed" (RRCWRP 2019). The plan was based in part on the observation that among several parameters monitored, the number of days pools were disconnected from surface flow most strongly explained observed fish survival (Obedzinski et al. 2018). Recommendations presented in the plan include reduction or elimination of agricultural dry season diversions, reduction or elimination of rural residential dry season diversions, development of new flow releases, assessment of the impact of stormwater runoff, study of the surface-groundwater interaction and further habitat restoration.

Dutch Bill Creek

Grant History

Approximately $2 million was awarded for 11 projects from 2004 to 2018 that addressed water conservation, upslope erosion and sediment, instream habitat for fish, and fish passage (Table 8).

Table 8. Number of projects, project type, restoration outcome derived from performance measures, and amount of award, from 2004 to 2018, Dutch Bill Creek, Sonoma County, CA. See Table 3 for project codes.

Dutch Bill Creek			
# of Projects	**Type**	**Restoration Outcome**	**Amount ($)**
		Instream Habitat Restoration	
4	HI	Installed 60 LW structures along 0.85 miles of stream.	378,017
		Upslope Watershed Restoration	
2	HU	Treated/decommissioned 11.26 miles of road, 59 crossings, 5 culverts, 29 other sites, 11,746 yd^3 sediment savings.	541,948
		Fish Passage	
1	PM	Improved 1 fish ladder, 4 instream features, 0.008 miles of streambank stabilized.	20,418
1	PL	Developed one plan.	72,084
1	FP	Made 3.4 miles of stream accessible, 7 instream features, 0.05 miles of stream treated, 0.17 miles of bank stabilized, 0.35 acres riparian area treated.	189,832
		Water Conservation	
1	WC	Installed 2 water tanks with 100,000, and 75,000-gallon capacities, 1 instream diversion eliminated, 0.3 cfs conservation of water flow, 1 mile of stream protected, 4 acre feet water saved annually.	418,438
1	PD	Developed water conservation design.	212,073
Total			1,832,810

Over $600,000 was awarded to GRRCD for two water projects, one implementation and one design project. This included $418,438 to the Westminster Woods Conservation and Storage Project in 2015. This project increased instream flows for fish and paved the way for future work with large and small water users. In 2018, FRGP provided $212,000 to the Dutch Bill Creek Conservation Design Project that will complete 100% engineered designs and water rights change petitions to address both surface flows and springs from Redwood Gulch, a tributary to Dutch Bill Creek.

Two upslope watershed restoration projects received close to $550,000. Road upgrades and decommissions as well as degraded culvert replacements prevented

an estimated 11,250 yds³ of sediment from entering the stream. This work treated most of the high priority sites assessed in 2002 (PWA 2003).

Four instream habitat restoration projects received close to $400,000 in FRGP funding. These projects focused on large wood to increase habitat complexity for juvenile fish and contained community outreach components to solicit landowner involvement in the watershed.

Nearly $300,000 was spent on fish passage projects that included project maintenance, project planning, and fish passage at stream crossings type projects. Most noteworthy was the Dutch Bill Creek Market Street Fish Passage that contained design plans for the Dutch Bill Fish Passage Barrier Elimination Project. Three large fish passage projects followed and were completed under one grant awarded in 2008. All projects focused on barriers to all life stages of Coho Salmon, that when removed, opened roughly 3.4 miles of stream habitat. The culvert was ranked the fifth highest priority fish passage barrier in Sonoma County (Taylor et al. 2003).

Alignment with the Recovery Strategy and PACT

One of the tasks identified within the Russian River Hydrologic Unit is to "fix problem roads which contribute sediment to streams inhabited by Coho Salmon" (RR-HU-39). The extent of the sediment problem is further expressed within the four tasks listed within the Guerneville HSA that instruct implementation measures be assessed, prioritized and completed for sources of sediment (RR-GU-1, 2, 3, 4). As already noted, two HU-type projects addressed most, but not all, high priorities assessed in 2002 (PWA 2003).

The overarching range-wide recommendations call for increased habitat complexity and shelter throughout the range of Coho Salmon. Tasks calling for increased complexity are generally addressed by adding wood to streams. The PACT report calls for increases in shelter ratings. The wood-related tasks in the Russian River Hydrologic Unit do not call for adding more wood, but instead recommend retention of wood within streams. This concept is now dated but made sense when written at a time when wood was being removed from streams for flood control. All four focus streams lack sufficient large wood, and there continues to be a need for both funding and willing landowners in this area. FRGP has been a consistent supporter of these efforts.

Five FRGP funded instream habitat projects completed in Dutch Bill Creek addressed three recommendations made by the PACT Habitat Restoration and Protection TWG regarding fish passage and instream habitat improvements. Two recommendations made by the Captive Rearing and Rescue TWG were, or currently are, being addressed with FRGP funding—instream projects for broodstock release streams and CMP, respectively (PACT 2019).

The PACT Instream Flow and Conservation TWG also emphasized the need for enhanced summer flows to provide suitable summer rearing habitat. They provided eight region-wide recommendations and six that were focused on Dutch Bill Creek. One flow modeling project addressed one of the region-wide recommendations. In addition, FRGP funded one very successful water conservation project in Dutch Bill Creek and another is in the design phase.

See Appendix 2 for complete lists of Recovery Tasks for the Russian River Hydrologic Unit and the Guerneville HSA.

Watershed Specific Documents

The CDFG Stream Inventory Report identified fish passage/migration as the number one priority for restoration in the watershed, followed by instream shelter and roads/erosion control (CDFG 2000a). The report recommended that active and potential sediment sources related to the county road system should be improved and treated. The report also highlighted a problem that was common during this era: wood removal by flood control crews.

The RRCWRP published the Dutch Bill Creek SIP in March 2017. Similar to the Green Valley Creek SIP, this plan was written as part of the Russian River Keystone Initiative which is supported by NFWF and Sonoma Water, and it aims to restore a more natural flow regime, increase juvenile Coho survival, and increase water supply security for water users. Recommendations from the plan aimed at improving stream flow include reducing dry season diversions, pursuing flow releases and spring-to-surface water reconnection, assessing the impacts of stormwater runoff, and exploring infiltration and groundwater recharge opportunities (RRCWRP 2017).

Willow Creek

Grant History

FRGP funded a little over $950,000 to six projects from 2004 to 2018. Three upland watershed restoration projects received close to $450,000, one fish passage at stream crossings project received nearly $353,000, and two instream habitat restoration projects received nearly $150,000 (Table 9).

Table 9. Number of projects, project type, restoration outcome derived from performance measures, and amount of award from 2004 to 2018, Willow Creek, Sonoma County, CA. See Table 3 for project codes.

Willow Creek			
# of Projects	**Type**	**Restoration Outcome**	**Amount ($)**
		Instream Habitat Restoration	
2	HI	Installed 52 LWD structures, 2.71 miles of stream treated.	149,154
		Upslope Watershed Restoration	
3	HU	Treated 12.53 miles road, 16 rolling/critical dips, 48 upslope crossings treated, 112 culverts 18,444 yds³ sediment savings.	448,295
		Fish Passage	
1	FP	Installed 1 bridge, 0.11 miles stream length treated, 4 barriers removed, 4.7 miles stream made accessible.	352,990
Total			950,439

The most significant effort is the "2nd bridge crossing project" funded in 2010. FRGP awarded $352,000 for implementation with a total cost of $916,000. Six drainage culverts were removed and replaced with a single-span bridge, opening over 12 miles of stream to migrating fish.

Alignment with the Recovery Strategy and PACT

The Willow Creek 2nd bridge project addressed two range-wide tasks (RW-FP-1 and 7) and four tasks within the Russian River Hydrologic Unit (RR-HU-5, 23, 24, 25). The Guerneville HSA did not include any fish passage recommendations. The PACT and the NOAA Recovery Plan also called out this bridge as a high priority recommendation (NOAA 2012; PACT 2019). This is a county road crossing, so collaboration with the county and State Parks was a big part of the getting the project completed.

Three FRGP funded instream habitat projects completed in Willow Creek addressed two recommendations made by the PACT Habitat Restoration and Protection TWG regarding fish passage and instream habitat improvements. Two recommendations made by the PACT Captive Rearing and Rescue TWG were, or currently are, being addressed with FRGP funding—instream enhancement projects for broodstock release streams and CMP, respectively.

The PACT Instream Flow and Conservation TWG provided eight region-wide recommendations, but none of these pertained to Willow Creek since there are no diversions within the watershed.

See Appendix 2 for complete lists of Recovery Tasks for the Russian River Hydrologic Unit and the Guerneville HSA.

Watershed Specific Documents

The CDFG Stream Inventory Report identified sediment caused by excess roads as the number one priority for restoration in the watershed, followed by erosion and shelter (CDFG 2000e).

The Willow Creek Watershed Management Plan, prepared by a coalition of partners and funders, describes the geographic setting and history of the watershed, articulates the group's goals and visions over a five, ten, and 50 year time horizon, and diagnoses areas of environmental concern (PCI 2005). The plan also describes watershed enhancement projects which include general baseline habitat and population surveys and specific habitat restoration projects. The 2nd bridge crossing in Willow Creek was specifically called out by the Willow Creek Technical Advisory Committee (TAC) team.

The TAC's ten-year outlook envisioned that the Willow Creek watershed would be managed with sound ecological strategies, fish habitat restored, erosion areas stabilized, and invasive species managed. The 50-year vision is one of a restored, open, and preserved natural resource area. It would be beneficial to revisit and update the plan considering current conditions with restoration, drought, and climate change projections.

Mill Creek

Grant History

From 2004 to 2018, Mill Creek received almost $1.1 million to complete four projects. Project types included watershed evaluation and planning, upslope watershed restoration, instream habitat restoration, and instream barrier modification (Table 10).

Table 10. Number of projects, project type, restoration outcome derived from performance measures, and amount of award from 2004 to 2018, Mill Creek, Sonoma County, CA. See Table 3 for project codes.

Mill Creek			
# of Projects	**Type**	**Restoration Outcome**	**Amount ($)**
		Instream Habitat Restoration	
1	HI	Installed 12 LWD structures, 33 pieces of wood, 0.82 miles of stream treated.	66,796
1	PL	Completed watershed plan for Mill Creek.	83,808
		Upslope Watershed Restoration	
1	HU	Treated 20.4 miles of road, 7,035 yds³ sediment savings.	431,319
		Fish Passage	
1	HB	Removed 1 barrier, 0.04 stream length treated, 11.2 miles of stream made assessable.	513,339
Total			1,095,262

Felta Creek is a major tributary to Mill Creek and a top priority for erosion control for habitat restoration (CDFG 2000b). One important project, the Felta Creek Sediment Reduction Project, received $431,000 in FRGP funding in 2009. Approximately 20 miles of road were treated at 170 features preventing about 8,000 yards³ from entering the stream. Unlike some other erosion control projects, the assessment and implementation also occurred within this one grant.

Another noteworthy accomplishment in Mill Creek is the Mill Creek Dam Fish Passage Project. In 2016, Trout Unlimited (TU) received $513,000 in FRGP funding to remove a flashboard dam and restore access to 11.2 miles of high-quality habitat. The project was completed in the same year, and adult Coho Salmon were observed migrating upstream past the newly formed side channel in the first winter following completion of the project.

Alignment with the Recovery Strategy and PACT

The four FRGP funded projects completed in Mill Creek from 2004 to 2018 broadly addressed many of the same tasks that were identified for the other three focus streams within the Russian River Hydrologic Unit. In addition, three tasks described in the Warm Springs HSA (RR-WS-9, 10, 11), focused on treating sediment sources and increasing habitat complexity with wood and boulder structures, were also addressed.

The PACT Habitat Restoration and Protection TWG specifically called out the need to improve passage by remediating barriers. Some barriers still exist in Mill Creek and its tributaries, but one of the largest barriers was removed with immediate results observed. Two recommendations made by the PACT Captive Rearing and Rescue TWG were, or currently are, being addressed with FRGP funding—instream projects in broodstock release streams and CMP, respectively.

The PACT Instream Flow and Conservation TWG provided eight region-wide and seven Mill Creek specific recommendations. One flow modeling project addressed one of the region-wide recommendations. None of the Mill Creek recommendations have been implemented with FRGP funds. Multiple water storage and forbearance projects that address some of these tasks were funded by other sources.

See Appendix 2 for complete lists of Recovery Tasks for the Russian River Hydrologic Unit and the Warm Springs HSA.

Watershed Specific Documents

The CDFG Stream Inventory Report identified sediment caused by excess roads as the number one priority for restoration in the watershed, followed by erosion and shelter (CDFG 2000d).

The Mill Creek SIP identifies actions to improve streamflow conditions for salmon, steelhead, and water supply reliability for water users in the watershed. Research shows that, at a minimum, keeping pools connected all summer aids in over summer survival (Woelfle-Erskine et al. 2017, Obedzinski et al. 2018). However, even though fish can survive during extreme low flows, fish in poor condition may not survive to later life stages. The SIP recommends actions to maintain connectivity and provides an overview of permitting considerations for projects, as well as ideas for public outreach and education (RRCWRP 2015).

The planning project grant awarded in 2009 funded the completion of the Mill Creek Watershed Management Plan (SRCD 2015). This living document contains recommendations for water conservation, erosion control, and instream habitat improvements. A common theme throughout the report is the need for landowner outreach and involvement (SRCD 2015). Felta Creek, a major tributary to Mill Creek, received two FRGP grants as a result of the assessment plan. Like the Willow Creek plan, it would be beneficial to review and update parts of the document to assess current conditions and next steps for restoration of the watershed.

Mendocino Coast

The Recovery Strategy identifies several factors that may be limiting Coho Salmon abundance in the Mendocino Coast region including high summer water temperatures, lack of instream shelter, man-made barriers to migration, and water

diversions. Streamflow and velocity are two of the most critical factors influencing salmonid abundance (Bjornn and Reiser 1991). Because of logging and the removal of instream wood (stream clearing in 1970's and 80's), winter stream flows and velocities along the Mendocino Coast can be detrimental to Coho Salmon freshwater survival. Re-introducing large wood to streams lacking instream structure can significantly increase Coho Salmon freshwater survival (Johnston et al. 2005). Thus, almost 75% of the roughly $12.7 million allocated through FRGP since 2004 were instream habitat restoration (43 projects for $5,514,741) or watershed restoration (upslope) (20 projects for $3,954,932) projects (Figure 13, Table 11). These projects focused primarily on habitat enhancement, large woody debris (LWD) placement, sediment reduction/control, and road improvement/decommissioning.

Table 11. Summary of FRGP grants awarded in the selected Mendocino Coast watersheds (HUC 10s: Pudding Creek-Frontal Pacific Ocean, Noyo River, Ten Mile River, Navarro River, and Garcia River) since 2004. A total of $12,750,376 has been allocated in these watersheds.

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent of Total Approved in Basins
HI	43	5,514,741	128,249	41.8
HU	20	3,954,932	197,746	30
PL	8	508,844	63,605	3.9
PD	6	928,179	154,696	7
FP	4	611,930	152,982	4.6
HS	3	101,109	33,703	0.8
TE	3	50,886	16,962	0.4
HB	2	181,400	90,700	1.4
HR	2	234,133	117,066	1.8
OR	2	86,054	43,027	0.7
MD	1	209,110	209,110	1.6
MO	1	787,928	787,928	6
WC	1	15,000	15,000	0.1

The Recovery Strategy called for sediment reduction throughout the Mendocino Coast hydrologic unit. Most of this effort occurred in the Navarro and Garcia river watersheds, the two largest and most southern watersheds on the Mendocino Coast which were considered for this analysis. Watershed Restoration projects totaled $1,972,699 on the Garcia River and $682,183 on the Navarro River (Table 12).

Garcia River

Grant History

Eight of the 19 FRGP funded projects on the Garcia River since 2004 were upslope watershed restoration (HU) projects totaling $1,972,669 (roughly 70% of funds awarded) (Table 12). The mainstem Garcia river sediment reduction and habitat enhancement project was carried out by The Conservation Fund, which aimed to improve Coho Salmon habitat conditions by preventing approximately 14,250 cubic yards of sediment delivery and installing large redwood root wads. Initiated June 2014, the project was awarded $291,089. Further FRGP funding of similar projects and associated long term monitoring could be very beneficial to achieving a solution to the sediment problems facing Coho Salmon in the Garcia River watershed.

Table 12. Number of projects, project type, dollar amount approved, average cost per project and percent of total approved funds for respective watershed: a) Garcia Rivers b) Navarro River c) Novo River d) Pudding Creek or e) Ten Mile River that was dedicated to that project type from 2004 to 2018, for Mendocino Coast HUC10s. See Table 3 for project codes.

a) Garcia Rivers

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent Total Approved
HU	8	1,972,669	246,583	69.2
PL	3	346,097	115,365	12.1
HS	2	91,109	45,554	3.2
TE	2	40,728	20,364	1.4
PD	1	283,155	283,155	9.9
HR	1	67,695	67,695	2.4
HI	1	36,154	36,154	1.3
WC	1	15,000	15,000	0.5

b) Navarro River

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent Total Approved
HI	11	795,582	72,325	37.6
HU	4	682,183	170,545	32.3
FP	2	364,062	182,031	17.2
PL	2	78,285	39,142	3.7
PD	1	138,034	138,034	6.5
OR	1	49,931	49,931	2.4
HS	1	10,000	10,000	0.5

c) Noyo River

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent Total Approved
HI	23	2,163,442	94,062	51.9
HU	5	1,071,371	214,274	25.7
PD	3	309,235	103,078	7.4
PL	3	84,462	28,154	2.0
HB	2	181,400	90,700	4.4
MD	1	209,110	209,110	5.0
FP	1	138,395	138,395	3.3
TE	1	10,158	10,158	0.0

d) Pudding Creek

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent Total Approved
HU	3	231,214	77,071	10.4
MO	1	787,928	787,928	35.5
HI	1	760,100	760,100	34.2
MD	1	297,496	297,496	13.4
FP	1	109,473	109,473	4.9
OR	1	36,123	36,123	1.6

e) Ten Mile River

Project Type	Count	Total Approved ($)	Average Cost ($)	Percent Total Approved
HI	7	1,759,463	251,351	82.9
HR	1	166,438	166,438	7.8
PD	1	197,755	197,755	9.3

A single instream habitat restoration (HI) project was funded in the Garcia River watershed from the 2004 through 2015, accounting for five percent of the grant funding during this period, the lowest of any of the systems in the Mendocino Coast during the same time period. The Recovery Strategy only mentioned LWD implementation in the Garcia River HSA twice, so the low amount of instream habitat restoration projects likely reflects the intent of the Strategy.

Alignment with Recovery Strategy and PACT

The adverse effects of sedimentation and temperature on Coho Salmon in the Garcia River watershed were addressed in eight of the priority tasks for the Garcia River HSA in the Recovery Strategy. The PACT document listed 12 priority habitat restoration projects in the Garcia River watershed for fish passage at road crossings; however, no fish passage projects have been funded by FRGP in the Garcia River watershed since 2004. The revisiting of these recommendations now that PACT is published should be considered for funding by FRGP.

Watershed Specific Documents

The Garcia River watershed has been listed as water quality-limited (impaired) due to sedimentation on the 303(d) list as required by Section 303(d) of the Clean Water Act (CWA). Sedimentation is impacting the cold-water fishery, a beneficial use of the Garcia River watershed, including the migration, spawning, reproduction, and early development of cold-water fish such as Coho Salmon and steelhead. Cold freshwater and estuarine habitats are also impacted by sedimentation. Accelerated erosion due to land use practices and other causes is impacting migration corridors, spawning gravel and rearing pools, as well as impacting the overall channel stability (CRWQCB 2000).

Navarro River

Grant History

Since 2004, $2,118,077 has been awarded for 22 projects in the Navarro River watershed (Table 12). Eleven of these projects totaling $795,582 were instream habitat restoration (HI) projects focusing on Coho Salmon stream habitat enhancement via LWD implementation (Table 12). Four upslope watershed restoration (HU) projects totaling $682,183 (Table 12) were awarded during the same time period, the aim of these projects being instream enhancement via sediment reduction. The Navarro River watershed received the least amount of FRGP funds of any of the focus watersheds analyzed in this study, which is surprising considering its size compared to the other watersheds and its prevalence in the Recovery Strategy.

Alignment with Recovery Strategy and PACT

Nearly 70% of the projects funded through FRGP since 2004 were instream habitat restoration (HI) or watershed restoration (HU) projects (Figure 13, Table 11) which focused on LWD enhancement and sediment reduction. The Recovery Strategy prioritized sediment reduction in four of the nine priority action tasks for the Navarro River watershed, while the PACT document had one mention of sediment reduction. LWD enhancement was prioritized in three of the nine tasks in the Recovery Strategy and once in the PACT document.

Fish passage (FP) projects accounted for less than five percent of total FRGP funds spent on the Mendocino Coast (Table 11); however, it was mentioned once in the priority action tasks of the Recovery Strategy and twice in the PACT document. Two fish passage projects were funded in the Navarro River watershed since 2004, as well as a project design grant for a substantial barrier removal project on Neefus Gulch (Table 12).

Logging accelerates sediment production in the Pacific Northwest, and excessive sediment loads decrease the survival of anadromous fish (Anderson 1954). The

Little North Fork Navarro River sediment reduction and instream enhancement project, which was scheduled for Summer/Fall of 2013, was approved for $312,356 awarded to TU (Table 12). The project was a recommended action in the Recovery Strategy and PACT. The project decommissioned 4.1 miles of streamside road, upgraded 2.9 miles of upslope road, and contained approximately 8,000 cubic yards of sediment at 71 road features. Furthermore, 39 pieces of LWD were installed along 1.2 miles of core recovery stream in the Little North Fork Navarro River. Continued monitoring of these sediment reduction and road improvement and decommissioning projects will provide a better understanding of how to deal with sediment recruitment issues and indicate which methods are most effective.

Watershed Specific Documents

The Navarro River is listed on California's 303(d) report as a water body requiring the establishment of a Total Maximum Daily Load (TMDL) due to sedimentation and high temperatures. The lowest and most beneficial stream temperatures are found in tributaries while the mainstem suffers from higher temperatures and sparse riparian vegetation. According to the results of a California Waterboards report, human-caused sediment sources (road-related) deliver approximately 40% of the total sediment yield of the Navarro River watershed (CRWQCB 2005).

Noyo River

Grant History

The Noyo River watershed had the highest amount of FRGP projects and funds spent of all the watersheds considered in this study. A total of $4,167,573 has been awarded to thirty-nine projects in the Noyo River hydrologic unit since 2004, $2,163,442 was awarded to 23 instream habitat restoration projects ($94,063 average award) and $1,071,371 to five watershed restoration (upslope) projects ($214,274 average award) (Table 12). Three large-scale watershed evaluation projects were funded (PL), all three of which were related to sediment reduction. Three project design (PD) grants were funded since 2004, addressing fish passage, barrier improvement, and barrier removal.

Alignment with the Recovery Strategy and PACT

The Recovery Strategy proposed four recommendations for the Noyo River watershed, two addressing and removing the fish passage barriers associated with the California Western Railway, one for sediment reduction, and one to evaluate the biological justification of the egg-taking station on the south fork. Similarly, PACT mentioned the California Western Railroad but also made recommendations for habitat restoration and riparian canopy projects.

Three project development grants, one fish passage grant, and one barrier modification grant have been awarded since 2004, resulting in the removal of

three barriers (Newman Gulch, Olds Creek, and Parlin Creek). Two of the project development grants specifically addressed the Western Railway fish passage barrier and aimed to allow anadromous fish passage to over three kilometers of spawning and rearing habitat that is not currently accessible. Since the completion of these FRGP funded development grants, progress has been made on acquiring funding for removal of some of these barriers by the end of summer 2020.

Watershed Specific Documents

The Noyo River, pursuant to section 303(d) of the CWA, is listed as impaired by excessive sediment loading associated with logging, overgrazing, and road building. The availability of LWD and deep pools appear to be two of the main factors limiting the success of salmonids in the Noyo River watershed. Coho Salmon populations today are probably less than six percent of what they were in the 1940's and there has been at least a 70% decline since the 1960's (NCRWQCB 2005).

Pudding Creek

Grant History

One of the largest FRGP funded projects focused on LWD augmentation implemented on the Mendocino Coast includes the before-after control impact (BACI) study in Pudding Creek. This BACI experiment was funded by two separate grants awarded to TU. One grant ($760,000) was dedicated to implementation and the other ($787,928) to monitoring. These two grants made up almost 70% of the total amount awarded in the Pudding Creek-Frontal Pacific Ocean watershed since 2004 (Table 12).

Alignment with the Recovery Strategy and PACT

The only mention of Pudding Creek in the Recovery Strategy was in the Noyo River HSA, referencing the consistent presence of Coho Salmon and an assessing Pudding Creek Dam (MC-NO-01 and MC-NO-02). There were eight FRGP funded projects in the Pudding Creek watershed since the publication of the Recovery Strategy, including three road decommissioning projects (watershed restoration-upslope) two monitoring projects (one watershed restoration project (MO) and one monitoring status and trends (MD)), one fish passage project, and one large instream habitat restoration project (instream habitat restoration).

One watershed restoration monitoring grant was awarded for the Pudding Creek BACI study to assess the effectiveness of the project. This was one of three monitoring grants which was awarded in the Mendocino Coast hydrologic unit. The other two status and trend monitoring grants were awarded based on recommendations from the Recovery Strategy. Monitoring data could be very useful and provide a baseline for future restoration projects, and thus should be

continually considered for funding—especially considering the amount of money spent on these larger restoration projects.

The PACT document called for the development of LWD projects in Pudding Creek as well as the continued support of the life cycle monitoring station. The majority of FRGP funding awarded in the Pudding Creek HUC10 watershed between 2004 and 2018 has focused on LWD augmentation—see Grant History above. The life cycle monitoring station on Pudding Creek continues to operate with year to year funding and remains one of the highest priorities in the region.

Watershed Specific Documents

Coho Salmon in Pudding Creek experienced low growth in the summer months, likely due to diminished carrying capacity associated with the annual summer dry season. The findings from Wright et al. (2012) indicate that stream enhancement projects intended to augment pool habitat may be effective to increase juvenile salmon survival and growth over summer. Only one instream habitat restoration project, *Using Wood to Increase Salmon Abundance in Pudding Creek - A BACI Experiment,* was funded for the Pudding Creek watershed through FRGP since 2004, albeit the largest award in the watershed during that time.

Ten Mile River

Grant History

Seven (78%) of the FRGP funded projects in the Ten Mile River watershed between 2004 and 2018 have been instream habitat restoration (HI) projects, with $1,759,463 spent in total (Table 12). The other two grants awarded during this time period were: a riparian restoration (HR) project for cattle exclusions from the riparian zone, and a design project (PD) for Coho Salmon off-channel habitat. In 2016, The Nature Conservancy was awarded $1,501,011 for restoring winter refuge habitat, which addressed the need to create and restore floodplain and winter habitat in the Ten Mile River watershed. This project accounted for the majority of FRGP funds awarded in the Ten Mile River watershed and was the largest award given on the Mendocino Coast since 2004.

Alignment with Recovery Strategy and PACT

There was one action task for Ten Mile River in the PACT document. Partners called for the creation and restoration of winter habitat in the lower river, addition of LWD to streams lacking cover and wood, and secure landowner permission. Winter habitat restoration and LWD augmentation were the primary focuses of FRGP funded projects since 2004. FRGP's response to recommendations from the Recovery Strategy and PACT were amongst the best on the Mendocino Coast.

Watershed Specific Documents

The Ten Mile River watershed is listed in the 303(d) of the CWA due to impairment or threat of impairment to water quality by sediment and temperature. High concentrations of channel-bottom fine sediment, excessive gravel embeddedness, inadequate pool frequency and depth, and lack of LWD appear to be factors directly and indirectly related to sediment that are currently limiting the success of salmonids, especially Coho Salmon, throughout the watershed (US EPA 2000).

South Fork Eel River

Grant History

In the subsequent years since the Recovery Strategy was developed, FRGP has funded 112 projects intended to improve conditions for salmonids in the SFER and its tributaries (Table 13). Between 2004 and 2018, a total of $14,024,144 has been awarded to 18 different organizations. The majority of this funding (69.8%) was awarded to three project types; upslope watershed restoration (HU), instream habitat restoration (HI), and fish passage at stream crossings (FP) (Table 13). HU projects received by far the most funding with approximately $6,045,573 awarded (43.1% of the total) at an average project cost of $195,018 (Table 13).

Table 13. Summary of FRGP grants awarded in the South Fork Eel River Watershed. A total of $14,024,144 was allocated for this watershed.

Project Type	Count	Total Funding ($)	Average Cost ($)	Percent of Total Spent in Basin
HU	31	6,045,573	195,018	43.1
HI	22	2,212,485	100,567	15.8
FP	3	1,526,523	508,841	10.9
PL	11	1,060,511	96,410	7.6
HB	6	864,520	144,086	6.2
MD	6	542,396	90,399	3.9
HS	11	471,540	42,867	3.4
TE	8	378,788	47,348	2.7
AC	1	331,468	331,468	2.4
PD	4	210,101	52,525	1.5
HR	2	203,393	101,696	1.5
EF	2	83,182	41,591	0.6
MO	1	65,832	65,832	0.5
PI	1	14,801	14,801	0.1
ED	3	13,031	4,343	0.1

Alignment with the Recovery Strategy

The Recovery Strategy identifies several common threats to Coho Salmon in the SFER. These threats include high water temperatures, poor pool quantity and quality, limited refuge and escape cover, chronic sedimentation, limited canopy

shade, poor spawning gravel quantity and quality, problematic large debris accumulations, grazing in riparian areas, and barriers to migration. To address some of these threats, the Recovery Strategy lists high priority recommendations focused on assessing watershed conditions and developing management plans, removing barriers and improving fish passage, assessing and treating high priority sources of sediment, enhancing instream and riparian conditions through LWD additions, planting and fencing, managing water use, enforcement of regulations and management plans, outreach and support to cities and counties, and exploring conservation easement acquisition.

FRGP funding has supported restoration projects that addressed many of the threats and high priority actions identified in the Recovery Strategy. Upslope watershed restoration (HU), instream habitat restoration (HI), fish passage at stream crossings (FP), watershed evaluation, assessment, and planning (PL), and instream barrier modification for fish passage (HB) FRGP project types support 20 of the 23 tasks identified in the Recovery Strategy for the SFER and 10 of the 11 highest priority tasks (see Appendix 2). These project types also account for over 83% of the grants awarded in the watershed (Table 13). It should be noted that the structure of the FRGP Proposal Solicitation Notice (PSN) currently prioritizes four of these project types (FP, HB, HI, and HU) for 65% of the funding awarded. Planning and assessment (PL) project types are a lower priority, listed in the PSN as Priority 2. This has likely contributed to the distribution of project funding described above. FRGP priorities have shifted through time and across regions and likely account for some variation in the distribution of funds.

Assessing, prioritizing, and treating sources of sediment are the highest priority tasks specified for all HSA's in the SFER. The vast network of logging roads established prior to the Forest Practice Rules have been a scourge on the erodible geology of the watershed and led to the SFER being listed as sediment impaired according to section 303(d) of the federal CWA. FRGP has awarded the greatest proportion of funds in the SFER to upslope watershed restoration (HU) projects, and, to a lesser extent, watershed evaluation, assessment and planning (PL) projects to assess and plan remediation of these sediment sources (Table 13). Restorationists have spent approximately $959,527 in FRGP funding on 10 planning grants focused on assessing upslope erosion hazards and associated treatment plans and over $6 million on 31 treatments. The sum of the funding spent on these two project types to support sediment reduction account for over 43.1% of FRGP funding approved in the SFER since 2004.

The Recovery Strategy also prioritizes actions to improve instream conditions including temperature, shade, and LWD in all HSA's of the SFER. Instream habitat restoration (HI) projects, supported by these recommendations, have received the second greatest allotment of funding since 2004 with over $2.2 million dollars awarded for 22 projects (Table 13). Riparian habitat (HR) projects have received

relatively little funding with approximately 1.5% (just over $200,000) of the total awarded to only two projects.

Watershed Specific Documents

The recommendations listed in the Recovery Strategy (see Appendix 2) are generalized to very large regions of the SFER and have required more focused planning and assessment to identify and prioritize on the ground projects. From 2004 to 2016, 11 planning projects were funded to support watershed assessment and restoration planning in several tributaries of the SFER including Hollow Tree Creek, Bull Creek, Durphy Creek, Standley Creek, Redwood Creek (Briceland), Dutch Charlie Creek, Bull Creek, Redwood Creek (Branscomb), Indian Creek, and Jack of Hearts Creek. A total of $1,038,871 was spent through FRGP to fund these plans. The planning and associated restoration which has occurred in these tributary basins since the plans were developed is described below.

Hollow Tree Creek

A two-phase watershed assessment and road inventory of Hollow Tree Creek was funded through FRGP, with phase one initiated prior to the release of the Recovery Strategy and phase two completed in 2006. A third Watershed Assessment and Erosion Prevention Planning Project, including unevaluated portions of Hollow Tree Creek and Standley Creek, was completed in 2007. These plans focused on assessing road-related sources of sediment and developing associated treatment plans. Since 2004, over $1,930,492 of FRGP funding was spent on six road-related restoration projects in Hollow Tree Creek, accounting for approximately 82.5% of FRGP funds expended for on-the-ground projects in the sub-watershed since 2004.

The remaining FRGP funds were spent on four other restoration projects focused on improving instream habitat and fish passage through large wood installations, LDA modifications, and anthropogenic barrier removals. These other project types were unrelated to the watershed assessments described above.

Bull Creek

Two planning documents in Bull Creek were funded through FRGP and initiated in 2005. One focused on evaluating the physical limiting conditions for salmonids in the lower portion of Bull Creek and the other focused on treatment of the Devil's Elbow landslide complex. Since those plans were initiated, FRGP has funded one project focused on upslope habitat restoration with over $481,593 spent on decommissioning roads, upgrading stream crossings, and reducing the delivery potential of landslides in the upper basin near the Devil's Elbow. One other FRGP grant proposal was submitted by State Parks to address instream, floodplain, and riparian habitat, but it was not awarded due to engineering and geologic concerns. No other proposals have been submitted; however, in recent restoration planning

meetings, State Parks has indicated their renewed interest and staff capacity to revisit restoration of Bull Creek within the next two to three years.

It is important to note that the legacy effects of the old growth logging era, and the devastating floods of 1955 and 1964, have been a long-standing management concern for both CDFW and the State Parks. Prior to the publication of the Recovery Strategy, two other plans and subsequent restoration projects were funded by FRGP that resulted in the treatment of approximately 30% of the roadways in the Bull Creek sub-watershed.

Durphy Creek

California State Parks conducted an FRGP funded planning effort in 2005 to assess Durphy Creek and its upslope habitat for restoration planning. Since then, no subsequent projects were funded by FRGP in the Durphy Creek watershed or elsewhere in Richardson Grove State Park. State Parks staff indicated that priority projects were not likely completed through other programs, but due to staff turnover it was uncertain why there had been little follow through of the plan (S. Dempsey, CA State Parks, pers. comm., 9 July 2020).

Standley Creek

Watershed Planning and Assessment of Standley Creek upslope sediment sources was funded in 2005 and completed in 2007. A coordinated instream and upslope action plan for Standley Creek and other watersheds within the Usal Redwood Forest Company landholding was later completed in 2015. From 2007 to 2015, over $943,016 of FRGP funding was spent in Standley Creek on six phases of upslope habitat treatments. By 2018, the projects collectively treated and decommissioned 19.49 miles of road in the Standley Creek watershed, treated landslides, planted thousands on coniferous trees to stabilize slopes, and improved fish passage at stream crossings (Novelli and Leroy 2019). Additionally, instream large wood features were installed in 2015 as a component of phase five of the project.

Prior to the 2005 planning and assessment grant, an instream restoration project was completed in 2001 by TU, Redwood Forest Foundation Inc. (RFFI), and Pacific Watershed Associates (PWA) on the North Fork of Standley Creek and lower Standley Creek funded through sources other than FRGP. No other restoration projects have been funded by FRGP in Standley Creek since 2015.

Redwood Creek (Briceland)

In 2016, FRGP funded a roads and erosion hazard sediment source assessment and treatment plan for the upper Redwood Creek Basin at Marshall Ranch. The project was completed in 2018. Subsequently, a project to implement some of the plan's sediment reduction recommendations was completed with non-FRGP funds.

Additional road decommissioning is planned for several high-priority areas and will be implemented in the near term with a funding source yet to be determined.

Dry season flow has also been a major focus of planning, monitoring and community engagement in the watershed. A community engagement and feasibility study was initiated in 2010, and a flow enhancement and feasibility study was initiated in 2015, both funded through FRGP. As a part of this funding, the Salmonid Restoration Federation (SRF) determined the feasibility of transferring a voluntary water conservation program from the Mattole River watershed in Southern Humboldt County to the Redwood Creek sub-watershed. SRF has also performed other community outreach and watershed education, including water conservation and flow enhancement workshops, water rights clinics, and community stakeholder meetings to build support for coordinated water management concepts and salmon restoration in the sub-watershed. With funding through the Wildlife Conservation Board (WCB), SRF has also been monitoring dry season flows in Redwood Creek and its tributaries since 2013 to track flows, advise local water usage, and identify priority areas for water conservation. Also, through WCB funding, SRF continues to identify and plan flow enhancement activities in high priority areas throughout the watershed, including a large stream flow enhancement project on the Marshall Ranch Conservation Easement which is currently in development.

Other projects completed in the basin unrelated to these planning efforts include instream habitat restoration and barrier removal. FRGP has spent $266,278 since 2010 on five separate projects intended to improve instream habitat and bank stability. An FRGP funded Dinner Creek Humboldt County road crossing fish passage design was completed in 2010, and subsequently the associated fish passage project was constructed under a FRGP grant.

Indian Creek

Two plans, covering both upslope and instream restoration needs in the Indian Creek watershed, have been funded through FRGP. An inventory and assessment of the 107 miles of forest roads was completed in 2014. A complimentary plan, which included an assessment of road networks in adjacent watersheds as well as an inventory of aquatic habitat, resulted in a restoration action plan for Indian Creek in 2015. Since 2014, three instream habitat restoration projects were awarded $572,464 to improve instream complexity in Anderson Creek, a major tributary of Indian Creek utilized by Coho Salmon. Guided by the completed watershed plans, road-related sediment reduction and decommissioning was completed at 35 sites on over 3.5 miles of road adjacent to Anderson Creek through two FRGP grants totaling $442,578. CDFW, RFFI, Lost Coast Forestlands, PWA, TU, and the Eel River Watershed Improvement Group, and the California Conservation Corps continue to collaborate on restoration projects in the Indian

Creek sub-watershed. Currently planned projects are primarily focused in Anderson, Moody, Couborn, and Sebbas creeks.

Jack of Hearts Creek

In 2013, FRGP funded project designs for a Jack of Hearts Creek fish passage barrier removal project. The barrier was removed in 2017 with funding provided through FRGP. A planning grant was also awarded in 2013 to fund an erosion inventory and assessment of approximately eight miles of road in the watershed. In 2015, after the assessment was completed, TU submitted a proposal to address high priority sources of sediment; however, their proposal was rejected because many of the roads were located upslope from riparian habitat and included many road upgrades as opposed to road decommissioning.

Dutch Charlie and Redwood Creeks (Branscomb)

An erosion hazard inventory, assessment, and treatment plan for approximately 43 miles of forest roads in the adjacent Dutch Charlie and Redwood Creek watersheds was funded in 2013 and completed in 2015. Recent timber harvest in the Redwood Creek watershed has necessitated the improvement of some of the roadways, but any improvements to sites identified in the treatment plan were incidental and minor in scale (E. Lang, Lyme Redwood Forest Company, pers. comm., 23 June 2020). Though no focused projects have been completed, FRGP funds were awarded in 2018 for the decommissioning of over seven miles of high priority roads and removal of poorly designed stream crossings. Implementation of these projects will be initiated in 2020 and completed by 2021.

Though there is some variation in the realization of these planning efforts, most of these plans have established a fruitful foundation for project implementation, in some cases leading to substantial and systematic restoration of watersheds. Five of the 11 plans above have resulted in multiple subsequent restoration projects funded by FRGP. Other public and private sources have also contributed to these efforts. Excluding FRGP projects approved after 2018 and projects funded through other sources, the planning described above has supported the disbursement of $4,316,617 in FRGP funding. This accounts for 30.7% of FRGP funding approved in the entire SFER between 2004 and 2018. Though substantial work has yet to be completed for five of the 11 plans, four have multiple projects planned for implementation within the next three years, several of which were awarded funding in 2018 and 2019. These planning efforts fill crucial data gaps that more general recovery planning does not provide. Creating supplementary plans improves focus and prioritization of existing recovery actions, allowing for strategic and efficient application of limited restoration funding. Thus, creating additional plans effectively augments the Recovery Strategy with more current and higher resolution data without a formal revision process.

Due to either a lack of implementation capacity or complications securing funding for implementation, a minority of the planning grants described above have resulted in little or no action so far. As described in the Jack of Hearts Creek section above, due to the current scoring system used in the FRGP grant proposal review process, some projects will inherently receive low scores and likely never be funded by FRGP under the current system. However, other grant sources are available to fund these projects, and landowners that conduct routine maintenance of their lands can use the information within the plans to guide their work. Other plans, such as those developed by the State Parks, have failed to produce subsequent restoration actions due, in part, to a lack of staff and other resources available to pursue funding (A. Transou, CA State Parks, pers. comm., 21 October 2019). For over a decade, the State Parks have been chronically understaffed; however, they have recently hired two new environmental scientists to manage natural resources in northern region park lands, doubling their capacity to manage and restore watersheds such as Bull Creek. With project designs and concepts already planned, State Parks staff are currently applying for funding to begin restoration projects within the next three years (A. Transou, CA State Parks, pers. comm., 18 February 2020).

Synthesis and Conclusions

Lagunitas Creek

Determining whether grant-funded planning projects were followed with physical restoration projects is particularly important in Lagunitas Creek, as planning projects accounted for the greatest number of projects funded. There have been eight planning projects funded between 2004 and 2018, accounting for $477,213. These projects have focused on a few themes for restoration: erosion assessment/sediment reduction, fish passage, and broader watershed enhancement plans. Even within a single theme, such as fish passage, the spatial scale at which these plans operate can range from assessing a single obstruction, like passage at the Dixon Weir on San Geronimo Creek, to designing multiple fish passage plans in Larsen and San Geronimo Creeks (both funded in 2010). These projects often are taken up by other FRGP grants. For instance, the plans developed from the 2010 study on passage in Larsen and San Geronimo Creeks led to a project funded in 2015 to remove the highest priority fish barrier in Lagunitas Creek. Other planning projects funded to address the lack of winter habitat highlighted by the Limiting Factors Analysis have led to two FRGP projects, each creating multiple areas of winter habitat for Coho Salmon. Planning projects in this watershed are largely acted on, and FRGP has been able to fund the planning and implementation process successfully across multiple grant cycles.

Juvenile Coho Salmon monitoring is fundamental in assessing the impacts restoration has on a population. The number of Coho Salmon leaving Lagunitas Creek watershed in 2018 (the most recently available data) was down 27%

compared to the same cohort three years earlier. While this decline is discouraging, over-winter survival for this year was 72%, the highest rate since 2011. This improvement in survival may be due to an increase in the available winter habitat for juveniles. The relationship between juveniles to smolts seems to have shifted from one resembling a life stage at a carrying-capacity (2006–2011) to a density dependent survival (2014–2016) (Ettlinger 2019). It will be important to continue tracking survival rates through time to reveal the causal mechanism for this change and determine if restoration is acting to increase the carrying capacity of Lagunitas Creek. Survival metrics and abundance at certain life stages can be particularly important in assessing restoration, as they can isolate particular habitats used, and are susceptible to fewer environmental factors, as compared to adult returns where ocean conditions play a large role. These trends in habitat and population abundance are important measures when prioritizing restoration resources going forward, and partners must stay advised of these dynamic conditions as efforts continue in the watershed to maximize the benefit for Coho Salmon.

In assessing FRGP efforts in the relatively small watershed of Lagunitas Creek in relation to the Recovery Strategy, PACT, and subsequent assessments, the fundamental question that arises is the degree to which the tasks outlined are addressed, and what should realistically be considered achieved. Many of the tasks in the Recovery Strategy are not defined in a measurable way, and some do not lend themselves well to being quantified. This approach allows flexibility in restoration, which is important in ecology as a system is expected to change. However, it also leaves it up to individuals operating in the watershed and managers to decide on targets, restore to those targets, and manage adaptively along the way. While restoration in this watershed has been responsive to the latest recommendations, the absence of a clear trend in habitat improvement and Coho Salmon abundance could suggest that restoration has not been able to keep up with other environmental impacts (including ocean conditions), or that more restoration resources and time are needed to see responses. Studies have shown that at least 20% of available habitat would need to be restored to detect any population response, and 100% of habitat would need to be restored to be 95% certain an increase of 25% in smolt production would be achieved (Roni et al. 2010). With mixed results in the habitat quality in Lagunitas Creek, it would likely take further concentration of resources in restoration to expect a measurable response in Coho Salmon.

Russian River

This report focused on FRGP funded projects within the four NCSP focus streams in the lower-basin Russian River—Green Valley, Dutch Bill, Willow, and Mill creeks—where native Coho Salmon are recovering from near extirpation through habitat restoration and the conservation hatchery broodstock program at DCFH. In addition to the 42 projects examined in this report, it is important to note that

FRGP has played a vital role funding the RRCSCBP monitoring, both in the early years of the broodstock program and currently as the major supporter for the CMP. These programs are vital to tracking recovery and identifying restoration actions.

The Recovery Strategy provided important recommendations needed for Coho Salmon recovery in the Russian River. FRGP provided funding to projects that addressed several recovery tasks listed for the Russian River Hydrologic Unit, with 33% of the recommended tasks addressed within the four focus streams, including four of the 16 high-priority level tasks. These 16 high-priority tasks emphasize road-related erosion control, fish passage, and increased instream flow for fish. Of the $6.3 million awarded to the 42 projects in the focus streams, 27% was spent on upslope watershed restoration projects that addressed road-related erosion, 36% was spent on projects that addressed fish passage at stream crossings and instream barrier modification combined. These projects aligned with two of the three high-priority tasks mentioned above, road-related erosion and fish passage, but only received half of the total awards.

The water conservation (WC) project type has been available since prior to 2004 and the oldest WC project was completed in 1989 (T. Chorey, CDFW, pers. comm., 21 July 2020). Seven percent of the total funding was awarded to one water conservation project. The high cost, complexity, and need for willing water users, may be limiting the number of these projects implemented. The SIPs prepared by the RRCWRP prioritize projects for increasing instream flows that can be used to guide future projects and effective grant proposals.

More recent funding available through the Wildlife Conservation Board's Streamflow Enhancement Program (Proposition 1) has been instrumental with the implementation of several projects within the Russian River watershed with FRGP as a cost-share.

Looking at the high-priority tasks and FRGP funding, it is important to note that road related sediment and erosion projects were removed from the FRGP focus list contained in the PSN from 2011 to 2017. The examination of FRGP administrative protocols is beyond the scope of this document. However, project proponents expressed that they would have continued submitting FRGP proposals to address sediment problems if they would have been considered for funding. Today, upland reports and surveys for the four focus streams are almost a decade old and would need to be updated to move forward with these tasks. The local RCDs do not seem interested in pursuing FRGP funding for this project type to any further extent.

Despite the decrease in FRGP funded sediment remediation projects, the work that was completed over the years may have contributed to the increase in redd production and survival. Redd data provided by the CMP between 2014 and 2018 indicate an upward trend in Coho Salmon redd abundance until 2017/2018 when 97% of the return were age-2 jacks (Sonoma Water and Sea Grant 2018, 2019).

In 2003, Ross Taylor completed his two-year FRGP funded study looking at both adult and juvenile fish passage at road-crossings in the Russian River watershed. This deliverable was a comprehensive ranking and scheduling document for county road crossings, as well as some city and private roads. Many passage impediments were identified and remediated within the four focus steams due to this study. A few remain unaddressed, such as the Lancel Creek crossing on Old Camp Meeker Road, the upper crossing of Green Valley Creek, and the third bridge on Willow Creek.

This summary shows that, from 2004-2018, FRGP funding contributed significantly to restoring instream habitat. Along with the general competition for limited grant funds, a lack of on the ground capacity within the RCDs, NGOs, and federal, state and county agencies limits the ability to write and review grant proposals and manage grants to completion.

Although there are other factors contributing to watershed dysfunction, lack of sufficient summer streamflow has emerged as a leading factor limiting Coho Salmon production and survival in the four focus Russian River tributaries. This is especially the case in Green Valley, Dutch Bill, and Mill creeks which are heavily impacted by agricultural land use. Additionally, streamflow deficiencies became more pronounced during the recent drought in California. Restoration projects designed around streamflow protection and water conservation strategies, as well as an increase in large wood, are likely to play an important role in Coho Salmon recovery in these sub-watersheds and the Russian River basin.

Moving forward, outreach and education are vital to build community support and concern for native salmon and steelhead. An increase in federal, state, and county capacity, as well as an increase in collaboration with the Water Board and CDFW, are also needed to pick up the pace of restoration. FRGP can continue to be a supporter in these efforts.

Mendocino Coast

The Recovery Strategy called for comprehensive sub-basin erosion control combined with installation of LWD into streams throughout the Mendocino Coast hydrologic unit. Numerous LWD augmentation projects were implemented in the Mendocino Coast hydrologic unit. Instream habitat restoration (HI) (Table 11, Figure 13) represented the majority of the projects and FRGP funds spent in the Mendocino Coast hydrologic unit. Instream habitat restoration was also the most funded project type on the North Coast since 2004 (Figure 7). FRGP has been able to respond to recommendations put forth in PACT and the Recovery Strategy and succeed in implementing important restoration actions, but sustained comparable effort is required to keep up with the essential biological needs of Coho Salmon on the Mendocino Coast.

FRGP funded projects between 2004 and 2018 have prevented 2,375 and 1,205 cubic yards of sediment from entering the Garcia and Navarro rivers, respectively (Appendix 1.), and a total 6,220 cubic yards in the Mendocino watersheds highlighted in this study. Approximately 52 miles of instream habitat were treated, with the Noyo (18.5 miles) and Ten Mile (29.3 miles) river watersheds receiving the most treatment (Appendix 1.). To bolster Coho Salmon survival and abundance, 97 new pools were created, 41 of which are in the Noyo River watershed alone.

Monitoring results for multiple Mendocino Coast rivers and their tributaries indicate that no Coho Salmon were observed spawning in some years during the 1990's. A lack of consistent data and the impacts of drought years make it difficult to produce a complete history of Coho Salmon abundance on the Mendocino Coast. However, CMP, which utilizes statistically rigorous modeling in combination with a variety of in-river sampling and survey methods, has provided us with escapement estimates dating back to 2009. Some areas, like the Garcia River, which saw no Coho Salmon returning in the 1990's, have recently reported years with hundreds of adults returning. Whether or not these results can be attributed FRGP funded projects, restoration in general, or natural conditions is difficult to discern, but it is an encouraging trend.

Post-implementation monitoring of restoration projects could be paired with the funding of FRGP projects and potentially built into the grants themselves. It is important to understand the effectiveness of these projects not just immediately after implementation but also as they age. Consistent monitoring could provide restoration professionals with the ability to gauge the effectiveness of structures and the need for retreatment as time passes. Projects like the BACI study carried out on Pudding Creek provide us with a timely story of restoration in action. Similarly, monitoring efforts following the removal of barriers are needed to assess the benefit of the newly available spawning and rearing habitats to Coho Salmon. Fish presence and use of newly available habitat will better inform restoration professionals of the value of the habitat and its potential for fish production.

Four of the FRGP funded instream habitat restoration projects in the Noyo watershed took place in the South Fork Noyo River, where CDFW maintains a life cycle monitoring station. CDFW reports (Holloway et al. 2016) indicate that smolt-to-adult survival declined in the mid to late 2000's and potentially rebounded beginning in 2011 in the South and North Fork Noyo rivers. Continued instream habitat restoration projects in portions of the Noyo River watershed with life cycle monitoring stations could provide data to support the effectiveness of restoration efforts. This is not to say that restoration efforts on the Mendocino Coast should focus solely on areas associated with life cycle monitoring stations, but it highlights the importance of the data that can be derived from proper planning of restoration projects.

The Pudding Creek BACI experiment seeks to understand habitat and biological responses to an extensive large wood Coho Salmon habitat restoration treatment. Information from the pre-existing Pudding Creek life cycle monitoring station, additional Pudding Creek habitat and biological monitoring, and biological monitoring of the separate and untreated Casper Creek watershed are the basis of the experiment to understand factors limiting Coho abundance. Reporting from the Pudding Creek BACI experiment will inform best practices for recovery of Coho habitat in California. Salmonid life cycle monitoring stations, such as Pudding Creek, fulfill Coho population monitoring needs, and provide an opportunity for further habitat restoration and fisheries science experiments.

A joint study between CDFW and Campbell Timberlands Management California produced a report identifying limiting factors on Pudding Creek and two other coastal streams on the Mendocino Coast (Gallagher et al. 2012). These streams were referred to as Life Cycle Monitoring Streams. Data from this study were used to calculate marine and freshwater survival, estimate carrying capacities, and investigate relationships between survival and abiotic factors. All three streams showed that both density dependence in freshwater, and paucity of winter habitat, likely limit Coho Salmon production in streams in coastal California (Gallagher et al. 2012). Creating additional, and restoring existing, winter habitat on the Mendocino Coast could elicit the positive response in population data we expect to see.

If effective habitat restoration is implemented in these watersheds, Coho Salmon freshwater survival and abundance should see improvement. We expect, even in times of poor ocean conditions, more fish will survive to return as adults because freshwater life stages are crucial to providing stock resilience to fluctuations in the marine environment (Gallagher et al. 2012). Continuing to restore and provide new habitat could bolster the freshwater habitat availability and alleviate issues facing Coho Salmon in the Mendocino Coast hydrologic unit. Lawson et al. (2004) reported a strong negative relationship between smolt production and temperature. The future impacts of climate change are a serious concern for future smolt production. In addition to improving water quality and other watershed functions, large wood is needed to help recover Coho Salmon because it will induce sediment sorting, improve habitat shelter, increase pool frequency and depth, and reconnect flood plains (CDFG 2004). With continued FRGP response to habitat issues highlighted by regional professionals and planning documents, we anticipate a positive response from Coho Salmon on the Mendocino Coast.

South Fork Eel River

Habitat inventories and watershed assessments of the SFER indicate that fish habitat is generally improving through most of the basin; however, it is difficult to discern whether these improvements are due to restoration actions, improvements in environmental regulation, or natural processes. Furthermore, it may be difficult

to detect improvements due to restoration actions because anthropogenic threats and stressors continue to affect surrounding areas. The Coastal Watershed Planning and Assessment Program has conducted habitat inventories in the SFER since 1990 and has compiled those data into a multi-decade assessment (CDFW 2014). Comparing habitat suitability indices from data collected from 1990-1999 to values from 2000-2010 show that overall habitat suitability has increased in the northern and western portions of the watershed and decreased slightly in the eastern portion of the watershed, though it is important to note that these scores are all still below target values (CDFW 2014).

Overall improvements in canopy cover within in the northern and western portions of the watershed, as well as marginal improvements to canopy cover scores in the eastern portion of the watershed, can be attributed in part to the growth and expansion of riparian forests. Due to the low overall number of FRGP projects focusing on riparian restoration (Table 13. Summary of FRGP grants awarded in the South Fork Eel River Watershed. A total of $14,024,144 was allocated for this watershed.) and the relatively small amount of area affected by these projects (*Table 14*), it is likely these improvements are due to natural growth and succession of the riparian forest aided by protections afforded by the Forest Practices Act. The riparian habitat of many streams in the SFER was swept clean as a result of the 1955 and 1964 flood events (Sloan et al. 2001), as well as decades of poorly regulated logging. The colonization and succession of vegetation in these riparian zones can be clearly seen in aerial imagery of the watershed (CDF 1942, 1965; Google Earth 2018). While canopy cover is increasing relatively rapidly, the size of the trees and overall composition of the forest will take decades or centuries to recover to pre-impact conditions (Gregory et al. 1991). Until that occurs, natural wood recruitment processes will likely remain diminished, reducing a stream's capacity to maintain complexity. Additionally, while the average canopy cover has increased across the watershed, individual streams or reaches still have poor canopy cover, typically creating water temperatures that are locally unsuitable for salmonids. In response to these findings in stream inventories, CDFW biologists have frequently recommended improving riparian cover and/or water temperatures (CDFW 2014).

Table 14. Performance metrics of FRGP projects completed in the South Fork Eel River Watershed between FY 2003/2004 and 2017/2018. Only performance metrics related to a) fish passage, b) sediment reduction, c) riparian and upslope habitat restoration, or d) instream habitat restoration are shown here for simplicity. A full list of performance metrics can be found in Appendix 1.

a) Fish Passage

Performance Measures	*sum*
Total blockages/impediments/barriers removed/altered (number)	11
Total length of stream made accessible by removing blockages (miles)	59.5
Bridges installed or improved (number)	1

b) Sediment reduction

Performance Measures	*sum*
Length of road closed/abandoned (miles)	12.8
Road length treated (miles)	15.7
Upslope stream crossings treated, not for fish passage (number)	111
Erosion/sediment control installations (number)	15
Sediment volume prevented from entering stream (cubic yards)	155,275.1

c) Riparian/ Upslope Habitat

Performance Measures	*sum*
Amount of upland area treated (acres)	150.3
Area planted in riparian (acres)	2.9
Plants planted (number)	14,380
Fence length installed/repaired, actual length of fence (miles)	2.6
Water gap installations (number)	2
Length of riparian stream bank treated, count both sides of stream if applicable (miles)	5.2

d) Instream Habitat

Performance Measures	*sum*
Length of streambank stabilized, count both sides of stream if applicable (miles)	2.7
Total amount of riparian area treated (acres)	43.8
Instream features installed/modified (number)	435
Pools created through channel structure placement (number)	68
Overall stream length treated, count one side of stream only (miles)	21.6

Habitat suitability indices are also increasing due to improvements in substrate embeddedness values, a measure of how much fine sediment is filling interstitial spaces between cobble. Thirteen of the 14 sub-watersheds with reaches surveyed in both the 1990's and 2000's have had a net improvement in substrate embeddedness. This may be attributed to FRGP funded restoration actions, improved land management practices, and environmental policies governing water quality, though determining the exact mechanism is very difficult without higher resolution data. The majority of FRGP funding spent in the SFER has been spent either assessing road networks or directly remediating upslope sources of sediment (Table 13). This has resulted in 12.8 miles of road decommissioning, 15.7 miles of other road treatments, over 111 crossing treated, 15 sediment control structures installed, and an estimated 155,275 cubic yards (~200,114 tons[2]) of sediment

[2] Estimate based on volume to weight conversion of dry sand.

prevented from entering waterways(*Table 14*). Based on an analysis of sediment sources, approximately 46% of the sediment in the SFER originates from anthropogenic sources related to roads, resulting in 581,746 tons of sediment entering waterways per year (Stillwater Sciences 1999). Although it is difficult to compare these metrics directly, FRGP restoration actions alone could account for significant improvements to sediment loads and the resulting improvements to fish habitat, though there is no significant correlation between FRGP funding to improve sedimentation and net improvements to embeddedness ratings. Many more sediment sources have been treated through State Water Board funding, routine maintenance related to timber harvest practices, and more recently, through cannabis legalization requirements. However, due to the lack of tracking and monitoring, it is difficult to quantify these changes and there are no current data to evaluate basin-wide sediment budgets and outstanding anthropogenic sources of sediment.

Despite the potential sediment savings of restoration actions in the SFER, chronic sedimentation remains a threat to salmonids. Based on recommendations derived from CDFW stream inventories, addressing sediment sources is still a priority; however, it is typically second or third to improving instream habitat and/or riparian condition throughout the watershed (CDFW 2014). Recent planning efforts in tributaries of the SFER have revealed several sub-watersheds crucial to Coho Salmon that have un-inventoried and untreated road networks. Limiting factor analyses conducted by a panel of experts have indicated that sediment may be limiting salmonid production in several of these tributaries. With over 20 years since the development of the TMDL recommendations for the SFER, it is likely that significant changes have occurred in the watershed, and more contemporary monitoring and assessment of sediment loads and sources in the watershed will help prioritization treatment areas for sediment reduction.

While many aspects of stream habitat have been improving, pool depth and pool shelter indices indicate many tributaries of the SFER are declining in quality (CDFW 2014). Average primary pool depths in northern and western sub-basin tributaries have increased slightly from the 1990's to the 2000's; however, indices for pool depth remain well below target values, and for most tributaries surveyed they are the lowest category for all habitat considered. Primary pool depths have decreased on average throughout the eastern sub-basin. Pool shelter values have increased slightly in the northern sub-basin, but elsewhere have decreased over time, with no streams currently meeting target values. The primary method used to restore pool habitat in streams is to install large wood and boulder features to scour pools. Restoration efforts between 2004 and 2018 have resulted in the installation or modification of over 435 instream structures within 21.6 miles of stream (Table 14).

This has been no small feat to accomplish, requiring 22 individual projects and approximately $2.2 million in funding (Table 13); however, this accounts for less

than 10% of Coho Salmon-bearing tributaries in the SFER. With no tributaries meeting their primary pool targets or shelter ratings as of 2010, the SFER will require a lot more effort to elevate the habitat quality of its tributaries. It is important to note that the creation of pools is a function of stream geomorphology, velocity, instream complexity, and sediment budget, so restoring pool habitat requires both instream features in appropriate morphological settings and appropriate sediment loads (CDFW 2014). Based on the monitoring and restoration work related to sediment described above, sedimentation rates in the SFER may be on a trajectory towards improvement, so a stronger focus on improving instream complexity may be necessary to shift instream habitat metrics in tributaries with appropriate sediment budgets.

In addition to changes in existing habitat, access to aquatic habitat has been improved for salmonids. Since 2005, FRGP has funded eight projects to improve fish passage through seven stream crossings and other barriers. Five of the crossings and barriers were partial or temporal barriers, blocking upstream access for juvenile salmonids and impeding adult immigration. Restoring natural passage through these barriers improved salmonid access to approximately 57.3 miles of stream. Two of the crossings were complete barriers to all life-stages of salmonids, but only one of the crossings has been addressed. Restoration of a crossing on Little Waldron Creek restored access to approximately one mile of stream; however, salmonid use of this stream has not yet been verified (Elston 2020). FRGP funding was awarded for design and implementation of the road crossing barrier on Fish Creek, but the funding was later revoked due to CDFW concerns over project designs.

Fish passage has also been addressed by county resource departments, Caltrans, and by private organizations through other funding means. At least ten partial or temporal barriers have been removed or remediated, restoring natural access for all life-stages of salmonids (Elston 2020). Though subsequent monitoring has documented fish use above these barriers after project implementation, it is difficult to quantify a significant change in the frequency or magnitude of salmonid use as all of these barriers had at least partial access prior to implementation. One notable observation was the presence of a juvenile Coho Salmon above a road crossing on Bridge Creek one year after the partial barrier was removed. This was the first observation of a Coho Salmon in Bridge Creek since CDFW surveys have been conducted in this stream.

Despite indications that some aspects of fish habitat and distribution are improving, returns of adult Coho Salmon do not yet reflect a growing population. CDFW monitors adult Coho Salmon returns on the SFER via annual spawning ground surveys conducted within a spatially balanced sample framework (Guczek et al. 2019). The estimated number of Coho Salmon redds resulting from this monitoring work is presented in Table 1. Linear regression suggests that there is

no trend in the annual redd estimates, which indicates the population is neither growing nor continuing to collapse.

Considering the relatively small scale of the restoration work discussed in this analysis with respect to the great size of the SFER watershed, it may not be reasonable to expect a fish population response yet. Of the 275 miles of tributaries, 21.6 miles, or 7.9%, have been treated to improve instream complexity between 2004 and 2018 for a cost of approximately $2,212,485 (mean $100,567), and 59.5 miles of stream have been made accessible to fish (Table 14). Of the 687 miles^2 (439,680 acres) of watershed, over 150 acres (<1%) of upland habitat have been restored, 27.5 miles of road have been decommissioned or improved, and 155,275.1 cubic yards of sediment were prevented from entering waterways (Table 14). While these are commendable achievements, this scale of restoration is not likely to result in landscape and population level responses. The Recovery Strategy estimates that there are over 26,600 miles of roads in the entire Eel River watershed that require treatment or decommissioning, leading to an estimated <1% that have been addressed through FRGP in 15 years. However, by estimates reported to FRGP, sediment savings could account for over 34% of the anthropogenic sediment sources in the SFER. It is important to note that it is difficult to detangle anthropogenic sediment from natural sediment since FRGP projects can address both sources; however, the majority of HU projects reviewed in this section focused on anthropogenic sources. While there may have been significant gains made with sediment savings, there has been relatively little progress restoring stream complexity. Roni et al. (2010) found that a minimum of 20% of a stream would need to be fully restored (including instream, upslope, and flood plain habitats) before a population response could be detected. Furthermore, responses to instream restoration may be delayed or muted by other effects such as a large sediment supply (Anderson et al. 2019).

The Recovery Strategy provided estimates of fiscal costs for implementing recovery actions throughout the Eel River basin. Aggregate cost estimates were developed by expanding the estimated unit cost for commonly implemented restoration actions and expanding those values to the estimated scale that each recovery action will be implemented. The estimated cost of restoring stream complexity to the entire Eel River is $4,724,764, slightly more than twice what has been spent on instream restoration in the SFER. This estimate includes $15,000 in permit costs per mile and $20,000–$30,000 in implementation costs per mile, for a total of $35,000–$45,000 per stream mile. Based on reported metrics and costs reviewed in this report, actual costs for instream restoration have been $102,429 per mile, more than twice the estimates described above. The Recovery Strategy does not provide a fiscal cost estimate for road treatment or decommissioning; however, the range-wide average cost for these activities was estimated to be $19,875 per mile. By this estimate, the cost of treating the 26,600 miles of road in the Eel River would be $528,675,000. The actual cost per mile, excluding planning and prioritization efforts, have been $219,839, an order of magnitude greater than

what was estimated. These cost discrepancies and lack of South Fork specific estimates make it difficult to assess progress on specific projects types.

It is apparent that while progress towards restoring habitat in the SFER has been made, costs are considerably higher than anticipated, and there is more restoration that needs to be done compared to what has been completed. It is also important to keep in mind that these figures only represent the work that has been completed through FRGP funded projects alone, and do not account for road improvements made through implementation funded by other agencies or privately funded by timber companies and other landowners. Furthermore, stream restoration has occurred through mitigation efforts and other funding streams that are not accounted for in this analysis.

Range Wide Conclusions

This analysis of the NCSP initial watersheds highlights the variation in how FRGP funding has been applied across different regions. The initial watersheds have been the focus of many projects (Figure 9 and Figure 11) and the vast majority of those were successfully implemented and function as intended (Figure 4, Figure 5, and Figure 6). However, the difference in spatial scale among watersheds, as exemplified by Lagunitas Creek and the South Fork Eel, is important when considering the expected outcomes based on the resources allocated. The relatively large South Fork Eel watershed (689 miles^2) received \$20,736/mile^2 compared to \$88,065/mile^2 in Lagunitas Creek (103 miles^2), which likely reflects both the different concentrations of restoration efforts and the regional differences in project implementation cost. However, the concentration of funding alone cannot guarantee the growth of a fish population. As discussed in the Lagunitas Creek section above, despite the considerable expenditure and planning in this small watershed, a clear response in fish abundance and habitat quality has not been observed, but there are signs that over-winter survival, an area of focus, is improving. These improvements in certain juvenile survival rates are encouraging, but the mixed results raise the question of whether the current level of resource allocation is sufficient for Coho Salmon recovery.

It is important to consider these findings in the broader scope of species recovery. Environmental challenges including continued habitat degradation, climate change, a five-year drought, and a significant decline in marine survival during the time period explored in this analysis (CDFW 2019) likely contributed to the downward trend observed among Coho Salmon populations, even with the concerted restoration efforts implemented through FRGP. FRGP grants have spent \$193 million over the 15 years since publication of the Recovery Strategy, which represents 12.9% of the \$1.5 billion that NOAA estimates it would cost to recover just CCC Coho Salmon over the next 100 years. At the current level of funding spread over both ESUs (approximately \$13 million per year), FRGP would have to continue operating for more than another 100 years to implement the restoration

necessary to achieve recovery in just the CCC ESU. This projection does not take into account the fact that over the years and decades that restoration occurs, natural and anthropogenic pressures on the habitat do not cease entirely, so the effectiveness of restoration work is likely diminished by the ongoing nature of processes that make or keep habitat dysfunctional. Consequently, the net positive effect of a restoration project may be considerably lower than what its price tag might suggest. Recent work points to the extent of habitat that needs to be restored to detect a population-level response. Studies have shown that 20% of floodplain and in-channel habitat would need to be restored to see responses in smolt production through typical monitoring regimes (Roni et al. 2010). This same study found that 100% of habitat would need to be restored to be 95% certain of detecting a population-level response (Roni et al. 2010). This level of restoration is not being met in any of the focus watersheds, and concerted recovery efforts have only been underway for less than 25 years.

FRGP was designed to fund relatively small projects that can fit under a programmatic permit, that are implemented over a relatively short timeframe, and with funds spread out over the entire range of both Coho Salmon and steelhead. This approach may have mitigated some of the most pressing threats to Coho Salmon by addressing habitat dysfunction and degradation in many watersheds simultaneously. However, this approach may also limit success in reversing population trajectories overall and within individual watersheds, and evidence suggesting significant positive trends in populations is lacking in both Coho Salmon ESUs (NMFS 2016a, 2016b). In the restoration community there is a push for restoration to address ecosystem processes and restore to "stage 0" where possible in order to address concerns that 'ad-hoc' or opportunistic restoration is not necessarily sustainable or effective on a landscape (Roni et al 2008; Beechie et al. 2010). While many of the restoration actions funded by FRGP seek to address watershed processes (fish passage improvements, riparian planting, floodplain activation, etc.), the scale of FRGP projects may limit its ability to restore processes to a level that benefits fish populations. Additionally, as FRGP priorities change through time, restoration plans and multiphase projects may not be fully realized (see Green Valley Creek and Jack of Hearts Creek).

Through this analysis, we have highlighted how the Recovery Strategy and other guiding documents have been supported by FRGP funding. This effort was particularly challenging and labor intensive as recovery tasks are not well tracked through a grant's execution, and determination of whether specific recovery tasks have been addressed relies on the professional opinion of regional experts. Many of the Recovery Strategy's task are not defined in a measurable way making it especially challenging to assess whether tasks have been completed or sufficiently addressed.

Where specific recovery recommendations pertinent to focus watersheds were available in the Recovery Strategy, response to those recommendations by the

restoration community via FRGP varied by watershed. Lagunitas Creek had many projects supporting recovery tasks, while work in the Russian River tributaries focused on a relatively small subsection of recovery tasks (see Appendix 2). For all of the focus watersheds in this report, many recovery tasks that were addressed are not yet completed and require additional restoration or ongoing efforts.

FRGP did support planning, which is one way to address restoration needs where only range-wide recommendations are available, or where HSA recommendations were not specific. Grants supported further study, planning, and prioritization to identify and develop subsequent restoration plans. The ability to restore systems fundamentally depends on a comprehensive understanding of the biological and physical processes of each watershed. Assessment, monitoring, and planning all require additional funding that must be balanced with the pressing need to implement projects immediately. This analysis highlights that formal planning projects have been effective in turning into actual restoration projects and may be more capable of improving fish survival than projects without a higher resolution planning stage.

Results such as those observed in Lagunitas Creek would not be possible without data from concerted monitoring efforts. Given the amount of variability in survival through all life stages, monitoring focused on adult abundance alone does not lend itself to assessing the effectiveness of individual projects. Life cycle monitoring provides invaluable biological data pertinent to the assessment of restoration techniques and allows for restoration projects, such as the large scale large wood augmentation on Pudding Creek, to be tested in a scientifically rigorous manner (see Pudding Creek). In areas with known limiting factors, the relative impacts of different project types could help guide restoration planning and project selection. Assessing habitat conditions and watershed health allows restorationists and managers to plan and prioritize restoration efforts and provides another mechanism to assess restoration effectiveness. Effectiveness monitoring of individual projects may be useful for determining if restoration creates robust physical responses to a localized area and can be useful for investigating how implementation and site selection change effect project results. However, the bulk of data pertaining to this information was not available for our analysis and remains to be analyzed. Monitoring of individual restoration projects will always be limited in scope; thus, this type of information will not be able to inform watershed scale effects or population responses. Furthermore, putative responses will likely remain confounded by highly variable interannual population dynamics and environmental stochasticity.

The analysis performed for this report revealed that some data sets were either unavailable or formatted in ways that do not facilitate assessment of restoration. Most habitat restoration and habitat monitoring are conducted in an opportunistic fashion resulting in data that have limited alignment and thus a limited scope of inference. To be able to make robust conclusions on the effects of restoration,

implementation and monitoring should be conducted in a design-based approach. MESHR has gathered over 15 years of data on project effectiveness but there has been little to no analysis of this data due in part to its inaccessibility. Quantitative metrics specific to each project type are gathered and stored in multiple data bases that are unrelatable. Similarly, habitat monitoring data are stored in individual databases for every stream and year, making quantitative analysis across space and time extremely cumbersome. Tasks outlined in the Recovery Strategy and included in the grant application process as justification for the project are not carried over into the FRGP database, which prevents a direct comparison of each FRGP project to a relevant state or federal recovery task. This limits our ability to track progress on recovery tasks, making it difficult to adjust priorities for future projects. Moreover, with over 1,000 tasks to choose from in state and federal plans when applying for funding, it is questionable if this breadth of choices focuses projects on high priority restoration needs.

This report has attempted to draw connections between restoration histories and monitoring data where sufficient data has been available or accessible. However, many of the status and trends population monitoring programs were not designed to validate the success of individual restoration projects, and none or the focal streams discussed in this report have reached a level of restoration effort that would likely result in detectable changes of fish populations (Roni et al. 2010). The availability of monitoring data and how those data could be focused to better serve restoration is a focal point of the NCSP, with an independent report on the state of monitoring forthcoming. It is the goal of this Project to draw on the findings in this report, and from future analyses, to recommend how FRGP and monitoring should adapt going forward to be mutually beneficial and support the recovery of Coho Salmon.

Recommendations

1. Improve the reporting and tracking of restoration projects to facilitate understanding of progress on recovery tasks. It is difficult to determine which recovery tasks are being supported by restoration and to what degree those tasks are accomplished. Recovery tasks cited in grant applications are not tracked through implementation and only grants with Department oversight are being tracked, though this effort is labor intensive and sporadic. Recovery tasks listed in a grant application should be carried forward in the database of funded grants. Many tasks are not easily quantifiable, which requires a great deal of interpretation to determine whether they are addressed in a sufficient manner.
2. Provide higher resolution plans and more specific quantifiable restoration tasks based on updated science, monitoring, and collaborative efforts (SHaRP, PACT, etc.). Additionally, consider limiting future PSNs to the recovery tasks prioritized through these processes. More specific watershed plans and high-priority actions facilitate a structured approach to restoring

watersheds and move restoration away from opportunistic projects. Focusing grant funds on areas with specific plans and pathways to recovery could increase the likelihood of seeing significant habitat and population responses. While FRGP requires citing a NOAA recovery task, in watersheds with high priority actions established through collaborative planning efforts, grants should consider limiting funding opportunities to these specific and limited tasks.

3. Conduct a more robust analysis of MESHR data to investigate project failures and successes and provide feedback to practitioners on how to improve implementation practices. While summarized data on project effectiveness was broadly available and analyzed in this report, a wealth of data that would likely inform future restoration practices remain un-analyzed. Based on communications with MESHR staff, detailed data for each project type are collected, but only analyzed to a limited extent to assess individual project effectiveness. Furthermore, complications with data organization has limited the accessibility of this data for broader analysis, and multiple data bases will need to be made relatable before this analysis can be completed. NCSP is actively participating in an ongoing MESHR review to ensure these data are used to promote effective restoration.
4. Apply restoration in a complementary manner to existing monitoring efforts so projects can be assessed in a more robust experimental design to detect changes in habitat and population parameters. Projects should be designed in ways that leverage existing data so that questions regarding the biological and habitat outcomes of projects can be answered.

Works Cited

Anderson, H.W. 1954. Suspended sediment discharge as related to streamflow, topography, soil, and land use. Eos, Transactions American Geophysical Union 35(2):268-281.

Anderson, J.H., K.L. Krueger, C. Kinsel, T. Quinn, W.J. Ehinger, and R. Bilby. 2019. Coho Salmon and Habitat Response to Restoration in a Small Stream. Transactions of the American Fisheries Society 148:1024-1038.

Bearss, E.C. 1969. Redwood National Park; History Basic Data. U.S. Department of the Interior, National Park Service Office of Archaeology and Historic Preservation.

Beechie, T.J., D.A. Sear, J.D. Olden, G.R. Pess, J.M. Buffington, H. Moir, P. Roni, and M.M. Pollock. 2010. Process-based principles for restoring river ecosystems. BioScience 60(3):209-222.

Bjornn, T., and D. Reiser. 1991. Habitat Requirements of Salmonids in Streams. In: Meehan, W., editors. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19. Bethesda, Maryland.

Burns, J.W. 1971. The carrying capacity for juvenile salmonids in some northern California streams. California Fish and Game 57:44-57.

Burns, J.0W. 1972. Some Effects of Logging and Associated Road Construction on Northern California Streams, Transactions of the American Fisheries Society, 101:1, 1-17

CalFish (California Cooperative Anadromous Fish and Habitat Data Program). 2017. Dutch Bill Creek Coho Habitat Enhancement Project Case Study Reports https://www.calfish.org/ProgramsData/ConservationandManagement/RestorationProjects.aspx

California Department of Fish and Game (CDFG). 2000a. Dutch Bill Creek Stream Inventory Report. Assessment 1997, Report completed 2000, Revised 2006.

California Department of Fish and Game (CDFG). 2000b. Felta Creek Stream Inventory Report. Assessment 1995, Report completed 2000, Revised 2006.

California Department of Fish and Game (CDFG). 2000c. Green Valley Creek Stream Inventory Report. Assessment 1994, Report completed 2000, Revised 2006.

California Department of Fish and Game (CDFG). 2000d. Mill Creek Stream Inventory Report. Assessment 1997, Report completed 2000, Revised 2006.

California Department of Fish and Game (CDFG). 2000e. Willow Creek Stream Inventory Report. Assessment 1997, Report completed 2000, Revised 2006.

California Department of Fish and Game (CDFG). 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission.

California Department of Fish and Wildlife (CDFW). 2014. South Fork Eel River Watershed Assessment. Coastal Watershed Planning and Assessment Program. California Department of Fish and Wildlife.

California Department of Fish and Wildlife (CDFW). 2019. Statewide Drought Response: Stressor Monitoring Summary Report 2014–2017.

California Department of Forestry (CDF). 1942. Historic Aerial Photos of the Northwest Coast, California 1941–1942.

California Department of Forestry (CDF). 1965. Historic Aerial Photos of the Northwest Coast, California 1965.

California Regional Water Quality Control Board (CRWQCB). 2000. Reference Document for the Garcia River Watershed Water Quality Attainment Action Plan for Sediment North Coast Regional Water Quality Control Board September 21, 2000.

California Regional Water Quality Control Board (CRWQCB). 2005. North Coast Regional Water Quality Control Board Watershed Planning Chapter Section 2.3.8. February 2005.

California Regional Water Quality Control Board (CRWQCB) San Francisco Bay Region. 2014. Lagunitas Creek watershed fine sediment reduction and habitat enhancement plan.

California Sea Grant. 2020. Russian River Coho Salmon and Steelhead Monitoring Report: Winter 2019/20. Windsor, CA.

Ettlinger, E. 2017. Lagunitas Creek Salmonid Habitat 2016. Marin Municipal Water District, Corte Madera CA.

Ettlinger, E. 2019. Smolt monitoring in the Lagunitas Creek watershed – 2018. Marin Municipal Water District, Corte Madera CA.

Elston, A. 2020. California Fish Passage Assessment Database [ds69]. California Department of Fish and Wildlife. Biogeographic Information and Observation System (BIOS). Retrieved June 30, 2020 from http://bios.dfg.ca.gov

Flosi, G. and Reynolds, F. 2004. California Salmonid Stream Habitat Restoration Manual Part IX : Fish Passage Evaluation at Stream Crossings. California Department of Fish and Game. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=105810

Guczek, J., S. Powers, and M. Larson. 2019. Results of Regional Spawning Ground Surveys and Estimates of Salmonid Redd Abundance in the South Fork Eel River, Humboldt and Mendocino Counties California, 2018-2019. Pacific States Marine Fisheries Commission, Fortuna, CA.

Gallagher, S.P., S. Thompson, and D.W. Wright. 2012. Identifying factors limiting Coho salmon to inform stream restoration in coastal Northern California. California Fish and Game 98:185-201.

Gold Ridge Resource Conservation District (GRRCD). 2013. Green Valley Creek watershed management plan, phase II. FRGP #P0930400.

Google Earth. 2018. "Briceland, CA." 40° 6'29.75"N, 123°53'59.16"W. 20 June 2019.

Gregory, S.V., Swanson, F.J., McKee, W.A., and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. BioScience 41(8)540-551.

Holloway, W., S.P. Gallagher, S. Thompson, E. Lang, and D. Ulrich. 2016. Coastal Mendocino County Salmonid Life Cycle and Regional Monitoring: Monitoring Status and Trends for 2015. 2014–15 Annual Report. Pacific States Marine Fisheries Commission and the California State Department of Fish and Wildlife, Coastal Watershed Planning and Assessment Program, 1487 Sandy Prairie Court, Suite a. Fortuna, CA 95540.

Johnson, S.L., J.D. Rodgers, M.F. Solazzi, and T.E. Nickelson. 2005. Effects of an increase in large wood on abundance and survival of juvenile salmonids (*Oncorhynchus* sp.) in an Oregon coastal stream. Canadian Journal of Fisheries and Aquatic Sciences 62:412-424.

Ketcham, B.J., G.G. Brown, and O.G. Wolff. 2004. Index reach monitoring program summary - Olema Creek, Marin County, California: 1999–2003. PORE/NR/WR/04-04.

Lawson, P.W., E.A. Logerwell, N.J. Mantua, R.C. Francis, and V.N. Agostini. 2004: Environmental factors influencing freshwater survival and smolt production in

Pacific Northwest coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 61, 360-373.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-42.

McGee, H. 2010. Mattole Restoration Council Riparian Conifer Enhancement Final Report. Mattole Restoration Council. Prepared for the California Department of Fish and Game (contract #P0610535).

Mendocino County Resource Conservation District (MCRCD). 2012. Russian River Integrated Coastal Watershed Management Plan.

Marin Municipal Water District (MMWD). 2014. Marin County Fish Passage Program. https://www.marinwatersheds.org/sites/default/files/2017-11/Fish-Passage-Program_3_2014%20standard_0.pdf

National Marine Fisheries Service (NMFS). 2016a. 5-Year Review: Summary and Evaluation of Southern Oregon/Northern California Coast Coho Salmon. National Marine Fisheries Service West Coast Region. Arcata, CA.

National Marine Fisheries Service (NMFS). 2016b. 5-Year Review: Summary and Evaluation of Central California Coast Coho Salmon. National Marine Fisheries Service, West Coast Region. Arcata, CA.

National Marine Fisheries Service. 2012. Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

North Coast Regional Water Quality Control Board (NCRWQCB). 2006. Desired salmonid freshwater habitat conditions for sediment-related indices. State of California.

Novelli, E.M., and T.H.Leroy. 2019. Standley Creek Sediment Reduction and Habitat Improvement Project, Phase 6, Mendocino County, California. Report prepared for Trout Unlimited, CDFW Fisheres Restoration Grant Program: Grant # P1410539. Pacific Watershed Associates Inc., Arcata, CA.

Obedzinski, M., S. Nossaman Pierce, G.E. Horton, and M.J. Deitch. 2018. Effects of flow-related variables on oversummer survival of juvenile Coho Salmon in intermittent streams. Transactions of the American Fisheries Society 147:588-605.

Pacific Watershed Associates (PWA). 2003. Summary Report S.B. 271 watershed assessment and erosion prevention planning project for the Dutch Bill Creek watershed, Sonoma County, CA. #P0030475.

Pess G.R., D.R. Montgomery, E.A. Steel, R.E. Bilby, B.E. Feist, and H.M. Greenberg. 2002. Land-scape characteristics, land use, and coho salmon (*Oncorhynchus kisutch*) abundance, Snohomish River, Wash. Canadian Journal of Fisheries and Aquatic Sciences 59:613-23.

Priority Action Coho Team (PACT). 2019. Priority Action Coho Team: Strategic partnering to accelerate Central California Coast Coho Salmon Recovery 164 pp. California Department of Fish and Wildlife and NOAA Fisheries. Sacramento, CA.

Prunuske Chatham Inc. (PCI). 2005. Towards a healthy wildland watershed: Willow Creek watershed management plan. Prepared for Stewards of the Coast and Redwoods, Duncans Mills, CA.

Roni, P., K. Hanson, and T. Beechie. 2008. Global review of the physical and biological effectiveness of stream habitat rehabilitation techniques. North American Journal of Fisheries Management 28(3):856-890.

Roni, P., G. Pess, T. Beechie, and S. Morley. 2010. Estimating changes in Coho Salmon and steelhead abundance from watershed restoration: how much restoration is needed to measurably increase smolt production? North American Journal of Fisheries Management 30:1469–1484.

Russian River Coho Water Resources Partnership (RRCWRP). 2015. Mill Creek streamflow improvement plan.

Russian River Coho Water Resources Partnership (RRCWRP). 2017. Dutch Bill Creek streamflow improvement plan.

Russian River Coho Water Resources Partnership (RRCWRP). 2019. Upper Green Valley Creek streamflow improvement plan.

Sloan, J., J.R. Miller, and N. Lancaster. 2001. Response and recovery of the Eel River, California, and its tributaries to floods in 1955, 1964, and 1997. Geomorphology 36:129-145.

Sommerfield, C.K., D.E. Drake, and R.A. Wheatcroft. 2002. Shelf record of climatic changes in flood magnitude and frequency, north-coastal California. Geology 30(5):395–398.

Sonoma Resource Conservation District (SRCD). 2015. Mill Creek Watershed Management Plan, Needs Assessment and Action Plan, a living document.

Sonoma Water and California Sea Grant. 2018. Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) update handout for TAC meeting. 5/10/2018.

Sonoma Water and California Sea Grant. 2019. Implementation of California Coastal Salmonid Population Monitoring in the Russian River Watershed. Santa Rosa, CA..

Spence, B.C., and T.H. Williams. 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Central California Coast Coho Salmon ESU. NOAA Southwest Fisheries Science Center, Santa Cruz, CA.

Stillwater Sciences. 2007. Middle Lagunitas Creek watershed sediment delivery analysis. Prepared for the Department of Public Works, Marin County, CA.

Stillwater Sciences. 2008. Lagunitas limiting factors analysis; limiting factors for Coho Salmon and steelhead. Final report. Prepared by Stillwater Sciences, Berkeley, California for Marin Resource Conservation District, Point Reyes Station, California.

Stillwater Sciences. 1999. South Fork Eel Total Mass Daily Load: Sediment source analysis. Prepared for Tetra Tech, Arcata, California.

Taylor, R.N., T.D. Grey, A.L. Knoche, and M. Love. 2003. Russian River stream crossing inventory and fish passage evaluation, final report. Ross Taylor and Associates, McKinleyville, CA.

United States Environmental Protection Agency (US EPA). 2000. Ten Mile River Total Maximum Daily Load for Sediment.

Woelfle-Erskine, C., L.G. Larsen, and S.M. Carlson. 2017. Abiotic habitat thresholds for salmonid oversummer survival in intermittent streams. Ecosphere 8(2):e01645. 10.1002/ecs2.1645.

Wright, D., S. Gallagher, and C. Hannon. 2012. Measurements of Key Life History Metrics of Coho Salmon in Pudding Creek, California 1.

Appendix 1.

Performance Measures for HUC 10s in Initial Watersheds

Lagunitas Creek Performance Metrics:

HUC 10	Metric	Amount
Lagunitas Creek	Area encompassed by planning/assessment (acres)	78375.68
Lagunitas Creek	Watershed area monitored (acres)	56992
Lagunitas Creek	Area/footprint of instream features installed within bankfull channel (square feet)	16976
Lagunitas Creek	Amount of habitat assessed (acres)	5990
Lagunitas Creek	Amount of habitat assessed that needed restoration (acres)	5990
Lagunitas Creek	Sediment volume prevented from entering stream (cubic yards)	3273
Lagunitas Creek	Plants planted (number)	2547
Lagunitas Creek	Length of aquatic habitat disturbed (feet)	1483.1
Lagunitas Creek	Stream crossings assessed (number)	190
Lagunitas Creek	Length of stream monitored for adult salmonids (miles)	184.92
Lagunitas Creek	Participants in workshop/training events (number)	178
Lagunitas Creek	Road length assessed (miles)	156.33
Lagunitas Creek	Stream length monitored (miles)	155.33
Lagunitas Creek	Students educated (number)	150
Lagunitas Creek	Area of water monitored (square miles)	109
Lagunitas Creek	Length of stream monitored for salmonid smolt or fry (miles)	84.42
Lagunitas Creek	Length of stream monitored for redds (miles)	80.25
Lagunitas Creek	Length of stream monitored for carcasses (miles)	77.42
Lagunitas Creek	Outreach/education documents completed and distributed (number)	59
Lagunitas Creek	Schools and other institutions reached (number)	48
Lagunitas Creek	Instream features installed/modified (number)	25
Lagunitas Creek	Number of cooperating organizations (number)	20

HUC 10	Metric	Amount
Lagunitas Creek	Reports prepared on key management or restoration data (number)	16
Lagunitas Creek	Total amount of riparian area treated (acres)	13.7758
Lagunitas Creek	Area planted in riparian (acres)	13.62
Lagunitas Creek	Stream length assessed (miles)	13
Lagunitas Creek	Stream length assessed that contained salmonids (miles)	13
Lagunitas Creek	Stream length assessed that needed restoration (miles)	13
Lagunitas Creek	Pools created through channel structure placement (number)	8
Lagunitas Creek	Restoration projects proposed (number)	8
Lagunitas Creek	Potential barriers assessed for passage status (number)	7
Lagunitas Creek	Watershed plans/assessments completed (number)	7
Lagunitas Creek	Total blockages/impediments/barriers removed/altered (number)	6
Lagunitas Creek	Culverts installed or improved (number)	5
Lagunitas Creek	Workshop/training events (number)	5
Lagunitas Creek	Total length of stream made accessible by removing blockages (miles)	3.8932
Lagunitas Creek	Stream sites monitored (number)	3
Lagunitas Creek	Overall stream length treated, count one side of stream only (miles)	2.4924
Lagunitas Creek	Erosion/sediment control installations (number)	2
Lagunitas Creek	Name of the plan developed/implemented for engineering/design work for restoration projects	2
Lagunitas Creek	Length of road treated for drainage improvements/reconstruction (miles)	1.9074
Lagunitas Creek	Road length treated (miles)	1.7839
Lagunitas Creek	Stream length made accessible by culvert installation/repair (miles)	1.21
Lagunitas Creek	Length of riparian stream bank treated, count both sides of stream if applicable (miles)	1.1893

HUC 10	Metric	Amount
Lagunitas Creek	Description of the plan developed/implemented for engineering/design work for restoration projects	1
Lagunitas Creek	Road crossings removed (number)	1
Lagunitas Creek	Upslope stream crossings treated, not for fish passage (number)	1
Lagunitas Creek	Stream length opened for fish passage by improving stream crossings (miles)	0.8333
Lagunitas Creek	Area protected with acquisition, easement or lease (acres)	0.75
Lagunitas Creek	Total length of instream habitat treated (miles)	0.715
Lagunitas Creek	Amount of upland area treated (acres)	0.5899
Lagunitas Creek	Length of stream treated for channel structure placement (miles)	0.5531
Lagunitas Creek	Length of road closed/abandoned (miles)	0.4208
Lagunitas Creek	Length of streambank stabilized, count both sides of stream if applicable (miles)	0.3729
Lagunitas Creek	Amount of riparian area treated for invasive species (acres)	0.3698
Lagunitas Creek	Fence length installed/repaired, actual length of fence (miles)	0.2
Lagunitas Creek	Length of stream protected by acquisition, easement or lease (miles)	0.07
Lagunitas Creek	Volume of water conserved (acre-feet)	0.061
Lagunitas Creek	Length of stream treated for channel reconfiguration/connectivity (miles)	0.05

Russian River Performance Metrics:

HUC 10	Metric	Amount
Lower Russian River	Amount of habitat assessed (acres)	2224
Lower Russian River	Amount of habitat assessed that needed restoration (acres)	2224
Lower Russian River	Amount of upland area treated (acres)	0.13
Lower Russian River	Area encompassed by planning/assessment (acres)	14700.25
Lower Russian River	Area of water monitored (square miles)	0.107
Lower Russian River	Area planted in riparian (acres)	0.14
Lower Russian River	Area/footprint of instream features installed within bankfull channel (square feet)	155086
Lower Russian River	Blockages/impediments/barriers impeding passage (number)	3
Lower Russian River	Bridges installed or improved (number)	1
Lower Russian River	Change in water flow, not including water maintained in stream (cfs)	0.3
Lower Russian River	Culverts installed or improved (number)	6
Lower Russian River	Description of the plan developed/implemented for evaluation/analysis of restoration plans/projects	1
Lower Russian River	Description of the plan developed/implemented for restoration/action plan development	1
Lower Russian River	Erosion/sediment control installations (number)	2
Lower Russian River	Fish ladders installed/improved (number)	2
Lower Russian River	Fish screens replaced/maintained (number)	1
Lower Russian River	Flow of water conserved (cfs)	0.3

HUC 10	Metric	Amount
Lower Russian River	Hatchery fry/smolt released (number fish/year)	145
Lower Russian River	Instream features installed/modified (number)	192
Lower Russian River	Length of aquatic habitat disturbed (feet)	8145.11
Lower Russian River	Length of off-channel stream created (miles)	0.064
Lower Russian River	Length of riparian stream bank treated, count both sides of stream if applicable (miles)	0.044
Lower Russian River	Length of road closed/abandoned (miles)	0.0284
Lower Russian River	Length of road treated for drainage improvements/reconstruction (miles)	13.4124
Lower Russian River	Length of stream monitored for adult salmonids (miles)	28.25
Lower Russian River	Length of stream protected for adequate flow (miles)	1
Lower Russian River	Length of stream treated for channel reconfiguration/connectivity (miles)	0.064
Lower Russian River	Length of stream treated for channel structure placement (miles)	2.1694
Lower Russian River	Length of streambank stabilized, count both sides of stream if applicable (miles)	0.4336
Lower Russian River	Name of the plan developed/implemented for evaluation/analysis of restoration plans/projects	1
Lower Russian River	Name of the plan developed/implemented for restoration/action plan development	1
Lower Russian River	Number of cooperating organizations (number)	11

HUC 10	Metric	Amount
Lower Russian River	Outreach/education events (number)	1
Lower Russian River	Overall stream length treated, count one side of stream only (miles)	4.6527
Lower Russian River	Participants in workshop/training events (number)	100
Lower Russian River	Plants planted (number)	183
Lower Russian River	Pools created through channel structure placement (number)	1
Lower Russian River	Potential barriers assessed for passage status (number)	150
Lower Russian River	Reports prepared on key management or restoration data (number)	1
Lower Russian River	Restoration projects proposed (number)	4
Lower Russian River	Road length assessed (miles)	46
Lower Russian River	Road length treated (miles)	13.4124
Lower Russian River	Schools and other institutions reached (number)	7
Lower Russian River	Sediment volume prevented from entering stream (cubic yards)	14609
Lower Russian River	Stream crossings assessed (number)	237
Lower Russian River	Stream length made accessible by bridge installation/repair (miles)	4.7
Lower Russian River	Stream length made accessible by culvert installation/repair (miles)	1.91
Lower Russian River	Stream length monitored (miles)	28.25
Lower Russian River	Stream sites monitored (number)	3
Lower Russian River	Students educated (number)	1225

HUC 10	Metric	Amount
Lower Russian River	Total amount of riparian area treated (acres)	0.53
Lower Russian River	Total blockages/impediments/barriers removed/altered (number)	14
Lower Russian River	Total length of instream habitat treated (miles)	5.1817
Lower Russian River	Total length of stream made accessible by removing blockages (miles)	511.58
Lower Russian River	Upslope stream crossings treated, not for fish passage (number)	50
Lower Russian River	Volume of water conserved (acre-feet)	4
Lower Russian River	Watershed area monitored (acres)	68.48
Lower Russian River	Watershed plans/assessments completed (number)	5
Lower Russian River	Workshop/training events (number)	3

Mendocino Coast Performance Metrics:

HUC 10	Metric	Amount
Garcia River	Amount of upland area treated (acres)	10.1
Garcia River	Area encompassed by planning/assessment (acres)	14
Garcia River	Area of streambed created (acres)	1
Garcia River	Erosion/sediment control installations (number)	4
Garcia River	Instream features installed/modified (number)	18
Garcia River	Length of road closed/abandoned (miles)	0.67
Garcia River	Length of road treated for drainage improvements/reconstruction (miles)	5.61
Garcia River	Length of stream treated for channel structure placement (miles)	2.15
Garcia River	Pools created through channel structure placement (number)	12
Garcia River	Road length treated (miles)	1.78
Garcia River	Sediment volume prevented from entering stream (cubic yards)	2375
Garcia River	Total length of instream habitat treated (miles)	0.475
Garcia River	Upslope stream crossings treated, not for fish passage (number)	12
Navarro River	Amount of upland area treated (acres)	0.94
Navarro River	Area encompassed by planning/assessment (acres)	32
Navarro River	Area/footprint of instream features installed within bankfull channel (square feet)	8769
Navarro River	Instream features installed/modified (number)	186
Navarro River	Length of aquatic habitat disturbed (feet)	2818
Navarro River	Length of road closed/abandoned (miles)	3.8
Navarro River	Length of road treated for drainage improvements/reconstruction (miles)	0.94
Navarro River	Length of stream monitored for adult salmonids (miles)	0.51
Navarro River	Length of stream treated for channel structure placement (miles)	2.09275

HUC 10	Metric	Amount
Navarro River	Length of streambank stabilized, count both sides of stream if applicable (miles)	0.01
Navarro River	Overall stream length treated, count one side of stream only (miles)	3.0759
Navarro River	Pools created through channel structure placement (number)	23
Navarro River	Road length treated (miles)	0.94
Navarro River	Sediment volume prevented from entering stream (cubic yards)	1205
Navarro River	Total length of instream habitat treated (miles)	3.1409
Navarro River	Upslope stream crossings treated, not for fish passage (number)	4
Noyo River	Amount of upland area treated (acres)	1
Noyo River	Area encompassed by planning/assessment (acres)	8094.8
Noyo River	Area planted in riparian (acres)	0.313
Noyo River	Area/footprint of instream features installed within bankfull channel (square feet)	53047
Noyo River	Blockages/impediments/barriers impeding passage (number)	4
Noyo River	Bridges installed or improved (number)	2
Noyo River	Instream features installed/modified (number)	930
Noyo River	Length of aquatic habitat disturbed (feet)	13083
Noyo River	Length of riparian stream bank treated, count both sides of stream if applicable (miles)	1.009
Noyo River	Length of road closed/abandoned (miles)	0.616
Noyo River	Length of stream treated for channel structure placement (miles)	818.4372
Noyo River	Outreach/education events (number)	1
Noyo River	Overall stream length treated, count one side of stream only (miles)	32.9678
Noyo River	Participants in workshop/training events (number)	70
Noyo River	Plants planted (number)	1770

HUC 10	Metric	Amount
Noyo River	Pools created through channel structure placement (number)	41
Noyo River	Road length assessed (miles)	33.9
Noyo River	Road length treated (miles)	0.616
Noyo River	Sediment volume prevented from entering stream (cubic yards)	300
Noyo River	Stream crossings assessed (number)	128
Noyo River	Stream length made accessible by bridge installation/repair (miles)	2.86
Noyo River	Students educated (number)	70
Noyo River	Total amount of riparian area treated (acres)	0.243
Noyo River	Total blockages/impediments/barriers removed/altered (number)	5
Noyo River	Total length of instream habitat treated (miles)	18.1471
Noyo River	Total length of stream made accessible by removing blockages (miles)	8.66
Noyo River	Upslope stream crossings treated, not for fish passage (number)	2
Noyo River	Watershed plans/assessments completed (number)	2
Noyo River	Workshop/training events (number)	1
Pudding Creek-Frontal Pacific Ocean	Area/footprint of instream features installed within bankfull channel (square feet)	16855
Pudding Creek-Frontal Pacific Ocean	Culverts installed or improved (number)	1
Pudding Creek-Frontal Pacific Ocean	Instream features installed/modified (number)	236
Pudding Creek-Frontal Pacific Ocean	Length of aquatic habitat disturbed (feet)	4615
Pudding Creek-Frontal Pacific Ocean	Length of road closed/abandoned (miles)	0.8
Pudding Creek-Frontal Pacific Ocean	Length of stream treated for channel structure placement (miles)	0.82

HUC 10	Metric	Amount
Pudding Creek-Frontal Pacific Ocean	Media materials prepared (number)	2
Pudding Creek-Frontal Pacific Ocean	Outreach/education events (number)	39
Pudding Creek-Frontal Pacific Ocean	Overall stream length treated, count one side of stream only (miles)	0.87
Pudding Creek-Frontal Pacific Ocean	Participants in workshop/training events (number)	200
Pudding Creek-Frontal Pacific Ocean	Road length treated (miles)	2.1
Pudding Creek-Frontal Pacific Ocean	Sediment volume prevented from entering stream (cubic yards)	2340
Pudding Creek-Frontal Pacific Ocean	Stream length made accessible by culvert installation/repair (miles)	0.63
Pudding Creek-Frontal Pacific Ocean	Total blockages/impediments/barriers removed/altered (number)	1
Pudding Creek-Frontal Pacific Ocean	Total length of instream habitat treated (miles)	0.82
Pudding Creek-Frontal Pacific Ocean	Total length of stream made accessible by removing blockages (miles)	0.63
Pudding Creek-Frontal Pacific Ocean	Upslope stream crossings treated, not for fish passage (number)	13
Pudding Creek-Frontal Pacific Ocean	Workshop/training events (number)	39
Ten Mile River	Amount of riparian area treated for invasive species (acres)	38
Ten Mile River	Area encompassed by planning/assessment (acres)	23.6
Ten Mile River	Area planted in riparian (acres)	8

HUC 10	Metric	Amount
Ten Mile River	Area/footprint of instream features installed within bankfull channel (square feet)	66530
Ten Mile River	Fence length installed/repaired, actual length of fence (miles)	4.83
Ten Mile River	Instream features installed/modified (number)	715
Ten Mile River	Length of aquatic habitat disturbed (feet)	18808
Ten Mile River	Length of riparian stream bank treated, count both sides of stream if applicable (miles)	2.8
Ten Mile River	Length of stream treated for channel structure placement (miles)	34.9712
Ten Mile River	Overall stream length treated, count one side of stream only (miles)	46.71
Ten Mile River	Plants planted (number)	3890
Ten Mile River	Pools created through channel structure placement (number)	21
Ten Mile River	Total amount of riparian area treated (acres)	38
Ten Mile River	Total length of instream habitat treated (miles)	29.3112

South Fork Eel Performance Metrics:

HUC 8	Metric	Amount
South Fork Eel	Amount of habitat assessed (acres)	5908.8
South Fork Eel	Amount of habitat assessed that needed restoration (acres)	740.8
South Fork Eel	Amount of habitat protected/restored/proposed as a result of this project (acres)	500
South Fork Eel	Amount of upland area treated (acres)	150.3037
South Fork Eel	Area encompassed by planning/assessment (acres)	85774.1
South Fork Eel	Area of slope stabilization structures installed (acres)	9.03
South Fork Eel	Area of water monitored (square miles)	101
South Fork Eel	Area planted in riparian (acres)	2.85365
South Fork Eel	Area/footprint of instream features installed within bankfull channel (square feet)	49256.2
South Fork Eel	Blockages/impediments/barriers impeding passage (number)	1
South Fork Eel	Bridges installed or improved (number)	1
South Fork Eel	Culverts installed or improved (number)	4
South Fork Eel	Description of the plan developed/implemented for engineering/design work for restoration projects	1
South Fork Eel	Different locations where signs/posters/exhibits displayed (number)	52
South Fork Eel	Erosion/sediment control installations (number)	15
South Fork Eel	Exhibits/posters prepared (number)	88
South Fork Eel	Fence length installed/repaired, actual length of fence (miles)	2.575
South Fork Eel	Instream features installed/modified (number)	455
South Fork Eel	Interpretive signs (number)	6

South Fork Eel	Landowners contacted (number)	8
South Fork Eel	Length of aquatic habitat disturbed (feet)	14969.7
South Fork Eel	Length of riparian stream bank treated, count both sides of stream if applicable (miles)	5.2149
South Fork Eel	Length of road closed/abandoned (miles)	12.8447
South Fork Eel	Length of road treated for drainage improvements/reconstruction (miles)	6.7449
South Fork Eel	Length of stream monitored for adult salmonids (miles)	901.38
South Fork Eel	Length of stream monitored for carcasses (miles)	86.38
South Fork Eel	Length of stream monitored for habitat condition (miles)	1.5
South Fork Eel	Length of stream monitored for redds (miles)	86.38
South Fork Eel	Length of stream monitored for salmonid smolt or fry (miles)	37
South Fork Eel	Length of stream treated for channel reconfiguration/connectivity (miles)	0.1
South Fork Eel	Length of stream treated for channel structure placement (miles)	15.82127
South Fork Eel	Length of streambank stabilized, count both sides of stream if applicable (miles)	2.67927
South Fork Eel	Media materials prepared (number)	51
South Fork Eel	Name of the plan developed/implemented for engineering/design work for restoration projects	1
South Fork Eel	Number of cooperating organizations (number)	23
South Fork Eel	Number of volunteers solicited as a result of this project (number)	154
South Fork Eel	Outreach/education documents completed and distributed (number)	3265
South Fork Eel	Outreach/education events (number)	22
South Fork Eel	Overall stream length treated, count one side of stream only (miles)	22.49777
South Fork Eel	Participants in workshop/training events (number)	2223

South Fork Eel	Plants planted (number)	14380
South Fork Eel	Pools created through channel structure placement (number)	68
South Fork Eel	Potential barriers assessed for passage status (number)	9
South Fork Eel	Reports prepared on key management or restoration data (number)	9
South Fork Eel	Restoration projects proposed (number)	3
South Fork Eel	Restoration projects proposed as a result of this project (number)	2
South Fork Eel	Road length assessed (miles)	501.25
South Fork Eel	Road length treated (miles)	16.348
South Fork Eel	Schools and other institutions reached (number)	419
South Fork Eel	Sediment volume prevented from entering stream (cubic yards)	158099.1037
South Fork Eel	Stream crossings assessed (number)	868
South Fork Eel	Stream length assessed (miles)	46.4125
South Fork Eel	Stream length assessed for regulatory actions (miles)	44.4
South Fork Eel	Stream length assessed that contained salmonids (miles)	44.4
South Fork Eel	Stream length assessed that needed restoration (miles)	44.4
South Fork Eel	Stream length made accessible by culvert installation/repair (miles)	1.02
South Fork Eel	Stream length monitored (miles)	1063.2
South Fork Eel	Stream length opened for fish passage by improving stream crossings (miles)	0.35
South Fork Eel	Stream sites monitored (number)	4
South Fork Eel	Students educated (number)	3909
South Fork Eel	Total amount of riparian area treated (acres)	43.81097
South Fork Eel	Total blockages/impediments/barriers removed/altered (number)	11

South Fork Eel	Total length of instream habitat treated (miles)	16.56117
South Fork Eel	Total length of stream made accessible by removing blockages (miles)	59.5085
South Fork Eel	Upslope stream crossings treated, not for fish passage (number)	118.6666
South Fork Eel	Value of donations for habitat restoration/conservation as a result of this project (dollars)	10000
South Fork Eel	Water gap installations (number)	2
South Fork Eel	Watershed area monitored (acres)	65000
South Fork Eel	Watershed plans/assessments completed (number)	9
South Fork Eel	Watersheds protected/restored/proposed as a result of this project (number)	1
South Fork Eel	Workshop/training events (number)	29

Appendix 2.

Recovery Strategy Tasks

The Recovery Strategy rates tasks with described levels, which reflect their urgency and priority. Task level-E is the highest level. These tasks are described as "must be implemented rapidly or early in the Coho Salmon recovery process because they are critical to recovery or they must precede tasks in levels D and C". Task level D includes tasks that "contribute directly to the stated recovery criteria or goals, or must be implemented if recovery criteria or goals are to be achieved". Task Level C contributes to 'stated recovery criteria or goals or will likely result in the delay of recovery if not implemented" (CDFG 2004).

Recovery Strategy Tasks for the Lagunitas Creek HSA as described in the Recovery Strategy. FRGP project types that address those tasks are listed where applicable. The implementation status of each task is either fully or partially implemented (Yes), not implemented (No), or not applicable (N/A) because FRGP project types do not support this task. Note that this status only reflects the progress made through FRGP funding and does not account for actions implemented through alternative funding.

Level	Number	Description	Project Type	Completed
E	BM-LA-01	Use recommendations of existing sediment source surveys to restore habitat of salmon.	HR, HU, HI, HS	Y
E	BM-LA-02	Expand inventories as needed for a comprehensive watershed approach for coho salmon passage.	PL, MO, PD	Y
D	BM-LA--03	Coordinate with appropriate agencies to restore coho salmon passage at barriers identified by Ross Taylor, SPAWN, and others.	HB, FP	Y
D	BM-LA-04	Complete any needed surveys of migration barriers that were not Identified by Ross Taylor, SPAWN, and others.	PL, MO	Y
C	BM-LA-05	Investigate opportunities for restoring historic runs of coho salmon.		N

Level	Number	Description	Project Type	Completed
C	BM-LA—06	Continue ongoing efforts and support of stewardship in the basin to include riparian enhancement and protection, sediment source reduction, habitat typing and surveying, coho salmon surveys and counts, water conservation, outreach and education, effectiveness monitoring of projects, and planning and assessment of potential restoration projects to benefit coho salmon.	HR, PL, HU,	Y
C	BM-LA-07	Provide incentives for septic inspection, repair, and replacement to reduce aquatic pollution.		N
C	BM-LA-08	Assess and evaluate habitat restoration actions in Nicasio Creek.	PL, MO	N
C	BM-LA—09	Implement habitat restoration actions in Nicasio Creek.	HI, HR, HS, HU	N
C	BM-LA-10	Develop a monitoring and assessment program for the estuarine reaches of Lagunitas Creek and inter-tidal reaches of Tomales Bay, looking at impacts to coho salmon rearing and emigration.		N
C	BM-LA-11	Restore Olema Marsh, Bear Valley Creek, and the mouth of Olema Creek, to benefit coho salmon. The restoration should provide rearing habitat refuge during high flows, habitat protection, and hydrologic connectivity between marshes.		N
C	BM-LA—12	Work with private landowners to encourage biotechnical bank stabilization, riparian protections, woody debris retention, and timing of water withdrawals to help protect coho salmon.	HI	Y

Level	Number	Description	Project Type	Completed
C	BM-LA-13	In the San Geronimo Creek sub-watershed, continue public outreach and education for private landowners, residents, commercial, public utility and county workers regarding best management practices to control erosion, protect riparian vegetation, retain LWD, and minimize disturbance to coho salmon from domestic animals.	PI, ED, TE	N
D	BM-LA-14	In the San Geronimo Creek sub-watershed, work with stock pond owners to remove non-native fish species where they are a threat to coho salmon.		N
D	BM-LA—15	Marin County should develop a policy for reviewing the impacts of new development projects and how new well construction effects the streams. The County should consider adopting recommendations for well developments from the local coastal plan.		N
C	BM-LA-16	Recommend the NPS continue practices to benefit coho salmon, which include restoration projects, sediment control projects, locating fences out of riparian zones, repairing headcut gullies as possible, and implementing rotational grazing in locations to minimize erosion and impacts to the creek.		N/A
C	BM-LA-17	Continue to implement and coordinate the the Watershed Protection Agreement Program for additional water hook-ups in Nicasio and San Geronimo creek watersheds.		N

Level	Number	Description	Project Type	Completed
C	BM-LA—18	Look for opportunities to restore natural channel form and function in the upper watershed to protect summer flows into San Geronimo Creek.	PL. HI	Y
C	BM-LA-19	Continue riparian protection and sediment control projects with a focus on working with landowners to manage livestock to protect riparian areas, and to implement erosion control projects on State and Federal park and private lands (e.g., Devil's Gulch).	HS, HU, HR	Y
C	BM-LA-20	Continue public outreach and education for private landowners, residents, commercial, public utility and county workers regarding best management practices to control erosion, protect riparian vegetation, retain woody debris, and minimize disturbance to coho salmon from pets.	ED, PI, TE	N
C	BM-LA--21	Determine policy for reviewing new development projects and well construction. Consider adopting recommendations for well developments from the Coastal Plan.		N/A

Recovery Strategy tasks for the Russian River Hydrologic Unit, level, task number, description, project type and implementation (Y/N) within the four focus streams from 2004 to 2018. GVC = Green Valley Creek, DBC = Dutch Bill Creek, WC = Willow Creek, and MC = Mill Creek Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	GVC	DBC	WC	MC
C	RR-HU-01	Upgrade the Russian River Basin Plan to benefit Coho Salmon.	-	N	N	N	N
E	RR-HU-02	Identify water diverters.	WC, PL	Y	Y	N/A	Y
C	RR-HU-03	Review, and modify if necessary, water use based on the needs of Coho Salmon and authorized diverters.	WC	N	Y	N	N
E	RR-HU-04	Assess, prioritize, and develop plans to treat barriers to Coho Salmon passage in all HSAs.	PL, PD, FB, HB	Y	Y	Y	Y
D	RR-HU-05	Treat barriers to Coho Salmon passage.	FB, HB	Y	Y	Y	Y
E	RR-HU-06	Assess riparian canopy and impacts of exotic vegetation (e.g. *Arundo donax*), prioritize, and develop riparian habitat reclamation and enhancement programs	-	N	N	N	N
C	RR-HU-07	If appropriate, control exotic vegetation (especially *Arundo donax*).	-	N	N	N	N
C	RR-HU-08	Restore and enhance priority riparian habitat.	HR	Y	Y	Y	Y
C	RR-HU-09	Implement the Sotoyome Resource Conservation District's Fish Friendly Farming Program within Sonoma and Mendocino counties.	-	N	N	N	N

Level	Number	Description	Project Type	GVC	DBC	WC	MC
E	RR-HU-10	Continue genetic analysis of source stocks for Coho Salmon broodstock.	-	N	N	N	N
D	RR-HU-11	Stock first the priority streams missing Coho Salmon, including Felta and Mill creeks (tributary to Dry Creek west of Healdsburg), Freezeout, Willow and Sheephouse creeks (near Duncans Mills), and Ward Creek (tributary to Austin Creek). Identify additional streams that may be suitable for stocking as restoration occurs.	Y	N/A	N/A	Y	Y
E	RR-HU-12	Identify additional streams that may be suitable for stocking Coho Salmon.	-	N	N	N	N
C	RR-HU-13	Develop and implement a monitoring and evaluation program to adaptively manage the Coho Salmon broodstock program and meet high and medium priority monitoring objectives as outlined in the Coho Salmon HGMP.	MO	Y	Y	Y	Y
C	RR-HU-14	Review and revise long-term hatchery program goals based on results of the monitoring and evaluation program implemented in the experimental captive broodstock program.	MD	Y	Y	Y	Y
C	RR-HU-15	Develop and implement protocols for controlling Pierce's Disease to maintain native riparian corridor.	-	N	N	N	N

Level	Number	Description	Project Type	GVC	DBC	WC	MC
C	RR-HU-16	Develop an outreach program for controlling Pierce's Disease.	-	N	N	N	N
C	RR-HU-17	Evaluate recommendations to offset impacts from county policies and Operations, as developed by the FishNet 4C program in their report. Effects of County Land Use Policies and Management Practices on Anadromous Salmonids and their habitat.	-	N	N	N	N
E	RR-HU-18	Review and revise long-term hatchery program goals based on results of the monitoring and evaluation program implemented in the experimental captive broodstock program.	-	N	N	N	N
C	RR-HU-19	Implement appropriate recommendations to offset impacts from county policies and operations, as developed by the Fish Net program.	-	N	N	N	N
E	RR-HU-20	Evaluate recommendations to offset impacts from county policies and operations, as developed by the Five County effort.	-	N	N	N	N
C	RR-HU-21	Implement appropriate recommendations to offset impacts from county policies and operations, as developed by the Five County effort.	-	N	N	N	N

Level	Number	Description	Project Type	GVC	DBC	WC	MC
C	RR-HU-22	Develop a grading ordinance and grading and erosion control standards to minimize sediment impacts to Coho Salmon habitat.	-	N	N	N	N
E	RR-HU-23	Restore Coho Salmon passage at county structures on all streams inhabited by Coho Salmon, as identified in the Russian River Fish Passage Assessment report.	FP	Y	Y	Y	Y
E	RR-HU-24	Expand Coho Salmon passage barrier inventories as needed to use a comprehensive watershed approach improving Coho Salmon passage.	PL, FP, HB	Y	Y	Y	Y
C	RR-HU-25	Integrate Coho Salmon passage projects at county facilities with Coho Salmon passage improvements involving other landowners, throughout targeted Coho Salmon watersheds.	PL, FP, HB	Y	Y	Y	Y
E	RR-HU-26	Review and, if appropriate, approve Guidelines for Protecting Aquatic Habitat and Salmon Fisheries for County Road Maintenance (FishNet 4C 2004).	-	N	N	N	N
C	RR-HU-27	Implement any best management practices pertinent to Coho Salmon recovery in Guidelines for Protecting Aquatic Habitat and Salmon Fisheries for County road Maintenance (FishNet 4C 2004).	-	N	N	N	N

Level	Number	Description	Project Type	GVC	DBC	WC	MC
E	RR-HU-28	Review the Five County Roads Manual.	-	N	N	N	N
C	RR-HU-29	Implement any practices pertinent to Coho Salmon recovery in the Five County Roads Manual.	-	N	N	N	N
D	RR-HU-30	Reduce native riparian vegetation clearing and sediment removal adjacent to and in anadromous Coho Salmon streams.	HR	Y	Y	Y	Y
D	RR-HU-31	Retain LWD within streams to the extent possible.	HI	Y	Y	Y	Y
C	RR-HU-32	Store and make available woody material removed from streams for stream enhancement projects benefitting Coho Salmon.	HI	Y	Y	Y	Y
C	RR-HU-33	Promote alternatives to conventional bank stabilization for public and private projects including bioengineering techniques.	HB	Y	Y	Y	Y
E	RR-HU-34	Review development set-backs for adequacy in protecting key streams inhabited by Coho Salmon.	-	N	N	N	N
E	RR-HU-35	If appropriate, revise development set-backs to adequately protect key streams inhabited by Coho Salmon.	-	N	N	N	N
E	RR-HU-36	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	-	N	N	N	N
D	RR-HU-37	Implement streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	-	N	N	N	N

Level	Number	Description	Project Type	GVC	DBC	WC	MC
E	RR-HU-38	Inventory, evaluate, and prioritize problems roads which contribute sediment to streams inhabited by Coho Salmon.	PL, HU	Y	Y	Y	Y
D	RR-HU-39	Fix problem roads which contribute sediment to streams inhabited by Coho Salmon.	HU	Y	Y	Y	Y
E	RR-HU-40	Support efforts and develop county, city, and other local programs to protect and increase instream flows for Coho Salmon.	-	N	N	N	N
D	RR-HU-41	Develop and implement programs to protect and increase instream flows for Coho Salmon.	WC, PL	N	Y	N	N
C	RR-HU-42	Participate in regional water management planning through the general plan process and in other venues as appropriate.	PL	N	Y	N	N

Recovery Strategy tasks for the Guerneville Hydrologic Sub-Area, level, task number, description, project type, and implementation (Y/N). GVC = Green Valley Creek, DBC = Dutch Bill Creek, and WC = Willow Creek from 2004 to 2018. Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Task	Description	Project Types	GVC	DBC	WC
C	RR-GU-01	Encourage local agencies to implement recommendations of completed non-point source sediment assessments.	-	N	N	N
C	RR-GU-02	Implement recommendations of completed non-point source sediment assessments.	-	N	N	N
E	RR-GU-03	Assess and prioritize sources of excess sediment.	PL, HU	Y	Y	Y
C	RR-GU-04	Treat priority sources of excess sediment.	HU	Y	Y	Y
C	RR-GU-05	Stock Willow, Sheephouse, Freezeout, Dutch Bill and Green Valley creeks as part of the Coho Salmon broodstock program.	MO	Y	Y	Y
C	RR-GU-06	From willing Landowners, acquire conservation easements or fee-title of habitat essential for Coho Salmon.	-	N	N	N
E	RR-GU-07	Identify water diverters.	PL	Y	Y	N
E	RR-GU-08	Request that the SWRCB review and/or modify water use based on the needs of Coho Salmon and authorized diverters.	-	N	N	N
E	RR-GU-09	Monitor, identify problems, and prioritize needs for changes to water diversion on current or potential Coho streams that go dry in some years, in particular Green Valley and Dutch Bill creeks.	WC, PL	Y	Y	N

Level	Task	Description	Project Types	GVC	DBC	WC
C	RR-GU-10	Remedy priority water diversion problems for current or potential Coho streams that go dry in some years.	WC, PD	N	Y	N

Recovery Strategy tasks for the Warm Springs Hydrologic Sub-Area, level, task number, description, project type, and implementation (Y/N) in Mill Creek from 2004 and 2018. MC = Mill Creek, Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Task	Description	Project Types	MC
E	RR-WS-01	Develop plans to improve riparian vegetation in Dry Creek and its tributaries.	-	N
C	RR-WS-02	Implement riparian vegetation improvement plans.	-	N
C	RR-WS-03	Implement Sotoyome Resource Conservation District's Fish Friendly Farming Program.	-	N
C	RR-WS-04	Use land-use planning and conservation easements with willing landowners, to protect riparian vegetation.	-	N
C	RR-WS-05	Support implementation of measures to modify flows in Dry Creek to provide summer rearing habitat for coho salmon.	-	N
D	RR-WS-06	Modify flows in Dry Creek to provide summer rearing habitat for coho salmon.	-	N
C	RR-WS-07	Stock high-priority barren streams, such as Mill and Felta creeks, as part of the coho salmon broodstock program.	-	N
C	RR-WS-08	Review and develop preferred protocols for Pierce's Disease Control that would maintain a native riparian corridor and develop an outreach program.	-	N
E	RR-WS-09	Assess, prioritize, and develop plans to treat sources of excess sediment.	PL, PD, HU	Y
C	RR-WS-10	Treat high-priority sources of excess sediment.	HU	Y
D	RR-WS-11	Increase habitat structure and complexity in Dry Creek to enhance habitat diversity, including depositional areas for spawning gravels for coho salmon (E.g., place LWD or large boulders.	HI	Y

Recovery Strategy tasks for the Mendocino Coast Hydrologic Unit, level, task number, description, project type and implementation (Y/N) within the four focus streams from 2004 to 2018. GAR = Garcia River, NAV = Navarro River, NOY = Noyo River, and TEN = Ten Mile River Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
E	MC-HU-01	Update general plans to include measures to protect Coho salmon.	PL	Y	Y	Y	Y
C	MC-HU-02	Provide technical and staff support to update general plans to include measures to protect Coho salmon.	PL	Y	Y	Y	Y
D	MC-HU-03	Where development would adversely affect Coho salmon, limit development in the 100-year floodplain.	PL, PD	Y	Y	Y	N
C	MC-HU-04	Recommend Mendocino and Sonoma counties to adopt county grading ordinances.	-	N	N	N	N
C	MC-HU-05	Adopt county grading ordinances.	-	N	N	N	N
C	MC-HU-06	Recommend to Mendocino county to expand the CEQA checklist to include Coho salmon.	-	N	N	N	N
C	MC-HU-07	Include Coho salmon in CEQA checklist.	-	N	N	N	N
E	MC-HU-08	Maintain current LWD, boulders, and other features to maintain current stream complexity and pool frequency and depth.	HR, HS, PL	Y	Y	Y	Y
D	MC-HU-09	Install LWD, boulders, and other features to increase stream complexity and improve pool frequency and depth.	HR, HS, PL	Y	Y	Y	Y

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
D	MC-HU-10	Restore riparian vegetation and promote conifer recruitment for shade and for LWD recruitment to increase stream complexity.	HR, HS, PL	Y	Y	Y	Y
E	MC-HU-11	Assess, prioritize, and treat sediment sources at an HAS level.	HS	Y	Y	N	N
E	MC-HU-12	Determine site-specific recommendations, including incentives, to remedy high temperatures.	HU	Y	Y	Y	N
D	MC-HU-13	Implement recommendations to remedy high temperature.	PD	Y	Y	Y	Y
E	MC-HU-14	Map unstable soils.	-	N	N	N	N
C	MC-HU-15	Use soil mapping to guide land-use decisions, road design, THPs, and other activities that can promote erosion.	-	N	N	N	N
C	MC-HU-16	Provide education and training on water diversion practices.	TE	Y	N	Y	N
C	MC-HU-17	Ensure compliance with pertinent regulations on water diversion practices.	PL	Y	Y	Y	N
E	MC-HU-18	Continue to treat existing upslope sediment to improve pool frequency and depth and decrease sediment load.	HS ,HU	Y	Y	Y	N
E	MC-HU-19	Avoid or minimize land fragmentation or conversion to more intensive uses to maintain pool frequency and depth.	HR, HI, HU, PL	Y	Y	Y	Y

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
C	MC-HU-20	Cooperate with and provide incentives to Landowners to maintain road and trail closures to be effective against trespass and discourage poaching of coho salmon.	-	N	N	N	N
C	MC-HU-21	Monitor road closures to discourage poaching of coho salmon.	-	N	N	N	N
C	MC-HU-22	Repair defective or damaged roads to discourage poaching of coho salmon.	-	N	N	N	N
D	MC-HU-23	Promote CalTIP, especially with regard to coho salmon spawning sites, to discourage poaching of coho salmon.	-	N	N	N	N
E	MC-HU-24	Investigate the desirability and feasibility of beaver reintroductions to promote channel complexity and provide rearing habitat.	-	N	N	N	N
C	MC-HU-25	If appropriate, reintroduce beavers to promote channel complexity and provide rearing habitat.	-	N	N	N	N
C	MC-HU-26	Increase efforts to control alders, blackberries, and other competitors to restore LWD recruitment and shade.	-	N	N	N	N
C	MC-HU-27	Provide incentives to landowners, such as technical support, to increase efforts to restore LWD recruitment and shade.	-	N	N	N	N

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
D	MC-HU-28	Avoid or minimize increases in water use to maintain or improve instream flows.	OR	N	Y	N	N
D	MC-HU-29	Provide incentives to remove or convert direct diversions to off-stream storage to maintain or improve instream flow.	WC, PL	Y	Y	N	N
C	MC-HU-30	Restrict the season of diversion to December through March to maintain or improve instream flows.	-	N	N	N	N
E	MC-HU-31	Cooperatively evaluate the rate, location, and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon.	-	N	N	N	N
D	MC-HU-32	When feasible, use alternatives to water as a dust palliative that are consistent with maintaining or improving water quality. Consider existing regulations or other mechanisms when evaluating alternative to water as a dust palliative (including EPA certified compounds) that are consistent with maintaining or improving water quality.	-	N	N	N	N

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
D	MC-HU-33	Maintain or re-establish geographic distribution of coho salmon by allocating substantial improvement efforts towards identified biological refugia, spawning coho salmon populations, suitable habitat accessible to coho salmon.	HI, HU, PL, PD	Y	Y	Y	Y
C	MC-HU-34	Coordinate with RWQCB to implement water quality monitoring of coho salmon habitat restoration projects.	-	N	N	N	N
C	MC-HU-35	Streamline permitting of coho salmon habitat restoration projects.	-	N	N	N	N
E	MC-HU-36	Encourage funding authorities to allocate adequate resources to prioritize and upgrade culverts to provide coho salmon passage within the range of coho salmon to pass 100-year flows and the expected debris loads.	PL	Y	Y	Y	N
E	MC-HU-37	Adequately fund prioritization and upgrading of culverts to provide coho salmon passage within the range of coho salmon to pass 100-year flows and the expected debris loads.	FP	N	Y	Y	N

Level	Number	Description	Project Type	GAR	NAV	NOY	TEN
E	MC-HU-38	Identify areas of increased risk of mass wasting and fine sediment loads to decrease sediment from transportation projects and land management activities.	HU, OR	Y	Y	Y	N
D	MC-HU-39	Implement appropriate measures or mitigation for mass wasting.	HU, PL, OR	Y	Y	Y	N
E	MC-HU-40	Abandon riparian road systems and/or upgrade roads and skid trails that deliver sediment to adjacent watercourses to decrease fine sediment loads.	PL, PD	Y	Y	Y	Y
E	MC-HU-41	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	PL, PD, OR	Y	Y	Y	Y
E	MC-HU-42	Minimize the density of road and trail crossings of watercourses.	PL, PD	Y	Y	Y	Y
E	MC-HU-43	Wherever feasible, out-slope roads with rolling dips to decrease fine sediment loads.	PL	Y	Y	Y	N
E	MC-HU-44	Identify and modify road maintenance activities that generate fine sediment to decrease fine sediment loads.	PL, PD, HU	Y	Y	Y	Y
C	MC-HU-45	Develop erosion control projects similar to the North Fork Ten Mile River erosion control plan.	PL, PD	Y	Y	Y	Y

Recovery Strategy tasks for the Garcia River, level, task number, description, project type, and implementation (Y/N) from 2004 and 2018. Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	Y/N
D	MC-GA-01	Establish connectivity of North Fork Garcia River to the mainstem.	-	N
C	MC-GA-02	Provide technical assistance and incentives to Garcia River Landowners for developing and implementing sediment reduction plans to meet the requirements of the CWA TMDL.	PL	Y
C	MC-GA-03	Utilize as a model for erosion reduction and LWD placement the comprehensive approach practiced in the South Fork of the Garcia River.	-	N
C	MC-GA-04	Investigate stream nutrient enrichment and cycling needs for coho salmon.	-	N
E	MC-GA-05	Apply the Garcia River Estuary Enhancement Feasibility Study Report to investigate coho salmon in the Garcia River estuary, as well as new information, to consider restoring estuary functions that would benefit coho salmon.	-	N
D	MC-GA-06	If appropriate, restore estuary function to benefit coho salmon.	-	N
C	MC-GA-07	Coordinate LWD placement in streams with logging operations and road upgrades to maximize size, quality, and efficiency of effort.	HI	Y
D	MC-GA-08	Maintain Hathaway Creek, North Fork Garcia, Rolling Brook, Mill Creek (lower Garcia River), South Fork Garcia, Signal, Mill Creek (upper Garcia River) to continue to provide coldwater input to the mainstem Garcia.	HI, WC, HR, HU	Y
C	MC-GA-09	Plant conifers in riparian zone of Blue Waterhole, Inman and Pardaloe creeks to reduce instream temperatures and inputs into the mainstem and conifer LWD recruitment.	HS	Y

Level	Number	Description	Project Type	Y/N
C	MC-GA-10	Encourage, when necessary and appropriate, restricted access to unpaved roads in winter to reduce road degradation and sediment release. Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching coho salmon streams.	-	N
D	MC-GA-11	Where necessary and with willing landowners, protect riparian vegetation buffer zones through conservation planning, acquisition, and easements.	PL	Y
D	MC-GA-12	Excavate a geomorphically designed stream channel in the lower North Fork Garcia River to rectify subsurface flow during summer months and prevent coho salmon stranding.	-	N
E	MC-GA-13	Rescue juvenile coho salmon until subsurface summer flows are rectified.	-	N
C	MC-GA-14	Work with landowners to plant conifers in the lower mainstem Garcia River from Eureka Hill road Bridge to Windy Hollow road with the goal of reducing stream temperature, providing bank stability and long-term LWD.	PL	Y
E	MC-GA-15	Evaluate the value to coho salmon of projects to open logjam migration barriers in the North Fork, South Fork, and Fleming Creek.	PL	Y
D	MC-GA-16	If appropriate, open logjam barriers to coho salmon migration in the North Fork, South Fork, and Fleming Creek.	PL	Y
C	MC-GA-17	Complete the remaining 25% of erosion control sites, identified in the South Fork Garcia River by the Trout Unlimited North Coast Coho Salmon Project.	-	N
C	MC-GA-18	Where appropriate and with willing landowners, place LWD in Inman Creek, South Fork Garcia River, Signal Creek, and North Fork Garcia River.	HS, PD	Y

Level	Number	Description	Project Type	Y/N
C	MC-GA-19	Where appropriate and with willing landowners, plant redwood trees in the lower seven miles of the Garcia River mainstem between Eureka Hill road and Windy Hollow road to provide for LWD recruitment and bank stability and to reduce instream temperatures.	PL	Y

Recovery Strategy tasks for the Navarro River, level, task number, description, project type, and implementation (Y/N) from 2004 and 2018. Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	Y/N
C	MC-NA-01	Investigate stream nutrient enrichment and cycling needs for coho salmon.	PL	Y
D	MC-NA-02	Pay particular attention to Implementing actions regarding LWD and shade that are suggested at the HU level.	PL	Y
C	MC-NA-03	Prioritize enforcement of pertinent laws concerning illegal and unpermitted dams and diversions.	-	N
C	MC-NA-04	Conserve water by providing land-owners education, incentives, and technical assistance.	PL	Y
E	MC-NA-05	Implement comprehensive, subbasin-wide erosion control and LWD installation for Flynn, Dutch Henry, John Smith, Minnie, Horse Camp and German creeks such as is being implemented on Little North Fork.	OR	Y
C	MC-NA-06	Provide technical assistance and incentives to Navarro River landowners for developing and implementing sediment reduction plans to meet the requirements of the CWA TMDL.	-	N
C	MC-NA-07	Coordinate LWD placement in streams with logging operations and road upgrades to maximize size, quality, and efficiency of effort.	HI, HU	Y
C	MC-NA-08	Where necessary and with willing landowners, protect riparian vegetation buffer zones through conservation planning, acquisition, and easements.	-	N
C	MC-NA-09	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching coho salmon streams.	-	N

Recovery Strategy tasks for the Noyo River, level, task number, description, project type, and implementation (Y/N) from 2004 and 2018. Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	Y/N
E	MC-NO-01	Investigate the role of the Pudding Creek Dam impoundment in coho migration and freshwater survival rate.	-	N
C	MC-NO-02	If appropriate, repair the Pudding Creek Dam.	-	N
C	MC-NO-03	Implement actions of a sediment reduction plan to improve water quality.	PL	Y
E	MC-NO-04	Fund activities to address barriers to coho salmon passage on the California Western Railway right-of-way.	-	N
D	MC-NO-05	Remove barriers to coho salmon passage on the California Western Railway right-of-way.	PD	Y
C	MC-NO-06	Evaluate the biological justification for the egg-taking station on the South Fork Noyo River.	-	N

Recovery Strategy tasks for Ten Mile River, level, task number, description, project type, and implementation (Y/N) from 2004 and 2018. Y = task implemented partially or completely with FRGP funds. N = task not addressed with FRGP funds. (note: task could have been addressed with alternate funding).

Level	Number	Description	Project Type	Y/N
E	MC-TM-01	Complete erosion control on the North Fork Ten Mile River.	-	N
C	MC-TM-02	Where necessary and with willing landowners, protect riparian vegetation buffer zones through conservation planning, acquisition, and easements.	PD	Y
C	MC-TM-03	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching coho salmon streams.	-	N
C	MC-TM-04	Provide technical assistance and incentives to Ten Mile River landowners for developing and implementing sediment reduction plans to meet the requirements of the CWA TMDL.	-	N
C	MC-TM-05	Coordinate LWD placement in streams with logging operations and road upgrades to maximize the size, quality, and efficiency of effort.	HI	Y

Recovery Strategy Tasks for the South Fork Eel River for each of the three hydrologic subareas (HSAs) of the South Fork Eel River as described in the Recovery Strategy (Benbow (BE), Laytonville (LA), and Weott (WE)). FRGP project types that address those tasks are listed where applicable. The implementation status of each task is either fully or partially implemented (Yes), not implemented (No), or not applicable (N/A) because FRGP project types do not support this task. Note that this status only reflects the progress made through FRGP funding and does not account for actions implemented through alternative funding.

Level	Number	Description	FRGP Project Type	Implementation
D	ER-BE-01	Support watershed assessment	PL	Y
C	ER-BE-02	Request CDF monitor non-industrial timber management plans	-	N/A
D	ER-BE-03	Supplement on-going efforts to provide short-term and long-term benefits to Coho Salmon by restoring LWD and Shade	HR, HI	Y
E	ER-BE-04	Assess and prioritize sediment sources, including roads	PL	Y
D	ER-BE-05	Treat prioritized sediment sources, including roads	HU	Y
D	ER-LA-01	Continue watershed restoration efforts, including measures to reduce temperatures in Ten Mile Creek	HU, HI, HR, HS	Y
E	ER-LA-02	Prioritize culverts on county roads that are Coho Salmon barriers	PL	N
D	ER-LA-03	Treat culverts on county roads that are Coho Salmon barriers	FP	Y

Level	Number	Description	FRGP Project Type	Implementation
E	ER-LA-04	Work with the county to coordinate with landowners on the removal of Coho Salmon barriers on private property	OR, HB, FP	N
C	ER-LA-05	Support efforts by the county sheriff to enforce laws against illegal dumping and the Department of Health to clean up dumped materials	EF	N
D	ER-LA-06	Recommend that cities, counties, and Caltrans adopt maintenance manuals that protect Coho Salmon habitat	PI	N
E	ER-LA-07	Minimize and reduce the effects of water diversions	WC	N
D	ER-LA-08	Supplement on-going efforts to provide short-term and long-term benefits to Coho Salmon by restoring LWD and Shade	HR, HI	Y
E	ER-LA-09	Assess and prioritize sediment sources, including roads	PL	Y
D	ER-LA-10	Treat prioritized sediment sources, including roads	HU	Y
C	ER-WE-01	Complete storm proofing of the Bull Creek watershed	HU, HI, HS	Y

Level	Number	Description	FRGP Project Type	Implementation
C	ER-WE-02	Continue to implement the planting of trees and other habitat enhancement as necessary in the Bull and Salmon Creek watersheds	HU, HR	Y
E	ER-WE-03	Assess and prioritize barriers to Coho Salmon passage along the Ave. of the Giants	PL	N
D	ER-WE-04	Treat the prioritized culverts that are barriers to Coho Salmon passage along the Ave. of the Giants	FP, HB	N
E	ER-WE-05	Supplement on-going efforts to provide short-term and long-term benefits to Coho Salmon by restoring LWD and Shade	HI, HR	Y
E	ER-WE-06	Assess and prioritize sediment sources, including roads	PL	Y
D	ER-WE-07	Treat prioritized sediment sources, including roads	HU	Y