Recovery Strategy for California Coho Salmon
Progress Report
2004 – 2012

A Report Prepared for
California Fish and Game Commission
by
California Department of Fish and Wildlife

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EXECUTIVE SUMMARY

Coho salmon (*Oncorhynchus kisutch*) in the Central California Coast Evolutionarily Significant Unit (CCC ESU) and the Southern Oregon Northern California Coast Evolutionarily Significant Unit (SONCC ESU) are listed as endangered and threatened, respectively, under both the federal Endangered Species Act and the state California Endangered Species Act. This report summarizes progress made in implementing the *Recovery Strategy for California Coho Salmon (Recovery Strategy)* since it was produced in 2004 by California Department of Fish and Wildlife (Department)[1].

The *Recovery Strategy* provides a list of recovery goals, delisting criteria, and a detailed list of range-wide and watershed restoration recommendations to achieve recovery of coho salmon populations. The document includes over 85 range-wide recommendations, 320 watershed recommendations for the SONCC coho salmon ESU, 205 watershed recommendations for the CCC coho salmon ESU, and 145 watershed recommendations for the Shasta-Scott Pilot Program.

The restoration and enhancement of suitable habitat conditions for juvenile rearing and survival and adult reproduction in both freshwater and estuarine environments has been the main focus for coho salmon recovery programs in both the CCC and SONCC ESUs. The Department has funded and also undertaken extensive habitat restoration for coho salmon recovery throughout their geographic range. In addition, many other agencies and organizations have been involved with habitat restoration projects for the recovery of California coho salmon populations.

Since 1981, the Department, together with NOAA Fisheries, has administered the Fisheries Restoration Grants Program (FRGP), funded through the Pacific Coastal Salmon Recovery Fund (PCSRF). The program has approved and funded anadromous salmonid restoration and recovery projects in coastal watersheds throughout northern and central California. The FRGP is a collaborative effort involving more than 600 stakeholders that focuses on restoring fish habitat conditions in order to ensure the survival and protection of anadromous salmon and steelhead trout in California's coastal watersheds.

From 2004 to 2012, FRGP has allocated a total expenditure of approximately $100 million to coho salmon recovery projects in California. During this period a total of 433 FRGP-funded projects benefiting coho salmon recovery was completed, addressing 287 recovery tasks, listed in the 2004 *Recovery Strategy*. These projects include a wide range of recovery activities carried out in both ESUs over the reporting period. The main types of recovery actions undertaken include; i) restoration of suitable freshwater and estuarine habitat conditions for both juveniles and adults, ii) improvements in permitting and regulatory enforcement, iii) continued operation of captive rearing programs at Warm Springs and Kingfisher Flat conservation hatcheries, and iv) implementation of

[1] Formerly California Department of Fish and Game

range-wide and watershed-wide recommendations listed in the *Recovery Strategy*. The following table summarizes the types and amounts of restoration activities performed through FRGP funded projects from 2004 to 2012.

Table ES1. FRGP Funded Projects from 2004 to 2012

Project Type	Metric	Quantity
Fish Passage Improvement	Number of blockages removed	118
Fish Passage Improvement	Miles of stream opened	209
Fish Screening Projects	Number of fish screens installed/replaced	92
Instream Habitat Improvement	Total miles of stream treated	223
Riparian Habitat Improvement	Miles of riparian bank treated	149
Riparian Habitat Improvement	Acres of riparian area treated	1,467
Upland Habitat Improvement	Acres of upland area treated	4,117
Upland Habitat Improvement	Miles of road treated	462
Monitoring	Miles of stream monitored	1,578
Fish rearing	Number of hatchery fry/smolt released	182,675
Organizational Support	Number of watershed plans/assessments completed	196

Coho salmon habitat restoration and species recovery work is also undertaken in California by a wide range of other agencies and organizations. Examples include landowners and watershed groups, sport fishing organizations, non-governmental environmental groups (NGOs), Native American Tribes, timber companies, and Resource Conservation Districts (RCDs).

Recovery of coho salmon requires monitoring their population numbers at critical life stages in selected streams throughout the two ESUs. Juvenile and adult coho salmon are monitored in 23 streams and tributaries (10 in CCC ESU and 13 in the SONCC ESU) by the Department and other organizations. Juveniles are generally monitored by

trapping, electrofishing or direct observation (snorkeling), while adults may be monitored by trapping, video or sonar monitoring at weirs, carcass or redd counts, and direct observation.

Despite considerable restoration efforts and expenditures, the numbers of adult coho salmon in monitored streams in the SONCC and CCC ESUs have declined since 2004. However, since 2009 many streams have experienced a slight increase in coho numbers from the low points during the reporting period. Coho salmon in northern coastal streams are relatively more numerous than in southern streams, but northern populations are also experiencing declines in population size.

The overall picture of coho salmon in California is one of severely depleted populations. The main factors and threats affecting population viability of coho salmon, as listed in the *Recovery Strategy*, have not changed substantially over the reporting period. The ongoing population declines are thought to be largely attributable to human causes, such as water diversions, stream flow regulation, forestry and man-made barriers affecting migration. Of particular concern is the loss and degradation of suitable freshwater and estuarine habitat conditions for juvenile rearing and adult reproduction.

However, in recent years, the primary causes of population decline have been compounded by natural environmental factors, specifically poor ocean conditions in 2005 and 2006, which led to low adult survival in the marine environment and poor returns in both 2006-07 and 2007-08. In addition, recent ongoing drought conditions have further hampered population recovery through the adverse effects of low flow conditions on adult spawning and juvenile survival in coastal watersheds.

The degradation of coho salmon habitat and the resulting decline in population numbers has occurred over many decades. The positive effects of habitat restoration, as measured by increased fish distribution and abundance, are usually associated with a time lag of several years, even for robust populations, and probably longer where populations are at low numbers. Therefore, one should expect ongoing restoration efforts and the accompanying results to be a long-term process.

Of more immediate concern is the prevention of further population extirpations of coho salmon in California coastal watersheds. In this regard, range and watershed-wide recovery activities need to be expanded, and implementation of recovery efforts intensified and accelerated, especially in critical watersheds.

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Chapter 1. Introduction

1.1 Coho Salmon Status Reviews, California Endangered Species Act and Federal Endangered Species Act Listings

In 1995, the California Department of Fish and Wildlife (Department)[2] submitted to the California Fish and Game Commission (Commission) the *Status Review of Coho Salmon (Oncorhynchus kisutch) in California South of San Francisco Bay* (Anderson, 1995). The Department concluded that coho salmon south of San Francisco Bay were in danger of extinction because these southern populations had declined by over 98 percent from historical levels. Additionally, these populations would continue to decline near a point of extinction in the near future due to numerous factors.

The Department's status review indicated that uplisting from *threatened* to *endangered* was warranted. This determination was based on the best available scientific information regarding the distribution, abundance, biology and threats to coho salmon south of San Francisco Bay.

In April 2002, the Department submitted to the Commission, the *Status Review of California Coho Salmon North of San Francisco* (CDFG 2002). This review provided a detailed overview of the status of coho salmon populations, factors affecting their viability and influences of existing management efforts. The report concluded that California coho salmon had experienced significant declines in the past 40 to 50 years and that populations have been individually and cumulatively depleted or extirpated. It was further concluded that connectivity between populations was fragmented or severed.

The 2002 *Status Review* concluded that the listing of the California portion of the Southern Oregon Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU) as *endangered* was not warranted, but a listing as *threatened* was warranted. The Department recommended that the Commission add coho salmon north of Punta Gorda to the list of *threatened* species.

In 2005, the Commission, under the California Endangered Species Act (CESA), listed coho salmon in the California Central Coast (CCC) ESU as *endangered* and coho salmon in the SONCC ESU as *threatened*. In 2005, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) under the Federal Endangered Species Act (ESA) uplisted coho salmon in the CCC ESU from *threatened* status to *endangered*, while retaining the 1997 ESA listing of coho salmon in the SONCC ESU as *threatened*.

[2] Formerly the California Department of Fish and Game.

1.2 The Recovery Strategy for California Coho Salmon

In February 2004, the Department, in response to a directive from the Commission, produced the *Recovery Strategy for California Coho Salmon* (*Recovery Strategy*) (CDFG 2004). The *Recovery Strategy* provides a list of recovery goals, delisting criteria, and a detailed list of range-wide and watershed restoration recommendations to achieve recovery of coho salmon populations. The document includes over 85 range-wide recommendations, 320 watershed recommendations for the SONCC coho salmon ESU, 205 watershed recommendations for the CCC coho salmon ESU, and 145 watershed recommendations for the Shasta-Scott Pilot Program (see Section 1.5).

The primary objective of the *Recovery Strategy* is to identify tasks that when implemented will return coho salmon to a level of sustained viability, while protecting the genetic integrity of coho salmon in both ESUs. The ultimate goal of the *Recovery Strategy* is to delist the species so that protections under CESA will not be necessary. The Department defines “sustained viability” as a condition when naturally producing coho salmon are adequately abundant and occupy a sufficient range and distribution to ensure against extinction due to environmental fluctuations, stochastic events, and human land and water-use impacts.

A second objective of the *Recovery Strategy* is to achieve harvestable populations of coho salmon for Tribal, recreational, and commercial fisheries for the cultural and economic well-being of California. The *Recovery Strategy* states that improving coho salmon populations and habitat is the means to achieve these two objectives.

Since the *Recovery Strategy* was submitted to the Commission, the Department has progressed in implementing many of the range-wide and watershed recommendations. This report summarizes the recovery efforts made in the watersheds of the SONCC and CCC ESUs since the *Recovery Strategy* was produced in 2004. Additionally, this report also briefly describes the current status of coho salmon populations in both ESUs, provides updated information on coho salmon geographic range, distribution and biology, and lists the factors and threats currently affecting population viability.

1.3 Federal Coho Salmon Recovery Plans and Status Reviews

NOAA Fisheries has prepared recovery plans for coho salmon in both the CCC and SONCC ESUs. The final Coho Salmon Recovery Plan for the CCC ESU was released in September 2012 (NMFS 2012a), while a Public Review Draft of the SONCC Coho Salmon Recovery Plan was released in January 2012 (NMFS 2012b), with the final plan being anticipated for release in 2014.

In 2007, NOAA Fisheries published a coho salmon recovery plan for the Klamath River under the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSRA) (NMFS 2007). The MSRA Klamath River Coho Salmon Recovery Plan presents long-range guidance for various agencies, organizations and individuals to use

in actions that may affect Klamath River coho salmon. NOAA Fisheries has also published status reviews of coho salmon in both the SONCC and CCC ESUs (Williams et al. 2011). The 2011 status review of coho salmon in the SONCC ESU concluded that, similar to the last status review in 2005, coho salmon in the ESU remain in the ESA *threatened* category. Population monitoring has indicated that for many streams in the SONCC ESU the abundance of coho salmon has decreased, and that population trends are downward (NMFS 2011).

The 2011 status review of CCC ESU coho salmon concluded that conditions had degenerated for populations in this ESU since the last status review was published in 2005 (Spence and Williams 2011). Coho salmon in the ESU continue to be classified under ESA as *endangered*. Recent population trends in the ESU have been downward, with particularly poor returns during the period from 2006 to 2010. The poor returns in 2006-2010 were probably the result of poor ocean productivity and coho survival in 2005 and 2006 (Lindley et al. 2009). Poor returns in 2007 and 2008 severely reduced many coho populations, and therefore reduced potential numbers in subsequent years. The risk of local population extinction appears to have increased (NMFS 2011).

1.4 Other Coho Salmon Recovery Plans

The Mattole Salmon Group (MSG), a watershed restoration group focused on the Mattole River in Humboldt County, recently published the *Mattole Coho Recovery Strategy* (MSG 2011). The MSG has monitored coho salmon populations in the Mattole River system since the early 1990's. In recent years, populations have fallen to very low levels. There is a very real threat that without the implementation of extra-ordinary and continued restoration efforts coho salmon in the Mattole River may be extirpated in the near future.

In 2007, the Sonoma County Water Agency (SCWA) produced the draft *Russian River Coho Salmon Recovery Strategy Implementation Plan* which identifies and prioritizes possible coho salmon recovery activities that could be implemented in the Russian River Hydrologic Unit under the existing regulatory framework. The plan was developed collaboratively by state, federal, county, and non-governmental organizations.

Also in Sonoma County, the *Russian River Coho Water Resources Partnership*, funded by the National Fish and Wildlife Foundation, is working with its partners to study baseline streamflow conditions, develop water management plans, and develop priority infrastructure improvements to restore coho salmon populations to the Russian River system. For further information see: http://cohopartnership.org/ and text box on page 91.

In Marin County, the Marin Municipal Watershed District (MMWD) has produced the *Lagunitas Creek Stewardship Plan*, which addresses actions to be taken by MMWD, over a ten-year period, to manage the aquatic resource habitat of Lagunitas Creek for the benefit of coho salmon, steelhead, and California freshwater shrimp.

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For further information see:
http://www.marinwater.org/documents/Part_3_Tables_Lagunitas_Stewardship_Plan_Final_June_2011.pdf

1.5 Coho Salmon Recovery Teams and State Legislature Hearing

The statewide Coho Salmon Recovery Team (CRT) consists of 21 representatives from state and federal agencies, sport fishing, Tribes and other non-governmental organizations (Table 1.1). The group has met regularly since the *Recovery Strategy* was produced in 2004 and coordinates with the Department on issues related to statewide coho salmon recovery.

Table 1.1. Membership of the statewide Coho Salmon Recovery Team

State Government Agencies	Landowners	State, County or Watershed Organizations	Environmental Groups	Tribal Groups	Fishing Associations	Academia & Federal Government Departments
California Department Fish and Wildlife (CDFW)	California Farm Bureau	Sonoma County Water Agency (SCWA)	The Nature Conservancy (TNC)	The Yurok Tribe	California Trout (CalTrout)	National Oceanic & Atmospheric Administration (NOAA)
California Department of Forestry & Fire Protection (CalFire)	California Forestry Association	Five Counties Salmonid Conservation Plan (5C)	The Sierra Club (TSC)		Pacific Coast Federation of Fishermen's Associations (PCFFA)	Humboldt State University
California Department of Transportation (CalTrans)		Shasta Valley RCD				
State Water Resources Control Board (SWRCB)	Cattlemen's Association	Mattole Salmon Group (MSG)			Trout Unlimited (TU)	San Jose State University
		Smith River Alliance (SRA)				

The Shasta-Scott Coho Recovery Team (SSRT), consisting of 13 members representing a variety of local and regional interests, was established in 2003 to advise the Department on coho salmon recovery in the Scott and Shasta rivers in Siskiyou County. The SSRT created the Shasta-Scott Pilot Program (SSPP) (Chapter 10 of the *Recovery Strategy*), a recovery plan for coho salmon that specifically addressed agricultural practices and the use of water for agriculture in the two watersheds. In 2010, the SSRT was integrated into the CRT.

In August 2011, the Joint Committee on Fisheries and Aquaculture convened an all-day hearing in the State Capitol entitled "*Coho on the Brink"*. At this meeting representatives from state and federal agencies, together with non-governmental agencies, delivered updates and presentations to the Committee on the status of California coho salmon and on-going recovery activities.

In 2011, the Department and NOAA Fisheries, in response to the severe declines in coho salmon populations observed in the CCC ESU from 2008-2010, formed the Priority Action Coho Team (PACT). The focus of the PACT is to identify critical coho salmon recovery actions from the state and federal coho salmon recovery plans and elsewhere and create pathways for their rapid implementation with the immediate goal of preventing further population extirpations of coho salmon in the CCC ESU (see Chapter 7).

1.6 Coho Salmon Recovery Actions

Since the *Recovery Strategy* was produced in 2004, a wide range of recovery tasks has been implemented by the Department and other organizations. These activities include;

(i) Restoration and enhancement of suitable habitat conditions for juvenile and adult coho salmon throughout their range, funded partly through the Fisheries Restoration Grants Program, administered by the Department. Other government agencies that provide funding for coho salmon habitat restoration projects include United States Fish and Wildlife Service (USFWS) , NOAA Fisheries, Bureau of Reclamation, the California Department of Water Resources and the Regional Water Quality Control Board. In addition, a range of other non-governmental organizations also fund salmonid habitat restoration work.

(ii) Improvements in regulations to protect coho salmon populations on non-federal timberlands , such as the *Anadromous Salmonid Protection* (ASP) rules, approved by the Board of Forestry (BOF) in 2009 and implemented on the ground in January 2010.

(iii) Continuation and further development of captive rearing programs for coho salmon at Warm Springs and Kingfisher Flat conservation hatcheries, to help re-establish coho salmon in depleted streams north and south of San Francisco Bay, respectively.

(iv) Implementation of range-wide and watershed-wide recommendations identified in the *Recovery Strategy*.

Recovery activities carried out in the CCC and SONCC ESUs and within each recovery unit are summarized in Chapters 5,6 and 7 of this report.

Addendum

Appendix F. contains a list of acronyms and abbreviations contained in this report.

Chapter 2. Coho Salmon Biology

This section addresses recent scientific studies dealing with the biology of California coho salmon which have been published since the *Recovery Strategy* was produced in 2004. Both the *Recovery Strategy* and the *Status Reviews* provide comprehensive reviews of coho salmon biology up to the date of their publication.

2.1 Geographic range and distribution

The geographic range and distribution of California coho salmon, as documented in the *Recovery Strategy* and *Status Reviews,* do not appear to have changed substantially over the intervening time period. The natural range of California coho salmon extends from the Oregon border to the Monterey peninsula. The established southern boundary of coho salmon in California was recently questioned (Kaczynski and Alvarado 2006). The authors of the study suggested that it is improbable that coho salmon historically maintained self-sustaining populations south of San Francisco Bay. However, Adams et al. (2007) found no creditable climatic, oceanographic, or ecological evidence for habitat differences between areas immediately south and north of San Francisco Bay and concluded that coho salmon are in fact native to southern streams as far as Santa Cruz county.

The historical status of coho salmon in streams of the urbanized San Francisco estuary was recently reviewed by Leidy et al. (2005). The authors found evidence that at least four of sixty-five estuary watersheds (6 percent) historically supported coho salmon. A minimum of an additional 11 watersheds (17 percent) may also have supported coho salmon, but evidence is inconclusive. Coho salmon were last documented from the San Francisco estuary in the early to mid-1980's.

In the SONCC ESU, the Department reported recently on the historic and recent occurrence of coho salmon in streams, based on an analysis of fisheries data together with stream surveys carried out up to 2004 (Garwood 2012). This study provides an independent synthesis of available fisheries data through 2004, resulting in a list of 540 coho salmon streams in the California portion of the SONCC ESU. The list of streams includes 325 verified coho salmon streams from a previously published distribution list (Brown and Moyle 1991; Brown et al.1994) and 215 additional streams identified through this study. Based on the verification methods used, results from the study represent a 40 percent increase in the number of documented historic coho salmon streams. In addition to the data analysis and literature review, a standardized field observation study was conducted from 2001 to 2003 to establish a contemporary distribution for a subset of coho salmon streams. A total of 628 surveys was completed

in 301 coho salmon streams, resulting in an occupancy rate by coho salmon ranging from 31 percent to 62 percent (Garwood, 2012).

2.2 Life-history, population genetics and ecology

Formerly, it was generally believed that juvenile coho salmon in California streams spend just one year rearing in their natal stream after hatching before out-migrating to the ocean as smolts. Recent research in Prairie Creek, a tributary of Redwood Creek in Humboldt County, however, has demonstrated previously undocumented two-year freshwater residency of juvenile coho salmon (Bell and Duffy 2007). Previously, it had generally been assumed that all juvenile coho salmon in northern California streams spend only one year in freshwater before out-migrating at age one-plus and that a two-year freshwater life history pattern was found only in the more northerly portion of the species' range.

Water temperature is an important environmental factor affecting the survival of juvenile coho salmon (Stenhouse et al. 2012). In Redwood Creek, Humboldt County, Madej et al. (2006) assessed thermal rearing restrictions for juvenile coho salmon and found that coho salmon are currently restricted to one-fifth of the historical distribution due to increases in water temperature through channel widening and the removal of riparian vegetation. Similar examples of juvenile coho salmon habitat loss exist in other watersheds where such perturbations have taken place.

The genetic diversity of protected coho salmon populations in California has recently been investigated by several agencies and authors. Abundant new genetic data are available for California populations of coho salmon, including microsatellite genotypes from over 1,500 fish from nearly every extant population in the state (Garza and Gilbert-Horvath unpublished data). These recent genetic data do not suggest the need for a reexamination of the boundaries of the two coho salmon ESUs, as these data show a clear separation between populations south and north of Punta Gorda. Furthermore, there is no signal of populations at the southern end of the range having been derived from hatchery broodstock from another ESU (Williams et al. 2011). A recently published study found that California coho salmon populations comprise small numbers of endemic breeders, with populations experiencing high levels of genetic drift and inbreeding depression (Bucklin et al. 2007). The study implicated population fragmentation, genetic drift and isolation by distance, owing to the very low levels of migration, as the major evolutionary forces shaping genetic diversity within and among extant populations of California coho salmon.

Chapter 3. Status and Trends of Coho Salmon Populations

3.1 Monitoring of population status and trends

Coho salmon populations in both the CCC and SONCC ESUs are monitored by the Department and other agencies and organizations (see Table 3.1 and Figure 3.1). Juvenile coho salmon are generally monitored by trapping or by direct observation (snorkeling), while adult coho salmon may be monitored by various methods including trapping, video and Dual Frequency Identification Sonar (DIDSON) monitoring, redd and carcass counts and direct observation (Johnson et al. 2007).

Trends in population change of adult coho salmon in some representative monitored streams in the CCC and SONCC ESUs are shown in Figures 3.2 and 3.3, and also in Chapter 6. In most monitored streams, adult coho salmon have declined in abundance since the *Recovery Strategy* was produced in 2004 (for population data see Appendix A and Appendix B). The only exception to this is the Russian River where the numbers of returning adult coho salmon have recently begun to show increases, due to the on-going operation of the Warm Springs conservation hatchery. Note that high flows in some years may affect the ability to accurately estimate fish abundance and therefore results should be considered minimum estimates. However, numbers do reflect the relative strengths of each brood year.

NOAA Fisheries has recently published status reviews of coho salmon populations in both the CCC and SONCC ESUs (Spence and Williams 2011; NMFS 2011, Williams et al. 2011). The main finding of these reviews is that coho salmon populations in both ESUs are declining and that the long-term trend continues to be downward. In many of California's coastal streams and rivers the risk of population extinction appears to have increased.

The precise causes of the ongoing reductions in coho salmon populations in most watersheds have not been established, but it is apparent that the declines are associated with the continued deterioration in freshwater and estuarine habitat conditions through human land and water resource development activities (see Chapter 4). The declines in coho salmon populations recorded in many streams between 2008 and 2010 were compounded by poor ocean conditions in 2005 and 2006, which were also correlated with recent declines in populations of other salmon species, particularly Chinook salmon, in California and the Pacific Northwest (Lindley et al. 2009).

3.2 Coastal California Salmonid Monitoring Plan

Since the *Recovery Strategy* was produced, the Department and NOAA Fisheries have cooperatively worked to develop the *Coastal California Salmonid Monitoring Program* (CMP). The CMP is a comprehensive monitoring strategy for coastal California populations of salmon and steelhead (Adams et al. 2011). The CMP will enable tracking of the status, trends and recovery of coho salmon and other anadromous salmonid populations in both the SONCC and CCC ESUs (see following textbox).

Coastal California Salmonid Monitoring Program

California's salmonid populations have experienced marked declines leading to listing of almost all of California's anadromous salmonids under CESA and ESA. Both CESA and ESA listings require recovery plans that call for monitoring to provide some measure of progress toward recovery. In addition, there are related monitoring needs for other management activities such as hatchery operations and fisheries management.

The CMP is designed to provide a comprehensive monitoring program for anadromous salmonids in coastal basins to inform recovery, conservation, and management activities. The scientific foundation of the CMP is made up of a rigorous sampling design incorporating standardized field protocols to allow for valid evaluations of status and trends of fish populations across spatial (within a basin, among basins, independent populations, diversity strata) and temporal (annual variation, short-term trends, long-term trends) scales. Building from the initial efforts by Shaffer et al. (unpublished) and Adams et al. (2011), the CMP calls for standardized field protocols, data collection, and data reporting – the goal being open access of collected data from a web-based platform.

The CMP provides a sampling framework to collect information at the appropriate life stages and spatial scales to evaluate adult salmonid abundance, both at larger regional scales and at the population level. Productivity is calculated as the trend in abundance over time. CMP design also allows basic assessments of connectivity through the collection of juvenile distribution and relative abundance data. Measurements of diversity are based on local evaluation of essential life history variants and both broad and focused assessments of genetic diversity patterns.

Life Cycle Monitoring (LCM) stations will provide estimates of freshwater and ocean survival, essential to understanding whether changes in salmonid numbers are due to recovery from improvements in freshwater habitat conditions or changes in ocean conditions. An LCM station will include an absolute measure of adult abundance from a counting facility, a spawning survey estimate of adult abundance, and an estimate of outmigrating smolts. The adult counts and outmigrant smolt counts will provide estimates of fish in and fish out, that can be used to provide relative estimates of freshwater and marine survival. The counting station data and adult survey estimates will be used to develop an estimation factor between redds and adults for calibration of adult surveys conducted in other watersheds. The LCM sites are also expected to be magnets for other kinds of recovery-oriented research, particularly studies of fish habitat-productivity relationships and evaluations of habitat restoration effectiveness.

Monitoring is necessary to provide data that will be analyzed to inform management decisions, and those data must be made available in a timely manner to managers in a usable form. The data management structure is one of the most important parts of the CMP, ensuring that consistent data standards and protocols are applied across and within monitoring areas and that data flow is coordinated from the field to a central data collection center. It will also ensure that data reporting necessary for common analytical activities occurs in a timely manner and will provide a data source for other analytical needs.

Reference:

Adams, P., L. Boydstun, S. Gallagher, M. Lacy, T. McDonald, K. Shaffer 2011. California Coastal Salmonid Population Monitoring: Strategy, Design, and Methods. Fish Bulletin 180, California Department of Fish and Game, 82p.

Within the CMP, coho salmon population monitoring projects have already been established in coastal watersheds in Humboldt County and the Mendocino Coast (see Chapter 6). Several other planned projects will involve monitoring of coho salmon populations in coastal watersheds in both the SONCC and CCC ESUs.

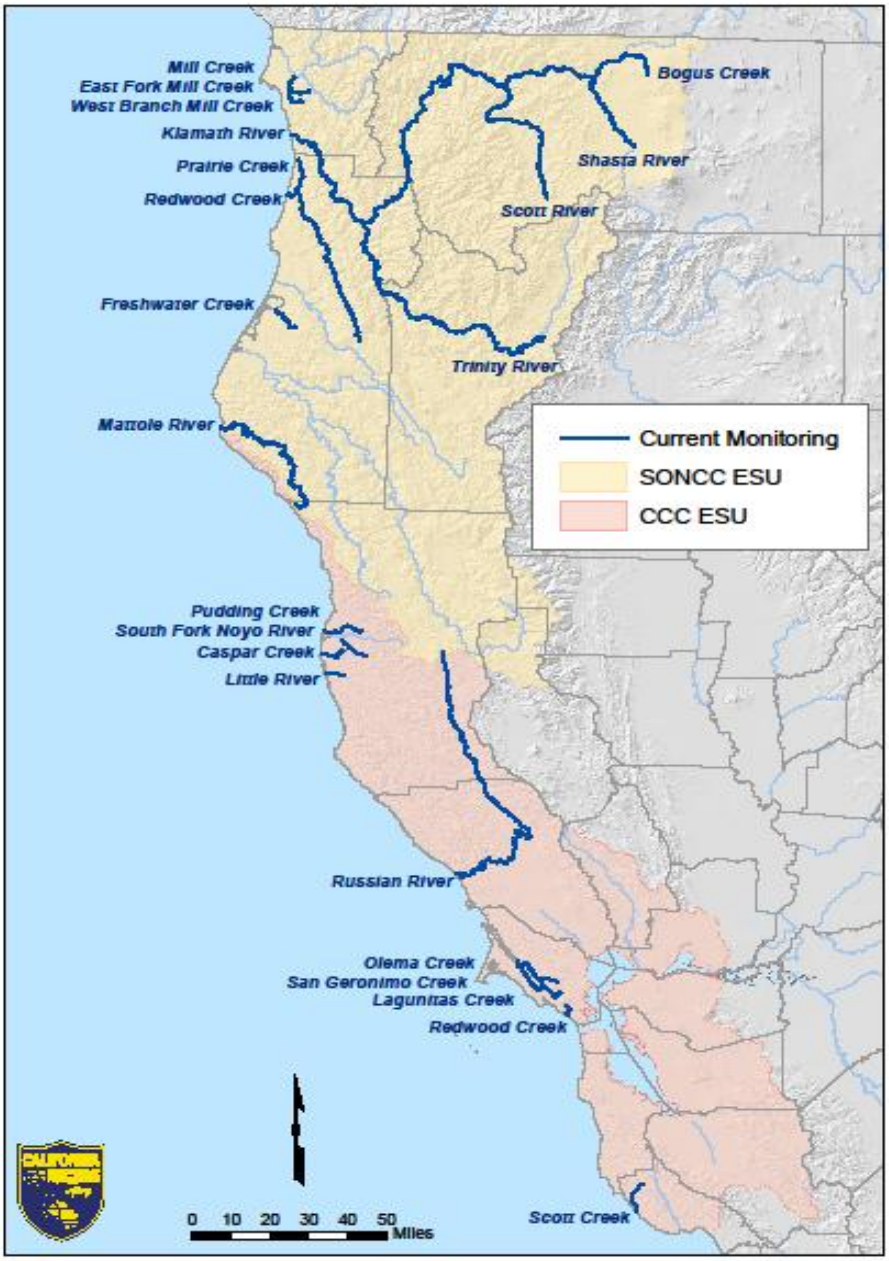
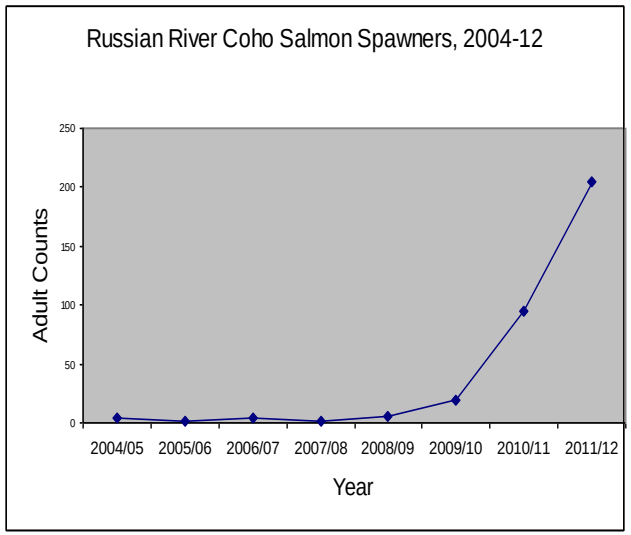


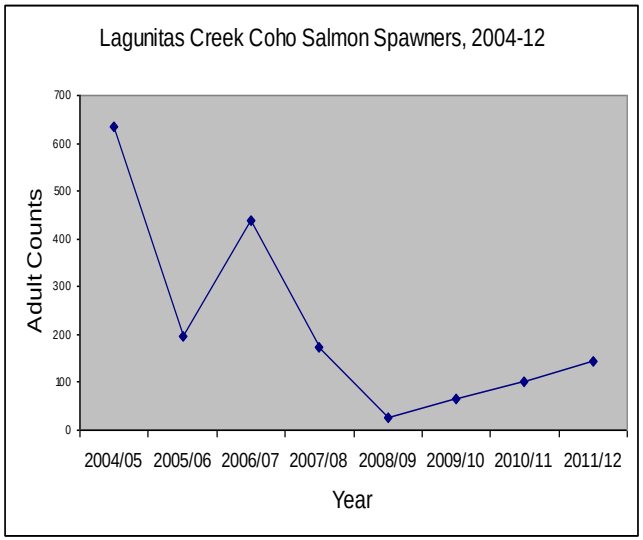
Figure 3.1. Locations of selected streams monitored for California coho salmon.

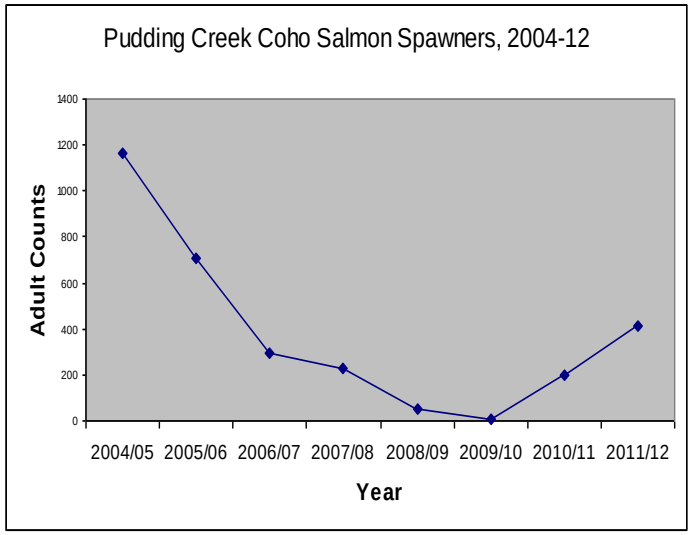
Table 3.1. Locations of California coho salmon monitoring sites and involved agency/organization.

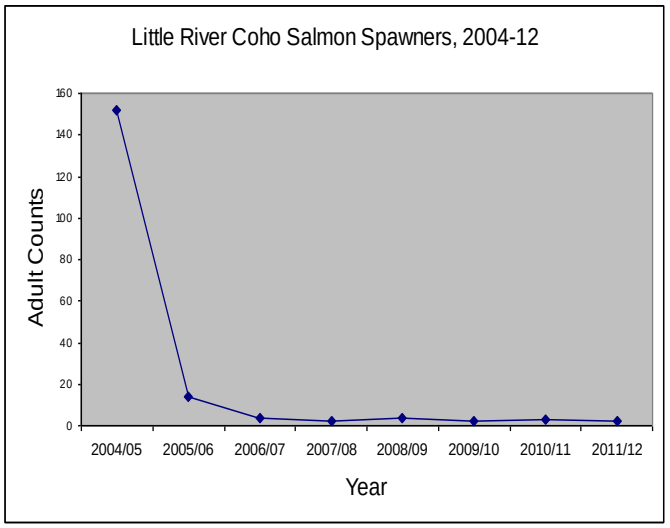
ESU River/Stream	County	Watershed Stream/River	Agency/ Organization	Form of monitoring
CCC ESU				
Scott Creek*	Santa Cruz	Scott	NOAA Fisheries	Juvenile and adult monitoring
Lagunitas Creek	Marin	Lagunitas	MMWD	Juvenile and adult monitoring
San Geronimo Creek	Marin	Lagunitas	MMWD	Juvenile and adult monitoring
Olema Creek	Marin	Lagunitas	NPS	Juvenile and adult monitoring
Redwood Creek	Marin	Redwood	NPS	Juvenile and adult monitoring
Russian River	Sonoma/ Mendocino	Russian	CDFW/SCWA/ UCCE	Juvenile and adult monitoring
Pudding Creek	Mendocino	Pudding Creek	CDFW	Juvenile and adult monitoring
Caspar Creek	Mendocino	Caspar	CDFW	Juvenile and adult monitoring
Noyo River South Fork	Mendocino	Noyo	CDFW	Juvenile and adult monitoring
Little River	Mendocino	Little River	CDFW	Juvenile and adult monitoring
SONCC ESU				
Mattole River	Humboldt	Mattole	MSG	Juvenile and adult monitoring
Trinity River	Humboldt	Klamath	CDFW	Juvenile and adult monitoring
South Fork Eel River	Humboldt	Eel	CDFW	Juvenile and adult monitoring
Klamath River	Siskiyou	Klamath	CDFW/Tribes/ FWS	Juvenile and adult monitoring
Bogus Creek	Siskiyou	Klamath	CDFW	Adult monitoring
Scott River	Siskiyou	Klamath	CDFW	Juvenile and adult monitoring
Shasta River	Siskiyou	Klamath	CDFW	Juvenile and adult monitoring
Freshwater Creek*	Humboldt	Humboldt Bay	CDFW	Juvenile and adult monitoring
Redwood Creek	Humboldt	Redwood	CDFW	Juvenile and adult monitoring
Prairie Creek	Humboldt	Redwood	CDFW	Juvenile and adult monitoring
Mill Creek – West Branch	Del Norte	Smith River	CDFW	Juvenile and adult monitoring
Mill Creek - East Fork	Del Norte	Smith River	CDFW	Juvenile and adult monitoring
Mill Creek - Mainstem	Del Norte	Smith River	CDFW	Juvenile and adult monitoring

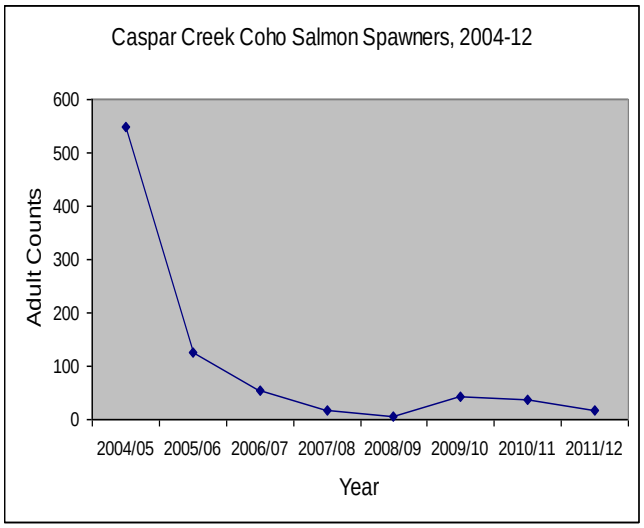
Key; CDFW: California Department of Fish and Wildlife , NOAA Fisheries: National Oceanic and Atmospheric Administration's National Marine Fisheries Service, NPS – National Parks Service, MMWD – Marin Municipal Water District, UCOE – U.S. Corps of Engineers, Tribes – Yurok and Hoopa tribes, SCWA – Sonoma County Water Agency, UCCE – University of California Cooperative Extension, FWS – U.S. Fish and Wildlife Service, MSG – Mattole Salmon Group. *indicates the presence of a life-cycle monitoring station.











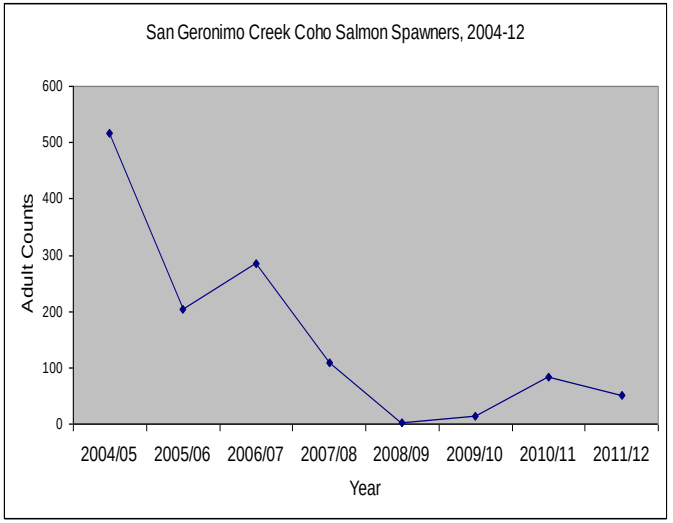


Figure 3.2. Trends in adult coho salmon populations in selected monitored streams in the CCC ESU, 2004-2010 (see Appendix A and Chapter 6 for further information on monitoring procedure).

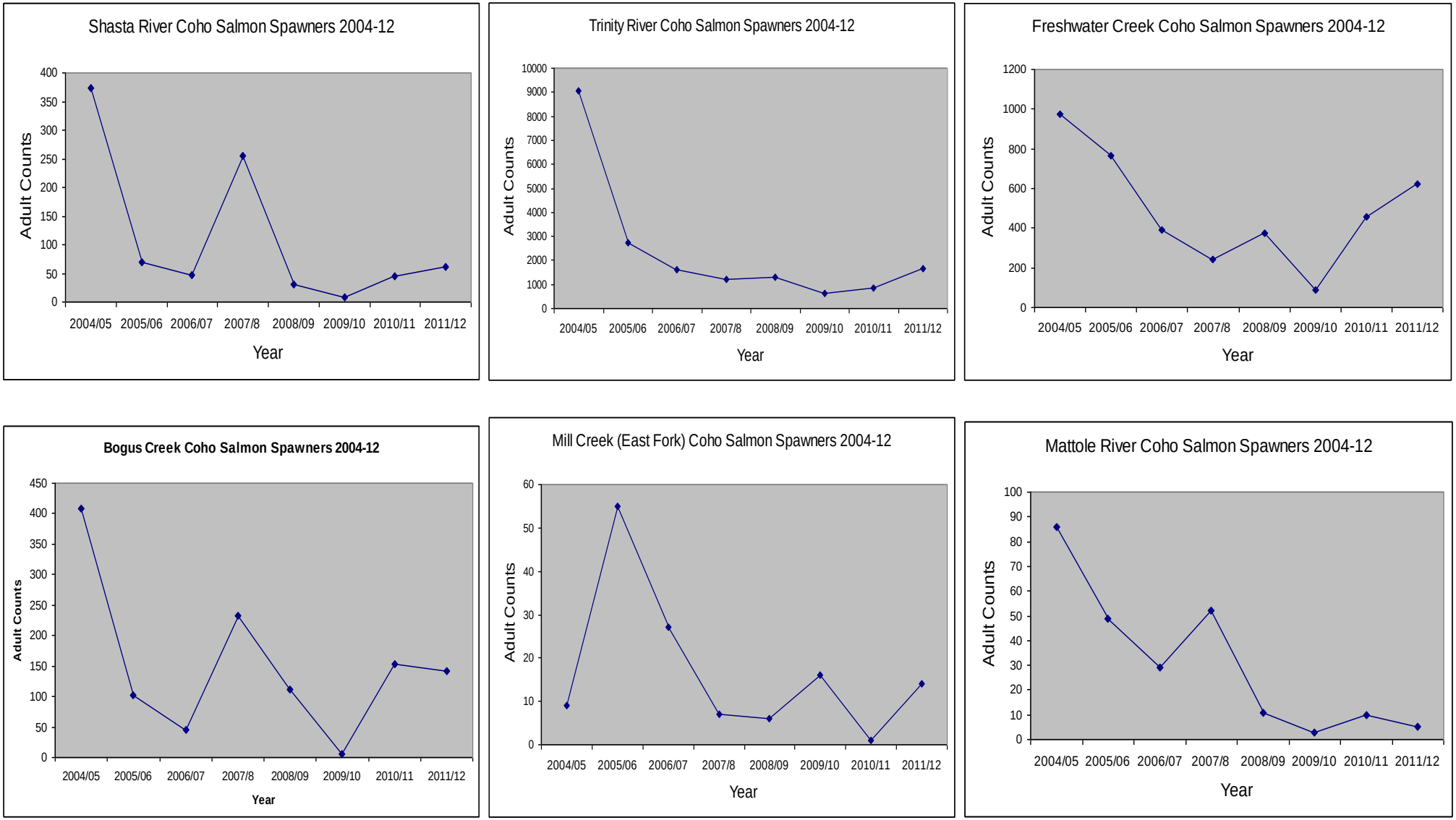


Figure 3.3. Trends in adult coho salmon populations in selected monitored streams in the SONCC ESU, 2004-12 (see Appendix B and Chapter 6 for further information on monitoring procedure).

3.3 Summary of current status of California coho salmon

Coho salmon populations in California have been in decline over the past several decades. In the 1940s, estimated numbers of adults spawning in California streams were 200,000–400,000. Even then they were regarded by Moyle and Williams (1990) as being in sharp decline but still common. Subsequent studies documented their rapid disappearance from their native streams throughout the state and by 1996 coho salmon in the CCC and SONCC ESUs were listed as *threatened* or *endangered*. Today, coho salmon populations in both ESU's are at just a small fraction of their previous levels (Moyle et al. 2008, 2011).

Since 2011, however, coho salmon populations in some central and northern California coastal watersheds have increased, following very poor returns in 2009 and 2010. These increases have been associated with improved ocean conditions, which have increased the marine survival and growth of salmon populations. However, the overall trend in coho salmon populations in most monitored streams in the state remains downward.

In the CCC ESU, Lagunitas Creek exhibited a steady upward trend of returning adult coho salmon from a low of less than 25 in 2009 to 65, 101 and 145 for 2010, 2011 and 2012 , respectively (Figure 3.2). These numbers are close to average over a 17-year monitoring period. Preliminary population estimates for 2012/13 show a continued upward trend. However, most streams south of San Francisco Bay, such as Scott Creek, now have only remnant coho salmon populations which are at or near extirpation. In some streams, including southern streams (Redwood Creek in Marin County, and Scott, Waddell, and Gazos creeks, south of San Francisco,) the severe impacts of the poor ocean conditions in 2005 and 2006 on adult returns essentially extirpated wild runs, so no natural rebound was possible when ocean conditions improved. In streams south of San Francisco Bay, including Scott, Gazos, and Waddell creeks, there has been little or no production of wild coho salmon since 2008 (Smith 2013).

In Mendocino County, for the past ten years the Department has conducted life-cycle monitoring of coho salmon in Pudding Creek, Caspar Creek, Little River, and the South Fork Noyo River. As in other monitored streams in the CCC ESU, coho salmon populations in streams such as Pudding Creek have shown some increases following extreme lows in 2009-10, although in most streams, represented by Caspar Creek and Little River, the overall population trend remains downward (Figure 3.2).

In some watersheds in the SONCC ESU, such as the Mattole and Shasta rivers, coho salmon populations continue to decline, and without the implementation of extra-ordinary measures, appear to be heading towards near-term extirpation. However, in other rivers, such as the Eel, Scott, Klamath, and Smith rivers, in recent years there have been increases in adult coho salmon returns. The Department continues to conduct population status and trend monitoring in the Smith River and in Humboldt Bay tributaries, such as Freshwater Creek. It is expected that the CMP will continue to be expanded in both coho salmon ESU's, with the goal of having at least one life cycle

monitoring station in each diversity stratum (populations are categorized into diversity strata based on the geographical structure described in Spence et al. 2008).

The current status of coho salmon populations in California's waters may be summarized as follows:

1) Coho salmon are currently extirpated from many of their historically occupied watersheds in the CCC. This has created a fragmented pattern of stream occupancy that strongly affects population structure and negatively affects recovery potential.
2) Due to the dominant 3 year life cycle of coho salmon, in some populations there are year-class gaps or weak year-classes that without intervention, such as brief captive rearing or broodstock transfers, will only recover slowly.
3) The numbers of adult coho salmon in monitored streams in the SONCC and CCC ESUs have declined considerably since 2004.
4) Wild coho salmon populations in the CCC ESU have declined from estimates of over 50,000 in the early 1960's to approximately 1,000 - 2,000 at the present time.
5) The most adversely affected populations in the State are in the Shasta River, Mattole River, Russian River and streams south of San Francisco Bay, such as Scott Creek.
6) Coho salmon in northern coastal streams are relatively more numerous than in southern streams, but northern populations are also experiencing declines in population numbers.
7) Coho salmon populations were historically abundant in large northern river systems in the SONCC ESU, such as the Klamath, Smith and Eel Rivers, but in some areas numbers are now considerably reduced.
8) The overall picture of coho salmon in California is one of severely depleted populations, many of which, without expanded recovery efforts, may be heading towards extirpation.
9) The ongoing population declines are thought to be largely attributable to human causes, particularly the loss and degradation of suitable freshwater and estuarine habitat conditions for juvenile rearing and adult reproduction in coastal watersheds.
10) In recent years, the primary causes of population decline have been compounded by poor ocean conditions which have led to low survival in the marine environment and subsequent poor adult returns.
11) Many factors affect coho salmon throughout their life-cycle, and not all are amenable to management, such as ocean conditions.
12) It is possible that current management efforts are not of a scale to be effective in achieving full recovery, or are not addressing the primary limiting factors affecting populations.
13) As discussed in the *Recovery Strategy,* adaptive management is essential for successful planning and implementation of coho salmon recovery.

Chapter 4. Factors and Threats Affecting Population Viability

As described in the *Recovery Strategy* and the *Status Review,* there are a number of activities related to human uses of land and water which affect the viability of California coho salmon populations. In addition, other environmental factors, which may be related to human activities, such as climate change, and also natural factors such as ocean conditions, are thought to affect populations of anadromous salmonids, including coho salmon. This section provides updated information, where available, on some of the major threats listed in the *Recovery Strategy.*

4.1 Forestry activities

The *Recovery Strategy* lists forest management practices (FMPs) as one of the major threats to anadromous salmonids in general, and to coho salmon in particular. Although FMPs have improved considerably over recent years, there still remains room for improvement and there are considerable legacy effects from past forestry practices in the State which continue to adversely affect the habitats and ecology of anadromous salmonids, including coho salmon.

The Board of Forestry (BOF) recently consulted with the Department, California Department of Forestry and Fire Protection (CalFire) and other state and federal agencies in revising the FMPs to benefit the recovery and conservation of coho salmon and other anadromous salmonids. As part of this process, the Fisheries Branch of the Department recently undertook a scientific literature review of California forest management practices in relation to the conservation of anadromous salmonids, with particular emphasis on the role of FMPs in coho salmon recovery (Swales 2010).

The existing FMPs were subsequently revised by the BOF and were renamed the *Anadromous Salmonid Protection Rules* (ASP). The new rules were adopted permanently in October 2009 with the goal of providing increased and lasting protection for coho salmon. However, no information is currently available as to whether coho salmon recovery is benefiting from the new rules. In order to answer this question requires population monitoring and the implementation of experimental research.

The ASP rules also include provisions to allow site-specific riparian management to more rapidly improve conditions for listed anadromous salmonids, including coho salmon. A detailed guidance document was produced to illustrate where to implement these types of projects (VTAC 2012). CalFire produced a detailed ASP Rule Question and Answer document to provide insight into the application of the rules (DFW and CalFire 2010). Further refinements in the rules for Class II-Large watercourses were approved by the BOF in the fall of 2013. Implementation of modern FMPs (post-1975) has substantially reduced the impacts of forestry operations on water quality (both sediment and water temperature) (Ice 2011). Additionally, in 2013 the BOF approved the *Road Rules*, a rule package designed to reduce sediment impacts, both in ASP watersheds and statewide. However, concern remains over cumulative watershed

effects related to logging in erodible North Coast watersheds. Although FMPs have improved, it will take more time for comprehensive monitoring work to fully document improvements to water quality, habitat and fish populations.

4.2 Water diversions and fish screens

The *Recovery Strategy* identifies water diversions and groundwater extraction as being significant threats to coho salmon, acting through changes to the hydrologic regime of rivers, which may adversely affect fish survival, movement and migration. In addition, juvenile salmon may be entrained into water diversions, leading to increased mortality. Screening to prevent entrainment in water diversions is consequently required to reduce fish mortality.

These threats to coho salmon recovery are still extant in most areas of the State and are known to inhibit coho salmon recovery. Since the *Recovery Strategy* was produced, the Department has worked in consultation with other state and federal agencies to limit water diversions in river systems and to install fish screens in many streams and rivers. However, even though water diversion agreements have been reached with many user groups, water diversions remain a significant threat to coho salmon recovery in many areas of the State. There are currently 464 unscreened diversions affecting coho salmon recovery in the CCC and SONCC ESUs (source: Fish Passage Assessment Database; see Appendix D).

Among the water diversion agreements that have recently been developed are those for vineyards and irrigation of other agricultural crops, livestock watering, and municipal and small domestic water supplies. Some important areas of water diversion regulation that Department staff have been investigating since the State listing of coho salmon are: a) the diversion of water by vineyard managers for frost protection, b) diversion of water for agricultural purposes in the Shasta and Scott Valleys in Siskiyou County, c) water diversions for dust abatement on timber roads and d) water diversion for illicit purposes, such as marijuana cultivation, which increasingly is a major issue in watersheds on the central and north coast.

4.3. Regulated stream flows

Land-uses such as urbanization, agricultural activities, and timber harvest can alter natural hydrologic cycles and impact stream flows, low flows, peak flows, flow timing, and flood frequencies. Alterations to the natural hydrological cycle can in turn create significant impacts to coho salmon and their habitat (Lawson et al. 2004). The *Recovery Strategy* identifies modifications to the natural flow regime of streams and rivers as being a significant threat to coho salmon populations in the State. The development of more natural streamflow regimes that minimize the adverse effects of flow regulation is consequently an important aspect of coho salmon recovery.

The Department has interest in assuring that stream flows are maintained at levels adequate for long-term protection, maintenance and proper stewardship of aquatic resources. In April 2008, the Instream Flow Program was initiated by the newly developed Water Branch of the Department. The primary objective of the Instream Flow Program is to develop scientific information on the relationship between stream flow and available habitat to determine flow levels needed to maintain healthy conditions for fish and wildlife. Relationships between flow and habitat are developed on selected streams for each species' critical life stage need, including spawning, rearing and migration.

The Instream Flow Program has developed a list of 22 priority streams or watercourses for future instream flow work pursuant to Public Resources Code (PRC) 10004 (listed in Appendix C). The Navarro, Mattole, Scott and Shasta Rivers are important watercourses identified on the priority streams list in the North and Central Coast that afford important habitat for coho salmon, among other aquatic resources.

In the *Recovery Strategy,* the Shasta Scott Recovery Team identified the need for instream flow studies in each of the Shasta and the Scott watersheds as a high priority to recover coho salmon populations. In November 2008, the Department's Instream Flow Program was successful in securing grant funding from the Ocean Protection Council to conduct stream flow studies on the Shasta River. The flow studies began in 2009 and are expected to result in identification of interim instream flow needs for coho salmon in the upper Shasta Springs Complex and the Shasta Canyon reaches of the watershed. Upon completion, the Shasta Canyon interim instream flow recommendations are intended to be submitted to the State Water Resources Control Board (SWRCB).

Forest management practices may also result in changes to water quality and the hydrologic regime of river systems. In coastal watersheds, water yields and summer low flows may also be altered through land management and forestry. For example, in Caspar Creek in Mendocino County, it was shown that summer flows increased following logging activities, which has numerous ecological ramifications (Keppeler, 1998). Similar findings have been recorded at other sites in the Pacific Northwest.

4.4 Artificial barriers

The *Recovery Strategy* identifies artificial barriers on streams and rivers as being a significant factor impeding fish passage for both coho salmon adults and juveniles. In listing coho salmon, resource agencies have cited the loss of historic spawning and rearing habitats that are upstream of large, impassable dams as a primary factor contributing to fish decline and a threat to their recovery. Other structures contributing to their decline include road crossings, bridges, culverts, flood control channels, erosion control structures, canal and pipeline crossings, tide-gates and gravel mining pits.

The Passage Assessment Database (PAD) has been developed to provide a common framework for the collection, management and analysis of known and potential barriers to fish passage in California streams. It is intended to capture a set of basic information about each potential barrier to aid in inventorying and assessing fish passage issues on a statewide scale.

The PAD is an ongoing map-based inventory of known and potential barriers to anadromous fish in California. It compiles currently available fish passage information from more than two hundred data sources and references, and allows past and future barrier assessments to be standardized and stored in one location. The inventory is to be used to identify barriers suitable for removal or modification to restore spawning and riparian habitat and reduce stream fragmentation. The PAD database is available to the public via the CalFish website: www.calfish.org.

During the period 2004 to 2011, state and federal agencies completed 189 fish passage improvement projects in the range of coho salmon, with an additional 36 projects ongoing (see Appendix D). These projects involved culvert renovations, dam removals, and installation of fish passage structures or natural by-passes, modification of stream grade control structures, and barrier inventory and assessments. Most of the completed projects have been carried out on public lands and there still remain over 1,902 known barriers that have been identified in need of remediation.

The implemented barrier removal projects are expected to contribute to restoration of natural-flow regimes in California rivers and streams and are likely to benefit coho salmon by making additional habitat available for spawning, rearing and feeding.

4.5 Hatcheries

In northern California, coho salmon are produced artificially using hatcheries, both as mitigation for human impacts, such as dam construction, and also as conservation facilities. Currently, four hatchery programs are engaged in artificial propagation of coho salmon in California. Iron Gate Hatchery (IGH) and Trinity River Hatchery(TRH) are operated largely as mitigation hatcheries, located in the SONCC ESU. Warm Springs Hatchery (WSH) and Monterey Bay Salmon and Trout Project's (MBSTP) Kingfisher Flat Hatchery are conservation hatcheries located within the CCC ESU. All of these programs were active at the time of the listing. No new coho artificial propagation programs have been initiated since the listing in 2004. However, the WSH program since 2009 has expanded to include coho salmon from other basins, mainly for the purpose of outbreeding.

IGH's coho salmon program, located on the Klamath River, continues to produce a relatively small number (about 75,000) of yearling coho salmon annually. Since the listing, the Department, in consultation with NOAA Fisheries and Pacificorp, has developed a draft Hatchery and Genetic Management Program (HGMP) for this hatchery and has recently begun to incorporate substantial conservation elements in its

operations, including genetic management of spawning to reduce inbreeding. There is an active multi-agency steering group that has guided modifications of hatchery operations to benefit coho salmon in the Klamath River.

TRH continues to produce relatively large numbers of coho salmon annually (approximately 500,000 juveniles) as mitigation for the adverse effects of dam construction on coho salmon populations. A preliminary draft HGMP has been produced for this hatchery program. This hatchery has not substantially changed its production or operations since the listing.

The coho salmon captive rearing program at WSH is a conservation/recovery effort that has been in operation since 2001. Since 2004, this program has steadily increased its production and has improved the condition of fish produced. The program carries out intensive genetic stock management, including minimization of inbreeding using genetic spawner pairing and careful outbreeding to mitigate inbreeding effects.

South of San Francisco Bay, the *MBSTP* continues to produce relatively small numbers of coho salmon annually at the Kingfisher Flat Hatchery for stocking into Scott Creek in Santa Cruz County. Since the listing, coho salmon propagation in this program has steadily shifted to include captive broodstock housed at WSH, in cooperation with NOAA Fisheries Southwest Regional Science Center (SWFSC).

In Scott Creek the last wild runs of coho salmon were in 2005 and 2006, with no apparent successful wild returns in 2007 through 2011. The captive broodstock program at the hatchery had limited brood stock or egg production until the captive broodstock program ramped up in 2011-12.

The hatchery operation with captive brood stock to produce fry, smolts, and some rereleases of adults to spawn in the wild in Scott (and San Vicente Creek) is currently preventing extirpation of the stocks south of San Francisco. Some wild rearing in San Vicente and Scott creeks was produced from release of surplus adults to spawn in the wild in 2012, and substantial wild juveniles were produced in 2013 in Scott Creek by the release of captive broodstock to spawn in the wild (Smith 2013).

In general, artificially produced hatchery salmon may potentially have adverse ecological and genetic effects on wild stocks through increased competition for food and space and inbreeding (e.g. Christie et al. 2012, Eldridge & Nash, 2007; Rand et al., 2012). However, in California, there have been few studies on the effects of hatchery coho salmon on wild stocks (see Conrad et al. 2013). Hatchery reform programs are currently being developed in California and the Pacific Northwest to mitigate potential adverse impacts of hatchery practices on populations of wild salmon.

4.6 Climate change

California experiences wide variation in climatic and hydrologic conditions. Various climatic phenomena including severe storms, drought, seasonal cycles, El Niño and La Niña events, decadal events, and regime shifts can alter the physical, chemical, and biological aquatic environment (Parrish and Tegner 2001). These changes can, in turn, play a major role in the life history, productivity, and persistence of coho salmon populations. Coho salmon evolved with, and have persisted in the face of, extreme variability in habitat conditions caused by these natural phenomena. However, catastrophic conditions combined with low population numbers, habitat fragmentation, impacts of human activities, and habitat degradation or loss can cause an unrecoverable decline of a given population or species (Moyle et al. 1995).

There is evidence that recent changes in populations of Pacific salmon in the Pacific Northwest may be related to patterns in climate change (Beamish et al. 1999; Hare et al. 1999; Mantua et al. 1997; Battin et al. 2007)). Climate change may affect flood frequency in California streams, which may in turn impact salmonid populations (Meyers et al. 2010).

It is predicted that globally within the next few years, climate change may surpass habitat loss as the primary threat to the conservation of most animal species (Thomas 2004; Schwartz et al. 2006). Moreover, climate variability is known to affect the marine survival of coho salmon in Oregon and Washington (Lawson et al. 2004). Marine factors have been used to explain up to 83% of the variability in Oregon coastal natural coho salmon recruitment, yet about half the variability in coho salmon recruitment comes from the freshwater life phase of the life cycle. This seeming paradox could be resolved if freshwater variability were linked to climate and climate factors influencing marine survival were correlated with those affecting freshwater survival (Lawson et al. op.cit.). In California it will be (and currently is) the multiple stressors, that include climate extremes, that are most important for salmon survival and recovery.

California coho salmon are at the southern limit of their geographic range and often reside in streams near the upper limits of their thermal tolerance and hence may be more susceptible to any increases in water temperature due to climate change. Coho salmon are also thought to be one of the most sensitive of all anadromous salmonids to climate variability because of their life history, with most spending an extended time rearing in freshwater (Bell & Duffy 2007; Moyle et al. 2013). However, there is little or no data on actual or potential impacts of climate change on California coho salmon, or the consequences for population recovery. It has also been suggested that habitat restoration for salmon recovery may also be impacted by climate change and that habitat deterioration associated with climate change will make salmon recovery targets much more difficult to attain (Battin et al. 2007; Beechie et al. 2012).

Climate change will likely produce a range of responses in different life stages. Many will likely be negative while others may be positive (Schwartz et al. 2006). Negative effects may occur due to increased water temperatures which may decrease juvenile

freshwater survival rates. The impacts from climate change will likely exacerbate the current stresses and threats affecting California coho salmon and may push many systems beyond current thresholds for suitability and beyond their potential for recovery (Moyle et al. 2013).

Droughts, especially those of long duration and high intensity, are a major hazard to both natural and human-dominated environments and can be damaging and leave long-lasting effects on aquatic biota, including fish populations (Lake 2003). California is known to experience periodic drought conditions, dating back most recently to 2012, which results in severely reduced precipitation, and hence lower stream flows, in many coastal rivers. Coho salmon recovery in coastal watersheds may be impeded as adult spawning success and juvenile survival are reduced as a result of lower stream flows and higher water temperatures (CDFG 2004).

4.7 Ocean conditions

It has been reported that poor ocean conditions in 2005 and 2006 were an important contributing factor in the recent declines of runs of Pacific Salmon in California and the Pacific Northwest (Lindley et al., 2009). It is well established that ocean conditions in the Pacific Northwest have considerable influences on anadromous salmonids, including California coho salmon, especially through changes in ocean productivity. (Nickelson 1986; Mueter et al. 2002; Hobday and Boehlert 2001; Ryding and Skalski 1999). It is likely that downturns in ocean productivity in 2005 and 2006 affected coho salmon more than other anadromous salmonids because of their low population numbers. The adverse effects of poor ocean conditions were also severe on Central Valley Fall Chinook salmon (Lindley et al., 2009).

Survival rates of coho salmon smolts in the eastern North Pacific are influenced by broad-scale climate patterns (Coronado and Hilborn 1998). Survival of coho salmon in the ocean is correlated with physical environmental factors, including upwelling and sea surface temperature (Nickelson 1986) operating across scales of hundreds of kilometers(km) (Mueter et al. 2002). In Oregon, ocean environmental indices explained 75 percent to 83 percent of adult recruitment in naturally spawned coho salmon (Koslow et al. 2002).

The extent to which the recent declines in California coho salmon populations are attributable to changes in ocean conditions is not clear. Further investigations are needed to answer this question. However, recent data from across the range of coho salmon on the coast of California and Oregon reveal that there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008).

Chapter 5. Coho Salmon Habitat Restoration

The restoration and enhancement of suitable habitat conditions for juvenile rearing and survival and adult reproduction in both freshwater and estuarine environments has been the main focus for coho salmon recovery programs in both the CCC and SONCC ESUs. The Department has funded and also undertaken extensive habitat restoration for coho salmon recovery throughout their range in both the CCC and SONCC ESUs. In addition, many other agencies and organizations have been involved with habitat restoration projects for the recovery of California coho salmon populations.

5.1 The California Fisheries Restoration Grants Program (FRGP)

Since 1981, the Department has funded, through the Fisheries Restoration Grants Program, anadromous salmonid restoration and recovery projects in coastal watersheds throughout northern and central California. FRGP is a collaborative effort involving more than 600 stakeholders that focuses on restoring fish habitat conditions in order to ensure the survival and protection of anadromous salmon and steelhead trout in California's coastal watersheds.

Over the last 30 years, FRGP has invested over $250 million and supported approximately 3,500 salmonid restoration projects. From 2004 to the present time, FRGP has allocated a total expenditure of over $100 million to coho salmon recovery projects in California. The Department conducts implementation and effectiveness monitoring of a sub-set of projects to track the success and benefits of FRGP habitat restoration efforts for the enhancement and restoration of salmonid populations.

Since 2004, the FRGP program has focused on projects intended specifically to benefit coho salmon through the restoration of suitable habitat conditions in watersheds within the CCC and SONCC ESUs. FRGP performance measures for coho salmon habitat improvement projects carried out in the State over the period 2004-2011 are summarized in Table 5.1. The locations in the two ESUs where habitat restoration works and other types of FRGP funded projects for coho salmon recovery have been undertaken from 2004 to 2011 are shown in Figures 5.1 and 5.2 and Appendix G.

A total of 433 FRGP-funded projects benefiting coho salmon recovery was completed over the time period 2004 -2011, addressing 287 recovery tasks, listed in the 2004 *Recovery Strategy*. The locations of the recovery projects within each ESU and recovery unit, and the type of project undertaken, are shown in maps and tables, included in Appendix G.

Table 5.1. Summaries of FRGP Performance Metrics for Coho Salmon Recovery, 2004-2012.

Project Type	Metric	Quantity
Fish Passage Improvement	Number of blockages removed	118
Fish Passage Improvement	Miles of stream opened	209
Fish Screening Projects	Number of fish screens installed/replaced	92
Instream Habitat Improvement	Total miles of stream treated	223
Riparian Habitat Improvement	Miles of riparian bank treated	149
Riparian Habitat Improvement	Acres of riparian area treated	1,467
Upland Habitat Improvement	Acres of upland area treated	4,117
Upland Habitat Improvement	Miles of road treated	462
Monitoring	Miles of stream monitored	1,578
Fish rearing	Number of hatchery fry/smolt released	182,675
Organizational Support	Number of watershed plans/assessments completed	196

The various project types funded by FRGP grants were grouped together into six major categories: 1. Fish passage improvement, 2. Instream habitat improvement, 3. Organizational support, 4. Watershed restoration monitoring, 5. Water conservation, 6. Cooperative fish rearing.

The number of FRGP-funded projects in each category and recovery unit is summarized in Table 5.2.[3] In both the CCC and SONCC ESUs, the category with the most numerous projects has been instream habitat improvement, followed by organizational support and monitoring.

[3] The restoration projects approved for funding are listed annually on-line: http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/FundSummary.asp

For additional information on the FRGP grants program see: http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/index.asp

5.2 Coho salmon habitat restoration programs by other agencies and organizations

Coho salmon habitat restoration and species recovery work is also undertaken in California by a wide range of other agencies and organizations, including NOAA, water agencies, watershed groups, sport fishing organizations, non-governmental organizations (NGOs) and Resource Conservation Districts (RCDs). Some examples of other coho habitat restoration programs are listed below.

5.2.1 The NOAA Restoration Center

The NOAA Restoration Center provides funding and technical assistance for restoration projects benefitting NOAA trust resources, including salmon and steelhead. Since 1996, the Restoration Center has funded over 400 projects benefitting California's salmon and steelhead. The Restoration center works with NMFS staff and others to develop and implement projects addressing limiting factors to salmonid recovery, such as partnering with grassroots organizations to encourage hands-on citizen participation and providing technical support. Funding opportunities come from a variety of sources managed by the Restoration Center. More information is available at: http:/www.habitat.noaa.gov/funding/southwest.html.

5.2.2 Water agencies

Marin Municipal Water District (MMWD) is a public agency that aims to mitigate the effects of reservoir development in the Lagunitas Creek watershed and has a comprehensive, long-term program to enhance the habitat of the creek for the benefit of coho salmon and other aquatic resources. For further information see http://www.marinwater.org/176/Natural-Resources-Fisheries

Sonoma County water Agency (SCWA) conducts fisheries research and monitoring activities to support ongoing SCWA operations and ESA compliance, focusing on the Russian River system in Sonoma County. For further information see http://www.scwa.ca.gov/fisheries/

5.2.3 Sport fishing organizations

Trout Unlimited (TU) is a nationwide sport fishing organization. To date, TU's North Coast Coho Project and its partners have improved or eliminated over 514 miles of logging roads, removed 11 major fish migration barriers, reconnected 68 miles of stream habitat, and installed over 1,110 instream features to improve coho salmon and steelhead habitat. For further information see Appendix I and http://www.tucalifornia.org/index.php?page=north-coast-coho-recovery

Figure 5.1. Locations of FRGP-funded coho salmon restoration projects in the CCC ESU Recovery Units from 2004 through 2011 (map legend on following separate page).

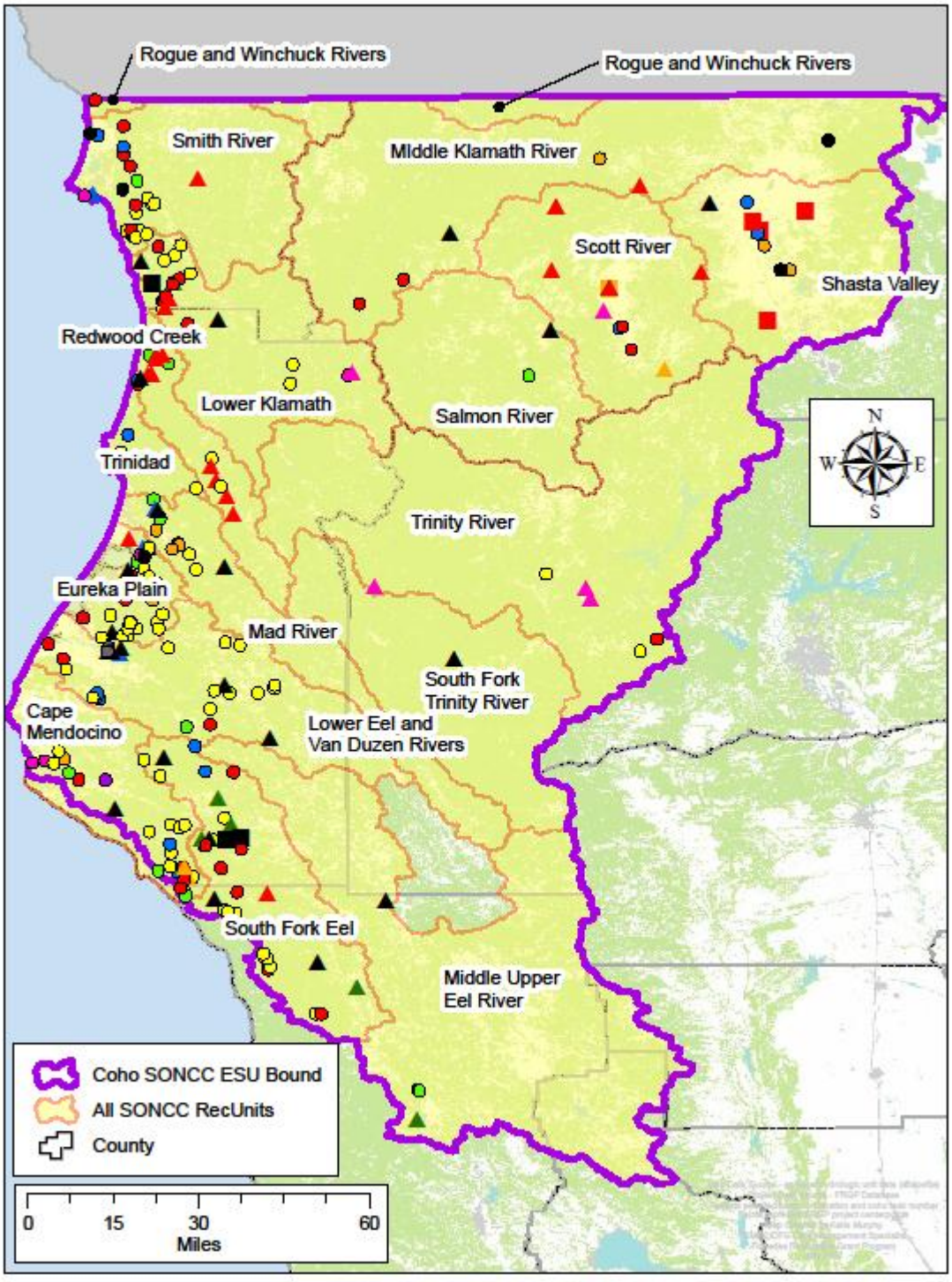


Figure 5.2. Locations of FRGP-funded coho salmon restoration projects in the SONCC ESU Recovery Units from 2004 through 2011 (map legend on following separate page).

Legend for Figures 5.1 and 5.2– SONCC and CCC ESU Projects

- AmeriCorps
- Public School Watershed and Fishery Conservation Education Projects
- Fish Passage Improvement at Stream Crossings
- Instream Barrier Modification
- Instream Habitat Modification
- Riparian Restoration
- # Instream Bank Stabilization
- Watershed Restoration (Upslope)
- # Monitoring Projects
- Project Monitoring Following Project Completion
- # Watershed Organization Support and Assistance
- Project Design
- # Public Involvement and Capacity Building
- # Watershed Evaluation, Assessment and Planning
- " Project Maintenance
- " Fish Screening of Diversions
- " Private Sector Technical Training and Education Projects
- # Water Conservation Measures (Ditch lining, Piping, Stock Water Systems)
- " Cooperative Rearing

Table 5.2. Summary of numbers of FRGP-funded projects in each project category and recovery unit in the CCC and SONCC ESUs from 2004 through 2011.

ESU and Recovery Unit	Fish Passage	Instream Habitat	Organizational. Support	Monitoring	Water	Fish Rearing	Total
CCC ESU							
Big Basin	0	0	2	4	0	4	10
San Mateo	0	1	2	0	0	0	3
San Francisco Bay	0	0	5	3	0	0	8
Bodega-Marin	3	10	10	5	1	0	29
Mendocino Coast	8	39	13	3	0	0	63
Russian River	4	16	11	2	0	0	33
NUMBER OF PROJECTS	15	66	43	17	1	4	146
SONCC ESU							
Middle-Upper Eel	2	1	1	0	0	0	4
South Fork Eel	1	25	9	1	0	0	36
Lower Eel/Van Duzen	1	17	11	0	0	0	29
Cape Mendocino	4	17	4	2	2	0	29
Eureka Plain	2	21	7	5	0	0	35
Mad River	5	3	3	0	0	0	11
Trinidad	0	4	0	0	0	0	4
Redwood Creek	2	4	1	11	0	0	18
Lower Klamath	0	19	6	4	0	0	29
Middle Klamath	7	2	2	1	0	0	12
Salmon River	1	0	0	0	0	0	1
Trinity River	0	4	3	0	0	0	7
South Fork Trinity River	0	0	1	0	0	0	1
Shasta River	14	2	7	1	0	0	23
Scott River	5	5	6	5	2	0	23
Smith River	0	18	10	0	0	0	23
Rogue/Winchuk Rivers	0	2	0	0	0	0	2
NUMBER OF PROJECTS	44	144	71	30	4	0	292
OVERALL TOTALS	59	210	114	47	5	4	433

California Trout (CalTrout) is an NGO currently focused exclusively on protecting and restoring wild trout, salmon, steelhead and their waters throughout California. CalTrout currently focuses their efforts around restoring salmon and steelhead and saving imperiled native trout. For further information, see http://caltrout.org/

5.2.4 Non-governmental environmental groups (NGOs)

This section includes information on the work of some NGOS actively involved with coho salmon recovery in the State of California. However, it is beyond the scope of this report to provide information on all NGO activities. A partial list of organizations is provided in Appendix E.

The **Salmon Protection and Watershed Network** (SPAWN) is a science-based watershed protection organization located in Marin County that engages community members to take action in order to help with salmon recovery. The group focuses on restoring suitable habitats and monitoring coho salmon populations in the Lagunitas Creek watershed. See: http://seaturtles.org/programs/salmon/

In Humboldt County, the **Mattole Restoration Council** (MRC) the **Mattole Salmon Group** (MSG) and **Sanctuary Forest** (SF) are community based non-profit organizations that are actively involved with habitat restoration, water storage and forbearance, salmon population monitoring and education and outreach in the Mattole River watershed. For further information see: MRC, http://www.mattole.org/, MSG, http://www.mattolesalmon.org/, SF, http://sanctuaryforest.org/

Founded in 1976, the **Monterey Bay Salmon and Trout Program (**MBSTP) is a non-profit organization dedicated to the restoration and enhancement of the native salmon and steelhead populations of the greater Monterey Bay area. To accomplish the goals, MBSTP has developed three major programs: Coho Salmon and Steelhead, Chinook Salmon Enhancement, Salmon and Trout Education. See: http:// www.mbstp.org

5.2.5 Local government organizations (LGOs)

This section includes information on the work of some LGOs actively involved with coho salmon recovery in the State of California. However, it is beyond the scope of this report to provide information on all LGO activities. A partial list of organizations is provided in Appendix E.

FishNet 4C was a county-based salmon protection and restoration program that brings together the Central California Coastal Counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey. The focus of the FishNet 4C program was on implementing on-the-ground restoration projects, employing best management practices during maintenance activities, and incorporating aquatic habitat protections into land use regulations and policies. Due to funding short-falls, this program ceased operations in 2012.

Five Counties Salmonid Conservation Program. In 1997, the northwestern California Counties of Del Norte, Humboldt, Mendocino, Siskiyou and Trinity agreed to collaborate on a proactive, positive response to the federal listing of coho salmon as a *threatened* species by forming the Five Counties Salmonid Conservation Program (5C). The primary goal of 5C is "to strive to protect the economic and social resources of northwestern California by providing for the conservation and restoration of salmonid populations to healthy and sustainable levels and to base decisions on watershed rather than county boundaries." See: http://www.5counties.org/

5.2.6 Other government agencies

The **State Water Resources Control Board** (SWRCB) has worked actively to coordinate water rights activities with the Department, NOAA Fisheries, United States Fish and Wildlife Service (FWS), Army Corps of Engineers (USACE), and other stakeholders to address adverse impacts caused by water diversion (Appendix H). See; http://www.swrcb.ca.gov/

The **Point Reyes National Seashore Association** (PRNSA). When coho salmon and steelhead trout were placed on the ESA list, the National Park Service (NPS) initiated a five-year project to identify, evaluate, restore, and enhance coho salmon and steelhead populations and their habitat within three West Marin parks, Point Reyes National Seashore, Golden Gate National Recreation Area, and Muir Woods National Monument. The Coho and Steelhead Restoration Project focuses on Pine Gulch, Redwood, Olema, and Lagunitas creeks and their watersheds. For further information see: http://www.sfnps.org/species/

The **University of California Cooperative Extension Program** (UCCE) and the **Sonoma County Water Agency** (SCWA) have participated in a collaborative effort to re-establish coho salmon in the Russian River in Sonoma County since 2001. Warm Springs Hatchery captures, rears and spawns coho salmon broodstock from the Russian River and elsewhere. Juvenile salmon are released in selected tributary streams and UCCE and SCWA staff monitors their movements, growth and survival until they migrate downstream to the ocean for adult rearing and maturation. See: http://www.scwa.ca.gov/fisheries/

The **California Conservation Corps Watershed Stewards Project (WSP)** is a comprehensive, community-based, watershed protection, restoration and education program. Established in the spring of 1994, WSP was created by biologists and educators and brought together by the California Conservation Corps to fill critical gaps in scientific data collection, restoration efforts and community education.

In the past 20 years, WSP members have accomplished the following: inventoried over 34,504 miles through stream, riparian and upslope surveys; generated over 2,620 scientific reports and databases; developed over 1,600 watershed restoration projects;

instructed over 40,573 students on salmonid lifecycles and watershed processes; provided outreach to over 237,174 students and community members; and engaged more than 16,995 community volunteers in hands-on restoration projects. In collaboration with private landowners, timber companies, tribal communities, commercial and sport fishing industry representatives, teachers, community members, non-profit organizations, and public agencies, the WSP's partnerships work to revitalize watersheds that contain endangered and threatened species by using state-of-the-art data collection and watershed restoration techniques.

For further information see:
http://www.ccc.ca.gov/work/programs/AmeriCorpsPrograms/wsp/Pages/wsp1.aspx

5.2.7 Landowners and watershed groups

Private landowners have access to and knowledge of some of the most critical lands and waterways for coho salmon recovery. With the proper organization and partners, landowners have been able to successfully complete projects on their land that have benefits to a variety of resources.

Land owners, stakeholders, and interested parties have formed watershed groups and land conservancies to maintain and/or improve the status of the basins' aesthetic values, and economic and natural resources. These include groups such as the Yager/Van Duzen Environmental Stewards (YES), Friends of the Van Duzen River, Friends of the Eel River, the Eel River Watershed Improvement Group (ERWIG), Mid Klamath Watershed Council, Scott River Water Trust, Scott Valley Watershed Council and Salmon River Restoration Council . These groups and stakeholders along with state and federal agencies are working together to promote natural resource sustainability. Watershed improvement projects have focused on reducing erosion and sediment delivery to streams by improving road conditions and watercourse crossings, stabilizing stream banks, improving instream habitat conditions with instream enhancement structures, and facilitating fish passage. The majority of these projects have occurred on privately owned lands.

5.2.8 Native American Tribes

In coastal watersheds of the central and northern California coast, several Native American Tribes are involved with coho salmon recovery activities. In the Klamath River system these include the Yurok, Hoopa and Karuk Tribes. This summary will focus on the activities of the Yurok Tribe.

The Fisheries Department of the Yurok Tribe carries out adult and juvenile coho salmon population monitoring and stream habitat restoration work in the Trinity River and tributaries of the lower Klamath River, such as McGarvey Creek (Appendix J). In addition, the *Coho Salmon Ecology Project* monitors juvenile coho salmon habitat use, movement, growth and distribution throughout the Klamath estuary and surrounding

slough and backwater habitat. This project is undertaken in conjunction with the Karuk Tribe. For further information see:
http://www.yuroktribe.org/documents/FisheriesDepartment.pdf

5.2.9 Timber companies

Several industrial timber companies which operate in the CCC and SONCC ESUs, such as Green Diamond Resource Company, Humboldt Redwood Company, Mendocino Redwood Company and Campbell Global, undertake habitat restoration work and facilitate habitat restoration work and population monitoring for coho salmon in northern California coastal watersheds.

5.2.10 Resource Conservation Districts (RCDs)

A number of RCDs are involved with coho salmon recovery activities in California watersheds. However, it is beyond the scope of this report to provide information on all these activities. For further information on the activities of individual RCDs see:
http://www.carcd.org/home0.aspx.

As an example, in Sonoma County, the **Gold Ridge Resource Conservation District** is undertaking *The Salmon Creek Habitat Rehabilitation Program:*

"Coho and other salmonids have been the focus of watershed restoration efforts designed to improve habitat conditions for the fish and assist in their long-term survival in coastal California. In Salmon Creek, the Gold Ridge RCD has been an important part of these efforts, conducting assessments of watershed and habitat conditions, working with local landowners on stream protection and restoration projects, and helping to inform the public about the ecological and economic importance of coho.

Efforts to restore the fish in Salmon Creek have been given a huge boost by the California Department of Fish and Game, which has released spawning adult coho into the stream for the past four winters. But improvements to both summer flows and instream habitat must continue if the coho are to thrive once again in Salmon Creek."
Source: http://www.goldridgercd.org/project/SOS.html

Appendix E provides a partial list of organizations involved in coho salmon recovery in the State of California.

Chapter 6. Coho Salmon Recovery Status Report by Evolutionarily Significant Unit and Recovery Unit

6.1 Recovery Activities in the Southern Oregon – Northern California Coast Coho Salmon Evolutionarily Significant Unit

6.1.1 Introduction

Since the *Recovery Strategy* for coho salmon was produced in 2004, there have been numerous activities in the SONCC ESU aimed at protecting, restoring and enhancing anadromous salmonid freshwater and estuarine habitats in general, and coho salmon recovery specifically. Protection of coho salmon and their habitats from significant impacts continues to be a priority under the jurisdiction of the Department.

Habitat and species protection activities include: environmental review and permitting for timber harvesting, land development projects (for example - residential housing, commercial or industrial building), gravel mining, water diversion for domestic or agricultural use, and road maintenance and bridge replacement. In the SONCC ESU 292 FRGP projects intended to benefit coho salmon have been funded through the Department over the period 2004-2011 (Table 5.2). In addition, numerous additional projects have been funded by federal agencies and other entities.

Habitat improvement projects which have been carried out in the SONCC ESU since the *Recovery Strategy* was produced have included increased access to favorable spawning and rearing habitat. These projects were achieved through the combined efforts of the Department, other state agencies, federal agencies, non-governmental organizations, non-profit groups and industrial timber companies. The majority of FRGP project categories which were funded include instream habitat restoration, fish passage improvement and organizational support (Table 5.2). The locations of FRGP projects within each recovery unit, and the tasks which were addressed by the project are shown in Appendix G.

This chapter also describes population monitoring programs for coho salmon which have been performed in each recovery unit since the *Recovery Strategy* was produced. The Department monitors anadromous salmonid populations in several streams within the SONCC ESU, including Humboldt Bay tributaries in the Eureka Plain recovery unit, Shasta Valley and Scott River recovery units, Trinity River, South Fork Eel River and the Smith River recovery unit. In addition, other projects which may have been carried out and may have benefited coho salmon recovery are also described.

To facilitate monitoring of progress towards recovery, the Department divided each ESU into recovery units. The recovery units are groups of smaller drainages that are

related hydrologically, geologically, and ecologically are believed to function as unique and important components of the ESU. Measuring progress toward recovery is being done at the recovery unit scale. The SONCC Coho ESU has been divided into 17 recovery units:

SONCC ESU Recovery Units
Rogue and Winchuck Rivers
Smith River
Mad River
Shasta River
Redwood Creek
Scott River
Trinidad
Salmon River
Eureka Plain
Middle Klamath River
Lower Eel/Van Duzen rivers
Lower Klamath River
South Fork Eel River
Trinity River
Middle/Upper Fork Eel River
South Fork Trinity River
Cape Mendocino

To provide consistency with existing resource databases, recovery units are aligned with the geographic divisions of the CALWATER 2.2a system, the standard watershed mapping system used by the State of California. The CALWATER classification system includes (from largest to smallest) hydrologic regions, hydrologic units (HUs), hydrologic areas (HAs), hydrologic subareas (HSAs), and planning watersheds. The recovery units generally correspond with CALWATER hydrologic units, with the exception of the Klamath, Trinity, and Eel river systems, which are further refined at the hydrologic area level.

6.1.2 Rogue and Winchuck Rivers Recovery Unit

The Rogue and Winchuck rivers recovery unit encompasses tributaries that fall within the SONCC ESU. Portions of the Illinois River watershed, which is a tributary to the Rogue River, are also located in California. Coho salmon are present in both Elk and Dunn creeks, tributaries to the West Fork and East Fork of the Illinois River, respectively. The South Fork Winchuck River is the sole tributary of the Winchuck River located in California. General land use in this recovery unit is timber production.

Habitat Restoration

There has been some instream enhancement of coho salmon habitat in Elk Creek since 2004. In addition, there have been several projects for enhancement of habitat in the South Fork Winchuck under FRGP funding. Projects since 2004 include the installation of large woody debris (LWD) instream structures and boulder structures and planting of conifers to diversify the alder-dominated riparian (streamside) area.

6.1.3 Smith River Recovery Unit

The Smith River recovery unit encompasses all branches of the Smith River and Wilson Creek. The main coho salmon-producing streams include Mill Creek, Rowdy Creek and Wilson Creek. Land use includes timber production, recreation in state and national parks and national forest, and agriculture (in the coastal plain).

Habitat Restoration

Restoration activities for coho salmon have focused on improving fish passage, large wood enhancement, sediment reduction and riparian restoration. The Department, FWS, and the Smith River Alliance have been working with agricultural landowners in the lower river to control exotic canary reed grass, and to improve riparian vegetation by livestock exclusion fencing and riparian plantings. A pilot project was also recently completed on Reservation Ranch to improve estuary habitat for juvenile salmonids. Fish passage projects have been completed by Del Norte County on Peacock Creek and on Cedar Creek by the Pacific Coast Fisheries, Wildlife, and Wetland Restoration Association (PCFWWRA). PCFWWRA has also completed road decommissioning projects on Dominie Creek. Large wood enhancement projects were completed by Rural Human Services on Sultan Creek, along with noxious weed removal projects in the Smith River National Recreation Area. In east branch of Mill Creek, complex wood jams were effective at improving over summer and over winter pool habitats for coho salmon and other anadromous salmonids (Benegar 2011).

In 2002, California State Parks acquired the 25,000-acre Mill Creek property. Since that time, significant restoration has been completed using a variety of funding sources. The activities have been coordinated by California State Parks, Rural Human Services and

the Smith River Alliance. Projects include decommissioning roads throughout the property and large wood projects in the East Fork of Mill Creek. Riparian tree planting is also an important component of this program.

Extensive road decommissioning has occurred in the Wilson Creek watershed, carried out by PCFWWRA and Green Diamond Resource Company (GDRC). The California Conservation Corps with funding from the Department and NOAA Fisheries has also completed several large wood and riparian projects in coordination with the upslope projects.

Population Monitoring

The Mill Creek watershed supports the greatest number of coho salmon in the Smith River population. Juvenile and adult coho salmon have been monitored continuously from 1994 to present, with funding from the FRGP. Minimum counts of adult abundance, summer juvenile abundance, and juvenile outmigrant abundance have been generated each year within two major tributaries to Mill Creek including the West Branch and the East Fork (Figures 6.1 and 6.2, Table 6.1). Results from these monitoring activities are being used to estimate survival, productivity, and life history patterns. Additionally, results are being used to track salmonid population abundance trends relative to restoration efforts (e.g. road removal, reforestation) occurring throughout the Mill Creek watershed (McLeod and Howard 2010).

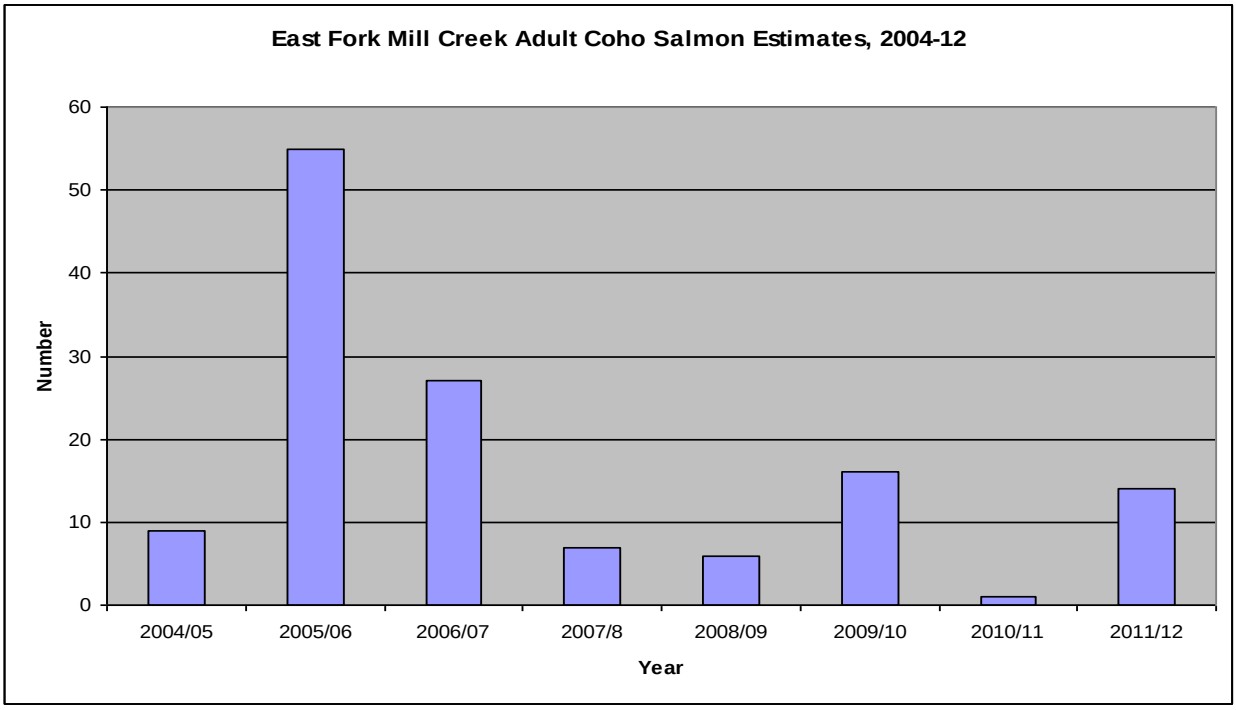


Figure 6. 1. Adult Coho Salmon Escapement Estimates, East Fork Mill Creek, Del Norte County, CA 2004-2012.

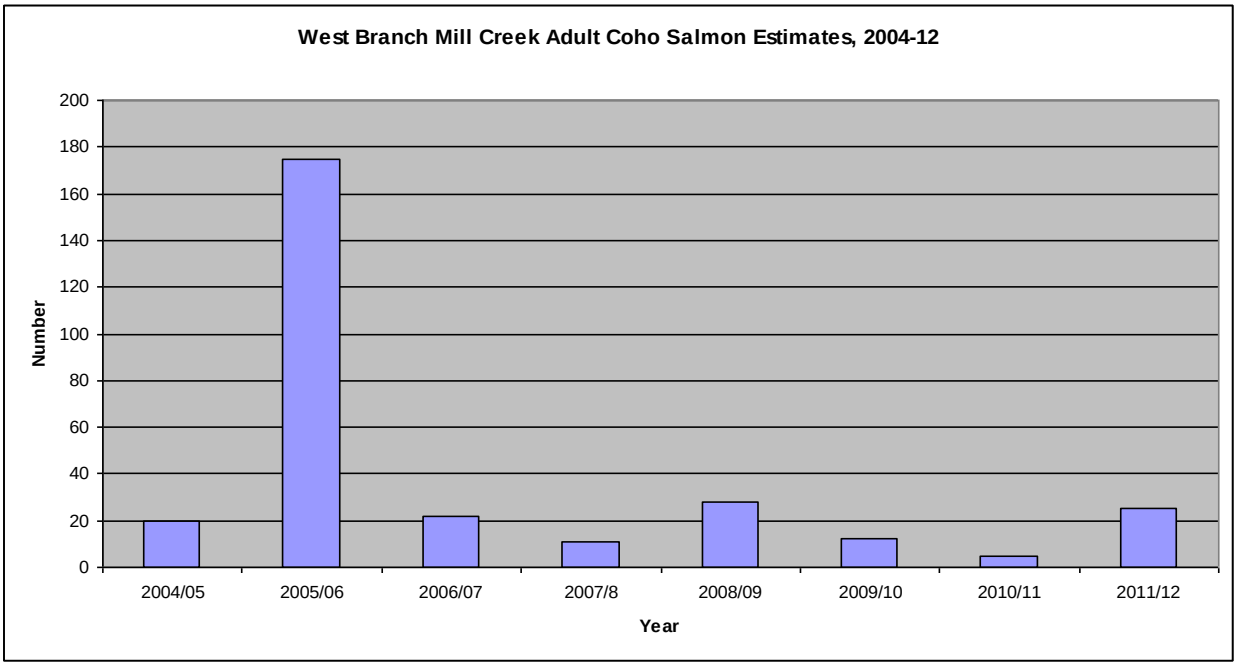


Figure 6. 2. Adult Coho Salmon Escapement Estimates, West Branch Mill Creek, Del Norte County, CA 2004-2012.

Table 6.1. Coho salmon abundance estimates by life stage in two tributaries of Mill Creek, Del Norte County, CA 2004-2011.

	East Fork Mill Creek				West Branch Mill Creek		
Year	Adults	Juveniles	Smolts		Adults	Juveniles	Smolts
2004	9	3,957	1,507		20	8,336	3,832
2005	55	12,067	496		175	24,527	763
2006	27	9,418	1,404		22	23,999	3,981
2007	7	4,491	3,018		11	13,826	3,129
2008	6	8,605	1,234		28	15,569	3,731
2009	16	9,934	1,766		12	8,628	4,535
2010	1	1,556	1406		5	2,659	3,456
2011	14	9,760	508		25	21,407	795
Means:	17	7,474	1,417		37	14,869	3,028

In addition to the Mill Creek monitoring program, a survey to estimate the annual abundance of adult coho salmon and the annual spatial distribution of juvenile coho salmon has been initiated in 2011 by the Department and the Smith River Alliance, funded through the FRGP. Spawning ground surveys and summer snorkel surveys will occur in reaches throughout the Smith River basin using a spatially balanced

Generalized Random Tessellation Stratified sample from a finite number of available reaches. These surveys will be part of the CMP and will follow the methods provided in Adams et al. (2011).

6.1.4 Lower Klamath River Recovery Unit

The Lower Klamath River recovery unit extends from the mouth of the Salmon River, approximately six miles upriver from the town of Orleans downstream to the Trinity River confluence at Weitchpec and on to the mouth of the Klamath River where it enters the Pacific Ocean. Land use includes timber production with public (USFS) and industrial timber ownership. All of the Yurok and some of the Karuk tribal lands are also located in the Lower Klamath River recovery unit.

Habitat Restoration

In the Orleans hydrologic sub area (HSA), Six Rivers National Forest has formed partnerships with the Karuk and Yurok Tribes to acquire funding for fish habitat improvement through road decommissioning efforts. Recent efforts have focused on the Bluff Creek watershed.

The Yurok Tribal Fisheries Program (YTFP) and the Yurok Tribe Watershed Program have worked with Green Diamond Resource Co. and a number of funding agencies to take a top-down approach to watershed restoration in the Lower Klamath River. Upslope restoration projects have been completed in McGarvey, Ah Pah, Tectah, Hunter, Terwer and Blue creeks. Instream projects have been completed in Hunter, East Fork Hunter, Waukell, Terwer, McGarvey, Ah Pah, Tectah creeks. They have also completed riparian projects in Hunter, East Fork Hunter, Waukell, McGarvey, Ah Pah, and Tectah creeks as well as livestock exclusion fencing and riparian planting in Terwer Creek. YTFP has also constructed off-channel alcoves in Terwer Creek (n=2), McGarvey Creek (n=2), and in Hunter Creek (n=1). Current restoration planning and implementation projects include continuing wood loading efforts and off-channel habitat enhancement in Hunter, Waukell, Terwer, and McGarvey creeks.

The FWS has worked with a private landowner to conduct livestock exclusion fencing and riparian planting within lower Salt and Hunter creeks. The FWS has also constructed off-channel habitat features in lower Salt Creek (n=1) and Panther Creek (n=1). These off-channel projects also included livestock exclusion fencing and riparian planting.

Population Monitoring

The Fisheries Department of the Yurok Tribe monitors juvenile salmonid populations in tributaries of the Lower Klamath River by trapping outmigrating juveniles, including coho salmon (Yurok Tribe Fisheries Program, 2009). A primary goal of YTFP is to restore habitats in the Klamath Basin to levels that support robust, self-sustaining populations of native anadromous fish. Primary roles of YTFP's Lower Klamath Division are to monitor

and assess fisheries populations and their habitats; identify factors currently limiting salmonid production; and integrate past and present data to further develop and implement meaningful and process-based restoration in the Lower Klamath River Sub-basin. Previous and ongoing monitoring projects include outmigrant trapping in Hunter Creek (1996-2001), Terwer Creek (2001-2005), McGarvey Creek (since 1997) and Blue Creek (since 1995); spawning surveys in Blue Creek (since 1995); regional and single stream juvenile coho salmon abundance surveys (since 2004); fish pathology monitoring in the lower river and estuary; and monitoring juvenile salmonid use, prey availability, and water quality of the estuary and its off-channel habitats. Current fisheries research projects include the Klamath River Coho Ecology Study, life history monitoring of salmonids in McGarvey Creek and assessing fish use of natural and constructed off-channel and slow velocity rearing habitat.
(see Appendix J and
http://www.yuroktribe.org/departments/fisheries/watershedrestoration.htm).

6.1.5 Middle Klamath River Recovery Unit

The Middle Klamath River extends from Iron Gate Dam to the confluence of the Salmon River.

Habitat Restoration

Most restoration work completed since 2004 has focused on fish passage improvements through, for example, culvert replacement (Table 5.2). The Mid Klamath Watershed Council (MKWC) and the Karuk Tribe have carried out habitat improvement on the South Fork Clear Creek. MKWC, in coordination with the Karuk Tribe and the USFS, have completed numerous projects to connect cold water tributaries to the mainstem of the Klamath River, providing non-natal rearing opportunities for coho salmon seeking refuge from high water temperatures in the Klamath River. In addition, MCWC has collaborated with the Karuk Tribe to enhance off-channel habitats along the Klamath River associated with tributary mouths crossing the floodplain. Projects to improve fish passage and fish screens associated with water diversions have been completed on Horse Creek and Seiad Creek.

Iron Gate Hatchery

IGH continues to produce coho salmon as mitigation for construction of Iron Gate and Copco dams , The annual mitigation production goal is 75,000 yearling coho salmon. , Coho salmon production at IGH is an important contributor to overall population abundance in the Klamath River system.

The *Recovery Strategy* outlines hatchery operation principles designed to minimize ecological, behavioral, and genetic impacts from artificial production. A first draft Hatchery and Genetic Management Plan (HGMP) for IGH was completed in 2009 and later drafts are currently under review by NOAA Fisheries. As of 2010, numerous

conservation elements from the HGMP are being implemented (prior to approval). The HGMP contains conservation measures designed to avoid impacts to listed species, preserve the genetic health of the natural and hatchery coho stocks in the basin, and enhance and accelerate coho salmon recovery. Conservation measures include operational modifications to avoid inbreeding and domestication, and to maximize fitness attributes of hatchery-origin coho salmon.

The total number of coho salmon adults entering IGH has varied from 1,734 in 2004 to 46 in 2009 (Table 6.2). The variability of available spawners resulted in the variable production of smolts from 2003-04 through 2010-11 (Table 6.3). Annual production from 2003-2010 exceeded the production goal of 75,000 coho salmon yearlings in five of the eight years. In two years production was well under the target, and in one year production was just slightly under the target. Overall, average production from 2003-2006 exceeded the 75,000-fish annual target by about 12 percent .

Table 6.2. Number of coho salmon entering Iron Gate Hatchery, 2004 through 2010.

Year	Females	Males	Grilse	Total
2004	865	630	239	1,734
2005	799	596	30	1,425
2006	151	112	69	332
2007	325	300	154	779
2008	770	508	18	1,296
2009	25	21	24	70
2010	235	193	57	485
Means	453	337	84	874

Table 6.3. Production data for Iron Gate Hatchery coho salmon, 2003-04 through 2010-11.

Season	Females Spawned	Total Egg Harvest	Yearling Production	Eggs per female
2003-04	197	502,048	74,714	2,548
2004-05	276	799,623	89,482	2,897
2005-06	103	295,101	118,487	2,865
2006-07	85	236,406	53,950	2,781
2007-08	124	316,155	117,832	2,550
2008-09	148	455,480	121,000	3,078
2009-10	20	53,435	22,236	2,672
2010-11	91	259,490	155,840	2,792
Mean	131	302,025	101,057	2,773

Bogus Creek

Bogus Creek is located on the south east side of the Klamath River just downstream of Iron Gate Hatchery (IGH) (between river mile 189 and 190) in Siskiyou County, near the Oregon border. The mouth of Bogus Creek is roughly 75 feet downstream of the entrance to the axillary ladder used to collected adult salmonid returns at IGH. As a result of the extremely close proximity of Bogus Creek to IGH there has been significant mixing of hatchery origin and natural origin salmonids from these two locations. The Department's Klamath River Project (KRP) operates a video fish counting facility and conducts spawning ground surveys (carcass surveys) on Bogus Creek during the coho salmon spawning season.

Bogus Creek, despite its small size, is particularly important because it is a major salmon spawning tributary of the Klamath River (Knechtle & Chesney 2013). A significant portion of natural escapement to the Klamath Basin would be unaccounted for if the Bogus Creek studies were not conducted. Since video operations began in 2004 the estimated escapement of coho salmon in Bogus Creek has averaged 184 fish. The run size of coho salmon during 2013 was estimated to be 446, 142.6% above the ten year average. The increase in brood year strength observed in 2013 can largely be attributed to the influence of IGH origin fish. Some adult coho stray into Bogus Creek after first entering IGH and are subsequently released as part of the surplus adult release program intended to reduce the demographic risk of extinction to the Upper Klamath coho salmon population unit.

The proportion of hatchery origin coho (HOR) in Bogus Creek has been estimated since 2004 and has ranged from 24% to 88% and has averaged 51%. As a result of hatchery management changes associated with IGH since 2010 surplus HOR adults have been released back to the river at the spawning building. During the 2010 season 60 adults were released from IGH but during 2011, 2012 and 2013, 259, 342, 896 were released respectively and this has significantly affected the proportion of HOR returns to Bogus Creek. Forty seven of the 174 (27.0%) coho salmon observed in the spawning ground survey upstream of the counting station were operculum punched, indicating that they were surplus coho salmon from IGH. However, spawning ground surveys may underestimate the proportion of surplus coho that enter Bogus Creek.

Utilizing total escapement, estimated proportion natural origin coho and estimated age structure of returning adult coho salmon to Bogus Creek allows for total spawner (hatchery plus natural origin) to natural origin recruit analysis for years 2004, 2005 and 2007-2010. The spawner recruit analysis is limited to six years of data, but indicates that the production of natural origin coho salmon in Bogus Creek may be limited to roughly 150 adults.

6.1.6 Salmon River Recovery Unit

The Salmon River recovery unit encompasses the Salmon River, a tributary to the Klamath River. The Salmon River currently has very low populations of coho salmon and suitable habitat conditions for juvenile rearing may be a limiting factor.

Habitat Restoration

Much of the habitat restoration completed on the Salmon River has been to reduce sediment delivery from roads. The USFS in cooperation with the Salmon River Restoration Council (SRRC) has completed several projects on forest service lands. The SRRC has also worked with private landowners in the watershed. Fish passage projects have been completed by Siskiyou County on Merrill Creek, Kelley Gulch and Whites Gulch. Two dams were also removed on Whites Gulch, with funding from NOAA Fisheries and the Department. Another focus has been to improve riparian areas by removing noxious weeds, primarily spotted knapweed. Since 2004, the SRRC has propagated and planted over 10,000 native plants and cuttings throughout the Salmon River at prioritized sites on federal lands.

6.1.7 Shasta Valley and Scott River Recovery Units

6.1.7.1 Shasta Valley

Habitat Restoration

The Shasta Valley Resource Conservation District (SVRCD) has taken the lead in implementing coho salmon recovery tasks in the Shasta River watershed. A total of 132 recovery projects were implemented by the SVRCD between 2004 and 2012.

Recovery actions included:

- Removal of fish barriers (2 summer flashboard permanently removed, actions initiated on a third, later also removed, along with remediation of one road barrier),
- Riparian fencing (approximately 9.3 km (5.8 miles) of additional fencing installed, along with one off-stream stock watering system),
- Fish screening (21 fish screens installed)
- Shade producing tree planting (one acre of riparian habitat was planted)
- Initiation of a major planning effort to identify and prioritize hot irrigation tailwater return to the river, along with multiple construction projects to begin addressing this long-standing problem.
- Multiple studies, including groundwater investigation and planning, irrigation efficiency studies, fish otolith studies, juvenile coho outmigration, rearing

behavior and distribution monitoring via advanced radio tracking, watershed assessment, development and joint implementation of a locally-based Shasta River Coho Emergency Action Plan, and the development and initial funding of a Shasta River water trust.

- Ongoing outreach along with the coordination needed to sustain this effort.

Recovery actions also included an effort to develop a watershed-wide coho salmon Incidental Take Permitting program as a partnership between CDFW and SVRCD. However, legal actions prevented the program from being implemented.

Voluntary efforts during this period included coordination with agricultural land irrigators to reduce water diversions and so increase instream flows to assist the out-migration of juvenile coho salmon .

Water conservation efforts in this watershed also included the purchase by The Nature Conservancy (TNC) of Big Springs and Nelson cattle ranches. Improvements in land and water management through these acquisitions have improved water quality conditions and assisted coho salmon recovery.

Population Monitoring

In 2005 the Department developed the Shasta-Scott Draft Monitoring Plan, which specifies priorities for long-term population monitoring in the Scott and Shasta rivers. The Plan's objectives are: i) develop statistically sound population estimates of adult and juvenile coho salmon, ii) identify successful coho salmon life history strategies and limiting factors, and iii) facilitate effective fish habitat improvement. The monitoring effort is consistent with recommendations in the *Recovery Strategy* concerning limiting factors and trends for coho salmon, the proposed anadromous salmonid CMP (Adams et al. 2011), and with prioritization of geographic locations for restoration.

An additional impetus for development of the Shasta-Scott Draft Monitoring Plan was the pilot program to address recovery issues associated with the agricultural use of water in the Shasta and Scott watersheds. On-going data collection activities began in 2001, and include estimating adult returns and juvenile outmigration to investigate status and trends in the smolt-to-adult ratios (Chesney et al. 2009).

Minimum adult escapements of adult and juvenile coho salmon in the Shasta River during the period 2004 to 2012 are provided in Figures 6.3 and 6.4 and Table 6.4. Adult coho escapements for the Shasta River are derived from video weir operations located approximately 0.3 km (0.20 mi) upstream from the Shasta River/ Klamath River confluence. Annual dates of operation are variable but attempts are made to operate the counting facility through the end of coho migration. Juvenile coho production estimates on the Shasta River are generated from rotary screw trap operation in the same location as the weir. Trap efficiencies are generated annually for 1+ coho using a mark and recapture estimate. In years when not enough coho are captured or marked

to generate independent trap efficiencies, the observed correlation between 1+ coho and steelhead smolt efficiencies from previous years is used to produce an estimate.

The estimated number of returning adult coho salmon has ranged from a high of 373 in 2004 to a low of nine fish (all males) in 2009, although this is a minimum estimate as high river flows at this time of year resulted in low trap efficiency. In 2010, an estimated 44 adult coho salmon returned to the Shasta River. The decline of the only relatively strong brood-year cycle, apparent in 2001, 2004 and 2007, to fewer than 50 fish in 2010 appears to indicate the possible extirpation of this brood year cycle, if conditions do not improve. Estimates of the remaining brood year cycles of adult coho salmon have in recent years been considerably fewer and extirpation is also possible.

Table 6.4. Adult Coho Salmon Escapement Estimates and Corresponding 1+ Juvenile Coho Production Estimates for the Shasta River since 2001. NA – data not yet available.

Brood Year	Number of Adults	1+ coho produced	Year of emigration	1+ per adult coho
2004	373	10,833	2006	29.04
2005	69	1,178	2007	17.07
2006	47	208	2008	4.43
2007	255	5,396	2009	21.16
2008	31	169	2010	5.45
2009	9	19	2011	2.11
2010	44	2,049	2012	51.57
2011	62	494	2013	7.97
2012	115	NA	NA	NA

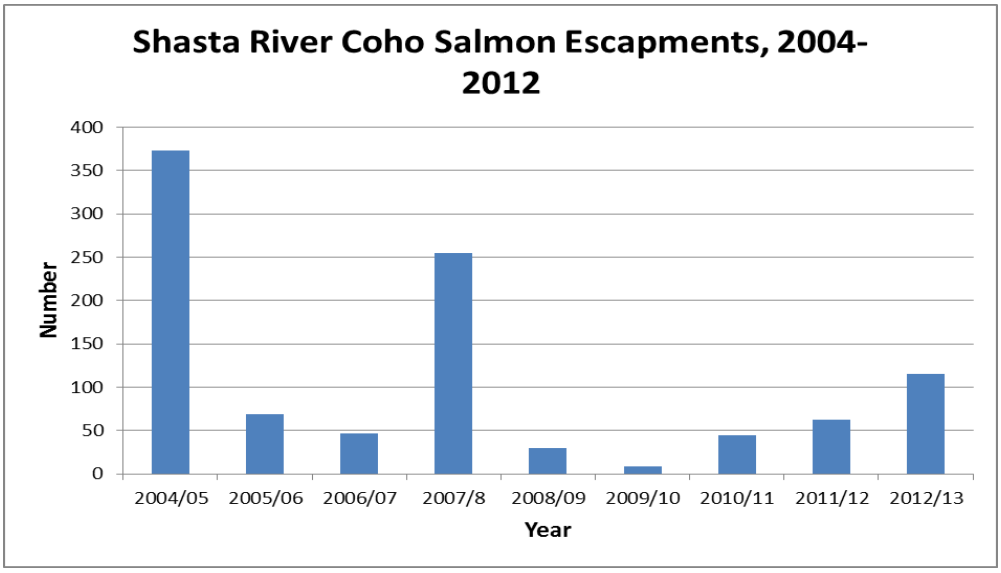


Figure 6.3. Shasta River Adult Coho Salmon Escapement Estimates, 2004-2012.

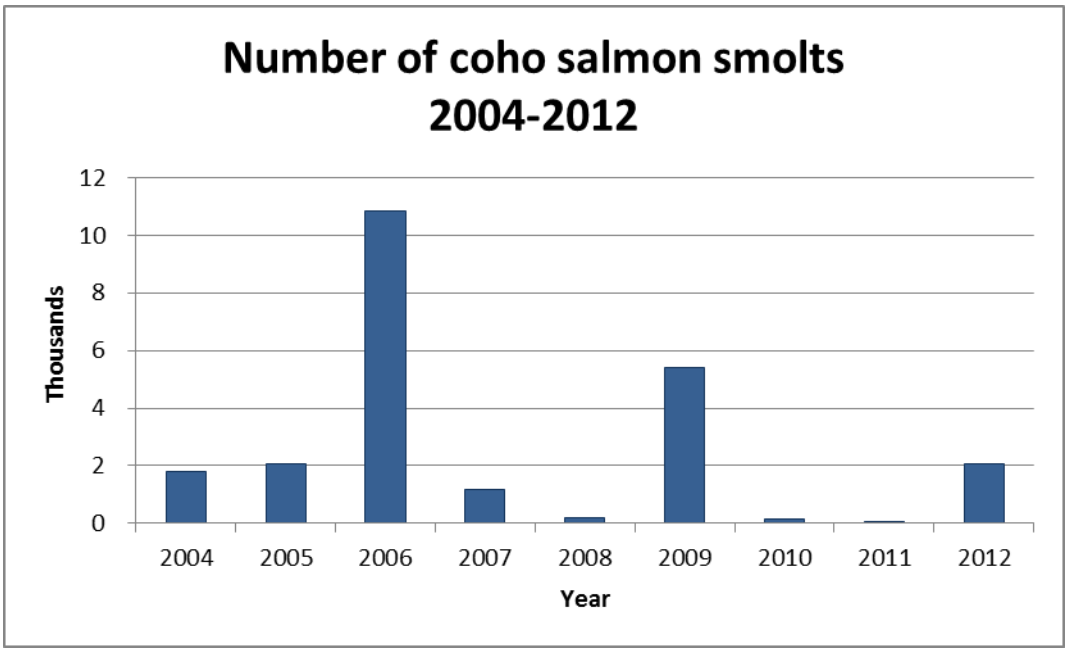


Figure 6.4. Shasta River 1+ Coho Salmon Production Estimates, 2004-2012.

Specific goals and objectives of the Department's Shasta-Scott Draft Monitoring Plan are:

1. Increase knowledge of basic life history requirements of salmonid species utilizing the Scott and Shasta watersheds.
2. Provide sound and statistically defensible data to estimate the number of adult and juvenile salmonids in the Shasta and Scott River basins.
3. Investigate factors that may be limiting salmonid populations, where possible.
4. Use limiting factor data to restore habitat and improve salmonid survival in both basins.
5. Work with local landowners and others to restore salmonid populations while allowing landowners to maintain their current way of life.
6. Identify the stream origin of coho salmon emigrating from the Shasta River and elucidate the significance of its role as a nursery area for Klamath River Basin juvenile coho salmon.
7. Identify the rearing areas of coho salmon within the Shasta River.
8. Quantify the contribution of age 0+ and age 1+ coho salmon to adult spawning populations returning to the Shasta River.

Fish monitoring techniques include; i) the use of rotary screw traps for capturing juveniles during the spring and early summer to obtain juvenile-production (juvenile population) estimates; ii) weirs, using visual and video graphic techniques to count immigrating adult salmon; iii) spawning adult carcass and redd surveys; iv) summer

juvenile counts combined with electro fishing verification in sub-watersheds to obtain a full juvenile production estimate; v) application of Passive Integrated Transponders (PIT tags) to monitor intra- and inter-basin movements and survival of juvenile salmonids, and vi) radio tracking of adults on the Shasta River to obtain information regarding spawning habitat and migration behavior. A summary of the results of these activities may be found in Chesney et al. (2009).

6.1.7.2 Scott River

Habitat Restoration

The Siskiyou Resource Conservation District (SQRCD) has taken the lead in implementing coho salmon recovery tasks in the Scott River watershed. The following summary is based on projects implemented by the SQRCD between 2004 and 2009. Ninety-four coho salmon recovery projects were funded. Approximately 10.8 km (6.7 mi) of riparian fencing was installed, 38 fish screens were installed, 22.1 hectares(ha) (54.5 acres(ac)) of riparian habitat was planted, 72.4 km (45 mi) of previously inaccessible fish habitat became accessible due to fish passage improvement projects, two alternative stock water systems were installed, 10 instream habitat improvement structures were installed, and 25 studies were funded. The studies included Scott River anadromous fish spawning assessments, Scott River thermal refugia analysis, juvenile coho salmon summer habitat utilization surveys, and a Scott River water balance evaluation.

Population Monitoring

Components of the Shasta-Scott Monitoring Plan discussed in the previous section are also currently being implemented for coho salmon population monitoring in the Scott River. These consist of monitoring adult coho salmon returns and smolt (1+ juvenile) production. Video-monitoring of adult escapements began in 2007. Escapements were not estimated prior to 2007. Instead, limited spawning ground surveys were conducted by a cooperative group, including the Department, FWS, USFS, Tribes and the SQRCD. Since large portions of available coho salmon spawning areas are located on private property, individual landowners may deny access thereby precluding complete spawning areas surveys. The data collected prior to 2007 are therefore limited in usefulness.

Complete estimates of adult coho salmon returning to the Scott River have only been available since 2007, and have ranged from a high of 1,622 in 2007 to a low of 63 in 2008, with 81 returning in 2009 and 927 in 2010 (Figure 6.5) Escapement counts are derived from video weir operations at river km 30 (mile 18) of the Scott River and spawning ground surveys downstream of the counting station. Estimates are the product of summing the number of coho observed passing through the counting station with the number of carcasses and adult coho observed during spawning ground surveys

downstream of the counting station (in both the mainstem Scott River and the tributaries). Annual dates of operation are variable but attempts are made to operate the counting facility through the end of the coho migration.

Juvenile 1+ coho salmon smolt estimates have been highly variable over the same period (Table 6.5). Juvenile coho production estimates from the Scott River are generated from rotary screw trap operation located approximately 5.5 km (3.5 mi) upstream from the confluence with the Klamath River. Trap efficiencies are generated annually for 1+ coho using a mark and recapture estimate. In years when not enough coho are captured or marked to generate independent trap efficiencies, the observed correlation between 1+ coho and steelhead smolt efficiencies from previous years is used to produce the estimate.

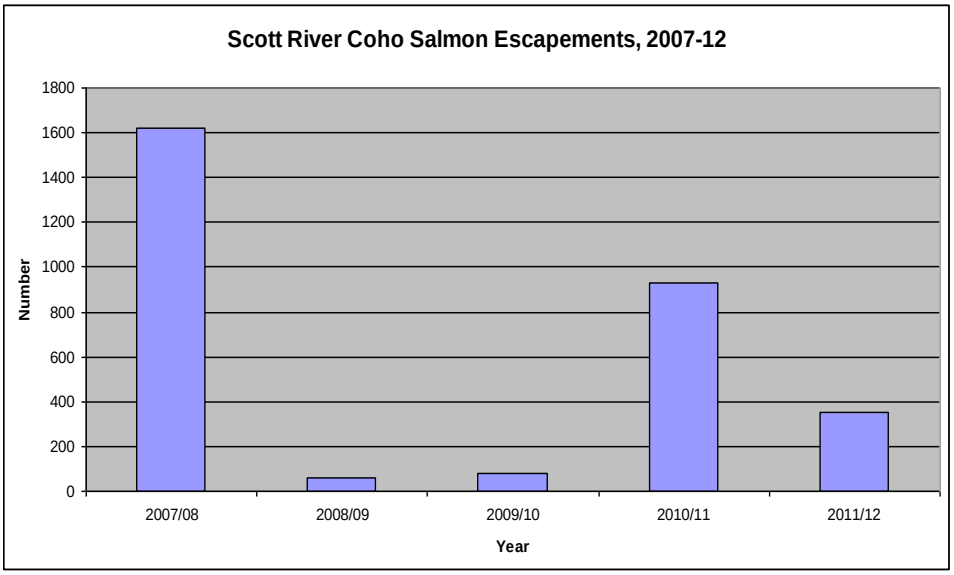


Figure 6.5. Scott River Coho Salmon Escapement Estimates, 2007-2012.

Table 6.5. Adult Coho Salmon Escapement and Corresponding 1+ Juveniles (smolts) Production Estimates for the Scott River since 2001.

Brood Year	Adult escapement	Number of 1+ juveniles produced	Year of emigration	1+ per adult
2001	NA	34,149	2003	NA
2002	NA	NA	2004	NA
2003	NA	1,660	2005	NA
2004	NA	75,097	2006	NA
2005	NA	3,931	2007	NA
2006	NA	941	2008	NA
2007	1,622	62,220	2009	38.36
2008	63	1,979	2010	31.41
2009	81	275	2011	3.4
2010	927	50,315	2012	54.28

6.1.8 Trinity River Recovery Unit

The Trinity River Hydrologic Unit constitutes the Trinity River Recovery Unit and includes the Trinity River mainstem and tributary channels located from the Trinity/Klamath confluence upstream to Lewiston Dam (river km 180.2, river mi 112). The Trinity Dam (TRD) is located approximately 11.2 km (7 mi) upstream from the Lewiston Dam. The Lewiston Dam blocks all anadromous fish passage on the mainstem Trinity River. Trinity River Hatchery (TRH), located just below Lewiston Dam, is operated to mitigate for the loss of anadromous salmonid habitat above the dam, and has an annual production goal of 500,000 yearling coho salmon for release into the Trinity River. The Trinity River recovery unit also supports naturally reproducing populations of coho salmon. Coho salmon utilize the mainstem channel as a corridor for upstream and downstream migrations, natural spawning, and juvenile rearing. Coho salmon also spawn and rear in Trinity River basin tributaries.

Habitat Restoration

The primary limiting factor for coho populations of the Trinity River has been identified as juvenile rearing habitat availability. Recent restoration activities intended to increase rearing habitat availability for coho salmon were prescribed in the 2000 Trinity River Record of Decision (ROD) and were first implemented in 2005. The ROD presents the culmination of over two decades of efforts aimed at understanding the necessary instream flow and physical habitat restoration requirements in order to improve the Trinity River for all anadromous salmon populations. These include: 1) increased flows and annually variable release flows from TRD; 2) physical channel rehabilitation, including the removal of riparian berms and the establishment of side channel habitat; 3) sediment management, including the supplementation of spawning gravels below the TRD and reduction in fine sediments which degrade fish habitats; and 4) watershed wide restoration efforts, addressing negative impacts from land-use practices in the tributaries and mainstem.

The first variable-flow releases from TRD were implemented in 2005. The annual discharge of variable-flow releases are based on forecasted hydrology for the Trinity River Basin for each year in April. The available water for release ranges from 369,000 acre-feet (af) in critically dry years to 815,000 af in extremely wet years. The increased flows are expected to improve habitat suitability for salmonids including coho salmon. Peak flow releases initiate fluvial geomorphic and riparian channel forming processes needed to improve mainstem channel habitats and also provide opportunities to inject spawning gravel to the system. Peak flows have ranged from 113.3 to 3115 cubic meters per second (4,000 to 11,000 cubic feet per second (cfs)). In addition, late summer season enhancement flows may be used to improve water quality in the Lower Klamath system.

Between 2004 and 2009, five habitat restoration sites were constructed on the mainstem Trinity River. Activities at each of these sites include channel widening, side channel construction, berm removal or modification, vegetation manipulation, large

woody debris addition, and gravel augmentation. Mechanical manipulation of the channel, coarse sediment augmentation and release of variable channel maintenance flows are expected to increase habitat quantity, quality, and diversity through rehabilitation of alluvial function. Benefits to coho salmon are expected due to the increased complexity of the available spawning and rearing habitat, increased habitat area in the form of side channels and backwaters, and a broader selection of preferred flow, depth, and temperature within habitat areas.

An important component of Trinity River habitat restoration is the addition of spawning size gravel to replenish the gravel being trapped behind Trinity and Lewiston dams. Gravel is important to replenish and build spawning areas, create channel bars to increase habitat complexity, and provide suitable substrate for riparian vegetation establishment. The addition of gravel and building of these features between 2004 and 2009 was intended to increase spawning and juvenile survival of all species of salmon, and of particular importance, naturally produced coho salmon. Approximately 408.1 million kilograms (kilos) (53,000 tons) of gravel was added to the river between 2004 and 2009. A majority of the gravel used for augmentation was acquired by sorting existing dredge tailing piles deposited during early gold mining activity. These dredge piles are located at numerous locations along the Trinity River. This method has been effective in supplying larger cobble for bar building, thereby generating suitable topsoil for riparian re-vegetation. Additionally, sorting and moving these dredge piles has helped reclaim floodplain habitat at these locations. Dredge tailing pile reclamation and gravel injections will likely continue annually for the foreseeable future.

The Trinity River has numerous tributaries important for coho salmon reproduction and rearing. Though the majority of habitat rehabilitation activities have been expended on the mainstem Trinity River, there have been several enhancement projects completed on tributary steams. Between 2007 and 2009, approximately 408,233 kilos (240 tons) of spawning-size gravel was added to Grass Valley Creek immediately downstream of Buckhorn Dam in an effort to supply gravel now being blocked by the dam. In 2008 a road crossing was modified on Grass Valley Creek to improve fish passage in a location where it was determined that passage may be a problem at certain flows. Since the passage improvement, coho salmon have been observed above the road crossing, and redds have been observed in the recently placed gravel. To date, habitat restoration programs totaling 4.5 million dollars have been carried out in tributaries of the Trinity River between Rush Creek and the South Fork Trinity River.

Population Monitoring

Juvenile and adult coho salmon populations within the mainstem Trinity River Basin are monitored by various agencies and tribes including the Department, FWS, USFS, Hoopa Valley Tribe and Yurok Tribe. Juvenile coho salmon monitoring is primarily accomplished using rotary screw traps on the main stem and fyke net traps in Hoopa Valley Reservation tributaries. These surveys have been conducted by FWS, Hoopa Valley Tribe and Yurok Tribe and have been continuous since 1995. Supplemental snorkel surveys were conducted by the Department in 2009 and 2010 in the upper

Trinity River to identify coho salmon distribution and habitat use (Sinnen et al. 2011). In 2012, a new study using snorkel surveys was initiated to estimate juvenile coho densities in the upper Trinity River.

Grilse and adult coho salmon returns to the Trinity Basin have been estimated continuously since 1977 and have been conducted by the Department using mark-recapture techniques. Fish are trapped and marked at mainstem weirs near the towns of Willow Creek and Junction City, located approximately 37 and 144.8 km (23 and 90 mi) upstream of the Klamath River confluence, respectively. Summaries of adult run-size estimates for 2004 -2012 are presented in Figure 6.6 and Table 6.6. The run size of both hatchery and natural coho salmon appear in a declining drift in recent years compared to peak numbers recorded earlier in the decade.

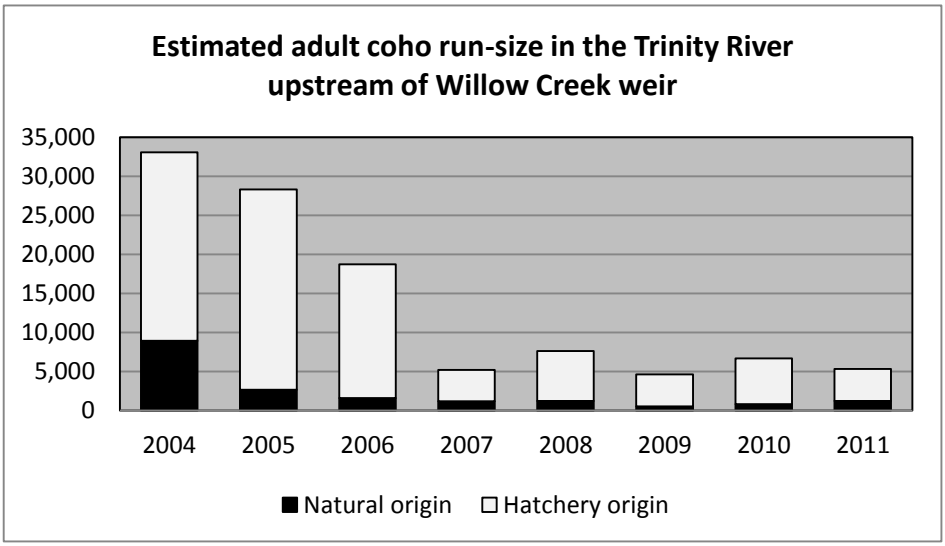


Figure 6.6. Trinity River Coho Salmon Run Size Estimates, 2004-2011.

Table 6.6. Trinity River coho salmon run-size estimates, upstream of Willow Creek weir, 2004 – 2011.

				Escapement Area	
Year	Grilse	Adults	Total	Natural	Hatchery
2004	5,819	33,063	38,882	27,859	10,983
2005	3,093	28,326	31,419	13,043	18,355
2006	1,369	18,709	20,078	9,578	10,500
2007	545	5,205	5,750	2,822	2,928
2008	2,379	7,603	9,982	4,794	5,188
2009	1,762	4,634	6,396	3,045	3,351
2010	1,278	6,669	7,947	3,522	4,425
2011	9,722	5,318	15,040	10,186	4,810
Mean	**3,246**	**13,691**	**16,937**	**9,356**	**7,568**

Mainstem Trinity River redd and carcass surveys are also conducted on a yearly basis. Though these surveys primarily target Chinook salmon and end prior to completion of coho salmon spawning, observations of coho salmon spawning are included in the data collection. These observations note that mixing of known hatchery and naturally produced coho occurs in the upper mainstem and tributaries located in close proximity to the hatchery (Sinnen et al., 2011). In 2011, approximately 60 percent of coho salmon carcasses observed during upper mainstem spawner surveys had right maxillary clips, identifying them as Trinity River Hatchery stock.

Hatchery Operations

Since 2005, the TRH has annually released approximately 500,000 coho salmon yearlings to meet mitigation and Tribal fishery obligations. The yearlings are marked with a right maxillary clip. The marking has enabled the Department to make independent estimates of hatchery and natural returns to the Trinity Basin. Summary information of coho salmon counted at the TRH is presented in Table 6.7.

Table 6.7. Summary of coho salmon trapped at Trinity River Hatchery, 2002-2011. The separation between adults and grilse is estimated by analysis of fork-length-frequency distributions.

	Adult Fish			Grilse			
Year	Males	Females	Total	Males	Females	Total	Totals
2002	3,538	2,957	6,495	602	101	703	7,198
2003	4,898	5,498	10,396	1,318	145	1,463	11,859
2004	4,716	5,190	9,906	1,038	39	1,077	10,983
2005	7,206	9,418	16,624	1,673	58	1,731	18,355
2006	4,531	5,308	9,839	561	100	651	10,500
2007	1,205	1,448	2,653	269	6	275	2,928
2008	1,960	2,579	4,539	616	32	648	5,187
2009	1,112	1,365	2,477	811	63	874	3,351
2010	1,634	2,265	3,899	444	82	526	4,425
2011	809	1,115	1,924	2,743	143	2,886	4,810
Mean	3,161	3,714	6,875	1,008	77	1,083	7,960

6.1.9 Trinidad Recovery Unit

The Trinidad recovery unit includes Freshwater, Big, and Stone coastal lagoons and their tributaries and the Little River drainage. Maple Creek (tributary to Big Lagoon) and Little River are the main coho salmon producing streams. The principal land use is industrial timber production.

Habitat Restoration

Most of the recent work in the Trinidad recovery unit has been in Maple Creek and Little River watersheds. PCFWWRA and GDRC have cooperated on upslope sediment reduction projects. In addition, large wood and riparian restoration projects have been completed in Maple Creek by Coastal Streams Restoration and the Humboldt Fish Action Council.

6.1.10 Redwood Creek Recovery Unit

The Redwood Creek recovery unit is a long, narrow unit that covers the Redwood Creek Hydrologic Unit in Humboldt County. Coho salmon are found in greatest numbers in Prairie Creek and other tributaries of the lower Redwood Creek recovery unit. The lower watershed contains Redwood National and State parks, while the mid-to-upper watershed is under industrial timber ownership.

Habitat Restoration

Restoration activities have concentrated on sediment reduction projects. Redwood National Park (RNP), the Bureau of Land Management (BLM) and PCFWWRA have aggressively decommissioned roads in the basin. Recent efforts have focused on the Lacks Creek watershed. Redwood National Park also completed fish passage projects on Streetlow Creek and North Fork Lost Man Creek. The North Coast Regional Land Trust with funding from the California Coastal Conservancy recently purchased the McNamara Property in the Redwood Creek estuary as a first step towards an estuary enhancement project. PCFWWRA in cooperation with private landowners, RNP, and the FWS have completed a planning project to restore non-natal coho salmon rearing habitat in Strawberry Creek a tributary to the estuary. Included in this project was a canary reed grass control and riparian restoration project.

Population Monitoring

The Department traps juvenile anadromous salmonids at two sites in Redwood Creek during the spring and summer emigration period (April – August). The lower trap site is located at approximately 3.8 km (2.3 mi) from the mouth just above the confluence with Prairie Creek. The lower trap has been operated each season from 2004-2009. The upper site is located approximately 33.6 km (20.2 mi) upstream from the mouth and captures salmonids from the 59 km (36.9 mi) of anadromous drainage upstream. The upper trap has been operated each season from 2000-2009 (Sparkman 2011 a,b).

The purpose of the monitoring program is to describe juvenile salmonid out-migration timing, partition the basin salmonid outmigration into that originating from the upper basin and lower basin, and estimate smolt population abundances for wild 0+ Chinook salmon, 0+ coho salmon, 1+ coho salmon, 1+ steelhead trout, 2+ steelhead trout, and cutthroat trout, using mark-recapture methods. The long term goal is to monitor the status and trends of out-migrating juvenile salmonid smolts.

For the first time, in 2007 six age 0+ young-of-the-year coho salmon were captured by the upper Redwood Creek trap indicating successful coho salmon spawning in the upper basin in that year. Abundances of age 1+ juvenile coho salmon migrants at the lower trap (above Prairie Creek) range between 102 and 879 over the five years of data (Figure 6.7).

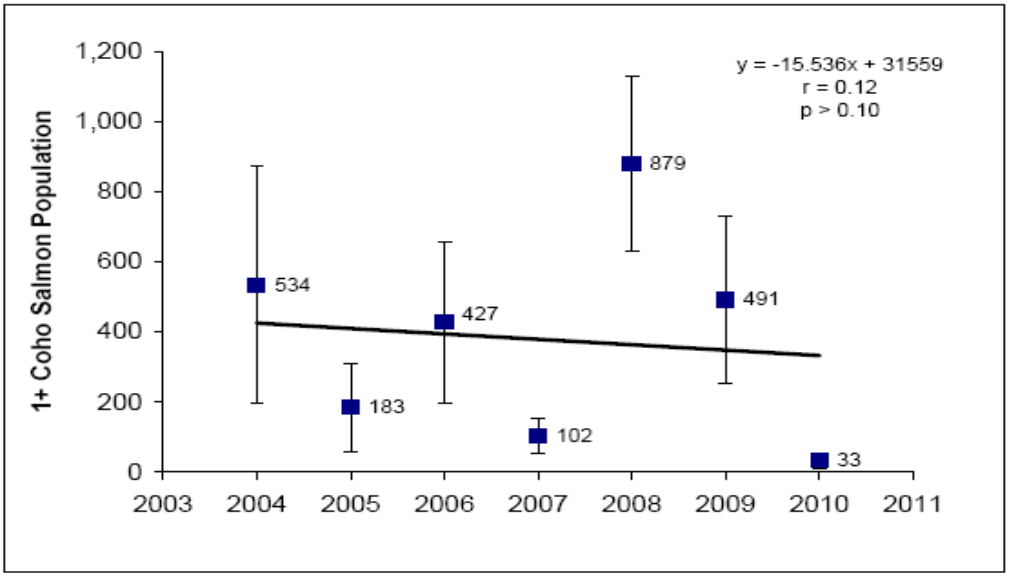


Figure 6.7. Population abundance estimates of 1+ coho salmon (error bars are 95% confidence intervals) in Lower Redwood Creek, 2004 – 2010. Source: Sparkman 2011a.

The Department initiated a survey in 2008 to estimate adult salmonid abundance within Redwood Creek; finalized data are not yet available. Additional salmonid monitoring within Redwood Creek, is conducted by the United States Geological Survey's California Cooperative Fisheries Research Unit at Humboldt State University, with funding from the FRGP. Prairie Creek Life Cycle Station is located in the largest tributary sub-basin to Redwood Creek. This project estimates juvenile summer salmonid abundance, spring smolt production and adult salmonid escapement estimates (Duffy 2008). Prairie Creek adult coho salmon escapement estimates are shown below in Figure 6.8.

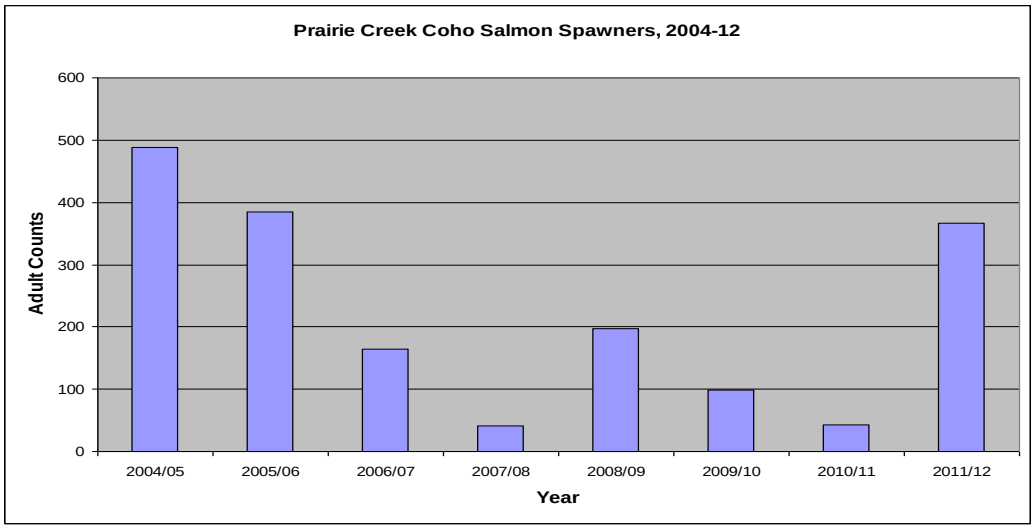


Figure 6.8. Adult coho salmon escapement estimates in Prairie Creek, 2004-12.

Watershed Assessment

A watershed assessment has been completed for Redwood Creek (Cannata et al. 2006). This assessment contains a detailed description of baseline watershed conditions, with good and poor aquatic habitat, and recommendations for addressing habitat deficiencies. As with other watershed assessments, this assessment document serves as a guide to focus restoration and habitat and species protection activities for the recovery of coho salmon.

6.1.11 Mad River Recovery Unit

The Mad River recovery unit is a long, narrow unit south of the Redwood Creek recovery unit that encompasses the Mad River watershed. The four tributaries supporting coho salmon in the lower Mad River watershed are Lindsay Creek, North Fork Mad River, Hall Creek and Canon Creek. BLM and USFS manage 39 percent of the watershed. The remaining 61 percent are in private ownership with two timber companies owning about half of the privately owned land.

Habitat Restoration

Major efforts have been made by Humboldt County, with funding from the Department and NOAA Fisheries, to improve fish passage in the Mad River. Projects have been completed on Lindsey, Grassy, Warren and Watek creeks. Humboldt Fish Action Council has also completed fish passage projects in Lindsey Creek and Hall Creek. Coastal Streams Restoration completed stream enhancement projects on the North Fork Mad River that included bank stabilization and large wood placement.

6.1.12 Eureka Plain Recovery Unit

The Eureka Plain recovery unit corresponds to the Humboldt Bay watershed, which encompasses four major tributaries and several smaller low-gradient tributaries that are used by coho salmon. The major Humboldt Bay tributaries include Jacoby Creek, Freshwater Creek, Elk River, and Salmon Creek, and all contain habitat well suited to support coho salmon. Principal land use includes industrial timber, agriculture, urban and rural residential development.

Humboldt Bay tributaries support populations of coho salmon, Chinook salmon, steelhead trout, and coastal cutthroat trout. Prior to the Department's Natural Stocks Assessment Project (NSA) studies, which began in 2003, little was known about juvenile salmonid use of Humboldt Bay or the sloughs and tidal portion of its tributaries. Recent studies conducted by NSA in the tidal portions of Humboldt Bay tributaries have shown that the stream-estuary ecotone habitat is heavily utilized by juvenile salmonids, including coho salmon.

Habitat Restoration

The City of Arcata has been active in coho salmon recovery through acquisition of property and restoration of the stream and riparian zones in streams flowing into Humboldt Bay. Projects include fish passage, livestock fencing, riparian planting and instream habitat improvement. The City of Arcata with funding from the FWS and NOAA Fisheries has completed restoration projects on Beith, Campbell, Jacoby, Janes and Jolly Giant creeks. Humboldt Fish Action Council has completed fish passage projects at three sites on the South Fork Janes Creek.

A comprehensive watershed restoration project has been completed on Rocky Gulch. The project included tide gate modification, channel reconstruction, fish passage at three sites, livestock exclusion fencing, riparian planting and road decommissioning in the upper watershed. Coho salmon were found in Rocky Gulch the first year after the tide gate was replaced with a fish-friendly gate. There have been numerous cooperators in this project including several key landowners, Humboldt County, FWS, NOAA Fisheries, GDRC and PCFWWRA.

Extensive upslope restoration has been completed on Freshwater Creek and Elk River and their tributaries by Trout Unlimited, PCFWWRA, Pacific Watershed Associates (PWA), Humboldt Redwoods Company, and Humboldt County RCD. Humboldt County completed a fish passage project on Graham Gulch. Humboldt Fish Action Council and the California Conservation Corps have modified log debris accumulations to provide fish passage and completed instream habitat improvement projects. The North Coast Regional Land Trust, FWS and Redwood Community Action Agency recently completed the Wood Creek Project to improve habitat in the Freshwater Creek estuary.

Case-Study. *Chad Creek Fish Passage Project*

Chad Creek is located in Humboldt County. The Chad Creek Highway 101 fish barrier was identified in an assessment and prioritization of Northern California state highway stream crossings carried out by Humboldt State University, California Department of Transportation (CalTrans), and the Department. The assessment identified that upstream passage of steelhead, Chinook, and coho salmon was blocked by high water velocities within the culvert and a 4.5 foot leap required for upstream migration.

In September 2011, juvenile coho salmon were observed upstream of the Highway 101 Chad Creek culvert for the first time since its construction 50 years ago. The successful retrofitting of this culvert to allow fish passage was made possible by a collaboration between the Department's FRGP and CalTrans. The success demonstrated by the return of coho salmon to Chad Creek represents the benefit to resources achieved through proper assessment and prioritization, clear standards for fish passage and design, multiple public and private entity partnership, effective funding mechanisms, efficient permitting, and post project validation monitoring.
See: http://www.dot.ca.gov/dist1/d1pubinfo/press/2007/07-093-photos.htm

The completed Chad Creek fish passage project.
CalTrans Photo

Case-Study. *Rocky Gulch Salmonid Access and Habitat Restoration Project.*

Rocky Gulch, a tributary to Humboldt Bay, is a small watershed of one square mile that was once home to trout and coho salmon, although those species have not been documented since the 1960's. The stream is now benefiting from a comprehensive, multi-phased restoration project which began with the installation of a new tide gate in the fall of 2004. The new gate replaced one that had acted as a barrier to fish migration for over 40 years. The channel rebuilding work included: restoration of the floodplain; the planting of native riparian plant species; installation of exclusionary livestock fencing; and the addition of several instream habitat structures. Also, two culverts are scheduled for replacement to eliminate the last barriers to fish migration in this watershed.

As part of the Rocky Gulch project, the antiquated tide gate was replaced with a new "fish-friendly" gate which allows unimpeded fish passage. Many benefits have been attributed to daily seawater intrusion past the gate but, undoubtedly the most exciting came in August 2005. Following the first winter with the new tide gate in operation, juvenile coho salmon, and steelhead and coastal cutthroat trout were positively identified in Rocky Gulch. Additional benefits to Rocky Gulch include the reduction of flooding, maintenance of salt marshes, enhanced fish habitat and fish migration, reduced impacts from cattle grazing, and increased plant diversity. This project serves as an example of successful stream restoration on many levels. The success of the project clearly illustrates the mutual benefits to private landowners and fisheries resources, and the feasibility to rapidly design and implement a large-scale project.
For final report see:
http://www.stream.fs.fed.us/fishxing/case/RockyGulch/Final_Report.pdf

Population Monitoring

Freshwater Creek, which drains into Humboldt Bay via the Eureka Slough, is a fourth order stream with a drainage area of approximately 9227 ha (31 square miles). The goal of the Freshwater Creek life-cycle monitoring station is to estimate fundamental population parameters essential for assessment of population viability (McElhany et al. 2000).The focus of the program is to estimate yearly abundance of adult and juvenile coho salmon (Ricker & Anderson 2011).

Adult coho salmon escapement to Freshwater Creek has declined from a high of 1,810 fish in 2002/03, to a low of just 89 fish in 2009/10 (Figure 6.9).

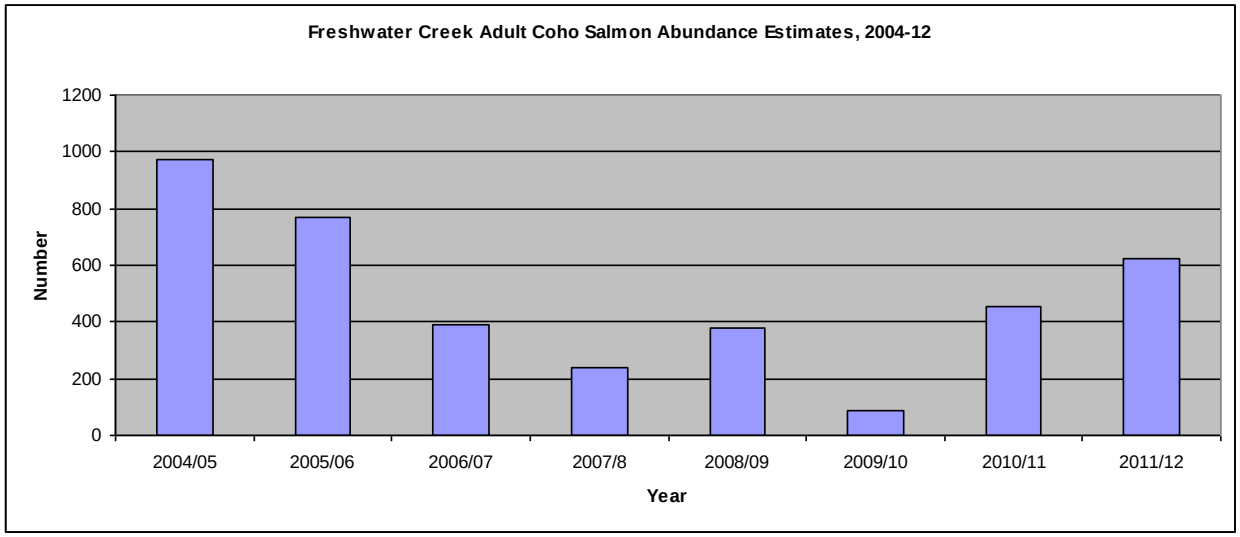


Figure 6.9. Adult Coho Salmon Abundance Estimates in Freshwater Creek, 2004-12.

There has been a clear and continuing downward trend in the abundance of adult coho salmon in Freshwater Creek over the period 2002 – 2010; with some increase over 2010 to 2012 (Figures 6.9 and 6.10). In addition, juvenile fall standing crop estimates have varied from 65,000 to under 15,000 juveniles. Estimates of spring smolt emigrants have remained relatively consistent over seven years at around 3,000 fish (range 2,376-3,600) (Ricker and Anderson 2011).

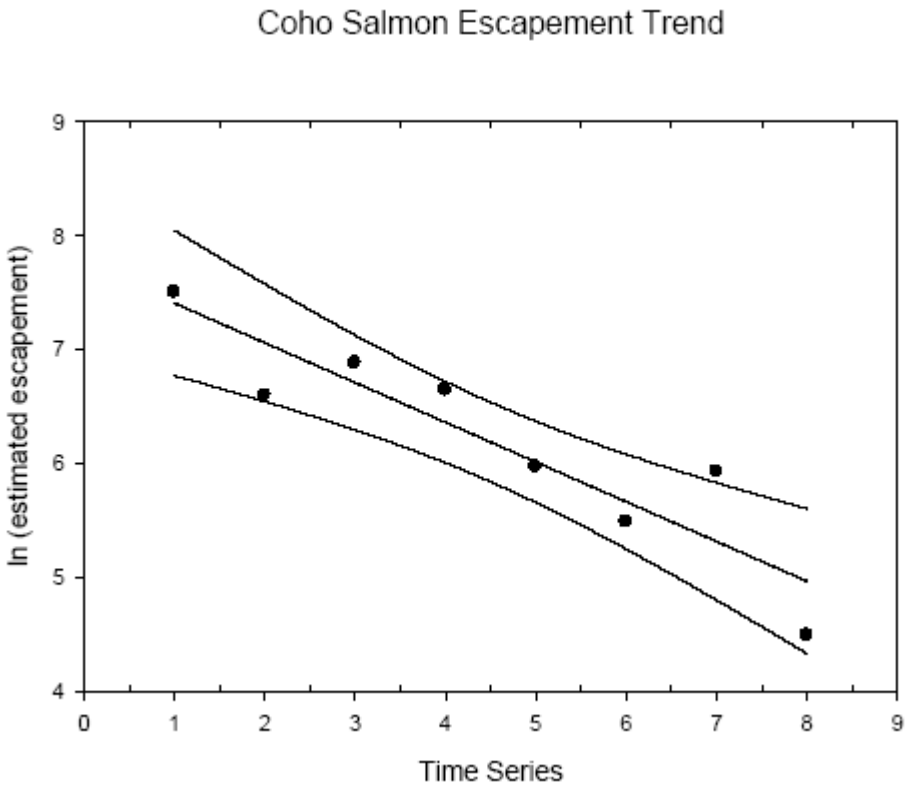


Figure 6.10. Scatter plot and regression of the log-transformed coho salmon escapement vs. the time series of available data, Freshwater Creek, 2002-2010. Source: Ricker and Anderson 2011.

Estuarine Rearing

In 2007, the Department's Anadromous Fisheries Resource Assessment and Monitoring Program (AFRAMP) and NSA estimated that 41 percent of coho salmon smolts and over 90 percent of large steelhead smolts originated from the stream-estuary ecotone of Freshwater Creek. In 2008, AFRAMP and NSA estimated that 38% of coho salmon smolts and 82 percent of large steelhead smolts originated from the stream-estuary ecotone of Freshwater Creek. These studies also showed that juvenile salmonids using this habitat experience faster growth, obtained a larger size, and likely experienced increased marine survival than juvenile salmonids rearing in stream habitat (Wallace and Allen 2012; CDFG 2008).

Wallace and Allen (2012) reported that juvenile salmonids, especially young-of-the-year coho salmon, rear in Freshwater Creek Slough for several months, though their abundance varies from year to year. Subsequent surveys in the tidal portion of other Humboldt Bay tributaries such as Elk River Slough, Martin Slough, Salmon Creek estuary, Wood Creek, and Rocky Gulch showed that juvenile salmonids, especially coho salmon, rear in the stream-estuary ecotone of these streams for several months using this important over-wintering habitat. This project has documented juvenile coho

salmon rearing in the tidal freshwater portion of Humboldt Bay tributaries throughout the summer. Some coho salmon continue to rear in the stream/estuary ecotone over the winter bringing their total estuarine rearing time to over a year.

Case Study. *Salmon Creek Delta Project.*

The Salmon Creek Delta Project is a relatively large scale FRGP funded estuarine habitat restoration project on lower Salmon Creek in Humboldt County. Salmon Creek is the third largest tributary to Humboldt Bay and is a tributary to Hookton Slough, located in Humboldt Bay National Wildlife Refuge. Salmon Creek historically supported large runs of coho and Chinook salmon as well as steelhead and coastal cutthroat trout.

Salmon Creek historically consisted of tidal salt marsh and complex slough channels, which provided important salmonid habitats. However, these lands were reclaimed for grazing during the early 1900's through construction of dikes and levees, draining of salt marshes, straightening or relocation of stream channels, and installation of tide gates to eliminate tidal influence. The lands were acquired by the U.S. Fish and Wildlife Service in the 1980's and became part of the Humboldt Bay National Wildlife Refuge. A management plan identified Salmon Creek as requiring habitat improvements to reestablish estuarine and off-channel stream non-natal rearing salmonid habitat.

The first phase of the project was completed in 2006 – 2008 and included the construction of two new adjustable tide gates to increase tidal influence and enlarge estuarine rearing habitat in Salmon Creek, providing unimpeded fish passage at all tide stages, and to improve drainage of stored floodwaters to reduce sediment deposition. Also, the project provided a connection of existing off-channel wetlands to Salmon Creek to create productive estuarine rearing habitat for coho salmon and other salmonids.

Phase 2 of the project, carried out in 2011, included creating 4,205 feet of tidal channel, converting 5,000 feet of ditched channel to backwater habitat, constructing 2.8 acres of new freshwater ponds, restoring 14 acres of salt marsh, and improving stream connectivity to seasonal freshwater habitat. Project implementation was intended to address high priority task EP-HU-10 identified in the *Recovery Strategy*. This task states, "In cooperation with willing landowners, restore and maintain historical tidal areas, backwater channels and salt marsh." The project was successful in achieving this goal.

Salmon Creek estuary artificial off-channel pond
DFG Photo: Mike Wallace

Salmon Creek estuary, Humboldt Bay
Photo credit: Pacific Coast Fish, Wildlife and Wetlands Restoration Association (PCFWWRA)

Case Study. *Wood Creek Habitat Restoration Project*

The Natural Stocks Assessment Project (NSA) of California Department of Fish and Wildlife recently assessed the performance of an estuarine habitat restoration project in Wood Creek, a tributary to Freshwater Creek Slough in Humboldt Bay, for coho salmon recovery.

In the early 1900's the marsh surrounding Wood Creek was diked, drained, and converted to pasture land, eliminating or reducing tidal influence and producing a single linear stream channel with little to no suitable habitat for coho salmon. Recent salmonid habitat restoration measures included removing a tide gate from the mouth of Wood Creek, creating a network of tidal channels in the lower portion of the project area, removing an undersized culvert and road crossing and replacing them with a bridge and constructing a new off-channel pond.

In 2010, the newly built off-channel pond supported large numbers of juvenile coho salmon throughout winter and spring. Therefore, creating additional low gradient habitat, especially in the stream-estuary ecotone where the Wood Creek restoration project is located, has provided important habitat for juvenile coho salmon and other salmonids. NSA found a seasonal pattern of young-of-the-year coho salmon moving into Wood Creek during the spring followed by a greater number of yearling coho salmon in winter months, suggesting that the pond provided important over winter rearing habitat for coho salmon both before and after project construction. Juvenile coho salmon throughout the Humboldt Bay watershed migrate, primarily downstream, to over-winter in low gradient habitat in the stream-estuary ecotone surrounding Humboldt Bay.

Wood Creek artificial off-channel pond
CDFW Photo: Mike Wallace

6.1.13 Eel River and Van Duzen River Recovery Units

Habitat Restoration

In the Eel River hydrologic unit, conservation easements have been secured on two large private properties that include anadromous reaches of Howe, Price and Atwell creeks. Riparian enhancement, livestock exclusion fencing, bank stabilization and instream improvement projects on Howe and Price creeks have been completed by landowners in cooperation with the Department, FWS and the Natural Resources Conservation Service (NRCS).

In the lower Van Duzen River, Humboldt County RCD, the Department and NOAA Fisheries have implemented bank stabilization and riparian projects. Trout Unlimited (TU), Humboldt County Department of Transportation, Pacific Watershed Associates (PWA), and the Yager Environmental Stewards (YES), a group of landowners in the middle Van Duzen River, have also implemented sediment reduction projects. In South Fork Eel River, California Department of Parks and Recreation has completed road decommissioning on much of Bull Creek and its tributaries. Eel River Watershed Improvement Group (ERWIG) and the California Conservation Corps have carried out stream habitat enhancement and riparian restoration projects on Bull Creek and bank stabilization and stream enhancement projects on Elk Creek. Restoration Forestry completed fish passage, sediment reduction and riparian projects on Seely Creek.

ERWIG has completed large wood projects on Sproul Creek, a fish passage project on Warden Creek a tributary to Sproul Creek and a bank stabilization project on China Creek. Eel River Salmon Restoration has implemented fish passage, bank stabilization and riparian projects on Leggett, Redwood and Miller creeks. The Redwood Forest Foundation, Inc. (RFFI) purchased the Usal Redwood Forest which includes tributaries to the South Fork Eel River. In cooperation with RFFI, TU, PWA and Campbell Global, LLC, road decommissioning projects have been carried out in Standley Creek. A major habitat restoration effort by TU, Mendocino Redwood Company, FWS and PWA has been undertaken in Hollow Tree Creek and its tributaries. Restoration work includes road upgrading, road decommissioning, fish passage and instream habitat enhancement

An Invasive Species is a Potential Threat to Coho Salmon Recovery

The Sacramento pike minnow (*Ptychocheilus grandis*) is an invasive species known to prey on juvenile coho salmon and other anadromous salmonids. The pike-minnow was introduced to the Eel River in 1979 and since then has spread throughout the drainage. It has also recently been recorded in Martin Slough in Humboldt Bay. If pike-minnow spread to other coastal drainages they may pose a serious threat to coho salmon populations and may inhibit species recovery.

Sacramento pike-minnow (*Ptychocheilus grandis*)
Photo: Dave Giordano

Population Monitoring

The Eel River is inhabited by coho salmon and the South Fork Eel River supports California's largest wild (i.e. non-hatchery) coho salmon population. Since 2010, monitoring for population and status trends are coordinated under the CMP.

Historically, the majority of Eel River coho salmon were spawned in tributaries of the South Fork Eel, Van Duzen River, Lower Mainstem Eel, and Outlet Creek. The current concentration of suitable coho salmon habitat and populations exists in tributaries to the South Fork Eel, where redwood forested watersheds with little water withdrawal support cool tree-shaded streams with adequate pools for shelter. Coho salmon populations are low outside the stronghold South Fork tributaries, and are absent from many of the sub-basin tributaries which were formerly occupied.

Sampling of coho salmon populations within the Eel River watershed has included historic fish-ladder counts at Benbow Dam, and spawner surveys in tributaries of the South Fork, main-stem, and Van Duzen River sub-basins. In recent years, coho salmon populations in many tributary streams have fallen to low levels.

Both the Recovery Strategy and federal coho salmon recovery plan call for monitoring spawning adults at the Eel River sub-basin scale. The CMP monitoring program estimates spawning coho salmon redd numbers by surveying randomly selected coho tributary stream sections throughout a sub-basin.

CMP population monitoring of coho salmon in the South Fork Eel commenced in 2010/11, when 1023 coho redds were recorded, equivalent to over 2,000 adult coho salmon (see Appendix B). This estimate is among the highest number of wild coho salmon currently recorded in any river in the State.

The Department plans ongoing CMP monitoring of coho salmon populations in the South Fork Eel River. Coho salmon population status, recovery planning, and delisting require the initiation of additional CMP monitoring projects, and further work within other Eel River sub-basins is under consideration.

6.1.14 Cape Mendocino Recovery Unit

Habitat Restoration

Many habitat improvement projects have been implemented by various groups in the Mattole River watershed, including the MSG, MRC, and Sanctuary Forest Inc. (SFI). Funding for those projects has come from the Department, the California Coastal Conservancy, Wildlife Conservation Board, CalFire, SWRCB and the North Coast Regional Water Quality Control Board (NCRWQCB), NOAA Fisheries, BLM, private foundations, and Mattole Basin landowners.

Population Monitoring

Two Mattole River plans were completed in 2009 by Mattole River watershed groups. The plans are the Mattole Salmon Group's Salmonid Population Monitoring Plan (Mattole Salmon Group, 2009), and the Mattole Integrated Coastal Watershed Management Plan. These plans, along with many Mattole River fisheries monitoring reports are available from the Mattole Salmon Group's web site: http://www.mattolesalmon.org/index.php/reports

This summary of coho salmon monitoring conducted in the Mattole River is primarily based on the Integrated Plan's Fisheries Companion Report and MSG's fisheries program data and reports.

Since 1981, the Mattole Salmon Group has conducted various types of annual fish monitoring surveys within the watershed. As of the 2008/2009 season, adult salmon and steelhead counts have taken place for 28 years, and juvenile salmon and steelhead have been monitored via downstream migrant trapping and dive surveys for 23 and 15 years, respectively.

Adult coho salmon population monitoring has primarily been conducted through redd/spawner surveys in index reaches rather than by a probabilistic sampling design. The reaches monitored have varied to some degree throughout the sampling period. Concentrations of coho salmon spawners observed in the Mattole River have generally been sparse. Carcass recoveries are few, and recaptures of previously marked spawners are rare, therefore mark-recapture methodologies are not suitable for coho salmon escapement estimates. During the period of 2004/2005 through 2008/2009, live adult coho salmon counts have ranged from three fish in 2009 to 86 fish in 2004. During the same period, coho salmon redd counts have ranged from nine to 68 (Figure 6.11, Table 6.8).

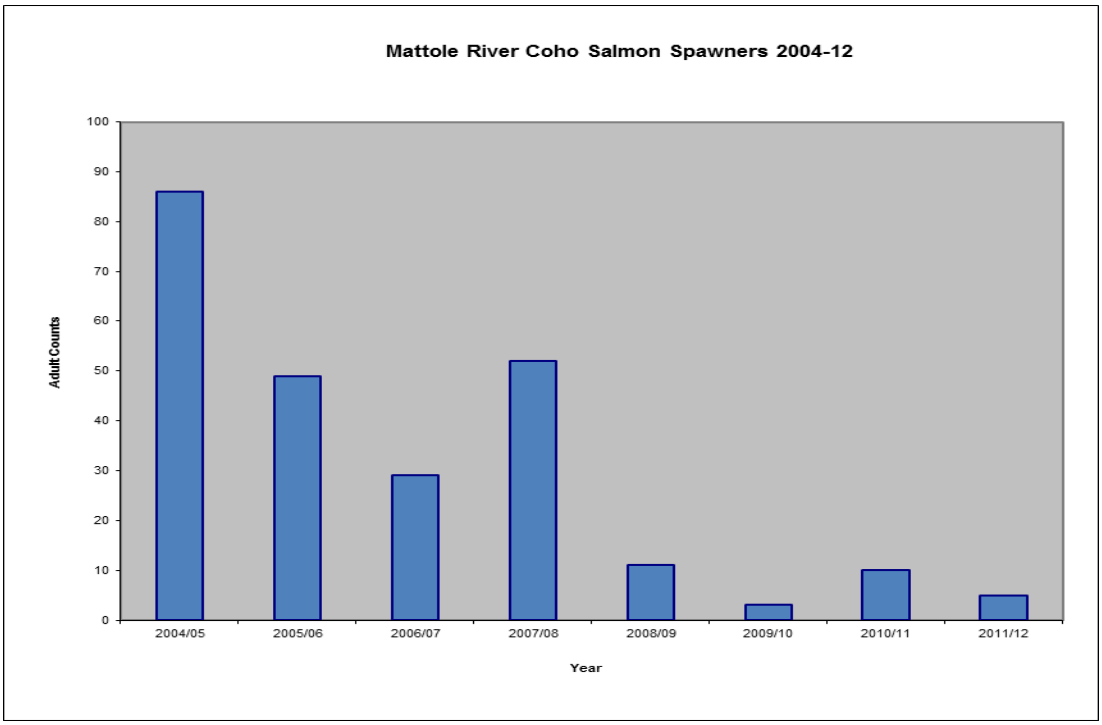


Figure 6.11. Adult coho salmon observed in the Mattole River, 2004-2012.

Table 6.8. Mattole River Observations of Live Adult Coho Salmon, Coho Salmon Carcasses, Definitive Redds, and Accumulated Survey Miles from Mattole Salmon Group Spawner Surveys, Seasons 2004 through 2011.

Season	Live Adult Coho Salmon Observations	Coho Salmon Carcasses	Number of Definitive Coho Salmon Redds	Accumulated Survey Miles
2004	86	29	68	99.3
2005	49	12	15	123.64
2006	29	6	18	100.76
2007	52	4	31	147.65
2008	11	0	9	139.83
2009	3	0	1	128.33
2010	10	3	5	177.93
2011	6	1	5	292.7
Mean	31	7	19	151.3

*Data provided by Mattole Salmon Group

Juvenile anadromous salmonid monitoring in the lower mainstem Mattole River has been conducted primarily by downstream migrant trapping. However, estimates of coho salmon smolt abundance were not made due to the low number of fish caught. Operational problems include the amount and timing of winter/spring rainfall, which affects emigration, and the timing of trap installation. The majority of Mattole River coho salmon smolt emigration is known to occur from early March to early May (MSG 2009). Both high stream flows and funding shortages at times have prevented initiation of trapping early enough in the spring to capture migrating fish.

Screw-trap monitoring of juvenile coho salmon in the Mattole River. Photo: Jim Korpi

6.2 Recovery Units in the Central California Coast Evolutionarily Significant Unit

6.2.1 Introduction

The CCC ESU includes six main recovery units: Mendocino Coast, Russian River, Bodega/Marin Coastal, San Francisco Bay, San Mateo Coastal and Big Basin. The CCC ESU includes historic coho salmon-bearing streams from Usal Creek at the northern end of the Mendocino Coast to Aptos Creek, south of Santa Cruz.

Since 2004, there have been numerous activities in the CCC ESU aimed at restoring and enhancing freshwater habitats, leading to recovery of coho salmon populations. A total of 146 projects benefiting coho salmon have been funded through the Department's FRGP and more have been carried out by other organizations. Many of these projects are being monitored for their effectiveness in remediating identified habitat-related problems. The FRGP project categories mostly funded through the FRGP in the CCC ESU include instream habitat restoration (56 projects) and organizational support (43 projects) (Table 5.2).

The Department routinely considers coho salmon during implementation of its regulatory programs and prioritizes projects, including implementation of CESA, responding to notifications for lake and streambed alteration, reviewing timber harvesting plans, review of projects under review by SWRCB, reviewing projects subject to the California Environmental Quality Act (CEQA) and participating in federal permitting processes on behalf of California's fish and wildlife resources.

Despite the numerous activities with potential benefits to coho salmon which have been carried out in the CCC ESU since 2004, coho salmon abundance and distribution in this ESU have experienced declines. Decreases in abundance have been particularly drastic since 2007, most likely partly associated with poor ocean survival acting on reduced populations with fragmented distribution. The declines were generally more pronounced to the south (for example Redwood Creek in Marin County and Scott Creek in Santa Cruz County).

NOAA Fisheries recently published a status review of CCC coho salmon (Spence and Williams 2011) which documented the further decline in coho populations in the CCC since the last status review was published in 2005. The report concludes that the risk of extinction for CCC coho salmon appears to have increased since 2005, when NOAA Fisheries concluded that the ESU was in danger of extinction.

Between 2004 and 2012, monitoring programs for coho salmon in the CCC ESU were underway in the Scott Creek, Santa Cruz mountains, Russian River, Lagunitas Creek, and Redwood Creek and in Mendocino streams (see Figure 3.1).

6.2.2 Mendocino Coast Recovery Unit

Habitat Restoration

The Mendocino Coast Recovery Unit is comprised of the coastal watersheds in Mendocino and Sonoma counties that are west and south of the Eel and Mattole river basins, and west and north of the Russian River basin. The northernmost anadromous stream is Whale Gulch in Mendocino County, and the southernmost anadromous stream is Russian Gulch in Sonoma County (not to be confused with the Russian Gulch in coastal Mendocino County). The larger river systems in the recovery unit include the Ten Mile, Noyo, Big, Albion, Navarro, Garcia, and Gualala rivers. Also included are numerous smaller streams draining directly to the Pacific Ocean, some of which have relatively high numbers of coho salmon.

In the Cottaneva Creek watershed, instream habitat enhancement has occurred through placement of log structures in the North Fork. In the South Fork, fish passage has been improved through replacement of a culvert with a bridge, and upslope sediment source control is in progress.

In the Ten Mile River basin, fish passage has been improved through replacement of culverts with bridges on several streams in the North Fork watershed. Upslope sediment source control has been implemented on riparian roads in the Little North Fork watershed. In the North Fork, Middle Fork and South Fork, instream habitat enhancement has occurred through placement of log structures.

In Pudding Creek, sediment source control has been implemented on riparian roads. In the Noyo River basin, instream habitat has been enhanced with log structures in the North Fork Noyo, South Fork Noyo, Kass Creek and Hayworth Creek and in underway in Little North Fork Noyo. Upslope sediment source control, though road upgrade and decommissioning, has occurred in the main stem, North Fork, Hayworth Creek, McMullen Creek, and Olds Creek.

In Caspar Creek, improvement of fish passage has occurred though the redesign and reconstruction of two fish ladders. Fish ladders were installed at both the South Fork and North Fork weirs in the Caspar Creek watershed in 2008, replacing the original wooden structures built in the early 1960's as part of a cooperative watershed study between Cal Fire and the PSW (Cafferata and Reid 2013).Three road decommissioning projects have been completed. In the Big River basin, instream habitat has been improved with log structures on East Branch North Fork Big, Daugherty Creek and Johnson Creek.

In the Albion River basin, fish passage has been improved by replacing culverts with bridges on the main stem and South Fork. Instream habitat has been improved with log structures in the main stem. Upslope sediment source control has been implemented in the South Fork watershed through road upgrading and decommissioning.

In Navarro River basin, instream bank stabilization has occurred on the main stem. Instream habitat enhancements using logs and boulders have been completed on Mill Creek and the North Fork. Upslope sediment source remediation has occurred in Little North Fork, North Branch North Fork, South Branch North Fork, Mill Creek, Jimmy Creek and Rancheria Creek.

In the Garcia River basin, instream habitat enhancement projects using logs and boulders have been implemented in the South Fork and Inman Creek. Riparian re-vegetation and bank stabilization has been implemented on the main stem. Upslope sediment control has been implemented in the watersheds of the South Fork, Fleming Creek, Inman Creek, Mill Creek and Pardaloe Creek.

In Gualala River basin, instream habitat enhancement projects using logs have been implemented in the Little North Fork, North Fork, and Rockpile Creek. Upslope sediment source control projects have been completed in the Little North Fork, North Fork, Robinson Creek, and Pepperwood Creek.

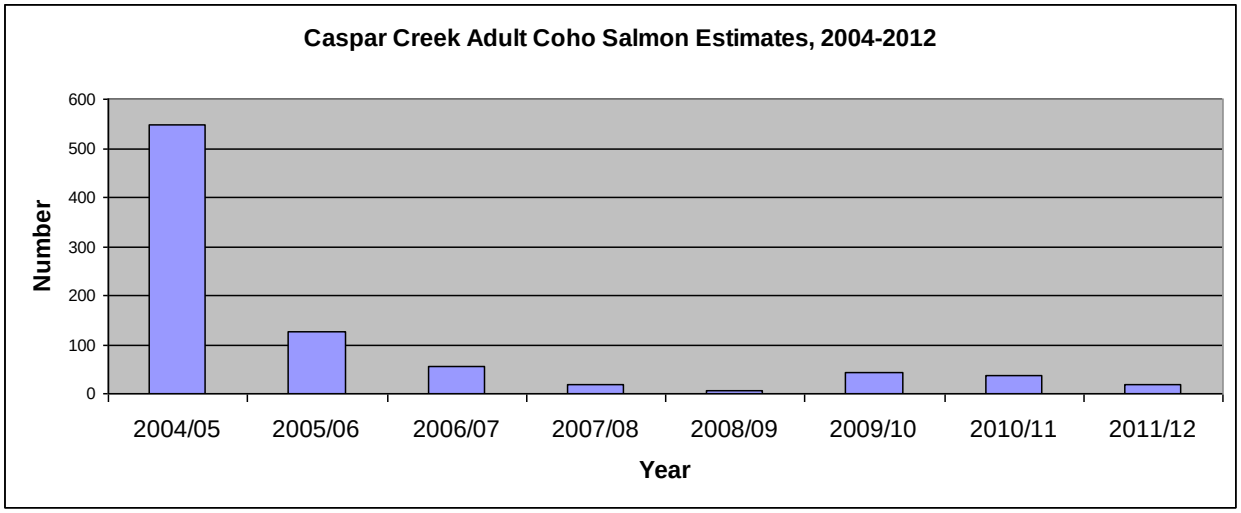
Population Monitoring

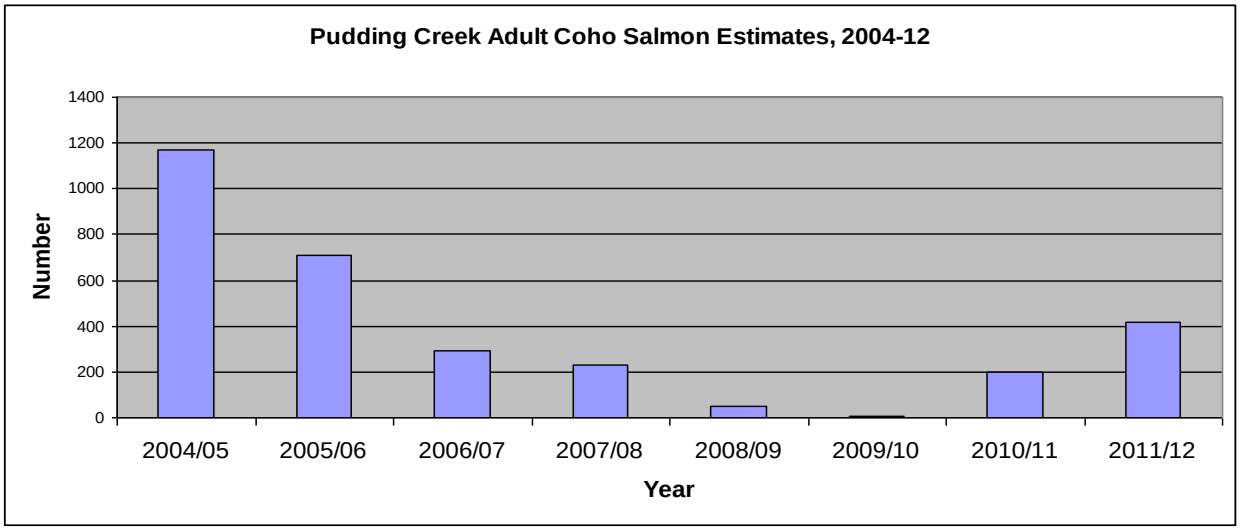
Coho salmon population monitoring in coastal Mendocino County streams has advanced significantly since 2004 (Gallagher and Wright 2011). Adult and smolt abundance monitoring in Caspar Creek and the South Fork Noyo and Little rivers constitute a nine-year time series. In 2004, the Department began working collaboratively with Campbell Global, LLC to estimate adult escapement in Pudding Creek (Figure 6.13). Also in 2004, NOAA Fisheries assisted with data collection in the South Fork Noyo River. During 2004 and 2005 the Department worked to further standardize data collection and analysis at these sites. Presently, coho populations are estimated annually from Usal Creek in the north to the Garcia River in the south.

Population estimates of the abundance of adult and juvenile coho salmon in coastal Mendocino streams from 2004 to 2010 are shown in Figures 6.12 and 6.13. The numbers of both adult and juvenile coho salmon have declined progressively in all monitored streams each year since 2004.

Taking coho salmon redd measurements (Pudding Creek).

CDFW Photo: Sean Gallagher





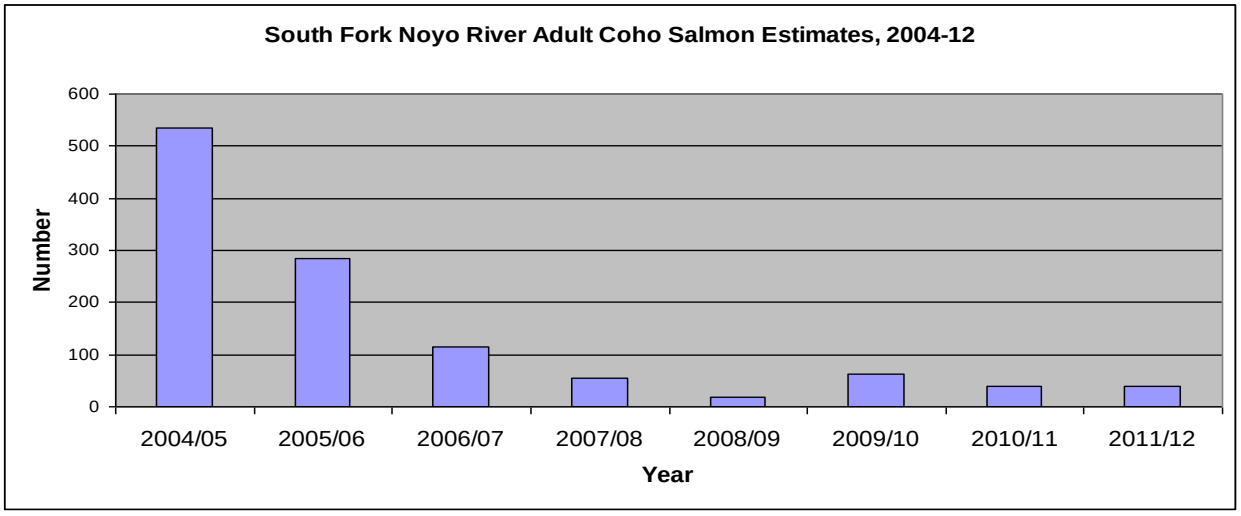
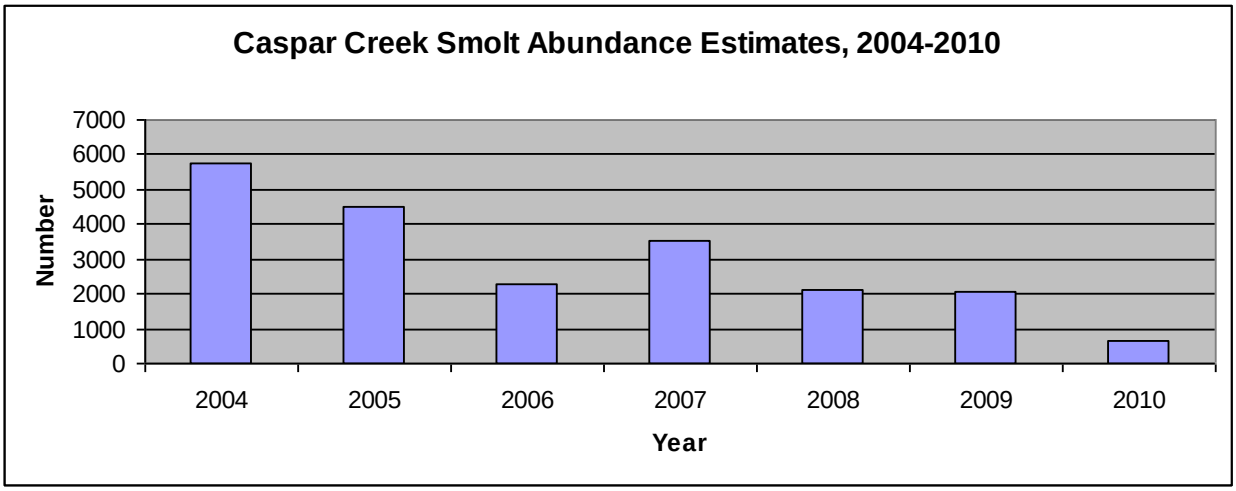
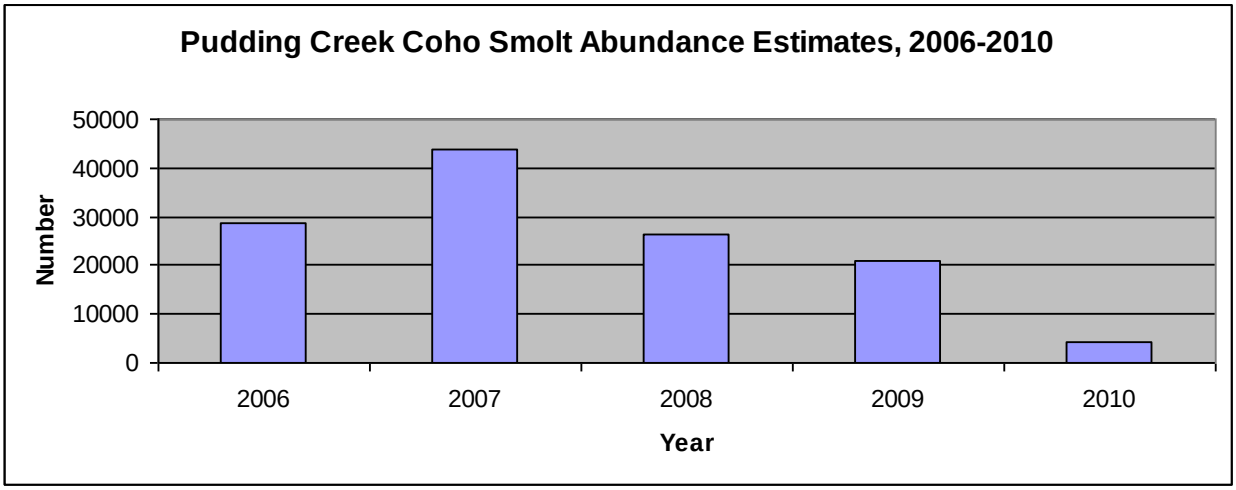


Figure 6.12. Adult Coho Salmon Escapement Estimates, Mendocino Streams, 2004-12





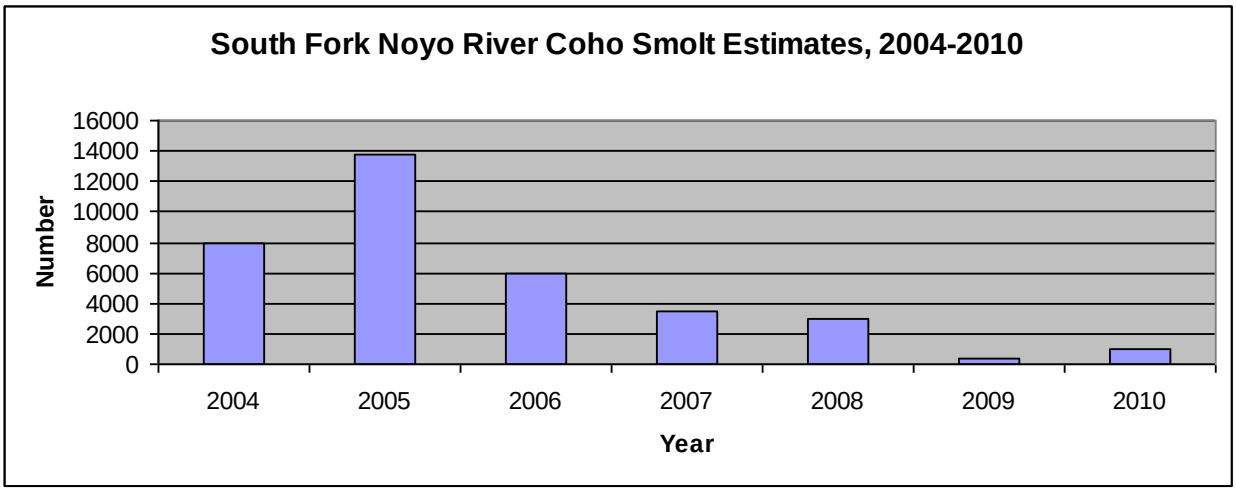


Figure 6.13. Coho Salmon Smolt Abundance Estimates, Mendocino Streams, 2004-2010.

Downstream migrant traps were used to estimate smolt abundance using capture-recapture methods. Traps were placed in the streams in early-March and checked daily until early-June each year. Smolt abundance was estimated using Darroch Analysis with Rank Reduction and a one-trap design (Bjorkstedt 2003).

6.2.3 Russian River Recovery Unit

The Department participated in the development of the NOAA Fisheries' *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance* for activities conducted by the USACE, SCWA, the Mendocino County Flood Control and Water Conservation Improvement District in the Russian River watershed. A final consistency determination on this project was issued by the Department in 2010. The Department continues to participate in oversight of implementation of the Biological Opinion. This includes review of monitoring reports, development of implementation project proposals, and review and permitting of implementation projects. The Department routinely reviews projects that may have adverse effects on coho salmon and issues permits containing conditions aimed at avoiding or minimizing such adverse effects.

The Department has participated in meetings of the Russian River Frost Protection Pumping Task Force (Task Force), established in 2008 to avoid take of listed anadromous salmonids which may result from water diversion for frost protection of grapevines. The Task Force is a collaboration of agencies, stakeholders, and public interest groups and is coordinated by NOAA Fisheries. The Task Force has been inactive since fall of 2009.

Habitat Restoration

More than 50 restoration projects intended to benefit coho salmon recovery have been funded through the FRGP in the Russian River watershed since 2004. These include GIS-based instream habitat data management to support basin planning, inventory and implementation of road-related and other erosion control projects, installation of instream structures and creation of instream habitat, culvert and other fish barrier improvements and replacements, invasive plant control and removal and other riparian zone restoration, construction of livestock exclusion fencing, bank stabilization projects, and monitoring activities in support of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP).

Population Monitoring

Systematic coho salmon monitoring in Russian River tributaries has been performed since 2004 by the UCCE and California Sea Grant Extension to evaluate the success of the RRCSCBP. Monitoring activities include summer juvenile surveys, outmigrant monitoring and adult monitoring (Obedzinski et al. 2009). Monitoring has been funded through FRGP grants from 2004-2009 and by the USACE since 2010. The number of coho salmon released into selected Russian River tributaries through the RRCSCBP has increased from 6,160 in three tributaries in 2004 to 172,000 in 20 tributaries in 2011.

More than 200 adult coho salmon are estimated to have returned to the Russian River system in 2010/11, increasing to over 450 in 2012.

Case Study. *Dutch Bill Creek Restoration*.
Implemented in 2009, this FRGP funded project was undertaken by the Gold Ridge Resource Conservation District (GRRCD), working with the Camp Meeker Recreation and Park District. The project involved removing the Camp Meeker Dam, which had been identified as one of the worst barriers to salmon and steelhead passage in the Russian River watershed. In place of the dam, a prefabricated 80-foot steel pedestrian bridge was installed, improving public access across the creek, and stream banks were stabilized and revegetated, along with creation of a more natural meander and grade change. These improvements will help return the natural transport of gravel from upstream and provide better fish habitat. The GRRCD also removed a culvert barrier to fish passage in nearby Occidental. For further information see: http://www.goldridgercd.org/watersheds/CampMeekerDamRemoval.

Dutch Bill Creek Fish Passage Improvement Project
Photo: Gold Ridge Resource Conservation District

Source: http://www.goldridgercd.org/project/dutch_bill_bid.html

Hatchery Operations

Coho salmon have been reared at WSH located at the base of Warm Springs Dam on Lake Sonoma as part of the RRCSCBP since 2001 (Conrad and Obedzinski 2006). Annual coho salmon production at WSH has increased to over 160,000 fingerlings in the year 2010.

Russian River coho salmon show evidence of a very high level of inbreeding due to extremely small population size. Since 2008, Russian River coho salmon have been intentionally and carefully out bred with coho from Olema Creek (Marin County) in an effort to increase diversity to mitigate founder effects and increase genetic diversity. The hatchery currently also rears a small number of coho salmon of Scott Creek origin (Santa Cruz County). The small number of fish reared of Scott Creek origin are for the captive broodstock program for Scott Creek. Only a very few natural-origin coho salmon have been observed in the Russian River system in the last few years. The vast majority of coho salmon in this system today are descendants of fish produced by the RRCSCBP.

Spring 2012 Update

Since 2010, the RRCSCBP has seen a significant increase in the number of returning adult coho salmon to Russian River tributaries (Fig.6.14). In addition, in 2011 the program recorded more than 5,300 naturally produced coho salmon juveniles in 23 tributaries (Fig 6.15). Although these numbers do not indicate recovery of the Russian River coho populations, they do show that captive rearing, under average or favorable environmental conditions, can effectively increase the abundance of coho salmon populations. The recent increase in adult returns is possibly due to improved marine survival of coho salmon since 2010 as a result of improved ocean conditions.

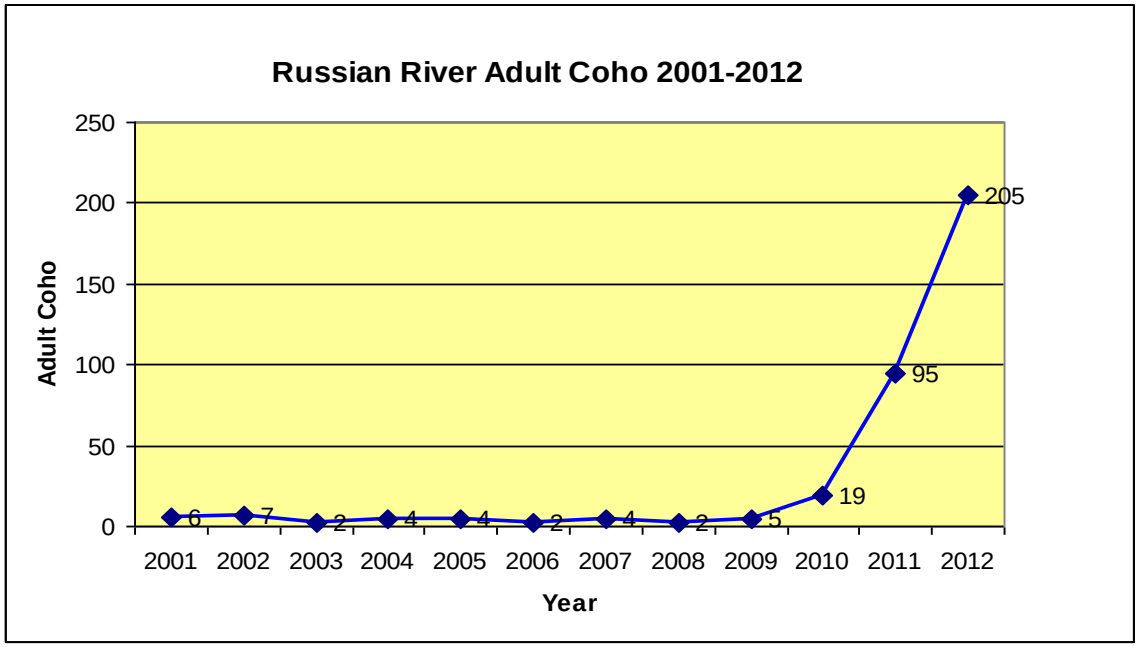


Figure 6.14. Russian River adult coho salmon returns, 2001-2012.

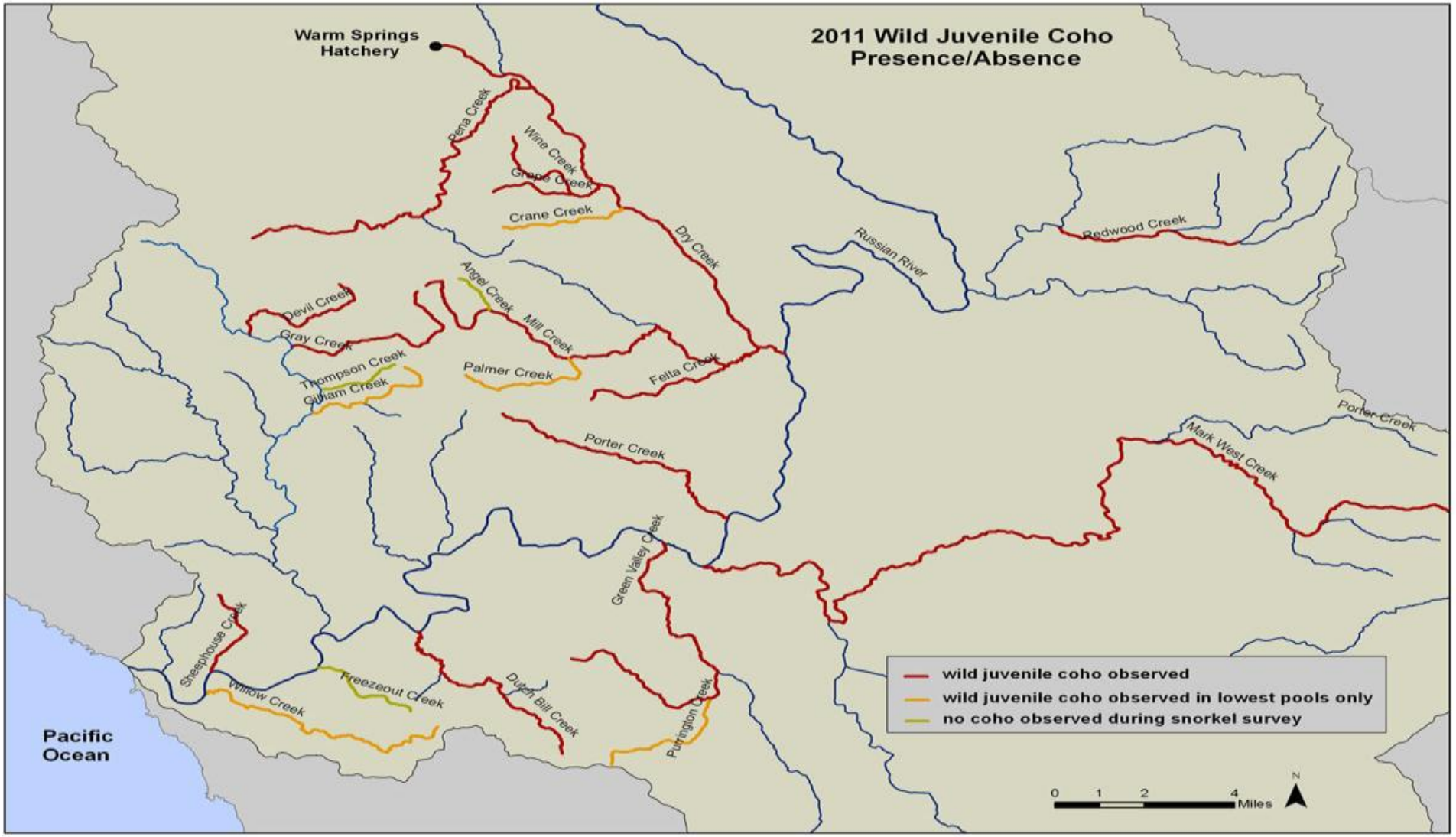


Figure 6.15. Distribution of juvenile coho salmon in Russian River tributaries, recorded in 2012.

Other Projects (text provided by Sonoma County Water Agency (SCWA)

In 2007, SCWA completed the *Draft Russian River Coho Salmon Recovery Strategy Implementation Plan* which identifies and prioritizes possible coho salmon recovery activities that could be implemented in the Russian River Recovery Unit under the existing regulatory framework. The plan was developed collaboratively by state, federal, county, and non-governmental organizations. Additional projects and activities in the Russian River basin have been funded by other entities.

The *Russian River Coho Water Resources Partnership* (Partnership), funded by the National Fish and Wildlife Foundation (NFWF), is working with its partners to study baseline streamflow conditions, develop water management plans, and develop priority infrastructure improvements in the Russian River watershed to benefit instream flow conditions (see text box below). As of June 2012, the Partnership's targeted outreach has yielded more than ten current or potential projects. Projects completed or in progress include (funding provided by NFWF unless otherwise indicated): installation of a fan to eliminate diversion of water for frost protection from on-stream flashboard dam at the Martorana Family Vineyard on Grape Creek (which also removed a fish passage barrier); an irrigation efficiency project that replaced an overhead sprinkler irrigation with a drip system on a vineyard along Purrington Creek in the Green Valley Creek watershed (estimated water savings is a minimum of 757,082 liters per year)(200,000 gallons per year); an irrigation efficiency project on a 8,094 square meter (2-acre) apple orchard adjacent to Purrington Creek; and a project planned for completion in 2012 to replace use of an on-stream pond on Grape Creek with an offstream storage reservoir that will mitigate the effect of frost protection and irrigation water use. Partners of these projects include NFWF, NOAA Fisheries, FWS, NRCS, SCWA, CDFW, RWQCB, UC Cooperative Extension and landowners. For more information on the Partnership, visit www.cohopartnership.org.

The California Coastal Conservancy has funded the Green Valley Creek Watershed Management Plan. The SWRCB has provided financial support for removal of invasive plant species and revegetation with native species in several tributaries, and one similar effort in Mark West Creek watershed has been funded by the City of Santa Rosa in 2005.

The SCWA has been engaged in additional activities that are likely to benefit coho salmon recovery in the CCC ESU, including studies of potential habitat improvements in Dry Creek, a feasibility study for construction of a pipeline for water transmission from Lake Sonoma, rearing and releasing annually 10,000 coho smolts into Dry Creek (2009 to at least 2023) and operating a rotary screw trap at Mirabel Dam since 2000 to monitor juvenile salmonids in lower mainstem Dry Creek.

Russian River Coho Water Resources Partnership

In 2008 and 2009, the NFWF and a number of organizations concerned about coho recovery came together as a "Partnership" and prepared the NFWF Keystone Initiative Business Plan for the Russian River Coho (March 2009). The goal of this initiative is to "return a viable, self-sustaining population of coho salmon to the Russian River watershed."

The Partnership is comprised of six organizations: Gold Ridge Resource Conservation District, Sotoyome Resource Conservation District, Center for Ecosystem Management and Restoration, Occidental Arts and Ecology Center, Trout Unlimited, and the UCCE program (Sonoma County) in partnership with the California Sea Grant. As of June 2012, NFWF has awarded the Partnership nearly $2 million to implement the business plan. The SCWA provides major support, currently valued at over $3.5 million, through implementation of habitat enhancement projects along six miles of Dry Creek, a major tributary to the Russian River, to improve rearing conditions for salmon and steelhead. The Partnership interfaces directly with federal and state regulatory agencies through a Technical Advisory Committee (TAC) that also includes local stakeholder representatives.

Because the keystone region incorporates the freshwater portion of the coho life cycle, the Partnership efforts focus on increasing juvenile survival to a level that supports a self-sustaining population of coho salmon in the Russian River watershed by restoring streamflow to critical reaches. The Central California Coast Coho Salmon Recovery Plan produced by NOAA Fisheries in 2008 set a goal of 10,100 returning adult coho to the watershed as signifying "population viability and final recovery." In support of this long-term adult recovery goal, the Partnership's initial efforts are concentrated on improving habitat for a consistent, naturally spawning population of adult coho in five core watersheds identified in the Department's and NOAA Fisheries coho recovery plans—Dutch Bill, Grape, Green Valley, Mill, and Mark West creeks.

The Partnership's goals in the Russian River watershed include: (1) restoring a more natural streamflow regime during the dry season, (2) increasing viability and numbers of coho salmon, (3) increasing water reliability for users in each priority watershed, (4) developing mechanisms for navigating the regulatory processes for water use and water rights, and (5) developing a watershed recovery model applicable to other watersheds throughout the state. These goals are attained through three key strategies: (1) water management plan development and implementation; (2) riparian/instream habitat enhancement, conservation, and augmentation; and 3) coho population augmentation, monitoring, and evaluation. The Partnership integrates landowner outreach and recruitment, hydrologic and fisheries monitoring, and water policy and permitting expertise to improve streamflow and water supply reliability in the core watersheds.

6.2.4 Bodega/Marin Coastal Recovery Unit

Watershed Assessment

A full watershed assessment for the Salmon Creek (Bodega HU) watershed was completed in 2007. Multiple road and upslope assessments were completed between 2006 and 2010. Additionally, in 2006 a full Tomales Bay watershed (Marin Coastal HU) stewardship and restoration plan was completed by the Tomales Bay Watershed Council. Habitat surveys were conducted in the Lagunitas Creek watershed (Marin Coastal HU) in 2007. Multiple road and upslope assessments were completed throughout the Lagunitas Creek watershed from 2004 to 2008. A full salmonid migration barrier assessment was completed for Marin County watersheds in 2006.

Case Study. *Giacomini Wetlands Restoration.*
This project was carried out in 2007 and 2008 by the NPS, funded by the Wildlife Conservation Board, and involved the restoration of tidal marshes within Tomales Bay in Marin County, located in the Lagunitas Creek watershed. It is hoped that the restoration of 222.7 ha (550 ac) of tidal marshes will have substantial ecological benefits to fish and wildlife and that the habitat improvements will benefit coho salmon recovery in the system. For further information see;
http://www.nps.gov/pore/parkmgmt/planning_giacomini_wrp.htm

Photo from NPS, taken by Robert Campbell, shows the extent of the new Giacomini Wetlands (222.7 ha, (550 ac)). The area in the photo' has been diked for over 60 years. See: http://pointreyesweekend.com/returning-tomales-bay-further-back-to-nature

Habitat Restoration

Since 2004, FRGP has provided funding for at least 50 projects intended to provide benefits to coho salmon in the Bodega and Marin Coastal areas. These included funding for FishNet 4C (ceased operations in 2012), a county-based salmon protection and restoration program that brings together the coastal counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey. Also, FRGP funding was provided for coho salmon population monitoring in Olema, Redwood, Pine Gulch, and Walker creeks, installation of large woody debris structures in the Salmon Creek watershed, bank stabilization and sediment reduction projects in various tributaries of the Lagunitas Creek watershed, riparian zone fencing and re-vegetation, fish passage improvement, and education and outreach projects.

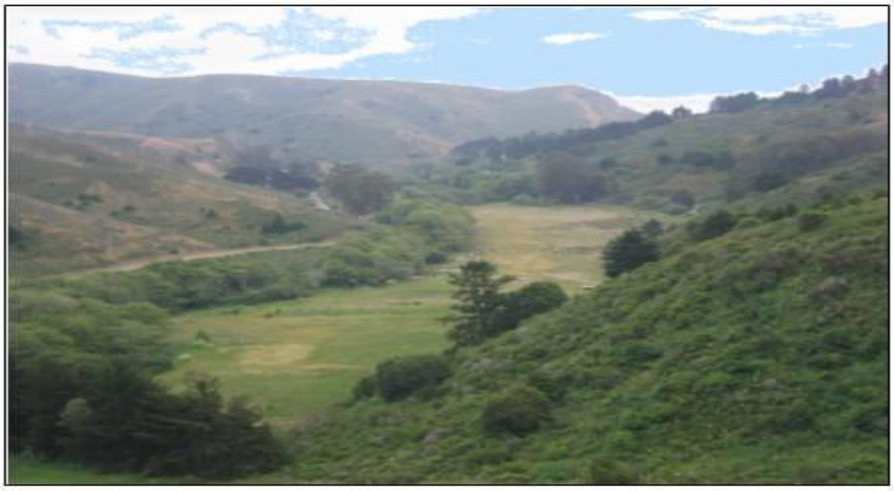
SPAWN has been the leader in water conservation education and implementation in the San Geronimo Creek watershed, located in the headwaters of the Lagunitas Creek system. A highly successful restoration of the Lagunitas Creek estuary (Giacomini Wetlands Project) was initiated and implemented by Point Reyes National Seashore, resulting in the restoration of 222.7 ha (550 ac) of tidal march floodplain at the confluence of Tomales Bay with Lagunitas and Olema Creeks (see text box). Habitat restoration and associated education and outreach programs have been conducted in Salmon Creek and Walker Creek, both coho salmon watersheds.

The Department has provided grant funding for habitat restoration and for salmonid population monitoring in Redwood Creek and Pine Gulch Creek in southern Marin County (see text box). Several other projects not funded through the FRGP are likely to provide significant benefits to coho salmon populations in the Bodega and Marin Coastal HUs. These include the Salmon Creek Ranch Enhancement Plan to reduce sedimentation, improve riparian habitat and stabilize eroding banks in Salmon Creek, creation of a Salmon Creek Watershed Management Plan funded by the SWRCB, and an extensive project to address limiting factors in Salmon Creek through riparian vegetation enhancement, installation of large wood debris structures, stream flow augmentation through water conservation practices, and reduction of fine sediment delivery.

Case Study. *Redwood Creek/Muir Beach Restoration.*
The restoration of Muir Beach and Redwood Creek is a FRGP funded project. Proposed actions and benefits: TheNPS, in cooperation with Marin County, is undertaking a wide variety of site improvements in lower Redwood Creek and Muir Beach in Marin County. This project is on the level of the Giacomini restoration project in Point Reyes. While significantly enhancing habitat for threatened and endangered species, including coho salmon, the changes to natural areas will restore ecological processes to the site that have been missing for decades. For further information see:
http://www.nps.gov/goga/naturescience/muir-beach.htm

Case Study. *Lower Redwood Creek Floodplain and Salmonid Habitat Restoration – Banducci Site.*

The purpose of this FRGP funded project in the Golden Gate National Recreation Area in Marin County is to restore natural hydrological processes to the project area for the benefit of aquatic and terrestrial fauna and for long-term creek recovery. Goals are to: 1) enhance summer rearing and winter refuge habitat for federally endangered coho salmon and federally threatened steelhead; 2) restore channel and floodplain connectivity, 3) create sustainable breeding habitat for the federally threatened California red-legged frog; 4) to restore tributary connections to the creek corridor, and 5) create self-sustaining conditions that minimize the need for maintenance. For further information see; http://www.nps.gov/goga/parkmgmt/banducci_restoration.htm



Looking downstream over the 28-acre agricultural field called the Banducci Site. Muir Woods Road and Redwood Creek are to the left of the field.

Photo: National Parks Service

Source: http://parkplanning.nps.gov/projectHome.cfm?projectID=15658

Population Monitoring

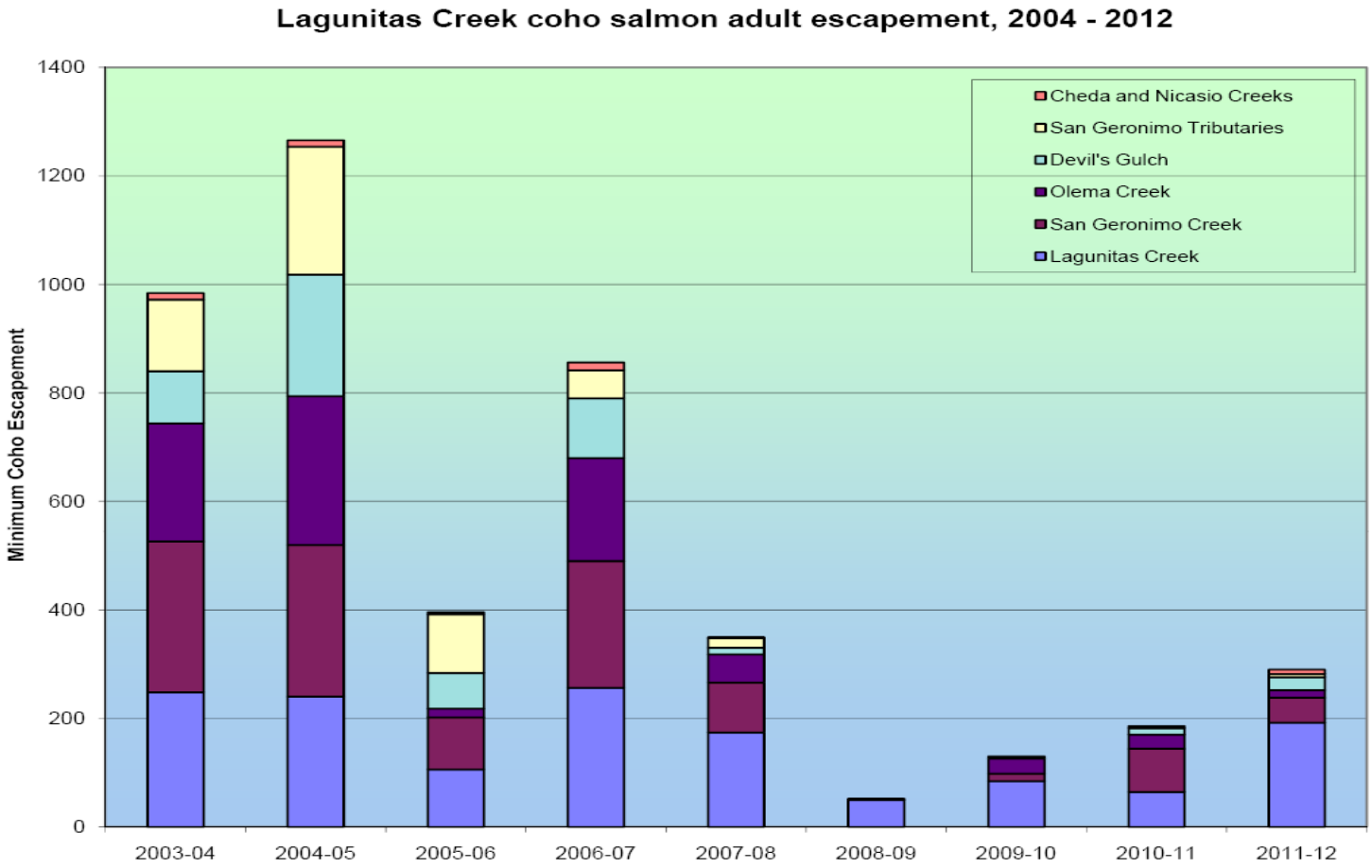
Systematic long-term monitoring of coho salmon populations in the Lagunitas/Olema Creek watershed as well as Redwood and Pine Gulch creeks (Marin Coastal Recovery Unit) has been performed since 1992 by MMWD, NPS and PRNSA. In addition, monitoring of coho salmon has been performed by MMWD in the Walker Creek watershed (Bodega Recovery Unit), with funding from the FRGP from 2006 to 2008, and sporadically before 2006.

Monitoring activities in Walker Creek were associated with annual adult and juvenile coho salmon releases in the years 2004 to 2008. Sporadic and opportunistic salmonid surveys were also performed in Salmon Creek (Bodega Recovery Unit), specifically following adult coho releases in winter 2008. Monitoring in Walker and Salmon Creek showed that coho salmon released as adults spawned successfully, although at levels too low to establish self-sustaining populations.

Coho salmon monitoring in Lagunitas/Olema Creek system by MMWD, NPS and SPAWN has shown a decline in adult escapement and coho salmon redds over the years 2004-2009, with some recent increase over 2009-2011 (Figure 6.16, Table 6.9) (Ettinger and Andrew 2012; Pincetich et al. 2009; Reichmuth et al. 2011). The decline in adult coho salmon returns in Lagunitas Creek started in 2007-2008, with a low in 2008-09. Both year classes were affected by the 2005 and 2006 decline in ocean productivity.

A SPAWN salmon monitoring team checks the monitoring station in San Geronimo Creek in Lagunitas Creek watershed.

Photo: Chris Pincetich, SPAWN.



Escapement = twice the numbers of coho redds.

Source: Marin Municipal Water District, National Park Service, and SPAWN.

Figure 6.16. Adult coho salmon escapement in the Lagunitas Creek watershed, 2004-2012.

Table 6.9. Coho salmon escapement estimates in the Lagunitas Creek Watershed*.

Minimum Coho Escapement in the Lagunitas Creek Watershed

Years	Lagunitas Creek	San Geronimo Creek	San Geronimo Tributaries	Devil's Gulch	Olema Creek	Cheda and Nicasio Creeks	Total
1982-83	130	94	No Data	54	No Data	No Data	278
1995-96	140	12	No Data	20	No Data	No Data	172
1996-97	196	230	No Data	82	No Data	No Data	508
1997-98	160	214	28	104	268	No Data	774
1998-99	184	92	28	64	46	No Data	414
1999-00	278	116	6	6	20	No Data	426
2000-01	238	112	36	22	160	No Data	568
2001-02	158	204	86	118	118	6	690
2002-03	142	78	44	48	40	2	354
2003-04	248	278	132	96	218	12	984
2004-05	240	280	236	224	274	12	1266
2005-06	106	96	108	66	16	4	396
2006-07	256	234	52	110	190	14	856
2007-08	174	92	18	12	52	2	350
2008-09	50	2	0	0	0	0	52
2009-10	84	14	0	4	28	0	130
2010-11	64	80	4	12	26	0	186
2011-12	192	46	6	24	14	8	290
1995 - 2012 Averages	**171**	**128**	**52**	**60**	**98**	**5**	**515**

Notes:
Minimum escapement is assumed to be two spawners per redd.
Survey data provided by Marin Municipal Water District, unless noted otherwise.
Lagunitas Creek is surveyed from Nicasio Creek to Peters Dam.
San Geronimo Creek is surveyed from its mouth to its confluence with Woodacre Creek.
Devil's Gulch is surveyed from its mouth to an impassable cascade two miles upstream.
Olema Creek & Cheda Creek data is provided by Point Reyes National Seashore.
San Geronimo tributaries: Arroyo Creek, Larsen Creek, Evans Canyon, Woodacre Creek, and San Geronimo Creek above Woodacre Creek; data provided by SPAWN.

Source: Marin Municipal Water District, National Park Service, and SPAWN.

* Coho salmon escapement estimates were based on redd surveys carried out weekly during the coho spawning season and escapements were estimated by assuming two spawners per redd.

Hatchery Operations

There are currently no hatchery operations for coho salmon in the Bodega/Marin Coastal Recovery Unit.

Other Projects

In 2010, field biologists from the Department and PRNSA collected approximately 200 juvenile coho salmon from Olema Creek to be reared at Warm Springs Hatchery. The majority of these fish will be reared to maturity and released back into Olema Creek. Some of the coho may be used as broodstock in the continuing systematic outbreeding of Russian River coho broodstock. Collection of a small number of juvenile coho salmon from Olema Creek will continue for at least two more years to complete the brood-year complement.

6.2.5 San Mateo Recovery Unit

Watershed Assessment

Three watershed assessments were completed between 2003 and 2010, the Pescadero-Butano Watershed Assessment (2004), Gazos Creek Watershed Plan (2003) and the San Gregorio Creek Watershed Plan (2010). Each assessment describes limiting factors for sensitive species including coho salmon at Pescadero-Butano Creek, Gazos Creek and San Gregorio Creek watersheds, respectively, and propose ways to address these limiting factors.

The FRGP program and Environmental Protection Agency have also funded studies to complete two instream flow and habitat studies on San Gregorio Creek in order to provide a basis for instream flow restoration, specifically for permitting terms for cooperative streamflow restoration projects with landowners. Streamflow in Pescadero Creek is being monitored by the Center for Ecosystem Management and Restoration with support from the California Coastal Conservancy and the Integrated Watershed Restoration Program.

Habitat Restoration

In the San Mateo Coastal HU, several projects in the Pescadero Creek watershed have focused on improving roads to reduce fine sediment delivery, removing a seasonal diversion dam and replacing use of diverted stream water with groundwater as drinking water supply, removing dams/barriers, replacing culvert/barriers with free span bridges, increasing late summer stream flow conditions by improving irrigation efficiency, modifying agricultural diversions and developing conjunctive use projects and collecting baseline habitat data. In San Gregorio Creek, a variety of partners are working to improve instream flow through a project to improve irrigation efficiency and reduce dry

season use through expanded agricultural pond storage. In Gazos Creek, rural road improvement projects have been funded to reduce fine sediment input.

CDFW and NMFS are working together on short term and long term solutions to water quality issues associated with the early winter sand bar breaching event in the Pescadero lagoon, which is the cause of an annual "fish kill" of juvenile steelhead and other fish species. This highly productive lagoon offers important rearing area for juvenile salmonids. Addressing this non-functioning aspect of the lagoon/marsh complex will greatly improve conditions for coho salmon survival.

CDFW is also working with NMFS on projects which will remedy the current migration barrier through the Pescadero/Butano lagoon complex into the Butano Creek watershed (currently little or no anadromy occurs thru the marsh into Butano Creek).

Population Monitoring

Staff from NOAA Fisheries South West Science Center has conducted monitoring of juvenile coho salmon in the Santa Cruz Mountain diversity stratum (San Gregorio Creek to Aptos Creek) during the summers of 2006, 2007, and 2008, using spatially balanced design. In each year, approximately 40 stream reaches were surveyed. In 2006, juvenile coho salmon were found in two watersheds (Scott and San Vicente creeks), no watersheds in 2007, and five watersheds in 2008 (San Gregorio, Waddell, Scott, San Vicente, and Soquel). Catch numbers were low (less than 200 individuals) and genetic evidence taken at three of the 2008 locations indicated that in each case juveniles were the result of 1-2 spawning pairs. Systematic adult salmonid monitoring in the Big Basin and San Mateo HUs was funded through the FRGP in 2010. These surveys commenced in winter 2010 and will continue through winter 2012/13. Finalized data is not yet available.

Hatchery Operations

There are no coho salmon hatchery operations in the San Mateo Coastal Recovery Unit. However, relatively small numbers of coho salmon smolts from the MBSTP at the Kingfisher Flat Hatchery in the Scott Creek watershed (Santa Cruz County) were released into Pescadero Creek in 2003 (approximately 10,000 smolt) and again in 2006 (another 10,000). Many of the coho salmon released in 2003 returned as jacks in the winter of 2003 and as adults to Pescadero Creek in 2005 and spawned.

6.2.6 Big Basin Recovery Unit

The Department is participating in ongoing discussions with the City of Santa Cruz Water Department and NOAA Fisheries regarding development of a Habitat Conservation Plan for the City's water diversion operations. This plan is intended to provide the basis for an authorization for take of coho salmon under ESA and CESA. The Department routinely reviews projects in this recovery unit that may have adverse effects on coho salmon and

issues permits containing conditions aimed at avoiding or minimizing such adverse effects.

Habitat Restoration

Since 2004, habitat restoration projects implemented in Big Basin streams have been primarily concerned with fish passage. However, NOAA Fisheries has provided funding for habitat restoration of off-channel pools in San Vicente Creek and for preserving large woody material in county streams and creeks. Improvements in salmonid habitat, road and upland restoration and watershed assessments, planning, education and outreach, public involvement, and water conservation have all been instrumental in guiding watershed planning actions in the Big Basin recovery unit.

Population Monitoring

NOAA Fisheries SWFSC has performed life-cycle monitoring of coho salmon in the Scott Creek watershed in Santa Cruz County, with funding from the FRGP (Hayes et al. 2011). The main goal of the ongoing project since its inception in 2003 has been to monitor coho salmon and steelhead populations in the Scott Creek watershed and to provide support for the coho salmon artificial propagation program at the MBSTP Kingfisher Flat fish hatchery.

Annual adult escapement estimates of coho salmon in Scott Creek have decreased from 272 and 329 fish in 2004 and 2005, respectively, to 46 fish in 2006, less than 20 fish in the years up to 2009 and fewer than five fish from 2010 to present. Just one fish was recorded in 2012 (Figure 6.17). The severe declines in 2007 and 2008 reflect the severe impact of poor ocean conditions in 2005 and 2006. The 2009 low reflects a weak year class in 2006 (and previously in 2003, 2000, 1997).

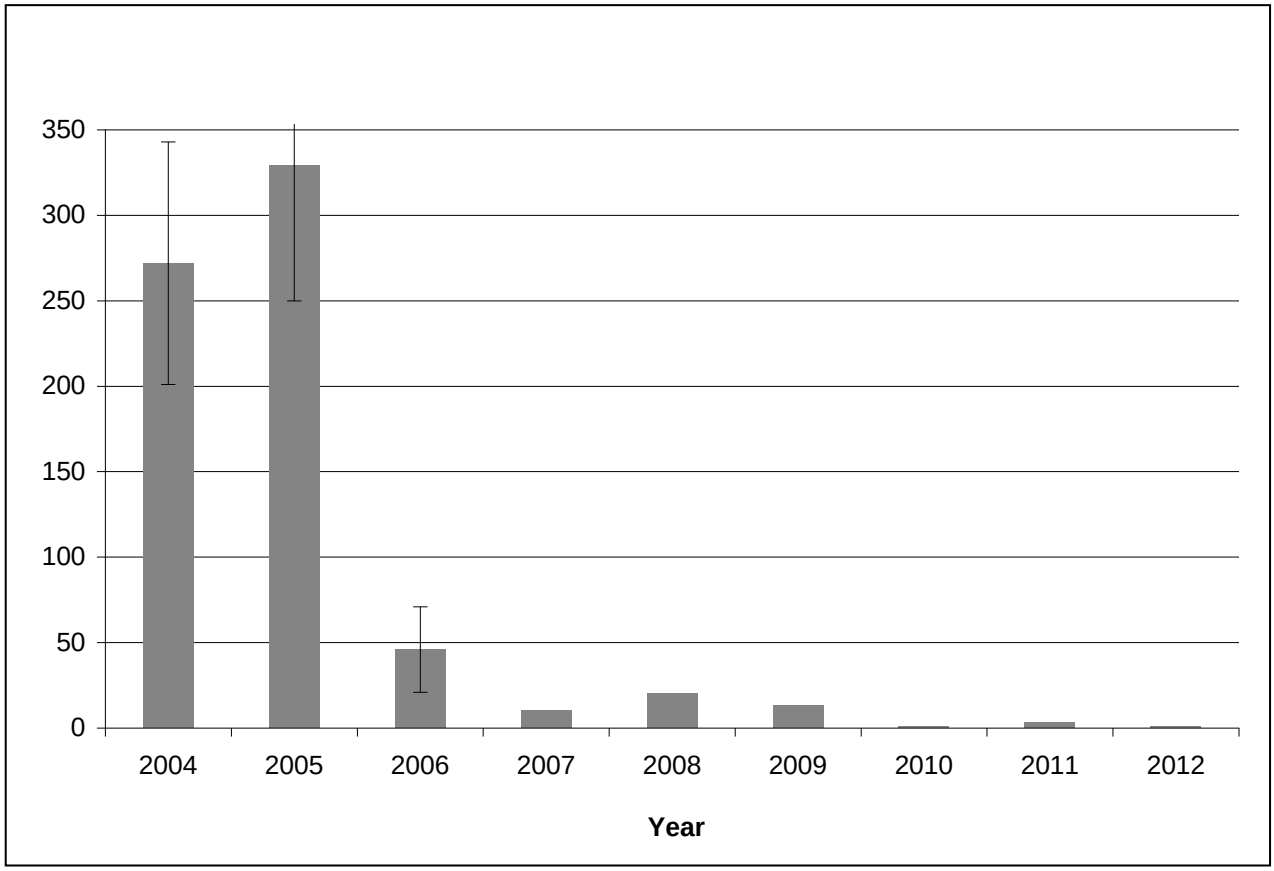


Figure 6.17. Scott Creek adult coho salmon escapement estimates, 2004-2012. Data provided by NOAA Fisheries.

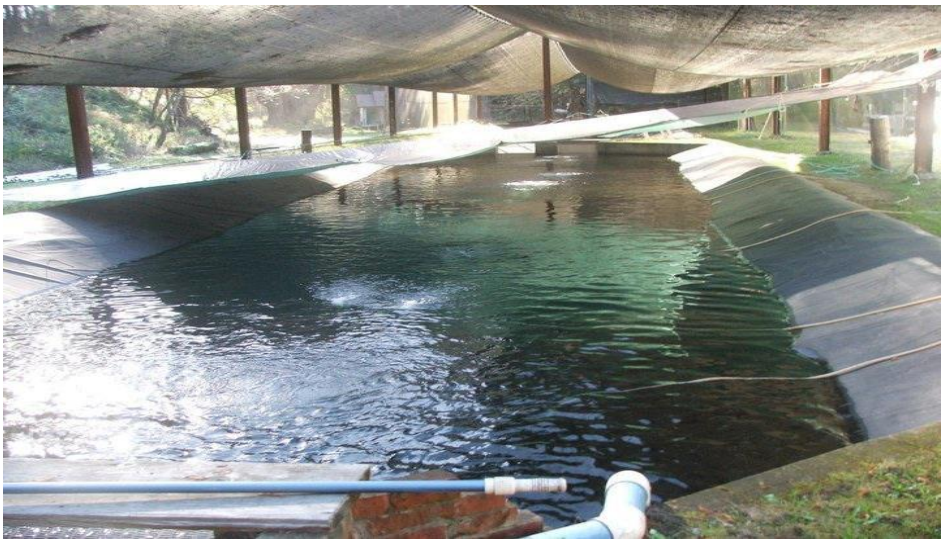
In 2010, a systematic adult salmonid monitoring program, including coho salmon, was funded through the FRGP in the Big Basin and San Mateo Recovery Units. These surveys commenced in winter 2010 and will continue through winter 2012/13. This monitoring is being carried out according to the protocols of the CMP (Adams et al. 2011) and covers all anadromous streams between San Pedro Creek in Pacifica to Aptos Creek in San Cruz County.

In addition, since 1988 monitoring of coho salmon and other juvenile salmonids has been performed in Waddell and Gazos creeks by Dr. Jerry Smith of San Jose State University (Smith 2013). The most recent juvenile monitoring data show no coho captured in Scott Creek from 2007-2011, none in Waddell since 2008, and none in Gazos Creek (San Mateo County) since 2005 (Smith, 2013). In Scott Creek in 2012, coho salmon from the release of captive brood stock adult spawning in the wild produced a weak juvenile year-class.

Kingfisher Flat (Big Creek) Conservation Hatchery (Santa Cruz County)

Monterey Bay Salmon and Trout Program (MBSTP) is a nonprofit organization concerned with the preservation of native coho salmon and steelhead and the watersheds that support them. MBSTP initiated the Big Creek Conservation Hatchery program in the Kingfisher Flat area of Big Creek near Davenport in 1982. Coho salmon production at MBSTP has varied widely over the last decade, reaching a maximum in 2006 with almost 26,000 smolts released. Since then, annual releases have numbered approximately 3,000 coho salmon or fewer. The last wild brood stock year for the hatchery was 2006.

A small captive brood stock program accounts for the low numbers of smolts produced from 2007-2011. The broodstock program recently ramped up during that period so that in 2012 it was sufficient to produce 30,000 smolts per year, and also release some fry to San Vicente Creek in 2012 and adults to spawn in Scott Creek in 2012. The captive brood stock program took six years to gradually ramp up with facilities and techniques, but has made substantial contributions in the last three years.



Rearing juvenile coho salmon at Kingfisher Flat hatchery.
Photo: MBSTP

Partially in response to the Lockheed Fire of 2009, the Kingfisher Flat Conservation Hatchery has made several changes to its operating procedures, including the addition of a new rearing tank for coho salmon and a moist air egg incubator, improving feed quality, and installing new pumps to create a current for the fish to swim against to help improve fish condition. The rearing program has so far had limited success in recovering coho salmon, but is still regarded as an important element of coho salmon recovery in the region. Recently the transfer of specific husbandry techniques developed at WSH has increased hatching success and juvenile survival in the program. It is likely that this program to date has prevented coho salmon stocks south of San Francisco Bay from localized extirpation.

Chapter 7. Priority Recovery Activities

The precipitous declines in coho salmon populations in the CCC ESU since 2004 prompted the Department to meet with NOAA Fisheries and other agencies and organizations, commencing in 2010, to investigate priority recovery measures which might be taken to prevent the imminent extirpation of coho salmon populations in CCC ESU watersheds.

The Department and NOAA Fisheries have jointly developed an inter-agency team named the Priority Action Coho Team (PACT), which has the following mission:

"The Department and NOAA Fisheries, in the context of their authorities and the State and Federal coho salmon recovery plans, will collaborate with other agencies and community entities, seek to identify clear objectives, develop specific priority action plans, identify new and available resources to expedite immediate actions to prevent imminent extirpation of coho salmon populations within the CCC ESU."

The Department and NOAA Fisheries are currently developing the PACT program, including the establishment of a number of technical working groups (TWGs). The TWGs consist of representatives from the Department, NOAA Fisheries and various other stakeholder groups and are tasked with developing action plans to develop and implement priority recovery measures to prevent population extirpation.

The following TWG functions have been established:

1. Habitat protection and restoration guidelines
2. Fish rescue and captive rearing procedures
3. Water quality and instream flow conservation
4. Fisheries regulations, permitting and enforcement
5. Funding of restoration, monitoring, rescue and rearing efforts
6. Public outreach and education

Management and coordination committees have been established to steer and oversee the activities of the technical working groups. The working groups will make recommendations on priority recovery actions to prevent the extirpation of coho salmon populations in the CCC ESU. The development and implementation of the recovery actions will involve a wide range of stakeholder groups.

Recent declines in coho salmon populations in many streams and rivers in the SONCC ESU may warrant the development of similar priority recovery action measures to prevent short-term population extirpation in some watersheds. Such measures are currently being investigated by the Department and other agencies. Priority action coho salmon recovery programs are currently being investigated for the Shasta and Mattole Rivers in Siskiyou and Humboldt counties, respectively, where coho salmon populations have fallen to very low levels.

Chapter 8. Summary and Recommendations

8.1 Summary

A wide range of recovery activities to restore coho salmon populations in the State has been carried out since the *Recovery Strategy* was produced in 2004. These activities include habitat restoration, regulatory and permitting improvements, watershed planning, improved timber management plans, improved land use planning, fish passage restoration and hatchery rearing of juveniles. However, despite these on-going activities, coho salmon populations in many areas throughout the State continue to decline. It is clear that range-wide and watershed-wide recovery activities need to be expanded and enhanced if the downward population trend of coho salmon is to be reversed. The Department and NOAA Fisheries are currently establishing inter-agency teams to develop priority recovery actions to halt the on-going state-wide declines in coho salmon populations.

The precise causes of the on-going reductions in coho salmon populations in most watersheds have not been established, but it is apparent that the declines continue to be associated with the deterioration of freshwater and estuarine habitat conditions through continuous human land-use and water development activities. The down-turn in ocean productivity, which occurred in 2005 and 2006, affected adult returns in 2007-2009. Severely low returns in those years, especially to the south, severely reduced some populations, which has affected abundance in subsequent years.

The downturn in ocean productivity between 2005 and 2006, and concomitant poor marine survival of the already depressed numbers of coho salmon, likely exacerbated the ongoing decline in coho salmon abundance. The positive effects of habitat restoration, as measured by increased fish distribution and abundance, are usually associated with a time lag of several years, even for robust populations, and probably longer where populations are below depensation levels. Recent and on-going drought conditions are also likely to adversely affect coho salmon recovery.

Increased inter-agency collaboration to implement recovery strategies is needed to bring about coho salmon recovery. Wide-scale monitoring of coho salmon populations is also required to track the progress toward recovery. The many range-wide and watershed-wide recommendations listed in the state and federal recovery plans need to be fully implemented to return California coho salmon populations to long-term viability.

8.2 Recommendations for future recovery activities

1. Fully implement the range-wide and watershed recommendations listed in the *Recovery Strategy* in an expedited fashion.
2. Expand collaboration with NOAA Fisheries and other agencies in implementing joint recovery efforts.
3. Implement adequate streamflow regimes and water quality to support healthy populations.
4. Identify and remove all instream barriers and impediments to coho salmon migration.
5. Threats to the survival of coho salmon populations must be identified and greatly reduced and, wherever possible, removed.
6. Watershed and stream habitat restoration programs should identify and target high priority areas for recovery. These watersheds and/or streams should contain the strongest and/or ecologically or genetically significant populations, where conditions still support all life stages.
7. Implement as soon as possible a comprehensive population monitoring program, including life-cycle stations, in streams in the SONCC and CCC ESUs to provide essential data on the current status of coho salmon populations.
8. Increase education and outreach programs to facilitate awareness of the needs of coho salmon and the effects of water use practices.
9. Recovery efforts that can be made to maintain or increase recovery of the species specific to watershed conditions must be described and fully implemented.
10. Recovery projects must focus efforts on restoring essential natural ecological processes in river systems.
11. Preserve and restore, wherever possible, the genetic integrity and diversity of coho salmon populations.
12. Expand the engagement and development of local communities in coho salmon recovery.
13. Implement research projects with experimental design to evaluate the effects of habitat restoration activities, such as large wood addition, floodplain restoration and fish passage improvement, on coho salmon distribution, abundance and species recovery.
14. Additional research programs may include – analysis of population datasets gathered to date, assessment of the relative importance of marine versus freshwater factors on recruitment variability and determination of suitable recovery goals and delisting criteria.

9. Conclusions

California coho salmon continue to decline throughout the state, despite the implementation of numerous range and watershed-wide recovery activities which have been implemented by the Department and other agencies and organizations since the *Recovery Strategy* was produced in 2004. The prevention of further population extirpations and reverse of on-going declines will require accelerated implementation of recovery tasks, particularly the restoration of suitable freshwater and estuarine conditions for juvenile rearing and adult reproduction. Furthermore, range and watershed-wide recovery activities need to be expanded, and implementation of recovery efforts intensified and accelerated. Increased inter-agency collaboration in implementing recovery tasks will greatly assist population recovery.

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APPENDICES

Appendix A. Adult coho salmon spawner estimates in the Central California Coast Evolutionarily Significant Unit, 2004-2012

Stream/ County/Recovery Unit/Region	Year								Sampling method	Notes
	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12		
Russian River (Warm Springs Hatchery) (Sonoma)	4	2	4	2	5	19	95	205	Trap/Video	Numbers are minimum counts, not estimates
Pudding Creek (Mendocino Coast)	1167	709	295	228	50	9	199	415	Redd counts	Mark-recapture point estimates
Caspar Creek (Mendocino) (Mendocino Coast)	548	126	54	17	6	43	36	17	Redd counts	Adult escapement estimates Mark-recapture estimates 05-10
South Fork Noyo River (Mendocino) (Mendocino Coast)	536	285	114	54	19	63	39	38	Mark-recapture	Adult escapement estimates
Little River (Mendocino) (Mendocino Coast)	152	14	4	2	4	2	3	2	Redd counts	Adult escapement estimates
Olema Creek (Marin) (Bodega-Marin Coastal)*	81 137	11 8	32 95	5 26	0 0	5 14	14 21	15 7	Minimum escapement estimate	
Lagunitas Creek (Marin) (Bodega-Marin Coastal) *	633 1266	198 396	433 866	175 350	26 52	65 130	101 202	145 290	Minimum escapement estimate	
San Geronimo Creek* (Marin) (Bodega-Marin Coastal)	258 516	102 204	143 286	55 110	1 2	7 14	42 84	26 52	Minimum escapement estimate	
Redwood Creek (Marin) (Bodega-Marin Coastal) **	76 90	5 11	6 24	0 0	2 2	10 23	1 3	10 4	Carcass counts Redd counts	
Scott Creek (Santa Cruz) (Big Basin) ***	90 139	0 15	2 2	8 2	13 1	1 0	3 0	1 0	Trap Trap	Hatchery fish Wild fish

* Data provided by Marin Municipal Water District ** Data provided by Point Reyes National Seashore *** Data provided by NOAA

Appendix B. Adult coho salmon spawner estimates in the Southern Oregon Northern California Coast ESU, 2004-2012

Stream/ County/Region	Year								Sampling method	Notes
	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12		
Mill Creek (Smith River) West Branch East Fork Mainstem	20 9 0	175 55 7	22 27 0	11 7 0	28 6 2	12 16 2	5 1 0	25 14 0	Trap	Spawner survey Minimum escapement estimates
Prairie Creek (Humboldt)	488	385	165	41	198	98	43	366	Redd counts	Escapement estimates based on redd counts
Freshwater Creek (Humboldt) (Eureka Plain)	974	767	391	241	376	89	455	624	Mark-recapture Trap	Adult escapement estimate
Shasta River (Siskiyou) (Shasta Valley)	373	69	47	255	30	9	44	62	Trap/video	In 2009/10 catches were all males. *see Footer note
Scott River (Siskiyou) (Scott River)	NA	NA	NA	1,622	62	81	927	355	Spawner survey/redd counts	Video monitoring
Bogus Creek (Siskiyou) (Middle Klamath River)	409	102	46	233	111	6	154	142	Fish counting facility	Video weir & Carcass surveys
Klamath River (Iron Gate Hatchery) (Middle Klamath River)	1,734	1,425	332	779	1,296	70	485	586	Fish counting facility	Video weir & Carcass surveys
Trinity River (u/s of Willow Creek weir) (Trinity River)	9,055 29,827 38,882	2,729 28,690 31,419	1,624 18,454 20,078	1,199 4,551 5,750	1,312 8,671 9,983	636 5,697 6,333	861 7,086 7,947	1,664 15,546 17,210	Trap Mark-recapture & Hatchery counts	[1]Wild fish [2]Hatchery fish [3]Total count (wild + hatchery)
Mattole River (Mendocino) (Cape Mendocino) #	86	49	29	52	11	3	<10	<5	Spawner survey	Live adult salmon observations
South Fork Eel River (Humboldt County)	_	_	_	_	_	_	1,023[1] 2,404[2]	1,084[1] 2,547[2]	Spawner survey	Estimate based on coho redd counts[1], based on minimum of 2.35 fish per redd[2], live and dead coho observations in randomly selected reaches.

*Note: High flows in some years may affect the ability to accurately estimate fish abundance and therefore these results should be considered minimum estimates. However, we believe that these numbers do accurately reflect the relative strengths of each brood year.

Appendix C. Priority Streams List for Instream Flow Assessment

Rank	Stream or Watercourse	DFW Region and County
1	Butte Creek	2 Butte
2	Tuolumne River (below La Grange Dam)	4 Stanislaus
3	San Gregorio Creek (lower)	3 San Mateo
4	North Fork of Navarro River	1 Mendocino
5	Big Sur River	4 Monterey
6	Santa Maria River	5 Santa Barbara
7	Redwood Creek (tributary to Maacama)	3 Sonoma
8	Bear River (below Camp Far West)	2 Placer and Nevada
9	Shasta River	1 Siskiyou
10	Carmel River	4 Monterey
11	Santa Margarita River	6 Riverside
12	Merced River (below Crocker-Huffman Dam)	4 Merced
13	Redwood Creek (tributary to Napa)	3 Napa
14	Scott River	1 Siskiyou
15	Mattole River (near Whitethorn)	1 Humboldt
16	Dry Creek (tributary to Napa River)	3 Napa
17	Deer Creek (tributary to Yuba River)	2 Nevada
18	Mojave River	6 San Bernardino
19	Carpinteria Creek	5 Santa Barbara
20	Santa Ana River	6 Riverside, San Bernardino
21	Middle Fork Feather River	2 Plumas
22	Dos Pueblos Creek	5 Santa Barbara

Appendix D. Known and potential fish passage barriers and fish passage improvement projects in California coho salmon ESUs.

COHO ESU	RECOVERY UNIT	Known Barriers [1]	Potential Barriers [2]	Diversions Unscreened	Natural Barriers	Passage Projects Completed 2004-2011 [3]	Passage Projects Ongoing [4]
SONCC	CAPE MENDOCINO	31	34	63	0	18	6
SONCC	EEL RIVER	272	223	7	0	11	5
SONCC	EUREKA PLAIN	111	241	0	0	15	3
SONCC	KLAMATH RIVER	271	311	70	0	41	5
SONCC	MAD RIVER	35	93	35	0	7	3
SONCC	MENDOCINO COAST	0	1	0	0	0	0
SONCC	REDWOOD CREEK	25	69	0	0	2	0
SONCC	ROGUE RIVER	7	7	0	0	0	0
SONCC	SMITH RIVER	98	181	53	0	11	1
SONCC	TRINIDAD	32	34	0	0	2	0
SONCC	TRINITY RIVER	169	196	148	0	15	2
SONCC	WINCHUCK RIVER	4	3	0	0	2	0
CCC	BAY BRIDGES	40	29	0	2	0	0
CCC	BIG BASIN	190	142	3	54	8	1
CCC	BODEGA	8	28	0	7	0	0
CCC	CACHE CREEK	0	1	0	0	0	0
CCC	MARIN COASTAL	89	105	0	3	8	1
CCC	MENDOCINO COAST	178	269	0	66	18	5
CCC	RUSSIAN RIVER	235	556	85	28	24	0
CCC	SAN MATEO	107	120	0	22	7	4
	Total	1902	2643	464	182	189	36

Source: Passage Assessment Database, December 2012

1 – Known barriers include man-made structures assessed as complete, partial and temporal barriers to fish passage.

2 – Potential barriers include in-stream structures that were not assessed for fish passage.

3 – Completed passage projects include all types of restoration activities and funding sources improving passage of the fish.

4 – Ongoing projects include on-the-ground restoration projects not yet fully completed.

Appendix E. Organizations in California involved with coho salmon recovery (not complete)

1. Bioengineering Institute
2. California Department of Forestry and Fire Protection (Cal FIRE)
3. California Cattlemen's Association
4. California Conservation Corps
5. California Department of Fish and Wildlife (CDFW)
6. California Department of Water Resources (DWR)
7. California Farm Bureau
8. California Forestry Association
9. California Department of Transportation (CalTrans)
10. CalTrout
11. City of Arcata
12. Del Norte Rural Human Services
13. Eel River Salmon Restoration
14. Eel River Watershed Improvement Group (ERWIG)
15. FishNet4C
16. Five Counties Salmonid Conservation Program (5C)
17. Forest Landowners of California
18. Gualala River Watershed Council
19. Hoopa Tribe
20. Humboldt County Department of Public Works
21. Humboldt County Resource Conservation District
22. Humboldt County Water Agency
23. Humboldt Fish Action Council
24. Humboldt State University
25. Institute for Fisheries Resources (IFR)
26. Jacoby Creek Land Trust
27. Karuk Tribe and possibly the Round Valley Tribe
28. Klamath and Six Rivers National Forests
29. Marin Municipal Water District (MMWD)
30. Mattole Restoration Council (MRC)
31. Mattole Salmon Group (MSG)
32. Mendocino County Resource Conservation District
33. Mendocino Department of Transportation
34. Mendocino Land Trust, Inc.
35. Mid Klamath Watershed Council
36. Monterey Bay Salmon and Trout Project (MBSTP)
37. National Marine Fisheries Service (NOAA Fisheries)
38. National Park Service (NPS)
39. Northcoast Regional Land Trust
40. Northwest California Resource Conservation and Development Council
41. Point Reyes National Seashore Association
42. Northern California Resource Center
43. Pacific Coast Federation of Fishermen's Associations (PCFFA)
44. Pacific Coast Fish Wildlife and Wetlands Restoration Association (PCFWWRA)
45. Pacific States Marine Fisheries Commission (PSFMC)

46. Redwood Community Action Agency (RCAA)
47. Redwood Forest Foundation Inc. (RFFI)
48. Russian River Coho Resources Partnership
49. Salmon Protection and Watershed Network (SPAWN)
50. Salmon River Restoration Council
51. Salmonid Restoration Federation (SRF)
52. Sanctuary Forest Inc.
53. Santa Cruz Resource Conservation District
54. San Francisco Bay Regional Water Quality Control Board
55. Scott River Watershed Council
56. Scott River Water Trust
56. Shasta Valley Resource Conservation District
57. Shasta River Coordinated Resources and Management Planning
58. Sierra Club
59. Siskiyou County Resource Conservation District
60. Smith River Alliance (SRA)
61. Sonoma County Water Agency
62. Redwood National and State Parks, Humboldt Redwoods State Park
63. State Water Quality Control Board (SWQCB)
64. The Conservation Fund
66. The Nature Conservancy (TNC)
67. Trout Unlimited (TU)
68. University of California Davis Cooperative Extension Program
69. U.S. Army Corps of Engineers (USACE)
70. U. S. Fish and Wildlife Service (FWS)
71. US Forest Service (USFS)
72. Yager Van Duzen Environmental Stewards (YES)
73. Yurok Tribe
74. Sea Grant
75. California Coastal Conservancy
76. National Fish and Wildlife Foundation
77. Gold Ridge Resource Conservation District
78. Sonoma Resource Conservation District
79. Marin RCD
80. San Mateo RCD
81. American Rivers
82. Stewards of the Coast and Redwoods
83. State Water Resources Control Board (SWRCB)
84. Occidental Arts and Ecology Center
85. Center for Ecosystem Management and Restoration.

Appendix F. List of acronyms and abbreviations

ac_ Acre
AFRAMP Anadromous Fisheries Resource Assessment and Monitoring Program
BLM Bureau of Land Management
BOF California Board of Forestry and Fire Protection
Caltrans California Department of Transportation
CalFire California Department of Forestry and Fire Protection
CCC Central California Coast
CDFW California Department of Fish and Wildlife
CEQA California Environmental Quality Act
CESA California Endangered Species Act
Commission California Fish and Game Commission
CMP Coastal California Salmonid Monitoring Program
CRT Coho Salmon Recovery Team
Department California Department of Fish and Wildlife
DIDSON Dual Frequency Identification Sonar
ERWIG Eel River Watershed Improvement Group
ESA Endangered Species Act (Federal)
ESU Evolutionarily Significant Unit
FRGP Fisheries Restoration Grant Program
FWS United States Fish and Wildlife service
GDRC Green Diamond Resources Co.
ha Hectare
HGMP hatchery genetic management plan
HSA hydrologic subarea
HU hydrologic unit
IGH Iron Gate Hatchery
kg Kilogram
km Kilometer
LCM Life cycle monitoring
LWD Large woody debris
MBSTP Monterey Bay Salmon and Trout Program
mi Mile
MKWC Mid Klamath Watershed Council
MMWD Marin Municipal Water District
MRC Mattole Restoration Council
MSG Mattole Salmon Group
MSRA Magnuson-Stevens Fishery Conservation and Management Reauthorization Act
NCRWQCB North Coast Regional Water Quality Control Board
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
NOAA Fisheries Fisheries Service of NOAA, formerly NMFS
NPS National Park Service
NRCS Natural Resources Conservation Service
NSA Natural Stocks Assessment
PACT Priority Action Coho Team

PAD Passage Assessment Database
PCSRF Pacific Coastal Salmon Recovery Fund
PCFWWRA Pacific Coast Fish, Wildlife and Wetlands Restoration Association
PIT passive integrated transponder
PRC Public Resources Code
PRNSA Point Reyes National Seashore Association
PWA Pacific Watersheds Associates
RCD Resource Conservation District
Recovery Strategy Recovery Strategy for California Coho Salmon
RFFI Redwood Forest Foundation Inc.
RNP Redwood National Park
ROD Record of Decision
RRCSCBP Russian River Coho Salmon Captive Broodstock Program
RST Rotary Screw Trap
RWQCB California Regional Water Quality Control Board
SCWA Sonoma County Water Agency
SFI Sanctuary Forest Inc.
SRRC Salmon River Restoration Council
SONCC Southern Oregon/Northern California Coast
SQRCD Siskiyou Resource Conservation District
SSPP Shasta-Scott Pilot Program
SSRT Shasta-Scott Coho Recovery Team
SVRCD Shasta Valley Resource Conservation District
SWRCB State Water Resources Control Board
SWFSC South West Fisheries Science Center
THP Timber Harvest Plan
TRD Trinity River Dam
TRH Trinity River Hatchery
TU Trout Unlimited
TWG Technical Working Group
UCCE University of California Cooperative Extension
USACE United States Army Corps of Engineers
USBR United States Bureau of Reclamation
USFS United States Forest Service
WSH Warm Springs Hatchery
YES Yager Environmental Stewards

Appendix G. Fisheries Restoration Grants Program – Locations of coho salmon recovery projects by project category in CCC and SONCC ESUs.

Project data captured in this data set encompasses all FRGP project locations that fall within the two Coho ESUs and identify a coho salmon recovery task. All of the projects identified occurred during the FY's 2004/05-2011/12.

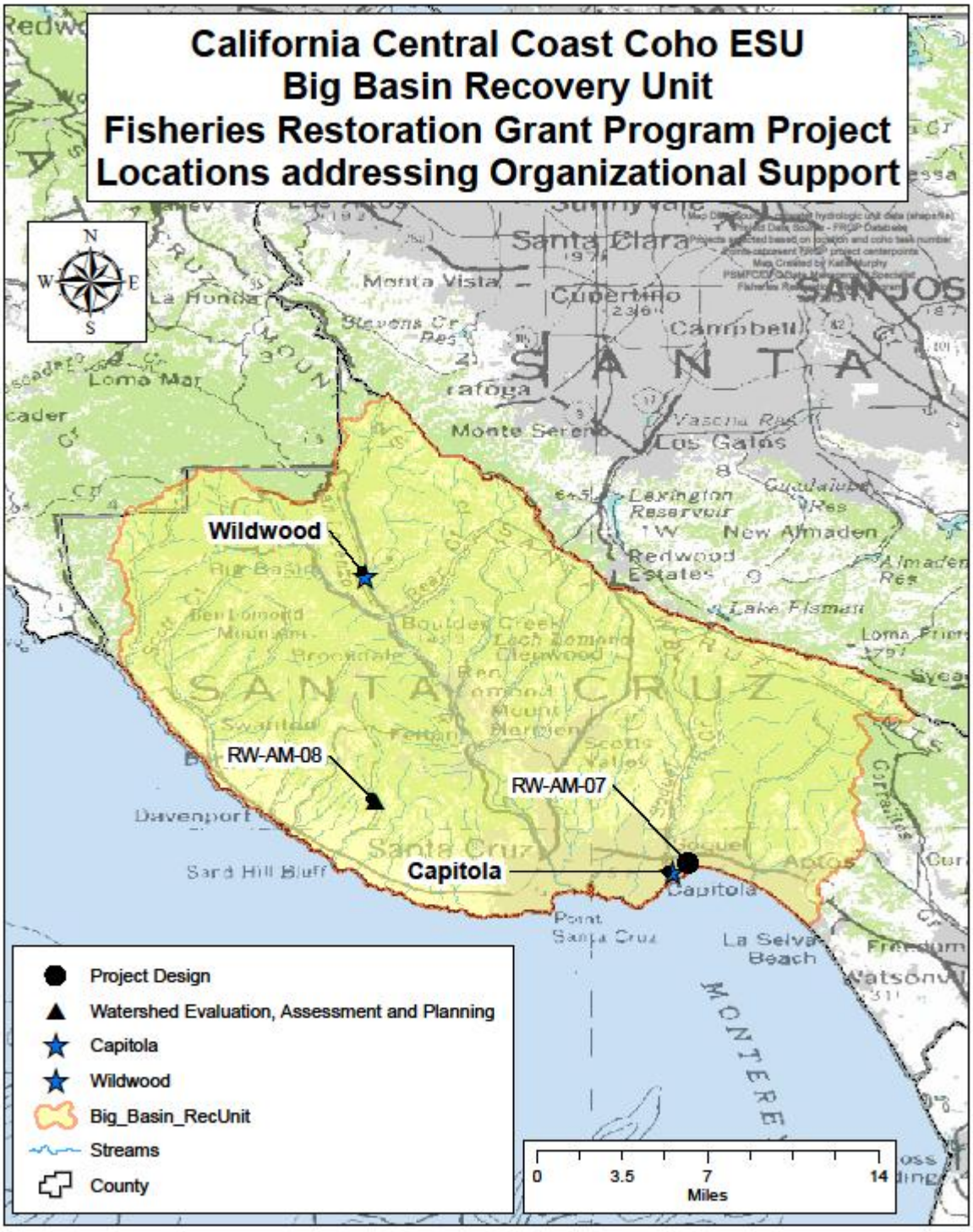
Project locations are based on project center points. Many of these projects have multiple locations; these sites have all been aggregated into one center point for ease of viewing on the maps. These points are labeled with the Coho task(s) identified for the project.

There is a map for each work category (Fish Passage, Instream Habitat, Organizational Support, Monitoring, Water and Cooperative Rearing), by recovery unit. The project types included in each category are listed below.

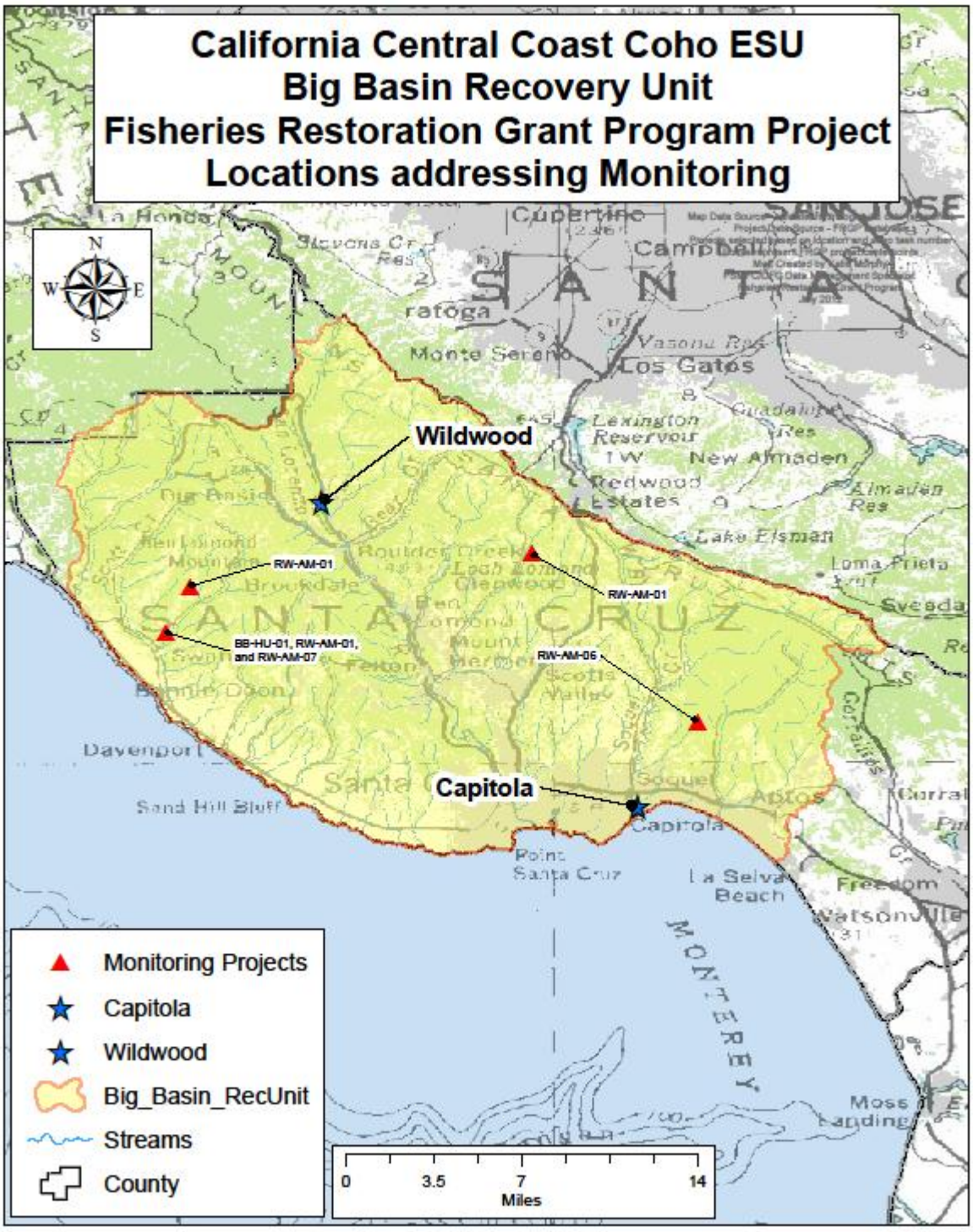
1. **Fish passage** – FP (fish passage at stream crossings), HB (Instream barrier modification for fish passage), SC (Fish screening of diversions), FL (Fish ladder)
2. **Instream habitat** – HA (Habitat acquisition and conservation easements), HI (Instream habitat restoration), HS (Instream bank stabilization), HR (Riparian restoration), HU (watershed restoration – upslope)
3. **Organizational support** – AC (Americorps program), OR (watershed and regional organization) PD (Project design), PL (Watershed evaluation, assessment and planning), PI (Public involvement), ED (Public School Watershed and Fishery Conservation Education Projects), TE (Private Sector Technical Training and Education Project Grants).
4. **Monitoring** – MO (Project Monitoring Following Project Completion), MD (Monitoring projects).
5. **Water** – WC (Water Conservation Measures (Ditch Lining, Piping, Stock Water Systems), WP (water Purchase), WD (water measuring devices).
6. **Cooperative rearing** – RE (Cooperative rearing).

Further information concerning the FRGP can be obtained at this site: http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/

Figure G1. Recovery Units in the Central California Coast ESU

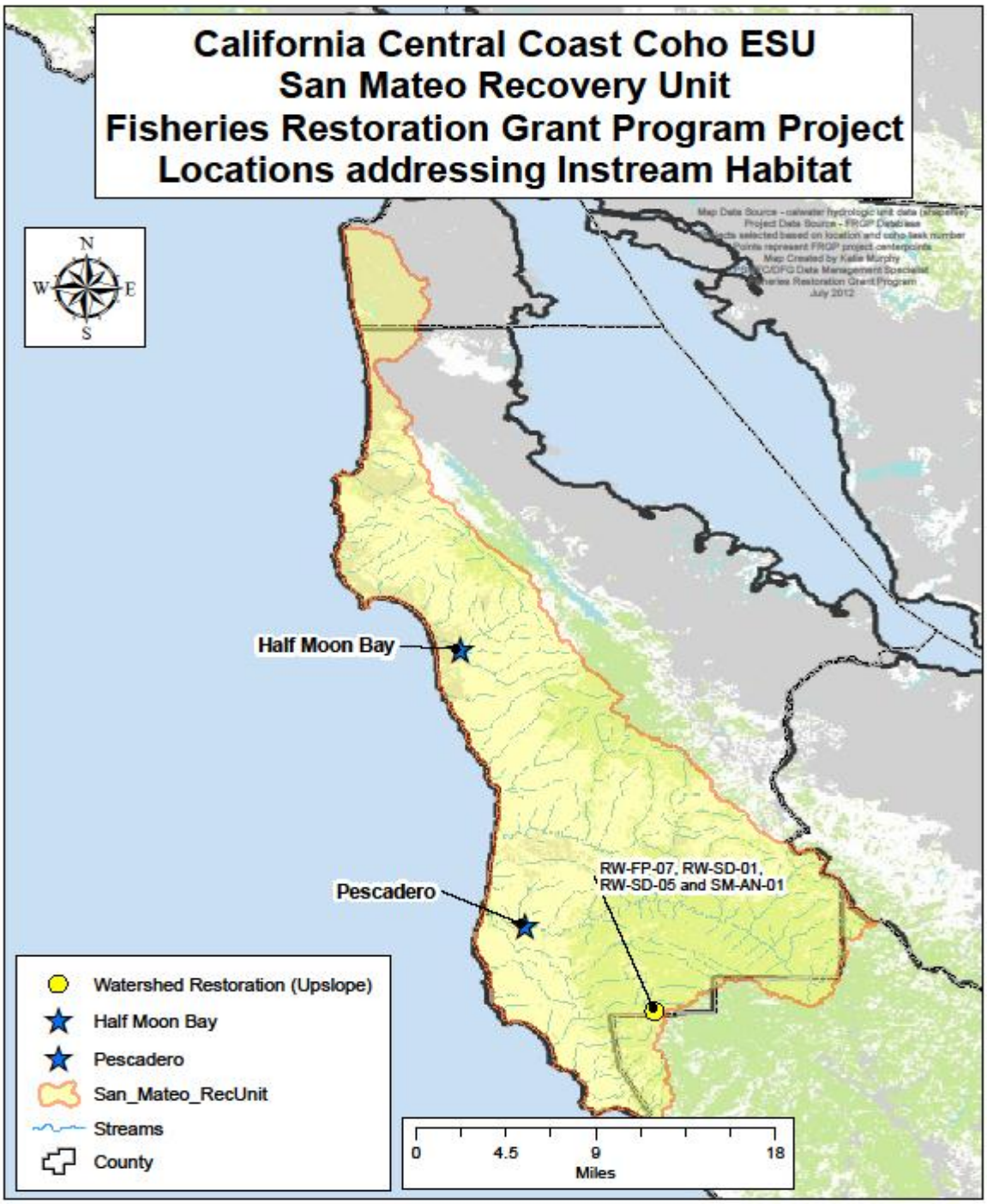


Appendix G (Continued) - Figure G2. Project locations in the Big Basin Recovery Unit – Organizational Support projects



Appendix G (Continued) - Figure G3. Project locations in the Big Basin Recovery Unit - Monitoring projects

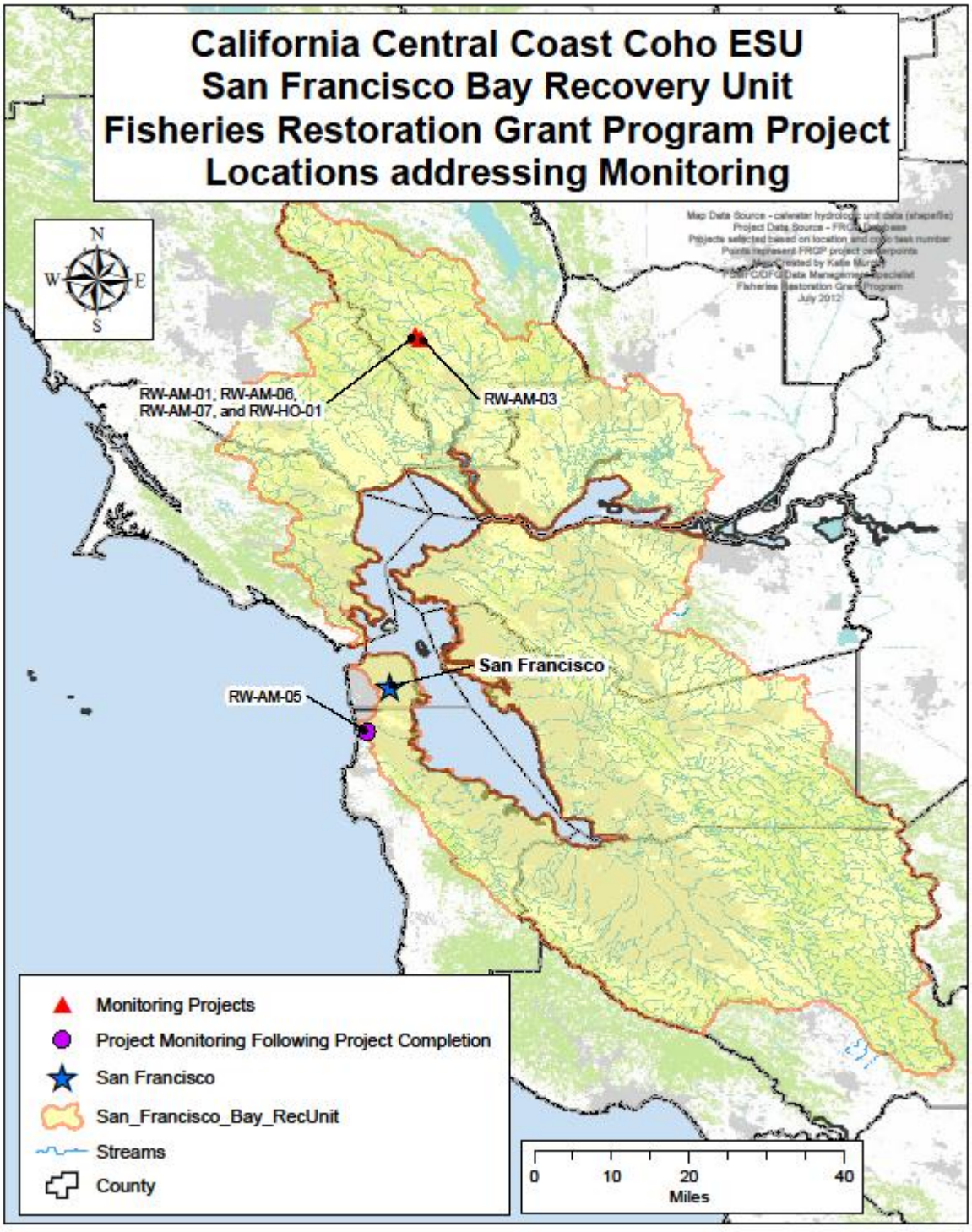
Appendix G (Continued) - Figure G4. Project locations in the Big Basin Recovery Unit - Cooperative Rearing projects



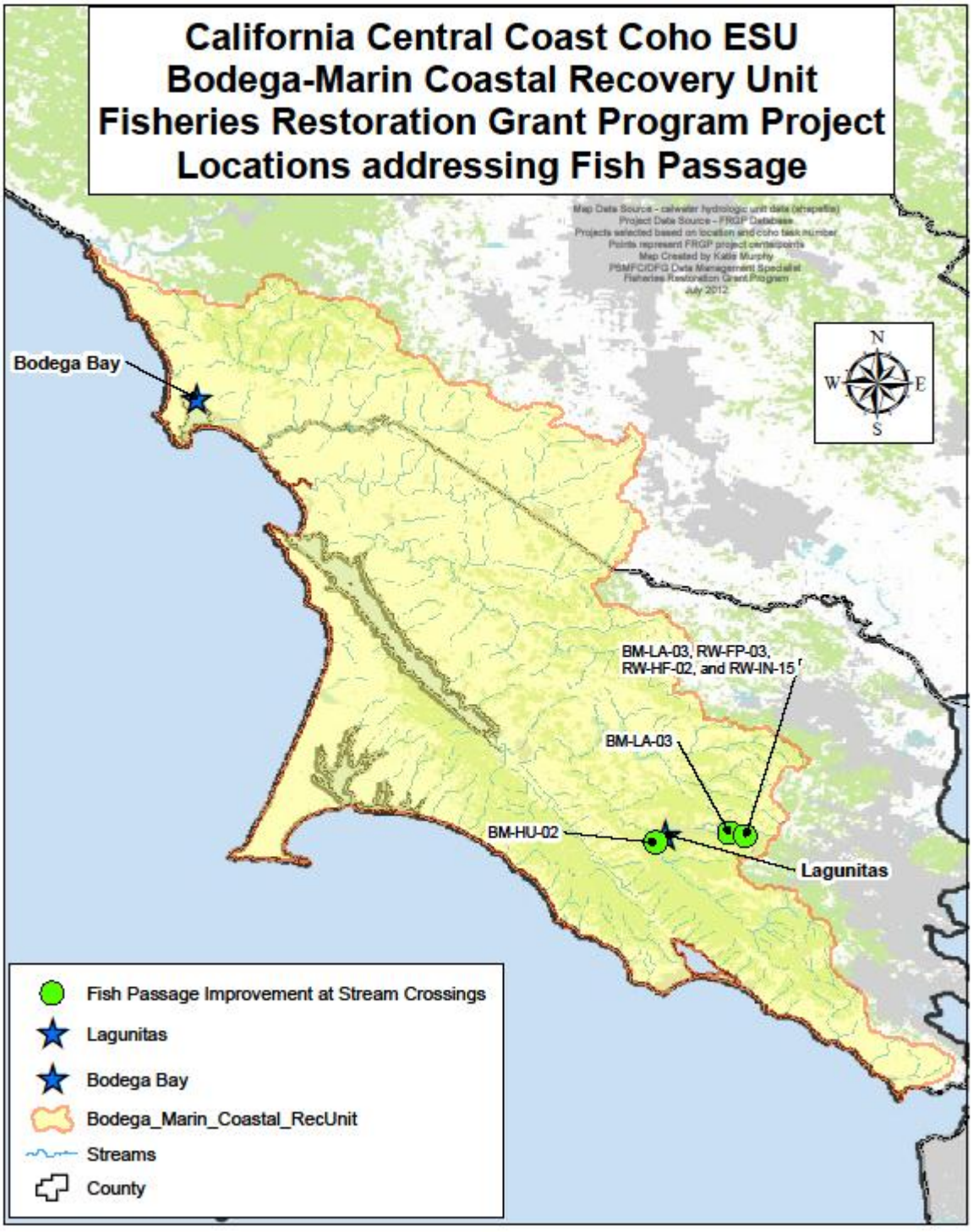
Appendix G (Continued) - Figure G5. Project locations in the San Mateo Recovery Unit - Instream Habitat projects

Appendix G (Continued) - Figure G6. Project locations in the San Mateo Recovery Unit - Organizational Support projects

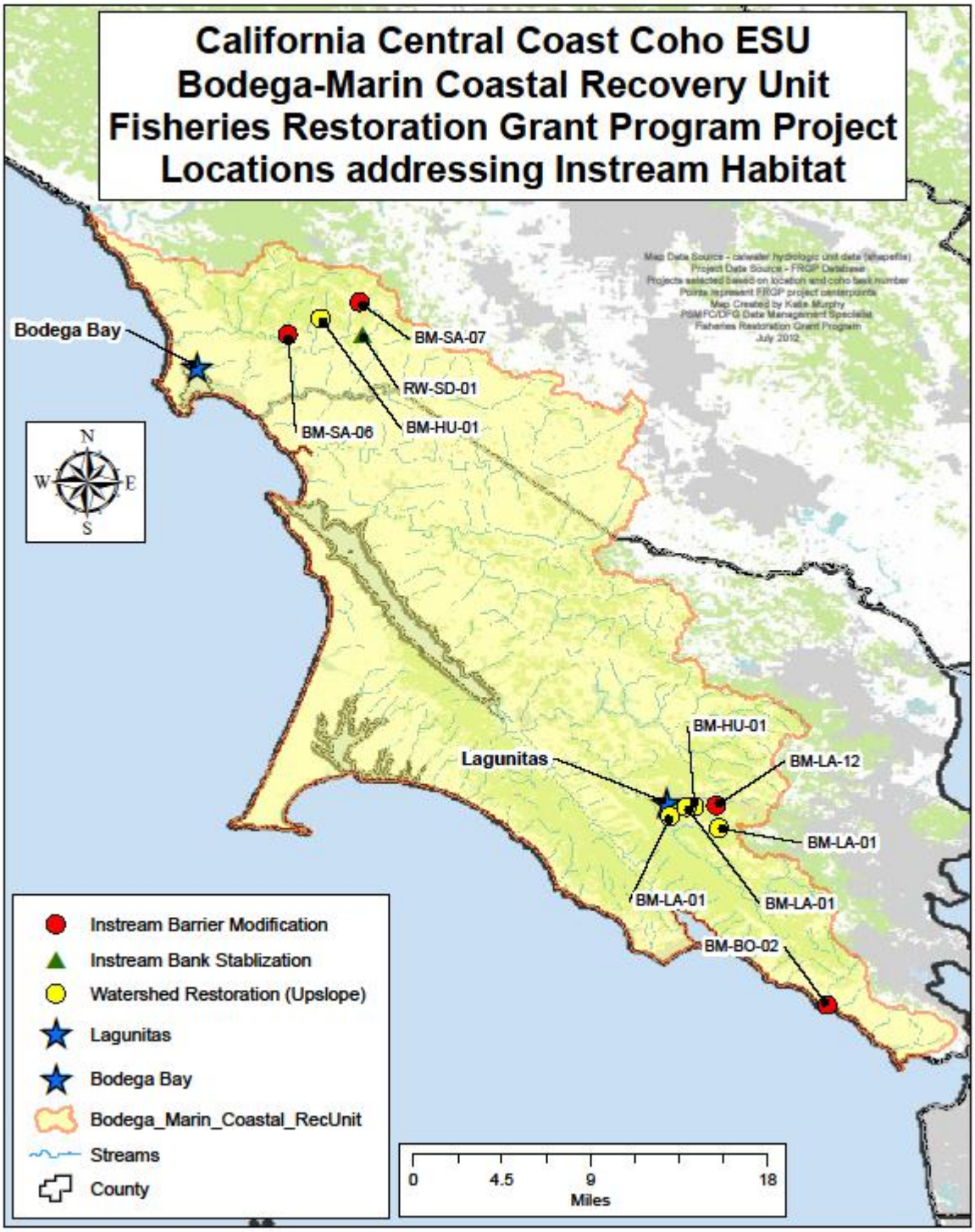
Appendix G (Continued) - Figure G7. Project locations in the San Francisco Bay Recovery Unit - Organizational Support projects



Appendix G (Continued) - Figure G8. Project locations in the San Francisco Bay Recovery Unit - Monitoring projects

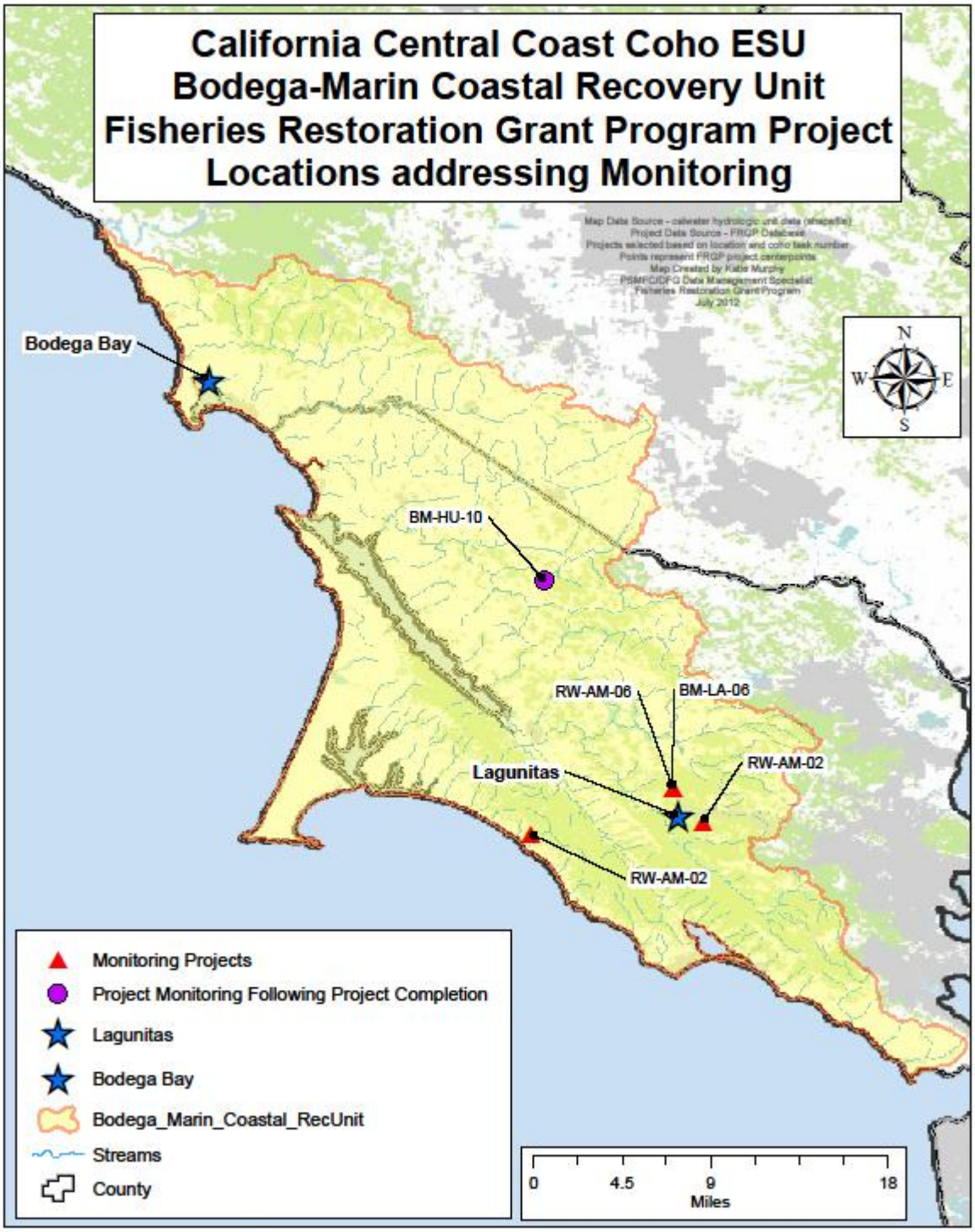


Appendix G (Continued) - Figure G9. Project locations in the Bodega-Marin Recovery Unit – Fish Passage projects

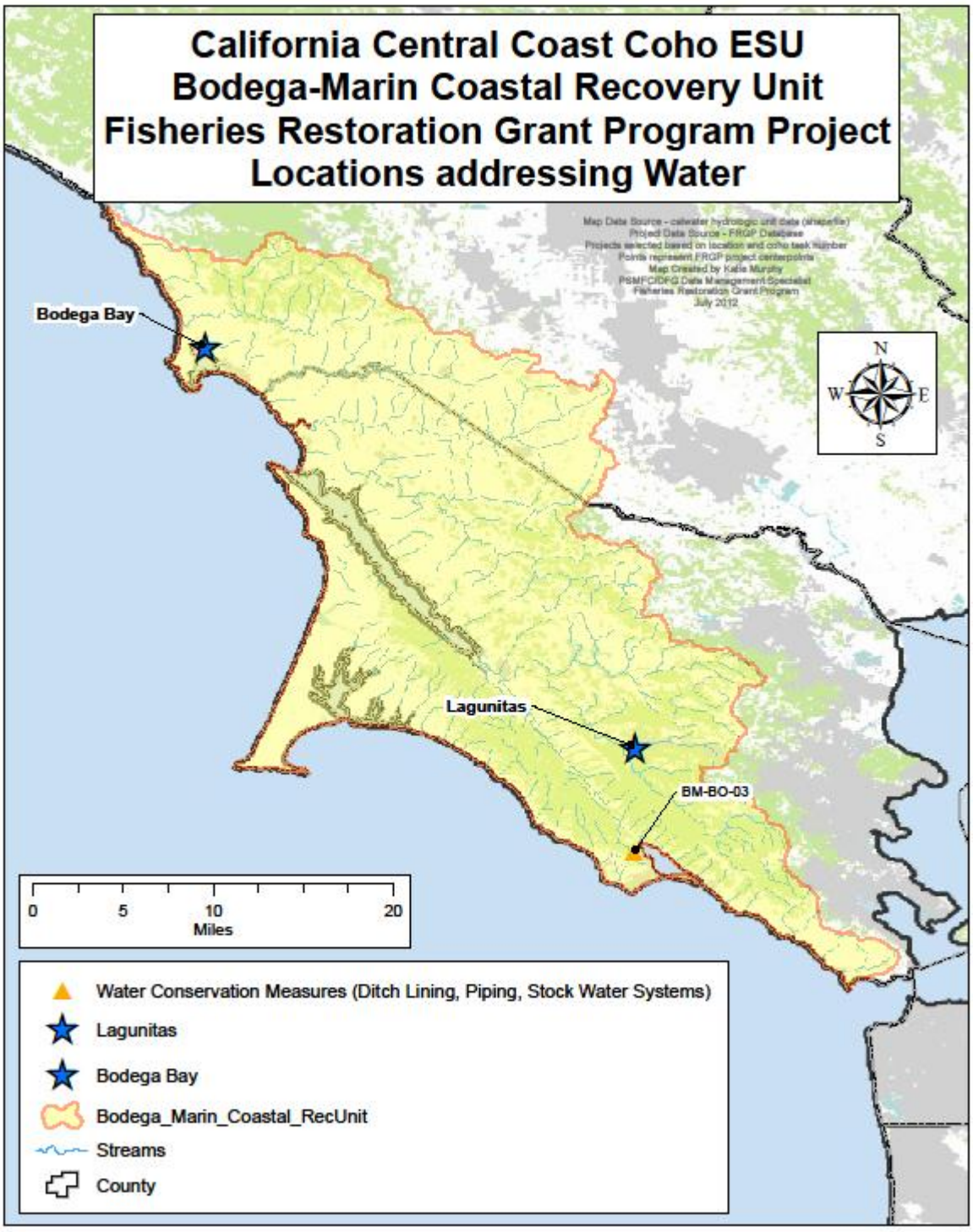


Appendix G (Continued) - Figure G10. Project locations in the Bodega-Marin Recovery Unit – Instream Habitat projects

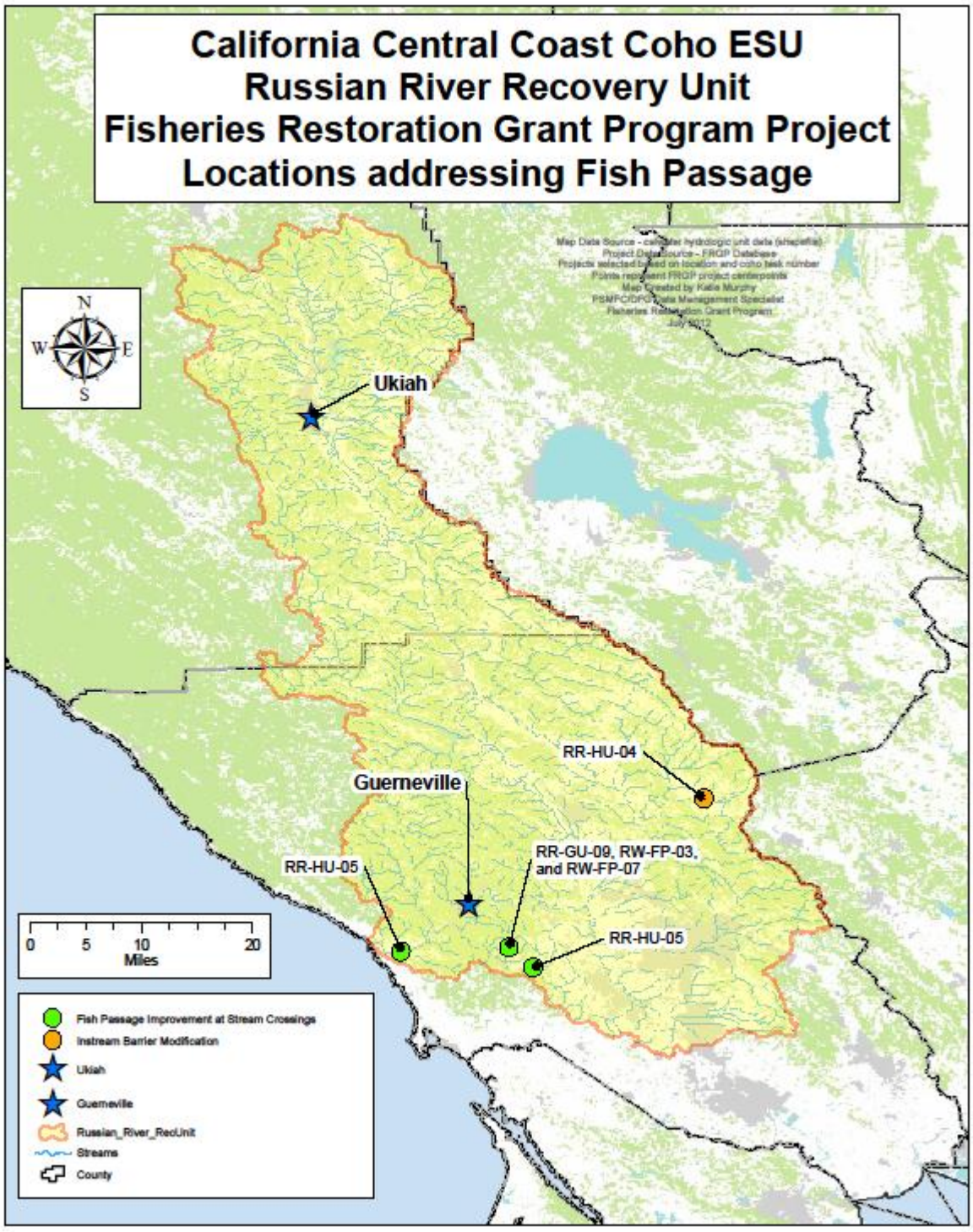
Appendix G (Continued) - Figure G11. Project locations in the Bodega-Marin Recovery Unit – Organizational Support projects



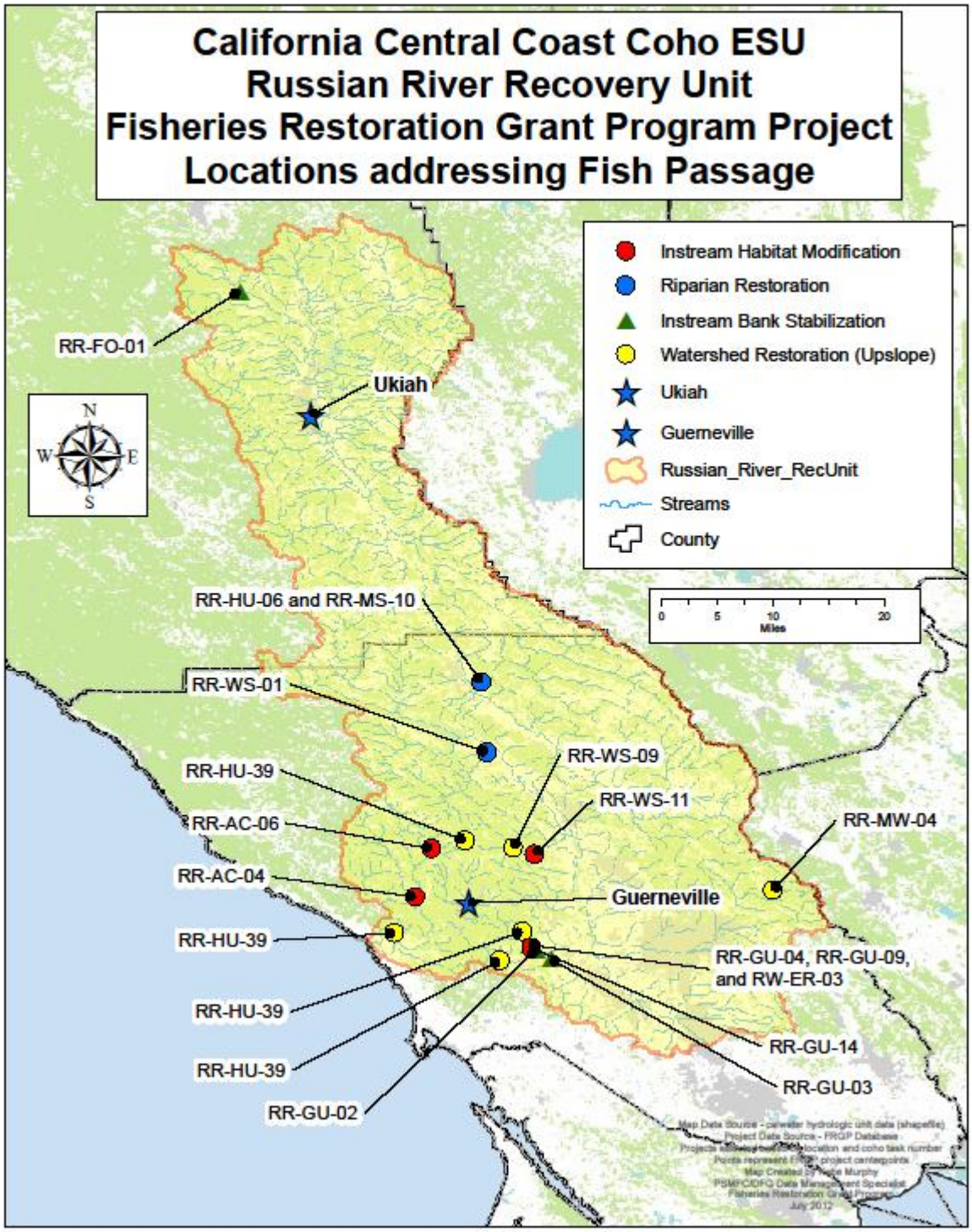
Appendix G (Continued) - Figure G12. Project locations in the Bodega-Marin Recovery Unit – Monitoring projects



Appendix G (Continued) - Figure G13. Project locations in the Bodega-Marin Recovery Unit – Water projects

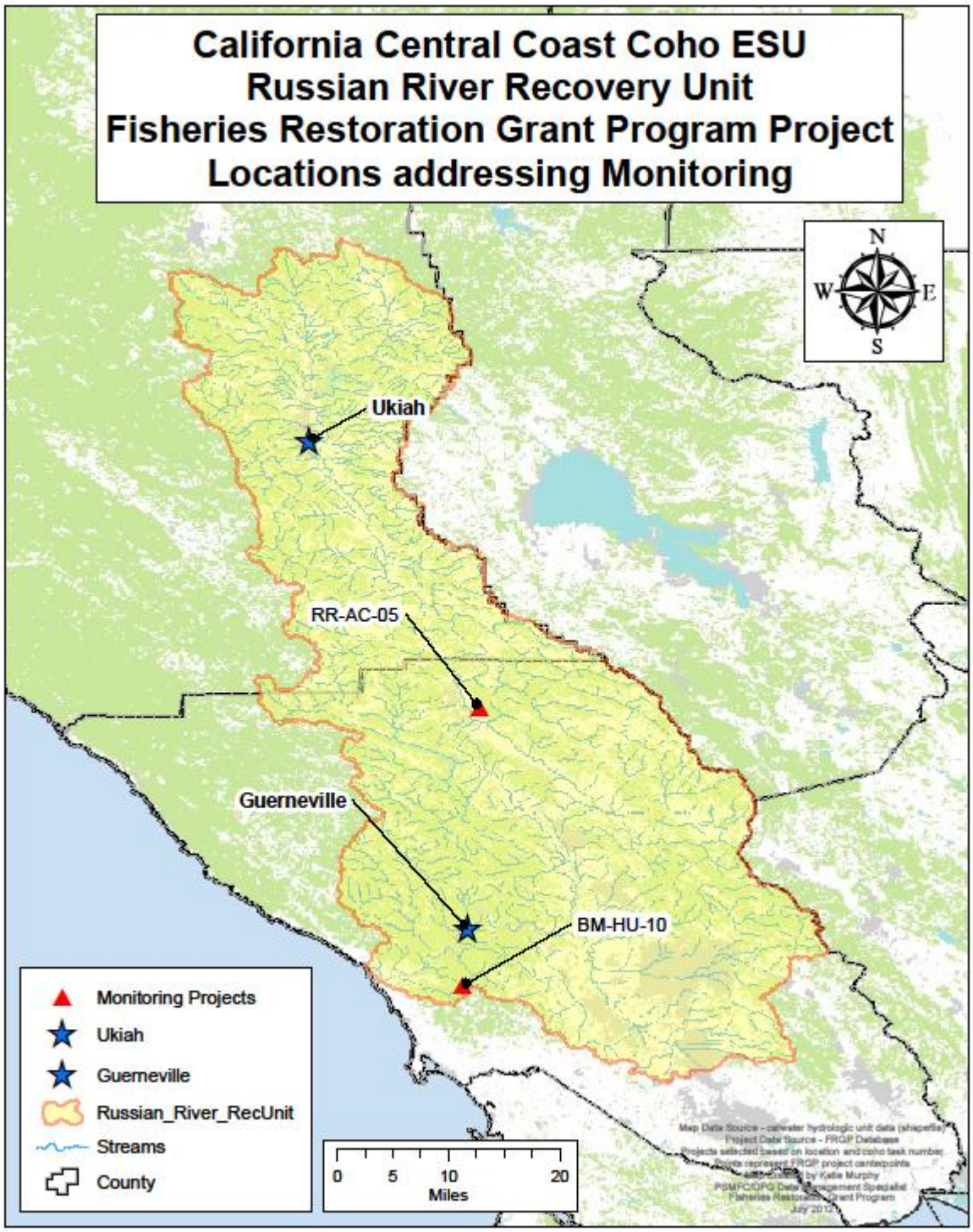


Appendix G (Continued) - Figure G14. Project locations in the Russian River Recovery Unit – Fish Passage projects



Appendix G (Continued) - Figure G15. Project locations in the Russian River Recovery Unit – Fish Passage projects

Appendix G (Continued) - Figure G16. Project locations in the Russian River Recovery Unit – Organizational Support projects



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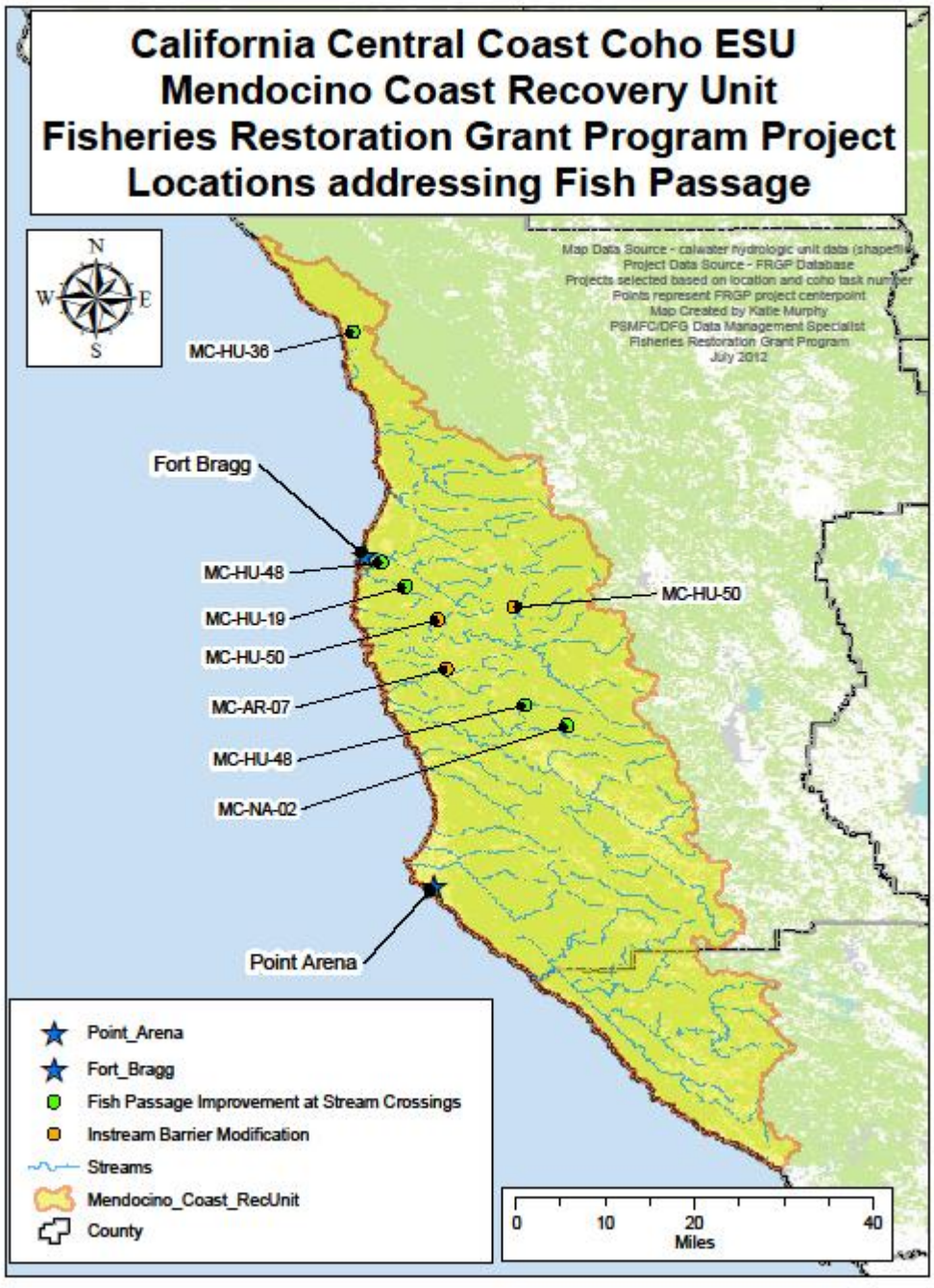
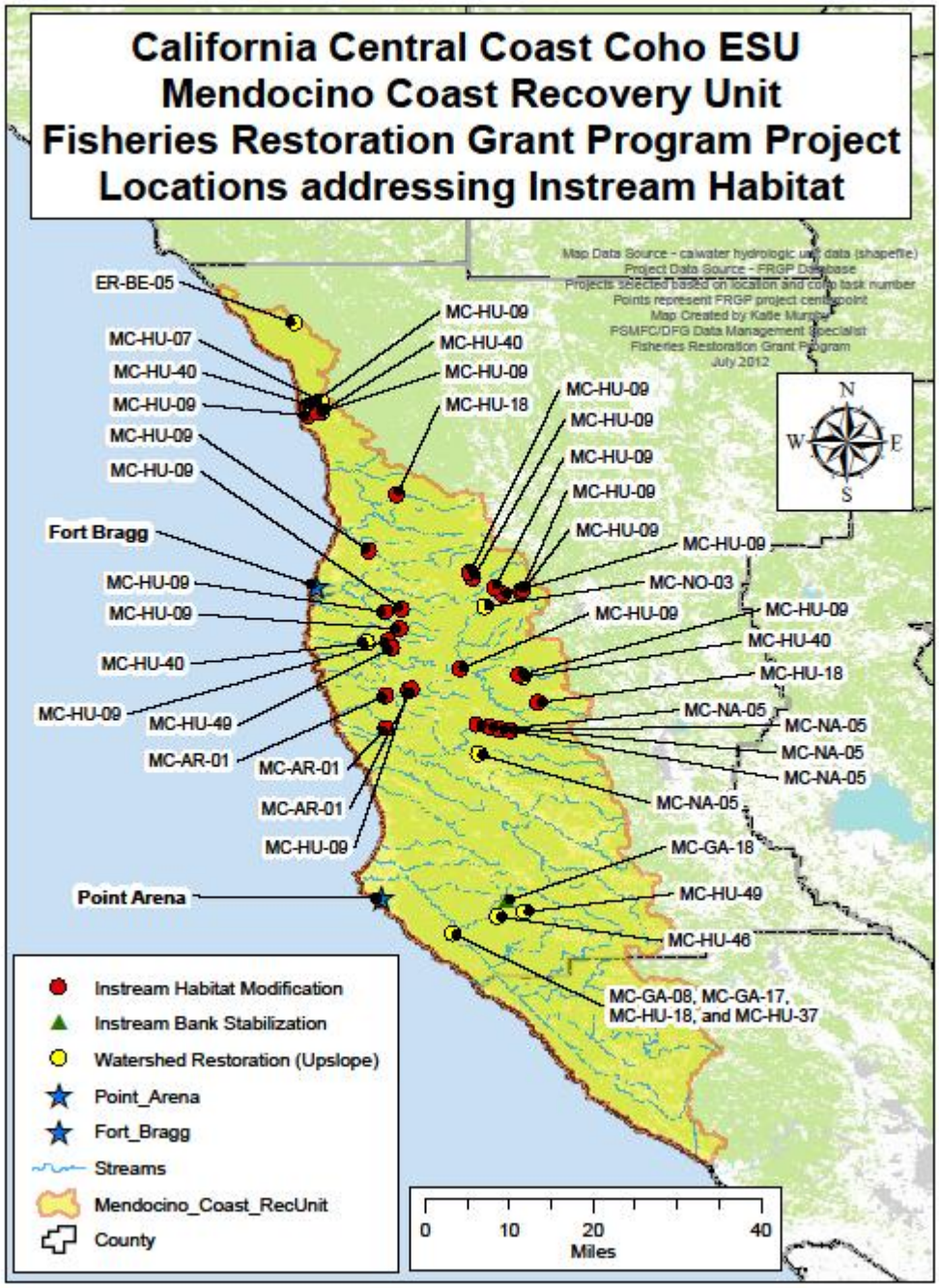
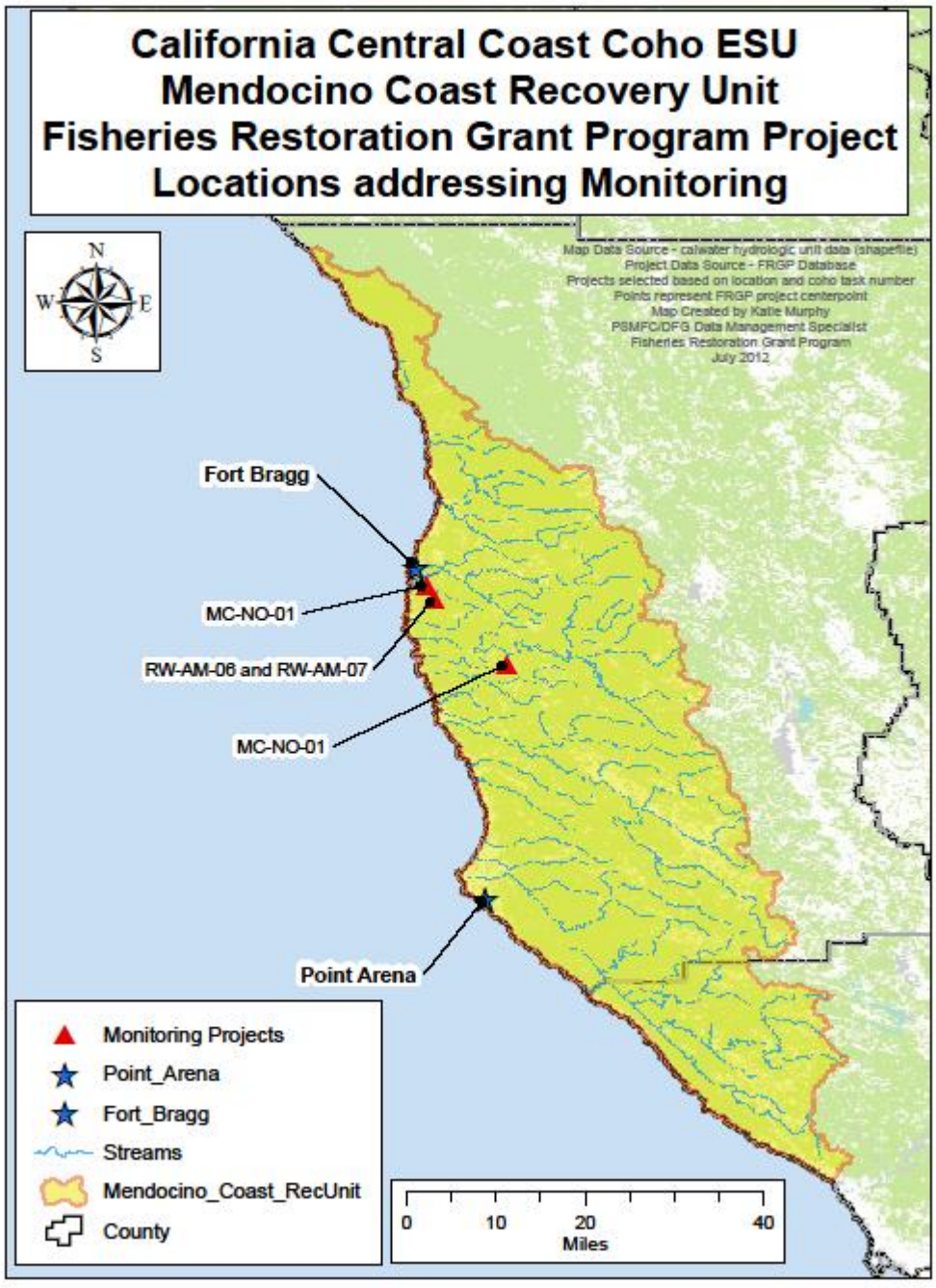


Appendix G (Continued) - Figure G18. Project locations in the Mendocino Coast Recovery Unit – Fish Passage projects



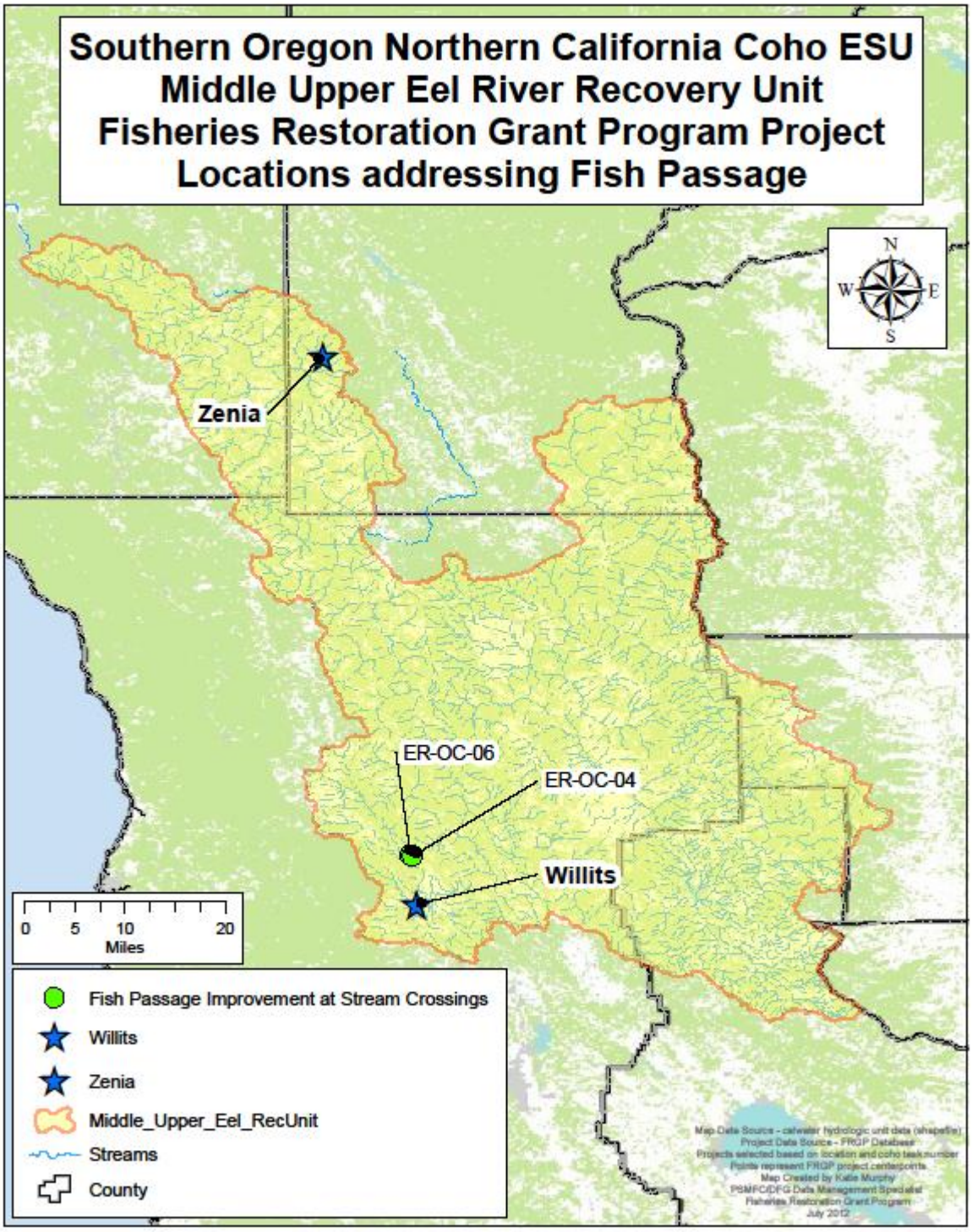
Appendix G (Continued) - Figure G19. Project locations in the Mendocino Coast Recovery Unit – Instream Habitat projects

Appendix G (Continued) - Figure G20. Project locations in the Mendocino Coast Recovery Unit – Organizational Support projects

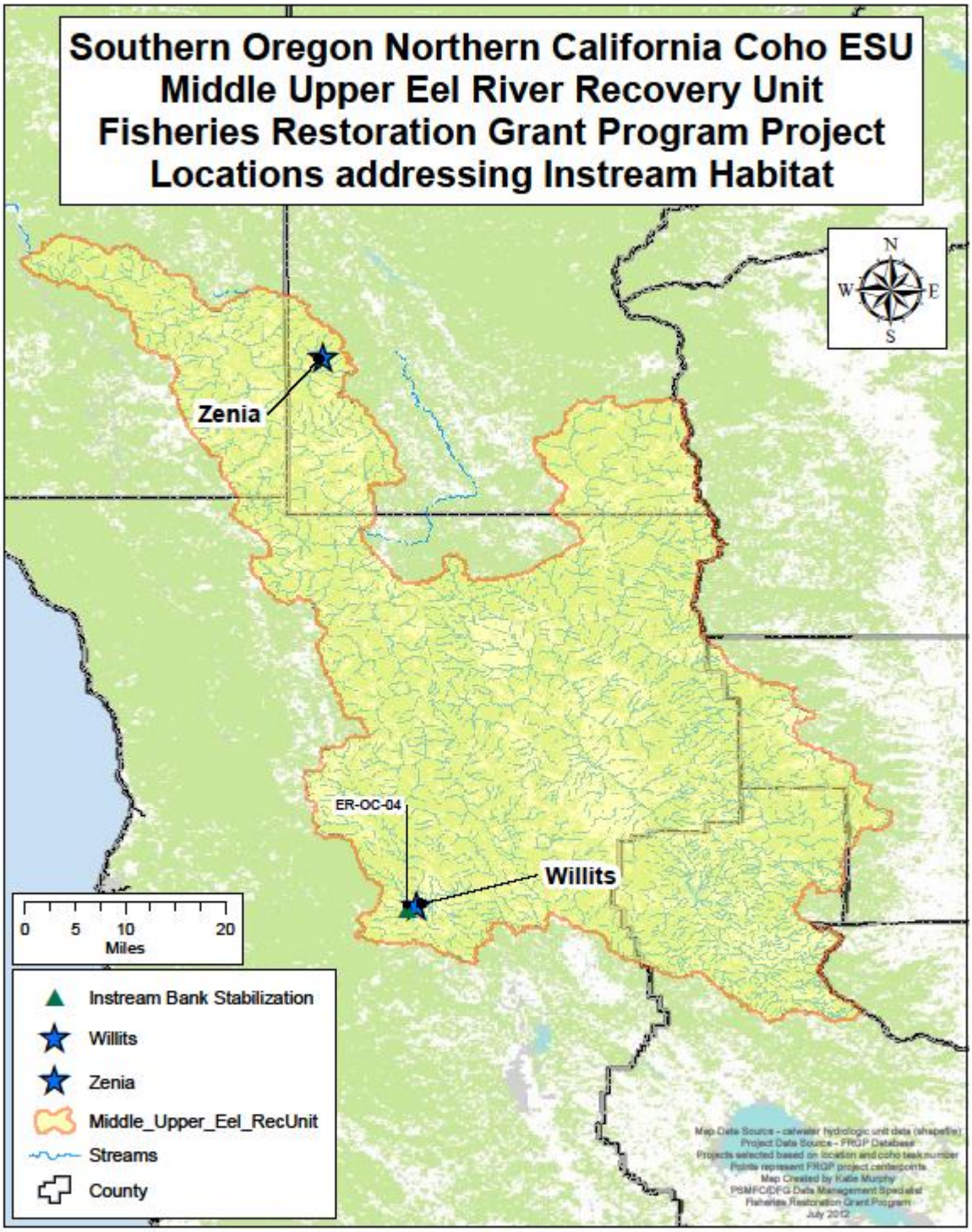


Appendix G (Continued) - Figure G21. Project locations in the Mendocino Coast Recovery Unit – Monitoring projects

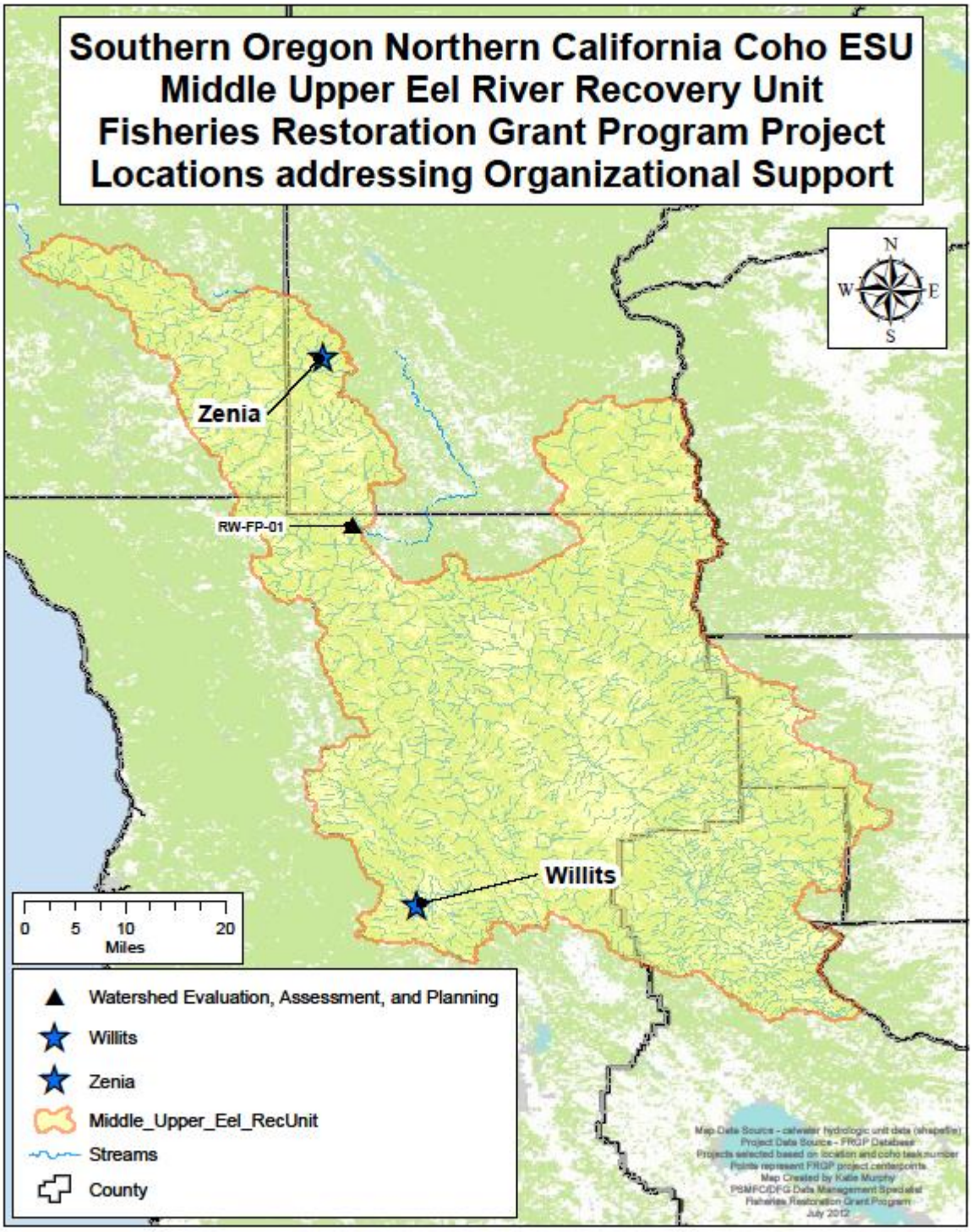
Appendix G (Continued) - Figure G22. Recovery Units in the Southern Oregon Northern California Coast ESU



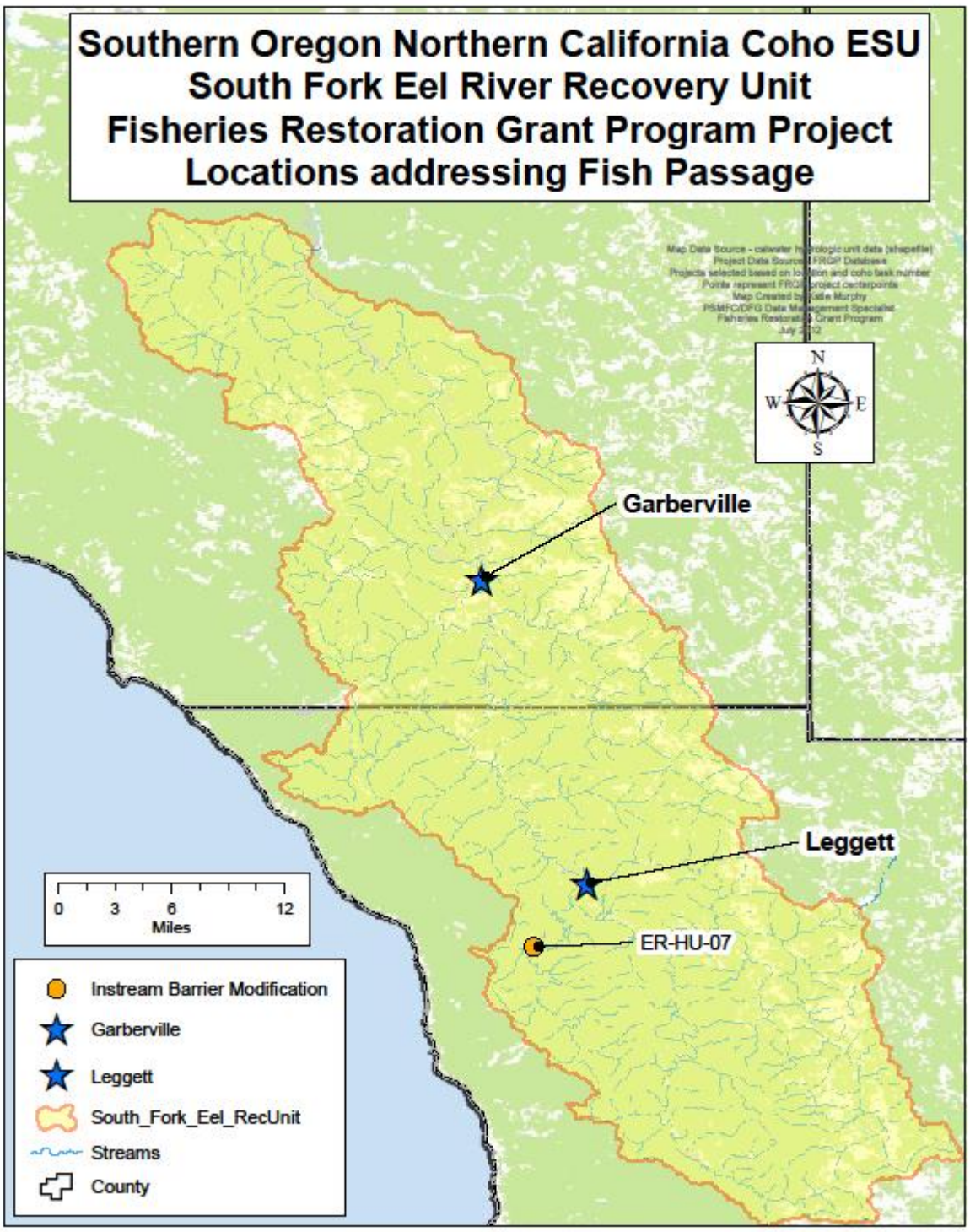
Appendix G (Continued) - Figure G23. Project locations in the Upper Middle Eel River Recovery Unit – Fish Passage Projects



Appendix G (Continued) - Figure G24. Project locations in the Upper Middle Eel River Recovery Unit – Instream Habitat Projects



Appendix G (Continued) - Figure G25. Project locations in the Upper Middle Eel River Recovery Unit – Organizational Support projects



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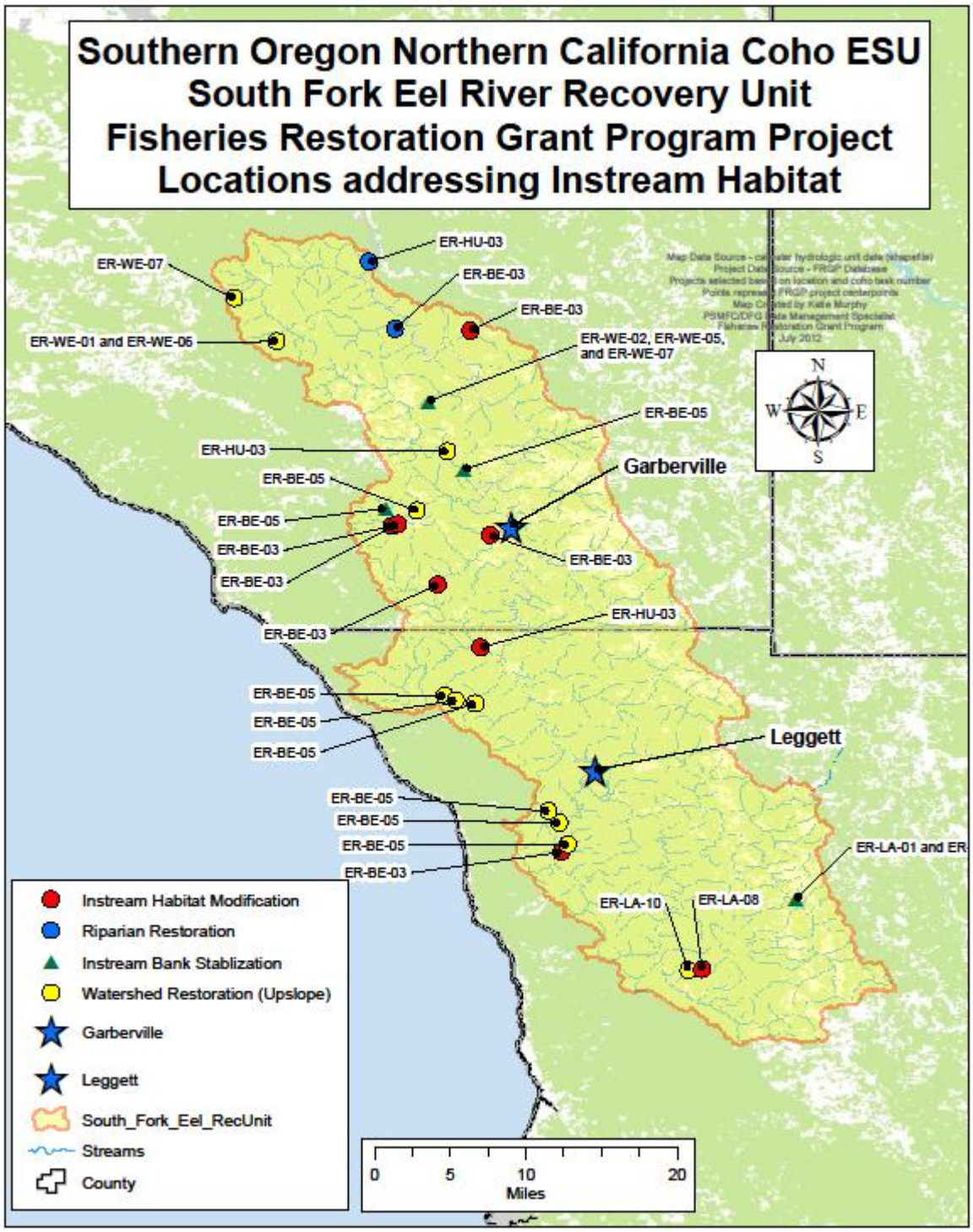

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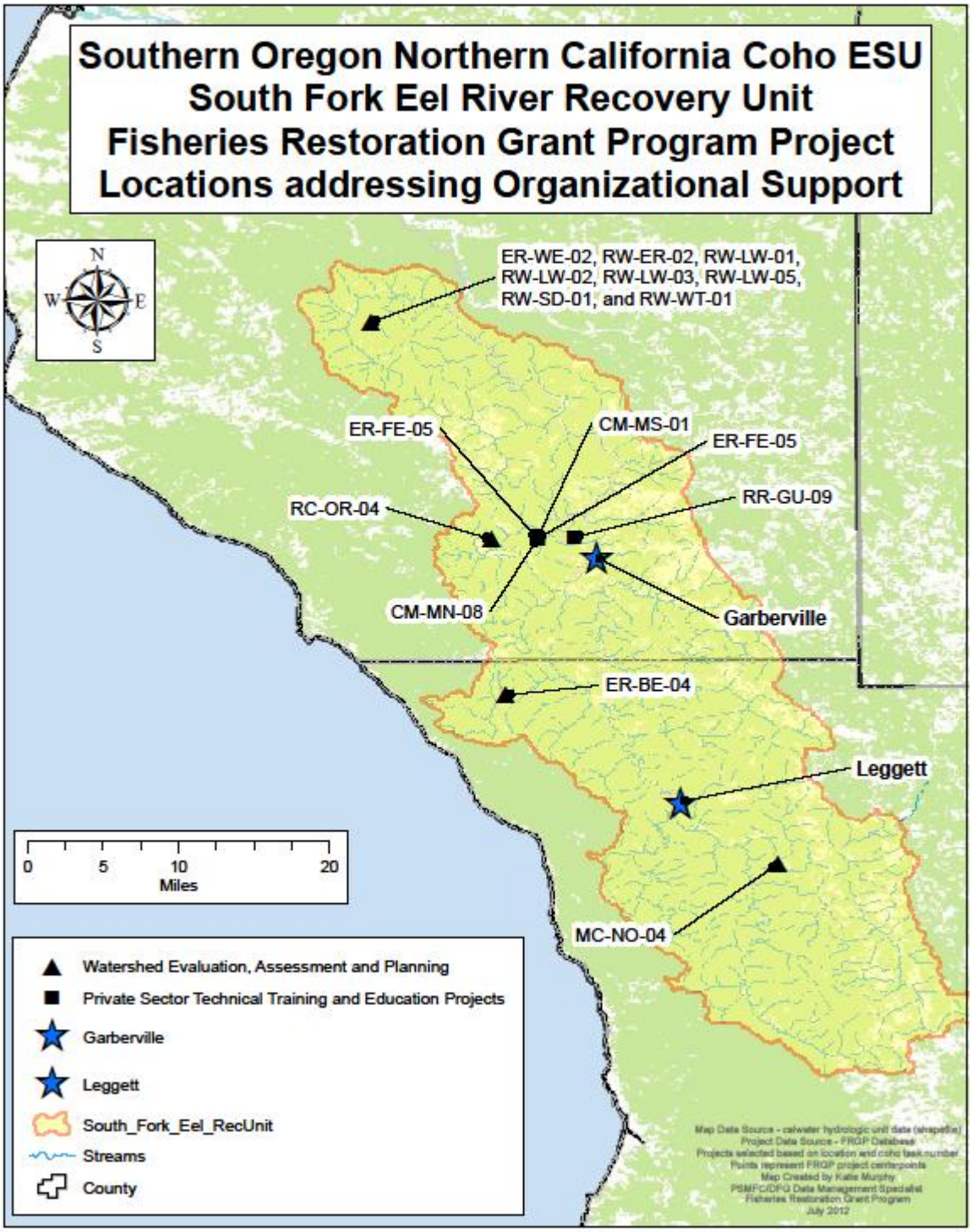

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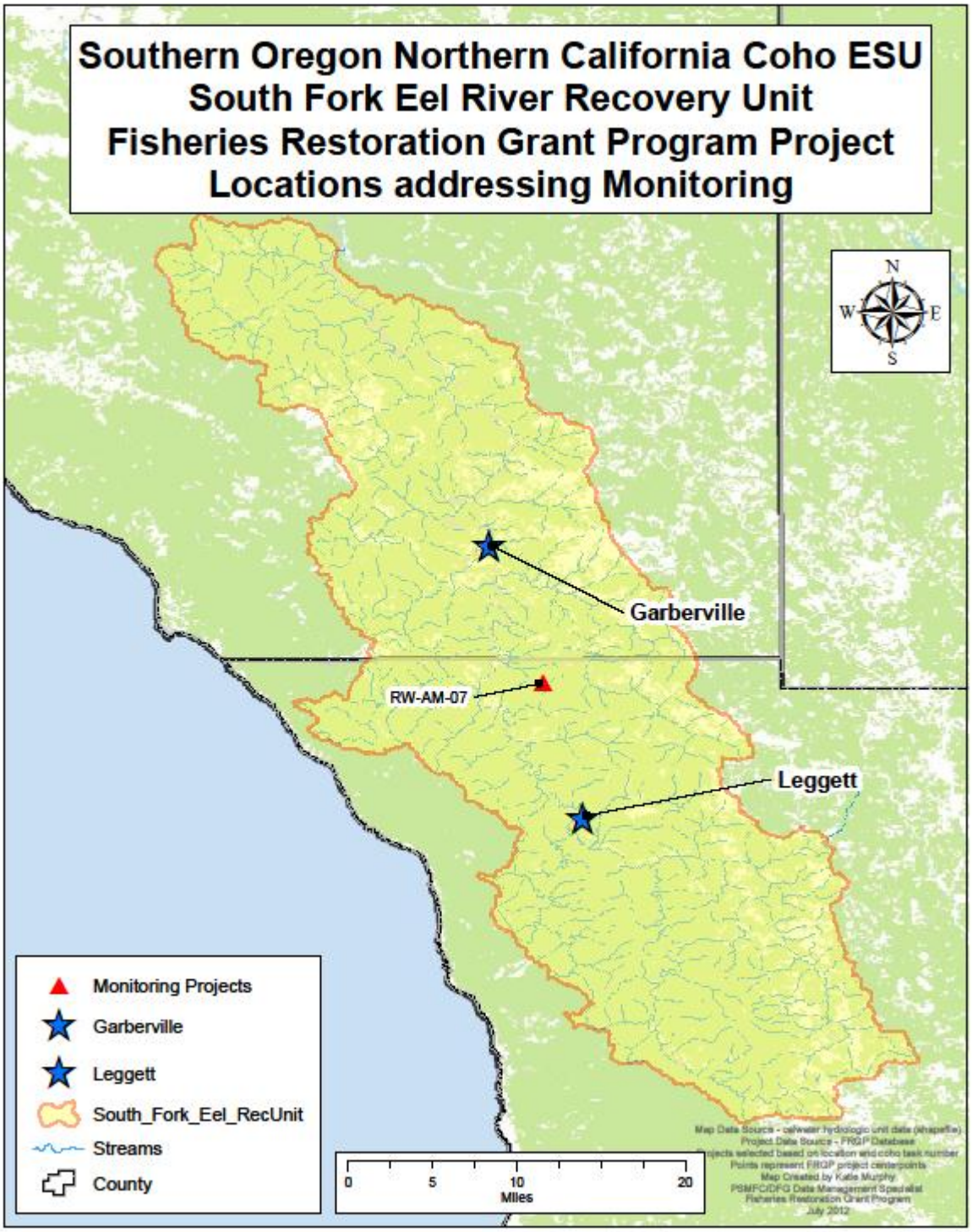

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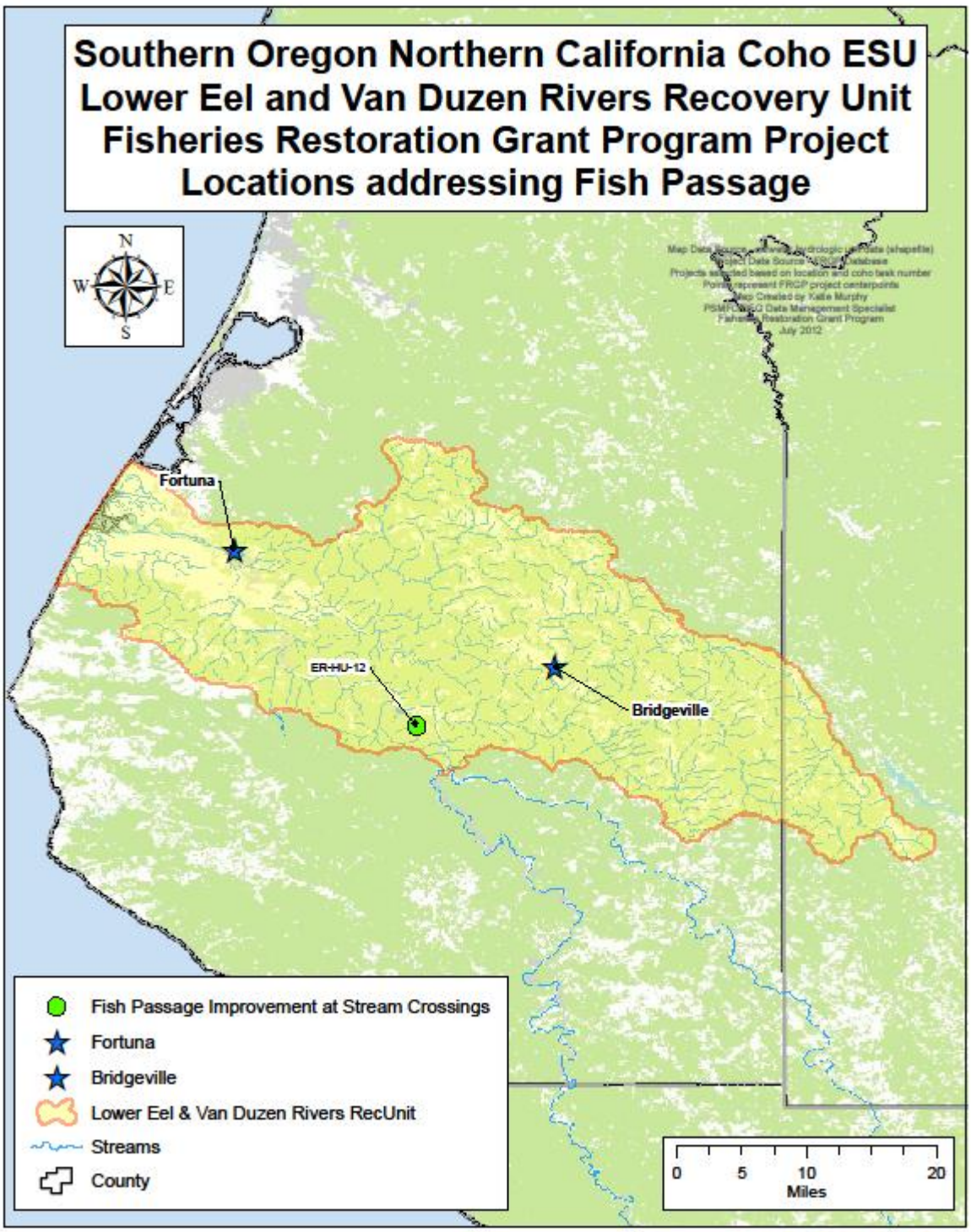
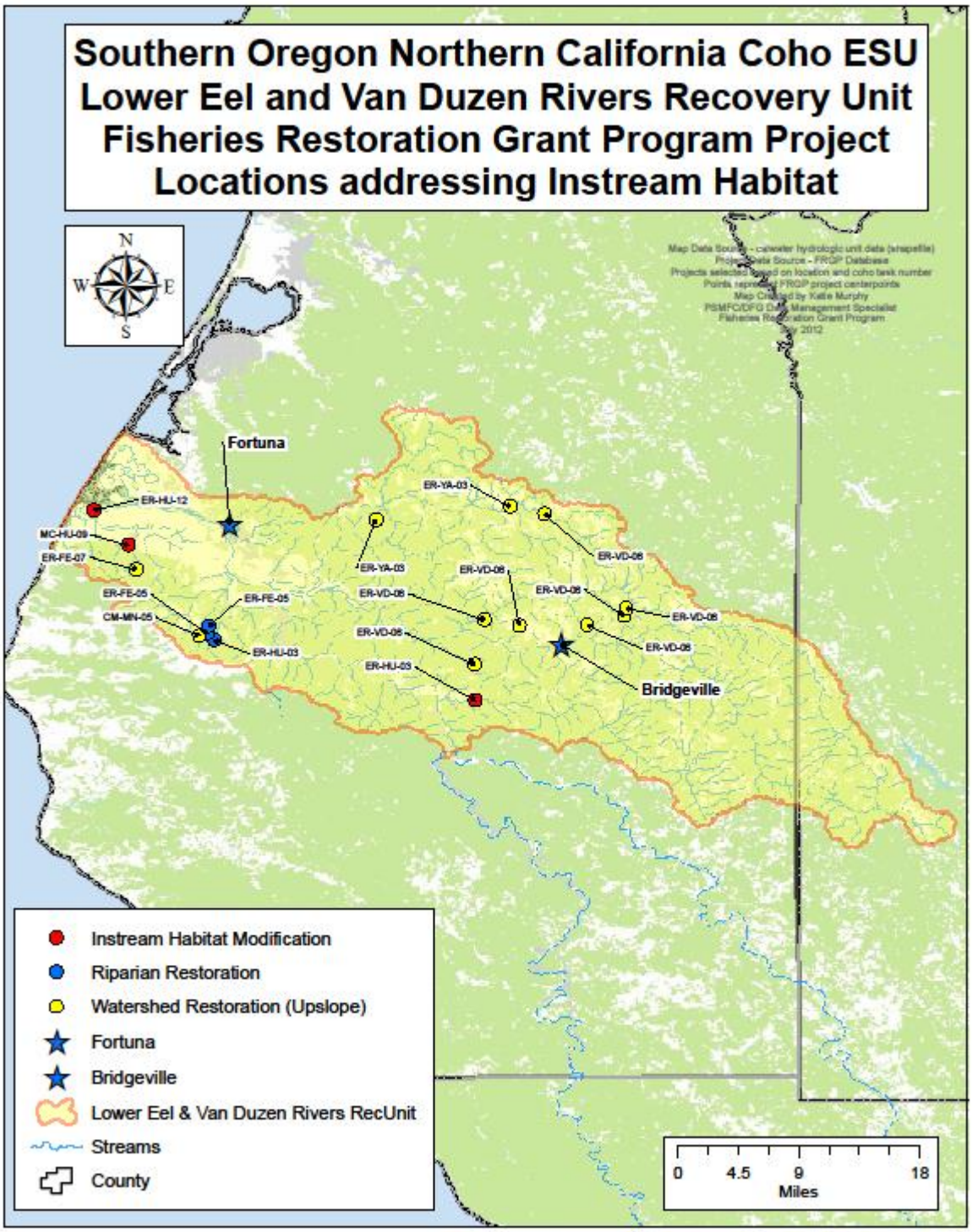


Appendix G (Continued) - Figure G30. Project locations in the Lower Eel/Van Duzen Rivers Recovery Unit – Fish Passage projects



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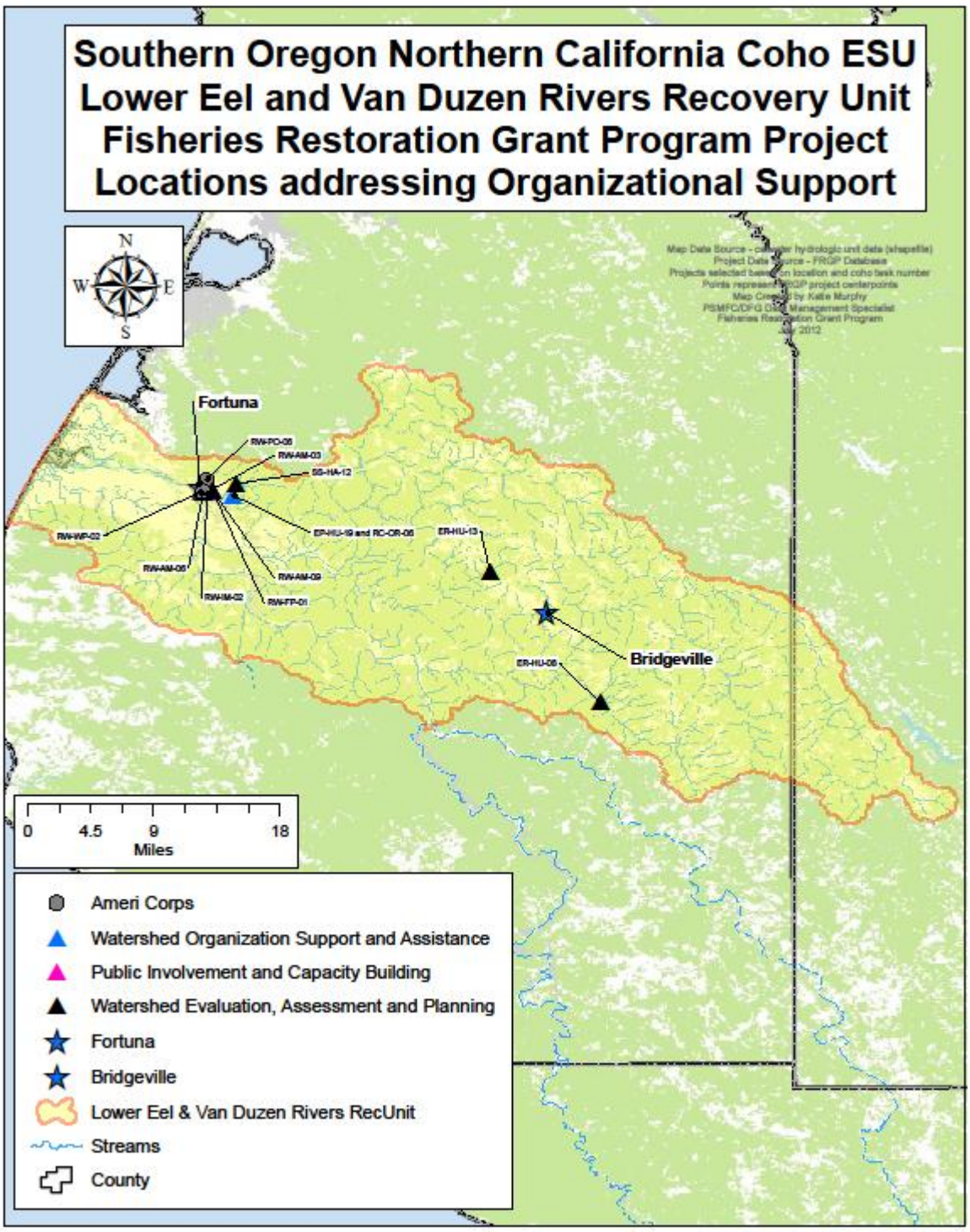

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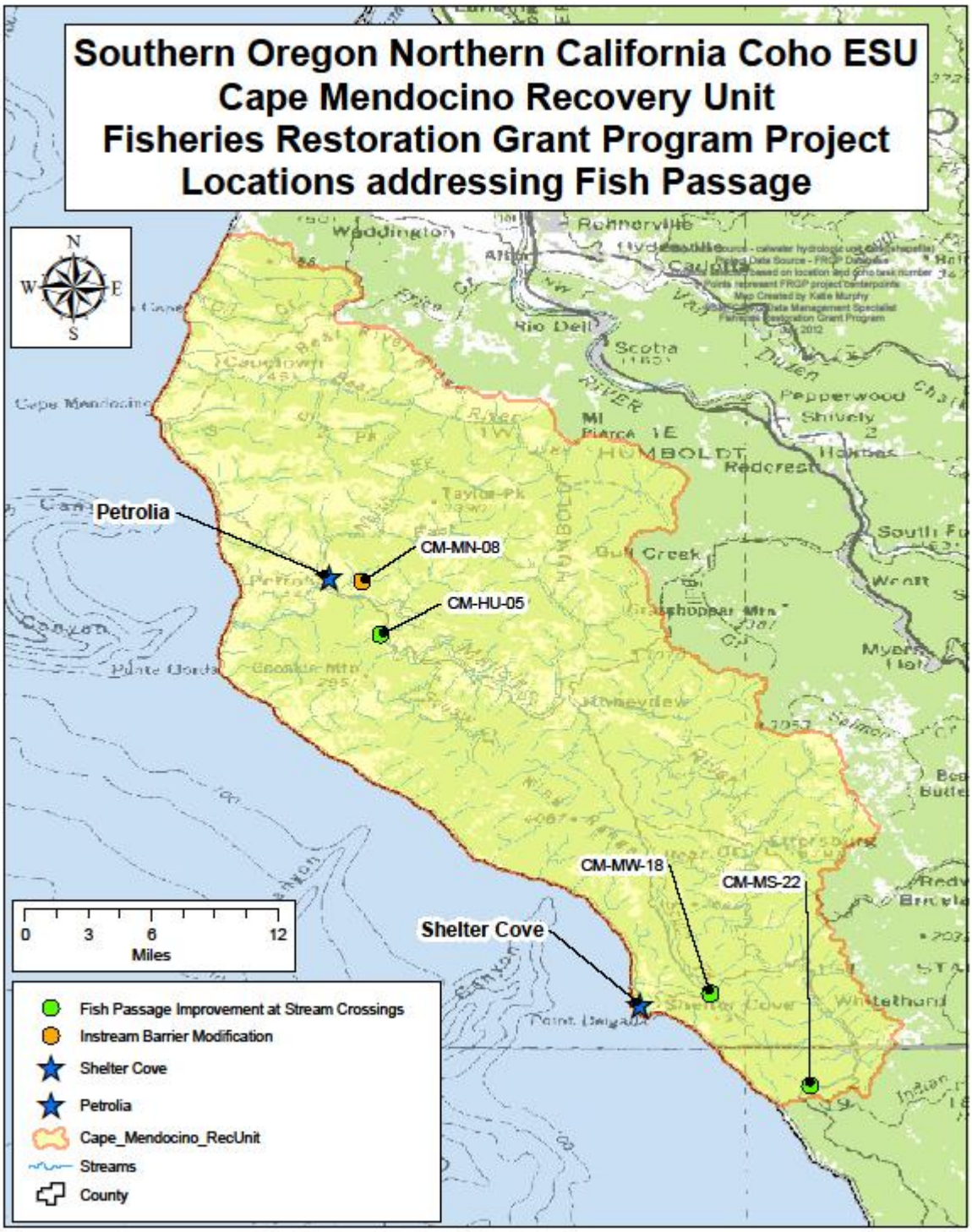

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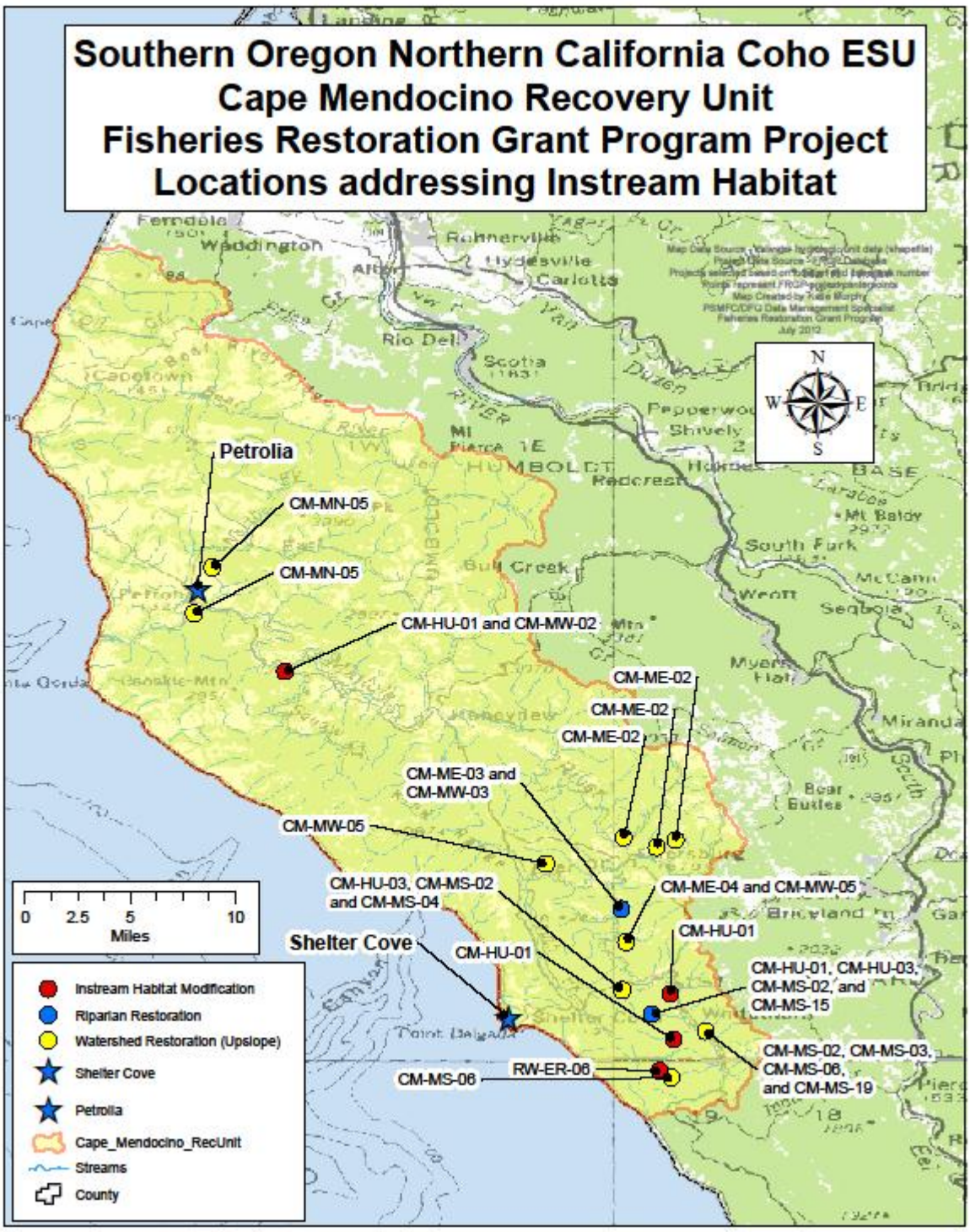
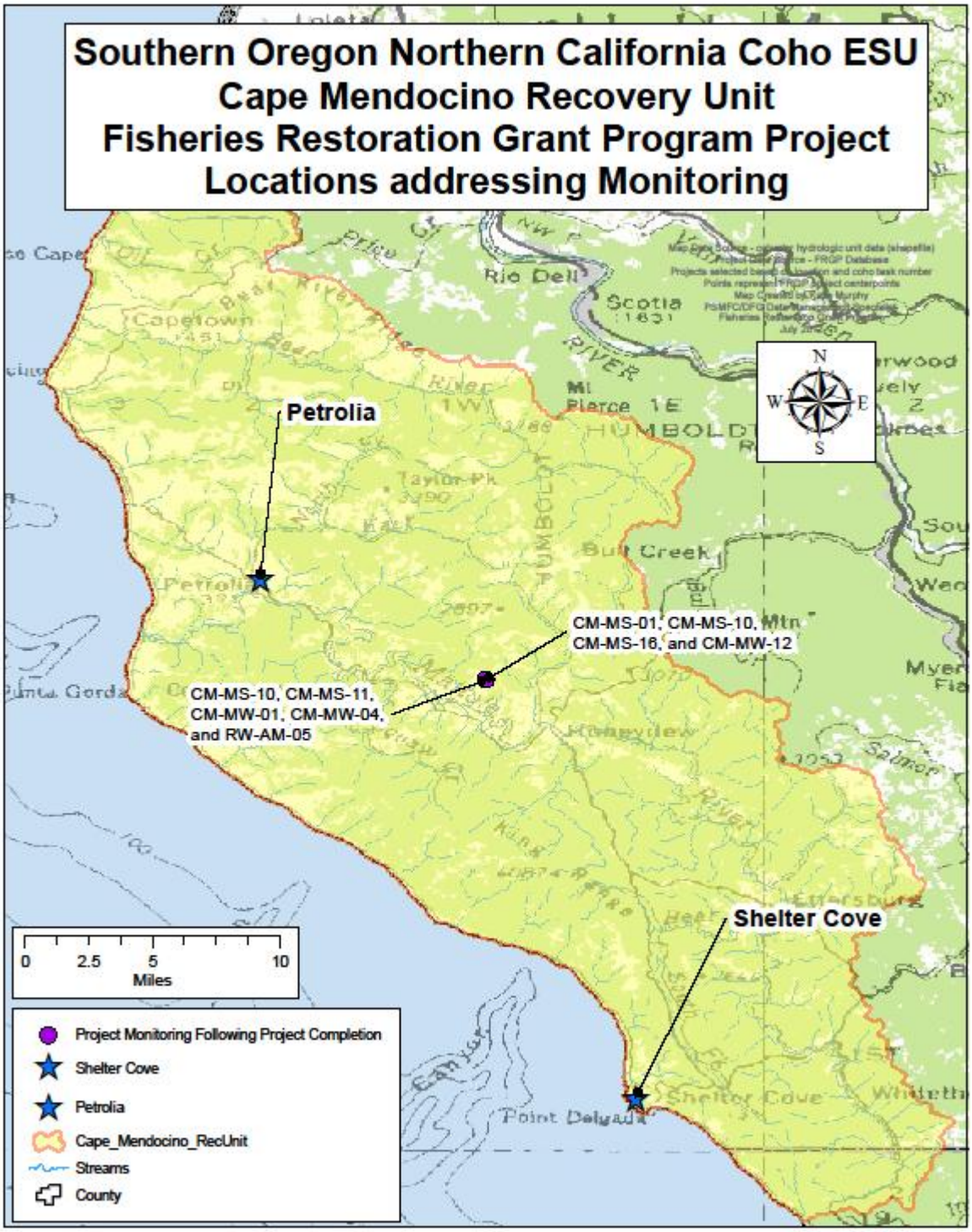


Appendix G (Continued) - Figure G34. Project locations in the Cape Mendocino Recovery Unit – Instream Habitat projects

Appendix G (Continued) - Figure G35. Project locations in the Cape Mendocino Recovery Unit – Organizational Support projects



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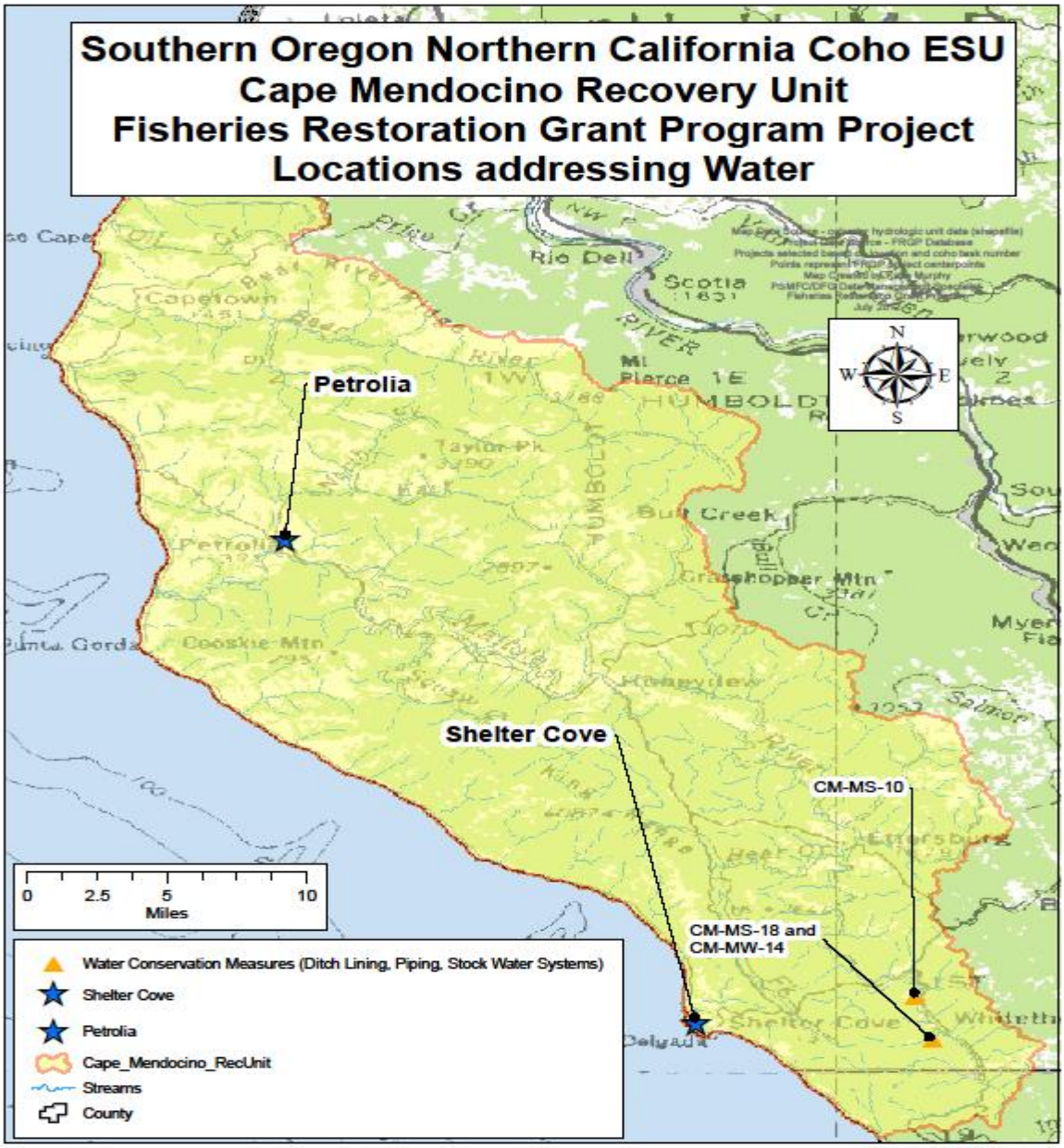

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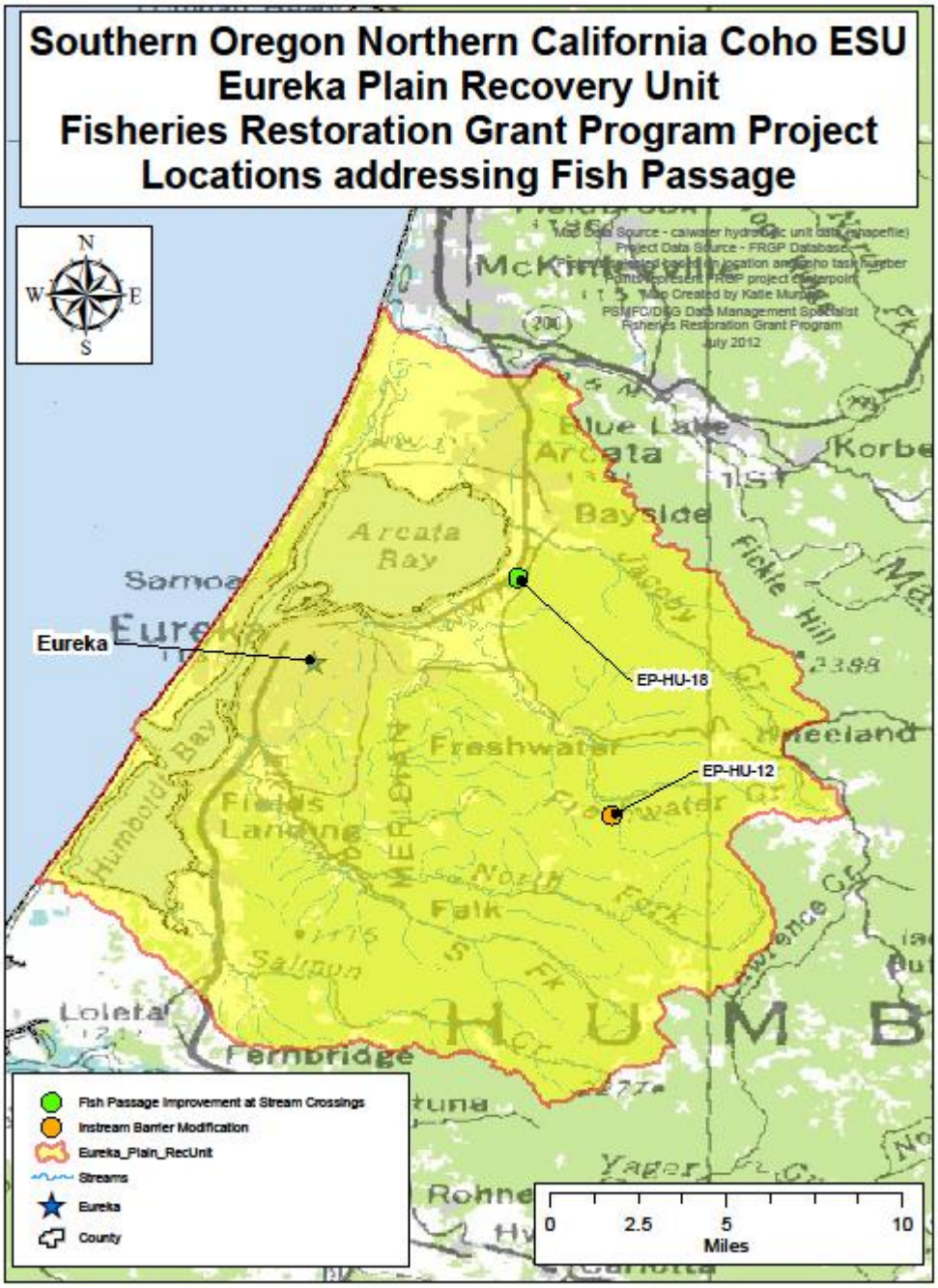

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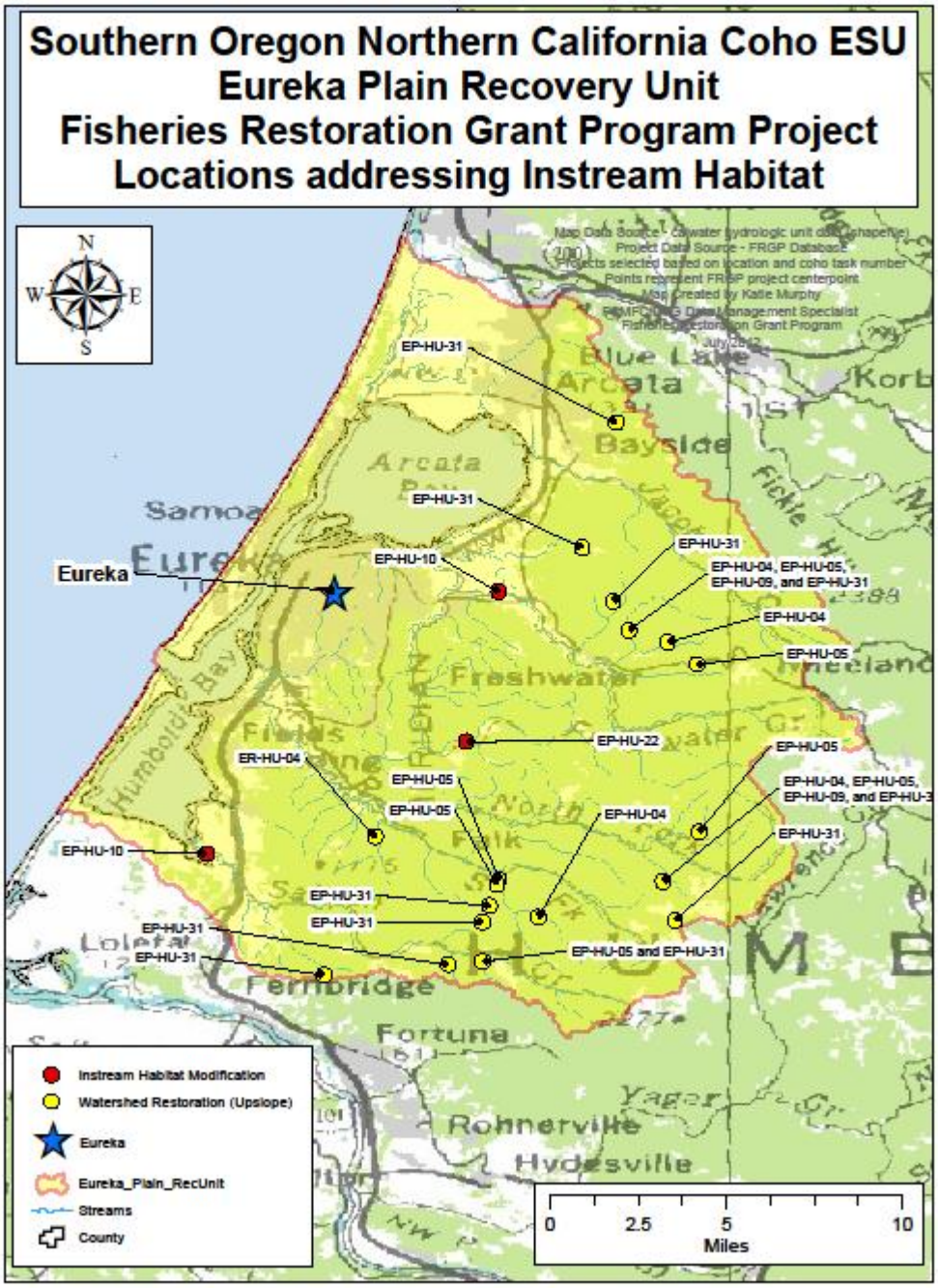

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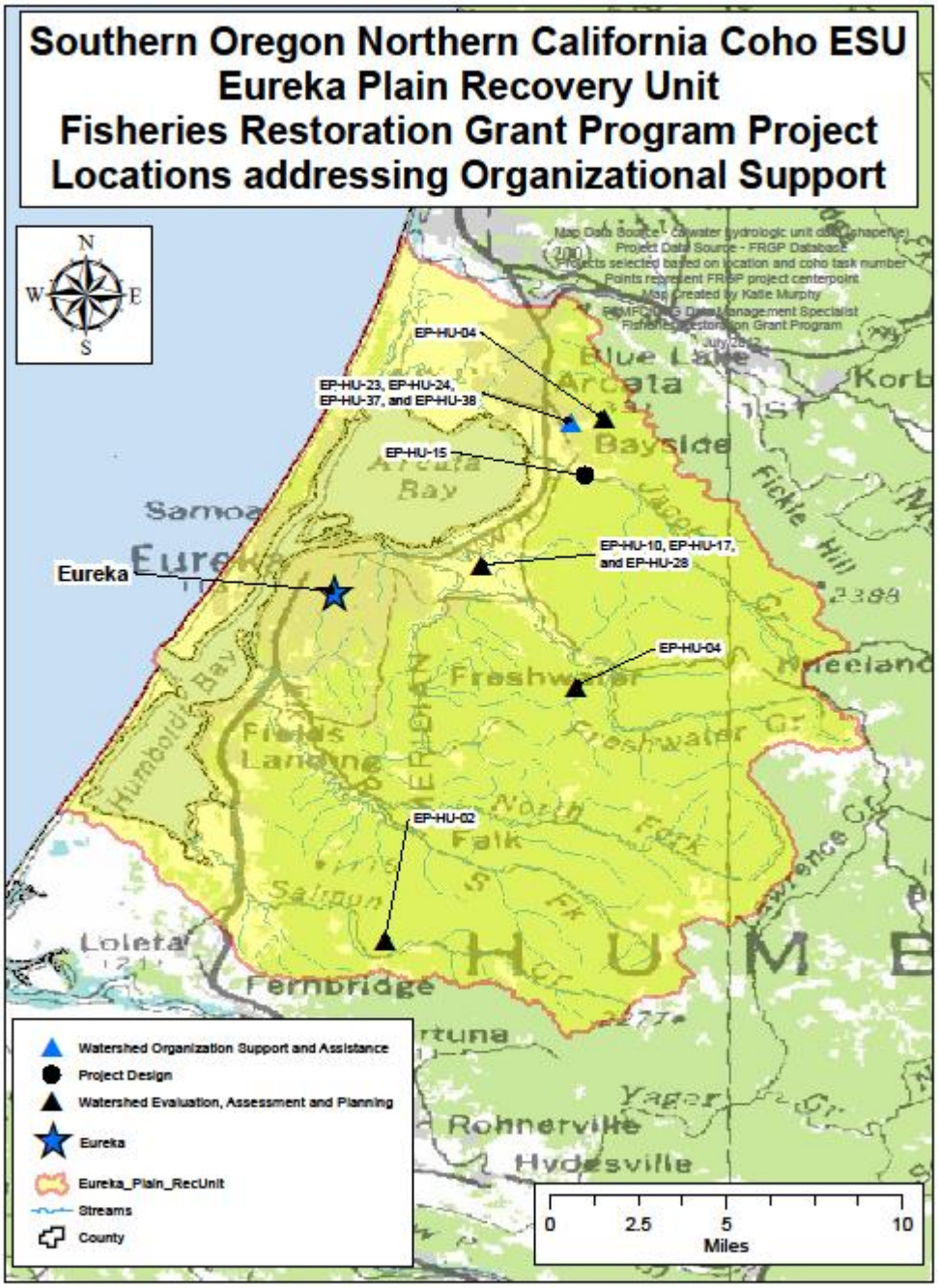
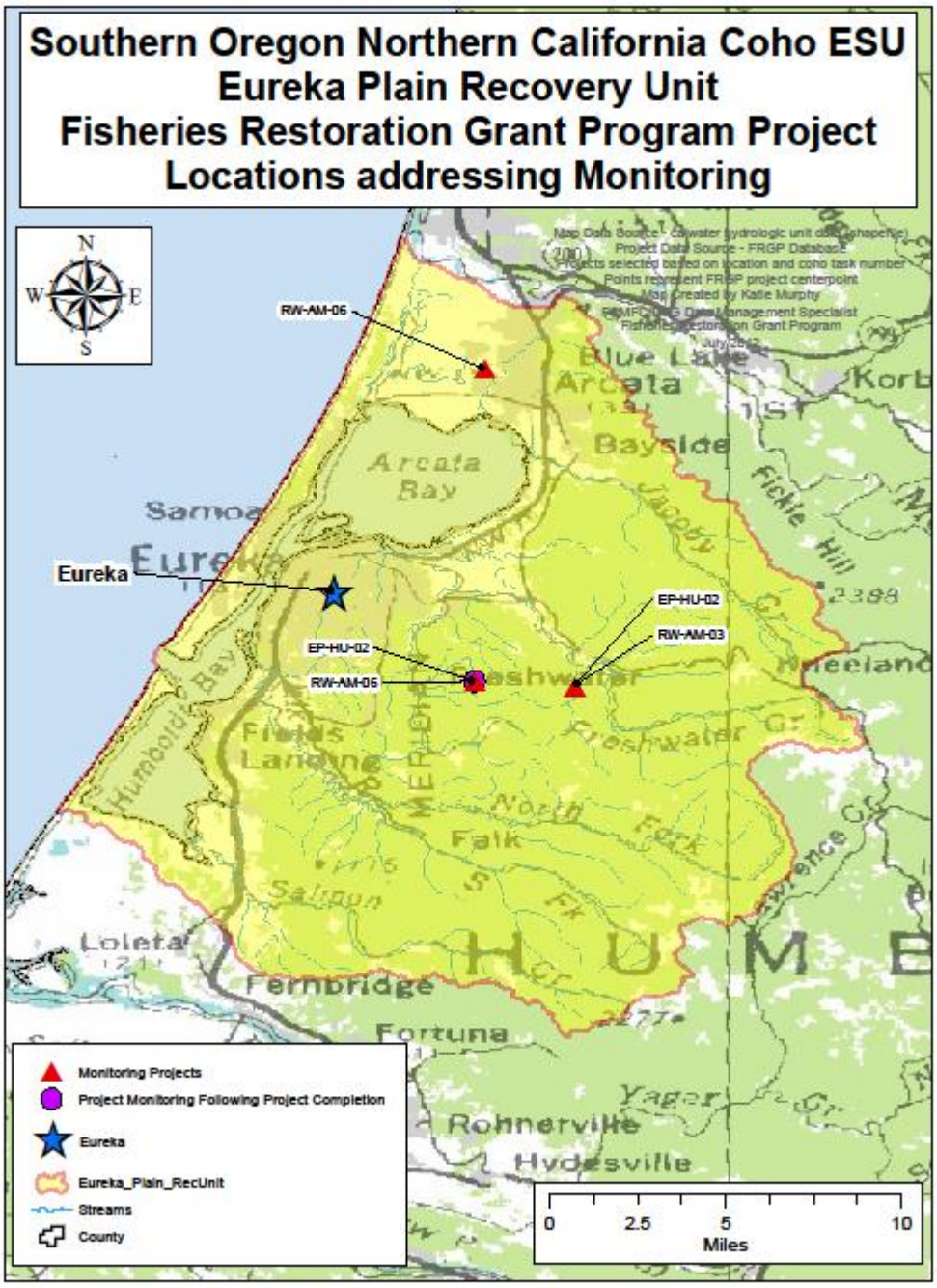


Appendix G (Continued) - Figure G 40. Project locations in the Eureka Plain Recovery Unit – Organizational Support projects



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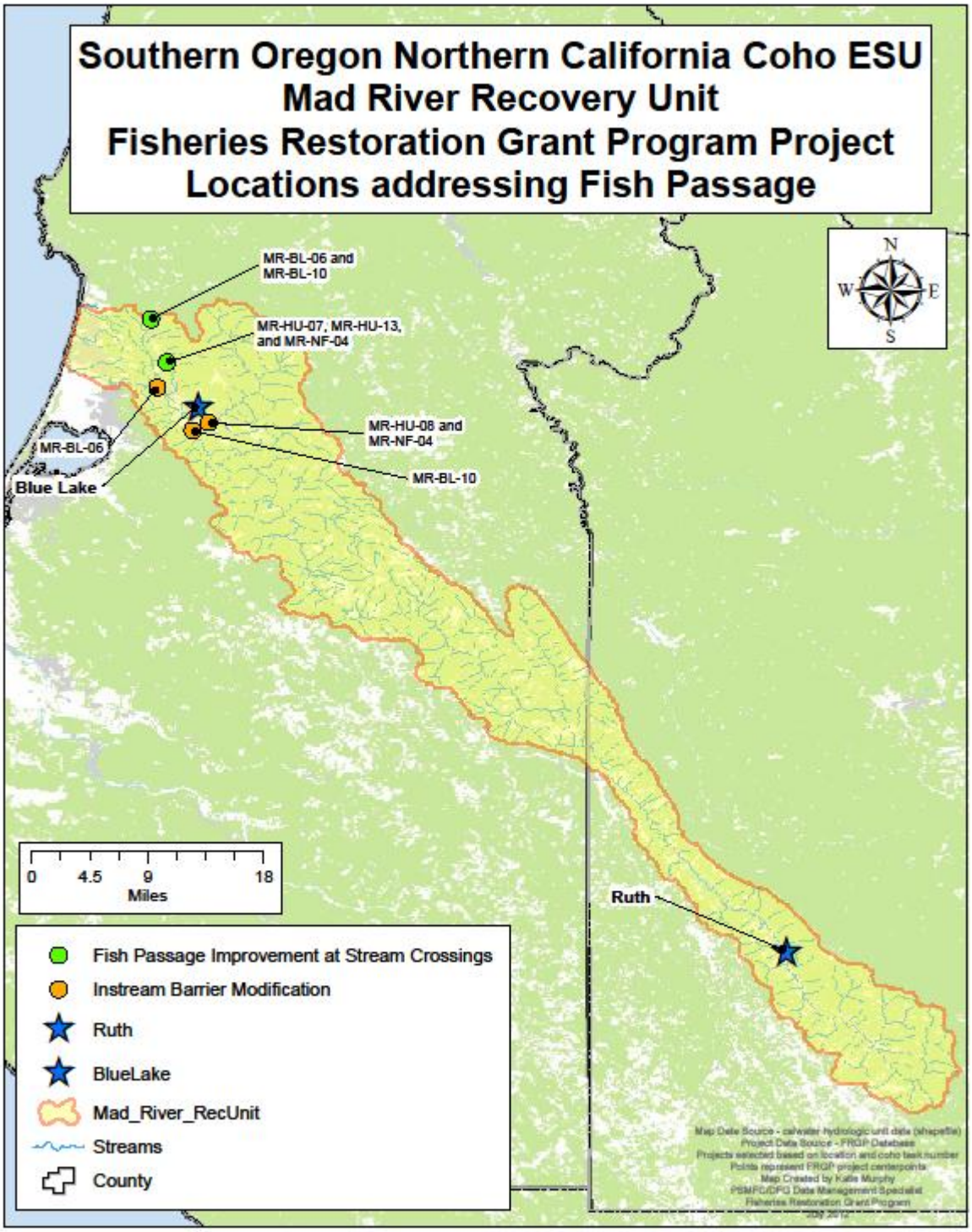

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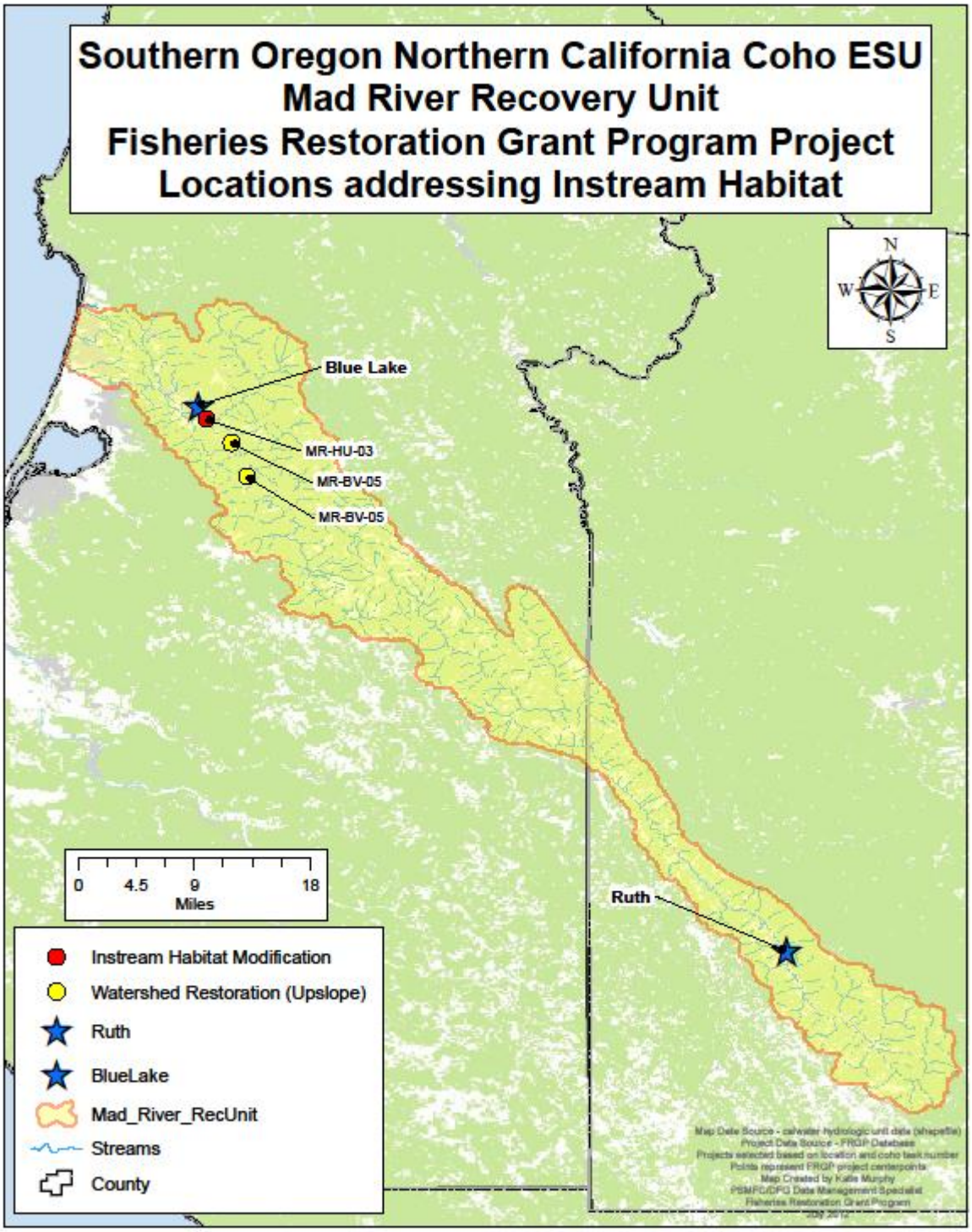

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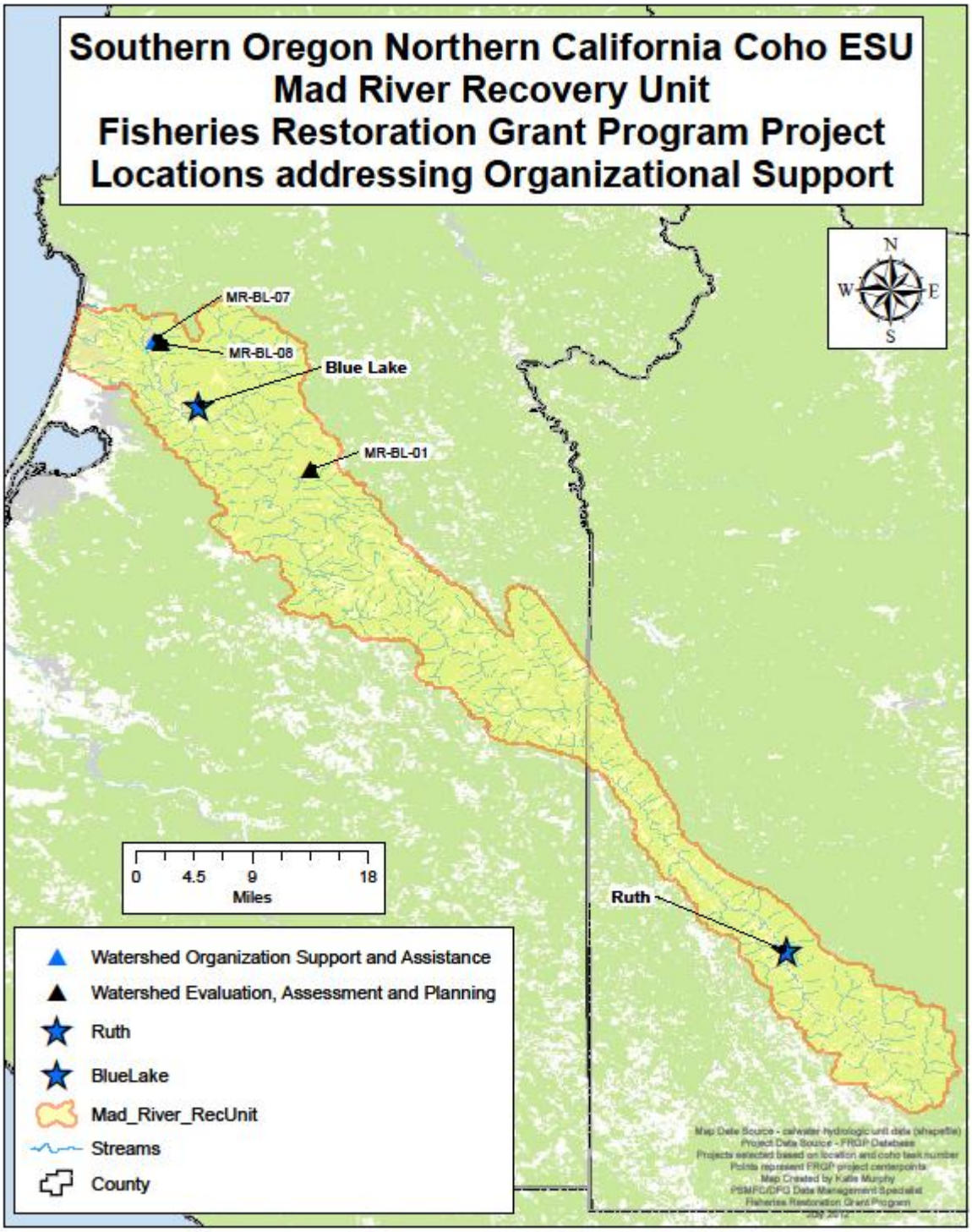
Appendix G (Continued) - Figure G43. Project locations in the Mad River Recovery Unit– Instream Habitat projects



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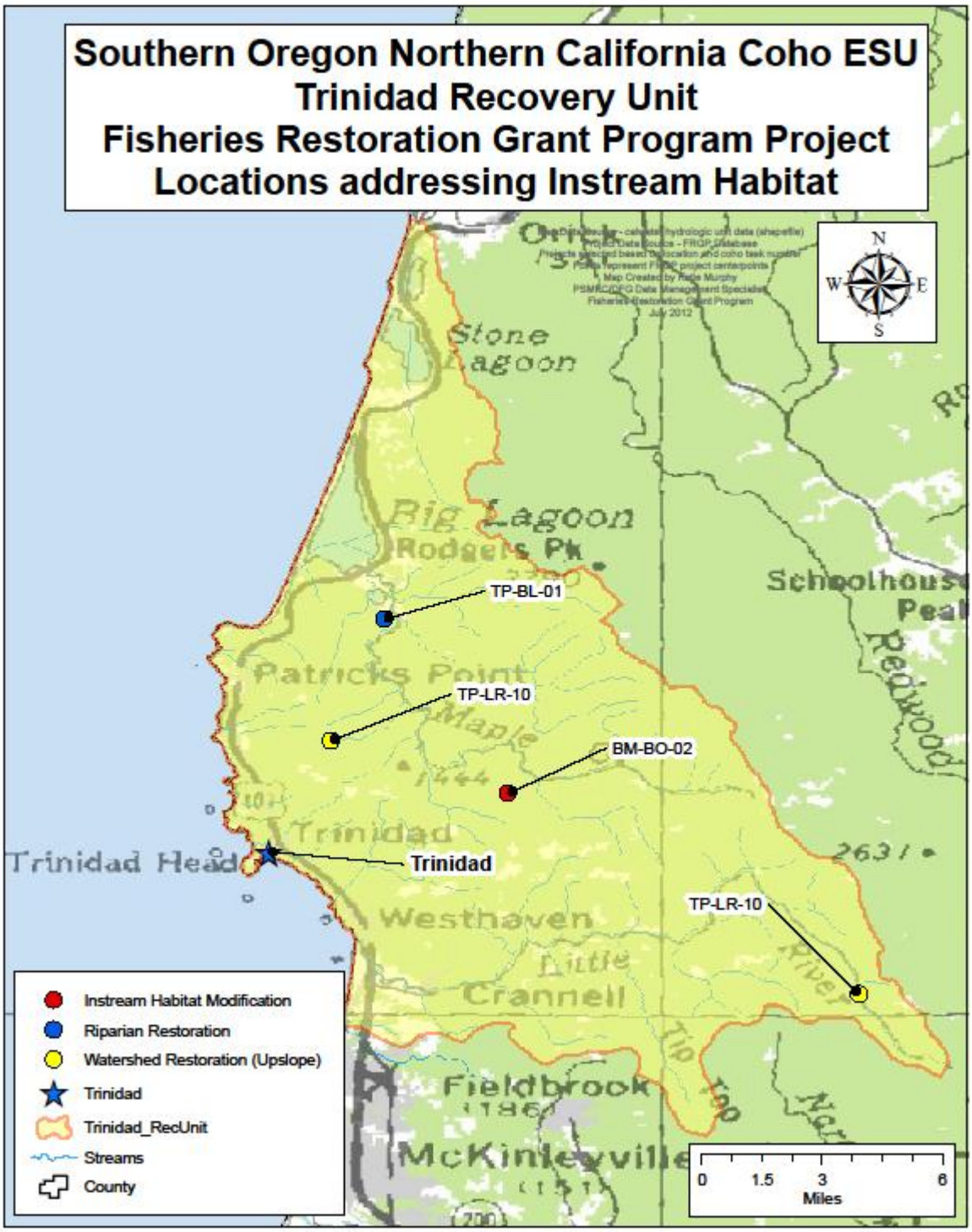

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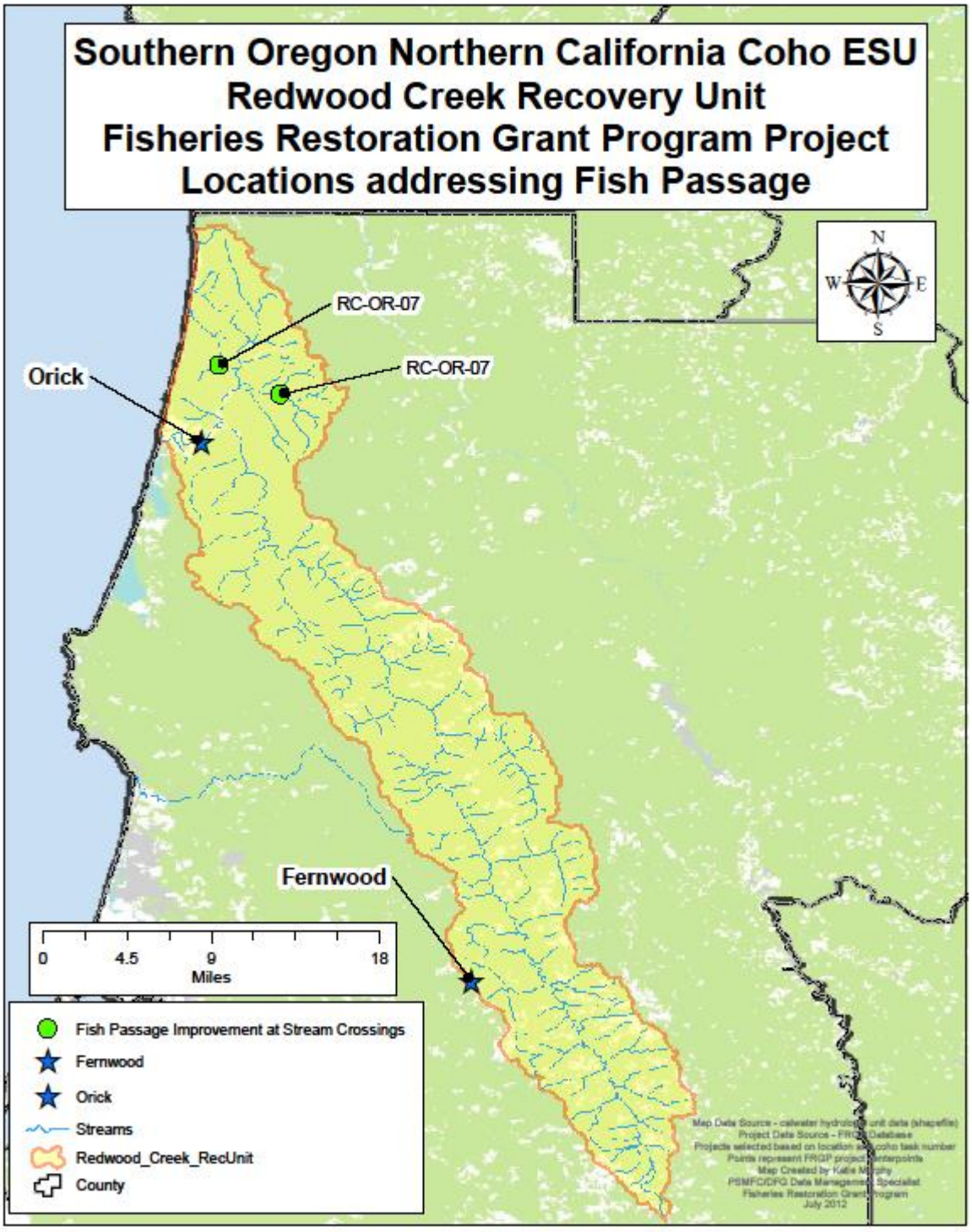

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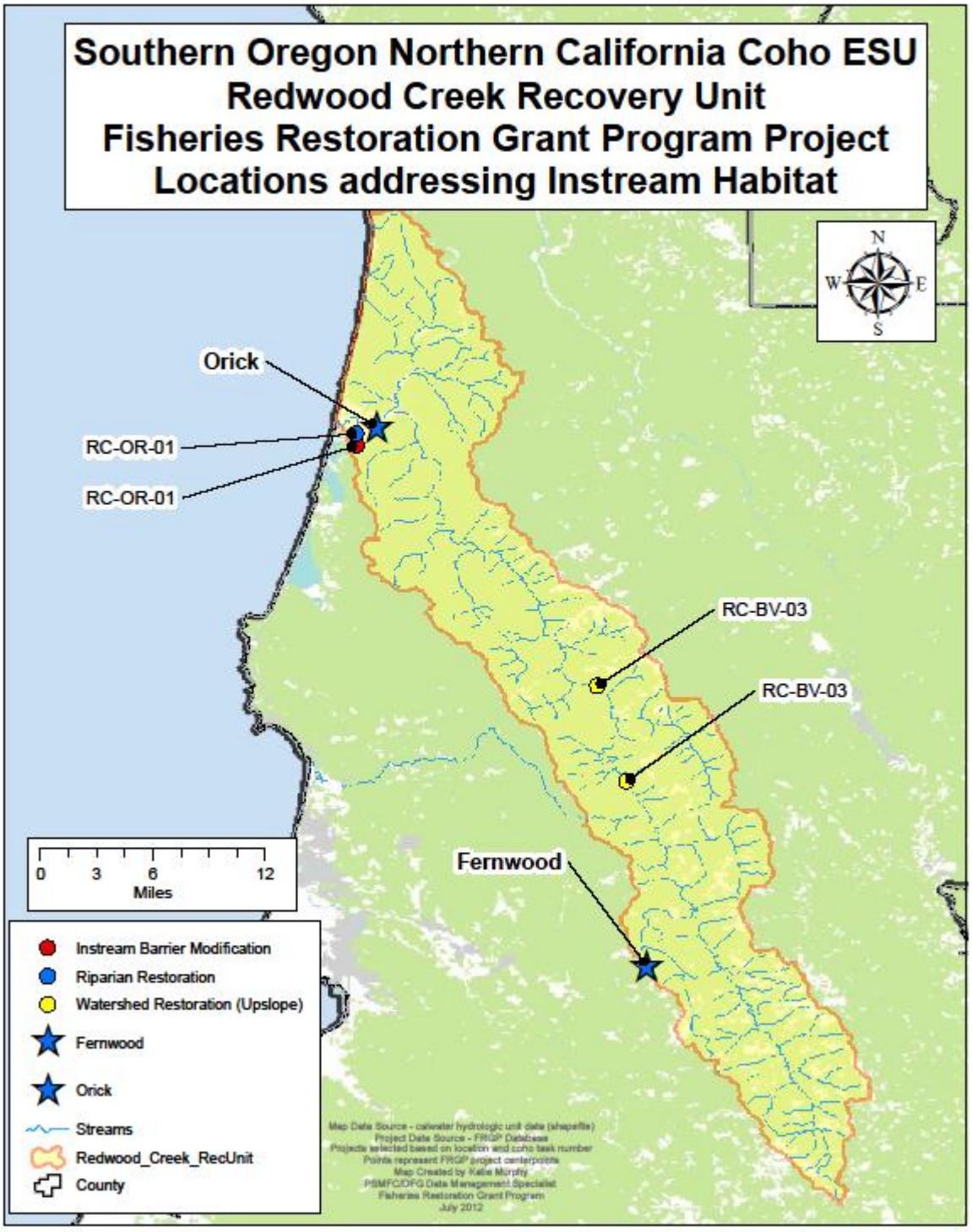

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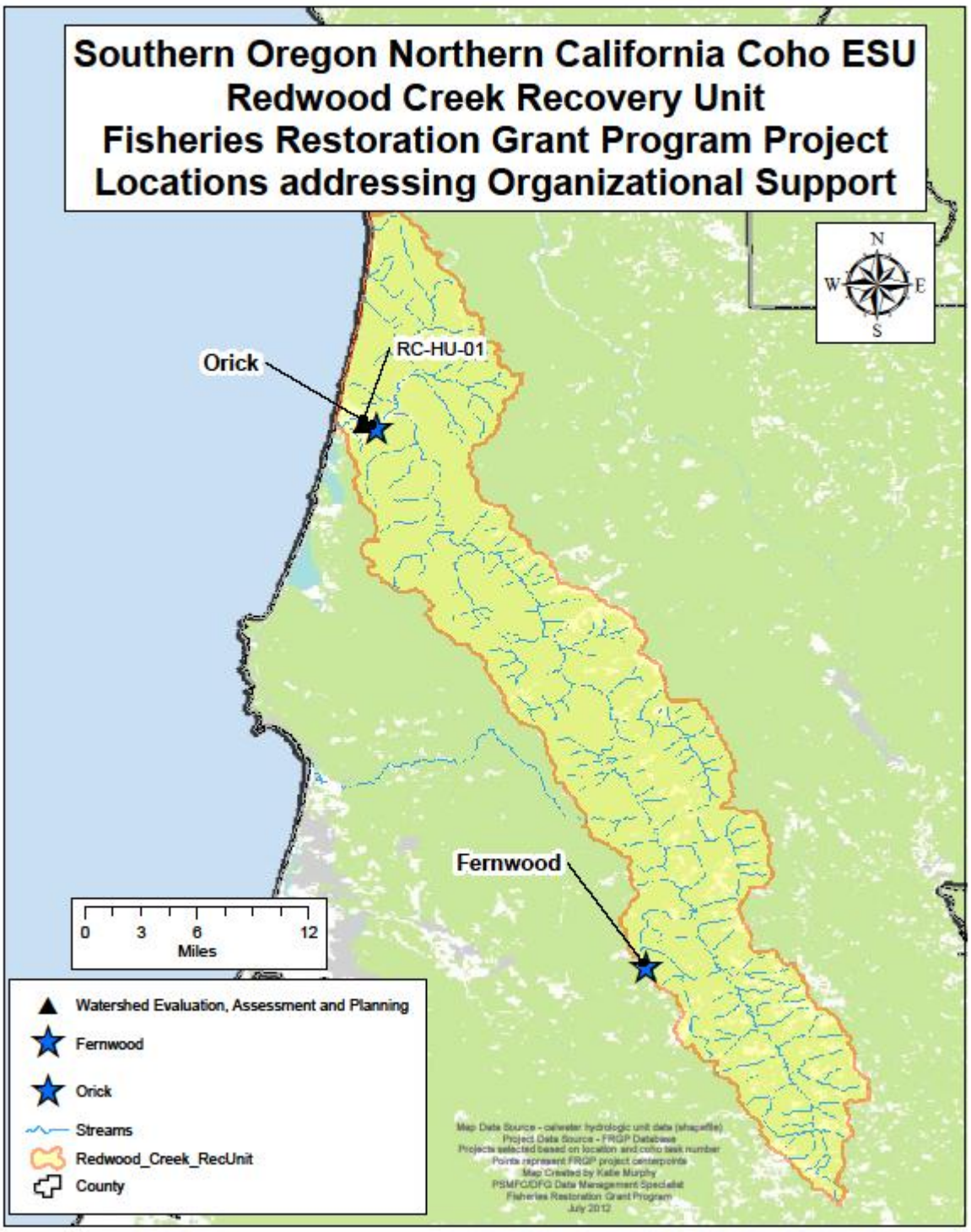

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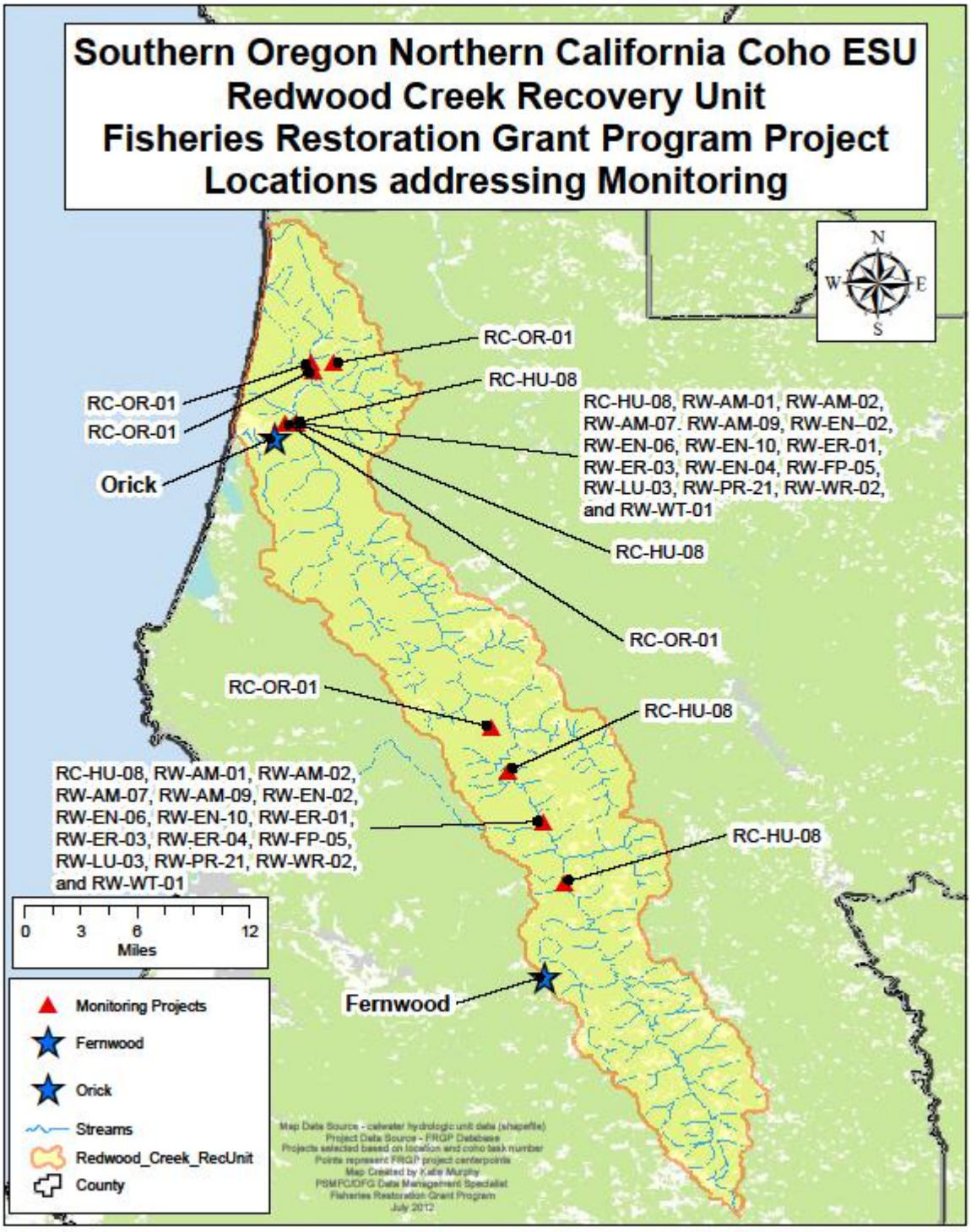

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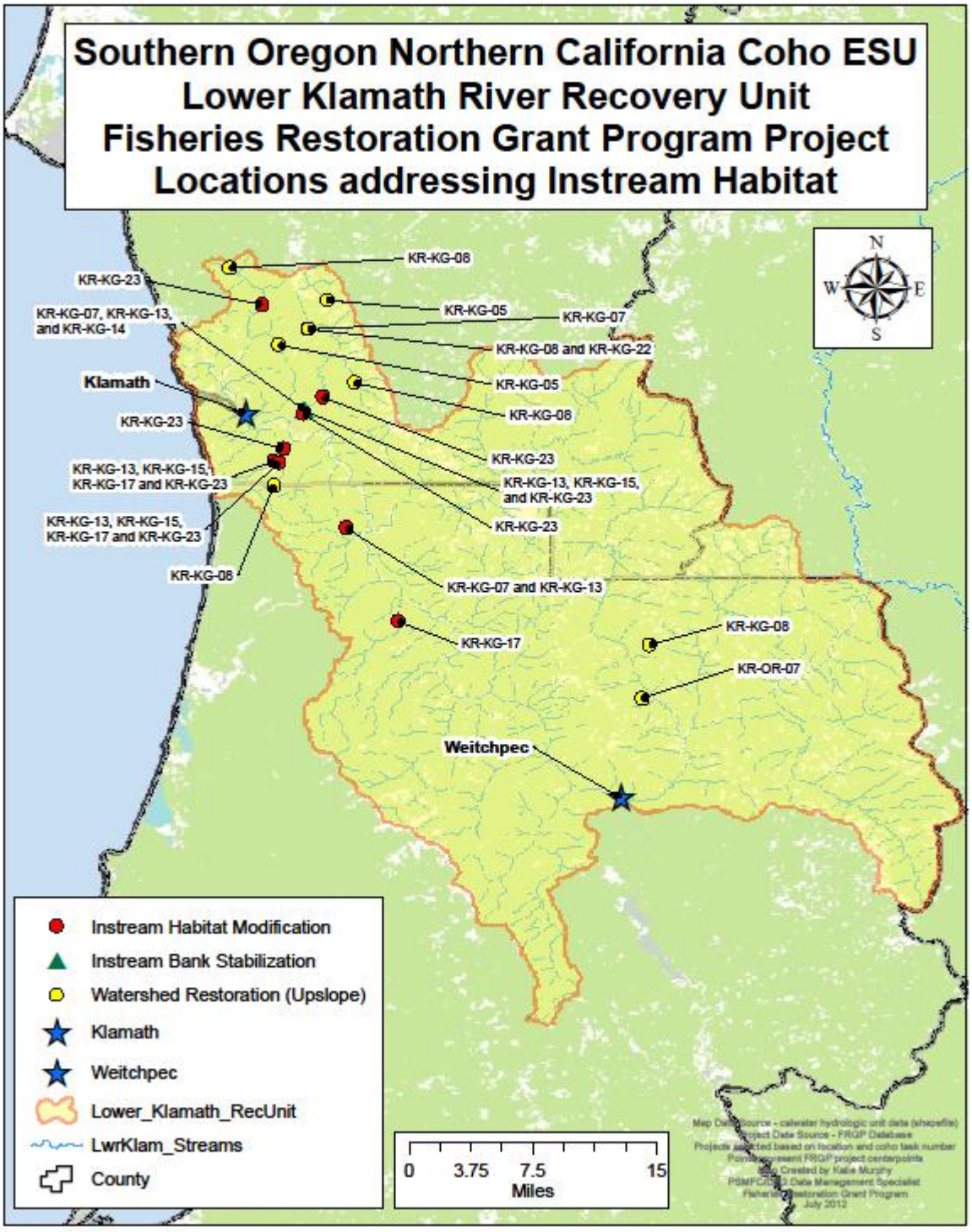
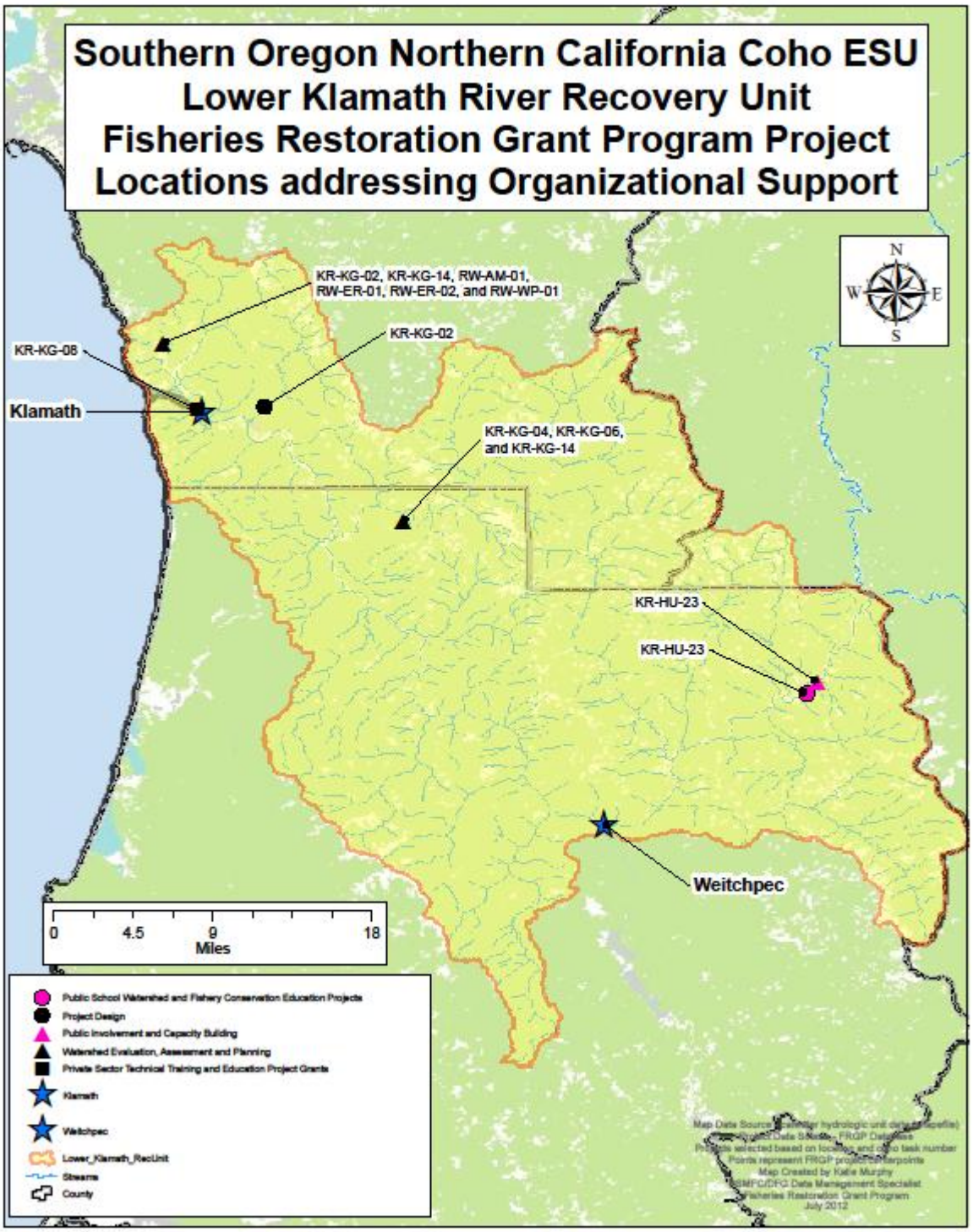
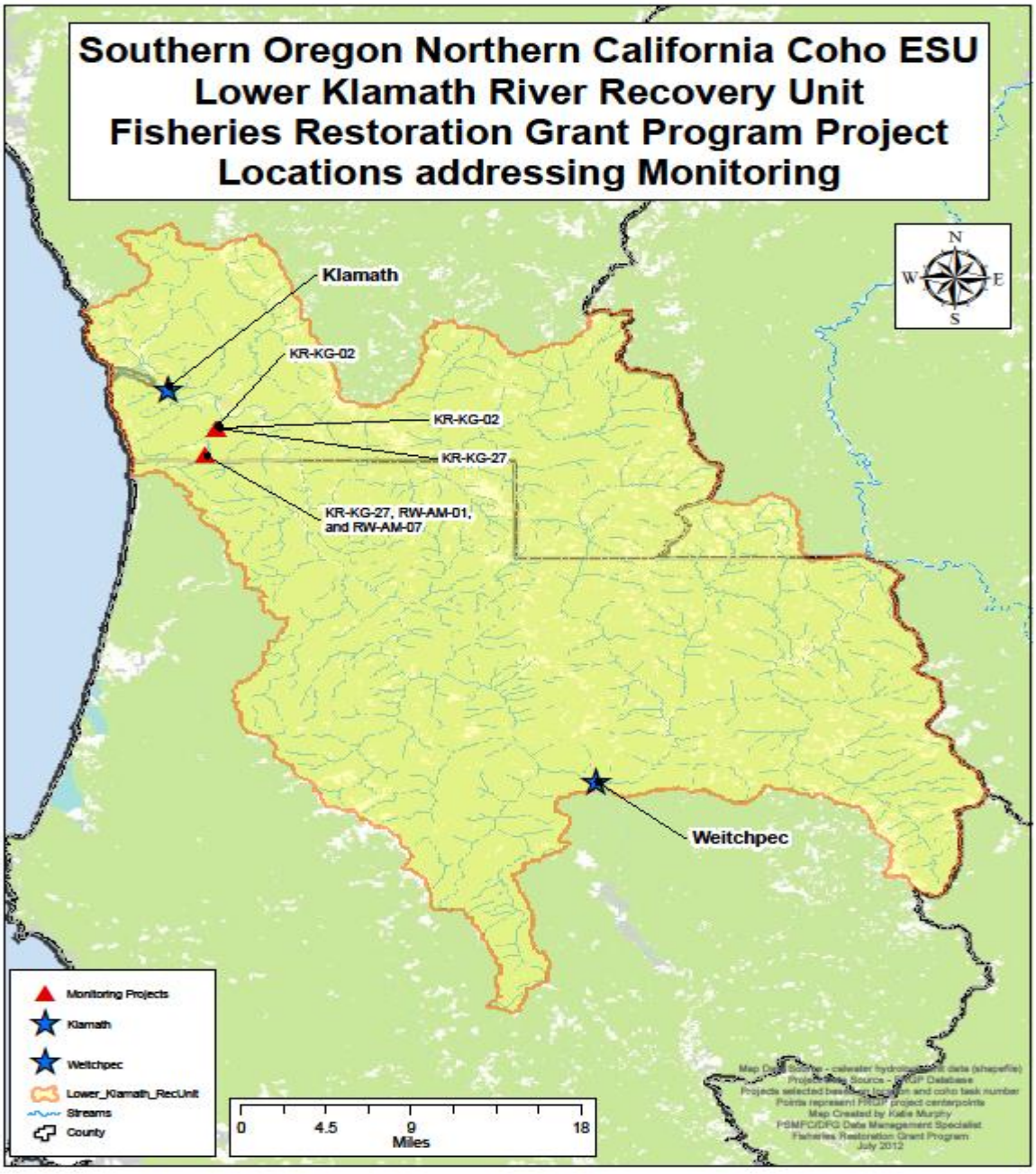


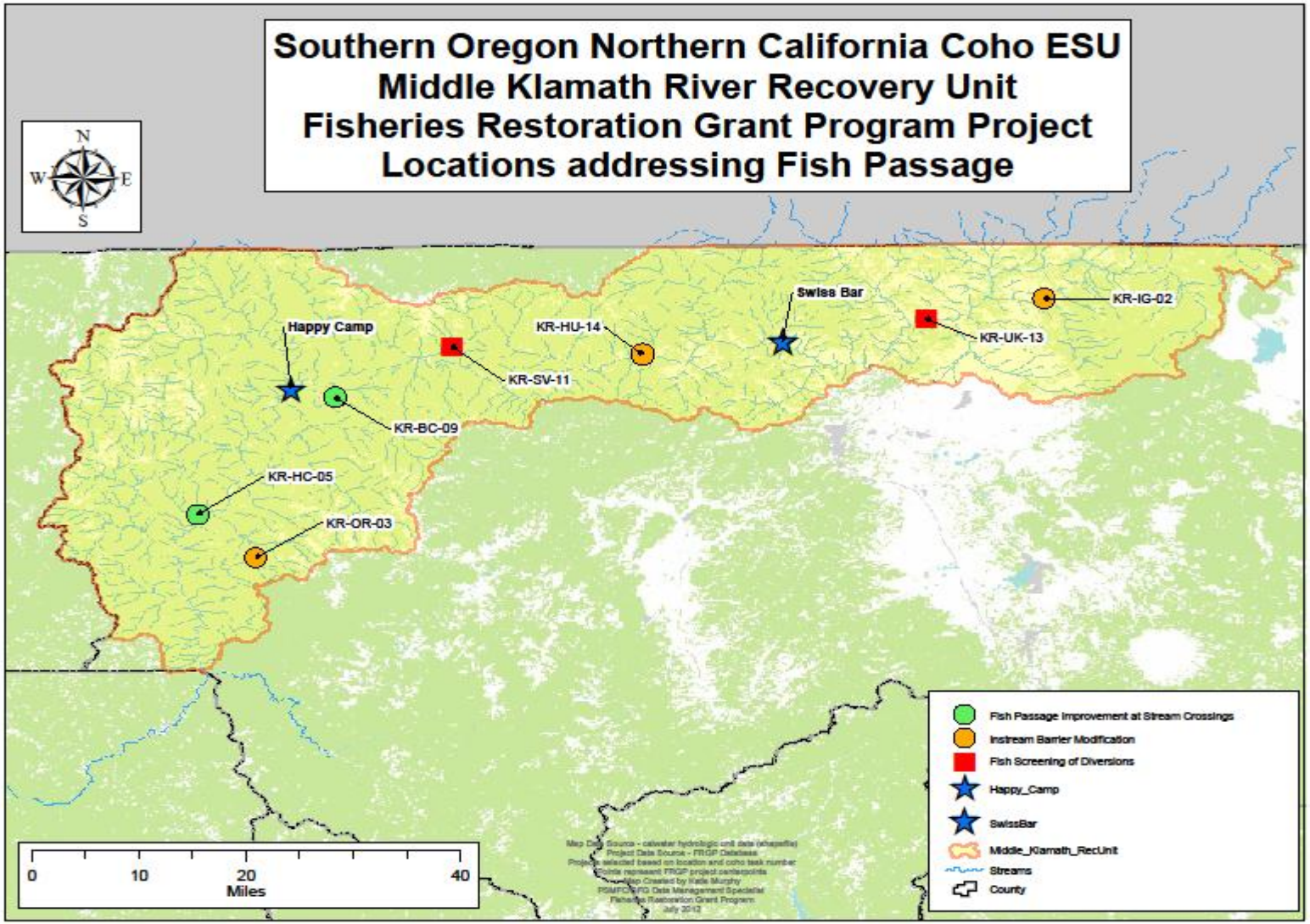
Appendix G (Continued) - Figure G50. Project locations in the Lower Klamath Recovery Unit – Instream Habitat projects



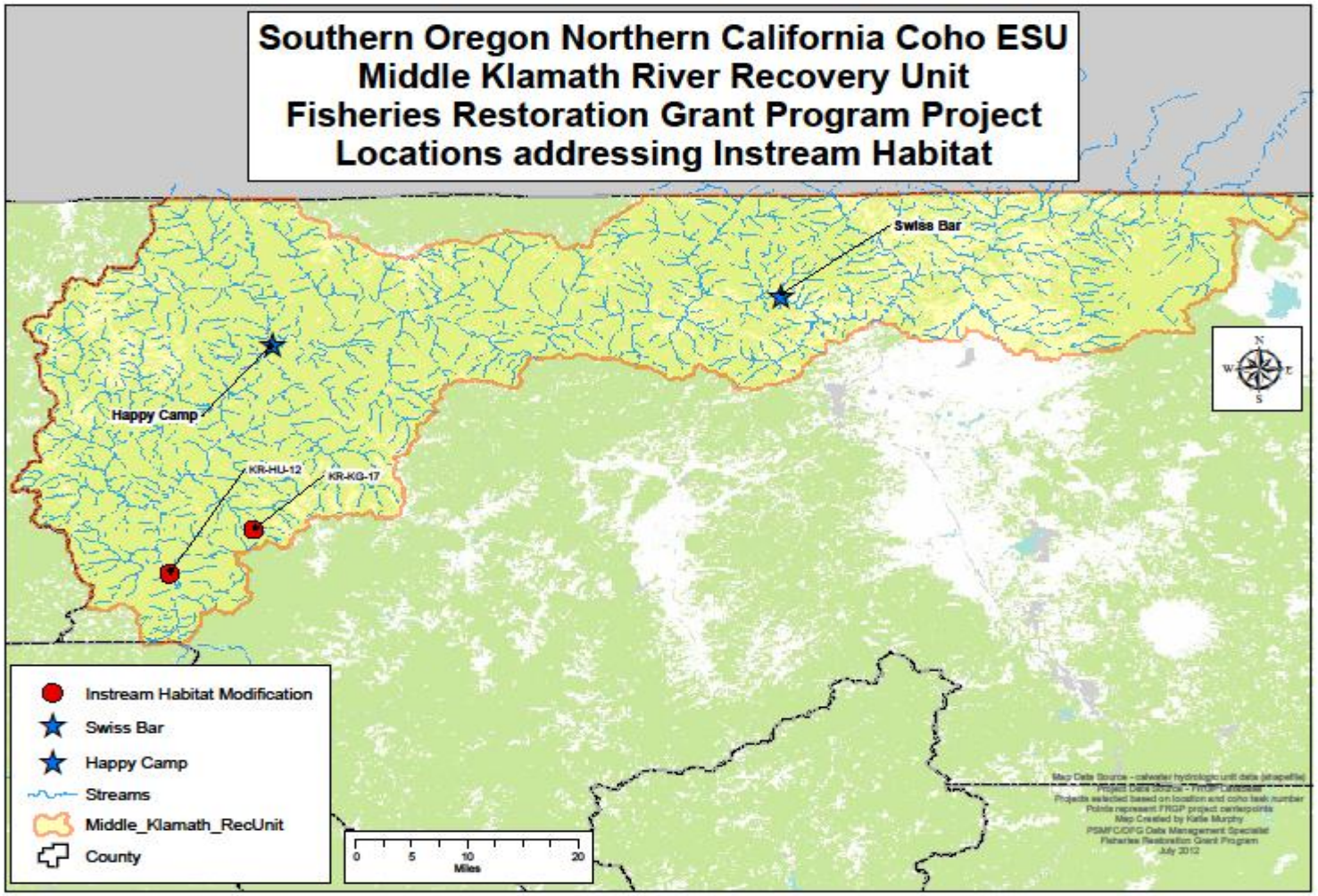
Appendix G (Continued) - Figure G51. Project locations in the Lower Klamath Recovery Unit – Organizational Support projects



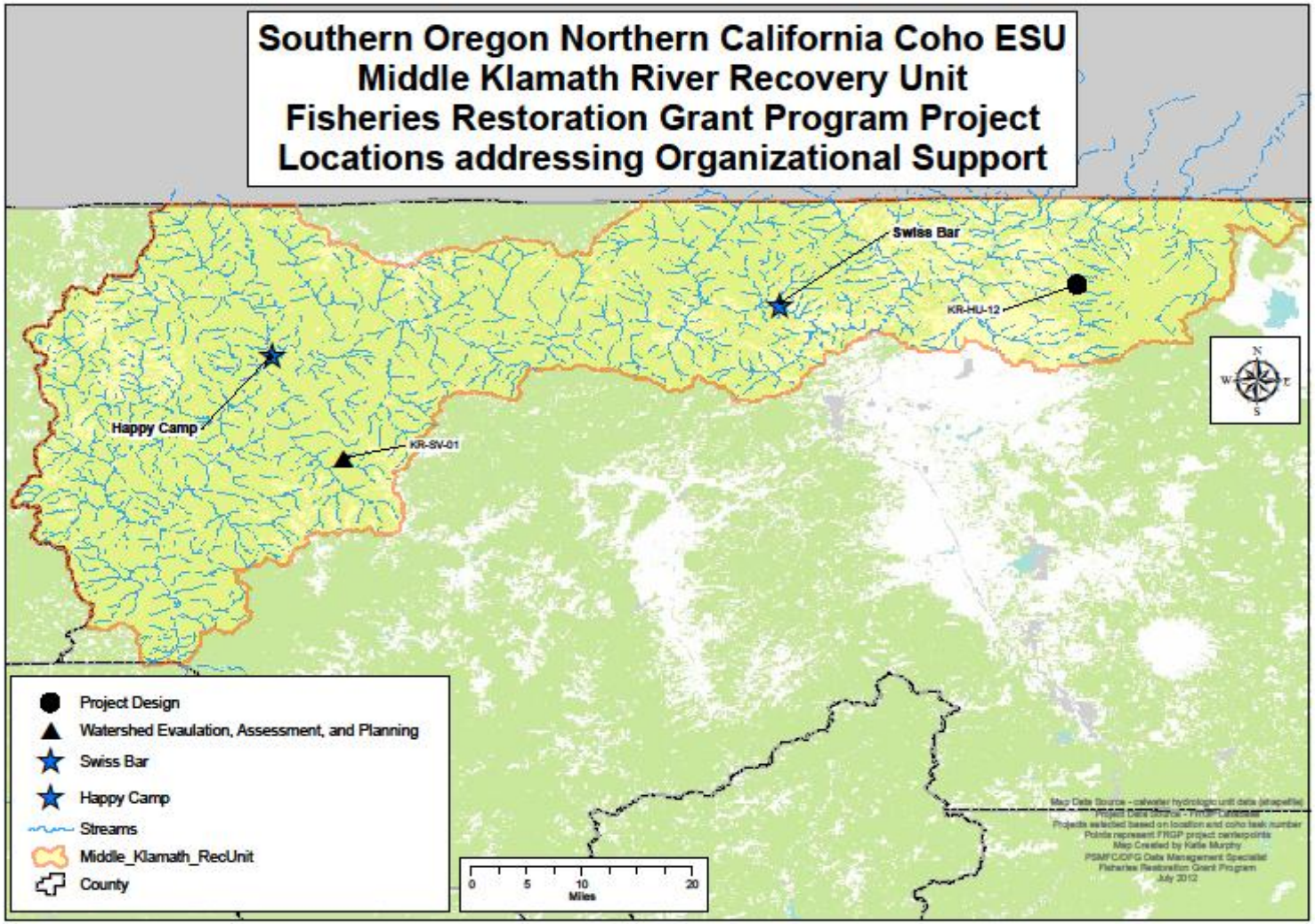
Appendix G (Continued) - Figure G52. Project locations in the Lower Klamath Recovery Unit – Monitoring projects



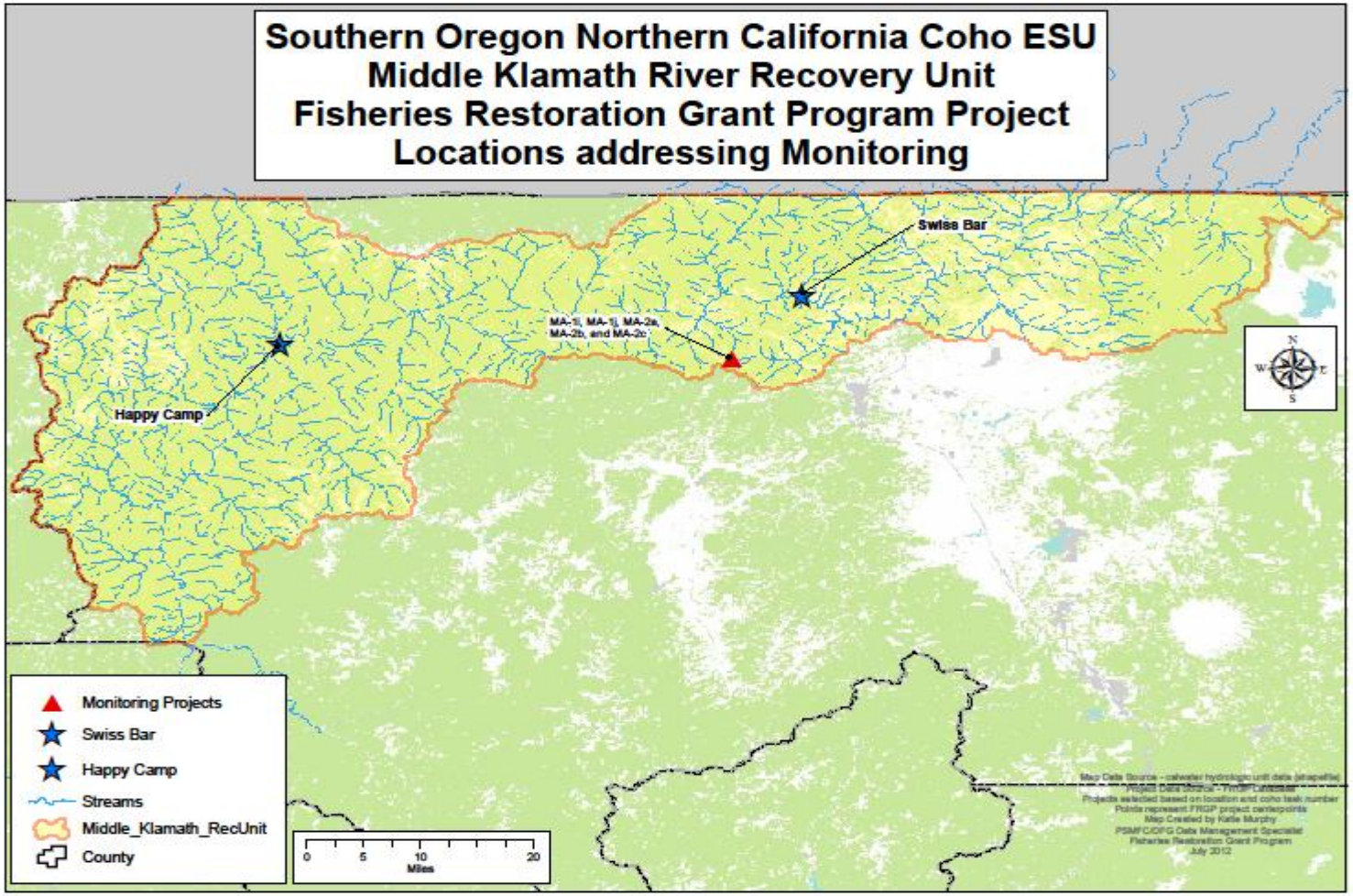
Appendix G (Continued) - Figure G53. Project locations in the Middle Klamath Recovery Unit – Fish Passage projects



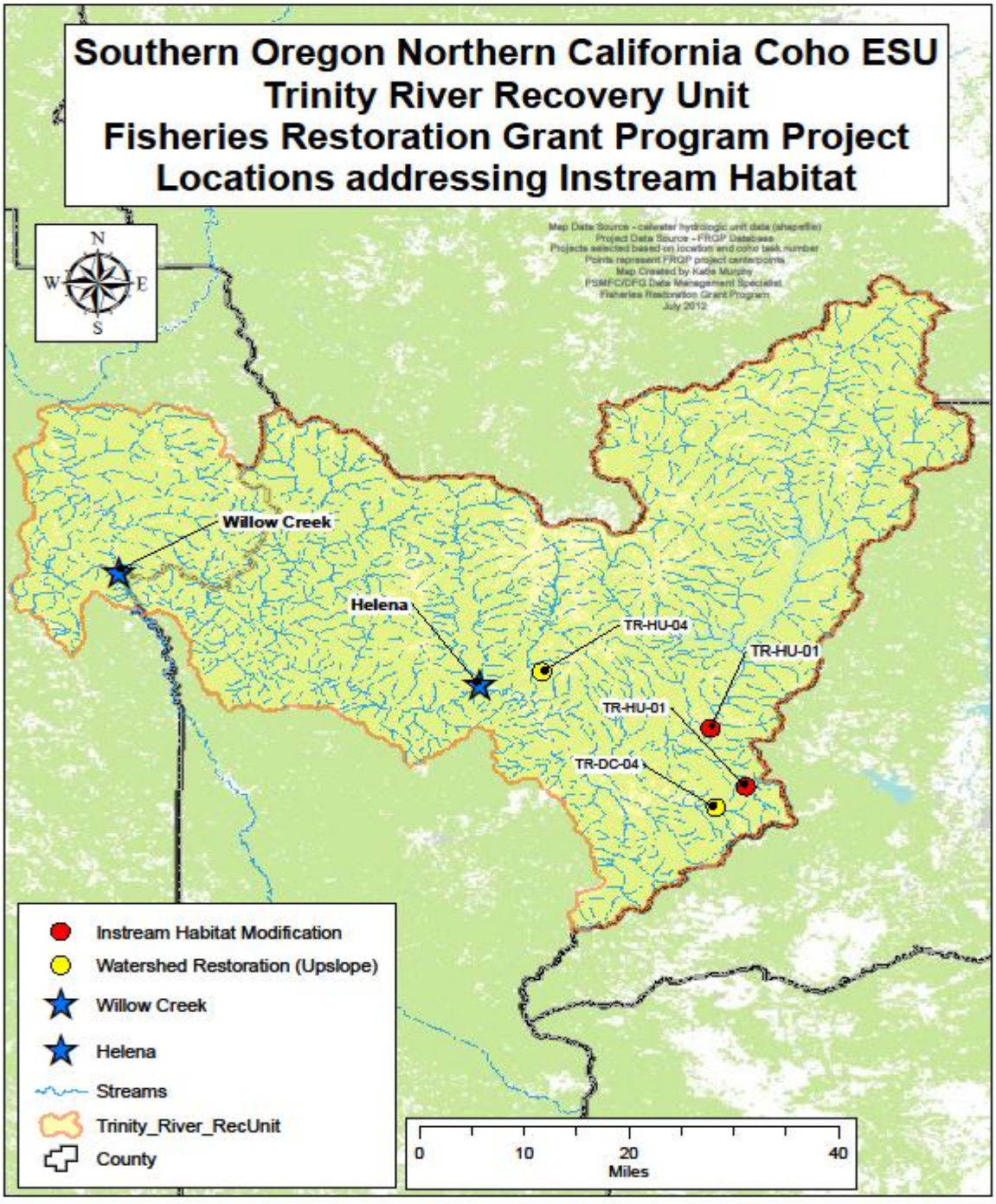
Appendix G (Continued) - Figure G54. Project locations in the Middle Klamath Recovery Unit – Instream Habitat projects



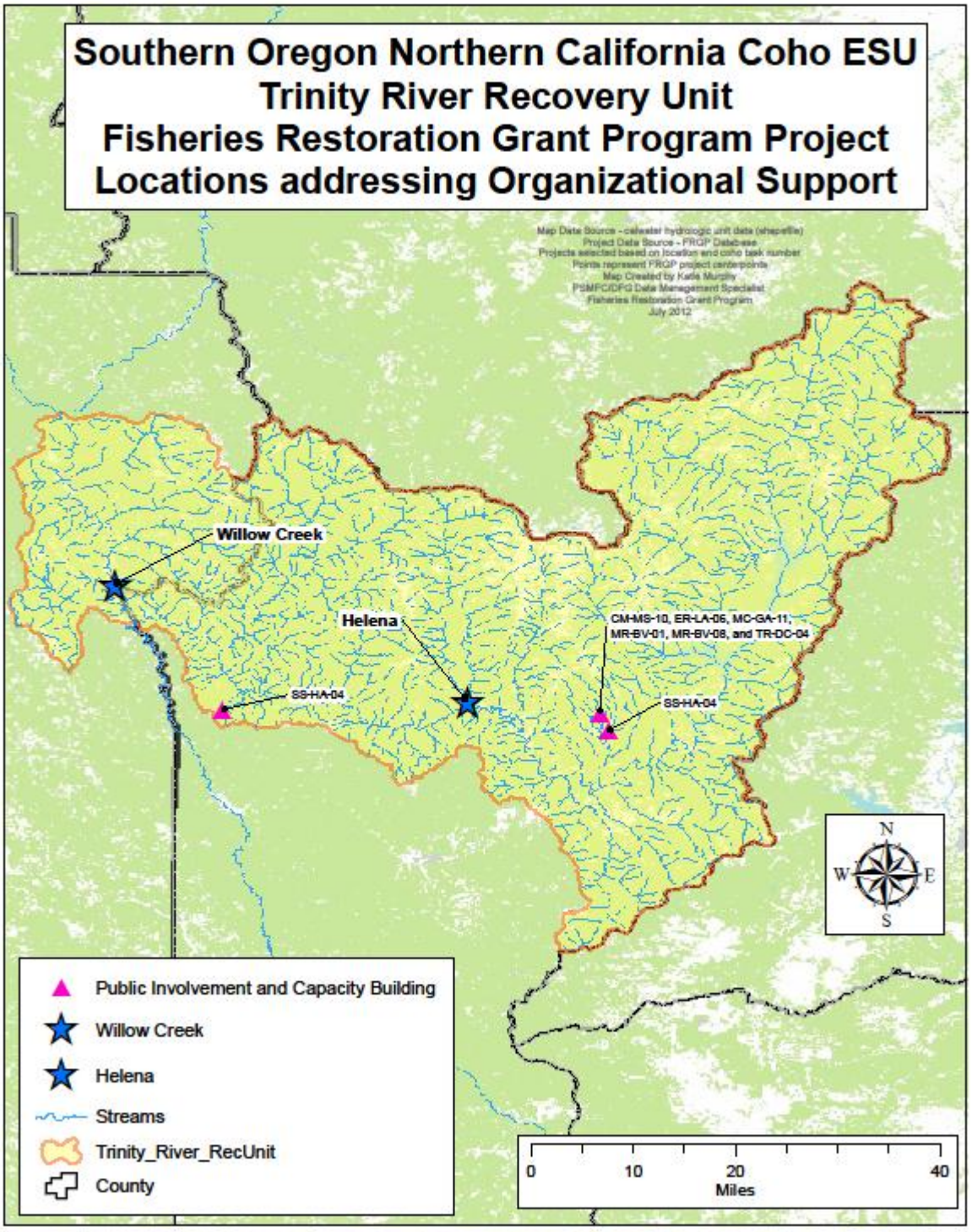
Appendix G (Continued) - Figure G55. Project locations in the Middle Klamath Recovery Unit – Organizational Support projects



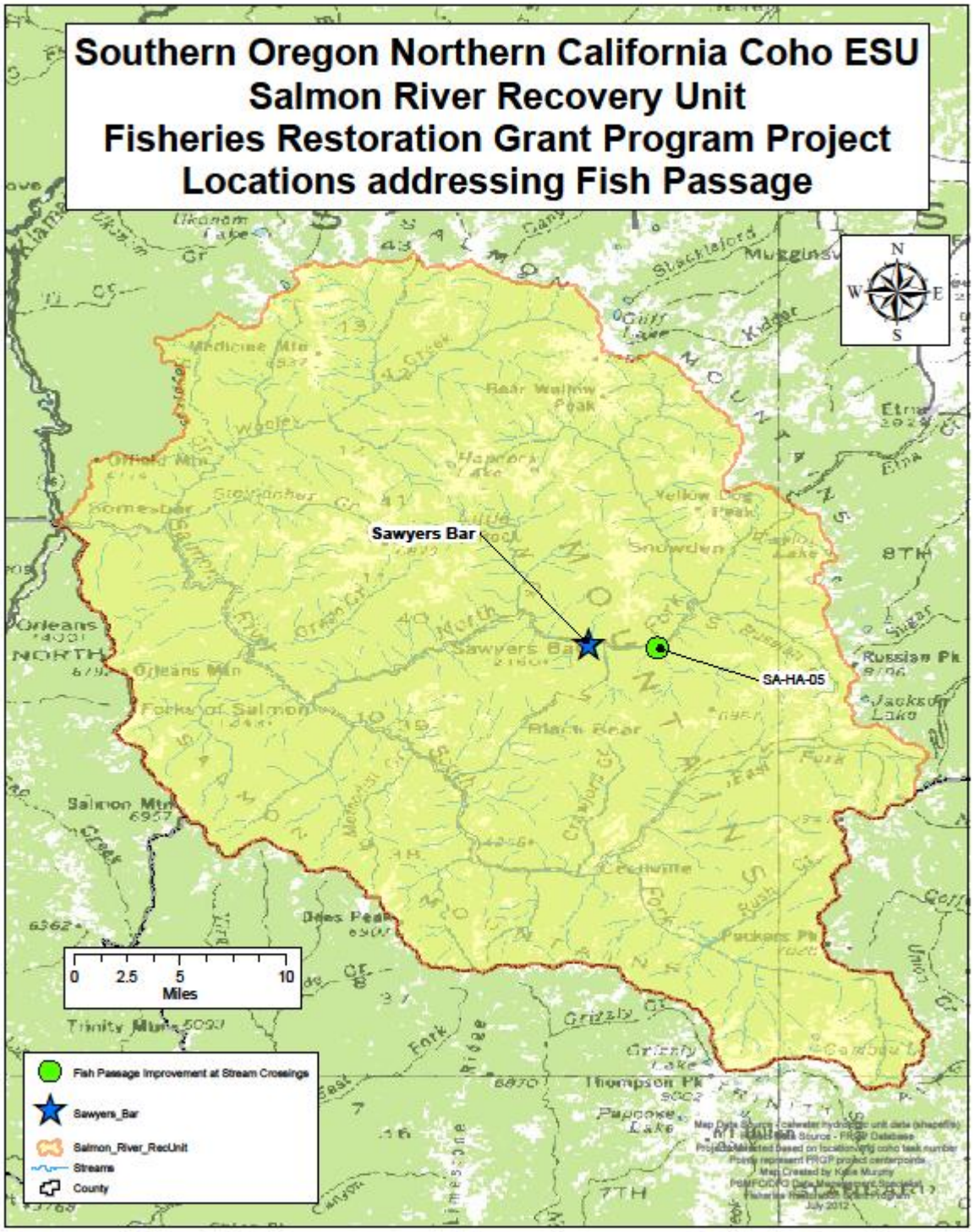
Appendix G (Continued) - Figure G56. Project locations in the Middle Klamath Recovery Unit – Monitoring projects



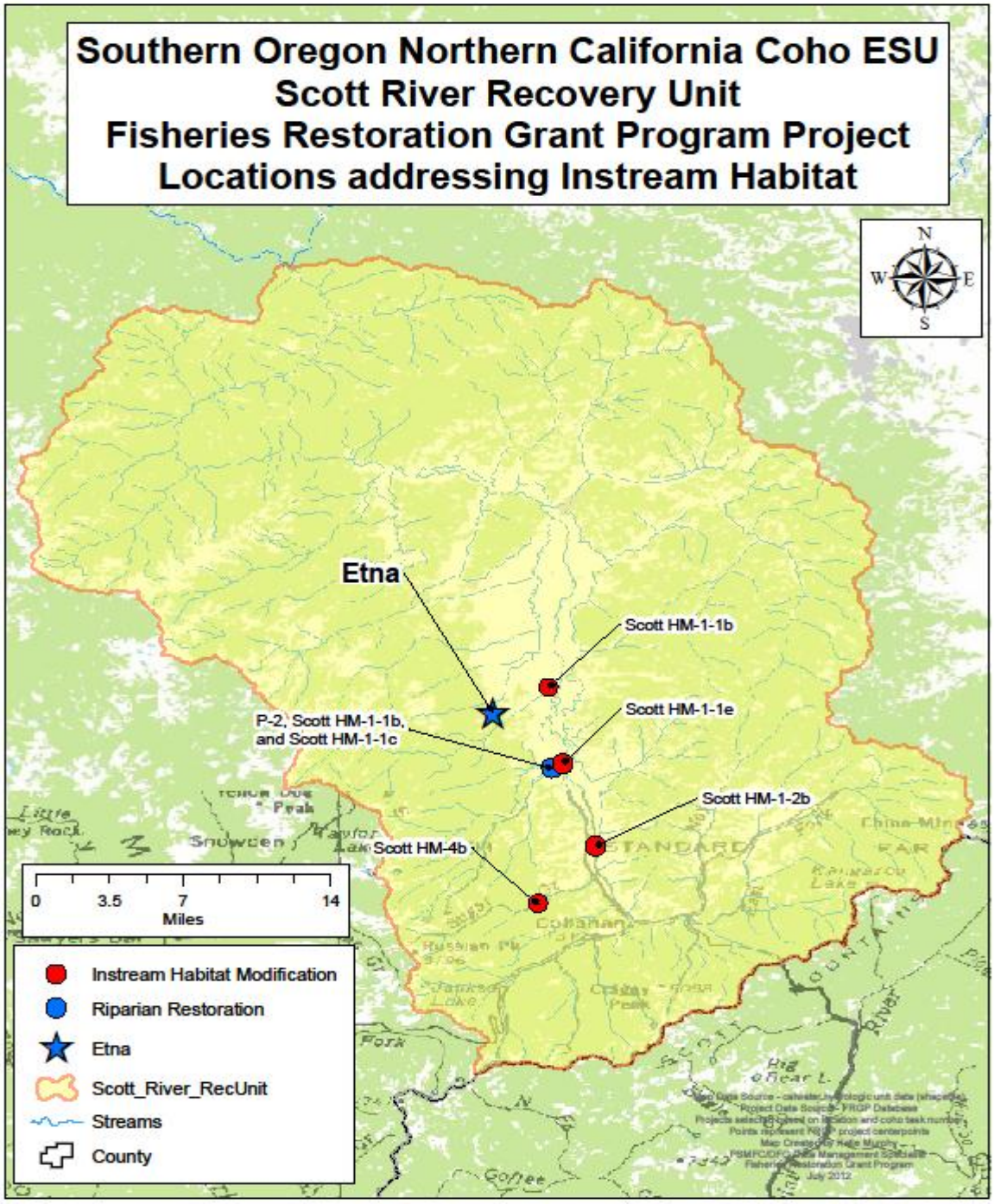
Appendix G (Continued) - Figure G57. Project locations in the Trinity River Recovery Unit – Instream Habitat projects



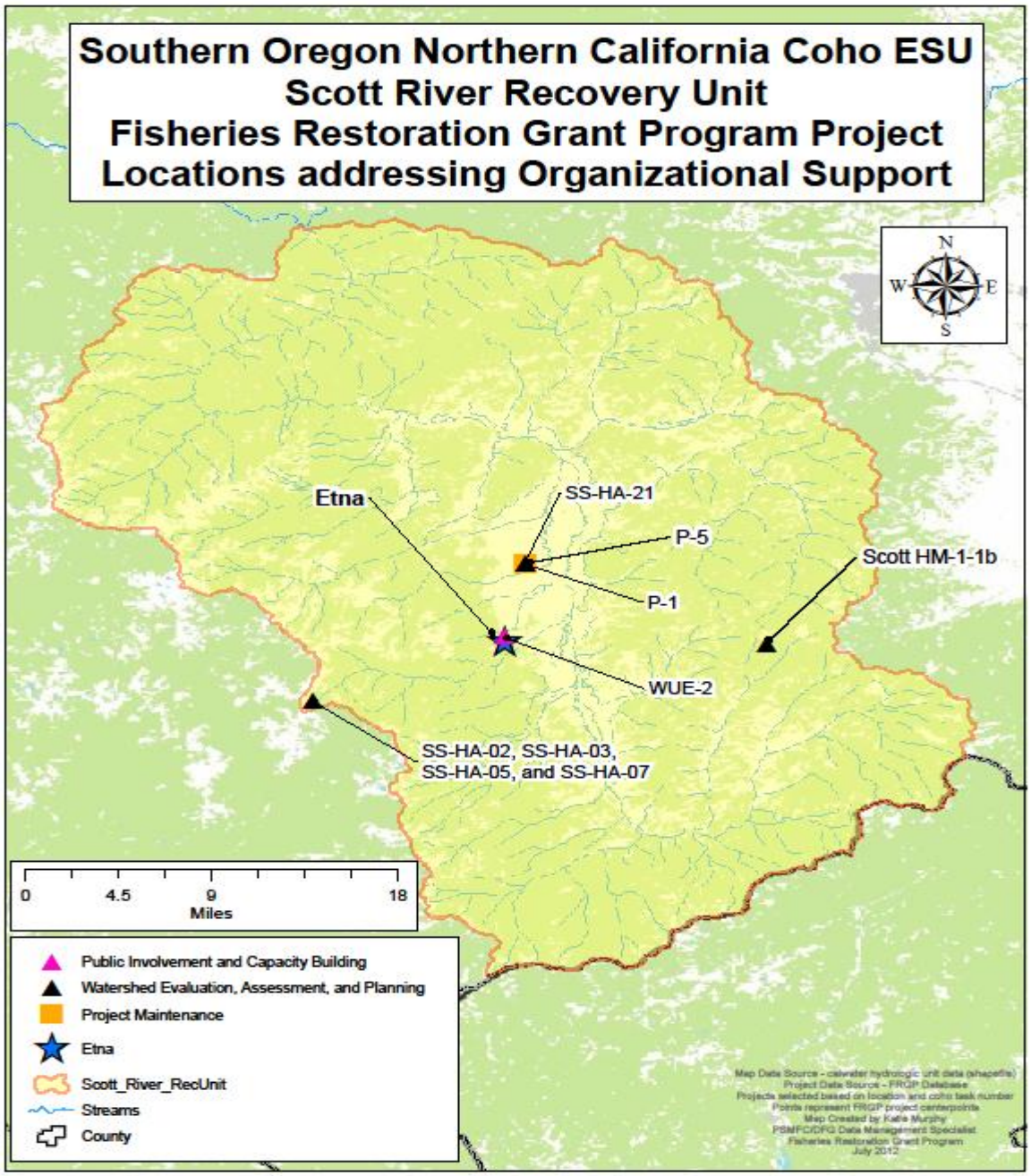
Appendix G (Continued) - Figure G58. Project locations in the Trinity River Recovery Unit – Organizational Support projects



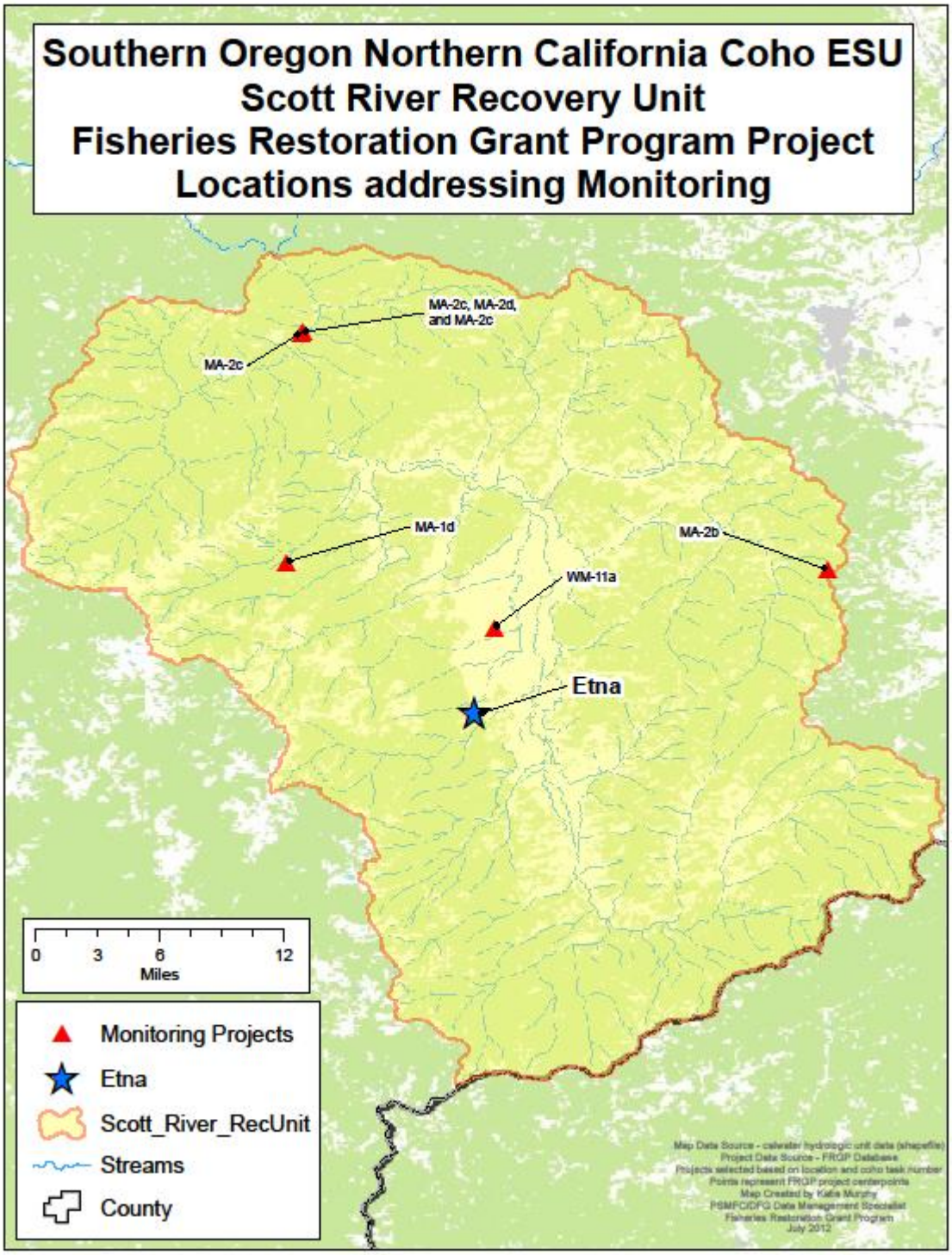
Appendix G (Continued) - Figure G59. Project locations in the Salmon River Recovery Unit – Fish Passage projects



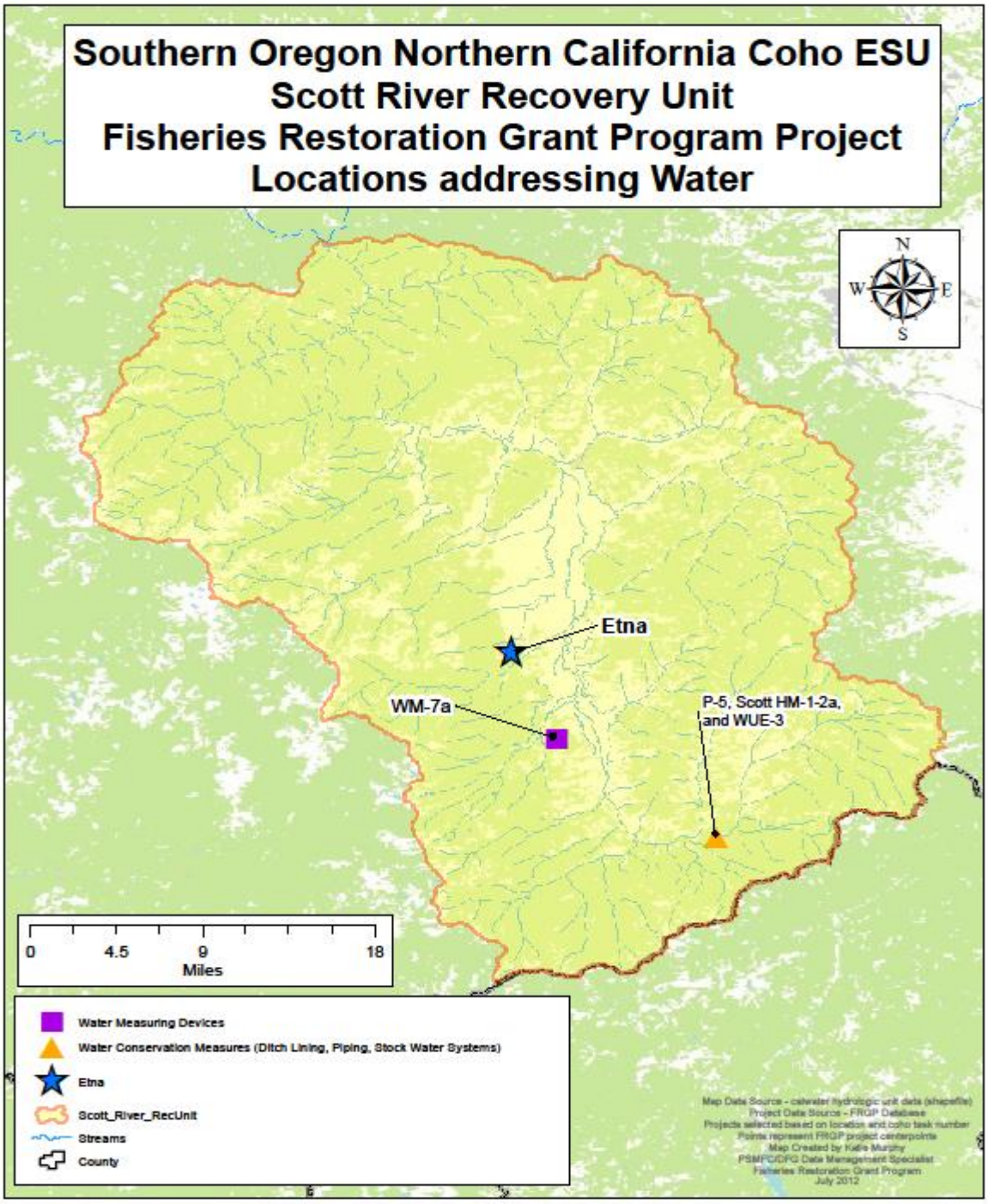
Appendix G (Continued) - Figure G60. Project locations in the Scott River Recovery Unit – Instream Habitat projects



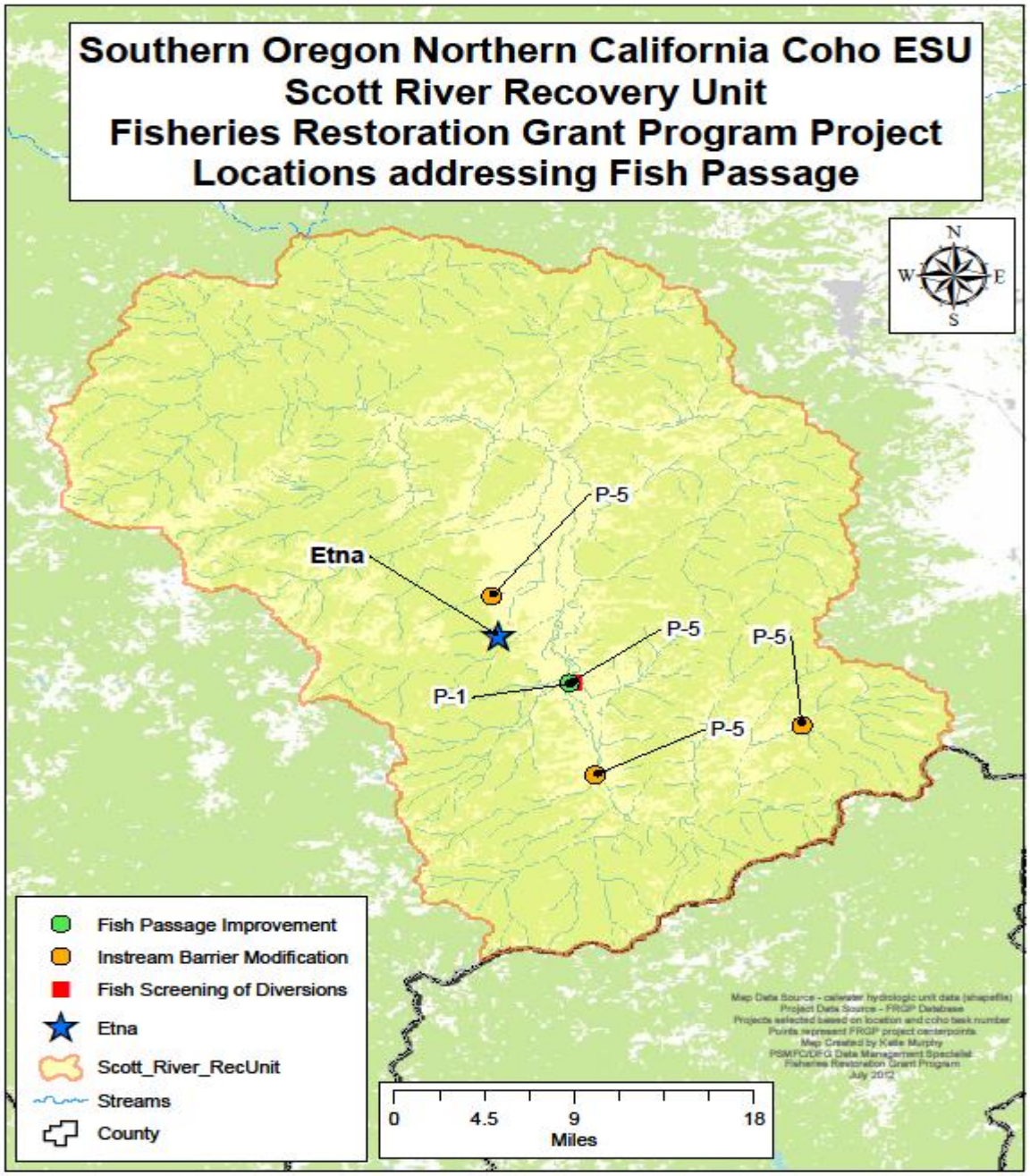
Appendix G (Continued) - Figure G61. Project locations in the Scott River Recovery Unit – Organizational Support projects



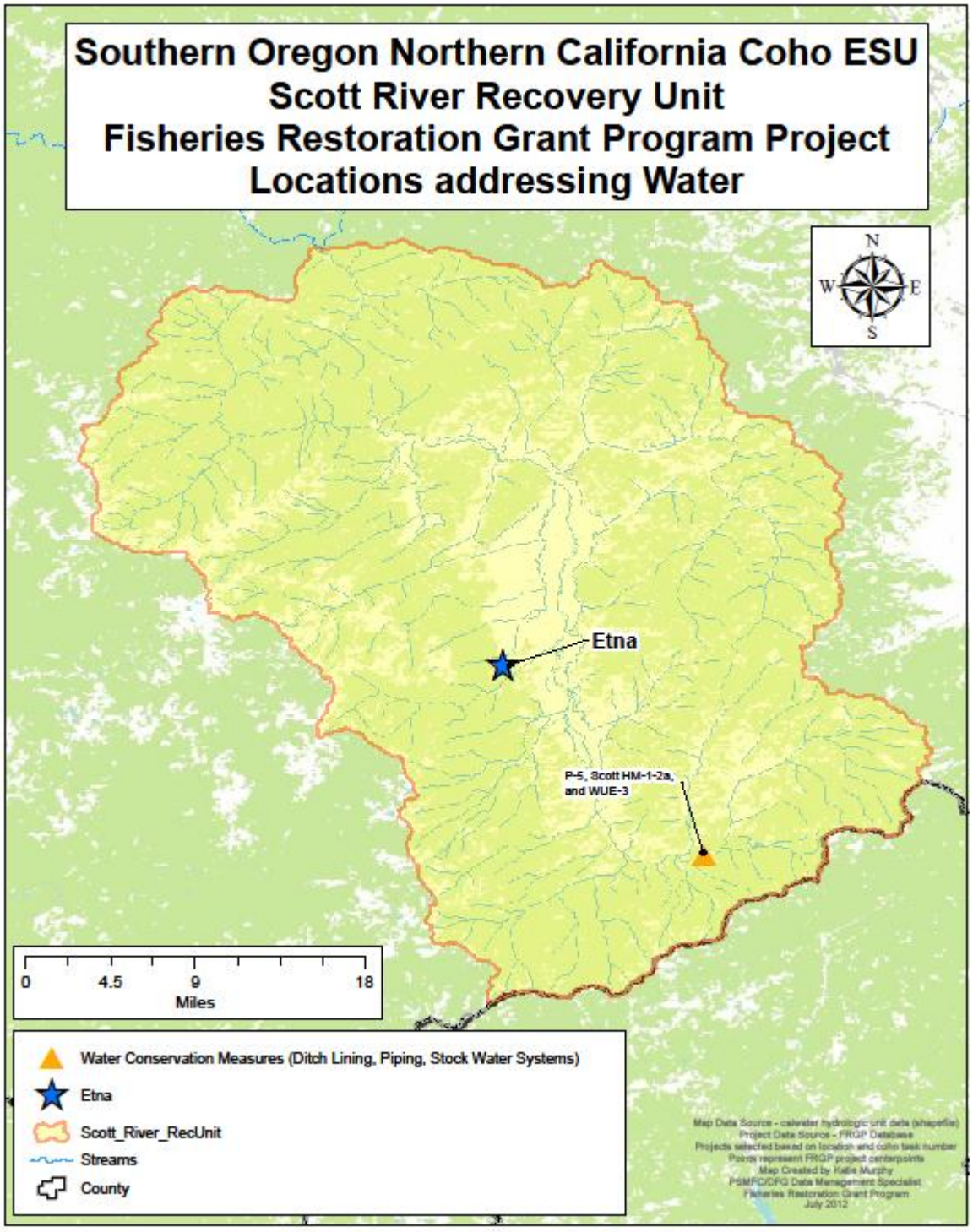
Appendix G (Continued) - Figure G62. Project locations in the Scott River Recovery Unit – Monitoring projects



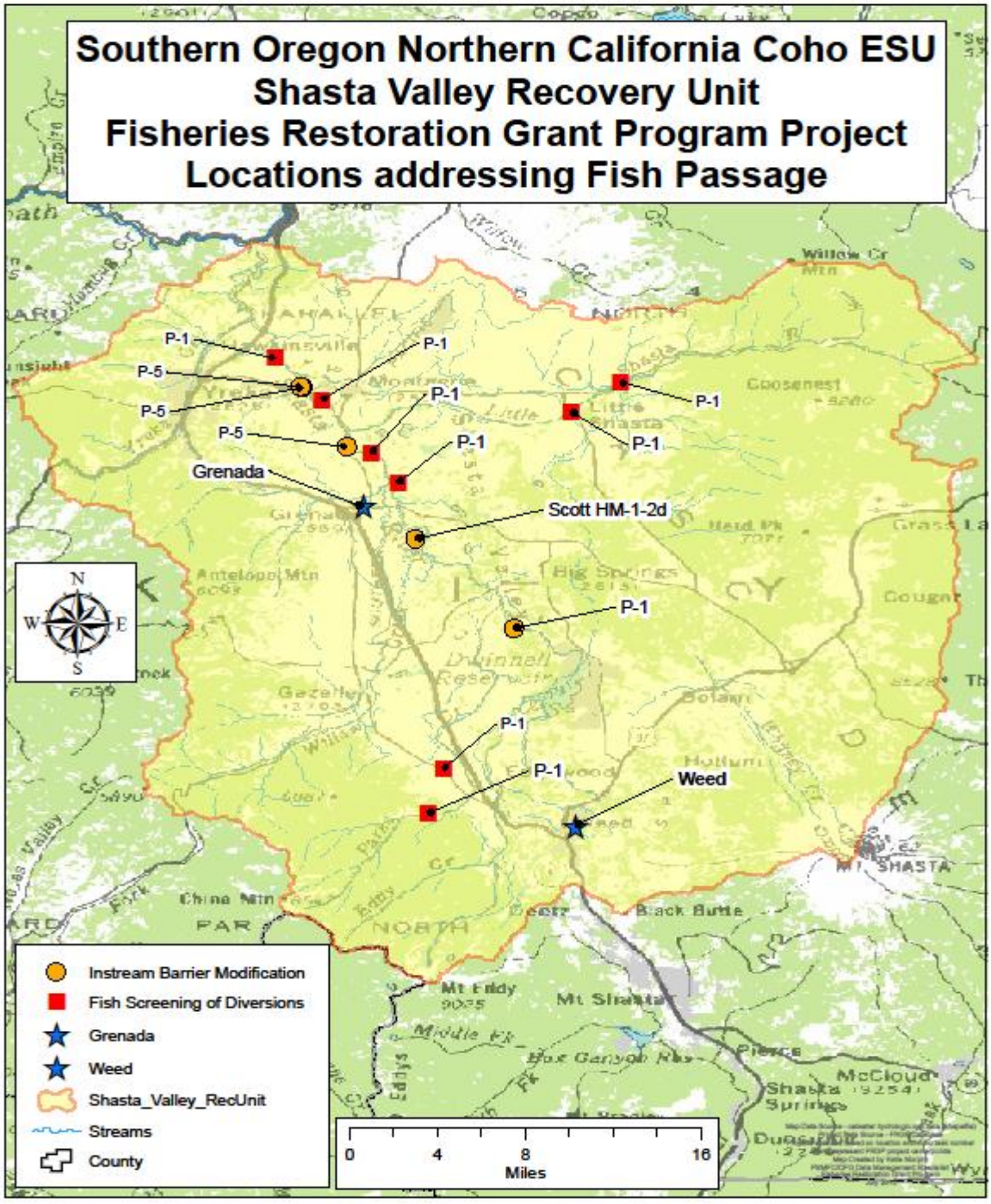
Appendix G (Continued) - Figure G63. Project locations in the Scott River Recovery Unit – Water projects



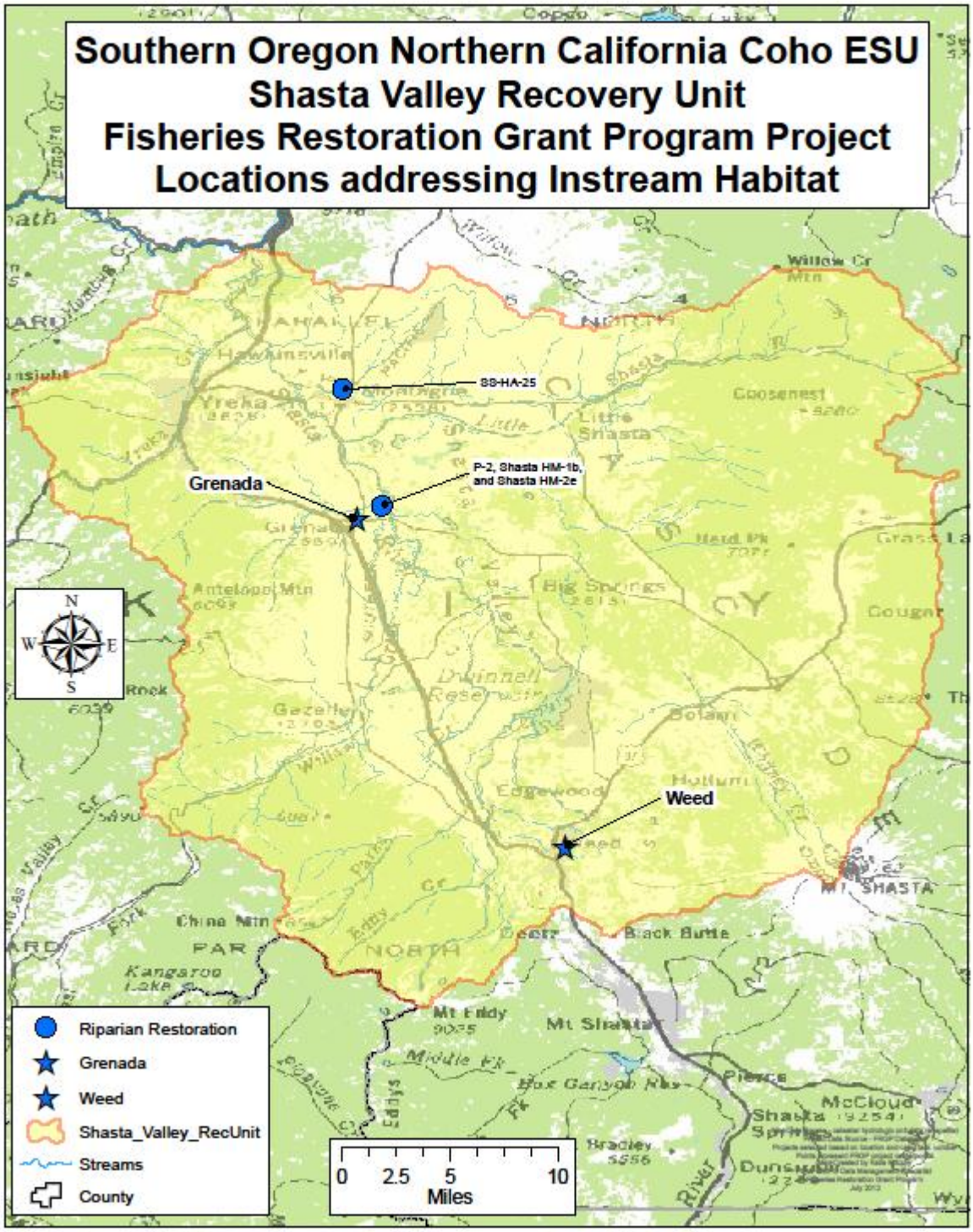
Appendix G (Continued) - Figure G64. Project locations in the Scott River Recovery Unit – Fish Passage projects



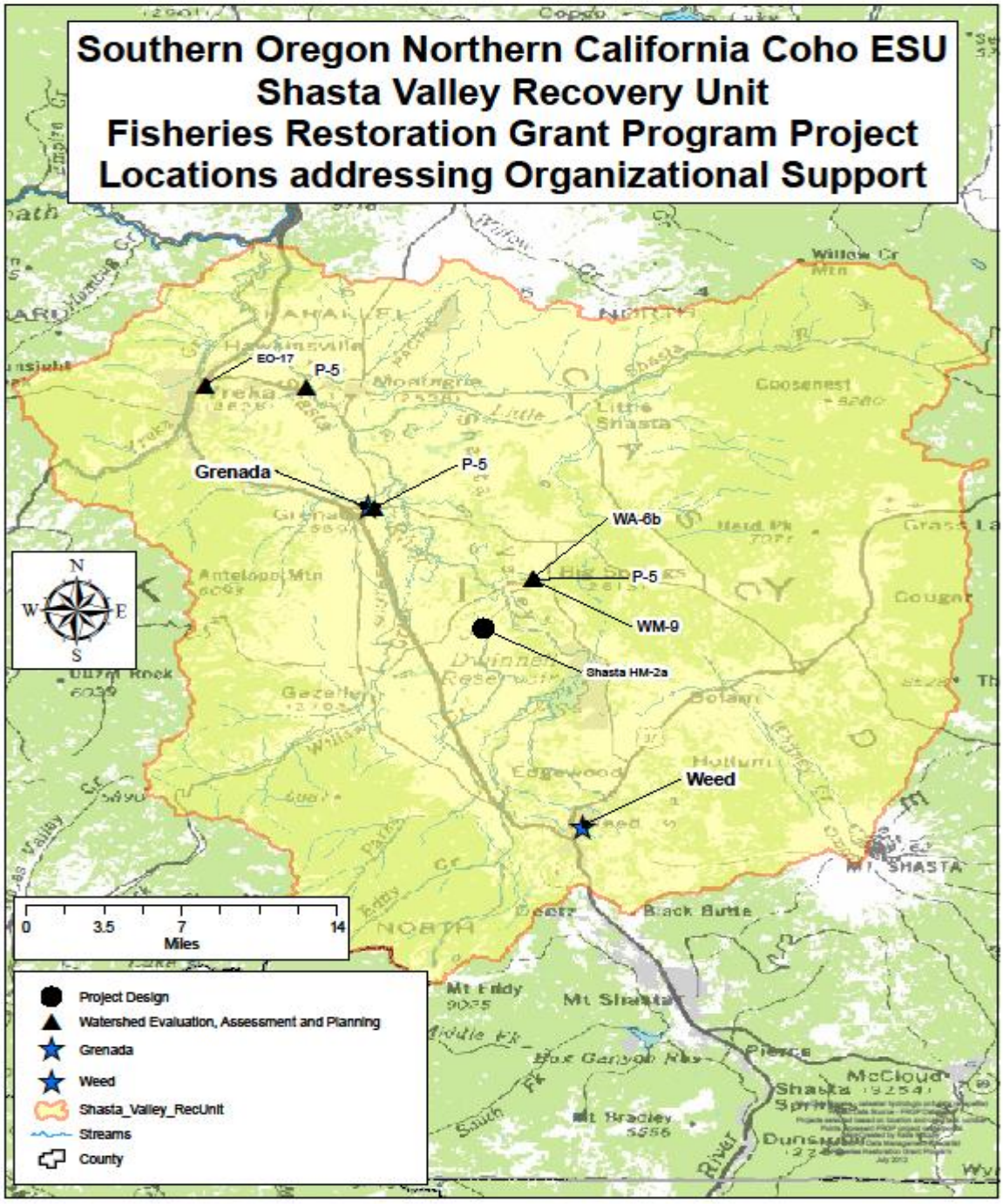
Appendix G (Continued) - Figure G65. Project locations in the Trinity River Recovery Unit – Water projects



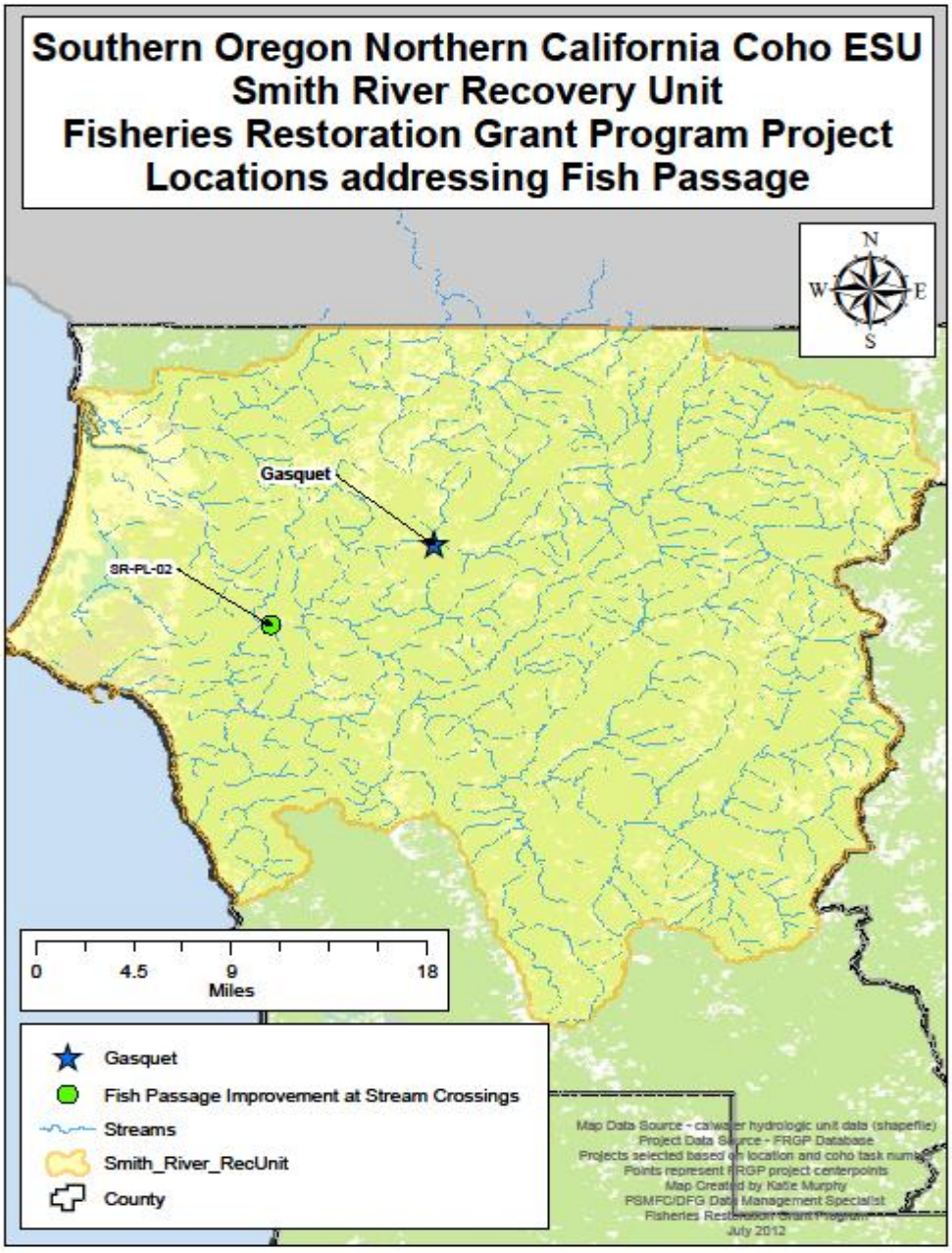
Appendix G (Continued) - Figure G66. Project locations in the Shasta Valley Recovery Unit – Fish Passage projects



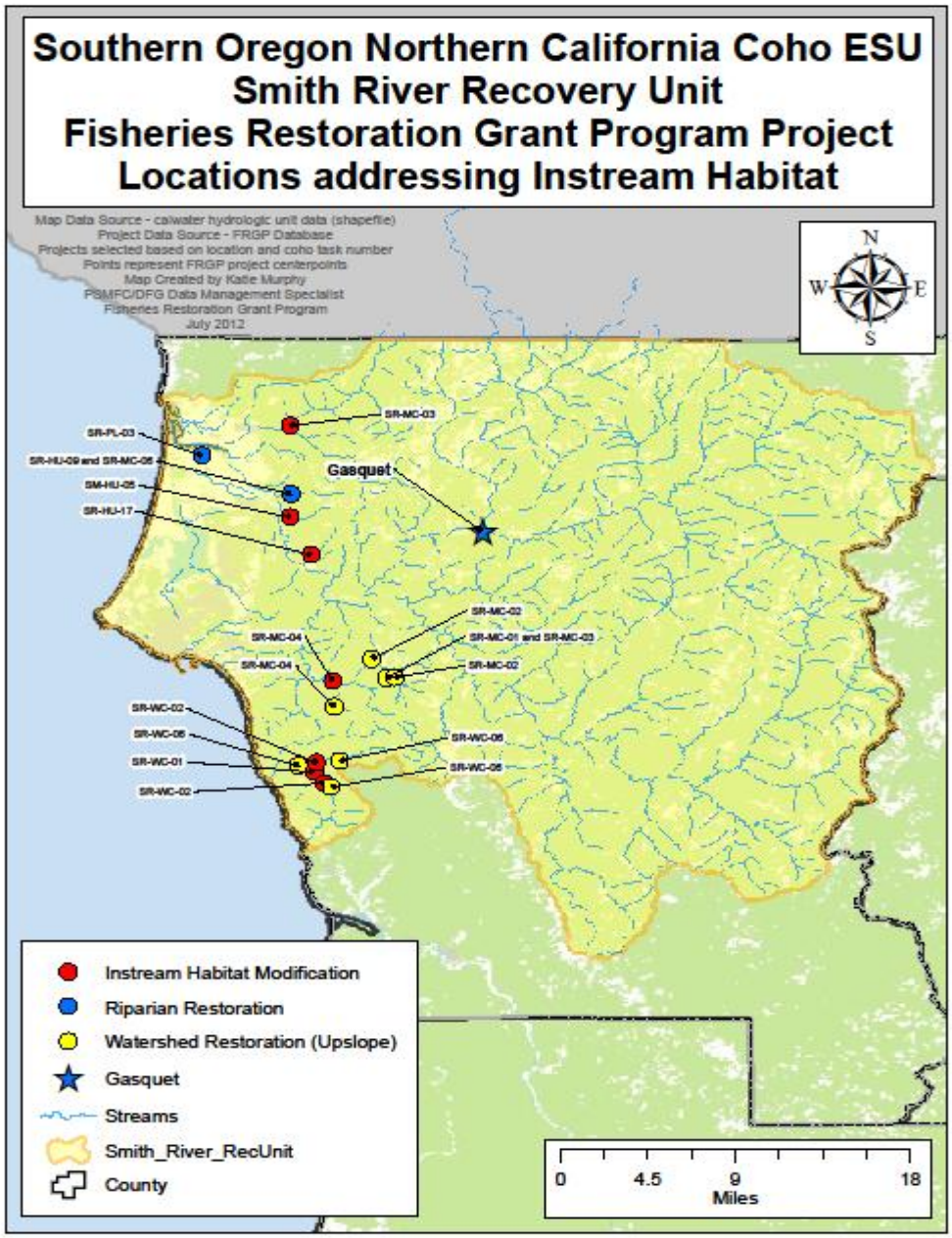
Appendix G (Continued) - Figure G67. Project locations in the Shasta Valley Recovery Unit – Instream Habitat projects



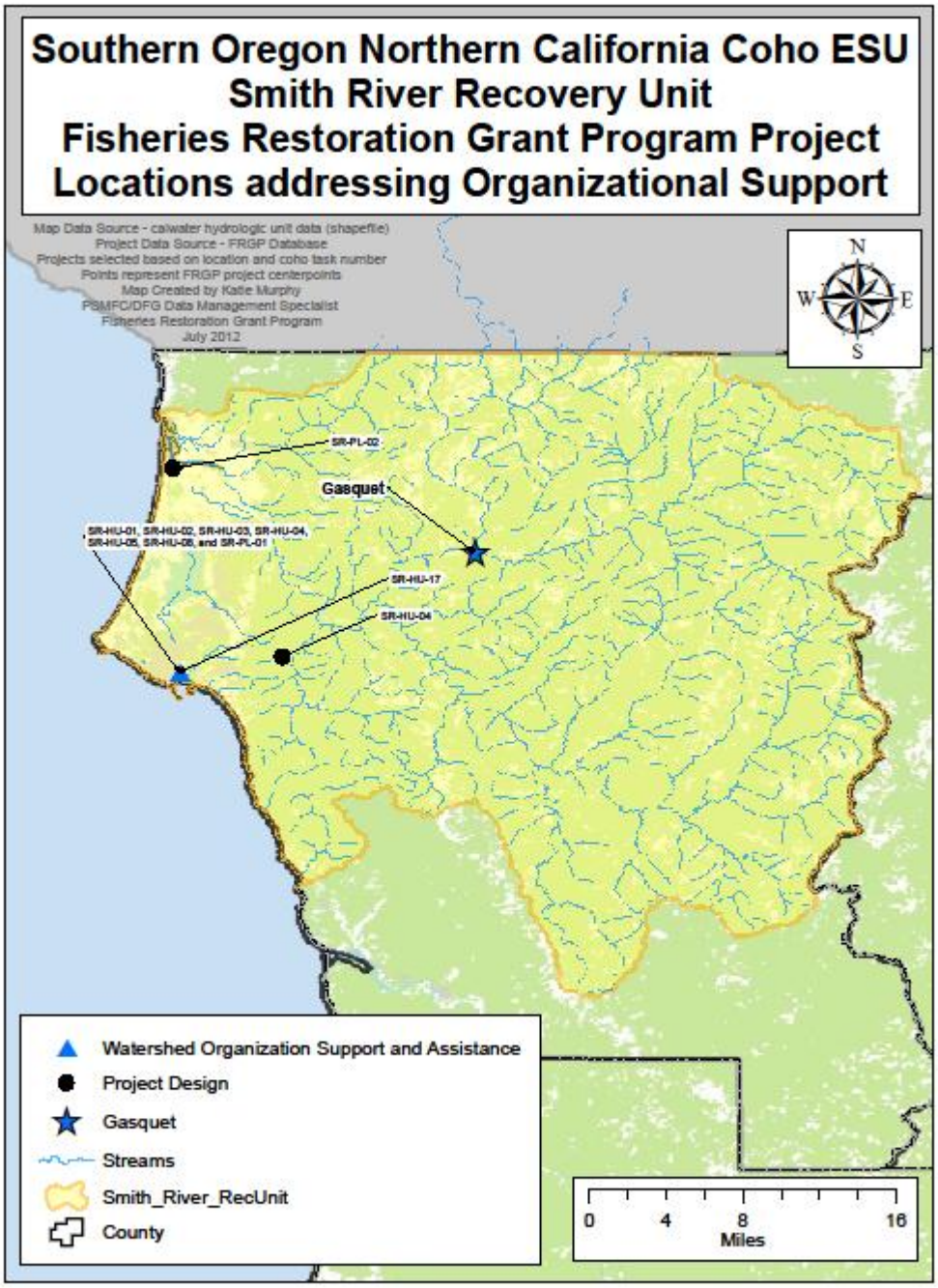
Appendix G (Continued) - Figure G68. Project locations in the Shasta Valley Recovery Unit – Organizational Support projects



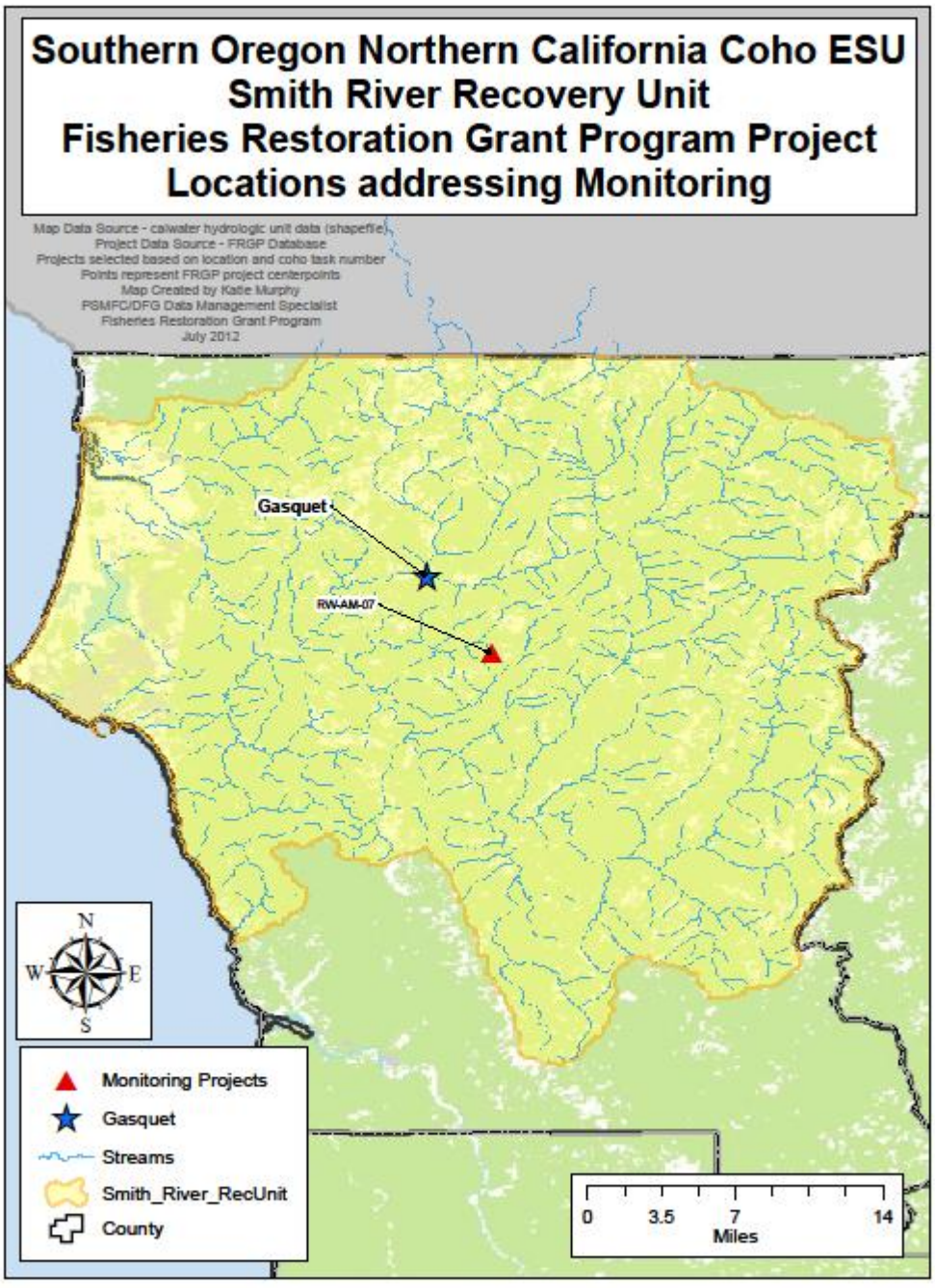
Appendix G (Continued) - Figure G69. Project locations in the Smith River Recovery Unit – Fish Passage projects



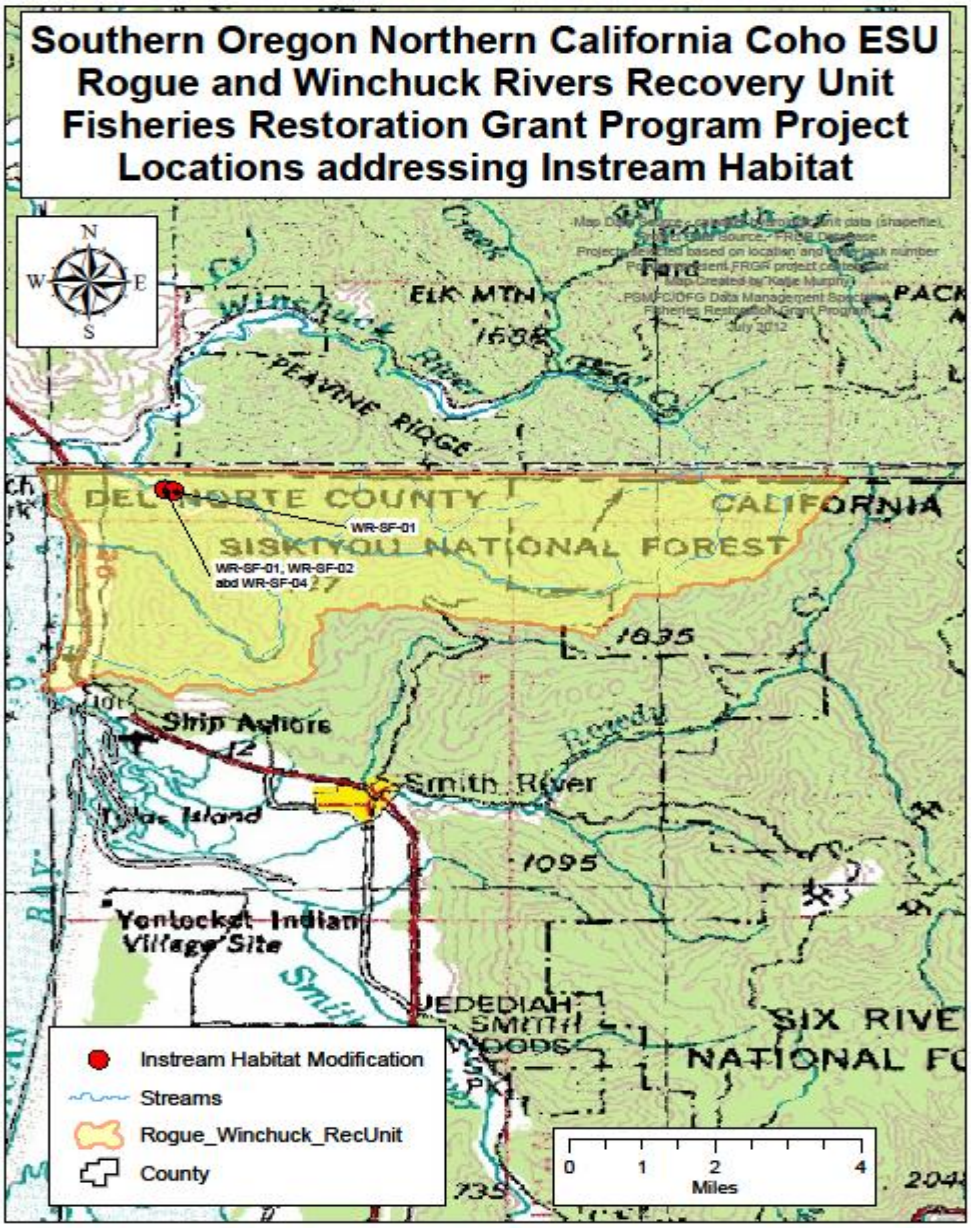
Appendix G (Continued) - Figure G70. Project locations in the Smith River Recovery Unit – Instream Habitat projects



Appendix G (Continued) - Figure G71. Project locations in the Smith River Recovery Unit – Organizational Support projects



Appendix G (Continued) - Figure G72. Project locations in the Smith River Recovery Unit – Monitoring projects



Appendix G (Continued) - Figure G73. Project locations in the Rogue and Winchuk Rivers Recovery Unit – Instream Habitat projects

Appendix G (Continued) - Table G1. List of Coho Salmon Recovery Tasks

Task I.D. Number	Task Description
BB-HU-01	Continue to operate MBSTP Kingfisher Flat Hatchery as a conservation hatchery, following the guidelines of the Department and NOAA Fisheries.
BM-BO-02	Continue restoration efforts on Bolinas and Big lagoons to benefit coho salmon during all life phases and seasons.
BM-BO-03	Work with landowners through outreach and education and appropriate agencies to manage summer flows for coho salmon, on a watershed basis. Provide support and incentives to protect both fisheries flows and agriculture by timing of withdrawals, construction of off-site storage facilities, water conservation practices, and riparian zone protections. Conduct outreach and education for landowners on these practices.
BM-BO-08	Treat coho salmon passage barriers in the Redwood Creek drainage.
BM-HU-01	Implement BMPs for road projects maintaining environmentally sound upgrades, modifications, and new construction of road projects, including culverts and stream crossings.
BM-HU-02	Support local agencies, Caltrans, and others in implementing and maintaining environmentally sound upgrades, modifications, and new construction of road projects, including culverts and stream crossings.
BM-HU-04	Avoid and/or minimize the adverse effects of water diversion on coho salmon by establishing: a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage.
BM-HU-10	Investigate opportunities for restoring historic runs in identified watersheds.
BM-LA-01	Use recommendations of existing sediment source surveys to restore habitat of coho salmon.
BM-LA-02	Expand inventories as needed for a comprehensive watershed approach for coho salmon passage.
BM-LA-03	Coordinate with appropriate agencies to restore coho salmon passage at barriers identified by Ross Taylor, SPAWN, and others.
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.
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.

Task I.D. Number	Task Description
BM-SA-06	Implement recommendations of watershed or restoration plans within the range of coho salmon and implement actions consistent with priority recommendations of the coho salmon recovery strategy.
BM-SA-07	Design vineyard operations to ensure adequate protection of coho salmon habitat attributes, including riparian corridors, instream flow, and water quality.
CM-HU-01	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage of alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
CM-HU-03	Treat sources of sediment, including roads.
CM-HU-05	Prioritize and upgrade all county culverts identified as passage barriers.
CM-ME-02	Continue to implement road and erosion assessments, especially in Middle, Westlund, Gilham, Sholes, Blue Slide, and Fire creeks.
CM-ME-03	Use tree planting and other vegetation management to improve canopy cover, especially in Dry and Blue Slide creeks.
CM-ME-04	Through cooperative efforts, reduce sediment yield at stream-bank erosion sites, especially in Middle, Westlund, Gilham, North Fork Fourmile, Sholes, Harrow, Little Grindstone, Grindstone, Eubank, and McKee creeks.
CM-MN-05	Treat sources of excess sediment.
CM-MN-08	Treat high priority battiers to coho salmon passage.
CM-MS-01	Promote outreach and education of water and conservation practices to improve stream surface flows and coho salmon habitat.
CM-MS-02	Protect the high quality habitat found in the Mattole River Headwaters and historic coho streams.
CM-MS-03	Protect high quality habitat found in the South Fork of Vanauken, Mill, Stanley, Thompson, Yew, and Lost Man creeks, recognizing current and continued land management practices by private landowners.
CM-MS-04	Promote a cooperative effort to establish monitoring stations at appropriate locations to monitor in-channel sediment (or turbidity) both in the lower basin and in the lower reaches of major tributaries.
CM-MS-06	Treat sources of excess sediment.
CM-MS-10	Work with University of California Cooperative Extension (UCCE) specialists to monitor summer water and air temperatures and flow in cooperation with landowners using Department-accepted protocols.
CM-MS-11	Continue and expand on-going temperature monitoring efforts.
CM-MS-15	Develop educational materials for landowners explaining how they can protect coho salmon.
CM-MS-16	Begin the process of declaring the southern subbasin to be fully appropriated in the spring and summer.

Task I.D. Number	Task Description
CM-MS-18	Pursue opportunities to acquire fee title, easement, and water rights from willing sellers.
CM-MS-19	Plant trees appropriate to the location in riparian areas where conditions are suitable.
CM-MS-22	Treat high priority barriers to coho salmon passage.
CM-MW-01	Assess current levels of LWD in the western subbasin, and determine amount necessary for improved flushing, pooling and habitat conditions for coho salmon.
CM-MW-02	Facilitate immediate placement of LWD in areas where lacking.
CM-MW-03	Develop and implement a plan for long-term recruitment of LWD.
CM-MW-04	Cooperate in establishing monitoring stations at appropriate locations (e.g., Squaw, Honeydew, and Bear creeks) to monitor in-channel sediment and track aggraded reaches in the lower basin and in the lower reaches of major tributaries.
CM-MW-05	Support the assessment, prioritization, and treatment of sources of excess sediment.
CM-MW-12	Work with the SWRCB to expedite the processing of projects, including 1600 agreements, that are intended to reduce summer diversions.
CM-MW-14	Develop incentives for landowners and communities to reduce summer water withdrawals and enhance habitat.
CM-MW-18	Treat high priority barriers to coho salmon passage.
EO-17	Establish contacts and organize events that bring resource-dependent people from throughout the Klamath Basin together, and that foster communication, friendship, and cooperation. Short-term: Organize an event/gathering that people throughout the Klamath Basin might want tottend (SSRT brainstorming needed). Long-term: Continue to organize basin wide gatherings regularly, and publicize these gatherings widely.
EP-HU-02	Work with agencies and landowners, to re-establish estuarine function.
EP-HU-04	Assess and prioritize sources of sediment and implement remediation projects.
EP-HU-05	Implement the prioritized remediation projects for the sources of sediment.
EP-HU-09	Improve quality and quantity of deep pools and spawning gravels.
EP-HU-10	In cooperation with willing landowners, restore and maintain historical tidal areas, backwater channels and salt marsh.
EP-HU-12	Restore channel conditions important for all life stages of coho salmon.
EP-HU-15	Identify impacted reaches where a functioning flood plain could be re-established: a. Prioritize areas that are not naturally functioning for restoration potential; and b. Develop site specific project objectives to protect and restore naturally functioning channel and flood plain conditions where feasible.
EP-HU-17	Establish access for both adult and juvenile coho salmon to suitable habitat where practicable.
EP-HU-18	Prioritize for repair all county culverts already identified as coho salmon passage barriers.

Task I.D. Number	Task Description
EP-HU-19	Assess and prioritize migration barriers other than county culverts (private roads, tide gates), including Rocky and Washington gulches.
EP-HU-22	Increase the amount of LWD in rearing reaches.
EP-HU-23	Establish adequate streamside buffer areas that are protected from vegetation removal ensuring retention of mature trees in the riparian corridor.
EP-HU-24	Increase canopy by planting appropriate conifer and hardwood species composition along the stream where the canopy is not at acceptable levels. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.
EP-HU-28	Develop site specific riparian restoration plans to: a. Restore degraded riparian habitat; and b. Establish a monitoring program to evaluate success of restoration projects.
EP-HU-31	Reduce input of fine sediments into stream systems by: a. Conducting comprehensive road inventory; b. Carry out priority road related sediment reduction; c. Implement priorities for road-related sediment reduction projects identified in existing road inventories projects; d. Identify areas still needing road/erosion inventories; e. Identify on-going road maintenance needs; f. Identify landslide hazard areas such as steep unstable slopes, stream crossings,(other than those identified in the road inventory) and inner gorge area; g. Implement pre-project geological surveys and/or reducing management activities within these areas, especially road construction, grading, intensive timber harvests; and h. Identify and treat bank erosion sites.
EP-HU-37	Facilitate and sustain a well informed watershed community with regards to coho salmon habitat issues.
EP-HU-38	Ensure that there are adequate incentives for landowners who choose to protect and/or restore watershed processes.
ER-BE-03	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-BE-04	Assess and prioritize sediment sources, including roads.
ER-BE-05	Treat prioritized sediment sources, including roads.
ER-FE-05	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-FE-07	Treat prioritized sediment sources, including roads.

Task I.D. Number	Task Description
ER-HU-03	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-HU-04	Recommend that the SWRCB make a high priority the identification of unauthorized diversions and enforcement actions to stop them.
ER-HU-07	Implement the plan to restore an adequate migration corridor in the mainstem Eel River.
ER-HU-08	Assess and prioritize sediment sources, including roads.
ER-HU-09	Treat prioritized sediment sources, including roads.
ER-HU-12	Request that Caltrans assess, prioritize, and treat culverts that are barriers to passage on State highways. Identify barriers to passage and prioritize them for removal, through collaborative efforts with other agencies.
ER-HU-13	Explore opportunities to aquire conservation easements with conditions that benefit coho salmon.
ER-LA-01	Continue watershed restoration efforts, including measures to reduce temperatures in Ten-mile Creek.
ER-LA-06	Recommend that cities, counties, and Caltrans adopt maintenance manuals that protect coho salmon habitat (e.g., standards for side-casting of spoils and identification of spoils disposal sites).
ER-LA-08	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-LA-10	Treat prioritized sediment sources, including roads.
ER-OC-04	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-OC-06	Treat prioritized sediment sources, including roads.
ER-VD-06	Treat sediment sources including roads.
ER-WE-01	Complete storm proofing of the Bull Creek watershed.
ER-WE-02	Continue to implement the planting of trees and other habitat enhancement as necessary in the Bull and Salmon creek watersheds.
ER-WE-03	Assess and prioritize culverts that are barriers to coho salmon passage along Avenue of the Giants through collaborative efforts with other agencies.

Task I.D. Number	Task Description
ER-WE-05	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Improvement of existing riparian zones through plantings, release of conifers, and manage alders, blackberries, and other competitors; and c. Bank stabilization and fencing projects.
ER-WE-06	Assess and prioritize sediment sources, including roads.
ER-WE-07	Treat prioritized sediment sources, including roads.
ER-YA-03	Treat prioritized sediment sources, including roads.
KR-HU-12	Protect and enhance tributary reaches identified as providing refugia to juvenile coho salmon.
KR-HU-14	Implement the plan that addresses water quality and quantity in the Klamath River tributaries that exacerbate mainstem water quality problems.
KR-HU-23	Promote public interest in the Klamath River Basin's coho salmon, their beneficial use and habitat requirements.
KR-KG-02	Develop a plan to restore off-channel estuarine, wetland, and slough habitat in the Klamath River estuary and adjoining lower tributary reaches that includes: a. Determining if key properties, conservation easements, or development rights need to be purchased and the work with wiling landowners; and b. Determining the need and installation of livestock exclusion fencing to protect restored areas.
KR-KG-04	Develop a plan to maintain Blue Creek watershed tributaries as key thermal refugia for their cool water contributions to the mainstem Klamath River. The plan should emphasize that: a. Sediments from upslope activities do not impact the refugia; b. Upslope stabilization and restoration activities continue, including road assessment and treatment; c. In-channel and riparian restoration efforts (target riparian retention efforts) continue; and d. Feral cattle are removed.
KR-KG-05	Implement the plan to maintain Blue creek watershed tributaries as key thermal refugia for their cool water contributions to the mainstem Klamath River.
KR-KG-06	Develop a plan to protect and restore Klamath River mainstem tributaries, even those that do not support populations of coho salmon but that provide cool water and which improve mainstem Klamath water quality, particularly during warm summer months. Plan should emphasize the: a. Protection and/or restoration of riparian habitat; b. Stabilization of upslope areas to prevent sedimentation and aggradation of tributaries at their mouths; c. Improvement of Federal land management activities to reduce impacts to riparian corridors and decrease sediment loads; and d. Finalize and/or refine the Lower Klamath Sub-Basin Watershed Restoration Plan (Gale and Randolph 2000) that focuses on the tributaries to the Lower Klamath within the Klamath Glen HSA.
KR-KG-07	Finalize and Implement the Lower Klamath Sub-Basin Watershed Restoration Plan (Gale and Randolph 2000) to protect and restore Klamath River mainstem tributaries.

Task I.D. Number	Task Description
KR-KG-08	Reduce sediment input from upslope sources, including activities such as: a. Decommissioning skidtrails and unmaintained roads, where possible; b. Upgrading roads and maintenance practices; c. Stabilizing slopes to minimize or prevent erosion and to minimize future risk of eroded material entering streams, and d. Minimizing alteration of natural hillslope drainage patterns.
KR-KG-13	Treat sediment sources and improve riparian and instream habitat conditions to provide adequate and stable spawning and rearing areas for coho salmon.
KR-KG-14	Develop a plan to restore in-channel and riparian habitat in tributaries to address: a. Revegetating riparian zones with native species (e.g., conifers) to stabilize stream banks and promote a long-term supply of LWD; b. providing adequate protection from development, grazing, etc; and c. Relocating roads out of riparian areas when feasible.
KR-KG-15	Implement the plan to restore in-channel and riparian habitat in tributaries.
KR-KG-17	Implement the plan to provide suitable accumulations of woody cover in slow-velocity habitats for coho salmon winter rearing on a short-term basis by placing wood in needed areas until natural supplies become available.
KR-KG-22	Encourage cooperation between industrial timber land managers and tribes to restore coho salmon habitat Use the successful Tribal/Simpson Resource Company program as an example.
KR-KG-23	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; b. Management to promote conifer recruitment; c. Improvement of existing riparian zones through planting and release of conifers, and control of alders, blackberries, and other competitors; and d. Provide technical support as an incentive for landowners.
KR-KG-27	Support continued implementation of the Coho Salmon Regional Abundance Inventory throughout the lower Klamath River subbasin.
KR-OR-07	Implement the plan to protect and enhance Bluff and Red Cap creek watersheds.
KR-SV-01	Develop a plan to protect and restore tributaries, even those that do not support populations of coho salmon, that provide cool water, improve mainstem Klamath River water quality, and provide thermal refugia for coho salmon, particularly during warm summer months. The plan should: a. Improve land management to reduce impacts to riparian corridors, reduce sediment loads, and protect water resources; b. Request that the SWRCB review existing water appropriations for compliance; c. Petition the SWRCB to designate streams with critical summer flows as fully appropriated streams during the appropriate period; and d. Provide measures that reduce hydrologic connectivity between streams and roads where feasible.

Task I.D. Number	Task Description
MA-1d	Assess water quality/quantity parameters including but not limited to dissolved oxygen, pH, suspended sediment, temperature, turbidity, flow, hyporheic flow, nutrients/pollutants (agricultural return flows, pesticides, herbicides, wastewater) and monitor changes through time. Identify and assess point and non-point pollution sources (e.g., irrigation returns, sediment). Coordinate with the TMDL process. Short-term: Design and implement comprehensive assessment and monitoring incorporating protocols developed in range-wide or regional monitoring programs. Long-term: Continue implementation.
MA-1i	Inventory, evaluate, and monitor changes in land use practices over time including conversion from agriculture to other uses for impacts on coho salmon and their habitat. Short-term: Collect baseline data. Long-term: Evaluate and incorporate information into the County land use policy.
MA-1j	Conduct adult and juvenile current and potential carrying capacity estimates and monitor changes over time. Short-term: Assess and estimate current and potential carrying capacity. Evaluate potential method for predicting carrying capacity. Long-term: Apply abundance data to determine realization of carrying capacity.
MA-2a	Conduct limiting factors analysis and monitor changes through time by life stage for coho salmon. Short-term: Identify additional data needs to complete both efforts. Assess disease as a limiting factor. Long-term: Develop management plans for remediation of limiting factors. Monitor effects to coho salmon populations and habitat.
MA-2b	Continue to identify the historic and current distributions of coho salmon adults and juveniles within the Scott Bar, Scott Valley, and Shasta Valley HSAs. Short-term: Identify, evaluate, and map coho salmon spawning and rearing habitat utilization areas and monitor changes through time. Long-term: Monitor and analyze spatial structure and changes in distribution through time. Continue to implement and use results to modify monitoring protocols, and modify restoration techniques.
MA-2c	Conduct adult and juvenile abundance estimates and monitor changes over time. Short-term: Begin abundance surveys. Develop and implement statistical methodology for adult and juvenile salmon. Improve methods for counting adult salmon in the Scott. Long-term: Continue and improve abundance surveys. Use data to develop annual adult and outmigrant abundance estimates for both valleys.
MA-2d	Conduct analysis of juvenile growth rates and production estimates and monitor changes through time. Short-term: Develop and implement a comprehensive study plan with appropriate agencies Long-term: Continue studies and apply results as appropriate.
MC-AR-01	Place instream structures to improve gravel retention and habitat complexity.

Task I.D. Number	Task Description
MC-AR-02	Provide technical assistance and incentives to landowners in developing and implementing sediment reduction plans to meet requirements of the CWA TMDL, making watersheds with an implementation schedule the highest priority.
MC-AR-07	Modify stream barriers to allow coho salmon passage while maintaining LWD.
MC-BR-03	Identify actions to improve coordination between the agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitat including spawning gravel and natural hydrograph, and avoidance of adverse impacts caused by water diversion.
MC-GA-06	If appropriate, restore estuary function to benefit coho salmon.
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.
MC-GA-11	Where necessary and with willing landowners, protect riparian vegetation buffer zones through conservation planning, acquisition, and easements.
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.
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.
MC-HU-07	Include coho salmon in CEQA checklist.
MC-HU-09	Install LWD, boulders, and other features to increase stream complexity and improve pool frequency and depth.
MC-HU-11	Assess and prioritize sediment sources at an HSA level to decrease streambed fine sediments and pool filling. Includes upslope roads upgrade/ decommission.
MC-HU-18	Introduce instream wood to improve shelter value, pool frequence, and pool depth. Focus on key streams for coho salmon (Appendix D, recovery strategy).
MC-HU-19	Avoid or minimize land fragmentation or conversion to more intensive uses to maintain pool frequency and depth.
MC-HU-35	Streamline permitting of coho salmon habitat restoration projects (RWQCB 401, USACE 404, NOAA Fisheries, and FWS permitting).
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.
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.
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.

Task I.D. Number	Task Description
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.
MC-HU-46	Treat sediment sources, based on prioritization and current list of key streams for coho salmon (Appendix D, recovery strategy)
MC-HU-48	Upgrade culverts to provide coho salmon passage and pass 100-year flows and expected depris loads.
MC-HU-49	Conduct comprehnsive sub-basin erosion control 'storm-proofing,' combined with installation of LWD into streams. Apply to all HSA's.
MC-HU-50	Modify stream barrriers to allow coho salmon passage while maintaining in-stream LWD. Apply to all HSA's.
MC-NA-02	Pay particular attention to Implementing actions regarding LWD and shade that are suggested at the HU level.
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.
MC-NO-01	Investigate the role of the Pudding Creek Dam impoundment in coho migration and freshwater survival rate.
MC-NO-03	Implement actions of a sediment reduction plan to improve water quality.
MC-NO-04	Fund activities to address sedimen sources and tbarriers to coho salmon passage on the California Western Railway right-of-way.
MR-BL-01	Develop a watershed restoration plan in conjunction with landowners, municipalities, and Tribal interests.
MR-BL-06	Assess barriers to coho salmon passage, prioritize barriers for removal, and treat the barriers, with Warren, Lindsay, and Essex creeks given a high priority for treament.
MR-BL-07	Continue stream management activivties with landowners in Lindsay Creek
MR-BL-08	Continue road and/or watershed assessments to identify and prioritize sources and risks of road related sediment delivery to watercourses.
MR-BL-10	Treat high priority barries to coho salmon passage.
MR-BV-01	Establish adequate streamside buffer areas to promote appropriate water temperatures for coho salmon.
MR-BV-05	Address priority sources of fine and coarse sediments into streams.
MR-BV-08	Treat prioritized culverts to allow access to suitable habitat for juvenile or adult coho salmon.
MR-HU-03	Work with landowners and other entities to: a. Protect existing LWD recruitment potential through the retention of mature coniferous trees in the riparian zone; b. Establish adequate streamside buffer areas; c. Increase the amount of in-channel LWD; d Continue to review THPs; and e. Continue riparian management projects.
MR-HU-07	Assess barriers to coho salmon passage, prioritize barriers for removal, and develop a plan to treat the barriers.

Task I.D. Number	Task Description
MR-HU-08	Develop a plan to restore and maintain tributary and mainstem habitat connectivity where low flow or sediment aggradation is restricting coho salmon passage. This is a known problem at Cañon Creek, Dry Creek, North Fork Mad River, and other streams. The plan should: a. Evaluate management techniques; b. Implement the identified strategy; and c. Address permitting complexity for identified implementation measures.
MR-HU-13	Encourage Federal, State, and county agencies and private landowners to reduce impacts to coho salmon habitat from public and private road systems.
MR-NF-04	Treat high priority barries to coho salmon passage.
P-1	Screen all diversions in the known and potential range of coho salmon. Short-term: Identify funding and complete ongoing screening program within known and potential range of coho salmon. Assess habitat that will be made accessible to coho salmon after completion of scheduled projects. Coordinate between involved Federal and State Agencies, local and private entities to develop a prioritized list of any remaining unscreened diversions and action plans including designs. Long-term: Deal with screen maintenance problems. Identify funding and complete ongoing screening program within the known and potential range of coho salmon. Develop protocols for coho salmon trapping and relocation. Establish verification procedures to assure that screens are properly installed and maintained by person(s) benefiting from use of the screened diversion. Support evaluation of, and transition to, less labor intensive designs to minimize future maintenance.
P-2	Promote and encourage protection of riparian zones that are important for coho salmon through fencing or other measures. Use grazing management, where appropriate, in association with vegetation utilization monitoring and stream-bank protection. Short-term: Identify and continue to develop incentive based programs (e.g., NRCS's CRP) for riparian protection zones. Develop GIS layer for accomplished and needed protection areas. Limit funding to planting of trees from local native stock only. Provide funding for greatly expanded tree re-planting program. Provide protection for remaining large trees along Shasta from beavers. Provide public with visual aids and recognition of achievement of desired future condition. Fund studies to solve regeneration problems as found in Shasta due to altered hydrological cycle and Scott due to drop in groundwater level. All riparian areas within range of coho salmon will be identified and protected within 5 years. Long-term: Develop long range riparian protection goals statement and recommendations based on stream meander width (e.g., Rosgen et al. year?). Continue to emphasize need to establish/protect/maintain desired conditions. If consequences of altered hydrograph in Shasta cannot be overcome with native trees, investigate and develop biologically appropriate recommendations.

Task I.D. Number	Task Description
P-3	Expand routine/ daily fish screen maintenance program (volunteer and paid) whether installed with grant funds or by the CDFG. Short-term: Local groups to work with CDFG and NOAA to develop comprehensive maintenance program by 2005. Work with screen users to develop inspection verification procedure for use after transition period. Use time afforded by grant funds to transition away from non-owner screen maintenance and, where appropriate, transfer screen maintenance to the diverter. Prepare maintenance manual, provide part names, numbers and sources, encourage local hardware or farm supply store to stock parts subject to wear, or make arrangements for CDFG to stock and sell. Use existing grant-funded personnel to assess existing screens (public and private) to identify all normally replaceable parts used, to modify screens where possible to standardize all parts possible, and prepare hardware lists of replacement parts and number of screens needing each. Long-term: Long-term procedure should implement inspection/verification, integrated with verification of water use described in WM-2. Provide periodic on-site training on proper screen maintenance and repair.
P-5	Develop construction and removal procedures or alternate means of diverting water for irrigation dams (gravel or flashboard) that minimize impacts to coho salmon. Short-term: Identify locations of existing structures, assess impacts to coho salmon, and recommend improvements to procedures and individual structure design. Work with diverters to implement these improvements. Determine timing of coho salmon emergence. In Shasta, proceed to implementation phase, complete assessments. Eliminate passage problems wherever possible, install or replace ladders where necessary as short term fix. Provide qualified CDFG engineer for design assistance in retrofitting barriers with ladders or correcting problems with locally produced and installed ladders as short term, temporary fix. Develop BMPs for removal/ replacement/ operation, and include these in 1600 process and monitor for effectiveness for both agriculture and fish. Long-term: Work with other agencies to assure that additional barriers are not created in future. Eliminate or reduce passage problems where ladders were used as short-term solutions or mitigation. Fund experimental designs to test approaches under local field conditions.
RC-BV-03	Implement the recommendations contained in the assessments for sediment paying particular attention to road assessment and improvement projects; also incorporate measures to preclude sediment delivery to stream systems in near-stream land use planning (especially on slopes greater than 35%).

Task I.D. Number	Task Description
RC-HU-01	Work with Redwood National and State Parks (RNSP), private landowners, and interested parties to improve habitat conditions of the estuary while protecting Highway 101 and the Town of Orick. These plans should aim toward restoring the historic form and function of the estuary/lagoon and slough channels, riparian forests, and adjacent wetlands. This includes providing for: a. Unconfined channels by modifying levees; b. Restoration of riparian vegetation, tree cover, wetlands, and off-channel and rearing habitat; c. Increased sediment transport, pool depth, and LWD; d. Restoring natural drainage patterns from adjacent wetlands; and e. Improving the conditions of sloughs and tributaries to the estuary (Strawberry, Dorrance, and Sand Cache creeks).
RC-HU-08	Coordinate a long-term, concerted effort between land owners, interested parties, and responsible agencies to determine the current population size and trends of coho salmon of Redwood Creek.
RC-OR-01	Work with Redwood National and State Parks (RNSP), private landowners, and interested parties to improve habitat conditions of the estuary while protecting Highway 101 and the Town of Orick. These plans should aim toward restoring the historic form and function of the estuary/lagoon and slough channels, riparian forests, and adjacent wetlands. This includes providing for: a. Unconfined channels by modifying levees; b. Restoration of riparian vegetation, tree cover, wetlands, and off-channel and rearing habitat; c. Increased sediment transport, pool depth, and LWD; d. Restoring natural drainage patterns from adjacent wetlands; and e. Improving the conditions of sloughs and tributaries to the estuary (Strawberry, Dorrance, and Sand Cache creeks).
RC-OR-04	Complete the assessments of sediment sources and road upgrades.
RC-OR-06	Assess and prioritize barries to coho salmon passage.
RC-OR-07	Treat high priority barriers to coho salmon passage
RR-AC-03	Assess and prioritize sources of excess sediment.
RR-AC-04	Treat high-priority sources of excess sediment.
RR-AC-05	Identify and stock high-priority barren streams, including Ward Creek, with the coho salmon broodstock program.
RR-AC-06	Increase habitat structure and complexity to enhance habitat diversity for coho salmon.
RR-FO-01	Restore riparian vegetation to improve migration and summer/overwintering habitat for coho salmon.
RR-GE-01	Pursue land-use planning and conservation easements, from willing landowners, to maintain and improve riparian vegetation condition and water temperature.
RR-GU-02	Implement recommendations of completed non-point source sediment assessments.
RR-GU-03	Assess and prioritize sources of excess sediment.

Task I.D. Number	Task Description
RR-GU-04	Treat priority sources of excess sediment according to the DFG Russian River Fisheries Restoration Plan and other assessments.
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 Dutchbill creeks.
RR-GU-14	Increase habitat structure and complexiity to enhance habitat diversty, including depositional/retention areas for spawning gravels for doho salmon.
RR-HU-01	Upgrade the Russian River Basin Plan to benefit coho salmon.
RR-HU-04	Assess, prioritize, and develop plans to treat barriers to coho salmon passage in all HSAs.
RR-HU-05	Treat barriers to coho salmon passage.
RR-HU-06	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax), prioritize, and develop riparian habitat reclamation and enhancement programs.
RR-HU-39	Upgrade or decommission problem roads which contribute sediment to streams inhabited by coho salmon. Reduce risk of road failure by upgrading stream crossings to recommended sizes.
RR-MS-03	If appropriate, operate the estuary as a natural system to benefit coho salmon rearing and migration.
RR-MS-10	In upper mainstem, prioritize and plan coho salmon habitat restoration programs and projects.
RR-MW-04	Assess, prioritize, and develop plans to treat sources of excess sediment.
RR-WS-01	Develop plans to improve riparian vegetation in Dry Creek and its tributaries.
RR-WS-09	Assess, prioritize, and develop plans to treat sources of excess sediment.
RR-WS-11	Increase habitat structure and complexity in Dry Creek (and it's tributaries) to enhance habitat diversity, including depositional areas for spawning gravels for coho salmon (e.g., place LWD or large boulders).
RW-AM-01	Support research necessary to understand crucial aspects and uncertainties regarding coho salmon ecology. Three important issues are: a. Genetic relatedness and health; b. Potential of local adaptive differences to environmental factors, specifically water temperature; c. Biological refugia, including non-natal rearing areas.
RW-AM-02	Evaluate and prioritize coho salmon issues and questions in need of research.
RW-AM-03	Develop and maintain data/information system for compiling, analyzing, and distributing information on the status and trend of coho salmon and the status of coho salmon recovery.
RW-AM-05	Use field-tested implementation, effectiveness, and validation monitoring protocols for coho salmon restoration activities.

Task I.D. Number	Task Description
RW-AM-06	Conduct key assessments to understand essential aspects of coho salmon populations and life-history, including: a. Relative abundance; b. Spawning sites/success; c. Estuary use; d. Barriers to juveniles; e. Over-wintering growth and survival; and f. Ocean condition effects on coho salmon populations.
RW-AM-07	Develop and implement a strategic, long-term population assessment and monitoring program for coho salmon.
RW-AM-08	Recommend to agencies and organizations that they assess and prioritize actions within a watershed prior to implementation of comprehensive restoration plans.
RW-AM-09	Fund research, monitoring, and evaluation of the effectiveness of restoration.
RW-EN-02	Fully enforce existing laws, codes, regulations, and ordinances that address the protection of coho salmon and their habitat. Habitat includes but is not limited to water (quality and quantity), pools, riffles, instream LWD, riparian vegetation, and estuaries.
RW-EN-06	Conduct field studies to evaluate impacts of water use on coho salmon.
RW-EN-10	Make a high priority of efforts to prevent unauthorized diversion and use of water and water permit processing.
RW-ER-01	Identify and characterize coho salmon refugia.
RW-ER-02	Provide information to land managers, agencies, and landowners of the location and characteristics of coho salmon refugia.
RW-ER-03	Identify key coho salmon populations.
RW-ER-04	Inform land managers, agencies, and landowners of locations of key coho salmon populations.
RW-ER-06	Allocate substantial improvement efforts towards identified biological refugia, spawning coho salmon populations, suitable habitat accessible to coho salmon.
RW-FP-01	Continue and complete assessments and prioritizations for correction of fish passage barriers.
RW-FP-03	Encourage funding authorities to provide adequate resources to construct new crossings and upgrade existing crossings (bridges, culverts and fills, other crossings) within the range of coho salmon to accommodate100-year flows flood and associated bedload and debris. Priority for upgrading should be based upon the potential impact to coho salmon habitat.
RW-FP-05	Evaluate NOAA Fisheries standards for passage at summer dams, and if necessary, develop additional policies and guidelines for passage at summer dams. Implement any recommendations resulting from this process.
RW-FP-07	Encourage funding authorities to allocate adequate budgets to Federal, State, and local agencies for identifying, designing, and implementing fish passage projects. This includes, but is not limited to, funding for road maintenance programs and capital project activities.
RW-HF-02	Within prioritized watersheds, reduce habitat fragmentation by restoring fish passage to high quality habitat.
RW-HO-01	Maintain the local genetic diversity of coho salmon populations.

Task I.D. Number	Task Description
RW-IM-02	Support continued and increased funding for the California Conservation Corps to implement coho salmon restoration projects throughout the coho salmon range in California.
RW-IN-15	Continue to implement FishNet 4C and Five County salmon restoration goals, including adopting and implementing Guidelines for Protecting Aquatic Habitat and Salmon Fisheries for County Road Maintenance (FishNet 4C 2004), training staff on guidelines, addressing fish passage and road sedimentation issues, developing riparian protections, promoting alternatives to conventional bank stabilization, and developing land-use policies beneficial to coho salmon.
RW-IN-16	Incorporate the Guidelines for Protecting Aquatic Habitat and Salmon Fisheries for County Road Maintenance (FishNet 4C 2004) within incidental take authorizations.
RW-LU-03	Establish incentives and standards to protect riparian and wetland areas on private lands.
RW-LW-01	Identify near stream vegetation communities that provide good opportunities for conifer LWD recruitment to coho salmon habitat. Address and identify possible solutions to potential conflicts between flood management activities and maintenance of riparian vegetation and LWD.
RW-LW-02	Provide education and information on the importance of these near stream communities to appropriate agencies, restoration funding groups, and landowners, and work to maintain them in a healthy condition.
RW-LW-03	Prioritize near stream vegetation communities for the purposes of restoring conifer LWD recruitment.
RW-LW-05	Encourage funding authorities to provide funding and technical support for riparian restoration.
RW-LW-08	Encourage Federal, State, and county agencies and private landowners to protect instream LWD to the greatest extent practicable without endangering public safety, life or property.
RW-PO-06	Educate and train restoration specialists and watershed restoration groups on the coho salmon recovery strategy.
RW-PR-21	Implement actions to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitat including spawning gravel and natural hydrograph, and avoidance of adverse impacts caused by water diversion.
RW-SD-01	Identify and prioritize specific sediment source locations for treatment that may deliver sediment to coho salmon streams.
RW-SD-02	Use protocols, such as the California Stream Habitat Restoration Manual Guidelines for upgrading areas of sediment delivery.
RW-SD-05	Continue to fund and provide technical support to local government and private landowner actions to reduce identified sediment input from upslope sources. Basin-wide assessments should prioritize remediation activities, which would include slope stabilization and minimizing sediment production.

Task I.D. Number	Task Description
RW-WP-01	Provide adequate funding to the agencies to coordinate and support preparation of comprehensive watershed assessments and restoration plans: a. Include a professional fisheries scientist; b. Assess streamflow, water diversions, water quality, sediment sources, fish barriers, riparian corridors, instream habitat, estuarine habitat, and land use, as necessary; and, c. Identify and prioritize site-specific restoration to benefit coho salmon.
RW-WP-02	Review existing, approved watershed management or restoration plans within the range of coho.
RW-WR-02	Identify unauthorized diversions.
RW-WT-01	Identify actions to maintain and restore water temperatures to meet habitat requirements for coho salmon in specific streams.
SA-HA-05	Provide coho salmon passage to all life history stages where roads affect streams inhabited by coho salmon implement the recommendations for the completed assessment of barriers.
Scott HM-1-1b	Identify methods for increasing habitat complexity and appropriate locations for instream habitat structures to create pools, increase habitat complexity, and improve bank stabilization. All bank stabilization projects should be done in a fish-friendly manner. Short-term: Research and quantify locations and develop restoration plans for them. Define what constitutes fish-friendly bank stabilization. Evaluate existing alternative bank stabilization methods. Continue to seek funding and carry out specific projects. Long-term: Assess and monitor activities to determine whether or not instream structures are working properly and doing no harm. There should be a decreasing need to install instream structures as natural river channel processes (channel meander, riparian vegetation recruitment, reduced sedimentations, etc.) are improved.
Scott HM-1-1c	Encourage riparian restoration projects using locally native vegetation. Project implementation should consider if: 1) the site previously supported riparian vegetation and still has the soil and hydrologic characteristics to support it; 2) the native plants selected are likely to flourish; 3) the width of the planted riparian zone is appropriate for the hydrologic regime at the site; and 4) the plan includes effectiveness monitoring using approved protocols. Establish procedures for recommending appropriate plant materials where natural conditions are significantly compromised. Short-term: Support ongoing riparian restoration efforts and continue to seek funding and carry out projects with an emphasis on the tributaries, especially those identified as potentially major coho salmon streams. Evaluate outcomes of replanting and research causes of riparian planting outcomes, appropriate width of planted areas, and new strategies for restoration. Monitor past projects to secure updated information on most effective techniques. Long-term: Assure implementation monitoring with emphasis on protecting the coho salmon refugia.

Task I.D. Number	Task Description
Scott HM-1-1e	Evaluate the use of beaver ponds and other efforts that contain similar benefits to increase habitat complexity. Short-term: Review literature (studies done in Washington and Oregon). Hold workshops and publish newsletters as appropriate. Investigate projects in prioritized areas to support beaver activity if appropriate. Coordinate with related projects to improve stream complexity and habitat. If projects are planned, ensure that riparian growth is adequate or provide materials for beaver needs, so that appropriate riparian cover is maintained. Long-term: Include implementation monitoring. If beaver reintroduction fails or is found to be inappropriate, consider analogous habitat attribute efforts.
Scott HM-1-2a	Identify location, timing, frequency and duration of thermal barriers to migration for adult and juvenile coho salmon. Develop habitat improvement measures that address temperature. Short-term: Identify and map locations and timing of thermal barriers. Coordinate information and projects to address appropriate solutions in prioritized areas with the most benefit to coho salmon. Long-term: Implement projects or measures in coordination with over-all habitat recovery process and monitor for improvements in an adaptive fashion.
Scott HM-1-2b	Investigate the contribution to stream cooling of the flow of cool water through gravel. Investigate the interference of fine sediment in that process. Short-term: Seek funding and carry out study using agreed-upon scientists identified by the Technical Committee of the SRWC. Long-term: Use results to plan projects and drive adaptive management.
Scott HM-1-2d	Model the relationship of temperature and flow and use the results to plan the timing and locations of water additions to the river. Short-term: Fund and implement temperature studies. Coordinate with the NCRWQCB TMDL process in data collection. Long-term: Monitor projects to determine optimum benefits are achieved with implementation of habitat improvement actions.
Shasta HM-1b	Implement habitat protection, restoration, and improvement projects that enhance rearing habitat in high priority areas. Short-term: Focus on areas currently accessible to coho salmon or potentially accessible (e.g. below Greenhorn and Dwinnell Dams). Conduct habitat suitability studies (see also Shasta HM-1a) on other streams to guide future actions. Coordinate with long-range planning effort for addressing barriers (Shasta HM-2). Possible projects to include are livestock control or exclusion fencing, tree and emergent planting, bioengineered bank stabilization, and irrigation tailwater reduction. Long-term: Continue projects. Monitor for effectiveness over the long term, utilizing adaptive management to fine-tune projects for best benefit to coho salmon.

Task I.D. Number	Task Description
Shasta HM-2a	Identify barriers to fish passage throughout the watershed for adults and juveniles, and work to implement solutions to these barriers. Short-term: At each site assess impacts on water quality and assess importance for coho salmon passage at each site. Assign each dam/impoundment a priority for reduction or removal. Work with users to select workable management measures. Implement short term solutions and work towards removal or remediation of passage problems at flashboard dams as soon as possible where feasible; otherwise develop temporary modifications to minimize passage and water quality problems. Long-term: Implement removal or remediation of passage problems at flashboard dams where feasible, otherwise modify to minimize passage and water quality problems. Continue to work with affected landowners and implement workable solution. Refine and Implement long-term solutions.
Shasta HM-2e	Eliminate barriers caused by high water temperatures throughout the river. Short-term: Work with Shasta Temperature model and through TMDL process to establish appropriate targets based on system capability. Provide for passage to safe areas in the short term.
SM-AN-01	Implement the projects recommended as high priority for coho salmon in the Gazos Creek watershed restoration plan.
SM-HU-05	Develop written standards for routine operations and maintenance.
SM-SG-04	Use the assessment results to develop a plan for restoration of coho salmon passage, instream habitat, and upslope erosion control, for implementation by cooperating landowners/managers.
SR-HU-01	Develop a program to control exotic vegetation which impedes access to and use of tributaries by coho salmon.
SR-HU-02	Implement a program to control exotic vegetation which impedes access to and use of tributaries by coho salmon.
SR-HU-03	Assess and prioritize barriers and impediments to passage (including water diversions), especially those on smaller tributaries, including Cedar, Clarks, Morrison, Peacock, Sultan, and Little Mill creeks.
SR-HU-04	Treat barriers and impediments to passage (including water diversions), especially those on smaller tributaries, including Yontocket, Tillas, and Tyron sloughs.
SR-HU-05	Develop a plan to restore the effectiveness and use of off-channel areas, sloughs, and wetlands.
SR-HU-08	Where feasible, restore channelized reaches back to more natural fluvial processes (e.g. meander belts that recruit stored spawning gravel, re-establish scour pools, recruit woody debris from banks).
SR-HU-09	Protect existing LWD recruitment potential through the retention of mature coniferous trees in the riparian zone.
SR-HU-17	Support and work with the watershed coordinator to aid in implementing recommendations.
SR-MC-01	Assess and prioritize sediment sources.

Task I.D. Number	Task Description
SR-MC-02	Treat sediment sources.
SR-MC-03	Develop a short-term plan to add LWD and a long-term plan to promote recruitment of LWD.
SR-MC-04	Implement the short-term plan to add LWD and a long-term plan to promote recruitment of LWD.
SR-MC-06	Implement the revegetation plan for the riparian zone.
SR-PL-01	Assess and prioritize barriers to coho salmon passage.
SR-PL-02	Treat the barriers to coho salmon passage.
SR-PL-03	Implement the plan developed at the HU-level that speaks to restoring the effectiveness and use of off-channel areas, sloughs, and wetlands; and specifically give immediate attention to Yontocket (partially Stateowned), Tillas and Tryon sloughs, and Elk Creek (Cresent City).
SR-WC-01	Develop a short-term plan to add LWD and a long-term plan to promote recruitment of LWD.
SR-WC-02	Implement a short-term plan to add LWD and a long-term plan to promote recruitment of LWD.
SR-WC-06	Treat the sources of sediment.
SS-HA-02	Reduce human-caused sediment input from upslope sources identified through public and private inventories.
SS-HA-03	Prioritize and implement remediation activities for human-caused sediment, which would include slope stabilization, minimizing sediment production, and eliminating coho salmon passage barriers.
SS-HA-04	Encourage Federal, State, and county agencies and private landowners to reduce impacts to coho salmon habitat from public and private road systems.
SS-HA-05	Continue road and/or watershed assessments to identify and prioritize sources and risks of road-related sediment delivery to watercourses.
SS-HA-07	Decrease potential for stream flow to become diverted at road crossings during high flow events, resulting in flow along the road that returns to the channel at undesirable locations.
SS-HA-12	Identify barriers to passage and prioritize them for removal, through collaborative efforts with other agencies.
SS-HA-21	Complete the comprehensive, peer-reviewed watershed restoration plans for the Shasta and Scott rivers that include identification and prioritization of all restorative needs in each basin. When restoration funds are limited, implementation should occur on the highest priority issues most likely to effectively address coho salmon needs within each basin.
SS-HA-25	Supplement on-going efforts to provide short-term and long-term benefits to coho salmon by restoring LWD and shade through: a. LWD placement; and b. Management to promote conifer recruitment.
TP-BL-01	Continue to work with private landowners to develop riparian buffers with an adequate conifer component and canopy closure to reduce temperatures, increase LWD, and provide sediment filtration.
TP-LR-10	Treat high priority sediment sources.

Task I.D. Number	Task Description
TR-DC-04	Implement sediment reduction plans consistent with County plans and policies.
TR-HU-01	Implement the Trinity River Record of Decision (ROD), which would provide: a. Variable annual instream flows for the Trinity River from the Trinity River Dam (TRD) based on forecasted hydrology for the Trinity River basin as of April 1st of each year, ranging from 369,000 acre-feet in critically dry years to 815,000 af in extremely wet years; b. Physical channel rehabilitation, including the removal of riparian berms and the establishment of side-channel habitat; c. Sediment management, including the supplementation of spawning gravels below the TRD and reduction in fine sediments which degrade coho salmon habitats; d.Watershed restoration efforts, addressing negative impacts which have resulted from land use practices in the Basin; and e. Infrastructure improvements or modifications, including rebuilding or fortifying bridges and addressing other structures affected by the peak instream flows provided by the ROD.
TR-HU-04	Establish TMDL implementation plans for the mainstem and South Fork using the upslope indicators and targets established in the Main Stem Load Allocation.
WM-11a	Support completion of the Scott River Water Balance Study to learn how water behaves in the river; in particular establish the fate of water added to the Scott River to increase instream flow. The study should identify the best locations to augment flow and predict the impact of the additional water at downstream locations. Apply the results of the completed Water Balance Study to water management, water augmentation, and habitat enhancement recommendations. Short-term: Obtain funds to complete Water Balance Study. Use results to guide projects that will support improvement to coho salmon habitat. Long-term: Continue implementation.
WM-1a	Ask Scott River Watershed Council (SRWC) to develop a Dry Year Water Plan for the Scott. Components would include predetermined funding and prioritized actions for implementation, with identification of who, what, where, when, and how. Short-term: Seek funding and proceed with plan development. Long-term: Use plan to coordinate actions during low-water periods. Plan will define "low-water."
WR-SF-01	Develop a short-term plan to increase LWD until natural recruitment can be restored.
WR-SF-02	Implement the short-term plan to increase LWD.
WR-SF-04	Implement the long-term plan to restore a mature coniferous riparian zone to South Fork Winchuck River.
WUE-2	Promote and provide landowner workshops. Work with landowners to develop a method to prioritize efficiency improvements that will yield either increased instream flows or improved water quality. Use to avoid funding projects that would not benefit coho salmon. (See also EO-2.) Short-term: Evaluate and provide education as appropriate.

Task I.D. Number	Task Description
WUE-3	Identify water savings from lining and/or piping surface ditch systems. Identify and prioritize ditch systems that have potential water-saving benefits to coho salmon. Develop locally specific policies and provide guidance to entities that fund and review these projects. Evaluate potential negative impacts to groundwater, wildlife, and other resources that could result from lining or piping ditch systems. If appropriate, concurrently implement companion planned winter recharge program to maintain system balance. Short-term: Map all existing ditches, show season of use, quantity, and determine ditch loss. Prioritize potential ditch lining projects. Collect field data if needed. Consider opportunity for assured, measurable increase in quantity and duration instream flows in spring and fall relative to coho salmon needs for passage, other criteria as developed. Utilize outreach funds to develop appropriate lining projects, especially on shared ditches. Implement where costs, benefits and overall basin priorities coincide. Long-term: Continue implementation of high priority projects.

Appendix H. Materials provided by State Water Resources Control Board - Coho Recovery Activities

North Coast Instream Flow Policy

Background: Water diversions result in a significant loss of fish habitat in California. Water withdrawals change the natural hydrologic patters of streams and can directly result in loss or reduction of the physical habitat that fish occupy. Flow reduction can also exacerbate many of the problems associated with land use practices by reducing the capacity of streams to assimilate pollutants. Construction and operation of dams and diversions create barriers to fish migration, thereby blocking fish from access to historical habitat. Dams also disrupt the flow of food (i.e., aquatic insects), woody debris, and gravel needed to maintain downstream fish habitat.

Water Code section 1259.4, which was added by Assembly Bill 2121 (Stats. 2003, ch. 943, § 3), requires the State Water Resources Control Board (State Water Board) to adopt principles and guidelines for maintaining instream flows in northern California coastal streams as part of state policy for water quality control, for the purposes of water right administration.

State Water Board Action: The State Water Board adopted the Policy for Maintaining Instream Flows in Northern California Coastal Streams (policy) (adopted May 4, 2010, effective September 28, 2010). The policy applies to water right applications to appropriate water, small domestic use and livestock stockpond registrations, and water right petitions. The primary objective of the policy is to ensure that the administration of water rights occurs in a manner that maintains instream flows needed for the protection of fishery resources.

Contains:

- Principles and guidelines for maintaining instream flows for the protection of fishery resources while minimizing the water supply impacts on other beneficial uses including irrigation, municipal use, and domestic use
- Protective measures regarding the season of diversion, minimum bypass flow, and maximum cumulative diversion
- Limits on the construction of onstream dams with measures to ensure that approvals of new onstream dams do not adversely affect instream flows needed for fishery resources
- Guidelines for evaluating the effects of cumulative diversions on instream flow needed for fishery resources

Next Steps: Policy will be implemented in the processing of pending and new water right applications, petitions, and registrations in the policy area.

Coho Recovery Tasks:

Task Number	Task Description	Policy Section
RW-SF-08	Encourage NMFS and DFG to work with SWRCB to validate and modify the guidelines to be appropriate to the SONCC Coho ESU as needed	

RW-SF-10	Restrict the season of diversion to December through March	Section 2.2.1.1
RW-SF-01 and 02	Design / use passive diversion devices for water diversions	Section 5.0
RW-WR-09	Develop incentives for water right holders to dedicate instream flows	
RW-WR-11	Follow DFG-NMFS criteria for diversion screens	Section 6.0

Russian River Instream Flow Requirements

Background: State Water Board adopted Water Right Decision 1610 (D1610) in 1986 amending the Sonoma County Water Agency (SCWA) permits and setting the current minimum instream flow requirements for the Russian River. Decision 1610: 1) set instream flows to benefit both fishery and recreation uses while serving the needs of water diverters and 2) identified that additional fishery studies should be done in the Russian River and Dry Creek tributary.

The 2008 National Marine Fisheries Service (NMFS) Biological Opinion concluded that the current minimum instream flow requirements have an adverse effect on Central California Coast Steelhead and Central California Coast Coho Salmon because the artificially high flows limit the quality and quantity of rearing habitat. Reducing summertime flows in the Russian River and Dry Creek would provide better fishery habitat by reducing velocities, minimizing the need to artificially breach the sandbar at the river mouth and allow for the formation of a freshwater lagoon in the estuary. Based on the findings in the Biological Opinion SCWA has filed annual temporary urgency change petitions and a long term change petition to request modifications to the minimum instream flow requirements below Lake Mendocino and Lake Sonoma.

State Water Board Actions:

2010 Temporary Urgency Change Petition (TUC Petition) - The Division of Water Rights (Division) issued an order on May 24, 2010 approving the petition as follows:

- Reduction in Upper Russian River flow requirements (East Fork to Dry Creek) between May 25 – Oct 15 (from 185 cfs to 125 cfs)
- Reduction in Lower Russian River flow requirements (downstream of Dry Creek) between May 25 – Oct 15 (from 125 cfs to 70 cfs)
- Addition of special terms requiring fishery monitoring activities, water quality monitoring plan, water conservation and conjunctive use

2011 TUC Petition - The Division issued an order on June 1, 2011 approving the petition, similar to the 2010 TUC Petition, with the following additional condition:

- Allowing the minimum instream flow requirement that applies to the Upper Russian River to be implemented on a 5-day running average of average daily stream flow measurements, with the stipulation that instantaneous stream flows will be no less than 110 cfs.

2012 TUC Petition - The Division issued an order on May 2, 2012 approving the petition, similar to the 2011 TUC Petition.

Long Term Change Petition - SCWA submitted a petition in September of 2009 to modify the minimum instream flow requirements of their water right permits. The Division issued a public notice of the petition in January 2010. Approximately 396 protests were received. SCWA is the Lead agency as defined in the California Environmental Quality Act (CEQA) for this petition and is in the

process of preparing the CEQA document analyzing the requested change. The State Water Board will be a Responsible Agency as defined by CEQA.

Next Steps: The State Water Board will consider SCWA's request along with the information provided in the CEQA document and determine whether the water right permits will be amended and, if so, whether additional conditions should be included in the amended permits to protect the environment and downstream water users.

Coho Recovery Tasks:

Task Number	Task Description
RR-MS-01	Manage summer flows in the mainstem Russian River to benefit rearing coho salmon and the estuary, while ensuring that all existing legal water uses and rights are accounted for
RR-MS-02	Evaluate operating the estuary as a natural system to benefit coho salmon rearing and migration

Statements of Diversion and Use

Background: The Statement of Water Diversion and Use (Statements) Program was established in 1965 as a means for surface water diverters with riparian claims and water appropriated prior to December 1914 (Pre-1914 claim) to make an official record of their water usage with the State Water Board. Under the previous requirements, many water diverters were exempt from reporting on a Statement. In 2009, the legislature revised the regulations for the requirements to report surface water diversions under the Statements Program. The program was expanded to include all surface water diverters who were not permitted or licensed with an appropriative right from the State Water Board. The changes also give the State Water Board the authority to administer civil liabilities to diverters who are found in violation of the law.

Beginning January 1, 2012, water diverters who filed Statements are also required to measure the monthly amount of water diverted using best available technology and best professional practices, and report those monthly amounts when they submit their reports the following year (2013). The information collected from the Statements helps the Division to protect the rights of existing and known diverters and to evaluate whether there is a reasonable likelihood that water is available for appropriation for new applications. Water use reported on Statements and on reports required under appropriative rights will help the Division to assure the proper allocation of the state's water resources.

2009 Changes in Water Code

- Eliminate some of the exemptions previously allowed under the law
- Includes new penalties for failure to file a statement ($1,000 initial and $500 per/day after notification)

State Water Board Action: In April 6, 2010, the Division notified diverters with pending applications that statements must be filed for 2009 by July 1, 2010. Enforcement actions have been taken for failure to file reports.

Next Steps:

- Enter Statements into eWRIMs (electronic water right information management system)
- Implement mandatory online filing beginning 2011

Coho Recovery Tasks:

Task Number	Task Description
RW-WR-04	Inventory water use and water availability in streams with coho salmon habitat
RW-WR-07	Continue to require riparian and pre-1914 water users to file annual statements of diversion and use

Russian River Frost Protection Regulation

Background: Much of the floodplain area along the Russian River is cultivated for wine grape production. When "bud-break" occurs on the grape vines, the crops become susceptible to damage by frost. It is the general practice of growers to protect their vines with water during frost events in order to minimize crop loss, however, some growers rely on alternative protection methods including heaters, wind machines, and helicopters. During a frost event, the high instantaneous demand for water for frost protection can cause rapid decreases in flow. The resulting receding water levels can strand juvenile salmonids along margins and in riffle habitat.
NMFS documented two episodes of fish stranding mortality that occurred in April 2008, the first on Felta Creek in Sonoma County, and the second on the mainstem of the Russian River, near Hopland in Mendocino County. NMFS requested the State Water Board take immediate actions to address concerns that water diversions for purposes of frost protection may cause significant salmonid mortality.

State Water Board Action: On September 20, 2011, the State Water Board adopted a Frost Protection Regulation for the Russian River watershed. The regulation provides that, with the exception of diversions upstream of Warm Springs Dam in Sonoma County or Coyote Dam in Mendocino County, any diversion of water from the Russian River stream system, including the pumping of hydraulically connected groundwater, for purposes of frost protection from March 15 through May 15, shall be diverted in accordance with a board-approved Water Demand Management Program (WDMP). The diversion of water in violation of this regulation would be an unreasonable method of diversion and use and a violation of Water Code section 100. The regulation requires any WDMP to manage the instantaneous demand on the Russian River stream system during frost events to prevent stranding mortality.

The WDMP's are to be administered by an individual or governing body capable of ensuring that the goals of the program will be met. In addition, the WDMP is required to include the following: (1) an inventory of the frost diversion systems within the area subject to the program, (2) a stream stage monitoring program, (3) an assessment of the potential risk of stranding mortality due to frost diversions, (4) development and implementation of a corrective action plan if necessary to prevent stranding mortality, and (5) annual reporting of program data, activities, and results.

After adoption of the Frost Protection Regulation, the State Water Board was sued by two different groups. One case was filed in the Mendocino County Superior Court and the other in the Sacramento County Superior Court. On February 2, 2012, the Mendocino County Superior Court issued an order temporarily staying enforcement of the Russian River Frost Protection Regulation (Regulation). Both cases were consolidated and a hearing was held in the Mendocino County Superior Court on June 28, 2012. A decision by the court is currently pending.

Next Steps: Await a decision by the court on the merits of the Regulation. State Water Board staff will continue to assist diverters in voluntarily implementing the "phased approach" to the Regulation outlined in State Water Board Resolution No. 2011-0047.

Coho Recovery Tasks:

Task Number	Task Description
RR-HU-03	Review, and modify if necessary, water use based on the needs of coho salmon and authorized diverters
RR-HU-41	Develop and implement programs to protect and increase instream flows

Water Right Instream Flow Dedications

Background: State law allows for water right holders in California to petition to dedicate some or all of their water rights for a purpose of use of fish and wildlife enhancement. This dedication may be made through a short or long-term transfer of the water, or may be made through a permanent change in purpose and place of use. Dedications of water to instream purposes can benefit instream and riparian resources and at the same time relieve a water right holder of the requirement to make beneficial use of the water in years when water is dedicated.

State Water Board Action: The State Water Board considers petitions for instream flow dedication to be the highest priority for processing, and endeavors to complete the processing in as short a time and with the least expense to the petitioner as possible. Since 2004, the State Water Board has issued amended water rights that include instream flow dedication for many watersheds, including the Scott Valley HSA, Lagunitas Creek HSA, and Bolinas HSA.

Next Steps: The State Water Board will continue to make instream flow dedications a priority, as an incentive to promote the use of this tool, and will complete processing of a new dedication in the Lagunitas Creek HSA as soon as possible.

Coho Recovery Tasks:

Task Number	Task Description
RW-WR-09	Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (Water Code 1707)

Enforcement

Background: Water Code section 1825 states: "It is the intent of the Legislature that the state should take vigorous action to enforce the terms and conditions of permits, licenses, certifications, and registrations to appropriate water, to enforce state board orders and decisions, and to prevent the unlawful diversion of water." The Strategic Plans for both Cal/EPA and the State Water Board identify improvement in enforcement programs as a priority. Additionally, the Legislature enacted Water Code section 1259.4, which required that by January 2008 the State Water Board adopt a policy for principles and guidelines to maintain instream flows in coastal streams within the counties of Marin, Sonoma, Napa, Mendocino and Humboldt. This policy included enforcement provisions. As a result of Senate Bill 8 (SBX7 8), which was passed by the Legislature in 2009, the State Water Board was authorized to increase its Water Right Enforcement resources by 25 PYs.

State Water Board Action: The Division filled most of these new positions and at the same time restructured its Enforcement Program. The Division will maintain a compliance and enforcement presence throughout the state, with current emphases on high resource value areas, including Northern California coastal streams. The Enforcement section will coordinate with the Department of Fish and Game (DFG) and NMFS, as appropriate, on specific enforcement actions relating to projects having alleged impacts to instream resources. Formal enforcement actions have been taken, when appropriate.

Next Steps: Continue to evaluate compliance and pursue enforcement actions where appropriate. Coordinate with the CDFW and NMFS to ensure that staff resources are utilized in the highest priority areas.

Coho Recovery Tasks:

Task Number	Task Description
RW-WR-02	Identify unauthorized diversions
RW-EN-09	Coordinate enforcement efforts with local, State and federal agencies with regulatory authority affecting coho salmon
RW-EN-10	Make a high priority of efforts to prevent unauthorized diversion and use of water and water permit processing
RW-EN-11	Adequately fund water diversion enforcement and permit programs

Electronic Water Rights Information Management System (eWRIMS)

Background: The electronic Water Rights Information Management System (eWRIMS) is a computer database developed by the State Water Board to track information on water rights in California. eWRIMS contains information on Statements of Water Diversion and Use that have been filed by water diverters, as well as registrations, certificates, and water right permits and licenses that have been issued by the State Water Board and its predecessors. eWRIMS also features an online reporting component. The Report Management System provides water right holders the ability to report monthly diversion and use electronically.

Users can search eWRIMS data by several criteria, including the water right owner's name, watershed, stream system, and county. After a water right search has been executed, users can plot the results. The Geographical Information System (GIS) will visually display the point(s) of diversion for each of the water rights that matched the search criteria. In the GIS, important information can be viewed about each water right that has been selected.

Next Steps: In addition to ongoing general improvements, the State Water Board will continue to upgrade eWRIMS, including, but not limited to tasks such as:

- Enhancement of the existing eWRIMS Stream Trace functionality
- Development of a service to calculate catchments, attributes and generate impact analysis reports
- Revision of the Place of Use GPS and scanning applications to operate in the ArcGIS 10.X environment

Coho Recovery Tasks:

Task Number	Task Description
RW-EN-04	Review diversions and use of water in priority coho salmon streams to determine which permits and/or licenses need modification for the protection of coho salmon
RW-EN-20	As staffing allows, review all applications for proposed projects that may impact coho salmon
RW-SF-16	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed
RW-WR-01	Review authorized diversions that have no provisions to protect coho salmon in areas with high priority coho salmon habitat
RW-WR-04	Inventory water use and water availability in streams with coho salmon habitat
RW-SF-16	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed

Appendix I. Materials provided by Trout Unlimited - Coho Recovery Projects

A. Cooperative Streamflow Improvement Projects

Coastal Streamflow Stewardship Project

In 2008, the California Coastal Conservancy awarded funding to Trout Unlimited (TU) and the Center for Ecosystem Management and Restoration (CEMAR) to implement the Coastal Streamflow Stewardship Project (CSSP). The objective of CSSP is to improve streamflow and water supply reliability by working cooperatively with landowners. Through CSSP, we partner with landowners and water users in coastal California watersheds to develop water management tools and identify projects to protect and reconnect streamflow for fisheries and improve water supply reliability for coastal communities.

Salmon and steelhead salmonid populations are in decline throughout coastal California. In many locations, the biggest problem is a lack of water. Even under natural conditions, many coastal streams experience very low streamflow during the late summer months. Water diversions for irrigation and other human needs can easily make these streams go dry. When we started CSSP, approximately 500 applications for new water rights were pending in California, including 300 located along the north central coast. The backlog was failing new applicants (because they were unable to get a water right), senior water right holders (because unauthorized diversions continued to operate without regard for the interests of prior appropriators), and public trust resources (because inadequate safeguards were in place to protect the instream flows necessary for fish and wildlife). In addition, water users with existing and valid water rights had little incentive to explore changes in water management and infrastructure that could benefit fisheries resources, especially if such changes meant entering difficult water rights and other permitting processes. Very few people or organizations have ever successfully completed projects to improve streamflows by working cooperatively with water users.

CSSP was created to test an approach to break through the stalemate and distrust that regularly characterize issues of water diversion, water rights, and streamflow in coastal systems. We do so by identifying and developing high priority and technically and socially feasible projects that do two things: (a) yield benefits for fisheries and human populations and (b) have demonstration value beyond the pilot watersheds. We hypothesized that, in many cases, shifting water demand from the dry season to the rainy season would benefit salmon and steelhead populations and meet human water needs. We believed that this could be done by developing tanks and agricultural ponds as an alternative to in-stream pumps or streamside wells, and could be accompanied by improvements in water use efficiency and rotations of diversions. We also hypothesized that investing in stream gauges and habitat-flow studies could allow us to make practical recommendations for water supply improvements, and we believed that investing even more heavily in discussions with the people who live along the streams could allow us to develop mutually beneficial projects. In sum, the overarching goal of CSSP is to devise a “comprehensive and coordinated approach to water management and instream flow protection” (California Coastal Conservancy 2008) that demonstrates that water rights system reform and fisheries conservation can be accomplished in tandem with water users.

Through CSSP, we selected four watersheds in which to pilot the approach—the Mattole River in Humboldt and Mendocino counties, Grape Creek (Russian River watershed) in Sonoma County, San Gregorio Creek in San Mateo County, and Little Arthur Creek (Pajaro River watershed) in Santa Clara County. In 2012, we added two others: Chorro Creek in San Luis Obispo County and Pescadero Creek in San Mateo County. In each of these watersheds, diminished streamflow is limiting salmonid recovery, but the restoration of streamflow appears promising and feasible and water users are eager to participate in conservation-oriented actions to benefit local fish populations. We selected watersheds characterized not by seemingly intractable conflict but rather by "medium-gnarly" water management challenges that would produce meaningful solutions. We also considered the diversity and breadth of the watersheds to be important: they are geographically diverse and present an array of land and water uses and opportunities so as to create flexible models with wide applicability.

Through CSSP, we drafted a streamflow improvement plan (SIP) for each watershed. The plans are intended to pave the way for high-priority capital projects to improve streamflow. SIPs are complete for two watersheds (the Mattole and Grape Creek), and are in the process of partner review for two others (Little Arthur and San Gregorio creeks). In the process of creating the SIPs, we identified and developed some of the highest priority projects for each watershed. Some of these have been implemented, and all are scheduled for completion within the next two years. They include:

- **Mattole River Headwaters**: (a) off-stream storage and dry season forbearance for Whitethorn School, (b) off-stream storage and dry season forbearance for Whitethorn Construction Company
- **Grape Creek:** (in tandem with the Russian River Coho Water Resources Partnership): (a) off-stream reservoir as alternative to pumping from well adjacent to the creek, (b) frost fan as alternative to diversion from on-stream flashboard dam, (c) off-stream storage and source switch as alternative to diversion from on-stream dam for frost and irrigation use
- **San Gregorio Creek**: (a) pump efficiency improvements and off-stream pond enlargement to reduce dry season diversion, (b) off-stream pond and dry season forbearance
- **Little Arthur Creek**: residential tank storage and dry season forbearance at four sites on the middle creek.

Project funders include: the California Coastal Conservancy, the Dean Witter Foundation, ESRI, National Fish and Wildlife Foundation, National Oceanic and Atmospheric Administration's Restoration Center, Natural Resources Conservation Service, the Richard and Rhoda Goldman Fund, Santa Clara Valley Water District, S.D. Bechtel Foundation, U.S. Fish and Wildlife Service, and the Wildlife Conservation Society (through the Wildlife Action Opportunities Fund supported by the Doris Duke Charitable Foundation), among others.

Water and Wine

Water and Wine is a partnership with grape growers in Northern California to enhance instream flows and salmonid habitat and fulfill agricultural water demands in Wine Country. Low stream flow in summer and fall adversely affects salmon and steelhead rearing habitat and leads to unreliable water supplies for growers. TU and the wine industry learned that we have a common interest in practices such as the use of stored, rainy-season water for irrigation as an alternative to summertime pumping from salmon streams. Water and Wine shares a nexus with the Coastal Streamflow Stewardship Project in Grape Creek.

Trout Unlimited and its Wine Industry partners launched the Water and Wine program in 2008. Water and Wine participants account for more than 30 generations and 725 years of experience of agricultural stewardship.

B. Regulatory Changes

TU also worked toward and provided input on important regulatory changes relevant to anadromous fisheries and water use. These include the Policy for Maintaining Instream Flows in Northern California Coastal Streams (North Coast Instream Flow Policy), the Russian River Frost Protection Reasonable Use Regulation, Small Irrigation Registrations, the streamlined policy for adding residential storage via Small Domestic Use Registrations, and other policy clarifications and incentives.

North Coast Instream Flow Policy. The SWRCB adopted the policy -- which was required by California Assembly Bill 2121 -- in May 2010 and it went into effect on September 28, 2010. The policy area extends from the Mattole River to San Francisco (including streams draining into northern San Pablo Bay). The policy applies to new water right applications (appropriative, small domestic use, small irrigation use and stockpond registrations) and water right petitions and it provides standard terms for bypass flows, rates of diversion, and seasons of diversion based on regional criteria protective of fisheries resources as well as guidance for site-specific habitat/flow instream flow studies. Notably, Section 3.3.2.5 of the policy provides incentives for water users wishing to switch the timing of their diversion from the dry to rainy season (*e.g*., to off-stream storage) by providing for expedited permitting for projects with demonstrable fisheries benefits.

Frost Regulation. In response to the stranding and death of coho and steelhead in the Russian River watershed in 2008 and 2009, the SWRCB adopted a reasonable use regulation concerning diversions for frost protection in the Russian River watershed (23 Cal. CCR 3 § 862). The regulation was adopted on September 20, 2011 to reduce impacts on salmon and steelhead of water diversions for purposes of frost protection of crops in Mendocino and Sonoma counties. The regulation became effective on December 29, 2011 and the new regulations were scheduled to take effect on March 14, 2012, but litigation is pending. The regulation provides that any diversion of water from the Russian River stream system, including the pumping of hydraulically connected groundwater, for purposes of frost protection, from March 15 through May 15, shall be “unreasonable” and a violation of water code – unless the water is diverted in accordance with a Board-approved “Water Demand Management Program.”

Small Irrigation Registration. On October 10, 2011, Governor Brown signed water legislation (Assembly Bill 964) which will improve and expedite permitting for small off-stream storage ponds for frost protection. TU worked with the Wine Institute, legislators Huffman and Chesbro and staff to craft the language, and the law should create far-reaching benefits in our focal watersheds and elsewhere by expediting permitting for beneficial projects; the geographic scope of the bill is statewide.

We have also worked to create incentives for water users to engage in projects to improve instream flow: working with SWRCB to clarify that roof rainwater harvesting does not require a water right and working with SWRCB and other organizations to disseminate better information about Water Code Section 1707, which allows landowners to protect their water rights when they voluntarily forgo diversions.

Small Domestic Use Registrations. Following the Governor's declaration of drought emergency in January 2014, we approached DFW and SWRCB with a proposal to remove substantial permitting barriers encountered by existing riparian diverters who seek to add storage to their domestic water systems. Working with staff, we developed a set of standard terms that DFW can insert into qualifying registrations in lieu of a time-consuming and expensive site visit to develop site-specific terms. The standard terms incorporate a forbearance period calculated based on the registrant's daily water use and total storage capacity, and timed to coincide with the height of the dry season. Both agencies adopted our proposal with only minor changes, and will leave it in effect for the duration of the drought emergency.

C. North Coast Coho Project – Restoring Salmonid Habitat

The North Coast Coho Project (NCCP), initiated in 1998, is an innovative, entrepreneurial effort to restore entire coastal watersheds and return coho salmon to its historical habitat in Northern California. It is uniquely based on partnerships between TU, private enterprises, local, state and federal government agencies, and private contractors. The NCCP has been and continues to be successful in its ability to identify projects, secure funding, and implement restoration projects.

The mission of the NCCP is to restore wild coho salmon and steelhead trout populations to a viable, self-sustaining level in Northern California's coastal watersheds through coordinated efforts with landowners, local, state, and federal agencies and community watershed groups while utilizing the best available science and management practices and stimulating local and regional economies through watershed restoration projects.

The Project began in 1998 when the Mendocino Redwood Company, LLC (MRC-LLC) purchased Louisiana-Pacific's California holdings and became the largest private landholder in Mendocino County. Louisiana-Pacific had heavily logged the areas for decades with little concern for the salmon. TU approached MRC-LLC about launching a joint project to restore its new lands, and in an unprecedented agreement between a conservation organization and a forest products company, TU and MRC-LLC joined forces to restore beleaguered coho salmon and steelhead populations on California's north coast. Under the partnership, MRC-LLC is closing damaged roads, providing scientific information, and helping with instream restoration on eight coastal rivers: Garcia River, Navarro River, Albion River, Noyo River, Big River, Elk Creek, Cottaneva Creek, and Hollow Tree Creek (South Fork Eel River).

In 2001, the project expanded to another private timberland group –Hawthorne Timber Company, LLC (HTC), which purchased all of Georgia Pacific's landholdings in Mendocino County and is managed by Campbell Global, LLC (CG). HTC lands include several important coho and steelhead rivers including Ten Mile River, Pudding Creek, and Noyo River. In 2007, Redwood Forest Foundation, Inc (RFFI) purchased over 50,000 acres located in the Usal Creek and South Fork Eel River watersheds. The RFFI land, also managed by CG, is now part of the NCCP effort.

In 2008, the project expanded yet again when MRC-LLC's sister company, Humboldt Redwood Company, LLC (HRC) purchased all of Pacific Lumber Company's land in Humboldt County. On these lands, TU is working with HRC to restore habitat in Freshwater Creek, Elk Creek, and Van Duzen River.

In total, MRC-LLC, HRC, and CG manage over 600,000 acres in Mendocino and Humboldt counties and are the dominant land managers in at least a dozen key watersheds or subwatersheds.

Over the last decade, the NCCP has effectively managed over 20 watershed-level projects, reopened over 68 miles of stream to fish migration through the removal of 11 major migration barriers, installed over 1,110 instream features, evaluated over 800 miles of forest roads, and upgraded or decommissioned 514 miles of roads.

Project funders include: the Department's FRGP, National Oceanic and Atmospheric Administration's Restoration Center, CDFG Steelhead Report Card Fund, California Coastal Conservancy, the Dean Witter Foundation, National Fish and Wildlife Foundation, S.D. Bechtel Foundation, U.S. Fish and Wildlife Service, FishAmerica Foundation, Salmonid Restoration Association, among others.

Appendix J. Materials provided by Yurok Tribe - Coho salmon recovery activities

Juvenile coho salmon use of constructed off-channel habitats in two Lower Klamath River tributaries: McGarvey Creek & Terwer Creek

Prepared by:
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Spring 2013

Introduction

The Yurok Tribal Fisheries Program – Lower Klamath Division (YTFP) is dedicated to rehabilitating degraded stream and riparian habitats of the Lower Klamath River to levels that support robust, self-sustaining populations of native anadromous fish. Since 2007, YTFP has been working with Rocco Fiori of Fiori GeoSciences (FGS) to design and implement innovative stream and floodplain enhancement projects in priority Lower Klamath tributaries. Treatments have included installation of constructed wood jams and engineered log jams (CWJs & ELJs) to facilitate formation and maintenance of productive fish habitats (e.g. spawning beds, deep pools with cover, slow velocity areas), and enhancing off-channel habitats to increase salmonid rearing capacity (YTFP 2010; Hiner et al. 2011; Beesley and Fiori 2012a, 2012b, & 2013).

In 2009-2010, YTFP and FGS partnered with the U.S. Fish and Wildlife Service (USFWS - Tribal Landowner Incentive Program & Partners for Fish and Wildlife Program), the National Oceanic and Atmospheric Administration (Coastal and Marine Habitat Restoration Program - American Recovery and Reinvestment Act), and the U.S. Bureau of Reclamation (Native American Affairs Program). Primary objectives of these partnerships were to implement stream, riparian, and off-channel habitat restoration treatments in two priority Lower Klamath tributaries: Terwer Creek and McGarvey Creek (YTFP 2010; Fiori 2010; Fiori et al. 2009; Fiori et al. 2010; Fiori et al. 2011a & 2011b; Hiner et al. 2011; Beesley and Fiori 2012a).

In 2009, YTFP and FGS constructed two ELJs (ELJ 1 & Crib Wall Jam) and conducted extensive bioengineering in lower Terwer Creek as well as installed 13 CWJs in McGarvey Creek (Figures 1-6). In 2010, treatments included enhancement of two off-channel habitat features in Terwer Creek (Terwer Pond A & Terwer Pond B) and one in McGarvey Creek (McGarvey Alcove I) to increase juvenile salmonid rearing capacity (Figures 7-11). Physical habitat monitoring data collected in these treatment reaches indicates positive habitat response (e.g. reduced soil loss, increased pool formation & habitat complexity) to implemented treatments (Gale 2009; Hiner et al. 2011; Beesley and Fiori 2012b).

McGarvey Creek

Prior to off-channel enhancement in 2010 and 2012, the areas treated in lower McGarvey Creek were inundated only during very high tributary flow events or during backwater events created by high flows in the Klamath River. YTFP and FGS constructed the off-channel habitat features in a manner that has provided and will provide year-round habitat for native fish and amphibians.

Following construction of McGarvey Creek Alcove I, YTFP monitoring crews conducted fish surveys during winter, spring, and early summer 2011. In January 2011, crews captured a total of 54 juvenile coho salmon and several other native salmonids and amphibians. One of the coho captured during January was a PIT tagged fish that the Karuk Tribe marked in Slate Creek on 07/17/11. Slate Creek enters the Klamath River 51 river miles (RM) upstream of the Pacific Ocean (Figure 13). Trapping events in early March 2011 resulted in the capture of 21 juvenile coho. Five of the coho caught during spring had been previously captured (e.g. "recaptured" fish) in McGarvey Alcove I during the January 2011 survey. Surveys conducted in June 2011 resulted in the capture of 51 young of the year (YOY) coho, a YOY chinook, and other native fish and amphibians. Summer rearing habitat for juvenile salmonids is extremely limited in the Lower Klamath Sub-basin; therefore, these results are very encouraging and further support our plans to continue stream and floodplain restoration efforts in lower McGarvey Creek.

In March 2012, YTFP conducted a mark-recapture population estimate in McGarvey Creek Alcove I using the Chapman modification of the Petersen estimator (Ricker 1975). YTFP estimated a total of 213 juvenile coho residing in McGarvey Alcove I (Figure 14). Mark-recapture efforts conducted in McGarvey Alcove I during late July 2012 resulted in an estimate of 50 YOY coho (Figure 14). YTFP recently conducted mark-recapture surveys in both constructed off-channel habitats of McGarvey Creek. Late January – early February estimates for age 1+ coho were 121 for Alcove I and 154 for Alcove II (Figure 14). YTFP will continue monitoring salmonid abundance in these alcoves to further document seasonal and annual use of this constructed feature by natal and non-natal juvenile coho and other native fish. We are still processing the PIT tag data collected in these alcoves during fall 2012 - winter 2013.

Terwer Creek

YTFP conducted pre- and post-project fisheries investigations in the two off-channel habitat features in lower Terwer Creek. Pre-project trapping efforts conducted in Terwer Pond A during March 2009 resulted in the capture of 26 juvenile coho. One of these juvenile coho was initially PIT tagged by the Karuk Tribe in Independence Creek on 09/22/08 (Figure 13). In 2010, YTFP conducted pre-project mark-recapture population estimates in the Terwer Creek ponds using the Chapman modification of the Petersen estimator (Ricker 1975). In January 2010, YTFP estimated 39 juvenile coho in Terwer Pond A (Figure 14). Trapping events conducted in Terwer Pond B during March 2010 resulted in the capture of only two juvenile coho (Figure 14). The

moved into the pond. Mark-recapture events conducted in May 2011 resulted in population estimates of 75 YOY coho and 766 YOY chinook. In February 2012, YTFP estimated 65 juvenile coho residing in Terwer Pond A (Figure 14). Post-project studies conducted in Pond A during 2011 indicated fish use of the newly enhanced portion of the pond was minimal relative to fish use in the untreated area. February 2012 trapping events indicated fish use of the treated area of Pond A had dramatically increased relative to the previous year.

The number of juvenile coho estimated in Terwer Pond B was 121 in January 2011 and 212 during March 2011 (Figure 14). As was observed in Pond A during May 2011, a majority of the age 1+ coho had left Pond B while YOY coho and chinook moved into the pond. Mark-recapture events conducted in May 2011 resulted in population estimates of 172 YOY coho and 930 YOY chinook. In February 2012, YTFP estimated 18 juvenile coho in Terwer Pond B (Figure 14). Low numbers observed during this effort may have been related to low flow conditions that persisted throughout winter. YTFP recently conducted mark-recapture surveys in both constructed off-channel habitats of Terwer Creek. Late February estimates for age 1+ coho were very low in both ponds (Figure 14). Data collected by YTFP crews as part of the Coho Ecology Study indicate very low juvenile coho numbers within many of the Lower Klamath tributaries. Low numbers of fish within the Terwer ponds during winter 2013 may also be associated with a very low water year. Pit tag data collected in the Terwer ponds has revealed substantial use of these habitats by non-natal juvenile coho salmon (Figure 13).

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Figure 1. An engineered log jam (Terwer ELJ 1) in Terwer Creek following construction and during the first flows post-construction, Lower Klamath River (Fall 2009).

Figure 2. Looking downstream at Terwer ELJ 1 and willow baffles protecting a side channel and Holocene soils and creating low velocity habitat (01/01/10 - near bankfull event ~1,600 cfs).

Figure 3. Looking downstream at an engineered log jam (Terwer Crib Wall Jam) in Terwer Creek during construction (Fall 2009).

Figure 4. Looking upstream from Terwer Crib Wall Jam at Terwer ELJ1 and willow baffles protecting and creating complex slow velocity habitats for native salmonids (Winter 2010).

Figure 5. Looking upstream at Terwer Crib Wall Jam two years post-construction (Fall 2012).

Figure 6. A constructed wood jam site (2009 - Site 5) in McGarvey Creek prior to construction (Top), first winter post-construction (Bottom Left), two years post-construction (Bottom Right).

Figure 7. Oblique aerial photograph of lower Terwer Creek restoration sites (Summer 2011).


a)
b)
c)

Figure 10. Looking downstream at McGarvey Alcove I prior to construction (Top – Fall 2010) and two years following construction (Bottom – November 2012), McGarvey Creek.

Figure 11. Looking upstream at McGarvey Alcove I during winter flows (Winter 2011).


Note Orange Flagged Tree
Alcove II
Orange Flagged Tree
Alcove II

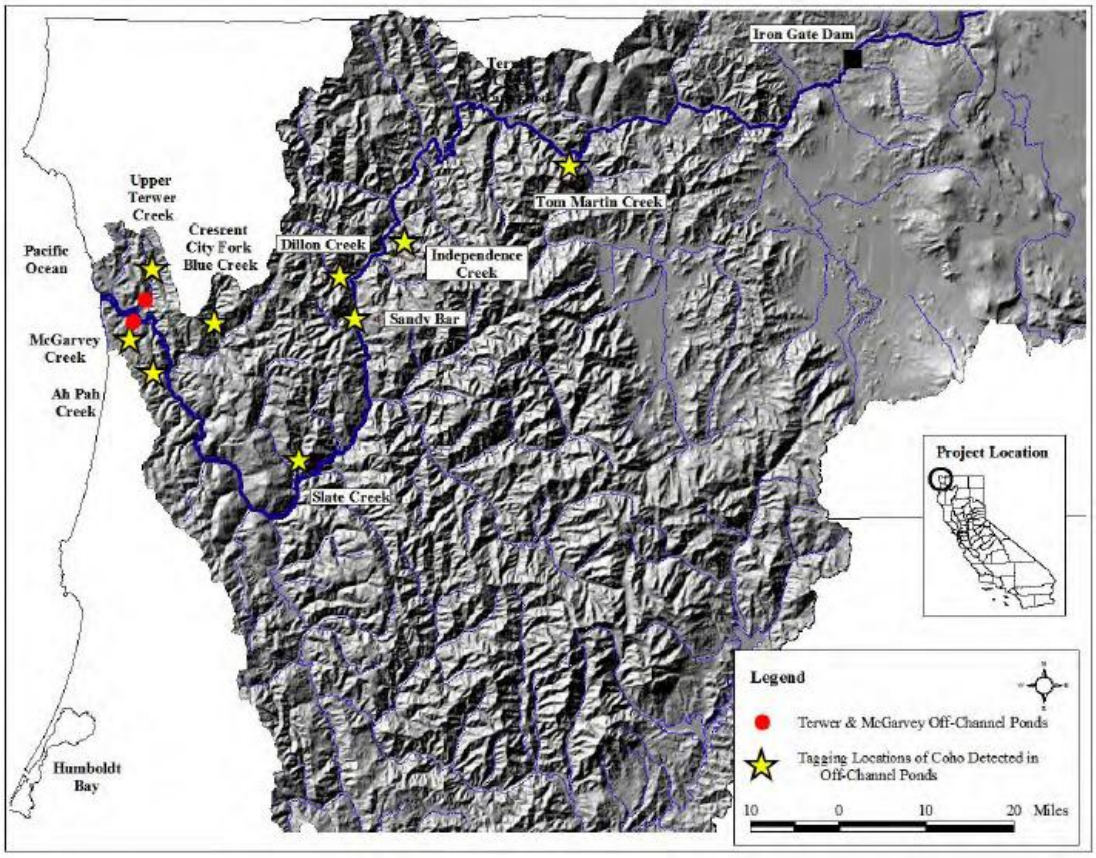

Figure 13. Map indicating tagging locations of non-natal juvenile coho recaptured in off-channel ponds constructed in two Lower Klamath tributaries between November 2010 and winter 2012.

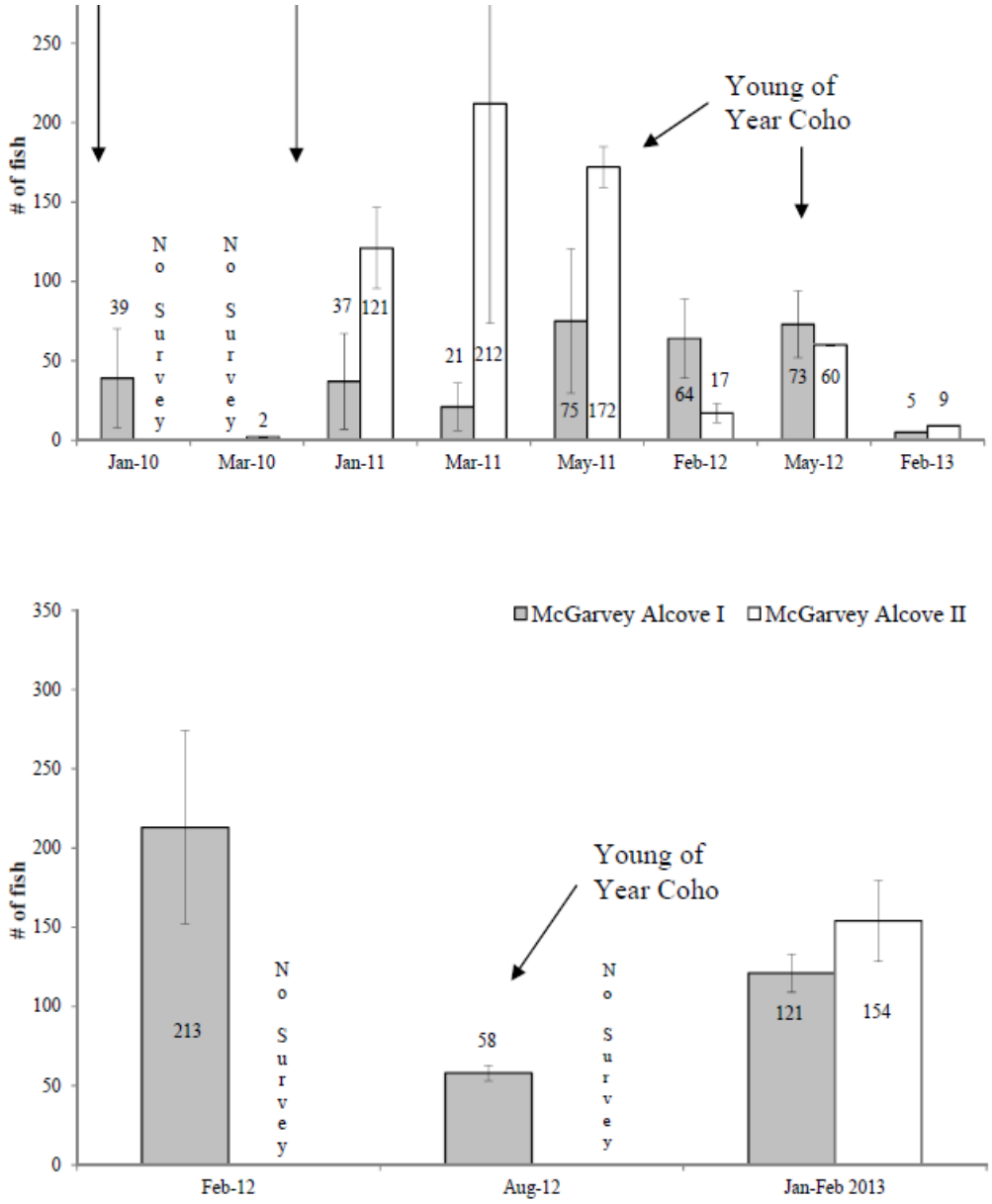

Figure 14. Mark-recapture population estimates for juvenile coho (1+ fish except where otherwise indicated as young of the year) in Terwer (Top) and McGarvey (Bottom) ponds.

Appendix K. Review Comments Received and CDFW Response

In addition to extensive internal review, California Department of Fish and Wildlife has also received review comments from the following agencies, which are appended below in Appendix K, together with CDFW response;

1. Statewide Coho Salmon Recovery Team Members
2. Fisheries & Oceans Canada
3. NOAA SW Science Center

1. Statewide Coho Recovery Team

Name	Stephen Swales
Phone	916 324 6903
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Comment Type (General, Chapter Title, Appendix Title, or Attachment Title)	Section Name	Page #	Reviewer	Comment	CDFW RESPONSE
Ex Summary	NA	5	PHC - CalFire	line 132: We suggest listing forestry as last in the list of human caused factors affecting coho salmon, since research related to current (contemporary) management practices shows that impacts associated with timber operations appears to be minimal in most cases (MacDonald and James 2012, Ice et al. 2010, Ice 2011, Ice 2012, Skaugset et al. 2012, Cafferata and Reid 2013). Additionally, considerable progress has been made in reducing the impacts of forest roads, a primary potential sediment generator, in the past 10 years (Cafferata et al. 2007), and with the passage of the Road Rules,2013 rule	Changes made

				package by the BOF.	
Chapter 1	1.6	15	PHC	line 486: ii should say "improvements in regulations to protect coho salmon populations on non-federal timberlands , such as the ASP rules , approved by the BOF in 2009 and implemented on the ground in January 2010.	Changes made
Chapter 3	3.3	25	PHC	lines 12-17: Should include comments about the winter of 2013-2014 and drought conditions--likely severely impacting this cohort of coho salmon. Lines 27 and 30: spell Caspar correctly.	No Changes made - report time-period is limited to 2012-2013
Chapter 4	4.1	27	PHC	Include language that states that implementation of the modern FPRs/BMPs (post-1975) have substantially reduced water quality impacts (both sediment and water temperature) [known from the Caspar Creek and Alsea study (OR) results]. There has been as much as 80 to 90% improvement in water quality performance (Ice 2011, 2012). Properly implemented BMPs can control the impacts of forest management on water quality at the site scale ("first line of defense for water quality").	Changes made
Chapter 4	4.1	27	PHC	Add: Additionally, the BOF approved the Road Rules, 2013 rule package in the fall of 2013, to reduce sediment impacts both in ASP watersheds and statewide. Key	Changes made

				statewide requirements include mandatory hydrologic disconnection and road erosion site inventories.	
Chapter 4	4.1	27	PHC	Add: Watershed-scale impacts from clearcut logging and road work in N. Sierra/Cascade watersheds with volcanic soils appear to be minimal (MacDonald and James 2012, BCTF 2011). Concern remains over cumulative watershed effects related to logging in erodible North Coast watersheds. Management practices have improved, but it will take more time for comprehensive monitoring work to document improvement to water quality and habitat.	Changes made
Chapter 4	4.1	27	PHC	Add: The ASP rules included provisions to allow site-specific riparian management to more rapidly improve conditions for listed anadromous salmonids, including coho salmon. A detailed guidance document was produced to illustrate where to implement these types of projects (VTAC 2012).	Changes made
Chapter 4	4.1	27	PHC	Add: line 107: The Department of Fish and Wildlife and CAL FIRE produced a detailed ASP Rule Question and Answer document to provide insight into the application of these rules (DFW and CAL FIRE 2010). Further refinements in the rules for Class II-Large watercourses were approved by the BOF in the fall of 2013.	Changes made

Chapter 4	4.3	28	PHC	line 144; add low flows to the list of hydrologic cycles that can be altered with land management activities. Additional summer base flows following logging for <10 years can benefit anadromous salmonids, including coho salmon, by increasing instream habitat capacity.	Changes made
Chapter 5	5.28	42	PHC	Should be "Campbell Timberland Management/Hawthorne Timber Company." Expand on the work of the timber companies. GDRCo began implementing an aquatic HCP in July 2007. HRC continued implementing the aquatic HCP initiated by PALCO in 1998. MCR is nearing approval of an aquatic HCP. All have monitoring components. For example, GDRCo has produced three aquatic HCP biennial reports submitted to NMFS and USFWS for 2009, 2011, and 2013 with abundant fisheries data.	Some changes made
Chapter 5	5.29	42	PHC	Add a section for the Mendocino County RCD. Discuss their Mendocino County Permit Coordination Program, which will reduce the permitting burdens faced by landowners for habitat improvement work, such as large wood placement projects (contact Patty Madigan for more information).	Beyond scope of report
Chapter 6	6.1.3	46	PHC	Cite Joel Benegar 2011 MS thesis from HSU for East Branch of Mill Creek, showing that complex wood jams were more effective at improving over summering and overwintered pool habitats for coho salmon and other anadromous salmonids than simple fish habitat structures following	Report does not include quantitative data on fish response to LWD

				standard California restoration protocols.	
Chapter 6	6.1.9	61	PHC	Include GDRCo fisheries monitoring results for Little River and Maple Creek watersheds (from 2009, 2011, and 2013 reports to NMFS and USFWS).	Monitoring data from timber companies is not available
Chapter 6	6.1.10	63	PHC	Correct citation for the Redwood Cr watershed assessment is Cannata et al. 2006. It was written by the Coastal Watershed Planning and Assessment Program and North Coast Watershed Assessment Program, not just DFW.	Changes made
Chapter 6	6.2.2	78	PHC	line 1214: reword to say: "State-of-the-art concrete fish ladders were installed at both the South Fork and North Fork weirs in the Caspar Creek watershed in 2008, replacing the original wooden structures built in the early 1960's as part of a cooperative watershed study between CAL FIRE and the PSW (Cafferata and Reid 2013).	Changes made
Chapter 6	6.2.6	95	PHC	Spell creek name as "San Vicente Creek."	Changes made
Chapter 8	8.2	100	PHC	Include as a recommendation: Work towards having a simplified, coordinated permitting process, outside of the California Department of Fish and Wildlife's Fisheries Restoration Grants Program (FRGP), that can facilitate large wood projects, and other habitat restoration work, to rapidly improve habitat for listed anadromous salmonids in California. This has been the goal of the Wood for Salmon Workgroup for over 3	Beyond the scope of the report

				years and continues to be its goal. The goal is to accelerate the pace and scale of in-stream restoration projects.	
Chapter 9	9	101	PHC	Sean Gallagher listed in his June 2013 PPT for the Caspar Creek 50 yr workshop that "marine survival drives coho salmon populations", followed by "density dependence in freshwater", "survival and high winter flows negatively correlated", and "winter habitat appears to be limiting." I believe these were his key summary points. Consider including them into the conclusions, or earlier in the document.	The importance of winter habitat is discussed in the 2004 Recovery Strategy
Appendix C	NA	112	PHC	Please include the CA Department of Forestry and Fire Protection in the list of organizations in CA involved in coho salmon recovery (see PPT delivered to the CRT at their last meeting by CAL FIRE staff). Efforts include: leadership for WFSW, VTAC work, State Forest habitat improvement projects (SDSF, JDSF), and contract with MCRCD for large wood projects and guidance document.	CalFire is already listed
general	NA	NA	CalFire	There is a lack of discussion regarding drought influences (the word drought did not appear in the document)	Changes made
general	NA	NA	BM - CalFire	There is a lack of discussion regarding the use of coho or other salmonids as “covered species” in several large landowner Habitat Conservation Plans	Beyond scope of report

general	NA	NA	BM	There is a need for improvements in treatment of recent BOF actions and Forest Practice Rule improvements	Suggestions needed
general	NA	NA	BM	The report was well done and very readable	
general	NA	NA	BM	Accelerating identified recovery actions beyond the current pace will require additional dollars and commitment/collaboration. There should be a thorough assessment of feasibility and likelihood of accomplishment beyond that mentioned as a Technical Working Group Function (p 98) to prevent extirpation of coho in coastal watersheds and other critical areas.	Comments noted
General	**Table of Contents**	**6**	S. Beesley, Yurok Tribe	Why isn't agriculture listed as a factor & threat to coho population viability?	This topic is discussed in the Recovery Strategy and no further updated information is available
General	**Native American Tribes**	**41-42**	S. Beesley	Need to correct - "restoration work in the Trinity River and tributaries of the Lower Klamath" and it is McGarvey Creek - no hyphen	Changes made
General	**Timber Companies**	**42**	S. Beesley	Timber companies do not undertake restoration - they allow other groups to conduct restoration on their property. Big difference.	Changes made
General	**Habitat Restoration**	**48**	S. Beesley	See word document for specific language request.	Changes made

General	**Population Monitoring**	**48**	S. Beesley	See word document for specific language request.	Changes made
Materials provided by Division of Water Rights - Coho Recovery Articles	**Appendix H**	**212-218**	Katy Lee, SWRCB	Appendix H is not in the same format as submitted by Division staff (numbering, tables, bullets are incorrect or missing). Please find attached two versions for resubmittal with the correct formatting (.pdf and .doc).	Changes made
Chapter 1, Section 1.4	Other Coho Salmon Recovery Plans	13	SM, Mattole Salmon Group	"The Mattole Salmon Group (MSG), a watershed restoration group focused on the Mattole River in Humboldt County, recently published the Mattole Coho Recovery Strategy (MSG 2011). The MSG has monitored coho salmon populations in the Mattole River system since the early 1980's. In recent years, populations have fallen to very low levels. There is a very real threat that coho salmon in the Mattole River may be extirpated in the near future, without extra-ordinary and continued restoration efforts". The following statement is a negative comment that is not supported by the evidence. If the following statement is to stay...This population decline has occurred despite the implementation of extensive habitat restoration projects for coho salmon and other anadromous salmonids in the Mattole River valley for over thirty years,...then this should be followed by..."It is not surprising that 30 years of restoration has not stopped the decline of populations, when in fact unregulated damaging land use practices continue to occur and when	Changes made

				the damages occurred over a period of more than 160 years". Additionally, positive effects from the 30 years of restoration have occurred. The headwaters mainstem Mattole clears more quickly after a storm thanks in part to extensive road restoration work done over the past few decades. Low flows in the upper mainstem have been positively affected by the "Storage and Forbearance: work of Sanctuary forest and landowners.	
Chapter 1, Section 1.6	Coho Salmon Recovery Actions	15	SM	(i) projects have been increasingly funded by other partners (SCC, CA WB, DWR, NOAA, NFWF, and others) as well as FRGP	Changes made
Chapter 3, Section 3.3	Summary of Current Status of California Coho Salmon	25; line 33	SM	"...and appear to be heading towards extirpation"… I would add…unless extra-ordinary measures are taken immediately to reverse this trend"	Changes made
Chapter 4, Section 4.2	Water Diversions and Fish Screens	28; line 140	SM	f) increasingly, water diversion for marijuana cultivation is a major issue in watersheds on the central and north coast. Inappropriate to name just a few watersheds such as the Mattole, Russian, and Eel rivers. All of the watershed have excessive withdrawals for marijuana, grapes, and many other uses.	Changes made

Chapter 4, Section 4.5	4.5 hatcheries	30; line 221	SM	No new coho artificial propagation programs have been initiated since the listing in 2004. Major efforts were made by many partners to initiate and approve a recovery rearing program for coho in the Mattole River. The MSG has 3 decades of experience and facilities dedicated to wild fish population enhancement efforts. The approach proposed had great merits and was supported by NOAA (NMFS) and many other partners, but DFW would not approve it due to flow requirements. The minimum flow requirements by DFW were not possible to be met in the Mattole. Efforts to look at other configurations and flow set ups were met with significant resistance by DFW, so MSG refocused its efforts on instream restoration of habitats. Please note that this statement is not made to stir up trouble or to make anyone look bad, but if we are to give the FGC an accurate report on current conditions it is important to know the facts.	No changes made - these were discussions only

Chapter 5, Section 5.3	Non-governmental environmental groups	40; line 19	SM	Change this section title to Nongovernmental Organizations; In Humboldt County, the Mattole Restoration Council (MRC), the Mattole Salmon Group (MSG), and Sanctuary Forest are community based non-profit organizations that are actively involved with habitat restoration, water storage and forbearance, salmon population monitoring and education and outreach in the Mattole River watershed. These three groups have formed a watershed partnership to cooperate rather than compete for the shrinking funding pie. The Mattole River and Range Partnership consists of three nonprofit organizations (the Mattole Restoration Council, Mattole Salmon Group, and Sanctuary Forest) who collaborate to conserve and restore the ecological integrity of the Mattole watershed. The Partnership coordinates our efforts to implement projects and monitor watershed health. .....This section is a little confusing as to why there is also a section titled Watershed Groups (5.2.6). Neither section is a complete list. Perhaps a reference to the large variety of NGO watershed groups that make up the California restoration landscape and why this variety has formed due to the lack of state direction and funding for watershed councils like in Oregon.	Changes made

General Comment				Would be good to talk about the wide variety of restoration program funding from multiple state agencies, federal agencies, and private foundations; also the challenge this presents in completing projects with multiple sources that have different requirements and costs shares.	Beyond the scope of the report
Chapter 6, Section 1.4	6.1.14	73-76	SM	Mattole Section good but need more detail include attempts at recovery rearing etc. .... Talk about cost effectiveness of doing instream off channel work rather than mega hatcheries thus no negatives from hatcheries etc. talk of the MSG Coho Strategy plans etc. and how road work and forbearance is starting to show results; need more LW and estuarine off channel etc...Add information about current adult coho monitoring and juvenile coho distribution surveys being done according to CMP and funded by the Department. Describe MSG's 3 decades of population enhancement activities pros and cons; these programs may very well be a big reason for their survival to this day. Add a 2012 Update like the Russian River section on new and improved monitoring according to CMP	Materials requested- some changes made
			SM	case study Baker Creek attached to this e-mail	Project is outside time-period of report
Conclusions		101	SM	line 259 grammar error…remove the word achieve	Changes made

Chapter 7		98 line185	SM	Mattole Pilot Priority Action Plans; critical!!!!	Changes made
Conclusions		101	SM	line 259 grammar error…remove the word achieve	Changes made
General Comment			SM	The CRT work with DFW and other state and federal agency reps work to develop a comprehensive Programmatic EIR for fisheries restoration state wide. The goal would be to develop a programmatic set of permits for restoration such that regardless of what state funds fund a restoration project, the project receives the programmatic permits, similar to how FRGP works now. All projects would need to follow DFW manual on BMP's. Might need to be limited regionally and focused on projects that are generally accepted as doable.	Beyond the scope of the report
General Comments			SM	Supplementation discussion should cover not just the existing efforts at Warm Springs etc., but recommendations for other appropriate scale supplementation. For the Mattole suggested language could be…Consider and implement appropriate scale supplementation in the Mattole. This might include something as simple as doing live capture of an adult male coho from the South Fork Eel (the closest genetically to the Mattole) and releasing in the Mattole Headwaters when know female coho are present. This can help the Mattole population diversify its genetics and move away from the current inbreeding situation. Another opportunity may include "Rescue	Beyond the scope of the report - not included

				Rearing" of Coho, where if rescue is needed due to drought and low flows, then these fish could be reared in small scale local facilities that can aid in recovery.	
GENERAL			PCFFA	(1.)Lack of Analysis of Instream Flow Regime Improvements and/or Deficits: Although the original Recovery Strategy document acknowledges that excessive water diversions and groundwater extraction are significant threats to coho salmon, and this is also acknowledge in this Draft Report at Section 4.2,1 there needs to be considerably more analysis of these impacts, preferably on a stream-by-stream basis, plus any changes in these impacts (positive or negative) since 2004, at least for key coho salmon productive rivers like the Scott and Shasta.	Related to comments on flow needs for fish and wildlife in the Shasta and Scott Rivers – updates of current efforts to develop study plans for instream flow studies in those watersheds are available at: http://www.normandeau.com/scottshasta/

GENERAL			PCFFA	"We are gratified to find a reference to the Department's Instream Flow Program established in April 2008 on pages 28-29. This is a good beginning for the important effort of establishing minimum instream flows for rivers throughout the state, starting with the Appendix C list of 22 priority rivers the Flow Program is assessing. Please also include the most current schedule for addressing these river segments as part of Appendix C."	There is no formal schedule for addressing flow needs in the 22 priority streams on a statewide basis (although there may be a draft schedule available for Sac/SJR Delta tributaries since that is the focus of most of the CDFW flow program due to Delta-specific funding). Unfortunately, there currently is a lack of resources available for flow study efforts on coastal streams.
chapter 4			PCFFA	(2) Reorganizing and Expanding Chapter 4 to Discuss all Factors and Threats Raised in the Recovery Strategy, in Addition to New Threats:	Beyond the scope of the report - not included
Page 4 – line 113:			PCFFA	Typo: "incudes"	Changes made
Page 32 – lines			PCFFA	Typo: spaces needed between number and	Changes made

308 and 314:				letters in percent's	
Beginning on Page 51, in Sec. 6.1.7.1 regarding the Shasta Valley			PCFFA	The text in this section should be updated to make some mention of the recent Dwinnell Dam lawsuit against the Montague Irrigation District and its successful settlement. This settlement is expected to benefit the salmon runs of the Shasta River in various ways. This is litigation filed May 17, 2012 by the Klamath Riverkeeper and the Karuk Tribe. The case citation is Klamath Riverkeeper, et. al vs. Montague Water Conservation District, US Dist. Court, Eastern District of California, Civil Case No 2:12-00717. The settlement in this case was signed in December of 2013, and information on that settlement is available at: www.klamathriver.org/Documents/PR-122313-MWCDsettlement.pdf. The settlement agreement itself is available from the Court's case file archives.	Beyond scope of report
Beginning on Page 54, Section 6.1.7.2 regarding the Scott River			PCFFA	It would be very helpful to have more information about what the original coho salmon runs sizes actually were prior to development of the Scott River basin as a baseline with which to compare.	Data not available
Beginning on Page 56, Section 6.1.8 regarding the Trinity River			PCFFA	Here too it would be very helpful to have more information about what the original coho salmon runs sizes actually were prior to European settlement and development of the Trinity River basin, as a baseline with which to compare. [Note: The prior two comments also apply to all other coastal river systems, i.e., what was the original baseline populations of these river systems	Data not available

				prior to European settlement and development? It would also be helpful to extend all the recent population charts to provide a lower-end comparison of the average escapement of the ten years PRIOR to 2004 (1993-2003) so as once again to have something to compare to in order to ascertain how close numbers have come toward recovery to earlier levels]	
Page 60, insert after line 699			PCFFA	In late 2013, the Environmental Protection and Information Center filed a federal lawsuit (Environmental Protection and Information Center vs. Lehr, et al.) in US District Court of the northern District (SF Division) (Case No. 3:13-CV-02293-MMC) against State and federal agencies which manage the Trinity River Hatchery (TRH), claiming that hatchery practices that release predatory hatchery fish into the river compete against and amount to a "take" of ESA listed wild coho in that same river system. The Hoopa Valley and Yurok Tribes have also intervened, and settlement negotiations are now close to resolving the issues of this case. In fact, that settlement may well be in place by now, and the outcome of that case will likely change TRH practices in a number of ways, with the intent to minimize impacts of hatchery releases on wild coho.	Beyond scope of report
Page 112 – numbered item 42:			PCFFA	PCFFA's name is incorrect, and should be Pacific Coast Federation of Fishermen's Associations (PCFFA), i.e., "Associations" should be plural. This list should also include PCFFA's sister organization	Changes made

				"Institute for Fisheries Resources (IFR)" which is also quite active on this issue	
executive summary		5	JS	line 137: the poor ocean conditions leading to poor marine survival should be indicated as occurring in 2005 and 2006. These resulted in the poor adult returns in 2006-07 and 2007-08. The effect was more severe to the south, so the near depletion of returns in 2007-2010 carried over to more recent years, because of little spawning in 2007-2010. . In addition, six of the last eight years have been drought years (2007-2009 and 2012-2014), further hampering general coho recovery and recovery from the poor ocean conditions of 2005 and 2006, by affecting coho up and downstream migration access and stream flows in rearing and spawning streams.	Changes made
Chapter 1	1.3 status reviews	13	JS	line 408: the poor returns in 2006-2010 were probably the result of poor ocean productivity and coho survival in 2005 and 2006 (Lindley et al. 2009). Poor returns in 2007 and 2008 severely reduced many coho populations, and therefore reduced potential numbers in subsequent years (see above).	Changes made

Chapter 2	2.2 life history	17	JS	lines 570-573: Bell and Duffy (2007) found yearling freshwater coho common in Prairie Creek, but elsewhere in the dominance of one freshwater rearing year appears to be typical, as witness the year class gaps and generally strong 3 year abundance cycles. Smith (2013; attached) is referenced only for the 2009 annual report, but Manfred Kittel and Joe Pisciotto have the other annual reports through 2013. I have found some holdover coho yearlings in Redwood Creek (Marin Co.) and in Waddell and Scott creeks (Santa Cruz County). The holdover percentage appears to range between 2% (in 2003) and 17% (2013), and can be a significant contribution to very weak year classes following strong year classes. In some cases yearlings represented all of the juvenile coho, obscuring the lack of successful coho spawning in a year.	Changes made
Chapter 3 status and trends	3.3 summary of status	25	JS	line 17: In some streams, including southern streams (Redwood Creek in Marin County, and Scott, Waddell, and Gazos creeks, south of San Francisco,) the severe impact of the 2005 and 2006 ocean conditions on adult returns essentially extirpated wild runs, so no natural rebound was possible when ocean conditions improved.	Changes made
Chapter 3 status and trends	3.3 summary of status	25	JS	line 23 and 24: There has been essentially no wild production south of San Francisco Bay, including Scott, Gazos, and Waddell creeks since 2007 (Smith 2013, juvenile sampling results).	Changes made

Chapter 3 status and trends	3.3 current status	26	JS	Line 47-50 #1: Due to the dominant 3 year life cycle of most female coho, there are year class gaps or weak year classes that will only slowly recover without intervention, such as brief captive rearing or broodstock transfers.	Changes made
Chapter 4 factors	4.5 Hatcheries	31	JS	Line 252-257: At Scott Creek the last wild runs of coho were in 2005 and 2006, with no apparent successful wild returns in 2007 through 2011. The captive broodstock program at the hatchery had limited brood stock or egg production until the captive broodstock program ramped up in 2011-12 through 2013-2014 (this included an addition rearing tank, change in food regime, rearing of some captive broodstock at Warm Springs Hatchery, and improved equipment for egg incubation). The hatchery operation with captive brood stock to produce fry, smolts, and some releases of adults to spawn in the wild in Scott (and San Vicente Creek) is preventing extirpation of the stocks south of San Francisco. Those last three years of expanded operations have produced 30,000+ smolts for release in spring of both 2013 and 2014 and about 30,000 eggs in 2013-2014, despite fungus problems associated with drought conditions. Some wild rearing in San Vicente and Scott creeks was produced from release of surplus adults to spawn in the wild in 2012, and substantial wild juveniles were produced in 2013 in Scott Creek by the release of captive broodstock to spawn in the wild (Smith 2013).	Changes made

Chapter 4 factors	4.7 ocean conditions	32	JS	Lines 299-301: The down-turn in ocean productivity should be indicated as occurring in 2005 and 2006 (Lindley et al. 2009). The effects were also severe on Central Valley Fall Chinook (which support the ocean fishery), resulting in the Lindley et al. 2009 analysis. Since the Chinook are heavily support by hatchery rearing, they rebounded much more quickly from the down-turn in ocean conditions in 2005 and 2006.	Changes made
Chapter 6 general comment			JS	The escapement numbers for adult coho may have some problems in interpretation, especially where the runs are small and there is substantial variation among year class abundance, by combining males and females. Precocial males from strong year classes can make an annual run appear large even though females may be relatively scarce (i.e. Table 6.6 Trinity River for 2011, when almost 2/3 of the run consisted of grilse (mostly males), and likely that half of the "adults" were males, so females made up perhaps 1/5 of the run.	Comment noted
Chapter 6 monitoring	6.1.6 Trinity River	60	JS	Table 6.7. The abundant male grilse in the table, especially in 2011, reinforces the comments in 26 above. Also of importance for coho recovery is the presence of some female grilse from the hatchery. Shapovalov and Taft 1954 found no apparent 1 year ocean wild females. However, accelerated growth in the hatchery environment can produce some precocial (grilse or “jills”) female returns. This can help to fill in missing or weak year classes in small runs (and break the	Comment noted

				dominant 3 year life cycle for females and juvenile production). At Scott Creek (Santa Cruz County) precocial returns did help strengthen or restore lost or weak year classes in a number of years prior to the collapse due to ocean conditions (see Smith 2013, introduction).	
Chapter 6 monitoring	6.2.1 introductio n	77	JS	Lines 68-70. The drastic declines began in 2007 (2004 year class smolts hit the ocean in 2005 with reduced production). The declines were generally more pronounced to the south (for example Redwood Creek in Marin County and Scott Creek in Santa Cruz County; Scott Creek had a strong juvenile year class in 2005, but no apparent juveniles in 2008).	Changes made
Chapter 6 monitoring	6.2 introductio n	77	JS	Line 1179: Scott River should be Scott Creek.	Changes made
Chapter 6 monitoring	6.2.3 Russian River	84	JS	lines 71-71. The small number of fish reared of Scott Creek origin are for the captive broodstock program for Scott Creek.	Changes made
Chapter 6 monitoring	5.2.4 should be 6.2.4	**91**	JS		Changes made
Chapter 6 montioring	6.2.4	94	JS	line 10. The decline in adult returns in Lagunitas, compared to 3 years previous, started in 2007-2008 (which was less than 1/3 as abundant as 3 years previously). The low was in 2008-09. Both year classes were affected by the 2005 and 2006 decline in ocean production.	Changes made

Chapter 6 monitoring	6.2.5 San Mateo unit	95	JS	lines 59-60. The coho salmon released in 2003 returned to Pescadero in 2005 and also strayed to adjacent San Gregorio Creek in 2005 and spawned successfully. Smolts were captured in San Gregorio Creek during sampling by Krissy Atkinson DFW.	Changes made
Chapter 6 monitoring	6.2.6 Big Basin unit	95-96	JS	Lines 93-94, page 96. The severe decline in 2007 and 2008 reflects severe impact of poor ocean conditions in 2005 and 2006. The 2009 low reflects a weak year class in 2006 (and previously in 2003, 2000, 1997).	Changes made
Chapter 6 monitoring	6.2.6 Big Basin unit	96	JS	See comments number 20 and 24 above: line 109. The most recent annual report (2013 by Smith) includes all years from 1988, 1992-present. The juvenile data show no coho captured in Scott from 2007-2011, none in Waddell since 2008, and none in Gazos Creek (San Mateo County) since 2005. Wild reared coho juvenile from the release of captive brood stock adult spawning in the wild produced a weak juvenile year class in Scott Creek in 2012 (partially due to storm destruction of redds) and a relatively strong juvenile year class in 2013.	Changes made

Chapter 6 monitoring	6.2.6 Big Basin unit	97	JS	Line 122-124. See comment 24 above. The last wild brood stock year for the hatchery was 2006. A small captive brood stock program accounts for the low numbers of smolts produced from 2007-2011. The broodstock program ramped (this included an addition rearing tank, change in food regime, rearing of some captive broodstock at Warm Springs Hatchery, and improved equipment for egg incubation) during that period so that in 2012 and 2013 it was sufficient to produce 30,000 smolts in each year, and also release some fry (to San Vicente Creek in 2012) and surplus adults to spawn in Scott Creek in 2012 and 2013. Fungus problems associated with drought have reduced egg production in 2014 from about 45,000 to 30,000. Therefore an update would change the statement that the program has limited success on far. The captive brood stock program took six years to gradually ramp up with facilities and techniques, but has made substantial contributions in the last three years.	Changes made
Chapter 8 summary	8.1 summary	99	JS	line 209: The down-turn in ocean productivity was in 2005 and 2006, which affected adult returns in 2007-2009. Severely low returns in those years, especially to the south, , severely reduced some populations, which has affected abundance in subsequent years. In addition, six of the last eight years have been drought years, affecting general recovery and recovery from the poor ocean years.	Changes made

1.3	Line 392	12	Adriane Garayalde	Was this a NOAA coho recovery plan or essential fish habitat?	As referenced
1.5	Table 1.1	14	AG	Shasta Valley RCD not listed as CRT Team member	Changes made
1.5	Line 455-461	14	AG	Not sure how to make the suggestion that the SSRT be revitalized, as a way of improving the working relationships in Siskiyou County.	Comment noted
1.5	Line 463	14	AG	Is there a link to the presentations? "Coho on the Brink"	Not available
1.6	Line 483	15	AG	Not sure that restoration and enhancement projects are largely due to FRGP. We have received much more funding $ from other entities.	Comment noted
2.2	Line 565-573	17	AG	Talk with Yreka fisheries (Chesney/Adams) re: Shasta fish that are out-migrating as 0+. They are growing so fast due to conditions in the Shasta that produce a lot of food.	Comment noted. The 0+ migrants are responding to elevated temperatures and low flows.
3.2	Shasta River graph	24	AG	These graphs need review, as numbers may be based on partial counts due to weather or other factors. Especially for the Shasta. That is not reflected here.	Changes made - graphs revised, data updated
3.3	Line 33-34	25	AG	Coho salmon in the Shasta River has been increasing in numbers since 2009. Also, 2009 was an incomplete count…9 fish were actually counted, weir washed out. Production occurred based on returns in 2012.	Overall, trends in the Shasta River are downward since 2004. Increases since 2009 are likely due to a change of management

					practices at Iron Gate hatchery.
4.2	Line 127-128	28	AG	Verify unscreened diversions in the Shasta per the database	Addressed
4.2	Line 135-136	28	AG	Since the Shasta River is adjudicated and most of the Scott River is, I am not sure that this wording is the best way to characterized the conditions here and makes it sound like there are illegal diversions all over the place that need regulation.	Re-adjudication should be initiated.
4.3	Line 167-168	29	AG	Did SSRT id the need for flow studies on the Scott/Shasta?	Not available
Shasta	Line 202-204	29	AG	Verify data for the Shasta. CalFish data is incorrect for the Shasta River.	Data verified. CalFish data not included
4.5	Hatcheries	30	AG	A mention of other means of supplementation should be made. We need to think outside the box and utilize other methods to save on monetary resources. And potentially have more success.	Comment noted
4.7	Ocean Conditions	32	AG	There is a need for ocean condition forecasting with modifications to Klamath fishing to allow more spawners. Also, modification of hatchery releases, based on natural production. Cite more recent data.	Comment noted
	Figure 5.2	37	AG	Shasta River data does not look correct.	Data verified
	Table 5.2	39	AG	Review…no rotary trap.	Changes made
5.29		42	AG	List all RCDs/website links active in fishery	Changes made

				improvement.	
5.26		41	AG	No mention of any watershed groups in the Shasta/Scott. SVRCD website has lots of information on projects.	Changes made
	SONCC ESU Recovery Units	44	AG	Should say Shasta **River**	The Shasta Valley Recovery Unit is listed in the Strategy
6.1.7		51	AG	Habitat Restoration data is incorrect. Why only use 04-09? Update.	Changes made
	Line 454-456	52	AG	I would change to 9+, as all counted were male, yet when the weir was out females must have come in, as there was production that year.	Changes made
	Line 458	52	AG	Delete: If conditions do not improve.	No changes made
	Figure 6.3	52	AG	Need to add 2013 and note that 2009 was incomplete data.	Report timeframe is 2004-2012
	Figure 6.4	53	AG	Update with current data.	Report timeframe is 2004-2012
	Table 6.4	53	AG	Data does not match above figure.	Changes made
Chapter 7	PACT program	98	AG	Update. Past development stage.	Comment noted
	Line 216	99	AG	Re-word: Increased inter-agency collaboration **with landowners** to implement recovery...	Comment noted
8.2		100	AG	None of this will happen without support $ for Watershed coordinators. Dedicated funding needs to be provided to groups undertaking these recommendations.	Comment noted
8.2		100	AG	Streamline permitting	Beyond scope of report

8.2		100	AG	Permit fee reduction	Beyond scope of report
8.2		100	AG	Regulatory certainty for landowners.	Beyond scope of report
8.2		100	AG	All agencies to have common criteria.	Comment noted
Chapter 9	Line 259	101	AG	Delete: achieve Change: reversal to reverse Delete: of	Changes made
	Line 264	101	AG	Add: Development of one common set of criteria/standards to be met that will satisfy all agencies	Comment noted
General	Executive Summary	3	TU- Mary Ann King	The Executive Summary states that the main types of recovery actions include restoration of habitat conditions, continued operation of captive rearing program, and "improvements in permitting and regulatory enforcement," yet the progress report does not cover the permitting or regulatory work in any systematic way (and certainly with less detail than either habitat or captive rearing work). This seems worth mentioning in terms of both progress and future actions.	Comment noted
Chapter 1	1.4	13	Mary Ann King	Addition to Mattole recovery plan list: Sanctuary Forest Inc., Trout Unlimited, and the Center for Ecosystem Management and Restoration prepared a Streamflow Improvement Plan for the Mattole River Headwaters.	Comment noted

Chapter 4	4.2	28	Mary Ann King	Line 138: This paragraph appears to lump proactive actions to improve streamflow (e.g., diversion to storage tanks for summer use) with threats to coho (e.g., water diversion for marijuana cultivation). We recommend parsing these out and providing additional detail on how DFW is addressing some of the threats and also working toward proactive solutions (e.g., DFW's recent work with the SWRCB to streamline small domestic use registrations during the drought). http://cdfgnews.wordpress.com/2014/03/13/state-streamlines-domestic-water-tank-storage-process-in-response-to-drought/	Comment noted - section refers to water flow regulation
Chapter 4	4.3	29	Mary Ann King	DFW, through FRGP, also funded part of an instream flow-habitat study in San Gregorio Creek through American Rivers.	Comment noted
Chapter 4	4.7	32	Mary Ann King	Typos in lines 308 and 314 where the word "percent" appears.	Changes made
Chapter 5	5.2.2	35	Mary Ann King	The link at line 404 is not working anymore. Please substitute this one instead: http://www.tucalifornia.org/index.php?page=north-coast-coho-recovery	Changes made
Chapter 5, 6	5.2.2, 5.2.8, 6.1.13, 6.2.2		Lisa Bolton - TU	Comments on these sections have been included as track changes and attached to this document (Main Document Selections)	Changes made
Chapter 5	Table 5.2	39	Mary Ann King	It is striking how few projects have been funded that pertain to Water.	Comment noted
Chapter 6	6.2.3	86	Mary Ann King	Line 13: Please add that the infrastructure improvements are to benefit instream flow; Line 23: the project has been completed; Line 26: Please add the following partners - SCWA, DFW, RWQCB, UC Cooperative	Changes made

				Extension.	
Chapter 6	6.2.5	94	Mary Ann King	TU has some additions and revisions to the content for the San Mateo Recovery Unit. I will include these as a Word document attachment with these comments (Main Document Selections).	Changes made
General	4.3, Chapter 7, 8.1 and throughout	-	Mary Ann King	Streamflow monitoring is noticeably absent from the document in at least two regards: (a) what resources are available and what monitoring is being conducted in watersheds and (b) as a recommendation for action in tandem with fisheries and habitat monitoring efforts. Streamflow monitoring is the foundation for recommendation (3) under Section 8.3 and also should be critically important to many of the other recommendations as well.	Comment noted
Chapter 8	8.2	100	Mary Ann King	The sense of urgency and specific, tangible section seem to be missing from this list. Why not consider breaking this down into short, medium and long-term actionable recommendations? The near-term actions ought to include specific steps for targeting high priority areas and turning DFW recovery strategy and NOAA's recovery plan into tangible and implementable items, providing technical support and streamlined processes for landowners to ramp up habitat and instream flow restoration projects, etc. If anything, it seems like this section ought to provide a plan for addressing the urgent need commensurate with the dire status of coho.	Comment noted

Appendix E		113	Mary Ann King	This list is not complete, but DFW could consider adding at least the following organizations (in no particular order): Sea Grant, California Coastal Conservancy, National Fish and Wildlife Foundation, Gold Ridge Resource Conservation District, Sonoma Resource Conservation District, Marin RCD, San Mateo RCD, American Rivers, Stewards of the Coast and Redwoods, SWRCB, Occidental Arts and Ecology Center, Center for Ecosystem Management and Restoration. In addition, FishNet4C is included twice: #15 and #65.	Changes made
Appendix I		219	Mary Ann King & Lisa Bolton	TU is providing an updated copy of its materials as a Word document attachment to these comments.	Changes made
General			CalTrout - Darren Mierau	Does the Department have more detailed plans to change the listing status of coho salmon in California?	Currently, no plans
General			CalTrout	In addition regarding the Shasta River, the Department initiated a multi-phased Instream Flow Assessment program, beginning with an FRGP grant to CalTrout in 2006. During the ensuing 8 years, two critically important instream flow assessment reports have been completed, providing interim flow recommendations for the Shasta River Big Springs Complex, and more detailed, long-term recommendations in a second report for the Shasta Canyon. However, beginning in 2010, the Department initiated a wholly separate Instream flow program (with Normandeau Associates), but has not articulated why	Comment noted - Related to comments on flow needs for fish and wildlife in the Shasta River – updates of current efforts to develop study plans for instream flow studies in those watersheds are available at:

				there is need for two separate processes, nor how the results of each program will be utilized by the Department to secure adequate instream flows for Shasta River Coho salmon. A well-developed strategy for resolving long-standing instream flow issues in the Shasta River, provided by your Department, is critically needed. More clarity is needed on how these various flow studies will be interpreted and used to establish policy in the Shasta River.	http://www.normandeau.com/scottshasta/
	Page 28, Section 4.3		CalTrout	Your report (Page 28, Section 4.3) describes the Water Branch's Instream Flow Program, initiated in 2008, and which is purportedly pursuing instream flow studies on a set of 22 priority streams, some of which are within coho salmon range. We are all keenly aware of the need for sustained instream flows to promote coho salmon recovery. However, since this program's inception six years ago, the Department has not transmitted any instream flow study results or flow recommendations to the State Water Resources Control Board. The program has, however, created a set of "protocols" for conducting studies. These protocols are often inadequately peer reviewed and are frequently in direct conflict with methods being pioneered in the Regions to deal with the ongoing water crisis. A review of this Program's focus and execution is critically needed.	Comment noted

			CalTrout	The CDFW Coho Report describes the Fisheries Restoration Grants Program, or FRGP. CalTrout continues to strongly support the goals of this program in restoring critical habitat for coho salmon and other anadromous species. We also applaud efforts by the Department to secure a consistent funding base for this program, as well as your efforts to develop the Coastal Monitoring Program to provide an overall strategy, design, and methods for monitoring salmonid populations. Both these efforts are commendable, and should continue to be implemented. However, much more strategic planning is needed in order to implement successful recovery efforts. For example:	Comments noted
			CalTrout	Funding for research is critically needed but is largely unavailable to restoration practitioners; this situation must be remedied for recovery efforts to continue to tackle increasingly complex issues;	Comment noted
			CalTrout	The Department should work with restoration practitioners and partners to develop a plan for the strategic expenditure of the next $100 million in FRGP funds;	Comment noted
			CalTrout	The FRGP program should not be the permanent source of funding for the Department's monitoring programs. We understand the Department's budget constraints, but we nevertheless recommend a separate and permanent source of funding for salmonid population monitoring be established;	Comment noted

			CalTrout	The past decades of implementing the "low hanging fruit" of habitat restoration is rapidly coming to a close, and the Department will increasingly be confronted with more challenging implementation projects, particularly related to water management and estuarine restoration. It would behoove the Department to begin developing strategies to tackle these critical issues;	Comment noted
	Table ES1, page 4	4	CalTrout	It is important to document past and ongoing funding expenditures and restoration project implementation (for example as reported in Table ES1, Page 4), but the Department should place these metrics into context of what proportion of the total restoration need has been accomplished, so that we can track progress. For example, 118 passage barriers have been removed, but how many remain? This context is extremely useful in justifying continued funding support.	Comment noted
			CalTrout	The FRGP Programmatic Permitting Program has become quite successful, helping facilitate and streamline environmental compliance for FRGP-funded projects. This permit program could be significantly expanded to include non-FRGP projects, as well as to include estuarine and tidal marsh restoration projects in the Coastal zone, which currently are hugely expensive to permit. Perhaps the Department could consider adding a Coastal Commission member to the CRT.	Comment noted

			CalTrout	Finally, we wish to emphasize that while we understand the current economic strain in state and federal government budgets, much more financial resources are needed to ensure the recovery of coho salmon. Conservation organizations such as CalTrout, and the entire salmonid restoration community have the capacity to expand to meet this level of funding allocation, and the knowledge needed to implement meaningful recovery actions. With the Recovery Strategy's continued implementation, more detailed population status and effectiveness monitoring is needed throughout the coho region and coastal watersheds.	Comment noted
		11, line 312	Sierra Club - Richard Gienger	I think the history of the state Coho listings needs to be more complete, including events, circumstances, people and organizations that petitioned for the listings, followed and aided the processes, and represented the many stakeholders in the formation and content of the Coho Recovery Strategy. One important example is the inclusion of the "achieve harvestable populations of coho salmon" as an objective. Another is the content of the Timber Management section of the Range-Wide Recommendations	Comment noted - this information is detailed in the Recovery Strategy
		14	Sierra Club	The paragraph above is pertinent to the discussions starting at line 443 of page 14	Comment noted
		14	Sierra Club	I think it was the Joint Committee on Fisheries and Aquaculture Committee hearing, not the California Legislature Commission on Fisheries and Aquaculture	Changes made

		21/22	Sierra Club	On page 21 & 22 it would be good to give a more complete set of streams/rivers being monitored for Coho populations (Usal Creek isn't included, for instance, but many are referenced later in the Report & Addenda).	The streams listed are sites at which CDFW has some involvement in monitoring programs
		28	Sierra Club	Off channel water storage is actually a positive action to stop water diversion in crucial summer and fall low stream flows.	Changes made
		40-42	Sierra Club	Some additions/corrections: (some entities are listed elsewhere) Sanctuary Forest, Eel River Recovery Project, Eel River Forum, Eel River Salmon Restoration Project, North Coast RWQCB, Coastal Conservancy, Hoopa Tribe (rather than "Hoopa Valley Tribe", Redwood Forest Foundation Inc./Usal Redwood Forest, Campbell Timberland Management is now Campbell Global (much of Campbell's Coho work is done on Campbell-Hawthorne lands e.g: Wages and Pudding Creeks)	Changes made
		87	Sierra Club	page 87, between lines 6 & 7 (description of goals Russian River Coho Water Resources Partnership), I would draw attention to "developing a watershed recovery model applicable to other watersheds throughout the state." – which fits right in with the Summary on page 99, line 218-220; Recommendations on page 100, line 25-26; and the Conclusions on page 101, line 261-263	Comment noted

			Sierra Club	The emphasis on a watershed recovery model is very basic and important. Recovery actions should generally be directed based on the evaluation and priorities in the watershed, and the basic/foundational 'building-block' watershed is the Cal Water Planning Watershed. The Report should include some serious emphasis on the relationship between forestland Timber Harvest Plan requirements to evaluate and respond to cumulative impacts on a Planning Watershed scale, and the recommendation in the Recovery Strategy that the Department of [now] F&W carry out Recovery Plans, determine Limiting Factors , and organize data/information on a Planning Watershed basis. NMFS has stated that 80% of the land essential for Coho protection and recovery are in the forestlands of the Central California Coho ESU. The information that will facilitate adequate actions is sequestered in the hundreds (or more) of logging plans that have invaluable information digitalized, but remain to be brought to bear on the recovery actions that need to take place.	Comment noted
		100	Sierra Club	In the Recommendations (page 100, line 235-238) about “high priority areas” – I would use as an example the Ten Mile River north of Fort Bragg. It has it all – few landowners & related complications, beaucoup low-gradient coho habitat, and a REAL estuary. Of course it also has an array of significant legacy problems, but problems that are not insurmountable if	Comment noted

				good watershed models for recovery are applied	
		99	Sierra Club	Lastly, I would emphasize the need for expanded community engagement and development of employment in the arts and sciences of recovery. Please add this to page 99, line 216, in the Summary, to page 100, line 228-229 in the Recommendations, and to page 101, line 263-264 in the Conclusions.	Changes made
			Sierra Club	I am attaching some of the important Timber Management Recommendations to implement, a recent letter to the Assembly Budget Committee, and a text flow-chart regarding pilot projects (that would lead to integration of recovery measures in the forest practice process – of a much more beneficial and long-lasting impact then the current Section (v) of 14 CCR 916.9). Thank you for your consideration, and I hope for some additions to the Progress Report	Comment noted

COMMISSION COHO RECOVERY UPDATE REPORT REVIEW COMMENTS

Commenting Agency	**Fisheries and Oceans Canada**

Name	Dr. J.R. Irvine
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Comment Type (General,Chapter Title, Appendix Title, or Attachment Title)	Section Name	Page #	Reviewer	Comment	CDFW Response
General			Jim Irvine	An impressive report documenting a huge range of recovery activities. I am not familiar with the watersheds investigated and will not comment on site specific activities. My review will focus on "bigger picture" issues and suggestions for improvements, whether through revision of the current document, or future work. I have had a long history assessing the status of coho salmon in British Columbia including the production of a Conservation Assessment (similar	Comment noted

				to your Recovery Strategy) - see document at http://www.dfo-mpo.gc.ca/Library/329140.pdf . Some of my comments will try to present some of the "lessons learned" through our experiences.	
General			Jim Irvine	I was surprised not to see any real data analyses in the Recovery Strategy. Below I try to provide constructive criticism on some of the general types of analyses that I suggest could have been undertaken. Perhaps this type of work is being done elsewhere? Regardless, in my view, the only way to evaluate whether the implementation of specific tasks will return coho to a level of sustained viability or to achieve harvestable populations is through the rigorous implementation of an experimental approach with appropriate data analyses.	Comment noted - experimental studies are currently underway
Executive Summary		3-5	Jim Irvine	I did not see a clear statement of the 2 primary objectives of this review in this summary as stated on pg 12 and suggest these should be given	Changes made

Executive Summary		5	Jim Irvine	In the penultimate paragraph, I question validity of 2nd sentence "The positive effects of habitat restoration, as measured by increased fish distribution and abundance, are usually associated with a time lag of several years, even for robust populations, and probably longer where populations are below depensation levels." If the habitat restoration is expected to benefit juvenile coho salmon, one would expect a benefit in terms of juvenile coho growth/survival to be detectable reasonably quickly. However, an experimental approach would be needed to detect this (more on this later).	Benefits to coho recovery are likely to depend on the form of habitat restoration undertaken (see; Roni et al. 2008).
Introduction		12	Jim Irvine	I question whether the two main goals of the Recovery Strategy are achievable "The primary objective of the Recovery Strategy is to identify tasks that when implemented will return coho salmon to a level of sustained viability, while protecting the genetic integrity of coho salmon in both ESUs. A second objective of the Recovery Strategy is to achieve harvestable populations of coho salmon for Tribal, recreational, and commercial fisheries for the cultural and economic well-being of California." The authors may wish to consider including a section in this report on the feasibility of recovery (see section starting on p. 67 in 2006	Comment noted

				Canadian Conservation Strategy document cited in first comment above.)	
			Jim Irvine	California coho salmon are at the extreme southern extent of the distribution of the species. It is entirely natural for species and populations at the extremes of their distribution to "wink out" periodically, often to be replaced at some future time when environmental conditions permit them to do so (we are talking over periods of perhaps centuries). In general, coho salmon populations that enter the California Current (i.e. coho from California, Oregon, Washington and southern British Columbia) have experienced significant declines in recent decades. There is little reason to be optimistic about the future of California coho salmon.	Comment noted

		20-21	Jim Irvine	The obvious question with populations such as California coho salmon is "what to do". The approach taken has been to focus on watershed restoration. Given the concerns related to increasing urbanization, water abstraction, etc., this seems reasonable. However, I see little evidence in this recovery strategy of any evaluation of the effectiveness of these many and costly restoration projects. The California Monitoring Program and Life Cycle Monitoring Stations as described in Adams et al (2011) (NB note that Boyston is misspelled in on p. 21) will help resolve these questions. The Recovery Strategy document seems to present finding from many separate projects rather than a comprehensive analysis of all the results.	The implementation of effectiveness monitoring of habitat restoration is a high priority issue in California coastal watersheds

		205	Jim Irvine	For example, given the numbers of projects funded and reported upon, I was surprised not to see results from any experiments, although such an approach was referred to on p 205. It is very easy to imagine a series of experiments designed to evaluate short term and longer term effects (on coho salmon survival, growth and production) of watershed restoration. These would include control and experimental reaches within watersheds to compare the benefits in terms of juvenile coho salmon growth and survival of restoration. And, more importantly, experimental and control watersheds where restoration occurs in the experimental watersheds and not in similar, nearby control watersheds and pre-smolt and post smolt survivals are monitored in each. Power analysis could be undertaken to evaluate how many replicate sites/watersheds would be required and the likely duration of the experiments in order to detect an effect. Maybe this type of work has been done, but I saw no evidence of it in the Recovery Strategy.	Several projects are underway in California coastal watersheds to evaluate using a scientific experimental approach the effects of habitat restoration on coho abundance and population dynamics

		33-34	Jim Irvine	In addition to a lack of studies to evaluate the effectiveness of restoration efforts, I expected to see more effort expended to relative importance of mortality in fresh water versus the ocean in controlling populations of coho salmon in California, as well as the effects of climate change and variability. The reviews on pages 33-34 were a start but why not more analysis of data from the various projects?	Comment noted
		24 and elsewhere	Jim Irvine	The document presents numerous escapement time series for individual streams. Is the stream the appropriate unit to report spawner numbers? How much gene flow is there among streams? Has straying been evaluated? In interior streams in British Columbia we find there is relatively little site fidelity and we generally present our time series at the Conservation Unit level (similar to American ESU's).	Comment noted - few such genetic studies of coho populations have so far been undertaken in California
General			Jim Irvine	The authors may benefit from viewing some of the types of analyses performed on Canadian coho salmon that were classified as biologically endangered by the Committee for the Committee on the Status of Wildlife in Canada (COSEWIC) - see recent reports at http://publications.gc.ca/collections/collection_2013/mpo-dfo/Fs70-5-2013-121-eng.pdf and http://www.dfo-mpo.gc.ca/csas-	Comment noted

				sccs/publications/sar-as/2014/2014_032-eng.pdf	
Conclusions and recommendations		104	Jim Irvine	I suggest that these recommendations and conclusions should highlight the need for implementation of a proper experimental design to evaluate effects of restoration on coho salmon, additional analyses of data sets gathered to date, assessment of the relative importance of marine vs. fresh water factors on recruitment variability, and a realistic assessment of the feasibility of recovery.	Comment noted - changes made

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Comment Type (General, Chapter Title, Appendix Title, or Attachment Title)	Section Name	Page #	Reviewer	Comment	CDFW RESPONSE
		5	TW	As you know, depensation levels are a difficult thing to "calculate" and in addition, the use of the term requires lots of explanation - seems easier just to say low numbers.	Changes made
		20	TW	The specific approaches that will be used in the different areas appears to be changing - I suggest deleting this whole paragraph so as not to box in folks as they plan the monitoring efforts	Changes made
		27	TW	in the SONCC, coho are found in a large portion of their historical range (with the exception of those areas upstream of Iron Gate, other dams, etc.), but clearly not the issue as it is in the CCC	Comment noted

		28	TW	We are not as up on these issues as folks at NMFS Regional Office, specifically recovery planners. Best to have some Region staff comment on Chapter 4 NOTE - Carlos Garza reviewed hatchery section given his involvement in hatchery reviews, etc. (section 4.5) AND Nate Mantua is a recognized expert on climate change and ocean conditions. Both of their reviews are in separate files.	Comment noted
		49	TW	My understanding is that these are counts, not estimates, and that how representative of the recovery unit is uncertain. I would just use the word "counts" to be clear that they are not estimates (in the since that they are statistically rigorous and do not have measures of uncertainty/error provided - neither process OR observer error). The are minimum counts - not estimates	Changes made
		55	TW	Note footnote on Appendix B - these are minimums. Perhaps a style thing, but I try to limit the use of the word "estimate " to those situations where we have an estimate with error(s) estimated. It is an easy way to let the reader know the nature of the data that is being considered.	Changes made

		58	TW	My understanding is that this is a count, not an estimate - at least for fish counted a video weir (i.e., there is no "recapture" or efficiency estimates for weir).	Changes made
		70	TW	NOTE: The Freshwater Creek data are not listed in Appendix B - there needs to be an entry for these data on the summary table in the Appendix. Also - Bogus Creek data are listed in Appendix B, I do not see them presented in the body of report (NOTE - no need to add narrative for Bogus in body of report; but if data are not going to be discuss perhaps best to delete from Appendix B)	Data are listed
		76	TW	I am not sure about this - the Van Duzen was likely a very big coho producer prior to the late 1800s and clearly prior to 1964 event. The TRT considered the lower portions of the basins, especially the Van Duzen to have been very productive coho producers prior to land use activities starting in the mid to late 1800 and clearly these areas were hit very hard with the 1964 event that brought down from the hillsides the legacy of the past 100+ years of land use.	Comment noted
		17	CG	Best to reference the dataset from the standardized 2003 collections which is over 1,500 fish. Citation	Changes made`

				would be Southwest Fisheries Science Center (or Gilbert-Horvath et al.) unpublished data.	
		53	CG	I don't think that this is accurate. In fact, starting in 2010, IGH began to release all HO adults in excess of broodstock needs, instead of sacrificing them, due to concerns about demographic and genetic status of naturally spawning fish in the upper Klamath/Shasta River populations.	Changes made
		87	CG	founder effects	Changes made
		87	CG	Should say descendants of fish produced by…	Changes made
		97	CG	Should be Redwood Creek and should indicate that collections have already occurred, with fish being held at WSH.	Outside time-frame of report
		97	CG	t is not my understanding that the Redwood Creek fish would be used for this purpose, although ALL of the Lagunitas fish that are collected to date are for this purpose.	Comment noted
		16	BS	The BRT does not accept or reject the petition. They merely provide a scientific opinion on it merits.	Comment noted

		19	BS	One could make the case that the precipitous declines began in 2006, at least south of San Francisco	Comment noted
		22	BS	This figure is outdated. Adult monitoring throughout the Mendocino Coast area (Usal Creek to Garcia River), as well as south of San Francisco, has been ongoing for at least a couple years.	The time-frame of the report is 2004-2012
		23	BS	Again, this table needs updating. Additionally, I think it would be useful to delineate which of these populations have life-cycle monitoring stations. Otherwise, watersheds for which there is only summer juvenile surveys and adult spawner surveys are not distinguished from those where smolts are being estimated.	Changes made TO DO
		24	BS	A figure showing Scott Creek data should be added, as it is an LCM station.	Changes made TO DO
		24	BS	IS this inclusive of Olema Creek and other Lagunitas tributaries? If so, why is San Geronimo listed separately? And if not, then why is Olema data not presented?	TO DO
		26	BS	Seems odd to be citing a 2009 publication to explain increases in abundance that have occurred since 2011.	Changes made

		26	BS	Implies you know how long the extirpation will last. Did you mean "near-term"?	Changes made
		26	BS	We did find naturally produced coho in 5 different watersheds south of SF in 2008.	Comment noted
		26	BS	Caspar not Casper	Changes made
		28	BS	Again, this is outdated. Adult monitoring has been initiated in the Santa Cruz Mountains as well and more Mendocino area streams than indicated in the figure	The time-frame of the report is 2004-2012
		87	BS	Seems like this could be updated fairly easily.	The time-frame of the report is 2004-2012
		87	BS	given that many of this fish are likely progeny of hatchery fish, it seems like "naturally produced" is the more fitting term	Changes made
		97	BS	Is this still being considered? I thought it was abandoned and Redwood Creek has now been proposed as a site for a captive rearing program	Changes made
		98	BS	This is not accurate. NOAA Fisheries SWFSC conducted juvenile monitoring in the Santa Cruz Mountain diversity stratum (San Gregorio Creek to Aptos Creek) during the summers of 2006, 2007, and 2008 using	Changes made

				spatially balanced design. In each year, approximately 40 stream reaches were surveyed. Coho salmon were found in two watersheds (Scott and San Vicente creeks) in 2006, no watersheds in 2007, and five watersheds in 2008 (San Gregorio, Waddell, Scott, San Vicente, and Soquel). Numbers were low (less than 200 individuals) and genetic evidence taken at three of the 2008 locations indicate the young produced were the result of 1-2 spawning pairs in each case.	
		99	BS	This has more or less been the goal of the monitoring since its inception in 2003.	Comment noted
		100	BS	I am aware of no direct evidence to support the idea that redds were destroyed	Changes made
		101	BS	This information is dated. In 2013 and 2014, 32,007 and 28,676 smolts were released, respectively	The time-frame of the report is 2004-2012