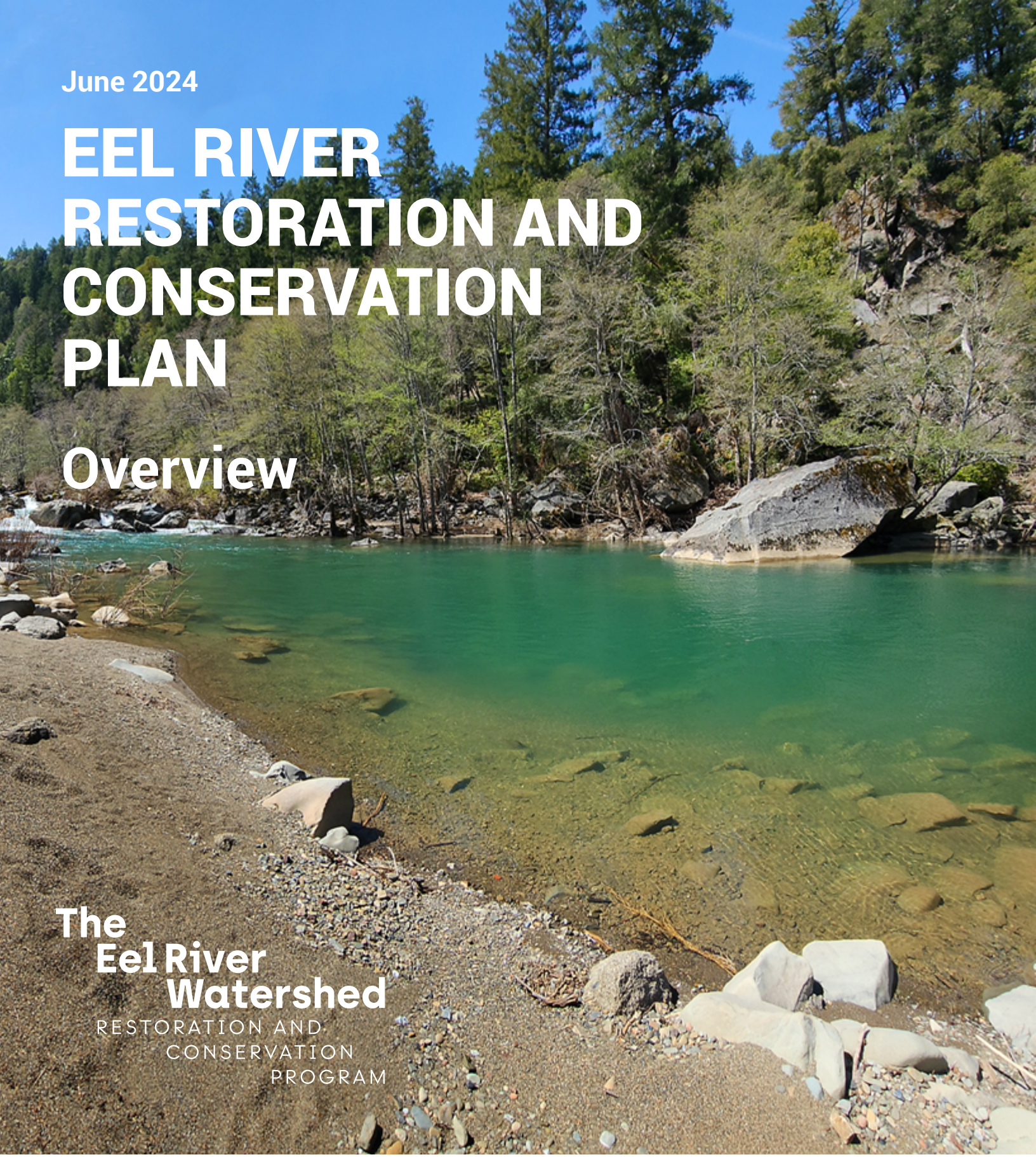
June 2024

# EEL RIVER RESTORATION AND CONSERVATION PLAN

## Overview



The Eel River Watershed
RESTORATION AND CONSERVATION PROGRAM

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Stillwater Sciences

APPLIED RIVER SCIENCES

THE UNIVERSITY OF CALIFORNIA, BERKELEY · 1868

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

# Acknowledgements


## Technical Advisory Committee

Thank you to our Technical Advisory Committee with representatives from NOAA, NMFS, USFS, BLM, UC Berkeley, CDFW, The Wiyot Tribe and for ongoing collaboration from the Eel River Forum participants.

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# The Eel River Watershed

RESTORATION AND CONSERVATION PROGRAM

Cover: The Eel River by Gabe Rossi. This page top: The Upper Eel River by Darren Mierau, This page bottom: The South Fork Eel River by Gabe Rossi.

# The Eel River Watershed:
## Sub watersheds of the Eel River




# The Need For Restoration And Conservation In The Eel River Watershed

Aquatic and riparian habitats in the Eel River watershed have been significantly impaired by past and recent land and water use practices. Fish populations within the Eel River watershed, whose historical salmon and steelhead abundance reached nearly a million adults, have substantially declined in response to habitat degradation, commercial fisheries, and ecological changes in the watershed. The drastic reduction in salmonid abundance has impacted all communities in the Eel River watershed: rural communities, indigenous peoples, sport and commercial fishers, recreational users, and others.

Despite these stressors, there is substantial reason for optimism and opportunity. The decommissioning of the Potter Valley Project will restore anadromous fish access to hundreds of miles of headwater streams in the upper Eel River, federal and state recovery plans and watershed assessments have been developed, and substantial restoration activities have been ongoing. This Eel River Restoration and Conservation Plan will build on these opportunities to guide substantial, collaborative, and long-term restoration and conservation actions to revitalize the Eel River and restore its fisheries. The Plan proposes a holistic approach to restoring and conserving the Eel River watershed, with a particular focus on the river corridor and its surrounding habitats.

Eel River by Michael Wier


- Historical over-fishing, harvest, road construction, cannabis
- Historical flooding (1955, 1964), coarse and fine sediment changes, fine sediment loading
- Dams and diversions, passage barriers, flow alteration
- Introduction of invasive predatory fish
- Channel simplification, levee construction in estuary and lower river
- Climate change, drought and warming, water temperature warming

## Program Strategy

The Plan does not propose returning the Eel River watershed to historic unimpaired conditions; rather, the plan defines a pathway for the rehabilitation of the Eel River corridor to increase productivity, abundance, diversity, and resilience of fisheries for the benefit of future generations. The Plan also adopts a strategy of preserving fish strongholds (conservation) to avoid the need for future restoration in these higher quality, highly productive areas. This Plan is the first of three phases to implement an Eel River Restoration and Conservation Program:

Phase 1, the planning phase of the Program is the topic of this overview document. In Phase 1 the Plan begins with overviews of the watershed and the Program Goals and Vision (Section 1), the spatial organization proposed by the Plan (Section 2), and the focal fish species driving restoration and conservations actions of the Plan (Section 3). The Plan then transitions to a summary of restoration and conservation actions (Section 4) and proposes a prioritization framework for those actions (Section 5). Next, the Plan proposes a management framework for a new Eel River Restoration and Conservation Program (Program) to be developed in Phase 2 (Section 6) and develops a monitoring and assessment framework for the new Program, both of which build from existing restoration planning efforts. The Plan concludes with a summary of recommendations and next steps as the Program transitions to Phase 2 (Section 8).

### PHASE 1
**Planning**

- Develop program vision, goals, and objectives
- Compile spatial data
- Identify spatial data organization
- Select focal species
- Develop species conceptual models
- Characterize life history diversity
- Describe restoration and conservation objectives and actions
- Develop prioritization framework
- Develop monitoring and assessment framework
- Construct Program administrative and management framework
- Integrate community and Technical Advisory Committee feedback

**EEL RIVER RESTORATION AND CONSERVATION PLAN**

### PHASE 2
**Program Formation & Prioritization**

- Form restoration Program entity and bylaws
- Identify program leadership and staff
- Finalize and execute prioritization process
- Develop prioritized restoration and conservation objectives and actions
- Continue and expand existing salmonid baseline monitoring
- Integrate community and Technical Advisory Committee feedback

**PROGRAM FORMATION AND EEL RIVER PRIORITY ACTION PLAN**

### PHASE 3
**Implementation, Monitoring & Assessment**

- Program governance, funding and resource allocation
- Program level monitoring:
  - Fish populations (escapement, production)
  - Life History diversity and survival
- Project level monitoring:
  - Habitat quality and quantity
  - Biological response to restoration
- Program assessment and refinement
- Integrate community and Technical Advisory Committee feedback

**IMPLEMENTATION & REFINEMENT OF RESTORATION PROCESS AND ACTIONS**

Reevaluate goals and objectives
Refine species conceptual models
Reassess key limiting factors

Refine designs and reassess priorities



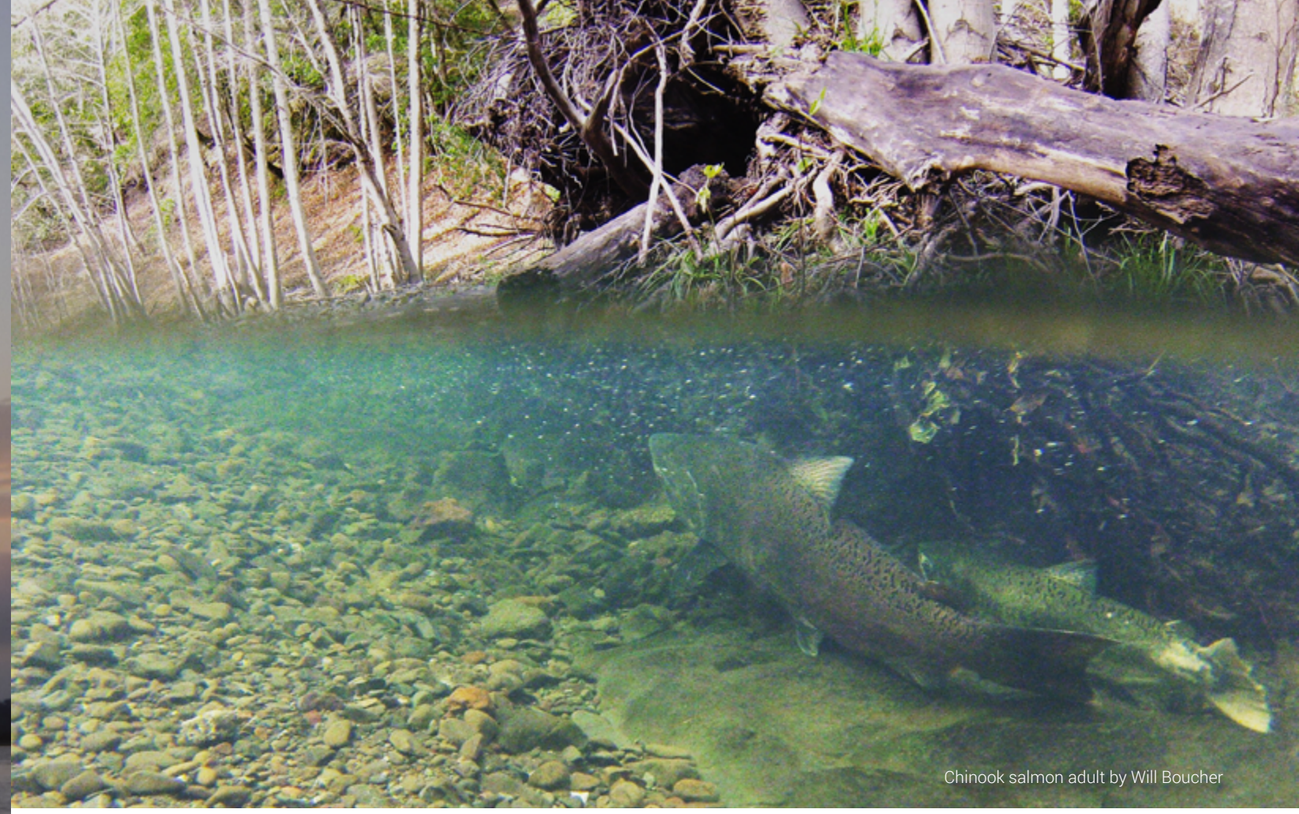
# Section 1:
## Vision and Goals

*A restored Eel River watershed that is composed of diverse and resilient habitats from headwaters to sea, self-sustaining and harvestable native fish, and healthy local communities.*

Eel High Rock by Michael Wier

*We are going to make the Eel River awesome again!*

Lower Eel River by Conrad Calimpong



Chinook salmon adult by Will Boucher

## Restore
Restore variable ecological and geomorphic processes that support diverse life-history strategies of native fish to increase population size and resilience.

## Protect
Protect and conserve landscape connections between important riparian and upland habitats.

## Incorporate Ecological and Geomorphic Process
Embrace the variability in dynamic ecological and geomorphic processes at the sub-watershed scale and integrate across the sub-watersheds to create an interconnected mosaic of habitats that support the various lifehistory stages and strategies of focal species.

## Support Socio-Economic Values
Support local community and Tribal resource needs, economics, and recreational values of the watershed.

## Recommend Meaningful Actions
Recommend restoration and conservation actions that are implementable on a timescale, magnitude, and trajectory that will achieve efficient and meaningful improvements.

## Prioritize
Implement a restoration and conservation action prioritization process that integrates watershed attributes with the needs of native fish and the habitats they rely on.

## Monitor and Assess
Include a robust monitoring, assessment, and active management process that allows evaluation of measurable goals and restoration targets, and refinement of the Program.

## Collaborate with Local Entities
Coordinate with Tribes, agencies, and local communities to build support for restoration goals and strategies.

## Integrate Best Available Information
Incorporate the best available information in the Eel River watershed by synthesizing existing data, input from experts, and species management plans within the watershed.

## Build in Lessons Learned
Incorporate lessons learned from ongoing and past restoration/recovery efforts in the Eel River watershed, and from other similar basin-wide programs.

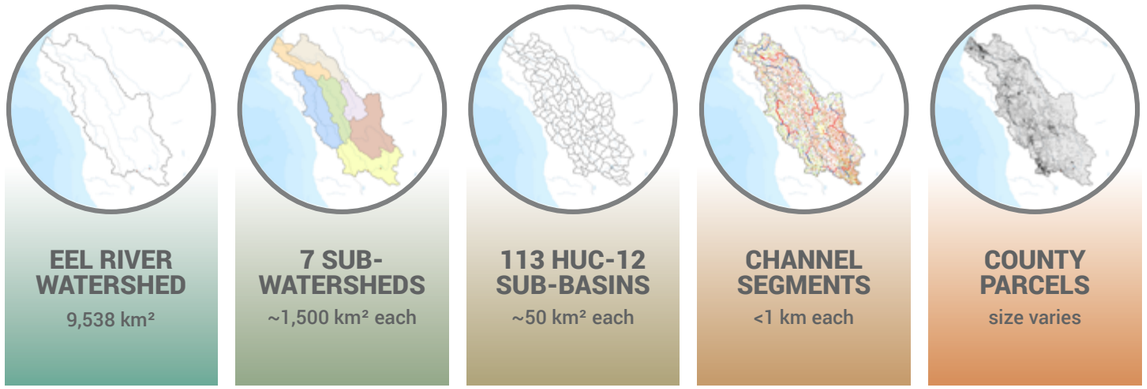
## Include Traditional Ecological Knowledge
Incorporate Traditional Ecological Knowledge from the Tribes within the Eel River watershed to understand historical ecology, develop restoration and conservation strategies, and inform the prioritization process.

# Section 2:
## Spatial Organization

The large size and physical and biological diversity of the Eel River watershed (over 3,600 mi², or over 9,300 km²), requires restoration planning to partition it into units that match the scale of the process or action of interest. Therefore the Plan proposes a hierarchy of planning scales that enables organization and assessment of potential restoration and conservation actions at smaller spatial scales, and then enables the potential actions to be reconnected and assessed across the entire watershed.

The levels of spatial organization, generally from large to small, are:

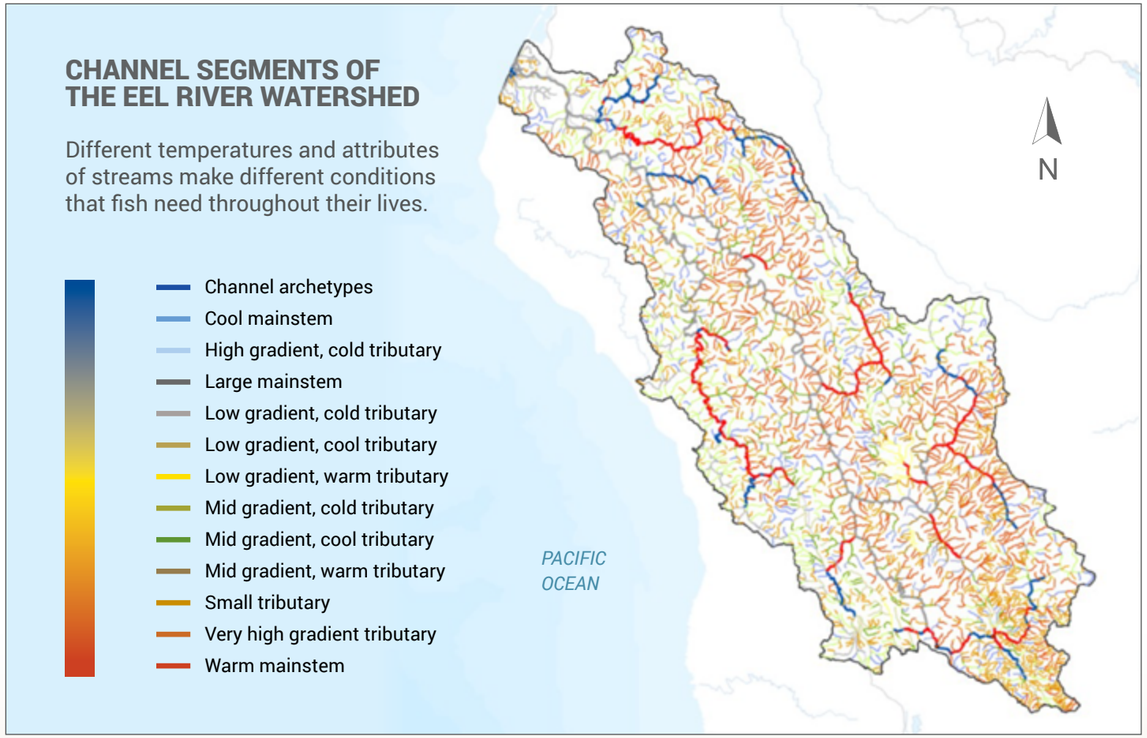
1. The entire Eel River watershed (~3,600 mi²; 9,300 km²);
2. The 7 sub-watersheds, consisting of the Lower Eel River, Van Duzen River, Middle Mainstem Eel River, North Fork Eel River, Middle Fork Eel River, and Upper Mainstem Eel River (~500-1,000 mi²; 1,300-2,600 km²);
3. Smaller sub-basins with USGS hydrologic unit code (HUC) 12, which are approximately 20 mi² (50 km²), and based on the USGS National Hydrography Dataset;
4. River channel segments, 1 mile (1.6 km) in length or less, and;
5. County parcels, which vary in size





Upper South Fork Eel River by Gabe Rossi






## Channel archetypes built from channel segments

***Channel archetypes*** **are functionally unique due to:**

- geomorphic,
- hydrologic, and
- thermal properties
- cold, cool, warm

**Groupings were developed based on:**

- drainage area,
- slope, and
- water temperature regime
- mainstem vs tributary

**Channel archetypes differ in:**

- fish species and life history strategies they can support
- possible restoration and conservation actions

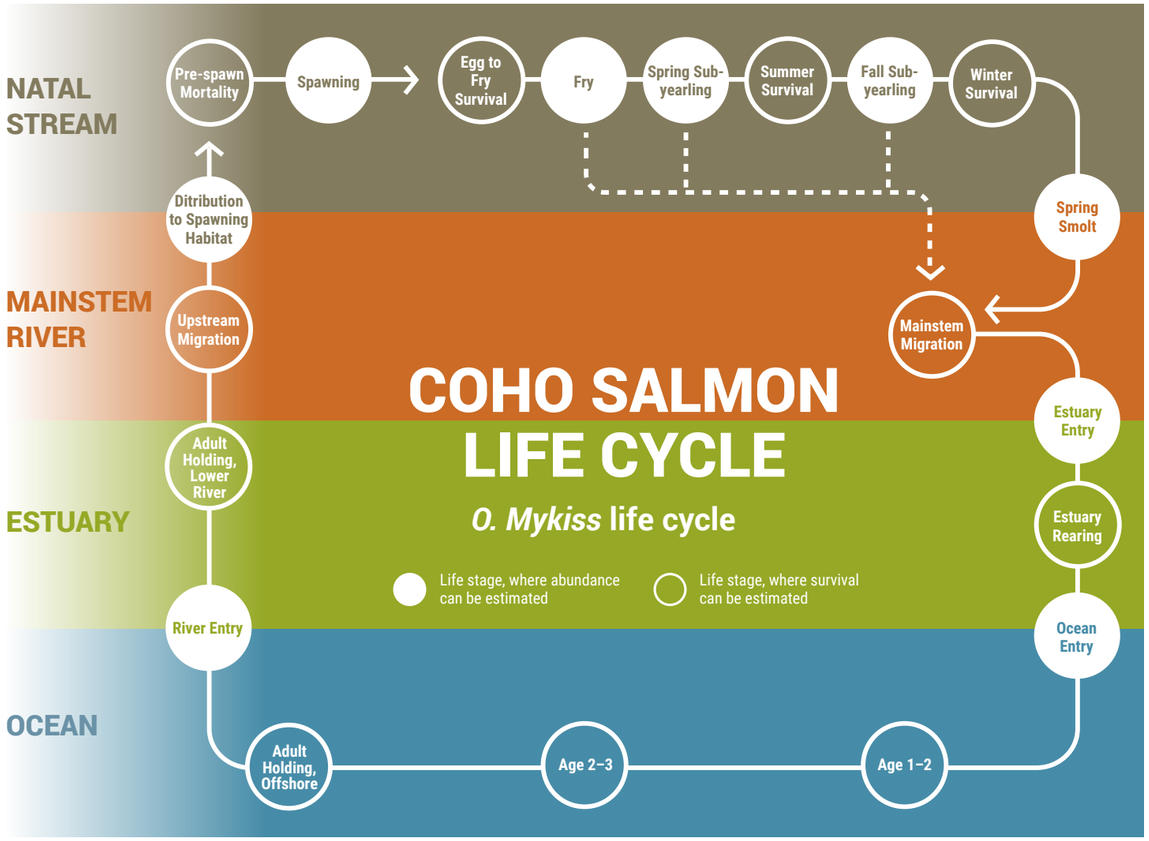
The Plan uses a watershed-wide system of characterization of channel segments, called “channel archetypes”, that represent groupings of distinct habitat types for fish use, and for potential restoration and conservation actions. Channel archetypes are categories of similar river channel segments based on primary physical and environmental attributes that reflect physical processes and disturbance mechanisms that work to maintain channel morphology over time (e.g., channel segments that have steep gradient, versus low gradient meandering channel segments). These archetypes help (1) predict how fish use these channel segments and (2) identify opportunities and constraints for restoration and conservation actions. Channel archetypes are proposed within the prioritization framework to assist in identifying stream reaches that may host a higher diversity of focal fish species life history strategies and provide opportunities for restoration actions.

# Section 3:
## focal fish species and restoration strategies

A primary goal of the Program is to conserve and recover native anadromous fish populations, and the Plan includes fall-run Chinook Salmon, Coho Salmon, steelhead (summer- and winter-run), Pacific Lamprey, and Green Sturgeon as focal species for restoration and conservation. These focal species collectively exhibit "life history strategies" that use diverse aquatic habitats across the Eel River watershed to successfully complete their life cycles. Focusing conservation and restoration actions on the diverse habitats and ecological processes needed by these focal fish species will improve habitat conditions and help recover other native species in the Eel River watershed.

The Plan adopts a strategy of restoring not only abundances (number) of focal fish species, but also their diversity of life-history strategies, as a way to build resilience. Similar to a diverse financial portfolio, having a diverse portfolio of life-history strategies in a fish population spreads the risk of mortality and reaps the benefits of surplus across time and space, contributing to resilience and reducing risk of extinction. Native fish species evolved to use the various river segments, habitats, and seasonal timing to maximize their chance of successfully completing their life cycle. For this reason, recovering life-history diversity of native fishes is an integral part of recovering abundance and resilience of their populations.


Marin Coho Salmon





Steelhead


Pacific Lamprey


Sturgeon
Photo by Thomas Dunklin

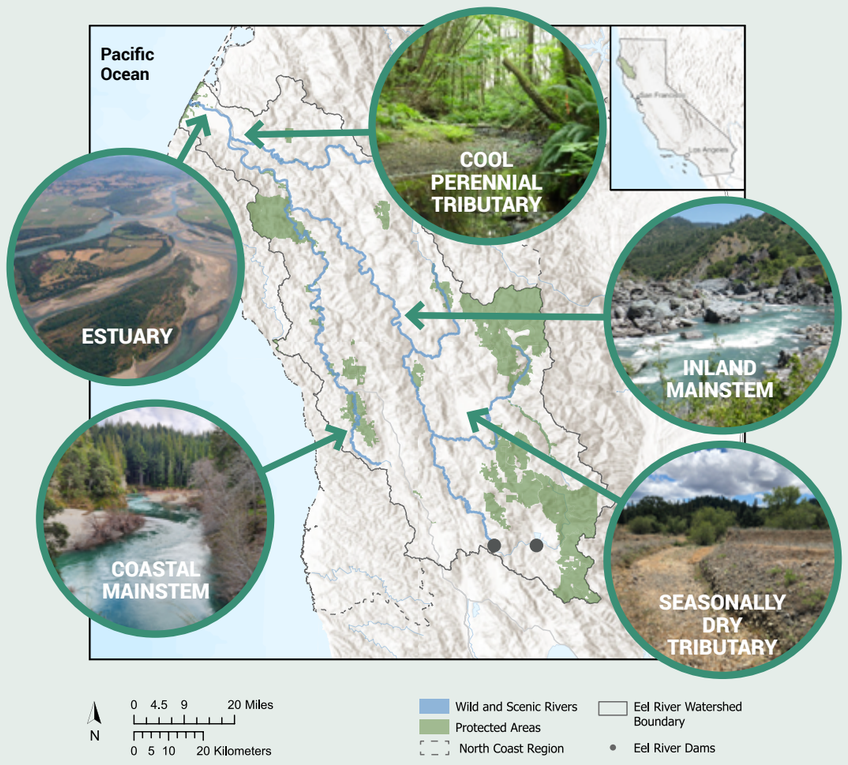

Coho Salmon


Chinook Salmon

## Life-history diversity supported by habitat diversity

In a healthy fishery, fish species have diverse life-history strategy, meaning individual fish make a variety of different choices for how much time they spend in different habitats. There is not a consistently "best set" of choices, rather in each year, some choices are a bust and some are a boom. In this way, life-history diversity provides stability and abundance in a fishery. The Eel River was, and to a lesser extent still is, historically rich with habitat diversity, from warm, mainstem waters to cool, headwater tribs. This mosaic of habitats fostered life history diversity. We can't directly restore fish life-history diversity, but we can enable the conditions that fish need to expand their life-history diversity strategies. This can increase fish production, abundance, and resilience.

### *O. Mykiss* life-history diversity





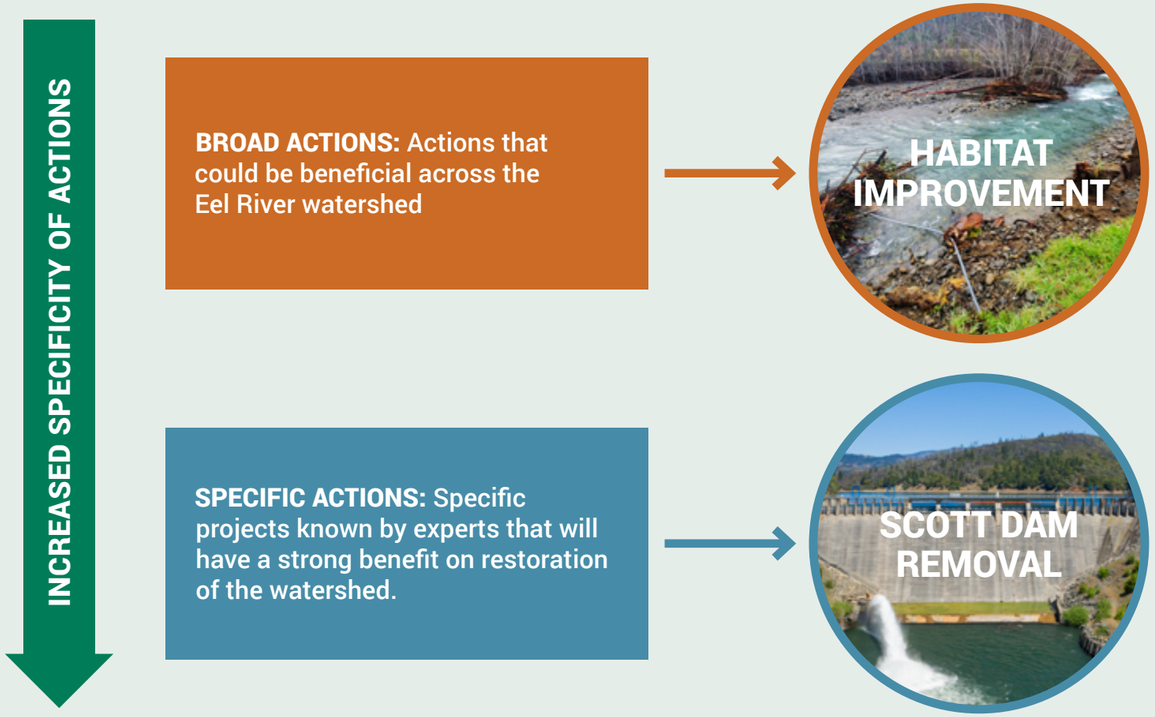
Different stages of fish life-history diversity require different stream conditions across the watershed.

# Section 4:
## Restoration and Conservation Actions

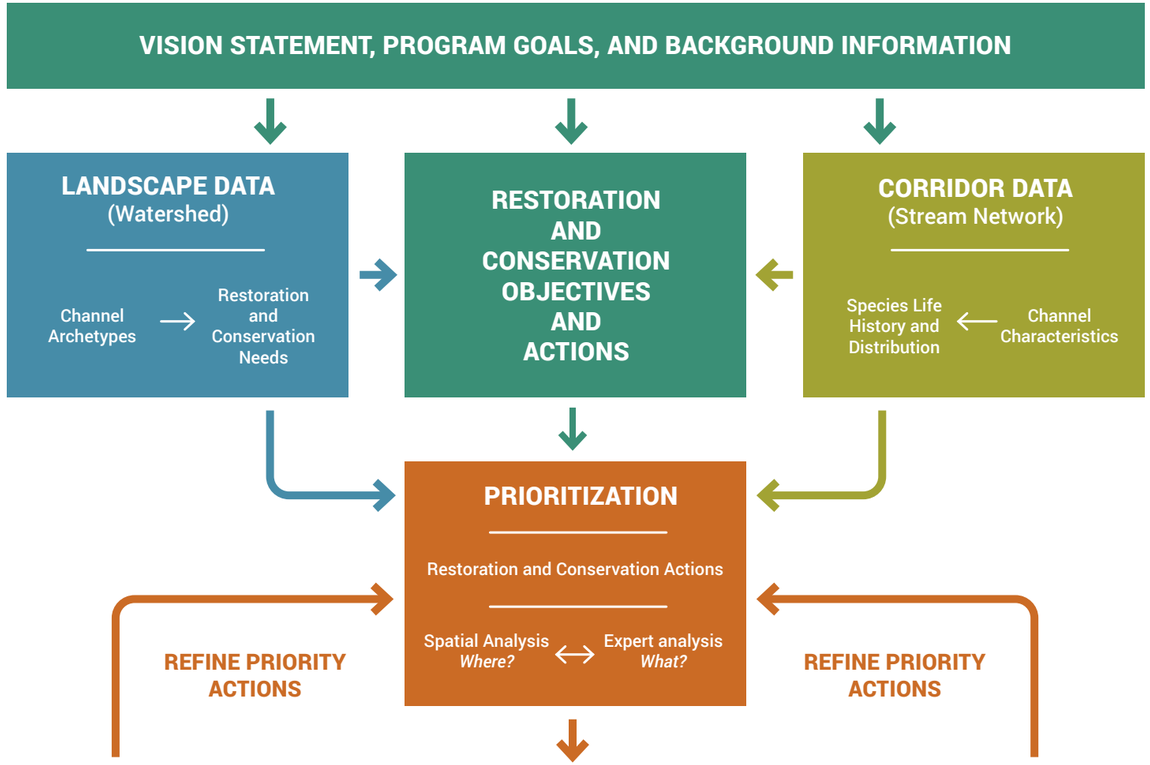
Given the large size of the Eel River watershed, there are numerous potential restoration and conservation actions that could be implemented. The Plan identified and organized potential restoration and conservation actions based on the goals and objectives, along with inputs from the species conceptual models (Section 3), and a careful review of existing assessments and plans that identify key restoration and conservation actions. For each of the goals, the Plan developed increasingly specific sub-goals, objectives, and sub-objectives for restoration and conservation to provide a resolution that is appropriate for linking with specific actions.

For example, by having a system of tiered goals and objectives, the Plan can transition from a very broad goal of "Achieve naturally self-sustaining and harvestable native anadromous fish populations" down to an objective that can be specifically achieved, such as "reduce mortality of juvenile salmonids in a particular restoration reach from non-native pikeminnow." The outcome of this process is a series of tiered goals and objectives tables and a resulting series of actions.

As an example of habitat improvement, the photo shows the installation of a large engineered wood structure at Bull Creek State Park, California. When water flows through the stream the engineered wood jam will help create better habitat by routing water into the floodplain and making a large deep pool for fish to rest in. Photo by Pusher Inc. August 2024.






Prioritizing restoration and conservation action means that the most important functions of the river corridors should be restored and protected. The prioritizated actions, if implemented, will help put this plan to work; to get millions of adult salmon back into the river.

# Section 5:
## Prioritization Framework

An effective approach to prioritize restoration and conservation actions identified in Section 4 includes a systematic, replicable, and transparent process for estimating about the efficacy of restoration and conservation actions. The Plan reviewed several action prioritization approaches developed by other restoration programs, and developed a prioritization framework for the Eel River that would result in prioritizing (1) restoration actions that will best recover native fish populations, and (2) strategic locations for conservation that will protect fish populations and foster watershed resiliency into the future.

The prioritization framework is designed to help identify and prioritize both broad and specific actions. Broad restoration actions are those that may be beneficial across many areas in the Eel River watershed. These are proven approaches to improve habitat conditions. However, the actions need to be prioritized using a process that integrates available data, watershed assessments, recovery plans, and incorporates expert opinion and coordination with local entities and agencies. Some examples of broad restoration actions that have the potential to benefit many areas of the watershed are shown here.

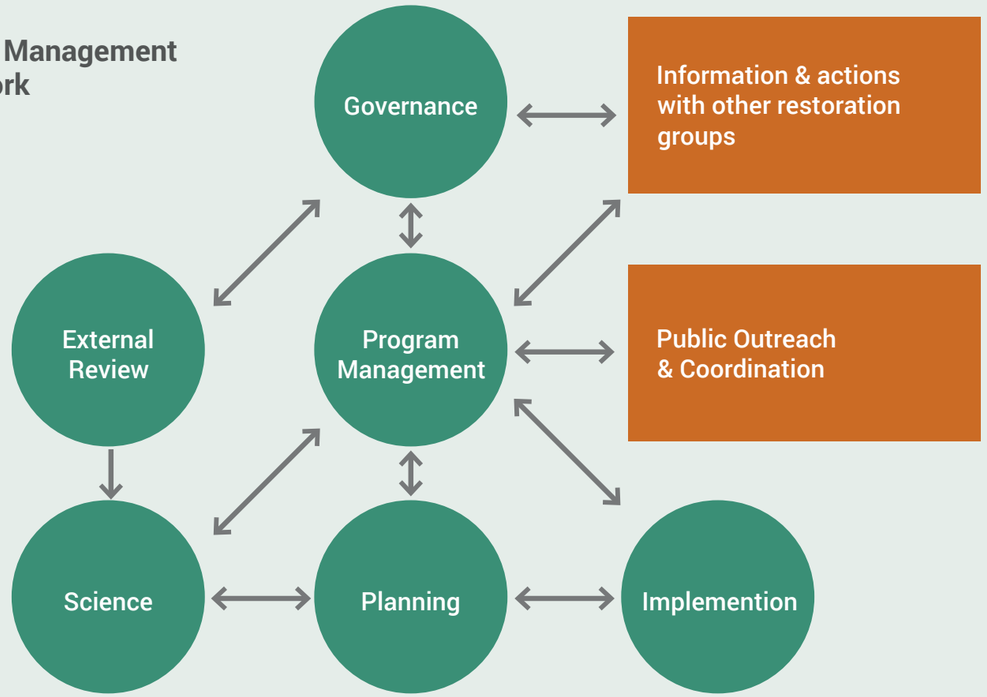
A specific action known to benefit the watershed's fisheries is the removal of the Scott and Cape Horn dams. For the past 100 years, the dams have restricted access to the Eel River's headwaters and fundamentally altered the ecosystem in the upper river. But there is hope. PG&E, the facility owner, is now working with federal regulators to decommission the Project and is planning to remove both dams. This is a once-in-a-lifetime opportunity to restore one of California's great salmon and steelhead rivers.

# Section 6:
## Program Management Framework

Successful implementation of an Eel River Restoration and Conservation Plan that achieves significant improvement to native fish abundance in the Eel River watershed will require the formation of a new program management framework (see figure below). Section 6 provides a summary of core components of a generic ecosystem management framework, reviews other comparable large-scale ecosystem restoration program management framework approaches, then recommends a future program management framework for an Eel River Restoration and Conservation Program that would be formed in Phase 2. The Plan does not recommend replacing existing restoration planning and implementation activities currently occurring within the Eel River basin, but rather recommends a future program management framework that builds from the existing work being done in different sub-watersheds, and provides a structure for organizing and guiding restoration efforts for the entire watershed. In addition, the recommended program management framework would also include support for watershed-wide monitoring and assessment, to build from existing monitoring and assessment efforts.

Bull Creek Restoration planning 2024, Photo by Pusher Inc.

### Program Management Framework



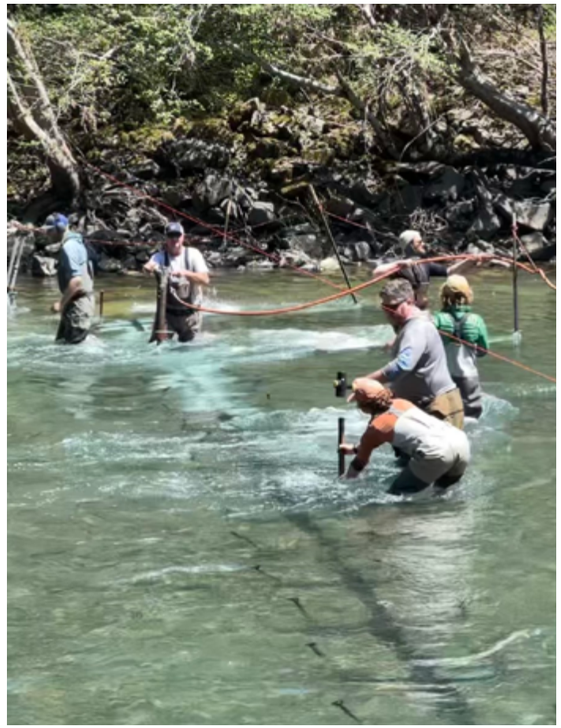



# Section 7:
## Monitoring and Assessment Framework

Monitoring and assessment of restoration and conservation actions are fundamental to determining whether, and to what extent, these actions are having the intended effect on improving habitat conditions for focal fish species and, more broadly, whether implementation is achieving desired species recovery goals and objectives. The three goals of the monitoring and assessment framework are to:

1. Evaluate whether restoration and conservation actions are working to meet the vision statement, goals, and for native anadromous fish recovery;
2. Use focal fish species' populations and habitat metrics to adapt, refine, and/or reprioritize restoration and conservation actions, as needed; and,
3. Share the recovery trajectory of anadromous fishes in the Eel River watershed with the public in accessible ways that inform and engage the community.

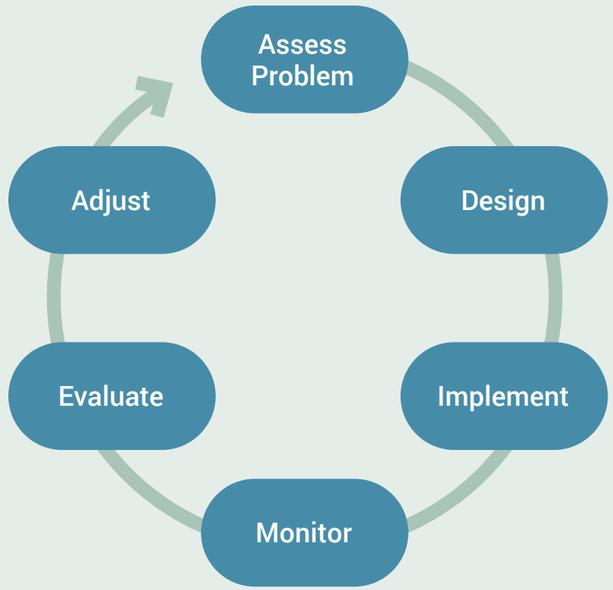
The core components of the monitoring and assessment framework are monitoring program oversight and coordination among partners; monitoring and assessment process; data management opportunities; and adaptive management opportunities.



Monitoring in the Eel River, photo by Philip Georgakakos

### Monitoring framework as an iterative process

The recommended monitoring and assessment framework includes a process that uses structured hypothesis testing, data visualization, and/or narrative interpretation to determine if the restoration program is meeting its goals – both at project and program scales.



Photos by Philip Georgakakos and Gabe Rossi

# Monitoring at the South Fork Eel Fish Weir

## An example of a type of project that could be coordinated by the Eel River Watershed Program

The Sacramento Pikeminnow, *Ptychocheilus grandis*, is a large piscivorous (fish-eating) minnow that was introduced into Lake Pillsbury in the upper mainstem Eel River around 1979 – and have since invaded almost every part of the Eel River mainstem and many tributaries.

Pikeminnow in the Eel River can grow 26 inches (or larger!) and weigh over 8 lbs. From a founding population of less than ten individuals – hundreds of thousands now live in the Eel River watershed.

Pikeminnow compete with, prey on, or alter behavior of juvenile salmonids, lampreys, and other native fishes in the Eel River basin.

In the South Fork of the Eel River, pikeminnow migrate seasonally – up river towards the prime juvenile salmon rearing habitat in the spring/summer and back down river in the winter.

The Wiyot Tribe and their partners have been leading pikeminnow suppression work in the Eel River for over 10 years. In 2022, CalTrout received funding to deploy a seasonal, resistance board weir to prevent the upstream migration of pikeminnow in the South Fork Eel River in the spring and summer.

A weir is a floating fence that can be used to control which fish are able to swim up or downstream. Constructing and operating the South Fork Eel Fish Weir is a community endeavor. First we laid out the “substrate rail” which attaches the weir to the bed of the river.

Next we attached the weir panels which are constructed from 1 inch PVC “pickets.” The pickets are spaced wide enough to allow juvenile salmonids, lamprey, and other small native fish to migrate freely through the weir… but close enough together to prevent the movement of larger pikeminnow.

Finally, we build the trap box which captures upstream migrating fish that are too large to swim through the pickets. Native fish are immediately release upstream and invasive pikeminnow are humanely euthanized. We also install a downstream passage chute which allows adult steelhead to swim back downstream after spawning. And of course we painted a beautiful salmon on the trap box to remind us of the goal: recovering wild, healthy populations of salmon and other native fish in the Eel River.



# Section 8: Recommendations and Next Steps

Based on materials developed the next steps to establish are as follows:

- *Program management framework;*
- *Funding strategies;*
- *Restoration and conservation priorities; and,*
- *Monitoring, assessment, and research priorities.*

The Plan outlines the fundamental components for creating and implementing a successful watershed-wide restoration and conservation program for the Eel River (Phase 1). The overall next step will be to implement Phase 2: Program Formation and Prioritization. The recommendations in this Plan are intended to guide the Phase 2 effort; however, participation by agencies, tribes, conservation groups, and the public will be critical for improving to improving the recommendations in this Plan and Phase 2 implementationprocess, assuming funding can be obtained to implement it, including:

**Phase 1 Plan Distribution and Outreach:** Continue conducting outreach of the Plan to community members or organizations (particularly those that have not been exposed to the Plan development process) to provide opportunities to provide input into the Phase 2 effort. The Phase 1 Plan will be published on the California Trout website and released via local media outlets to ensure broad distribution across the Eel River community.

**Entity Formation, Board of Directors, and Staff:** Building on Section 6, a Program entity would be formed so it can begin to execute the strategies being formulated in this Plan. A working group should be formed to help develop the details of entity composition, roles and responsibilities, administration, and funding.

**Financing and Budget:** Phase 2 of Program development will require additional financing and funding to implement, including financial requirements for developing the entity, startup costs (office space, supplies, legal costs, licenses), staff salaries, executing the restoration and conservation action prioritization process (Section 5), and conducting initial monitoring needs (Section 7).

**Prioritize Restoration and Conservation Actions:** Once the Program is formed, one of the first tasks would be to implement the prioritization framework (Section 5), including advancing the highest priority analyses and syntheses that will be used as inputs to the prioritization process. While completing the restoration and conservation action prioritization process should not preclude implementing actions (e.g., holding up implementation projects already in the design and permitting process), completing the prioritization process should be a high priority once the Program is formed to quickly inform the implementation process.

**Baseline Monitoring:** Continuation and expansion of the baseline monitoring of juvenile and adult salmonids being conducted in the Eel River watershed is imperative. The Plan illustrates multiple purposes of baseline monitoring. First, it will help establish the current fish population status, making future changes to fish population status clearer as cumulative restoration actions are completed (Program-level monitoring). Second, baseline monitoring will be the foundation for hypothesis testing and site-specific effectiveness evaluation (project-level monitoring). Lastly, baseline monitoring and research will help fill existing priority data gaps and identify additional data needs.

The Eel River by Gabe Rossi

# The Eel River Watershed

## RESTORATION AND CONSERVATION PROGRAM

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Eel River estuary photo by Michael Wier