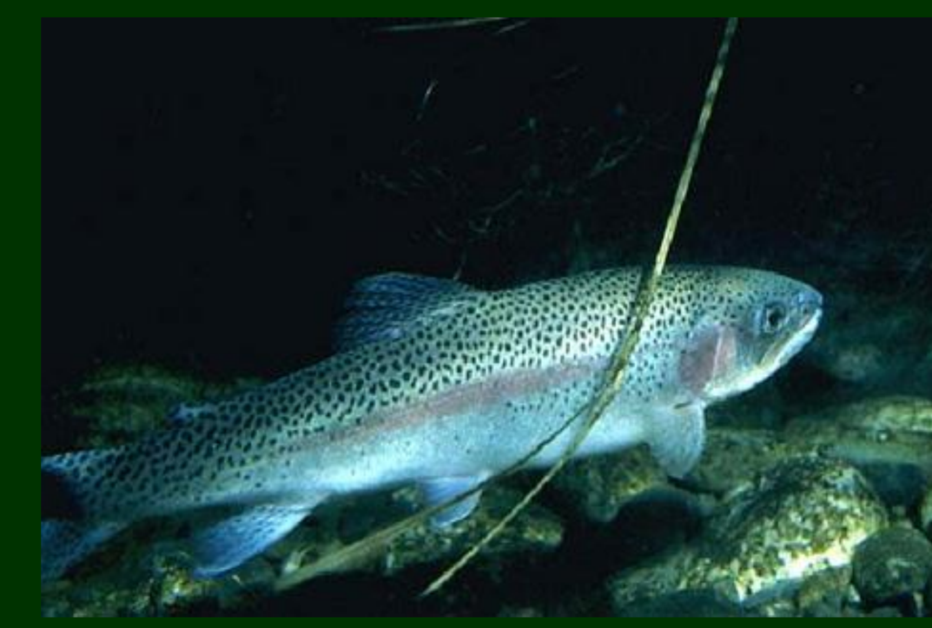
Steelhead Monitoring Programs in California

Past, Present, and Into the Future



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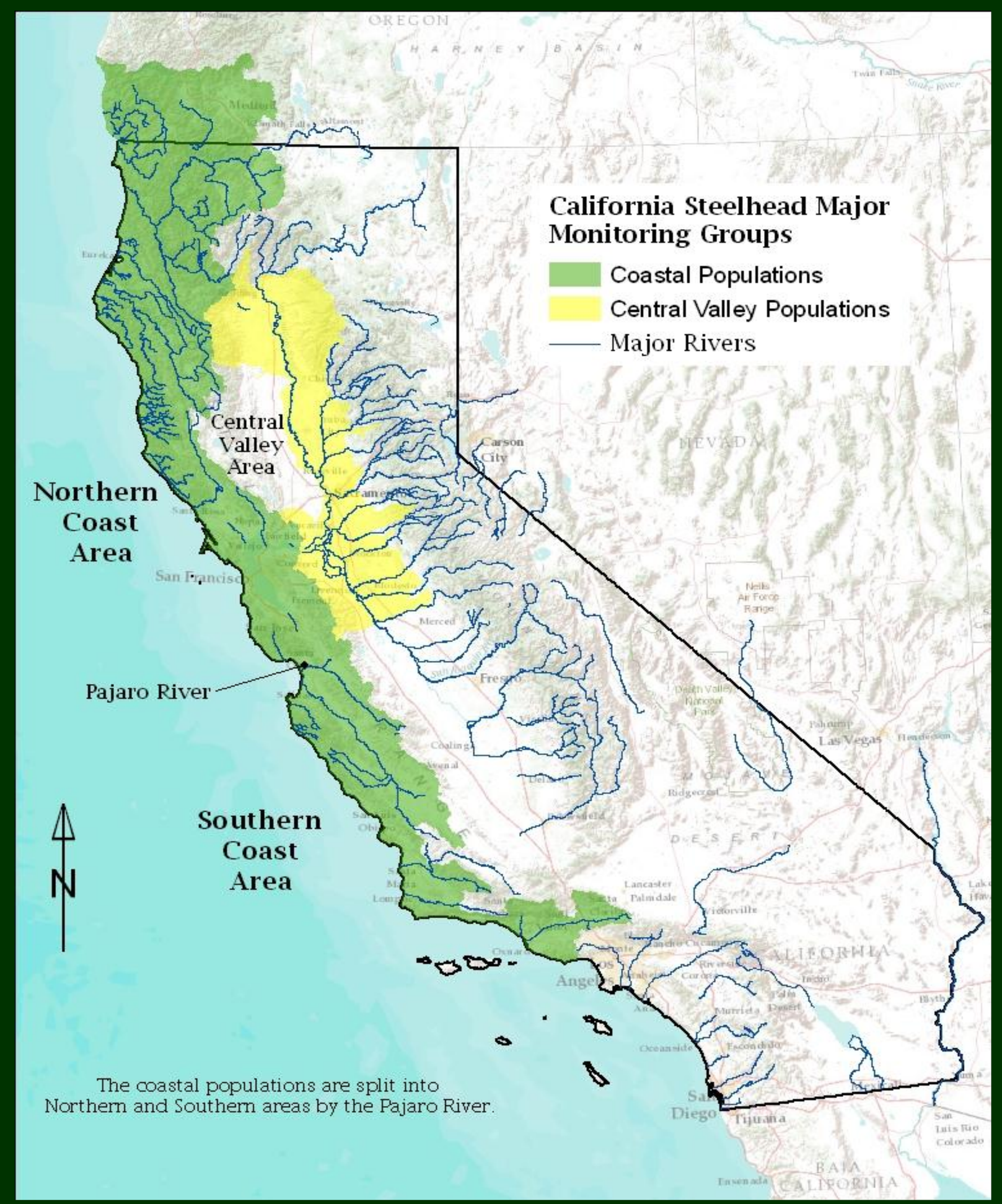
Background



California is home to multiple species of native anadromous salmonids. Anadromous rainbow trout (*Oncorhynchus mykiss irideus*), commonly referred to as steelhead, is one species that has risen to the forefront of conservation efforts in this state. Since the 1960s, steelhead population declines have been documented, and in 1997, the first populations of steelhead were ESA listed in California. These factors prompted an increase in recovery efforts for this species. Some of the most important tools which aid species recovery are monitoring activities. Steelhead monitoring efforts in California are examined here.

The Past

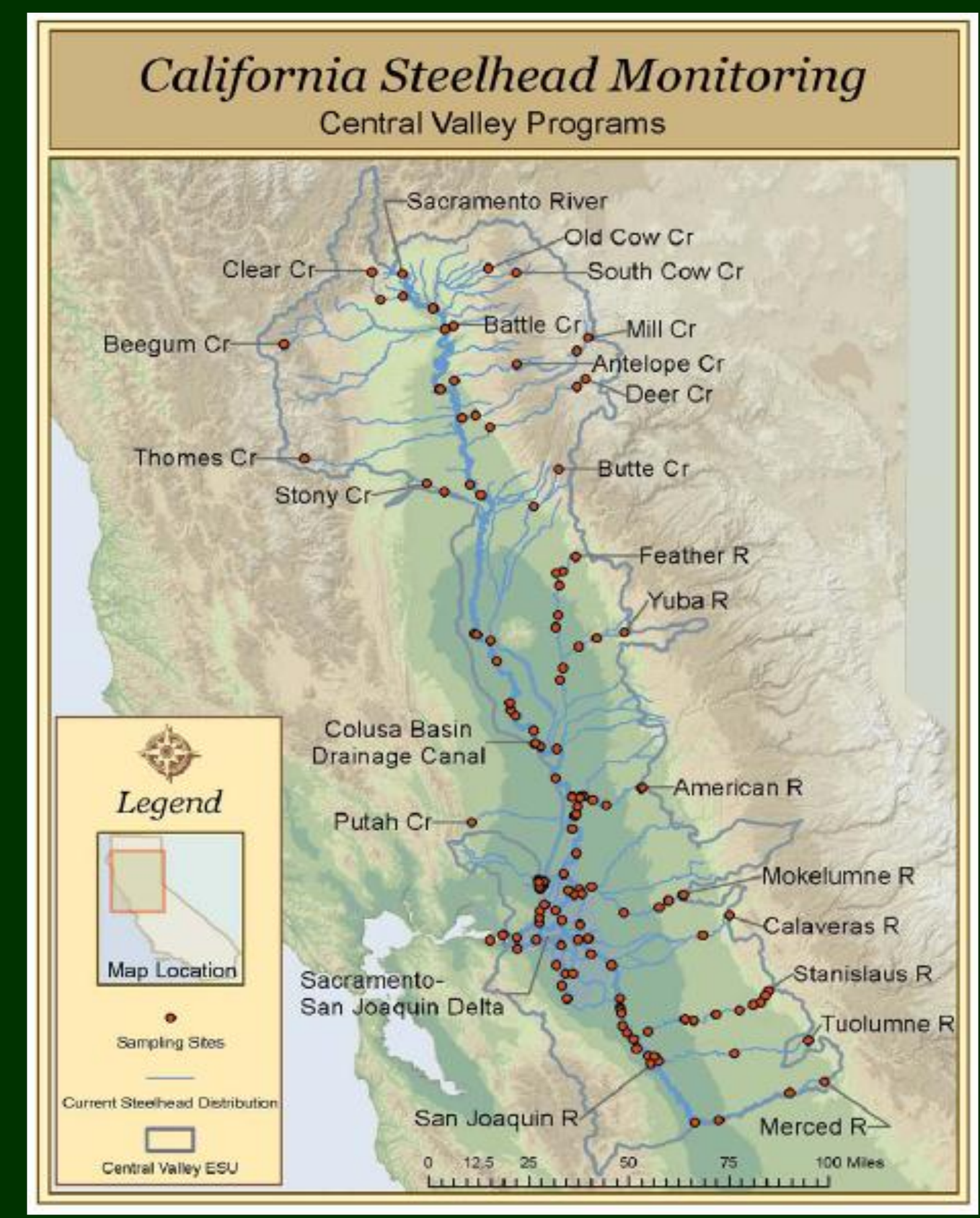
Along with scientific research, monitoring activities provide vital biological and life history information that direct recovery efforts. Previously, much of the information collected about steelhead came from monitoring programs aimed at other species, such as Chinook salmon (*Oncorhynchus tshawytscha)* and different natural resource management questions. Because the programs were not focused on the species, the steelhead data that was collected was inconsistent, inaccurate, and typically not shared. Steelhead and salmon species share a similar complex life history, and past monitoring activities still provided beneficial information that led to the development of current sampling methodologies.

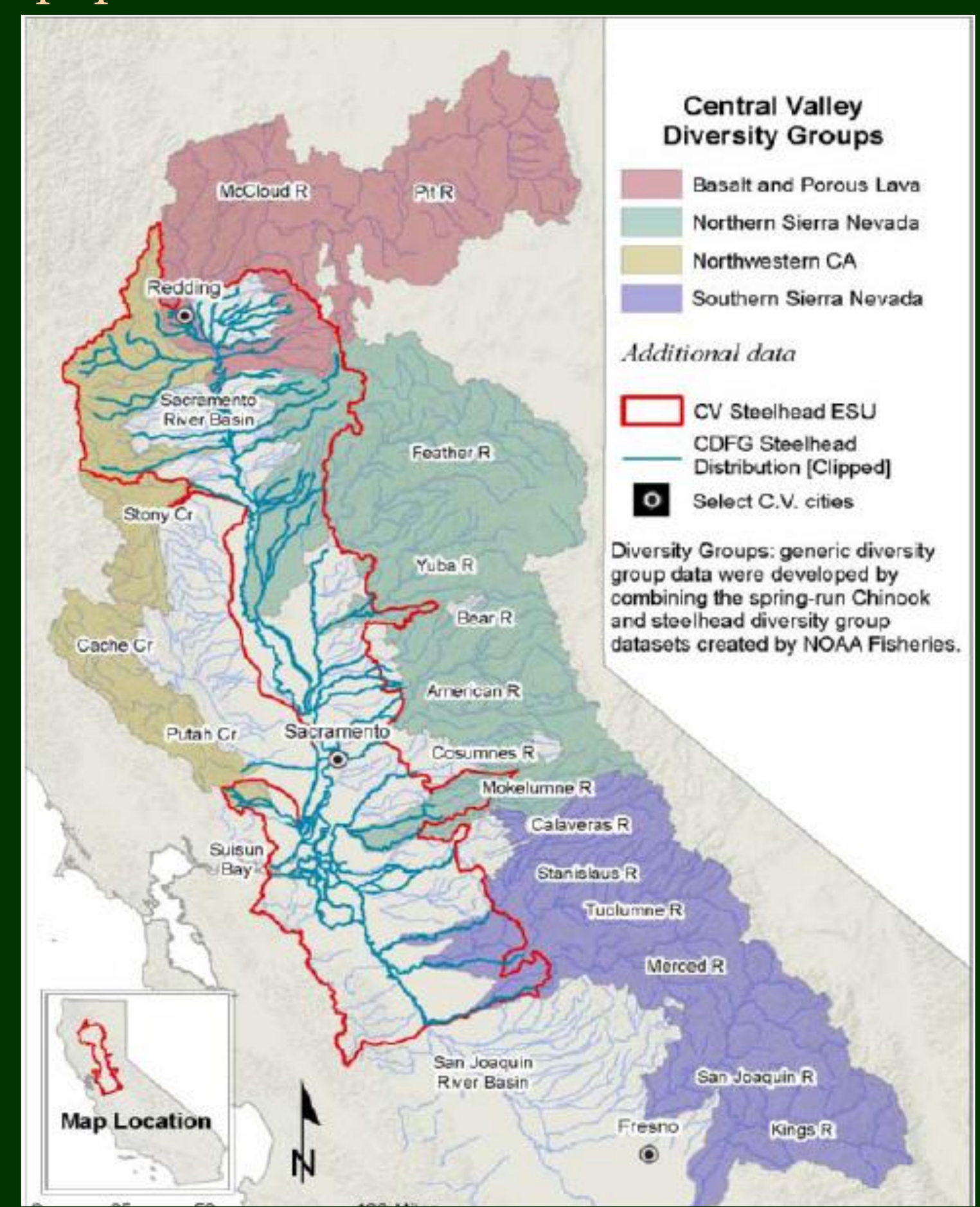
The Present

In order to implement a successful monitoring program, California's steelhead populations have been broken into 2 major categories: coastal populations and Central Valley populations. The coastal steelhead groups are further divided based on various population characteristics, such as abundance and migration timing. These characteristics are driven by the quality of the watersheds, the number of migration barriers, and latitude. While the California Department of Fish and Game implements monitoring programs that are specific to these areas, the sampling protocols allow for the data to be analyzed at multiple levels. Analyses assess species abundance and life history trends for implementation in statewide recovery actions. Monitoring programs operate under uniform methodologies, enabling higher level statistical analyses and data pooling at the population and subpopulation levels.

Central Valley Steelhead

For the Central Valley (CV) steelhead population, a monitoring plan was developed by the Interagency Ecological Program Steelhead Project Work Team in 2010. The plan identified the actions needed to fill knowledge gaps and collect baseline information on population abundance and distribution, which will help assess the recovery of the CV steelhead population.





Recognizing the affect of abiotic factors on ecological systems, the CV was broken down into 6 ecoregions based on climatological, hydrological, and geological characteristics. Monitoring efforts were designed to incorporate characteristic differences in ecoregions and their effects on occupying steelhead populations.

The major objectives of this plan are to estimate the abundance of adult steelhead in the mainstem Sacramento River, examine the spatial distribution of steelhead across the CV, monitor the status and abundance of steelhead in selected rivers in the ecoregions , and increase juvenile monitoring. Currently, a number of monitoring sites operate strategically in the CV to address some of these objectives.

Coastal Steelhead

For coastal salmonid populations, the California Coastal Monitoring Plan (CMP) has been developed to provide population information to aid recovery efforts. The CMP divides California into Northern and Southern areas with a boundary south of Aptos Creek and north of the Pajaro River. This division is based on differences in species composition, levels of abundance, distribution patterns, and habitat differences that necessitate different monitoring approaches. A key feature of this distinction is that the Northern area exhibits a species assemblage that includes multiple anadromous salmonids, and the Southern area is comprised of small populations of steelhead.

The CMP uses the Viable Salmonid Population (VSP; McElhaney et al. 2000) concept as the framework for plan development. The VSP conceptual framework assesses salmonid viability in terms of four key population characteristics: abundance, productivity, spatial structure, and diversity. In order to collect enough information to understand these characteristics, a widespread, multi-faceted monitoring program is in the beginning stages of implementation.

Monitoring Methods

A variety of monitoring methods are employed to obtain statistically relevant data that is needed for steelhead recovery efforts. The feasibility of different sampling methods is typically determined by the features of the watershed or the characteristics of the species within it. Commonly used monitoring methods and their associated variables are summarized in the table provided. To accurately assess steelhead populations, we utilize multiple, replicate sampling protocols on a single watershed, as feasible. This allows us to capture statistically relevant information from all different steelhead life stages in all of their habitats.

After collection, data is subjected to a multitude of statistical analyses. The results of these analyses provide us with an understanding of steelhead population dynamics. Currently, methods such as mark/recapture and determining catch-per-unit-effort (CPUE) are highly utilized for determining abundance estimates. These methods are undergoing statistical analyses to calculate standard deviations for the metrics collected to assess normal variation. The use of life cycle monitoring stations, which include an adult counting station, spawner surveys upstream from the counting station, and outmigrant juvenile trapping, provide estimates of freshwater and oceanic survival. A web based, centralized data management system for maintaining the complex data collected from the varying programs standardizes data collection and abundance and trend analyses across the state. This is crucial for the coordination of a multi agency monitoring program.

VARIABLES COLLECTED

METHOD	PRESENCE/ ABSENCE		ESCAPEMENT		IMMIGRATION TIMING		EMIGRATION TIMING		HABITAT USE		ABUNDANCE		PASSAGE ESTIMATES		DISTRIBUTION		DENSITY		LIFE HISTORY PATTERNS		EMERGENCE TIMING		DIVERSION MORTALITY		GROWTH		AGE		HARVEST		RESIDENCY RATES	
	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile	adult	juvenile
ROTARY SCREW TRAP		X						X				X				X																
TRAWL	X	X						X			X	X			X	X																
ANGLER SURVEY	X				X						X																		X			
REPORT CARD											X																		X			
FYKE TRAP	X				X						X				X								X									
VISUAL COUNTS, WEIR	X				X								X				X															
VISUAL COUNTS, REDDS	X		X																													
SNORKEL SURVEYS	X	X							X	X					X	X	X	X														
VISUAL COUNTS, ADULTS	X		X		X				X				X		X		X															
VIDEO MONITORING	X		X		X			X					X		X		X															
BEACH SEINING	X	X			X			X			X	X			X	X	X	X				X										
ELECTROFISHING	X	X			X			X			X	X			X	X	X	X				X										
LADDER COUNTS	X		X		X						X				X		X															
SCALE READING									X										X						X		X					
ACOUSTIC TAGGING			X		X			X	X	X					X	X															X	X
OTOLITH READING																			X	X					X	X	X	X				

adult — juvenile

The Future

In California, steelhead monitoring has made great progress over the last decade. However, as with any scientific or management endeavor, there is still much that needs to be done to make our monitoring efforts effective on a statewide basis. Part of this transition must include a standardized monitoring program. Both the CMP and the CV steelhead monitoring programs provide avenues of focused research, uniform modifications and expansion of current monitoring, and data management that will create a more comprehensive state wide dataset.

Both the coastal and central valley plans suggest similar needs for specific scientific investigations. One of these needs is to define the interaction between the anadromous and non-anadromous life history types of *Oncorhynchus mykiss*. Another research requirement is to further investigate the introgression of hatchery derived steelhead into wild populations. Steelhead focused research will further refine the monitoring programs.

Modifications and additions to current monitoring programs will continue to support recovery efforts. Ideally, we would like to integrate current, location specific monitoring plans into a statewide, collaborative effort that is supported by multiple entities, and centrally housed. Additionally, improvements to our current monitoring programs through expansion of spatial and temporal precision would enhance restoration and recovery efforts.

Crucial to the success of this future plan is the incorporation of an adaptive management approach, which allows decision makers to adjust, refine or modify the monitoring based on new technologies, techniques, information, and management needs.

Implementation of this monitoring plan will be in phases, as it was not designed as a work plan, but a framework to examine the status and trends of abundance. The steps for implementation include governance, resource support, monitoring priorities, timelines, and on-going evaluation with subsequent modification as needed. This framework will help the transition of localized steelhead monitoring efforts to a statewide, collaborative effort aimed at enhancing recovery efforts.