Strategic Plan for Trout Management

Draft 2021 Update

California Department of Fish and Wildlife

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Executive Summary

The wide range of ecosystems in California support diverse trout fisheries throughout the state. This includes trout populations in high alpine lakes and valley tailwaters, temperate rain forests, and desert basins. These waters support 11 extant native species and three non-native species of trout. Biologists with the California Department of Fish and Wildlife are presented with unique challenges when working to support trout populations and the anglers that target them. A changing climate and novel stressors may worsen existing impacts to trout populations from habitat alteration and introduced species.

The Strategic Plan for Trout Management—first published in 2003—provides a framework for the management of trout and landlocked salmon across the state. This update examines changes in law, policy, and scientific literature that have occurred over the last two decades. New approaches are needed to address changing ecosystems and trout fisheries, and this plan seeks to provide both the background and tools for biologists to be successful.

The recovery of native trout species can be achieved while maintaining California's renowned trout fisheries through a strong scientific foundation, the support of a robust state hatchery system, and collaboration with our partners. Specifically, the Department will have six goals for trout management for the next five years:

Goal 1: Investigate and Improve Wild Trout Populations.
Wild trout fisheries are the most common trout fisheries in California and are best supported by high-quality ecosystems.

Goal 2: Investigate and Improve Stocked Trout Management.
California's robust trout hatchery system provides biologists with tools to improve trout fisheries and, increasingly, opportunities to support native trout recovery.

Goal 3: Integrate Stakeholders.
We can achieve more through a better understanding of public interest in trout management and collaboration with our partners.

Goal 4: Evaluate Water and Land Use Practices.
Existing land use planning and regulatory tools can help mitigate ecosystem impacts and allow biologists and resource users to find common solutions.

Goal 5: Continue Applied Research Activities.
Department biologists can conduct research that has direct impacts on trout management decisions.

Goal 6: Increase the Resiliency of Trout Populations.
Trout populations are more resilient to long-term ecosystem impacts when other stressors are removed, or habitats are improved.

This Strategic Plan for Trout Management and the Strategic Plan for Trout Hatcheries are the principal documents that will guide the Department's management of trout into the future.

Contents

Introduction

The California Department of Fish and Wildlife (Department) is responsible for managing the state's trout resources to provide the public with diverse angling opportunities and to ensure the persistence of trout populations. The Fisheries Branch of the Department provides statewide direction, while local management and oversight are conducted by the six inland regions of the Department (Regions).[1]

Among California anglers trout are the most popular target, pursued by about 60 percent of those who fish in freshwater (U.S. Fish and Wildlife Service and U.S. Census Bureau 2014). California supports a rich heritage of native trout, excellent wild trout fisheries, and a hatchery system that produces and stocks abundant trout. This Strategic Plan for Trout Management (Plan) is intended to guide Department programs and staff in effectively managing the trout resources of California. This document acts as an update to the original plan which was finalized in 2003 (California Department of Fish and Game 2003), and draws from:

- broadly focused strategic plans and guidance documents from within the state;
- current law and policy located in the Fish and Game Code;[2]
- peer-reviewed literature; and
- public input through web-based platforms and townhall meetings held across California.

These sources provide valuable information regarding future developments within California, establish targets / mandates trout managers must pursue, and offer guidance from findings of the most recent and credible science. Public participation provided insight into the priorities and values of the trout angling community. The use of social media and a straightforward webform allowed us to reach far more people than similar planning efforts previously have. As we learn how to become more effective communicators and collaborators, the success of this Plan will continue to rely on engaged stakeholders.

Need for Revision

The 2003 Plan was intended to guide trout management for a period of 10-15 years. Developments in legislation and policy, and the advancement in scientific knowledge—including the role of climate change in trout management—have made this update necessary.

The 2003 Plan featured an ecosystem-based approach to trout management and direction to better utilize hatcheries products. While Department trout managers and stakeholders were in the process of implementation, three major events occurred that influenced how certain strategies could be pursued (see Lentz and Clifford 2014 for a review). These events were:

1. In 2005, the passage of California Assembly Bill 7, which established hatchery production goals tied to fishing license sales and increased priority for stocking native trout strains where appropriate (Fish and Game Code §§ 13007 and 13008).

[1] Regional boundaries and contact information available at: CDFW Regions
[2] Codified laws, including Fish and Game Code, available at: California Constitution - CONS

2. In 2007, the lawsuit *Pacific Rivers Council et al. v. California Department of Fish and Game*, which contested the hatchery stocking practices of the Department and resulted in completion of an Environmental Impact Report/Environmental Impact Statement (EIR) to guide trout hatchery and stocking practices (California Department of Fish and Game and U.S. Fish and Wildlife Service 2010).
3. In 2012, the passage of California Senate Bill 1148, which, in part, directed Department trout management and stocking, emphasizing the protection of native trout and their ecosystems (Fish and Game Code §§ 1725 et seq.).

Proactive measures by trout managers and these new legal and legislative mandates led to many of the goals and strategies of the 2003 Plan being addressed. This revised Plan reframes current priorities and direction in order to:

- sustain and restore wild trout fisheries;
- better utilize hatchery trout; and
- improve angling opportunities.

Scope of the Plan

Borrowing from lessons learned from the first plan along with the need for revisions, this plan will use the guiding principles of managing for the right fish, at the right place, for the right reason. This Plan is intended to guide statewide management of the twelve currently recognized forms of native California trout, Mountain Whitefish (*Prosopium williamsoni*), non-native species of trout and char, and landlocked salmon. In this Plan, "trout" refers to this larger group of species.

Life History Diversity

Trout possess a great variability in their approach towards success. Habitat use and migration habits throughout the lifespan of a trout define its life history strategy. Diversity in life histories has allowed trout forms to persist and spread over the millennia. Instream conditions along with genetic variability drive life history diversity. Life history strategies have been summarized into four broad types in this Plan:

1. <u>Resident</u>: All life stages reside in the stream in which they were hatched. In char species, all life stages may reside within a lake.
2. <u>Fluvial</u>: Early life stages hatch and rear in tributary streams, but as individuals age, they move into main-stem rivers. Adults perform seasonal migrations into tributary streams to spawn.
3. <u>Adfluvial</u>: Early life stages hatch and rear in streams, but as individuals age, they move into a lake. Adults migrate back to streams to spawn.
4. <u>Anadromous</u>: Also known as sea-run, early life stages are spent in streams, but as individuals age, they move into the ocean. Adults migrate seasonally into streams to spawn. In California, anadromous life histories are only found within Coastal Cutthroat Trout and Coastal Rainbow Trout.

Populations are more resilient to threats when they are diverse and possess multiple life history strategies (Figge 2004; Greene et al. 2010; Schindler et al. 2010). Manmade barriers to migration, particularly large dams, may now separate historically connected populations that express multiple life histories (e.g., Clemento et al. 2009). In these cases, consideration should be given to the preservation of now isolated trout populations.

Some above-barrier populations were once part of larger and more diverse connected groups of populations, or "metapopulations," separated to some degree by life history strategy rather than completely by migration barriers. When localized extinctions of populations occurred in the past, their legacy was continued through recolonization by trout expressing different life history strategies or occupying connected habitat (Rieman and Dunham 2000). This source-sink dynamic of metapopulations has largely been lost in many watersheds. In some areas, conservation of anadromous Coastal Rainbow Trout (*Oncorhynchus mykiss irideus*) may be reliant on above-barrier populations (Leitwein et al. 2017).

California's Native Trout

> *In their entirety they seem to form a huge mosaic, the elements of which, as diverse as the golden trout of the High Sierra, the coast rainbow and the royal silver trout of Lake Tahoe, are difficult to separate. The picture includes not only the colors of the entire spectrum, but numerous irregularities of form, anatomical structure and habits as well.*
>
> *-John O. Snyder in "The Trouts of California," 1940*

Defining the species, subspecies, or forms of trout in California has never been easy or consistent through time. The quote above highlights this, as John O. Snyder believed Lake Tahoe was host to a unique subspecies of rainbow trout that he named the Royal Silver Trout. However, it is currently understood that these were Coastal Rainbow Trout introduced in the mid-19th century, well before Snyder's description (Behnke 1992; Moyle 2002). The great diversity of trout, prolific widespread stocking, and a limited historical record in the 19th century explain the difficulty in classifying subspecies, species, or forms. Further genetic analyses will help clarify the origin and relationships of trout in California and may result in changes in the way species are classified by taxonomists.

No matter how they are split or lumped, few states rival California's diversity of native trout. The following characteristics of California have led to the great diversity of trout in the Golden State:

- A Mediterranean climate throughout much of the state.
- Ecosystems that range from deserts, to mountains, to estuaries.
- Geologic and climatic events that have occurred over the evolutionary history of trout.

While we can assign names to unique groups of trout,[3] they do not capture the relationships between native California trout or the diversity within each form. Using the framework of currently recognized species and forms, we can group each trout as follows to help explain both their origin and uniqueness.

[3] Appendix B provides a list of currently recognized species and forms of trout in California.

Cutthroat trout

Three currently recognized subspecies of native cutthroat trout are found in California:

- Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*)
- Lahontan Cutthroat Trout *(O. c. henshawi*)
- Paiute Cutthroat Trout (*O. c. seleniris*)

The most widespread and abundant of these is the Coastal Cutthroat Trout. Coastal Cutthroat Trout are found from the Eel River north into Alaska. An interstate working group of federal, state, and tribal governments is developing a database to describe range-wide population status, life history diversity, and data gaps.[4]

Lahontan Cutthroat Trout historically were widely distributed and abundant throughout the Lahontan Basin, encompassing much of eastern California and northern Nevada. Within California, they were found in the eastern draining watersheds of the Susan, Truckee, Carson, and Walker rivers in the Sierra Nevada. Changes in habitat and the introduction of non-native trout has led to the absence of Lahontan Cutthroat Trout in large portions of these drainages. Paiute Cutthroat Trout are closely related to the Lahontan Cutthroat Trout of the Carson River watershed. Barriers to migration in Silver King Creek allowed for the isolation and evolutionary divergence that led to this unique subspecies. Both of these subspecies are listed as threatened under the federal Endangered Species Act of 1973.

Coastal Rainbow Trout

The Coastal Rainbow Trout, both wild and domesticated strains, is the most recognizable and widely distributed trout in California. Coastal Rainbow Trout historically were found in most streams where no barriers to upstream migration from the ocean existed—along Coastal California from the California-Oregon border into San Diego County and rivers that drain to the Central Valley. A distinction is often created between the resident and anadromous Coastal Rainbow Trout, commonly known as steelhead, treating them as different forms of trout. For the purposes of this document, no such broad distinction is made because:

- resident and anadromous do not represent all life histories of Coastal Rainbow Trout (Moore et al. 2014; Hodge et al. 2016);
- these life histories do not exclude interbreeding, and progeny do not always express their parent's life history (Seamons et al. 2004; Christie et al. 2011; Courter et al. 2013);
- genetic differences between watersheds are frequently greater than genetic differences between life history forms within a watershed (Olsen et al. 2006; Pearse et al. 2009; Leitwein et al. 2017); and
- an ecosystem management approach recognizes the value of all life histories.

Nevertheless, it is necessary to acknowledge that anadromous Coastal Rainbow Trout have been heavily impacted due to habitat fragmentation and degradation. Many populations are now federally listed as threatened or endangered. Because of this, large efforts are undertaken which focus on the

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[4] Working group information available at:Coastal Cutthroat Trout Interagency Committee

conservation and restoration of this life history form, primarily performed under the guidance of other plans and in collaboration with the National Marine Fisheries Service. Given the significant efforts by the Department and other agencies for recovery and management of steelhead, this Plan will primarily focus on the non-anadromous forms, while still acknowledging an ecosystem management approach. A focal goal of this Plan is to manage for the improvement of all life histories, but a greater need does exist beyond this Plan to recover steelhead populations.

Redband Trout

Redband Trout comprise ancestral lineages of interior rainbow trout that evolved prior to the Coastal Rainbow Trout. Behnke (1992) suggests that the Sacramento and San Joaquin rivers and their tributaries once hosted primitive Redband Trout. During the progression into the current era from past glaciation, these primitive Redband Trout underwent mixing with Coastal Rainbow Trout, except in areas where populations remained isolated by barriers. Isolated Redband Trout populations then diverged from their primitive ancestors and persist today in the upper watersheds of the Kern and Sacramento rivers, as well as in the interior high desert basins of Northeast California. An interstate working group has developed a range-wide conservation strategy for interior Redband Trout.[5]

Kern Plateau

The Kern River remained largely isolated through time, experiencing sporadic connection to the San Joaquin River through the now-dry Tulare Lake basin (Behnke 1992). Long periods of relative isolation in the upper Kern River produced three distinct forms of golden trout that developed from the ancestral Redband Trout. Despite extensive non-native trout introductions, genetically pure populations of these three forms are present in headwater locations on the Kern Plateau:

- Kern River Rainbow Trout (*Oncorhynchus mykiss gilberti*)
- Little Kern Golden Trout (*O. m. whitei*)
- California Golden Trout (*O. m. aguabonita*)

Of the three golden trout subspecies, the extremes of coloration and meristic traits expressed by the California Golden Trout indicate it may have experienced the least exposure to periodic invasions from Redband Trout or Coastal Rainbow Trout. The Kern River Rainbow Trout shows the most influence from these periodic invasions (Behnke 1992). The Little Kern Golden Trout is federally listed as threatened.

Sacramento River Basin

Behnke (1992) places ancestral Redband Trout throughout the headwaters of the Sacramento River Basin, including the Sacramento, McCloud, Pit, and Feather rivers. Coastal Rainbow Trout expansion into these rivers displaced or hybridized with ancestral Redband Trout in much of these watersheds. Remnant populations are still present in the upper reaches of the Pit River, and possibly in the Feather River (Behnke 1992). The presence of waterfalls in the McCloud River created complete barriers to later invasions of trout. This has led to a distinct form that continues to persist today, the McCloud River Redband Trout (*O. m. stonei*).

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[5] Available at: Conservation Strategy for Interior Redband

Interior desert basins

Geologic changes in northeastern California and southeastern Oregon allowed ancestral Redband Trout to access several interior desert basins through nearby watersheds in the past. Today, these basins lack outlets to the ocean and usually have one or more terminal lakes. Trout in these interior desert basins may express resident or adfluvial life history strategies. The currently recognized forms are:

- Warner Lakes Redband Trout (*O. m. newberrii*)
- Goose Lake Redband Trout (*O. m. newberrii*)
- Eagle Lake Rainbow Trout (*O. m. aquilarum*)

Surprise Valley hosts Redband Trout as well, but their origin is uncertain due to poor early history records and the presumed early introduction of trout from neighboring areas. The present status of native Redband Trout in the headwater portion of the Klamath Basin in California remains uncertain.

The Eagle Lake Rainbow Trout is an anomaly among desert basin Redband Trout, as Eagle Lake is part of the Lahontan Basin and supports a native Lahontan Basin fish assemblage. It is likely that Redband Trout gained access to a tributary of Eagle Lake through a headwater capture from the Pit or Feather River.

Bull Trout

The only char native to California, the Bull Trout (*Salvelinus confluentus*), once shared the lower McCloud River drainage with Chinook Salmon (*Oncorhynchus tshawytscha*), Coastal Rainbow Trout, and Redband Trout. Bull Trout in the lower McCloud River were exposed to a combination of habitat and fish community changes that eventually resulted in their extirpation in the 1970s. The closing of Shasta Dam cut off access to the McCloud River for Chinook Salmon, eliminating juvenile Chinook Salmon, an important food source for Bull Trout. Other dams, diversions, and pressure from introduced trout competitors gradually produced the demise of Bull Trout in the McCloud River.

Mountain Whitefish

Mountain Whitefish are classified in the family Salmonidae along with the other fishes covered in this Plan. Their native watersheds overlap with the Lahontan Cutthroat Trout in the eastern Sierra Nevada, yet both coexist naturally due to differences in prey (Moyle 2002). Mountain Whitefish also coexist in many waters of eastern California with introduced Brown Trout (*Salmo trutta*) and Coastal Rainbow Trout, as well as in the Lake Tahoe basin with introduced kokanee (*Oncorhynchus nerka*) and Lake Trout (*Salvelinus namaycush*). Mountain Whitefish are similar to other trout in their reliance on water that is clean and cold, the threats they face, and their value as a sportfish.

Introduced Trout and Char

Non-native species of trout were introduced to California beginning in the 19th century. These sportfish are highly desirable for many anglers, and valuable fisheries exist that rely on them. Conditions in many parts of the state have proven to be favorable for the growth of these fishes, including where development of water resources has altered watersheds. Introduced trout will continue to play an important role in providing diverse angling opportunities. Non-native species of trout and char introduced from outside of California that continue to persist in the wild are:

- Brown Trout (*Salmo trutta*)
- Colorado Cutthroat Trout (*O. c. pleuriticus;* one small basin in the southern Sierra Nevada)
- Brook Trout (*Salvelinus fontinalis*)
- Lake Trout (*S.* namaycush)

Some populations of Brook Trout and Brown Trout continue to be supplemented with hatchery trout, and wild populations of all four of these introduced trout can be found today. Colorado Cutthroat Trout are an exception among this group, being found in one location and sharing a similar biology as other trout native to the Western United States.

Brook Trout and Lake Trout are species of char native to the Eastern United States, the Upper Midwest, and the Canadian Shield. Both are lake spawning, while Brook Trout will also take on stream resident life histories. Brook Trout are well known for the fast action fisheries they often create, with a tendency to overpopulate the high-altitude lakes and streams they occupy. Where little or no spawning habitat is available for Brook Trout, appropriate levels of fingerling stocking can lead to trophy-sized fish. Lake Trout are voracious predators and may reach incredible sizes. They create exciting fisheries in the Sierra Nevada lakes and reservoirs where they are found, Lake Tahoe being the most notable.

Brown Trout have a long legacy in the United States, being brought here over a century ago from European waters. Brown Trout are excellent game fish, eating nearly anything that can fit in their mouth. Fishing can be challenging for Brown Trout, but their tremendous fight and opportunities for trophy sizes have earned this species its place in California as a popular target with important fisheries built around them.

Efforts to protect and enhance watersheds can benefit all species of trout and provide other ecosystem benefits. These efforts are not performed for native forms alone, as trout fisheries are a valuable resource for Californians no matter what species are represented. Some habitats will continue to be best occupied by non-native forms of trout as changes in the environment and angler values dictate.

Landlocked Salmon

Landlocked salmon are sport species stocked and managed in lakes and reservoirs, and do not persist downstream of the barriers they are stocked above. In some populations natural spawning does occur in tributaries to the lakes and reservoirs they reside in, but many landlocked salmon fisheries are reliant on hatchery stocking to maintain a high quality. The landlocked salmon found within California are:

- Chinook Salmon (*O. tshawytscha*); and
- kokanee, the landlocked form of Sockeye Salmon (*O. nerka*).

Chinook Salmon are native to California, while kokanee are not. However, landlocked salmon do not represent life histories of any native California salmon, and are produced for sport only. Landlocked salmon fisheries are similar to trout fisheries in lakes and reservoirs, supported by Department trout hatcheries, and valued by many inland anglers.

Growing Threats to Trout and Cold-water Ecosystems

Trout and cold-water ecosystems throughout the state face unprecedented threats. Trout populations have persisted through well over a century of changes in species composition and degraded habitats, but with changing climatic conditions and a growing human population, these long-term stressors are becoming increasingly difficult to mitigate and reverse.

Climate Change

California's aquatic resources face reduced snowpack, rising air and water temperatures, shifts in seasons, and changes in precipitation patterns among other threats exacerbated by climate change (Hanak and Lund 2008; California Climate Change Center 2009; Moyle et al. 2013). More precipitation occurring as rain rather than snow over a shorter, warmer, winter season greatly increases the risk of flooding (Pierce et al. 2013). This will require water managers to allocate additional capacity in reservoirs for flood protection, leaving less water downstream for all uses, environmental and anthropogenic. Longer, warmer, dry seasons will mean decreased flows in watersheds that are snowpack dependent. Drying may occur in many headwater systems that currently serve as reserves for imperiled native trout. In response to rising temperatures the range of fish species is predicted to constrict and move to both higher altitudes and latitudes (Comte et al. 2013). Downstream migrations may be necessary towards available water (Rapacciuolo et al. 2014).

Periodic catastrophic disturbances—such as flooding, drought, wildfire, and landslides—are a normal and often beneficial function of healthy ecosystems. These events may cause localized extirpations, but connected populations allow for recolonization after habitats recover post-disturbance. Native trout evolved with periodic disturbances and their diverse life history strategies and localized adaptations have allowed species to persist through time. Changes in climate are predicted to increase the frequency and intensity of disturbances, and isolated and vulnerable populations of trout may now be ill prepared to withstand these pressures. If disturbances are frequent, ecosystems may be unable to rebound between disturbance events.

Prolonged and seasonal droughts of variable severity will continue to occur, and trout populations may increasingly be in need of emergency actions if long-term trends continue. Even as California emerges from the 2012-2016 drought, the effects on ecosystems will persist; trout populations will need several years of at least average precipitation to rebound.

Non-native Species

Trout

Non-native trout have been stocked throughout California since the 1870s to enhance recreational opportunities; a legacy that began even prior to the creation of the Department (Dill and Cordone 1997). Wild and self-sustaining populations of Brook, Brown, and Lake Trout are now widespread in California as well as native trout forms established outside of their historic watersheds. The Department recognizes the value of these fishes to many anglers, while also striving to support and conserve native fish in their historic waters.

Unfortunately, the spread of non-native trout has led to the displacement of many native trout from their historic drainages through predation, competition, and hybridization. The Department will continue to manage for high quality non-native trout fisheries where they are not in conflict with current conservation or restoration efforts for native species. The long-term sustainability of native trout depends on widespread reintroductions into their historic watersheds, accompanied by the removal of non-native trout from these areas.

Altered fish assemblages

Non-native gamefish other than trout—such as catfish and black bass—have been introduced and are common across the state. Also common are non-native minnows and bait fish. Trout face additional competition and predation within these novel fish communities. In some areas, these introductions have totally displaced native fishes; in others, native fishes persist but are limited in distribution and abundance within the watershed. Where non-native fish are primary components of aquatic communities, historic food webs and some ecosystem functions have been substantially altered or lost. These novel fish assemblages are commonly found in highly altered areas, where changes to instream habitat, riparian areas, and water flows have disturbed the ecosystem in favor of non-native species.

Habitat Loss and Degradation

The available habitat that trout depend on has shrunk considerably as California's population has grown and development has expanded. The state's population is expected to reach 50 million by the year 2050 (Governor's Office of Planning and Research 2015). As the human population continues to increase, trout face expanding urban centers, and new roads and homes in rural areas. Human expansion and associated development have resulted in:

- channelized streams and rivers;
- reductions in habitat complexity;
- barriers to fish movement;
- diminished water quality and quantity;
- lost habitat features such as spawning gravels; and
- lost habitat refugia that buffer populations during times of high stress or periodic disturbances.

Impermeable surfaces, such as parking lots and rooftops, increase the potential for flooding and reduce groundwater recharge. Withdrawals of surface water, and the infrastructure that support it, can fragment habitat, reduce flows, and diminish water quality.

The demands placed on cold-water habitat throughout the state only serve to exacerbate the threats of climate change and non-native species. All of these threats work in concert to further reduce the availability of cold-water habitat that trout depend upon. Warming temperatures and reduced summer flows from climate change will allow for the expansion of non-native fishes, as well as pathogens and disease, into shrinking suitable habitat for trout. Fortunately, time still exists to mitigate for these impacts and the current political climate within California supports the restoration of habitat and trout populations.

In some areas, disturbances can be remedied and the ecosystem will rebound from its degraded state. In others, the stressors are so long lasting that a new, altered state has emerged; novel ecosystems have been created (Moyle 2014). Depending on the current state of an ecosystem, three broad types of actions exist to address these issues (Hanak et al. 2011):

1. Reserve: Set aside high-quality intact habitat as biological preserves.
2. Restore: Bring altered habitats back to historic conditions.
3. Reconcile: Adjust management practices in novel ecosystems for the benefit of cold-water fish assemblages, maintaining ecosystem function while fitting the needs of humans.

Goals for the Future

Fish and Game Code sets forth a vision of success for trout conservation and management (Fish and Game Code § 1728(b)). This Plan incorporates that vision and expands upon it with the creation of six goals and their associated objectives.[6] These goals and objectives provide a pathway for achieving success and measuring progress, addressing the numerous threats that trout and cold-water ecosystems face. These six goals integrate Fish and Game Code, policy direction, previous strategies identified in the 2003 Plan, current scientific knowledge, and the continued work of the Department:

1. Investigate and Improve Wild Trout Populations
2. Investigate and Improve Stocked Trout Management
3. Integrate Stakeholders
4. Evaluate Water and Land Use Practices
5. Continue Applied Research Activities
6. Increase the Resiliency of Trout Populations

While striving to achieve all goals additional consideration will be given to the following elements:

- Adaptive management: A process that allows managers to take actions in the face of uncertainty, using management action as a learning tool.
- Angler satisfaction: Anglers across the state represent a diverse group. The Department strives to provide an array of trout fishing opportunities to meet the variety of demands.
- Ecosystem management: An approach that considers the impact of management decisions on all ecosystem components, including humans.
- Climate change: Changing climatic conditions could alter trout habitat use and availability. Improving habitat connectivity will provide resiliency to climate impacts.

Implementation of the Plan within a watershed will require coordination of staff across the Department. Within Headquarters, the Branches of the Department are tasked with the development and implementation of statewide policy, while the Department's Regions lead efforts locally. Meeting many of the goals and objectives outlined below will primarily be the responsibility of the Fisheries Branch of the Department, organizing statewide actions to benefit trout resources, and their cold-water habitats.

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[6] The goals and objectives of this Plan are presented as a table in Appendix A.

As we embrace an ecosystem management approach, the silos we sometimes find ourselves in must be broken down. Ecosystem functions span the boundaries we may place between groups of animals or their life histories, and the biotic and abiotic components that make up habitat.

Where watersheds are home to other important wildlife, the assistance of the Wildlife Branch will be needed. When cold-water ecosystems are under threat due to upslope development, staff within the Habitat Conservation Planning Branch can guide land-use planning. If instream conditions are degraded due to dam releases or water diversions, the Water Branch works to find remedies that benefit all uses. When habitat restoration or access initiatives are best performed by dedicated stakeholders, grants are awarded through the Watershed Restoration Grants Branch or the Wildlife Conservation Board.

Securing healthy trout streams and lakes throughout California requires a Plan to build from and gather around, sharing a single purpose:

> *To manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.*
>
> *-Mission statement of the California Department of Fish and Wildlife*

Goal 1: Investigate and Improve Wild Trout Populations

Most trout waters and fisheries throughout the state are occupied and supported by wild trout. Wild trout fisheries (e.g., those that are naturally self-sustaining) are the preferred and most efficient management strategy. These fisheries represent both native and non-native trout. They are best supported by high-quality ecosystems: complex and connected habitat types that possess clean, cold water.

Status and condition of the population

This approach represents the first step in an adaptive management process. Investigating populations allows managers to define problems and determine goals. Appropriate questions may be:

- What is the age class structure of the population?
- Which species are present and how abundant are they?
- Is the aquatic community diverse?
- What is the condition of the fish?
- How is distribution or range changing?

Department biologists have the knowledge and skills to perform these population assessments. Continued monitoring of trout populations statewide is necessary for implementing adaptive management decisions.

Objectives:

- Annually, Fisheries Branch in conjunction with Regional staff will review the information on population status for all designated Heritage and Wild Trout Waters and generate a report.

Status and condition of the habitat

The quality of habitat that wild trout populations occupy has much to do with the quality of the fishery. We can expect to find high-quality trout fisheries where the following is true:

- Water quality is good: cold and free of contaminants.
- Habitat types are complex and support all trout life stages.
- Watersheds are connected, allowing corridors for movement and supporting a variety of life histories.
- The surrounding riparian area is in good condition.

Habitat assessment allows us to determine where improvements are needed to support trout populations, by identifying limiting factors. With this knowledge, we can then work with stakeholders, water operators, and land managers to address these issues for the improvement of trout populations.

When evaluating habitat, it is necessary to consider future habitat conditions that could arise due to climate impacts. While research exists regarding potential overall effects of climate change to trout habitat, fine-scale assessments are needed. Department biologists are actively engaging in developing stream temperature datasets that will help provide insight into localized risks.

Objectives:

- By 2023, Fisheries Branch in conjunction with Regional staff will evaluate, assess, and acknowledge key wild trout watersheds across the state.
- By 2024, Fisheries Branch in conjunction with Regional staff will identify potential climate refugia for trout populations statewide.

Assess and determine appropriate management goals

As a first step in the adaptive management process, managers must define goals and establish specific objectives. The best method for achieving this is the creation of conceptual models: visualizations of implicit cause-and-effect relationships. Through conceptual modeling we can summarize our knowledge surrounding ecosystem structure and identify key uncertainties (CALFED Bay-Delta Program 2000).

For many California native trout and wild trout populations, management goals and strategies have previously been developed and are presented in various documents. These include conservation strategies, recovery plans, and fishery management plans that trout managers will continue to implement. It will be necessary to integrate elements of these management documents in implementing this Plan at the watershed scale. When determining the appropriate goals for a wild trout fishery, biologists must also consider what the appropriate species composition is for an individual water at the current time and in the future. This may or may not include the presence of native trout, as some wild trout fisheries provide quality angling for introduced species. Sometimes we can achieve recovery in the presence of existing fisheries; at other times, we must make a difficult choice to either preserve non-native trout fisheries or replace them with native species. These decisions should be guided by angler use and preference, project feasibility, and the level of impact to native species.

Objectives:

- Annually, Fisheries Branch will recommend to the Fish and Game Commission 25 miles of stream and one lake to be managed as Heritage or Wild Trout Waters based on a systematic phased assessment of the population and fishery.
- Annually, Regional staff will evaluate existing management goals and associated response within the fishery for all Heritage and Wild Trout Waters.
- By 2023, Fisheries Branch will develop a process by which stakeholders provide annual input on wild trout management at the Regional and statewide level.
- By 2024, Fisheries Branch will implement a process by which stakeholders provide annual input on wild trout management at the Regional and statewide level.

Harvest management

One of our best direct management tools is the use of angling regulations, and their enforcement, to direct the level of harvest to achieve sustainable wild trout fisheries. These actions should be driven by clear management planning and must fit within larger watershed and statewide goals. Department biologists must balance the recruitment potential of a wild trout population with a sustainable level of harvest, while considering angler preferences.

Managing the take of wild trout through bag and possession limits or gear restrictions can affect the number of trout in a population, the size of trout, and increase the availability of trout to a greater number of anglers. Where trout populations are sensitive to harvest, angling mortality may be reduced by implementing catch-and-release regulations along with gear restrictions. Where trout fisheries exist along with populations of sensitive non-target species, gear restrictions can reduce bycatch or increase post-release survival.

The complexity of angling regulations has been identified as a potential barrier to angling participation (Aquatic Resources Education Association and Recreational Boating & Fishing Foundation 2016).

Between the years 2018 and 2020, the Department, with the input of stake holders, conducted a review of all inland trout angling regulations with a goal of reducing complexity and increasing consistency where possible. A revised suite of inland trout regulations was implemented in 2021. As part of that effort significant changes were made based on extensive assessments regarding current management goals for California trout fisheries.

Angling regulations can only meet desired results when anglers adhere to them. Generally, anglers are aware of the utility of regulations and behave ethically in following them. Where compliance is deemed sufficiently low, Fish and Wildlife Wardens work to educate and cite individuals. Department biologists throughout the state should continue to consult and collaborate with Fish and Wildlife Wardens in monitoring high-priority wild trout waters. The Department continues to host a confidential secret witness program known as CalTIP.[7] Biologists can support this program by discussing it with constituents and including CalTIP information in outreach materials.

Objectives:

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[7] Information available at: [CalTIP]

- By 2022, Fisheries Branch in conjunction with Regional staff will generate a list of priority waters and begin monitoring these waters to ensure that changes to the regulations are effective in sustaining quality wild trout fisheries.
- By 2022, Fisheries Branch will create a standard step-wise approach to guide wild trout assessment and management recommendations.
- By 2022, Fisheries Branch will create a working group with the Department's Law Enforcement Division to evaluate issues facing trout fisheries across the state.

Native trout genetics

Native trout have suffered from a century-and-a-half of genetic mixing with domesticated and introduced trout. An essential component of trout conservation in the future will be preserving genetic diversity, while preventing or minimizing additional introgression. Trout genetic data allows managers to:

- determine which remaining populations can act as reserves for reintroductions;
- understand historic population connectivity;
- introduce individuals to populations to increase genetic diversity; and
- detect non-native trout invasions.

Genetic management plans are created for the conservation of native trout, and to guide hatchery practices in some areas. A Department funded genetics lab will assist managers in developing and meeting the goals of these plans. Basin planning efforts and assessment rely on genetic information of native trout to determine appropriate steps towards restoring connectivity or reintroducing populations. Conserving genetic diversity is also a climate adaptation strategy.

Objectives:

- By 2023, Fisheries Branch in conjunction with Regional staff will identify high-priority populations for genetic status assessment.
- Beginning in 2023, Fisheries Branch in conjunction with Regional staff will identify native trout populations in need of conservation programs and draft genetic management plans as programs are implemented.

Goal 2: Investigate and Improve Stocked Trout Management

> *The right fish, released for the right purpose, at the right location, in the right numbers, at the right time.*
>
> -*Strategic Plan for Trout Hatcheries* (California Department of Fish and Wildlife 2021)

Production and stocking of hatchery trout has a long history in California and continues to provide anglers with abundant and diverse trout fishing opportunities. Trout managers have numerous options in species, strain, and size of trout at stocking time from the state's hatchery system. The hatchery system features increasing production of native trout strains as the Department works towards goals found in Fish and Game Code (§§ 1728(c)(4)(C) and 13007(b)(4)). Some facilities have persisted for over one hundred years, while their dedicated staffs have adapted to shifts in policy and management decisions. The Strategic Plan for Trout Hatcheries (Hatchery Plan) covers in detail the ways that the Department will continue to meet the demand for fishery enhancement through trout production (California Department of Fish and Wildlife 2021). How these fish are allocated and the management principles that drive these decisions are subjects of this Plan. Stocking of hatchery fish provides a pathway for the sustainable use of all trout. By providing trout for consumptive use in some areas we can alleviate pressure on wild trout in others.

Status and condition of the habitat

The habitat conditions that trout are stocked into can greatly affect their success. Expectations of a high-quality fishery must be tempered with what a habitat can support. Some bodies of water can support tremendous growth and overwintering of trout. Other waters, such as community ponds, are only seasonally appropriate for trout survival. As conditions shift due to annual variation or climate impacts, the success of stocked trout in a habitat also changes. Cold-water pools in reservoirs may decrease during dry years, limiting the carrying capacity of a reservoir and raising downstream temperatures. Similar impacts can be expected in natural lakes and in community ponds. Regular assessment of stocked trout habitat allows Department biologists to practice adaptive management, selecting the right species and strain for an allotment or changing stocking time to fit fishery needs.

Objective:

- By 2026, Fisheries Branch will develop guidelines for species and strain selection based on environmental conditions.
- By 2024, Fisheries Branch in conjunction with Regional staff will identify stocked trout fisheries that are resilient to dry years and climate impacts.

Assess and determine appropriate management goals

For waters that are being evaluated or considered for stocking, it is valuable to collect data in relation to angler use, catch rates, and survival of hatchery trout. Hatchery trout survival and return to creel can be minimal in some waters, particularly in streams and rivers. In these situations, hatchery trout should be reallocated to better performing waters, where utilization is higher. Generally, larger fish have a greater return to creel than smaller fish—with a wide range in costs per fish caught—and survival and return to creel is greater in lakes than in rivers (e.g., Miller 1958, Walters et al. 1997). The allotments of hatchery trout statewide are in continual need of review, as it may be possible to increase angler use of stocked trout if popular and consumptive-use fisheries are targeted. Important insight into appropriate stocking allotments can be gained from:

- accessibility for anglers (e.g., boat ramps, shore, campgrounds);
- habitat quality;
- biological productivity;
- presence of predators that could limit stocking success;
- behavior and biology of different trout species or strains;
- local interest;
- management objectives; and
- angler satisfaction and preferences.

Periodic review of allotments based on credible science should occur to ensure that the Department is stocking fish where they will be caught. Waters that can support growth and survival but lack suitable spawning habitat should be managed as put-and-grow fisheries. Where growth is minimal, or where demand is higher than a put-and-grow or wild trout fishery can support, allotments of catchable-sized trout become more appropriate. However, stocking trout in wild trout fisheries may have detrimental effects on wild trout abundance, and wild trout fisheries are preferable where they can support fisheries without supplementation. Where the potential exists for establishing a wild trout fishery, but recruitment has been limited in the past, consideration should be given to periodic stocking of diploid fish.

Altered systems—such as reservoirs and dam tailwaters—may have conditions more favorable to non-native trout. When stocking non-native trout is not in conflict with restoration or recovery goals, their use can create unique high-quality fisheries.

An adaptive management approach applied to stocking decisions could provide new insights to the best use of hatchery fish. Examples already exist in developing analytical models to determine optimal fish size and stocking strategies (e.g., Lorenzen 2000, Dabrowska et al. 2014)., which is a crucial step in the adaptive management process. As hatcheries diversify their production to reflect native trout—as described in the Hatchery Plan—gaps in knowledge will grow in how hatchery fish perform on the landscape. Our ability to adjust strains, fish sizes, and allotment sizes provides perhaps the best opportunity we have to perform adaptive management studies.

The suitability of a stocking location is also dependent upon the presence of native species that may be affected negatively by stocking. The pre-stocking evaluation protocol (PSEP) was developed to assess these impacts (included as Appendix C). Use of the PSEP presents an opportunity to investigate standardized management goals while implementing native species protections. When determining management goals within a watershed, consideration should be given to the preservation of important fisheries in balance with the recovery of species in decline.

Objectives:

- By 2021, Fisheries Branch will create a list of all stocked waters and allotment sizes.
- By 2021, Fisheries Branch will integrate management-based rationale into the PSEP.
- By 2022, Fisheries Branch will develop standardized methods for determining stocking goals, species selection, and allotment sizes.
- By 2022, Fisheries Branch in conjunction with Regional staff will apply standardized methods to stocked waters throughout the state, and determine efficacy through an adaptive management process.

Harvest management

When managing for successful stocked trout fisheries we can utilize direct management strategies to ensure that fisheries are meeting management goals. A balance can be found between angling regulations that limit harvest and stocking frequency. This may take multiple years when utilizing put-and-grow strategies, or we can see immediate results using catchable sized trout. Bag limits may be used to ensure that fish are encountered by a greater number of anglers or to allow stocked trout to remain in a fishery long enough to put on substantial growth. Achieving these results is reliant upon anglers complying with angling regulations. Biologists can collaborate with Fish and Wildlife Wardens to communicate angling regulations and ensure they are enforced. Similarly, Wardens provide keen insights into the suitability of regulations on the waters they patrol due to their interaction with the public. Wardens are consulted when new angling regulations are proposed, and this practice will continue.

Objectives:

- By 2022, Fisheries Branch in conjunction with Regional staff will review angling regulations so that they are consistent and provide management for sustained quality stocked trout fisheries.
- By 2023, Fisheries Branch will create a standard step-wise approach to guide stocked trout assessment and management recommendations.

Ecosystem considerations

The production of the EIR for Department hatchery and stocking programs addresses in depth the potential harm hatchery fish may pose. The stocking of hatchery-reared fish can affect all ecosystem members and must be carefully considered. Changes in species occupancy through time—including in response to climate change impacts—require that pre-stocking evaluations be updated periodically. There are additional ecosystem-related issues beyond the scope of the PSEP, and stocking of trout must be done in consideration of:

- genetic effects of mixing multiple trout populations, even when they are the same species;
- introduction of diseases or pathogens into wild populations of trout;
- population-level effects of adding more individuals, and ecosystem carrying capacity;
- suitability of trout species or strains for certain habitat conditions; and
- presence of non-native species that may outcompete translocated or stocked fish.

Non-anadromous populations of Coastal Rainbow Trout are not included in the list of decision species in the PSEP. However, their conservation value should not be dismissed. These populations are often part of a larger metapopulation, and stocking of out-of-basin, non-native, or domesticated trout should be avoided when historic lineages of Coastal Rainbow Trout can be impacted. Threats include the loss of native genetic profiles through introgression with out-of-basin or domesticated Coastal Rainbow Trout and direct competition for resources.

Objectives:

- Beginning in 2021, and every five years following, Regional staff in conjunction with Fisheries Branch will update and review pre-stocking evaluations for all stocked waters.

Sterile fish production and management

The production of sterile fish at hatcheries serves as another measure to mitigate the impacts of stocking. A majority of the non-native and domesticated strains of hatchery trout produced at California's hatcheries are sterile to prevent introgression with native trout or the establishment of new wild populations. Trout sterility is induced most commonly through the application of pressure or heat to trout embryos, which causes the production of an additional set of chromosomes, also known as inducing triploidy. Certain exceptions exist to allow the stocking of fertile (diploid) trout, including where:

- reproducing trout are necessary to meet management goals (e.g., broodstock lakes); and
- genetic impacts are negligible.

Trout managers should develop a set of criteria to assist decisions on using diploid trout, as hatchery savings and efficiency can be achieved when avoiding the added expense of producing triploid trout.

Objectives:

- By 2022, Fisheries Branch will develop statewide standards for the use of both diploid and triploid trout.
- By 2022, Fisheries Branch in conjunction with Regional staff will perform efficacy evaluations of triploid trout allotments to determine if management objectives are being met.

Conservation purposes

Hatcheries can support the conservation of trout through a variety of efforts. The facilities and their adaptable staff have successfully shown that they are well suited to provide refuge for at-risk populations in extreme events. Production of native strains may support reintroduction efforts in the future, and potentially have a role in meeting recovery goals. Although hatcheries can provide critical elements of conservation, production and stocking alone cannot constitute species recovery. Development of “Trojan Y Chromosome” broodstocks may prove to be a valuable tool for the removal of undesirable populations of trout (see Gutierrez and Teem 2006; Cotton and Wedekind 2007; Schill et al. 2016), but further research is needed to evaluate the field-efficacy of this method. The expanding role of trout hatcheries and the ways they will continue to adapt is detailed in the Hatchery Plan.

Objectives:

- By 2024, Fisheries Branch in conjunction with Regional staff will evaluate all hatchery facilities statewide for their potential of establishing native trout conservation programs.
- By 2024, Fisheries Branch in conjunction with Regional staff will assess the efficacy and ability of the hatcheries to maintain and produce Trojan Y Chromosome broodstock for conservation purposes.
- By 2024, Fisheries Branch in conjunction with Regional staff will create hatchery conservation plans for facilities suitable for conservation programs.

Non-native and domesticated strains

By producing a suite of strains and species options in hatcheries, trout managers are able to sustain diverse as well as economically and socially valuable fisheries across the state. Hatchery production of different strains and species can support fisheries when and where they would not otherwise exist. Providing a diversity of trout allows the Department to adapt in the face of changing environments and recreational needs. Although non-native and domesticated strains may not be well suited for all situations—both in the hatchery and on the landscape—maintenance and use of these fish should be supported. Evaluations of non-native and domesticated strains are needed periodically to assess their performance in both stocked waters and in the hatchery.

Objective:

- By 2022, Fisheries Branch in conjunction with Regional staff will evaluate existing domesticated and non-native strains for operational success and efficacy.

Native broodstocks

Hatchery production of fish native to their watersheds may allow managers to meet the demands of anglers while protecting native populations. Occasional incorporation of wild fish will allow hatcheries to maintain a broodstock representative of their native ancestry. Before any additional expansion in the use of native broodstock occurs, the following considerations must be accounted for:

- Culture of broodstocks be done in continued isolation of domesticated strains.
- Continual genetic monitoring of broodstock lineage and allelic representation.
- Continued disease monitoring to prevent introduction of pathogens into wild fisheries.
- Hatchery infrastructure and budget constraints.

Native hatchery stocks should be diverse and represent all life histories. These changes will require a significant departure from the business-as-usual operations of state hatcheries. Conservation and enhanced angling opportunities can be achieved with support from trout managers and through the goals and actions of the Hatchery Plan. Where non-native fish are removed, the availability of native broodstocks may be an asset for Department trout managers. Wild-native populations will remain the preferred source for the restoration of native populations into their historic watersheds. Production and maintenance of native broodstocks will primarily be for recreational purposes.

Objective:

- By 2023, Fisheries Branch in conjunction with Regional staff will create conservation hatchery guidelines to direct native broodstock development.

Goal 3: Integrate Stakeholders

The Department alone cannot accomplish the goals in this Plan. It is necessary that the Department work with anglers, non-profit organizations, businesses, and landowners, as well as tribal governments and other state, local, and federal agencies. When planning actions, an approach that is inclusive of all stakeholders is essential. All Californians depend on cold-water ecosystems for their well-being, and a wide range of people depend on trout and natural landscapes for recreation. Any process that affects these resources should be transparent to stakeholders, with the Department acting in the role of trustee for fish and wildlife. Successful implementation of the goals of this Plan is reliant upon engaged stakeholders that are willing to contribute their collective abilities, knowledge, and resources for the improvement of cold-water ecosystems.

Stakeholder input

The goals of this Plan are in the common interest of many groups across the state. Department staff should be proactive in seeking stakeholder input. Through ecosystem-based management and working to improve landscapes and habitat, a greater range of stakeholders can be engaged in the improvement of trout resources. The wide range of stakeholders with an interest in cold-water ecosystems bring a diversity of experiences and perspectives that will improve the Department's ability to manage trout populations.

Objective:

- By 2024, Fisheries Branch will create a process by which stakeholders will provide input on trout-based management at the watershed scale.

Statewide angler survey

The Department holds the dual responsibilities when managing trout populations of providing sustainable recreational opportunities and protecting species. A statewide survey of angler use of fisheries and their preferences will allow the Department to better meet recreational demands and assign limited resources. A statewide survey can also help shape watershed planning efforts, hatchery stocking allotments, and future revisions of this Plan.

Objective:

- By 2022, Fisheries Branch in conjunction with the Department's Human Dimensions of Wildlife Conservation Unit will generate a report based on the results of the Department's Angler Preference Survey.

Citizen science

Anglers and people with a close connection to their local water resources present a sometimes-underutilized source for conducting research. These individuals are motivated and interested in assisting the Department collect information. Through implementing citizen science programs, Department staff can tap this resource and broaden their data collection efforts. Engagement in science allows constituents to not only feel involved in management actions, but also provides a better understanding of their resources. These types of programs have long been utilized by the Department in the form of specialized report cards, angler survey boxes, and targeted surveys. These data will continue to be an asset, along with any new developments that increase accessibility, transparency, and the Department's use of technology.

Objectives:

- By 2023, Fisheries Branch in conjunction with Regional staff will evaluate efficacy and create standard procedures for angler survey box use.
- By 2023, Fisheries Branch will provide a web-based portal for trout-angler entry of catch information.

Increase public understanding and appreciation of trout

Anglers in California have opportunities that are difficult to find anywhere else. Trout can be found throughout the state, from urban areas to remote backcountry settings. The diversity of trout ranges across a wide variety of colors, sizes, and life histories. Angling opportunities for trout exist year-round in select waters. Despite this, license sales and utilization of these resources have diminished through time. A crucial step towards promoting trout fishing in California is providing a foundational knowledge of trout, their habitat, and angling. The following efforts from the Department will continue in order to promote interest in trout:

- Classroom Aquarium Education Program[8]
- Heritage Trout Challenge
- Outreach at hatcheries
- Fishing in the City[9]

In order to facilitate improvements in engagement with current and prospective anglers, the Department has generated the California Hunting and Fishing Recruitment, Retention and Reactivation Action Plan (R3 Plan) (California Department of Fish and Wildlife 2019), overseen by the Department's R3 Program. A broad-scale marketing strategy, including the use of social media, can help reach a wide group of stakeholders (R3 Plan, Topic 6). New materials should be far reaching and engaging for experienced anglers, individuals interested in learning to catch trout, or groups that appreciate wildlife viewing and natural landscapes. Eliminating barriers to entry, such as providing local access to fishing opportunities or changes to fishing license structure, can help increase angling participation (R3 Plan, Topics 1 and 7). As the implementation of the R3 Plan continues, trout biologists must remain engaged with the R3 Program to ensure an increase in public understanding and appreciation of trout through new outreach strategies, as well as the implementation of any objectives originating from the R3 effort.

Objective:

- Beginning in 2021, Fisheries Branch will integrate with the R3 Program to enhance and amplify outreach regarding trout angling and conservation opportunities.

Access to information

The Open and Transparent Water Data Act requires the Department of Water Resources to maintain a publicly available database of all aquatic and fisheries data throughout the state (Water Code §§ 12400 et seq.). The inclusion of trout, habitat, and water data in this database will be an asset for Department biologists and other stakeholders. Implementation of the Open and Transparent Water Data Act will be phased in through 2020.

An increasing number of documents are made available through the Department website as part of an effort to maintain transparency. Products aimed towards the public should be written in a style that is readable for all people—concise and lacking scientific jargon or overly complicated phrasing—and accessible to individuals with disabilities. To aid in communicating research to the scientific community the Department maintains its quarterly scientific journal, *California Fish and Game*.[10]

Objectives:

- By 2022, Fisheries Branch will finish Department trout and habitat data server framework with public access.

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[8] Classroom Aquarium Education Program information available at: Classroom Aquarium Education Program
[9] Fishing in the City information available at:Fishing in the City
[10] Available at: Califronia Fish and Wildlife Journal

- Beginning in 2022, Fisheries Branch will collaborate with the Department of Water Resources for the inclusion of trout and habitat data in their implementation of the Open and Transparent Water Data Act.

Goal 4: Evaluate Water and Land Use Practices

The demand for clean, cold water in California will only continue to grow along with the state's population. Water operators must balance water supply and output with both human and environmental uses. Land use practices have a great effect on the seasonal availability of water, as healthy natural landscapes tend to store water while developed lands do not. The growing threat of climate change adds to the stressors of land use and water demand due to seasonally reduced surface water availability, and the greater potential for drought and floods. Ensuring that water and lands are managed for overall watershed health is imperative to the sustainability of our trout fisheries.

Land use planning

As California's population continues to expand it is inevitable that conflicts will occur between land development and cold-water ecosystems. The Natural Community Conservation Planning (NCCP) process allows for appropriate development and growth while protecting species and the habitats they depend on. A local agency oversees the development of an NCCP plan, working with landowners and other stakeholders, and the Department and U.S. Fish and Wildlife Service provide direction and support. Department biologists should proactively seek opportunities to provide input on land use beyond the NCCP process as well, including permitting under Lake and Streambed Alteration Agreements and the California Endangered Species Act.

An additional opportunity for voluntary land-use planning is available in the Department's Regional Conservation Investment Strategies Program. This program is intended to result in conservation actions that benefit focal species and their habitat.[11] Conservation actions taken under an approved Regional Conservation Investment Strategy may result in the creation of advance mitigation credits.

Objective:

- By 2023, Fisheries Branch in conjunction with Regional staff will create an assessment of key water and land use issues and opportunities for trout across the state.

Fish passage and flows for fish maintenance

The legal standards of the public trust doctrine and FGC § 5937 necessitate that dam operators allow sufficient downstream flow to maintain fish in good condition. The definition of "good condition" has evolved somewhat through case law, but is best defined at the individual, population, and community level (Moyle et al. 1998). Moyle et al. (1998) further defines good condition as disease-free individuals of good health, populations that represent all life histories and will persist indefinitely, and communities that:

- are dominated by co-evolved species;
- represent multiple trophic levels and have limited niche overlap;

[11] Program information available at: Regional Conservation Investment Strategies Program

- are resilient against disturbances;
- persist in species membership through time; and
- are replicated geographically.

Determining flow criteria that are most beneficial for aquatic communities is a task performed by the Department's Instream Flow Program (IFP).[12] The IFP provides flow criteria to the Water Resources Control Board, which oversees water rights and changes to use permits. Trout biologists must work to determine where fish are not in good condition and collaborate with the IFP to develop new flow criteria.

In addition to the requirements of maintaining fish in good condition, constructing or maintaining a barrier to fish passage is not allowed throughout much of the state (Fish and Game Code § 5901). This requirement is often complimentary of Fish and Game Code § 5937 in the issuance of Lake and Streambed Alteration Agreements (Fish and Game Code §§ 1600 et seq.).

Objective:

- By 2023, Fisheries Branch in conjunction with Regional staff will create a list of high-quality trout waters currently impaired from dam and diversion operations, or those that could benefit from revised flow regimes.

Natural flow regimes

The historic pattern of flow regimes in California have been altered below many large dams. Flows in these systems are driven seasonally by water demand and daily by energy demand, rather than natural sources such as snow melt and rain events. The practice of rapidly increasing flow through a hydroelectric plant to meet daily energy demands—known as "hydropeaking"—has been shown to limit trout prey resources such as river-edge egg-laying macroinvertebrates (Kennedy et al. 2016), a common life history in mayflies. Seasonally, river flows that mimic natural and historic flow regimes have been shown to be beneficial to fish communities (Marchetti and Moyle 2001; Propst et al. 2008; Wenger et al. 2011; Kiernan et al. 2012).

A natural flow regime for trout means maintaining seasonally appropriate minimum flows for target species and their life stages present, attractant flows for migrating fish, additional flows for spawning fish, and periodic high flow events for channel restoration and to limit non-native species abundance. Trout biologists, working with water operators, should focus on ecosystem processes, maintaining river function in highly altered systems while meeting the needs of an expanding population (Yarnell et al. 2015). This is an example of reconciliation, as a return to historic conditions is unlikely in many rivers with large dams present.

Objective:

[12] Program information available at: Instream Flow Program

- By 2023, Fisheries Branch in conjunction with Regional staff will create a list of high-quality trout waters that are currently affected by water operations that could benefit from more natural flow regimes.

Goal 5: Continue Applied Research Activities

The Department must rely on credible science in order to make defensible decisions regarding the fish and wildlife resources held in trust. Department biologists must be science integrators, taking broad ideas from both local and global researchers and synthesizing them into management decisions (California Fish and Wildlife Strategic Vision Project 2012). This requires Department biologists to have the ability to develop relationships with researchers, conduct in-house research when needed, and to practice adaptive management as we gain new information.

Targeted research

Targeted research occurs when we can test hypotheses while accounting for variability. Department scientist engagement in targeted research has diminished over time, best seen in a steady decrease in the rate that Department staff publish journal articles. This is largely due to a shift of focus to meeting regulatory requirements rather than performing research. It is imperative that the Department make research a priority, and develop and employ scientific experts to meet research needs as they arise. This research should be published in scientific journals to disseminate findings to colleagues. Research should be focused on management objectives, to gain better scientific understanding of fisheries-related issues and strengthen management decisions.

Objective:

- Beginning in 2021, Fisheries Branch in conjunction with Regional staff will create a prioritized list of applied research projects with associated budgets and timelines.

Adaptive management

Adaptive management provides an opportunity to increase knowledge of the systems we manage by pursuing multiple management options. Conventional resource management often assumes that there exists single-best solutions and that these solutions can be determined ahead of time. However, ecosystems are complex and managers may fail to detect differences between the effects of management actions and random environmental occurrences (Walters and Holling 1990). Adaptive management is necessary to successfully address climate change among other stressors. Rather than expecting single-best solutions, adaptive management recognizes uncertainties and relies on our management decisions to serve as tools for learning.

While adaptive management is often discussed as the preferred management technique, true examples of adaptive management are rare. Walters (2007) identifies three institutional hurdles—across all organizations—to implementing adaptive management:

1. Lack of management resources for the expanded monitoring needed to carry out large-scale experiments.
2. An unwillingness by decision makers to admit and embrace uncertainty in making policy choices.

3. Lack of leadership in the form of individuals willing to do all the hard work needed to plan and implement new and complex management programs.

The Department is unique in that adaptive management is institutionally accepted, and a mandate exists for the use of adaptive management when managing trout (Fish and Game Code §§ 1726.1, 1728, & 1729). Department biologists are empowered to implement management actions, but they must adhere to the adaptive management framework in order to ensure they are making defensible decisions. Opportunities exist to implement adaptive management studies that investigate the outcome of direct management actions; such as angling regulation changes, stocking events, species removals, and changes in water and land use. As part of the process, continued monitoring must occur in order to detect a change in conditions.

Objective:

- By 2023, Fisheries Branch in conjunction with Regional staff will assess all proposed targeted research projects for adaptive management opportunities.

Goal 6: Increase the Resiliency of Trout Populations

Populations of trout face both long- and short-term threats to survival and persistence. Periodic disturbances such as wildfire, flooding, and drought are normal in the landscape trout have evolved in. However, anthropogenic changes to watersheds and aquatic communities over the last century-and-a-half, along with the growing threat of climate change, have left many trout populations and the habitat they rely on in need of support. Broad connectivity between trout populations provides resilience to disturbances and climate change. As streams warm and flows become seasonally lower, trout must be provided pathways for migration to more optimal habitat. When localized extinctions do occur, large connected populations allow for the preservation of unique genetic forms and their reestablishment when favorable conditions return.

Watershed restoration

Stakeholders often conduct restoration efforts in trout habitat in cooperation with the Department. The Department oversees the distribution of funding for restoration from many sources. Currently, the largest of these funds come from the *Water Quality, Supply, and Infrastructure Improvement Act of 2014* (Proposition 1), administered through the Watershed Restoration Grant Program.[13] A second large source is the Wetlands Restoration for Greenhouse Gas Reduction Grant Program, which distributes proceeds from the sale of Cap and Trade credits.[14] Restoration of mountain meadows under this program have the potential to benefit trout habitats downstream. Meadow restoration aids in the storing of carbon, retention of surface water, water cooling through enhanced shading, and an increase in connectivity to groundwater.

Restoration under these grant programs should, in part, be directed to high-priority trout waters in the implementation of this Plan. The recognition of key areas that provide connectivity and refugia for populations of trout will assist project reviewers in determining which proposals are best aligned with

[13] Grant information available at: Restoration Grants Solicitation Information

[14] Grant information available at: Wetlands Restoration for Greenhouse Gas Reduction Program

management priorities. Restoration and planning efforts should encompass watershed units, rather than piecemeal sections of habitat. This allows for greater resiliency of trout by establishing habitat connectivity, metapopulations, and refugia from periodic catastrophes.

Objective:

- By 2022, Fisheries Branch in conjunction with Regional staff will develop a list of restoration needs for high-priority trout waters.

Department water and property acquisitions

The Wildlife Conservation Board (WCB) is responsible for the acquisition of Department real property, including property rights and water rights. Rights and properties purchased by the WCB are held in public trust, ideally for an indefinite period. Biologists can work to identify acquisitions that would benefit trout populations. New acquisitions should provide refugia for populations, preserve cold water and high-quality habitats, or offer pathways for connectivity between populations, and consider future habitat under climate change. A list should be maintained of properties or rights that would be most beneficial to trout populations for WCB consideration. While minimum flow standards and adjudicated systems exist for some rivers, many fisheries would further benefit by leaving additional flows appropriated for environmental use. Conservation-minded stakeholders should be identified in watersheds and provided opportunities to engage in an acquisition or water transfer program (Water Code § 1707).

Objectives:

- By 2022, Fisheries Branch in conjunction with Regional staff will develop a list of acquisitions that can enhance both trout resources and associated conservation values.

Non-native fish removal

The improvements we may make in ecosystem connectivity and habitat may be of little value for the protection of some native trout populations. The greatest barrier to population connectivity in many native trout populations is the presence of non-native trout. Reconnecting watersheds prior to removal efforts may compromise the genetic integrity of native forms or increase completion by allowing for the expansion of non-native species.

Non-native species removal represents a difficult and sometimes lengthy process even in the absence of additional stressors. Adding complexity to habitats can similarly add complexity to removal efforts. Before expanding any efforts to improve ecosystem conditions and connectivity in a watershed it is necessary to first determine a goal for the composition of the aquatic community; this may or may not include the presence of non-native fishes.

Maintaining separation between native trout and reproductively compatible introduced trout populations prevents the loss of unique genetic material through hybridization. In addition, competition and predation from non-native species may cause localized extirpations of native trout. Because of the threat non-native species represent, barriers to migration are sometimes created rather than removed. In these scenarios, it is necessary to first remove non-native fish populations prior to watershed level restoration efforts. This is usually accomplished through the mechanical removal of fish—with gill nets or electrofishers—or the application of chemicals lethal to fish.

The use of rotenone—the most commonly used fish removal chemical compound—has been greatly reduced in recent years due to various political, administrative, and legal hurdles. The Department has shown that rotenone can safely be used in order to protect all downstream users while achieving fisheries management goals. Rotenone is perhaps the best tool available to Department biologists to increase population resiliency through the removal of non-native species. Achieving the goals of this Plan is dependent upon expanding its use.

Objectives:

- Beginning in 2021, Fisheries Branch in conjunction with Regional staff will develop a chemical treatment committee tasked with designing and implementing treatment protocols and identifying priority treatment projects.
- By 2022, Fisheries Branch in conjunction with Regional staff will create guidelines for non-native fish eradication methods with associated costs based on species, habitat, and feasibility.

Fish rescues

Loss of localized populations will take place due to periodic disturbances; a normal occurrence over long periods of time. However, some populations are unable to withstand these pressures due to low abundance and habitat fragmentation. Where resiliency to disturbances has been lost, performing a rescue operation may be needed to ensure the long-term survival of a population, or even a species in some cases.

The 2012-2016 drought prompted the Department to draft a suite of response measures that involve monitoring at-risk populations, sensitive habitat, and evaluations of translocations or fish rescue options.[15] Translocation or rescue options may be triggered by high threat levels determined from the monitoring information as a last-best option. Utilization of these drought measures resulted in translocation or rescue-into-captivity efforts to save at-risk populations of:

- McCloud River Redband Trout;
- Lahontan Cutthroat Trout;
- California Golden Trout; and
- Coastal Rainbow Trout.

Some trout hatcheries have new capacity for conservation purposes with recently installed recirculating aquaculture systems. These new equipment provide secure facilities to house rescued and at-risk populations during disturbances. The Strategic Plan for Trout Hatcheries includes more detail regarding the expanding features and use of hatchery facilities.

Objectives:

[15] Draft guidelines available at: Risk Assessment and Relocation Guidelines

- By 2023, Fisheries Branch in conjunction with Regional staff will create guidelines and threat-based criteria that incorporate hatchery operations, reintroduction triggers, and associated protocols to address at-risk trout populations.

Stocking and translocations of native trout

Wild populations of native trout, or their hatchery-reared progeny, may be stocked or translocated for reasons such as:

- facilitating genetic mixing in metapopulations that are now isolated;
- rescuing populations threatened by environmental or manmade disturbances; and
- reintroducing native populations into historic watersheds where they have been extirpated.

The guidelines within this Plan and the PSEP must be used when stocking or translocating native trout as well, to ensure that we are not moving trout to the detriment of other native species. This includes both translocating trout into habitats occupied by the same form, which should be done in close consideration of genetic effects and ecosystem carrying capacity, as well as translocating trout which may express health or disease concerns.

Objectives:

- By 2022, Fisheries Branch in conjunction with Regional staff will develop guidelines for Department movement of native trout.

The Next Step: Watershed Planning

While some objectives of this Plan require a statewide effort, many will necessitate planning at the watershed scale. Watershed planning provides a geographic scope, encompassing an entire ecosystem. This will require a directed effort across Department Branches and Regions in collaboration with all stakeholders. By planning for management at the watershed scale, rather than a single species or ecosystem function, the Department can better leverage available resources in a coordinated effort. Achieving the goals of this Plan will require the creation of trout watershed management plans. These trout watershed management plans will be data driven, conservation based, and consistent in format throughout California (Fish and Game Code §1730(b)). They will identify:

- the presence, distribution, and status of trout, the habitat they depend on, and other ecosystem components;
- the appropriate trout management goals for available cold-water habitats within the watershed, including hatchery stocking goals and aquatic community restoration through fish removals;
- opportunities for fisheries development, including access;
- key stakeholders and other interested parties; and
- opportunities for alignment with existing regional planning efforts in order to reconcile human use of watersheds, historic fisheries management, and key conservation activities or concerns.

In the past, many trout populations were managed individually across a watershed and in an opportunistic manner. Managing at the watershed scale will provide greater continuity, ecosystem integrity, and overall resiliency. Integrating stakeholder involvement and comprehensive assessment of the resources at the watershed scale aligns management priorities, long-term planning, and stakeholder interests. Managing for ecosystem health allows for the inclusion of a larger group of stakeholders with varied interests, working to achieve common goals.

Objectives:

- Beginning in 2023, Regional staff in conjunction with Fisheries Branch will annually draft one trout watershed management plan across the state with stakeholder input.
- By 2023, Fisheries Branch in conjunction with Regional staff will convene an ad hoc committee for the peer review of trout watershed management plans.

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Strategic Trout Management Team

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Appendix A: Summary of Goals and Objectives

Goal	*Description/Target*	*Objective*	*Timeline*
1	Status and condition of the population	Review the information on population status for all designated Heritage and Wild Trout Waters and generate a report	Annually
1	Status and condition of the habitat	Evaluate, assess, and acknowledge key wild trout watersheds across the state.	By 2023
1	Status and condition of the habitat	Identify potential climate refugia for trout populations statewide.	By 2024
1	Assess and determine appropriate management goals	Recommend to the Fish and Game Commission 25 miles of stream and one lake to be managed as Heritage or Wild Trout Waters based on a systematic phased assessment of the population and fishery.	Annually
1	Assess and determine appropriate management goals	Evaluate existing management goals and associated response within the fishery for all Heritage and Wild Trout Waters.	Annually
1	Assess and determine appropriate management goals	Develop a process by which stakeholders provide annual input on wild trout management at the Regional and statewide level.	By 2023
1	Assess and determine appropriate management goals	Implement a process by which stakeholders provide annual input on wild trout management at the Regional and statewide level.	By 2024
1	Harvest management	Generate a list of priority waters and begin monitoring these waters to ensure that changes to the regulations are effective in sustaining quality wild trout fisheries.	By 2022

Goal	Description/Target	Objective	Timeline
1	Harvest management	Create a standard step-wise approach to guide wild trout assessment and management recommendations.	By 2022
1	Harvest management	Create a working group with the Department's Law Enforcement Division to evaluate issues facing trout fisheries across the state.	By 2022
1	Native trout genetics	Identify high-priority populations for genetic status assessment.	By 2023
1	Native trout genetics	Identify native trout populations in need of conservation programs and draft genetic management plans as programs are implemented.	By 2023
2	Status and condition of the habitat	Develop guidelines for species and strain selection based on environmental conditions.	By 2026
2	Status and condition of the habitat	Identify stocked trout fisheries that are resilient to dry years and climate impacts.	By 2024
2	Assess and determine appropriate management goals	Create a list of all stocked waters and allotment sizes.	By 2021
2	Assess and determine appropriate management goals	Integrate management-based rationale into the PSEP.	By 2021

Goal	Description/Target	Objective	Timeline
2	Assess and determine appropriate management goals	Develop standardized methods for determining stocking goals, species selection, and allotment sizes.	By 2022
2	Assess and determine appropriate management goals	Apply standardized methods to stocked waters throughout the state, and determine efficacy through an adaptive management process.	By 2022
2	Harvest management	Review angling regulations so that they are consistent and provide management for sustained quality stocked trout fisheries.	By 2022
2	Harvest management	Create a standard step-wise approach to guide stocked trout assessment and management recommendations.	By 2023
2	Ecosystem considerations	Every five years, update and review pre-stocking evaluations for all stocked waters.	Beginning in 2021
2	Sterile fish production	Develop statewide standards for the use of both diploid and triploid trout.	By 2022
2	Sterile fish production	Perform efficacy evaluations of triploid trout allotments to determine if management objectives are being met.	By 2022
2	Conservation purposes	Evaluate all hatchery facilities statewide for their potential of establishing native trout conservation programs.	By 2024

Goal	Description/Target	Objective	Timeline
2	Conservation purposes	Assess the efficacy and ability of the hatcheries to maintain and produce Trojan Y Chromosome broodstock for conservation purposes.	By 2024
2	Conservation purposes	Create hatchery conservation plans for facilities suitable for conservation programs.	By 2024
2	Non-native and domesticated strains	Evaluate existing domesticated and non-native strains for operational success and efficacy.	By 2022
2	Native broodstocks	Create conservation hatchery guidelines to direct native broodstock development.	By 2023
3	Stakeholder input	Create a process by which stakeholders will provide input on trout-based management at the watershed scale.	By 2024
3	Statewide angler survey	Generate a report based on the results of the Department's Angler Preference Survey.	By 2022
3	Citizen science	Evaluate efficacy and create standard procedures for angler survey box use.	By 2023
3	Citizen science	Provide a web-based portal for trout-angler entry of catch information.	By 2023

Goal	Description/Target	Objective	Timeline
3	Increase public understanding and appreciation of trout	Integrate with Department R3 Program to enhance and amplify outreach regarding trout angling and conservation opportunities.	Beginning in 2021
3	Access to information	Finish Department trout and habitat data server framework with public access.	By 2022
3	Access to information	Collaborate with the Department of Water Resources for the inclusion of trout and habitat data in their implementation of the Open and Transparent Water Data Act.	Beginning in 2022
4	Land use planning	Create an assessment of key water and land use issues and opportunities for trout across the state.	By 2023
4	Fish passage and flows for fish maintenance	Create a list of high-quality trout waters currently impaired from dam and diversion operations, or those that could benefit from revised flow regimes.	By 2023
4	Natural flow regimes	Create a list of high-quality trout waters that are currently affected by water operations that could benefit from natural flow regimes.	By 2023
5	Targeted research	Create a prioritized list of applied research projects with associated budgets and timelines.	Beginning in 2021
5	Adaptive management	Assess all proposed targeted research projects for adaptive management opportunities.	By 2023

Goal	Description/Target	Objective	Timeline
6	Watershed restoration	Develop a list of restoration needs for high-priority trout waters.	By 2022
6	Department water and property acquisitions	Develop a list of acquisitions that can enhance both trout resources and associated conservation values.	By 2022
6	Non-native fish removal	Develop a chemical treatment committee tasked with designing and implementing treatment protocols and identifying priority treatment projects.	Beginning in 2021
6	Non-native fish removal	Create guidelines for non-native fish eradication methods with associated costs based on species, habitat, and feasibility.	By 2022
6	Fish rescues	Create guidelines and threat-based criteria that incorporate hatchery operations, reintroduction triggers, and associated protocols to address at-risk trout populations.	By 2023
6	Stocking and translocation of native trout	Develop guidelines for Department movement of native trout.	By 2022
Next Step	Watershed Planning	Annually draft one trout watershed management plan across the state with stakeholder input.	Beginning in 2023
Next Step	Watershed Planning	Convene an ad hoc committee for the peer review of trout watershed management plans.	By 2023

Appendix B: List of Species Covered in Plan

Native Species and Forms

Taxonomists may group species differently, but this list represents what is currently recognized by the Department, found within Fish and Game Code § 7261, and covered in this Plan. All species are within the taxonomic family Salmonidae.

Cutthroat (Oncorhynchus clarkii)

- Coastal Cutthroat Trout (*O. c. clarkii*)
- Lahontan Cutthroat Trout (*O. c. henshawi*)
- Paiute Cutthroat Trout (*O. c. seleniris*)

Rainbow/Redband (Oncorhynchus mykiss)

- Coastal Rainbow Trout (*O. m. irideus*)
- Kern River Rainbow Trout (*O. m. gilberti*)
- Little Kern Golden Trout (*O. m. whitei*)
- California Golden Trout (*O. m. aguabonita*)
- McCloud River Redband Trout (*O. m. stonei*)
- Eagle Lake Rainbow Trout (*O. m. aquilarum*)
- Goose Lake Redband Trout (*O. m. newberrii*)
- Warner Lakes Redband Trout (*O. m. newberrii*)

Char

- Bull Trout, currently extirpated (*Salvelinus confluentus*)

Whitefish (subfamily Coregoninae)

- Mountain Whitefish (*Prosopium williamsoni*)

Non-native Species

Trout

- Brown Trout (*Salmo trutta*)
- Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*)

Char

- Brook Trout (*Salvelinus fontinalis*)
- Lake Trout (*S. namaycush*)

Landlocked Salmon

- Kokanee (*Oncorhynchus nerka*)
- Chinook Salmon (*O. tshawytscha*)

Appendix C: Pre-Stocking Evaluation Protocol

The pre-stocking evaluation protocol was developed to safeguard native species from hatchery stocking. A pre-stocking evaluation must be completed prior to Department stocking in any water of the state. Figure C-1 is the decision matrix used in determining the appropriateness of stocking hatchery-reared fish. Table C-1 is the list of decision species referenced in the decision matrix. Decision species are native species that may be affected negatively by stocking events.

Figure C-1: Pre-stocking evaluation protocol (from Trout and Inland Salmon Pre-Stocking Evaluation Protocol)

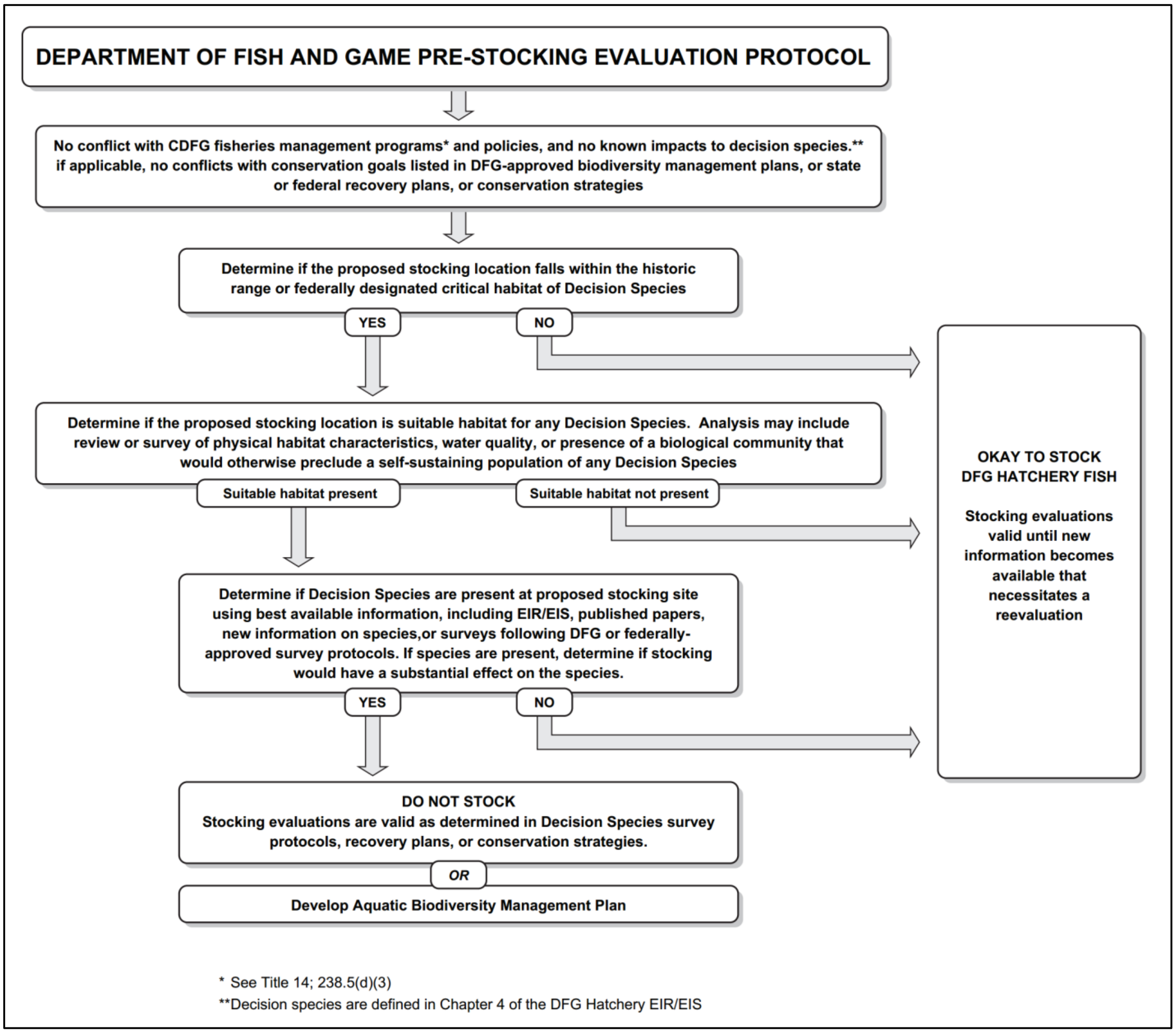

Table C-1: List of decision species. Adapted from California Department of Fish and Game and U.S. Fish and Wildlife Service (2010) Table 4-1. Distinct Population Segments (DPS) are populations determined to be of unique evolutionary importance for the purposes of listing, delisting, and reclassifying species under the US Endangered Species Act of 1973. Pacific salmon stocks are evaluated as Evolutionarily Significant Units (ESU), a term that is functionally synonymous to DPS for the purposes of this table.

Group	Common name	Scientific Name
Invertebrates	Shasta Crayfish	*Pacifastacus fortis*
Invertebrates	California Freshwater Shrimp	*Syncaris pacifica*
Lampreys	River Lamprey	*Lampetra ayresii*
Lampreys	Kern Brook Lamprey	*Lampetra hubbsi*
Lampreys	Klamath River Lamprey	*Lampetra similis*
Anadromous or estuarine non-salmonid fishes	Green Sturgeon (southern DPS)	*Acipenser medirostris*
Anadromous or estuarine non-salmonid fishes	Delta Smelt	*Hypomesus transpacificus*
Anadromous or estuarine non-salmonid fishes	Longfin Smelt	*Spirinchus thaleichthys*
Anadromous or estuarine non-salmonid fishes	Eulachon	*Thaleichthys pacificus*
Anadromous or estuarine non-salmonid fishes	Tidewater Goby	*Eucyclogobius newberryi*
Freshwater fishes	Owens Tui Chub	*Gila bicolor snyderi*
Freshwater fishes	Goose Lake Tui Chub	*Gila bicolor thalassina*
Freshwater fishes	Arroyo Chub	*Gila orcuttii*
Freshwater fishes	Hardhead	*Mylopharodon conocephalus*
Freshwater fishes	Owens Speckled Dace	*Rhinichthys osculus* ssp.
Freshwater fishes	Santa Ana Speckled Dace	*Rhinichthys osculus* ssp.
Freshwater fishes	Owens Sucker	*Catostomus fumeiventris*
Freshwater fishes	Modoc Sucker	*Catostomus microps*
Freshwater fishes	Santa Ana Sucker	*Catostomus santaanae*
Freshwater fishes	Cui-ui	*Chasmistes cujus*
Freshwater fishes	Unarmored Three-spined Stickleback	*Gasterosteus aculeatus williamsoni*
Freshwater fishes	Sacramento Perch (native range only; also estuarine)	*Archoplites interruptus*
Salmonid fishes	Coastal Cutthroat Trout	*Oncorhynchus clarkii clarkii*
Salmonid fishes	Lahontan Cutthroat Trout	*Oncorhynchus clarkii henshawi*
Salmonid fishes	Paiute Cutthroat Trout	*Oncorhynchus clarkii seleniris*
Salmonid fishes	California Golden Trout	*Oncorhynchus mykiss aguabonita*
Salmonid fishes	Eagle Lake Rainbow Trout	*Oncorhynchus mykiss aquilarum*
Salmonid fishes	Kern River Rainbow Trout	*Oncorhynchus mykiss gilberti*
Salmonid fishes	Goose Lake Redband Trout	*Oncorhynchus mykiss newberrii*

Group	Common name	Scientific Name
Salmonid fishes	Warner Lakes Redband Trout	*Oncorhynchus mykiss newberrii*
Salmonid fishes	McCloud River Redband Trout	*Oncorhynchus mykiss stonei*
Salmonid fishes	Little Kern Golden Trout	*Oncorhynchus mykiss whitei*
Salmonid fishes	Steelhead (Klamath Mountains province DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Steelhead (Northern California DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Steelhead (Central Valley DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Steelhead (central California coast DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Steelhead (south/central California coast DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Steelhead (southern California DPS)	*Oncorhynchus mykiss irideus*
Salmonid fishes	Coho Salmon (southern Oregon/northern California coast ESU)	*Oncorhynchus kisutch*
Salmonid fishes	Coho Salmon (central California coast ESU)	*Oncorhynchus kisutch*
Salmonid fishes	Chinook Salmon (Klamath and Trinity Rivers spring-run ESU)	*Oncorhynchus tshawytscha*
Salmonid fishes	Chinook Salmon (California coastal ESU)	*Oncorhynchus tshawytscha*
Salmonid fishes	Chinook Salmon (Sacramento River winter-run ESU)	*Oncorhynchus tshawytscha*
Salmonid fishes	Chinook Salmon (Central Valley spring-run ESU)	*Oncorhynchus tshawytscha*
Salmonid fishes	Chinook Salmon (Central Valley fall- and late fall-run ESU)	*Oncorhynchus tshawytscha*
Amphibians	California Tiger Salamander	*Ambystoma californiense*
Amphibians	Northwestern Salamander	*Ambystoma gracile*
Amphibians	Long-toed Salamander	*Ambystoma macrodactylum*
Amphibians	Santa Cruz Long-toed Salamander	*Ambystoma macrodactylum croceum*
Amphibians	California Giant Salamander	*Dicamptodon ensatus*
Amphibians	Pacific Giant Salamander	*Dicamptodon tenebrosus*
Amphibians	Southern Torrent Salamander	*Rhyacotriton variegatus*
Amphibians	Rough-skinned Newt	*Taricha granulosa*
Amphibians	Red-bellied Newt	*Taricha rivularis*
Amphibians	Sierra Newt	*Taricha sierrae*
Amphibians	Coast Range Newt (Monterey County and south only)	*Taricha torosa torosa*
Amphibians	Western Tailed Frog	*Ascaphus truei*
Amphibians	Western Spadefoot	*Spea (=Scaphiopus) hammondii*
Amphibians	Western Toad	*Bufo boreas*
Amphibians	Arroyo Toad	*Bufo (=Anaxyrus) californicus*

Group	Common name	Scientific Name
Amphibians	Yosemite Toad	*Bufo (=Anaxyrus) canorus*
Amphibians	Woodhouse's Toad	*Bufo woodhousii*
Amphibians	California Treefrog	*Hyla (=Pseudacris) cadaverina*
Amphibians	Pacific Treefrog	*Hyla (=Pseudacris) regilla*
Amphibians	Northern Leopard Frog (native populations only)	*Rana (=Lithobates) pipiens*
Amphibians	Lowland Leopard Frog	*Rana (=Lithobates) yavapaiensis*
Amphibians	Northern Red-legged Frog	*Rana aurora aurora*
Amphibians	California Red-legged Frog	*Rana draytonii*
Amphibians	Foothill Yellow-legged Frog	*Rana boylii*
Amphibians	Mountain Yellow-legged Frog (southern DPS)	*Rana muscosa*
Amphibians	Mountain Yellow-legged Frog (northern DPS)	*Rana muscosa* (includes *R. sierrae)*
Amphibians	Cascades Frog	*Rana cascadae*
Amphibians	Oregon Spotted Frog	*Rana pretiosa*
Reptiles	Western Pond Turtle	*Clemmys marmorata*
Reptiles	Common Garter Snake	*Thamnophis sirtalis*
Reptiles	Mountain Garter Snake	*Thamnophis elegans elegans*
Reptiles	Sierra (Western Aquatic) Garter Snake	*Thamnophis couchii*
Reptiles	Two-striped Garter Snake	*Thamnophis hammondii*
Reptiles	Giant Garter Snake	*Thamnophis gigas*
Reptiles	San Francisco Garter Snake	*Thamnophis sirtalis tetrataenia*
Reptiles	South Coast Garter Snake	*Thamnophis sirtalis* ssp.
Birds	Bald Eagle	*Haliaeetus leucocephalus*
Birds	Osprey	*Pandion haliaetus*
Birds	Willow Flycatcher	*Empidonax traillii*
Birds	Southwestern Willow Flycatcher	*Empidonax traillii extimus*

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