California Golden Trout

(Oncorhynchus mykiss aguabonita)

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Data:

2004 Conservation Assessment and Strategy for the California Golden Trout

Golden Trout Wilderness 2008 Summary Report (CDFW)

South Fork Kern River 2009 Summary Report (CDFW)

Mulkey and Golden Trout Creeks 2015 Summary Report (CDFW)

Statewide Drought Response: Stressor Monitoring summary report 2014-2017 (CDFW)

Technical report: Genetic analysis and management recommendations for California's official state fish, the California Golden Trout (*Oncorhynchus mykiss aguabonita*) (CDFW Unpublished, 2021)

Heritage and Wild Trout Program 2022 Annual Report (CDFW)

Heritage and Wild Trout Program 2023 Annual Report (CDFW)

Partners: California Department of Fish and Wildlife (CDFW), US Fish and Wildlife Service (FWS), US Forest Service (FS), Trout Unlimited

Introduction

The California Golden Trout (*Oncorhynchus mykiss aguabonita*; hereafter CAGT) is one of three subspecies of Rainbow Trout endemic to the Kern River Drainage (primarily Tulare County, CA), occupying this area alongside the Little Kern Golden Trout (*O. mykiss whitei*) and the Kern River Rainbow Trout (*O. mykiss gilberti*). California Golden Trout are brightly colored fish with a brassy or olive green colored dorsal side, intensifying to the characteristic golden/yellow moving down towards the ventral side of the fish. A crimson or red stripe runs laterally from the operculum (i.e., hardened plate covering the gills) towards the caudal peduncle (i.e., base of the tail) and ends approximately even with the anal fin. California Golden Trout have approximately 10 large spots, known as parr marks, present along the length of the lateral line. Relative to other subspecies of Rainbow Trout, CAGT have few spots on the body above the lateral line and almost none below it. Their spectacular coloring has led to the translocation of CAGT across California, and many other western states.

California Golden Trout have been teetering on the brink of listing under the Federal Endangered Species Act (ESA) for decades. It was petitioned for Federal listing as Endangered by Trout Unlimited in 2000 (Trout Unlimited 2000). In 2004 the US Fish and Wildlife Service (USFWS), the US Forest Service (USFS), and the CA Department of Fish and Wildlife (CDFW) signed a Conservation Agreement and Strategy (hereafter, the "Strategy") to formalize their commitments to protecting these unique fish. The agreement was considered by the USFWS to be robust enough to preclude listing, and in 2011 the USFWS completed their 12-month review and ruled that listing was not warranted pursuant to the Endangered Species

California Golden Trout in Golden Trout Creek. Photo credit: CDFW

Act of 1973 (USFWS, 2011). However, CAGT are now designated as a Species at Risk by the USFWS. The USFS Region 5 has added CAGT to its Sensitive Species List and the CDFW has designated it as a Species of Special Concern.

Historical and Current Distribution

The historic range of CAGT includes two watersheds draining the Kern Plateau of the southern Sierra Nevada Mountain Range in California (Figure 1). California Golden Trout are native to Golden Trout Creek (GTC) and the South Fork Kern River (SFKR), an area encompassing approximately 593 square miles (1,536 sq. km). The GTC watershed covers 60 square miles (155-sq. km). Elevations in this watershed range from 10,800 feet (3,294 m) at Rocky Basin Lakes to less than 7,000 feet (2,135 m) at the confluence of GTC and the Kern River. The SFKR watershed covers 533 square miles (1,380-sq. km). Its headwaters are in the eastern section of the Kern Plateau in the Golden Trout Wilderness, starting at South Fork and Mulkey meadows (headwaters of Mulkey Creek). Stream elevations range from 10,400 feet (3,172 m) above mean sea level near the headwaters to approximately 2,605 feet (795 m) at Lake Isabella.

California Golden Trout historically occupied GTC from the headwaters, with the possible exception of the upper reaches of some tributary streams and headwater lakes, downstream to a series of waterfalls near the mouth. In

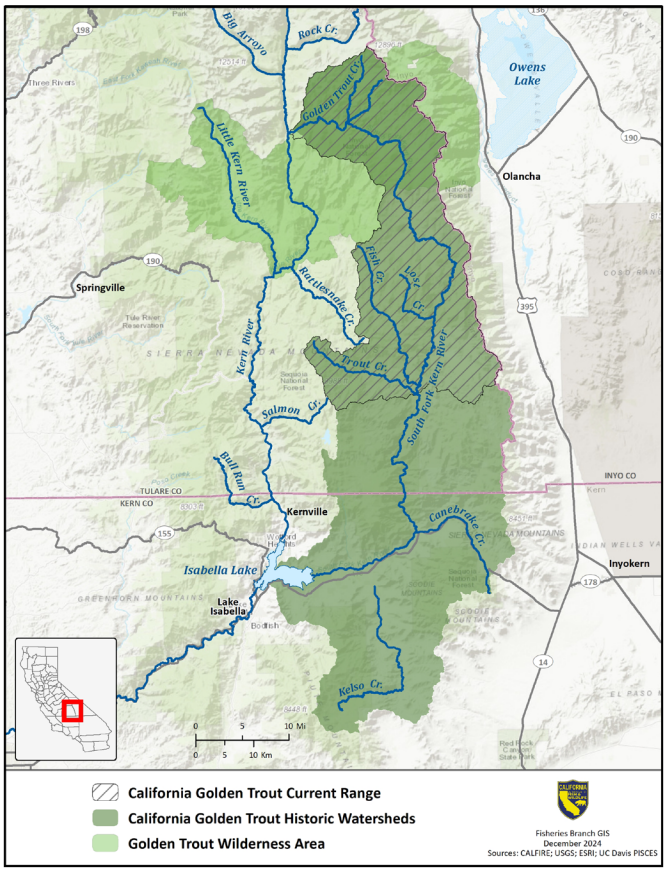

Figure 1. Current and historic range of the California Golden Trout

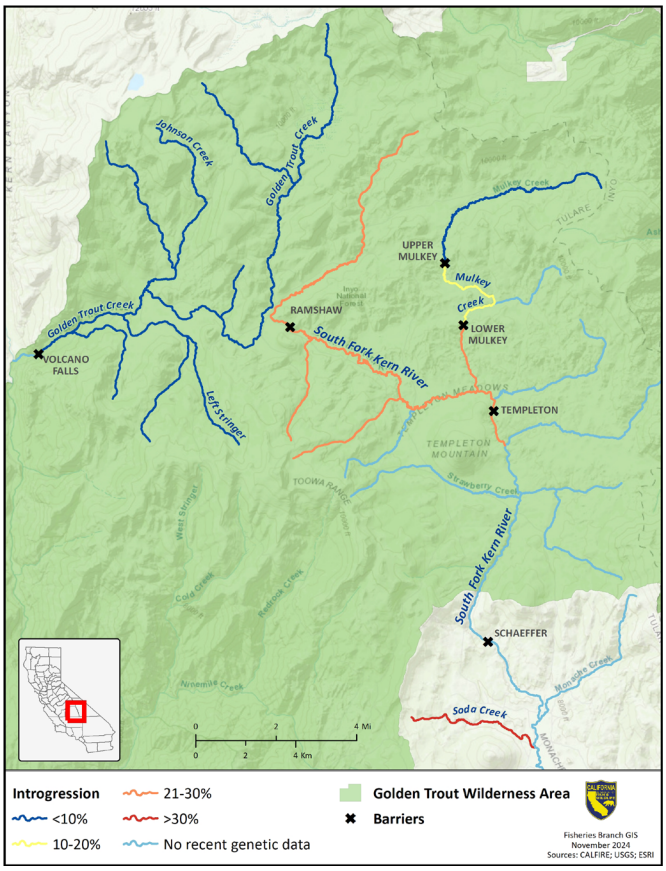

Figure 2. Areas of introgressive hybridization within California Golden Trout populations. Note that some admixture is with native Kern River Rainbow Trout rather than nonnative hatchery Rainbow Trout.

the SFKR, CAGT were present from the headwaters downstream at least to the southern end of the present-day Dome Land Wilderness (SE of Golden Trout Wilderness) and perhaps downstream of Lake Isabella.

Currently, CAGT are still found in their native water in GTC and the SFKR, albeit their distribution in the SFKR is significantly constrained. Populations of CAGT in the SFKR free from the effects of introgressive hybridization with other subspecies of Rainbow Trout are restricted to headwater reaches and the upper reaches of Mulkey Creek (a tributary of the SFKR that is thought to have been fishless historically, but has a self-sustaining population of CAGT translocated from GTC), where they are safeguarded by barriers to upstream movement. Additionally, CAGT have been transplanted to over 300 high mountain lakes and streams across the Sierra Nevada and have been established in several other Western States (e.g., WY, ID, CO, etc.). The history of translocating CAGT dates back more than a century. Many populations outside the historic range were established by stocking hatchery produced fingerlings from the Cottonwood Lakes brood stock, which were discovered in the 1990's to be hybridized with Rainbow Trout. These waters are found primarily in the Sierra Nevada between Yosemite and Sequoia/Kings Canyon National Parks. Story Fish Hatchery in Wyoming maintains a broodstock of genetically pure, albeit bottlenecked, population of CAGT used for recreational stocking.

Habitat Requirements

The native waters of the CAGT are mostly above 7,545 ft (2300m) in elevation. Valleys on the Kern Plateau are often broad, flat, and filled with alluvium, creating wide meadow habitat where streams meander. Generally, substrate in the streams range from sand to gravel, with limited sections of cobble. Habitat on the Kern Plateau is typified by clear, cold water (3-22°C) with relatively sparse riparian vegetation, especially outside of meadow areas. California Golden Trout are usually found in higher densities in pools and in meadow areas with undercut banks. California Golden Trout have small home ranges, usually around 16-18m. They have been observed to be active during the daytime and nighttime, which may be indicative of an evolutionary history that occurred without the presence of natural predators.

Summary of Management Actions

California Golden Trout have been the target of intensive conservation and management actions by resource agencies in CA since the 1960s. Chemical treatments to eradicate nonnative trout (Brown and nonnative Rainbow x CAGT hybrids) spanned four decades, peaking in the 1980s and 1990s. To improve the efficacy of the chemical treatments and to bolster the protection of pure populations of CAGT three major barrier projects were completed in the SFKR. In the early 1970s the uppermost of the three, Ramshaw Barrier, was constructed just below Tunnel Meadow by using explosives to create an impassable fall. The middle barrier, Templeton, was first constructed in 1973 by blasting and wrapping large boulders in fencing material. This structure was replaced by a gabion barrier at Templeton in 1980 and reinforced several times before it was finally bolstered by a more substantial concrete barrier adjacent to the gabion structure in 1996. The construction of Schaeffer Barrier followed a similar trajectory with the gabion structure built in the 1980s being replaced by a concrete structure in 2003. Schaeffer Barrier is situated just outside the boundary of the wilderness area. This allowed for the use of more materials and heavy-duty construction equipment, resulting in a substantial barrier under a wide range of flow conditions (Pister 2008).

In addition to barrier construction and chemical treatments, there have been years of habitat improvement, including research to investigate the impacts from grazing in CAGT's range. Currently, partnerships between Trout Unlimited, CDFW, and others are facilitating large-scale data collection efforts (fisheries, geospatial, hydrologic, etc.). At the time of writing, Trout Unlimited has conducted extensive restoration work on 30 miles of streams in the SFKR watershed, including the installation

of more than 750 low-tech process based restoration structures (i.e., beaver dam analogs and post-assisted log structures) to improve water temperatures and increase habitat complexity, pool availability, and instream flows. Additionally, 10 stream flow gages and more than 30 water temperature loggers were installed in the SFKR watershed to monitor restoration efforts and impacts of climate change on streamflow and water temperature. *(www.tu.org/magazine/conservation/from-the-field/seeking-blue-seeing-gold/)*.

Sportfishing

Their unique beauty and popularity as a sportfish led California's legislature to designate the CAGT as the State Freshwater Fish in 1947. In 1876, CAGT were transplanted from Mulkey Creek into (out of basin) Cottonwood Creek and later into the Cottonwood Lakes. Since 1918 the Cottonwood Lakes population has been used for broodstock to plant out of basin waters throughout the Sierra Nevada. Their popularity within the angling community, and their adaptation to high elevations, has made them an important sportfish for backcounty lakes throughout the Sierra Nevada, as well as outside of their native range (e.g., CAGT from Golden Trout Creek have been translocated to the Wind River Range in Wyoming). Unfortunately, at some point in time the Cottonwood Lakes fish were hybridized with nonnative Rainbow Trout and cannot serve as an option for future conservation actions.

Recreational angling and harvest are permitted in both Golden Trout Creek and the South Fork Kern River. Angling pressure is relatively low, due to the remote location of these waters, and likely has minimal effects on the long-term viability of the species. CDFW monitors these populations annually for changes in fishing pressure, angling success, and angler satisfaction. Monitoring data suggests that populations abundances are generally high where nonnative trout are absent, but there have been drastic fluctuations in the abundance of headwater populations in locations that have been impacted by drought.

The California Heritage Trout Challenge (www.wildlife.ca.gov/Fishing/Inland/HTC), an angling recognition program established by CDFW, features opportunities for native trout angling and promotes angler and public awareness of native trout conservation issues. Many anglers come to the region seeking the CAGT, and the other two subspecies of native trout endemic to the larger Kern River drainage in pursuit of completing the Challenge.

The California Fish and Game Commission recognizes all waters in Golden Trout Creek as Heritage Trout Waters and all waters in the South Fork Kern River from the headwaters downstream to the South Sierra Wilderness border as Wild Trout waters. Both of these waters are open to public angling and are managed as fast action fisheries that provide very high catch rates for small and medium size-class (less than 12 inches) CAGT. For more angling notes, see the Angler's Guide to the Heritage Trout Challenge (*www.nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=137391&inline*).

Threats

Genetic Concerns

There are two primary genetic concerns that resource managers must contend with while attempting to recover CAGT populations. One is related to the inevitable loss of genetic diversity that occurs in small, isolated populations (i.e., genetic drift), and the other is the loss of unique adaptations, characteristics, or reduced fitness due to hybridization with nonnative trout species.

Impassable barriers, manmade or natural, that isolate small populations of trout can exacerbate the loss of allelic richness through a process known as genetic drift. Genetic drift is the reduction or loss of alleles in a population simply due to chance during recombination. Ironically, this can be the indirect result of management actions taken to safeguard the genetics of pure populations of sensitive species from more acute threats like hybridization with nonnative species (Lusardi et al. 2015).

In 1876, 12 CAGT transplanted from either GTC or SFKR (the source is unclear) into the Cottonwood Creek watershed (i.e., small founding population) were the source for the 1891 transplant to Cottonwood Lakes. By studying this population Leary and Allendorf (1993) identified a loss of genetic variation in association with the small founding population size. Moreover, they concluded that the more generations away from the donor population the new population was, the greater the reduction of genetic diversity. Because only a few trout were likely used to establish most of the out-of-basin populations of CAGT, there has probably been a successive reduction of genetic diversity in each newly established population. Therefore, when considering specific populations as a source for restoration purposes, not all CAGT populations may be of equal value, especially those established using few adult trout.

Hybridization resulting from a nearly century-long history of stocking nonnative strains of Rainbow Trout in the lower reaches of the SFKR continues to be a major threat to CAGT. When pure CAGT hybridize with nonnative Rainbow Trout the resulting offspring often lack the brilliant coloration and patterns that make CAGT so unique (i.e., a phenotypic manifestation of the loss of a genotypically distinct population). Additionally, hybridization can result in the loss of local adaptations that allow species to thrive in the habitats that they evolved in. Complicating the situation is the likelihood that there are mixing zones where native Kern River Rainbow and CAGT naturally interbreed (Figure 2).

Conducting standardized surveys for California Golden Trout. Photo credit: CDFW

Non-native Fish Concerns

It is now recognized that the greatest threat to the continued existence of CAGT is from interactions with non-native trout (CAGT Conservation Strategy 2004). Illegal transplanting of trout is a real and continuing threat to the continued existence of CAGT and may have contributed to the mixing of native and nonnative strains of trout in the Kern Basin. In addition to impacts from hybridization with non-native Rainbow Trout (see above), competition and predation from Brown Trout severely constrains CAGT, suppressing population sizes drastically where their ranges overlap (CDFW unpublished data). Protecting pure populations of CAGT has been a priority for CDFW for many years and at times has included changes to fishing regulations, construction of barriers to movement, and chemical treatments.

A major restoration project began in 1966 to remove nonnative Brown Trout and CAGT x Rainbow Trout hybrids from the South Fork Kern River. This project involved the construction of three barriers to upstream fish migration and successive chemical treatments. The three barriers are, from upstream to downstream, Ramshaw, Templeton, and Schaeffer. Chemical treatments continued through 1994 and were successful in removing nonnative trout from the headwaters of the South Fork Kern River to Schaeffer Barrier. CAGT from the headwaters of the South Fork Kern were used to repopulate sections as the project progressed downstream. Deterioration of both the Schaeffer Barrier and the Templeton Barrier led to the construction of more permanent concrete barriers. Unfortunately, by the time these more permanent barriers were constructed, Brown Trout had already reoccupied the reach between Templeton Barrier and Schaeffer Barrier. Although the Templeton Barrier had prevented nonnatives from upstream migration for decades, 2023 surveys discovered Brown Trout have recently passed the barrier. The exact timing and mechanism for this is not yet clear, and since 2023 recovery partners have been actively working to mitigate the situation.

Previous genetic analyses showed widespread hybridization with nonnative Rainbow Trout throughout the South Fork Kern River sparking concerns of nonnative reintroduction post chemical treatment. More recent analysis has shown that this hybridization in the upper reaches of the SFKR is primarily with Kern River Rainbow Trout (KRRT), rather than nonnative strains of Rainbow Trout. This may represent natural introductions that occurred prior to the treatment, and that the KRRT genetics may have already been present in the headwater populations used to repopulate the treatment area.

Habitat degradation

Due to the remoteness of most of the Kern Plateau and its designation by the US Forest Service as Wilderness Area, the diversity of land uses is limited. The use with the highest impact and that which has caused most of the habitat degradation is grazing of domestic livestock. There are four major grazing allotments that have historically impacted meadow and riparian habitat. It is important to note that these grazing impacts affect most meadow and riparian dependent species, not just fish. The impacts of grazing to CAGT habitats include the loss of pool habitat, sedimentation, reduced instream cover, riparian cover loss, loss of undercut streambanks, stream channels becoming wider and shallower, the resultant inability of the system to buffer temperature extremes (increased summer water temperatures and threat of icing in colder months), loss of quality spawning habitat and reduction of instream and riparian area food production. Riparian and meadow habitat degradation is common to both the SFKR and Golden Trout Creek watersheds in many areas where cattle-grazing is permitted. Recreational use can have a similar, but usually less pervasive, negative impacts on streambanks. While these impacts may not lead to the extinction of the CAGT in the near-term, habitat degradation is certainly having an impact on the size, numbers, physical condition, and structure of CAGT populations (Knapp and Matthews 1996; Knapp and Dudley 1990).

Climate

Fire and drought can cause catastrophic impacts to CAGT habitat. Past fire suppression efforts have increased levels of fuel loading, which appears to have increased the severity and duration of recent fires. New wildland fire management programs may help reduce future fire intensity. While some climate models predict increased winter precipitation, there is near consensus among models that April 1st snowpack in the Sierra Nevadas will be drastically reduced by the end of the century (Sun et al. 2019). Earlier snow melt will likely lead to lower summer/fall base flows that will impact populations of CAGT already know to be highly susceptible to drought impacts.

Conservation

Priority actions to improve the status of the California Golden Trout

Population Surveys, genetic analyses, and fish population manipulation:

The most urgent actions needed relate to documenting the extent and severity of the recent invasion of Brown and likely CAGT x nonnative Rainbow Trout hybrids to the reach of the SFKR between Ramshaw and Templeton barriers. This sampling will inform the next steps needed to secure that habitat for pure populations of CAGT.

Key actions will include:

- Conducting intensive standardized surveys and genetic analyses to evaluate current status of population dynamics.
    - When the above step is completed, plan for non-native trout removal approach.
- Plan regularly timed standardized surveys and genetic analyses (i.e., long term monitoring) to evaluate shifting trends in population dynamics.
- Develop an eDNA surveillance monitoring program for early warning of future invasions.
- Expand CAGT populations through reintroductions, reducing impacts of stocked fish.
- Modify fishing regulations, as needed, to adjust for changing population sizes and distribution.
- Maintain and improve the genetic integrity, population structure and ecosystem structure and ecosystem elements of CAGT.
- Use new genetic information from the unpublished 2021 CDFW genetic analysis to update a genetics management plan which will lay out the options and consequences of management decisions.

California Golden Trout Habitat Manipulations:

Restoration of CAGT habitat will have to address both habitat quality issues and issues of spatial limitations. Current efforts to manage CAGT have been directed toward improving in-stream and meadow conditions and restoring limited stream fragments.

Primary Habitat Actions to be addressed:

- Improve riparian and instream habitat for the restoration of CAGT populations.
- Restore and improve altered channel beds and riparian zone habitats.
- Restore mountain meadow habitats.
- Restore and enhance water flow, quality, and sediment regimes.
- Address public and private land management practices to improve habitat.
- Monitor and evaluate natural catastrophe impacts like fire and drought.
- Continue annual monitoring of barrier integrity and effectiveness.

Expand Education and Outreach programs to garner public support for California Golden Trout:

Priority Actions to be addressed:

- Expand interagency coordination and collaboration.
- Expand public education efforts regarding CAGT restoration efforts.
- Update informational signage at trailheads; include information about ongoing CAGT recovery actions.
- Enforcement of State Fish & Game laws to protect CAGT.
- Initiate a dedicated PR campaign to garner broad public support for CAGT protection.

Data shortfalls

Recent genetic tissue collections covered the majority of the range of CAGT, however there are some tributaries of the SFKR that could benefit from more extensive tissue collection. Additional samples would help answer questions related to the extent of admixture between CAGT and KRRT.

Additionally, more information is needed on the abundance and extent of Brown Trout that recently invaded the reach of the SFKR above Templeton Barrier. Related to this, extensive evaluation of the structural integrity of the three constructed barriers and their effectiveness under high flow conditions is needed (and planned).

WNTI Completed or On-going Projects

CAGT Population Monitoring and Habitat Assessment (2008) - $7,800

Literature

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