

5-YEAR REVIEW

Little Kern Golden Trout (*Oncorhynchus aguabonita whitei*)

GENERAL INFORMATION:

Species: Little Kern golden trout (*Oncorhynchus aguabonita whitei*)

Date listed: April 13, 1978

Federal Register (FR) citation: 43 FR 15427 (Service 1978)

Classification: Threatened

State Listing:

The little Kern golden trout is not listed by the State of California.

BACKGROUND:

Species overview:

The Little Kern golden trout (*Oncorhynchus aguabonita whitei*) is a subspecies of rainbow trout in the family Salmonidae and endemic to the Little Kern River drainage in Tulare County, California. The Little Kern River drainage occurs primarily within the Golden Trout Wilderness on the Sequoia National Forest. Smaller areas of the drainage occur outside of designated wilderness in either Sequoia National Park or Sequoia National Forest (Service 2003, p. 126). Little Kern golden trout are known for their brilliant red to red-orange colors on their belly and cheeks, golden sides, olive green backs and orange and white tipped pectoral, pelvic, and anal fins preceded by a dark band (Moyle 2002, p. 283). Little Kern golden trout require cool, oxygenated water with significant clean gravel for reproduction. Like other *O. mykiss* forms, spawning occurs between May and June and is largely dependent on water temperature and snowpack runoff (Moyle 2002, p. 285). Most fish are relatively long lived, sexually maturing at age three or four and can live up to nine years (Moyle 2002, p. 285).

The subspecies was listed as threatened in 1978 under the taxonomic name *Salmo aguabonita whitei* (Service 1978, entire), but was subsequently changed to *O. aguabonita whitei* in 50 CFR 17.11. More recent genetic studies have indicated that the Little Kern golden trout is a subspecies of rainbow trout (*Oncorhynchus mykiss*) and is closely related to the other native trout of the Kern River basin, the California golden trout (*O. mykiss aguabonita*) and Kern River rainbow trout (*O. mykiss gilberti*) (Moyle 2002, pp. 283–284). See Service (2011, p. 8) for a thorough discussion of the subspecies' taxonomic history. We provide a recommendation below to formally change the subspecies name to *O. mykiss whitei* to reflect the current understanding of the Little Kern golden trout's taxonomy.

Most recent status review:

U.S. Fish and Wildlife Service. 2011. Little Kern golden trout (*Oncorhynchus mykiss whitei*). 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California. 32 pp.

We did not recommend a status change in the 2011 status review.

FR notice citation announcing this status review:

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 76 Species in California and Nevada. Federal Register 86:27462–27464.

We did not receive information from the public regarding the Little Kern golden trout in response to the notice.

ASSESSMENT:

Information acquired since the last status review:

This 5-year review was conducted by the U.S. Fish and Wildlife Service’s (Service) Sacramento Field Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on May 20, 2021. We also contacted subspecies experts, performed a literature search, reviewed information from our own files, including a review of Little Kern golden trout 10(a)(1)(A) recovery permit annual reports, and obtained data from an occurrence search of the California Natural Diversity Database maintained by the California Department of Fish and Wildlife (Department) and the Natural Resource Information System maintained by the U.S. Forest Service (Forest Service).

Since the last status review, Little Kern golden trout monitoring and surveying has been conducted throughout the range of the subspecies (addressed in **Distribution** and **Abundance**) and new and updated information on threats to the Little Kern golden trout such as grazing, fire, drought, and genetics became available (addressed in **Threats**).

Comparing the historical and current condition of the Little Kern golden trout is difficult due to the complex history of fishery management actions over the previous century, differences in methodologies used to inventory and assess genetic health of populations, and inconsistent collection or reporting of genetic data accompanying population surveys. Therefore, the reader is cautioned against drawing conclusions and making direct comparisons between historical and current distribution and abundance information without having a deeper understanding of the methodologies used for specific studies and analyses. For the purposes of this document, we attempted to provide context, when possible, to clarify when studies report information only for “pure” Little Kern golden trout or for introgressed populations. However, because this document simply serves as a summary of recent information produced since the previous status review (Service 2011, entire), please refer to the cited references for additional details about specific studies and analyses.

Distribution:

Historically, the Little Kern golden trout occupied approximately 99.4 miles of streams in the Little Kern River drainage (Moyle 2002, pp. 285–286). At the time of listing in 1978, the range of pure Little Kern golden trout had been drastically reduced to only six headwater streams, totaling approximately 9.9 miles of streams, or 10% of its historical range (Christenson 1984, pp. 5, 12–13; Moyle 2002, pp. 285–286). Little Kern golden trout were translocated between creeks within their native range and to creeks (*e.g.*, Coyote Creek) and lakes (*e.g.*, Crites Lake and Big Five Lakes) outside of their native range beginning in the late 1800s and continuing through the late 1990s (Stephens et al. 2014, pp. 3–4, 31–32, 43; Christenson 1984, pp. 7–8, 10, 12). We did

not receive any information pertaining to the current distribution of the Little Kern golden trout outside of its' native range.

Beginning in 2012, the Department's Heritage and Wild Trout Program, in collaboration with the Service, Forest Service, and National Park Service began a comprehensive rangewide assessment of the subspecies and its habitat (Department 2018, entire). Little Kern golden trout of varying levels of introgression were observed in all major tributaries surveyed (see **Hybridization and Low Genetic Diversity**, below, for more details about introgression) (Department 2018, p. 13). Upstream distribution typically coincided with a permanent upstream barrier or lack of flow and limited habitat (Department 2018, p. 33). Based on the Department's survey results, the Little Kern golden trout occupied 23.1 miles of the Little Kern River and 62.8 miles of major tributaries, for a total of 86 miles of occupied habitat (Department 2018, pp. 14, 33). Variation in the level of introgression between populations of Little Kern golden trout and differences in survey methodology and reporting preclude accurately comparing the current distribution with historical conditions or distribution at the time of listing unless more robust meta-analyses are conducted.

Abundance:

Little Kern golden trout population estimates have been conducted in various years prior to and following listing by multiple practitioners using different methods making direct comparison difficult. At the time of listing, the Little Kern River drainage contained less than 5,000 pure Little Kern golden trout individuals (Christenson 1984, p. 10). Other efforts have focused on population estimates or abundance records of specific streams or stream segments, rather than rangewide assessments (Service 2011, pp. 6, 28–31).

The Department conducted depletion electrofishing surveys in 21 tributaries in the Little Kern River drainage from 2012 through 2018 (Department 2018, pp. 5–6 and 15–33). In total, the Department estimated the Little Kern golden trout population contains approximately 60,000 individuals of varying levels of introgression (Department 2018, p. 34). Estimated mean abundance in occupied streams varied from a low of 31 trout/mile in No Name Creek to a high of 1,553 trout/mile in Alpine Creek (Department 2018, pp. 17–33), but variation in the level of introgression from stream to stream makes it difficult to compare subpopulation densities and estimate the mean abundance for the entire subspecies.

Threats:

At the time of listing, we identified the following threats to the subspecies: potential for uncontrolled use of off-road vehicles, improper road construction, careless logging activities, pollution from mining operations or overgrazing, and hybridization with non-native rainbow trout (Service 1978, p. 15428). Threats to the subspecies identified at the time of the 2011 5-year review included: grazing and habitat loss, hybridization and low genetic diversity, limited range and small population size, and climate change (Service 2011, pp. 11–21). These threats identified in our 2011 review are still acting on the subspecies. As stated in our previous review, we have no information indicating mining and logging currently threaten the subspecies.

Grazing and Habitat Loss

Our 2011 5-year review highlighted the acute and chronic impacts of livestock grazing on stream habitat and fish populations (Service 2011, pp. 11–13). As noted in our previous review, two

grazing allotments, the Little Kern and Jordan allotments, are located within the Little Kern River watershed on the Sequoia National Forest, and are guided under several management plans and other documents that establish standards for grazing management and limit potential disturbance in Little Kern golden trout habitat (Service 1997, entire; Forest Service 2012, p. 101; Forest Service 2023, p. 72). The Forest Service annually monitors livestock utilization in the Little Kern and Jordan allotments and conducts long-term monitoring of meadow and stream conditions in Little Kern golden trout critical habitat approximately every five years. The Forest Service most recently reported monitoring results in 2013 and 2022 and found that annual use and utilization has complied with the standards and requirements established by the various guiding documents (Forest Service 2013, pp. 2–4; Forest Service 2022b, pp. 3–4). No significant changes to stream condition, channel type, or meadow condition were observed during the Forest Service’s long-term monitoring conducted in 2012 and 2018 (Forest Service 2013, pp. 4–5; Forest Service 2022b, pp. 1, 4–5). Water temperatures recorded in 2012 were within the acceptable range to support trout (Forest Service 2013, p. 7). Conversely, the Department observed highly degraded habitat in the lower section of Lion Creek due to active cattle grazing in 2013. This is noteworthy because fish in Lion Creek exhibited high levels of fin erosion (possibly linked to poor habitat conditions and reduced food-web subsidies from terrestrial invertebrates in grazed locations (Knapp and Matthews 1996, entire; Latremouille 2003, entire)) and low levels of introgression, suggesting that this could be an important population to preserve in the greater context of threatened species recovery (Department 2018, pp. 21–22).

Hybridization and Low Genetic Diversity

Our 2011 review described the Little Kern golden trout’s genetic status, including the historical conditions, past conservation actions, and previous genetic analyses, concluding that hybridization with non-native salmonids and low genetic diversity are significant threats to the subspecies (Service 2011, pp. 8–10, 18–19). Once hybridization with non-native trout was identified as a significant threat to the Little Kern golden trout, managers used a variety of methods to reduce hybridization and competition with non-natives including the construction or enhancement of barriers in the 1970s and 1980s (Stephens 2014, pp. 5–6). While this likely helped preserve genetic integrity by preventing admixture between “pure” populations and introgressed populations, it has led to unintended negative consequences by contributing to reductions in gene flow and intensified inbreeding (Lusardi et al. 2015, p. 525; Department 2020, p. 1).

Recent genetic analyses suggest hybridization and low genetic diversity continue to be significant threats to the Little Kern golden trout. The Genomic Variation Laboratory at the University of California, Davis, developed a Genetics Management Plan (Stephens 2014, entire), which described their recent genetic analyses of Little Kern golden trout and other native trout and identified management units and core conservation populations to guide future translocations and other management actions. Expanding on the analyses described in Stephens (2014, entire), the Department’s Genetics Research Lab conducted rangewide genetic analyses using a larger number of genetic markers. They analyzed contemporary samples collected by the Department and partners since 2014 and reanalyzed many of the sample sets from Stephens (2014, entire) to provide an updated review of the impact of hybridization and the current levels of genetic diversity within the population (Department 2020, entire). The Department observed low levels of heterozygosity across all subpopulations of Little Kern golden trout in addition to positive estimates of F_{IS} (inbreeding coefficient) in nearly all populations, an indication that nearly all

populations of Little Kern golden trout are at risk of inbreeding (Department 2020, p. 2). Evidence of population bottlenecking was also found where non-native rainbow trout were not introduced (Department 2020, p. 2). The Department observed low levels of introgression (<5% introgression) in 15 streams and one lake and moderate (5 to <10%) to high ($\geq 10\%$) levels of introgression in all other subpopulations in the Little Kern River drainage (Department 2020, pp. 2–3, 5). Using the results of these analyses, the Department updated and modified the management units and cores described by Stephens (2014, entire) (Department 2020, pp. 3–4, 6). Additionally, the low levels of observed genetic diversity in “pure” (<5% introgression) Little Kern golden trout makes them particularly vulnerable to climate change and habitat alternation since they may lack the potentially adaptive genetic variation needed to survive and evolve under new environmental conditions.

Climate Change

Our 2011 status review described the threat climate change poses to the Little Kern golden trout, specifically in relation to increased air and water temperatures, changes in types of precipitation (*i.e.*, rain vs. snow), earlier spring run-off flow regimes, and changes in the components of the stream hydrograph (Service 2011, pp. 19–21). These factors are still expected to threaten the subspecies into the future. While not specifically discussed in our previous status review, increased frequency and intensity of wildfires and drought associated with climate change may also threaten the subspecies, especially given their lack of genetic diversity.

While the subspecies evolved in a fire-prone environment, increased frequency and severity of wildfires pose a heightened risk to the Little Kern golden trout. Severe fire events can cause short-term mortality due to increased stream temperatures and long-term mortality from habitat loss and degradation due to increased sediment loads and loss of canopy shading (Hogan and Weaver 2011, p. 2). The increased mortality rate, and more extreme variation in mortality rates over time, should increase the threat for more severe population bottlenecks and further erosion of adaptive genetic variation. From 2011 through 2022, 15 wildfires have burned in Little Kern golden trout critical habitat, totaling approximately 67,634 acres, or approximately 82% of the designated critical habitat (which encompasses almost the entirety of the Little Kern River drainage) (Table 1). Most notably, the 2011 Lion Fire and the 2020 Castle Fire burned significant portions of the subspecies’ critical habitat.

Table 1. Wildfires that have burned in Little Kern golden trout critical habitat and occupied streams from 2011 through 2022. Acreages calculated using National Interagency Fire Center fire perimeter data (National Interagency Fire Center 2023).

Year	Fire Name	Critical Habitat Acres Burned	Occupied Streams within Fire Perimeter
2011	Golden	12	None
2011	Lion	20,659	Tamarack, Willow, No Name, Sheep, Lion, Alpine, Pecks Canyon (and unnamed tributaries), Soda Spring, Deadman, Wet Meadow, Little Kern River

Year	Fire Name	Critical Habitat Acres Burned	Occupied Streams within Fire Perimeter
2012	George	123	None
2013	Angora	179	None
2013	Fish	1,863	None
2014	Soda	1,423	North Fork Clicks, Clicks
2015	Cabin	6,994	Alpine, Pecks Canyon, Soda Spring, Little Kern River
2015	Grey	19	None
2016	Jacobson	1,704	Mountaineer, Alpine, Little Kern River
2017	Lion	17,232	Shotgun, Pistol, Rifle, Tamarack, Willow, No Name, Sheep, Lion, Deep, Little Kern River
2018	Mountaineer	1,270	Jacobson, South Mountaineer
2018	Alder	99	None
2020	Castle	27,507	Deep, Trout Meadow, Fish, Clicks, North Fork Clicks, South Mountaineer, Jacobson, Mountaineer, Alpine, Little Kern River
2020	Shotgun	841	Shotgun, Pistol, Little Kern River
2021	Walkers	8,776	Shotgun, Soda Spring, Deadman, Wet Meadow, Little Kern River

Following the 2011 Lion Fire, surveys and habitat assessments conducted by the Department and the Forest Service in 2012 indicated there were minimal short-term effects on most Little Kern golden trout populations and their habitats. Surveyors observed various size classes of Little Kern golden trout, regenerating riparian vegetation, normal water temperatures, stable channel morphology, and intact instream habitat (Hogan and Zuber 2012, p. 10; Forest Service 2013, pp. 5–6). However, the headwaters of No Name Creek showed signs of significant sedimentation, decreased pool depth, loss of channel stability, abundant silt and woody debris, limited riparian vegetation, and poor instream fish cover, and no fish were observed in this segment of the stream (Hogan and Zuber 2012, pp. 6–7; Department 2018, p. 14).

In 2021, the Department conducted drought and post fire assessment surveys including visual encounter surveys on Clicks Creek, Fish Creek, Deep Creek, and Trout Meadow Creek following the 2020 Castle Fire. The damage from the Castle Fire and the 2021 drought appears to have eliminated several miles of once occupied habitat in the upper portions of Clicks Creek and Fish Creek. Additionally, no trout were observed in Deep Creek, although more surveys are needed to

confirm the absence of trout since conditions made visual detection difficult in some sections (Department 2021, pp. 7–11).

Castle fire suppression activities and burned area emergency response treatments (*e.g.*, dozer line construction, handline construction, and road and trail repairs) implemented in occupied drainages may have resulted in minor short-term impacts to the habitat, but the Forest Service expected minimal overall risk to the Little Kern golden trout from these activities (Forest Service 2022a, pp. 8–11).

While periods of drought are part of the natural variation of the climate in the Sierra Nevada, drought conditions have recently intensified in the Little Kern golden trout's range. Inland native trout populations have historically been negatively affected by drought and, in some cases, drought has led to localized extirpation (Hogan et al. 2014, p. 2). The Department assessed five Little Kern golden trout-occupied streams in 2014 and 2015 and determined that Lion, Willow, Sheep, and Tamarack Creek are at moderate risk and No Name Creek is at high risk of reduced streamflow and water depths due to drought (Hogan et al. 2014, p. 5; Hogan and Buchanan 2015, p. 3). Reduced habitat and dry stream segments likely associated with drought were also observed in Trout Meadow, Deep, Fish, and Wet Meadow Creeks (Department 2018, pp. 13, 34). These results indicate that potential loss of habitat by worsening drought conditions could threaten populations in these streams.

Recovery criteria:

There currently is not a published recovery plan for the Little Kern golden trout. The Revised Fishery Management Plan for the Little Kern Golden Trout (Christenson 1984, entire) is the most current document guiding the management, conservation, and recovery of the subspecies.

Conclusion:

After reviewing the best available scientific information, we conclude that Little Kern golden trout remains a threatened species. The evaluation of threats affecting the species under the factors in 4(a)(1) of the Endangered Species Act and analysis of the status of the species in our 2011 status review (Service 2011, entire) remains an accurate reflection of the current status of the species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

Here we propose several habitat conservation and ecological research recommendations which will aid in the recovery and conservation of the Little Kern golden trout. Some of these recommendations have already been discussed in previous recovery documents (Service 2011, p. 22) and remain valid.

1. Update the current Fishery Management Plan to include an official genetic management plan to guide restoration actions that consider lack of genetic diversity in the population and restore pure populations of Little Kern golden trout throughout their entire historical range. A genetic management plan should incorporate the best available information from recent genetic analyses (*e.g.*, Stephens 2014, entire; Department 2020, entire) to identify genetic management units and guide potential translocations, fish rescue, and genetic rescue efforts.

2. Conduct long-term monitoring by regularly surveying Little Kern golden trout populations and performing genetic analyses to evaluate trends in population dynamics. Consider using eDNA metabarcoding as a monitoring tool. Continue and expand systematic habitat monitoring in the Little Kern drainage that regularly (every five years) assesses stream conditions throughout the drainage, including both abiotic (temperature, water quality, bank stabilization, sediment distribution, riparian vegetation recruitment, *etc.*) and biotic (macroinvertebrate surveys and Little Kern golden trout population surveys) factors. More sensitive stream sites, such as those located in the Little Kern and Jordan grazing allotments or drainages that have recently been impacted by fire should be monitored more regularly (every two years).
3. Regularly evaluate the structural integrity of stream barriers and their ability to inhibit the dispersal of non-native salmonids throughout the Little Kern River drainage (especially during high water years) and make improvements where necessary. Assess and weigh the impacts of barriers (*e.g.*, preventing further hybridization and competition with non-native salmonids, reduction of gene flow between Little Kern golden trout populations, increased inbreeding). Consider these factors when deciding if improvements to existing barriers or construction of new barriers is necessary for the conservation of Little Kern golden trout populations. Consider experimental barrier removal to improve Little Kern golden trout dispersal and prevent further population bottlenecking.
4. Investigate the cause and impact of fin erosion on Little Kern golden trout and identify and implement corrective actions, if necessary.
5. In order to reflect the most current understanding of the subspecies' taxonomy, formally change the species name in the Code of Federal Regulations from *Oncorhynchus aguabonita whitei* to *Oncorhynchus mykiss whitei*.

Field Supervisor, Sacramento Fish and Wildlife Office

Approve _____ Date _____

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