# LITTLE KERN GOLDEN TROUT
## *Oncorhynchus mykiss whitei*

**High Concern. Status Score = 2.0 out of 5.0.** The Little Kern golden trout is vulnerable to extinction in its native range in the next 100 years. The restoration of Little Kern golden trout is ongoing, as recovery shifts from one focused on reducing hybridized populations to improving genetic diversity, population connectivity and size, as well as expanded distribution.

**Description:** This subspecies is similar in appearance to California golden trout but is not as bright in color (Behnke 2002). It also tends to have more small spots on the body and have more (ca.10) distinct parr marks. It has fewer scales along the lateral line (usually 155-160) than California golden trout, but more pyloric cecae (35-40) and more vertebrae (60-61).

**Taxonomic Relationships:** The complex history of nomenclature and taxonomy of the golden trouts is described in Behnke (2002) and in the California golden trout account in this report. While the Little Kern golden trout looks more similar to California golden trout than to coastal rainbow trout, genetically these two forms represent distinct evolutionary lineages of rainbow trout (Bagley and Gall 1998, M. Stephens 2007).

**Life History:** Only limited life history studies are available on this subspecies, but its life history is presumably similar to that of well-studied California golden trout, as described in this report. Spawning behavior, as described by Smith (1977) is similar to that of other rainbow trout, although Little Kern golden trout are known to produce fewer eggs during spawning and are generally less fecund. Konno (1986) showed the fish have relatively small home ranges compared to other inland salmonids.

**Habitat Requirements:** Little Kern golden trout have similar habitat requirements as California golden trout in the neighboring South Fork Kern River and Golden Trout Creek. They are adapted for living in small, meandering meadow streams and higher gradient tributaries. Myrick and Cech (2003) found that these trout are physiologically adapted to temperatures of 10-19°C. They co-occur with Sacramento suckers in some areas (Moyle 2002).

**Distribution:** This subspecies is endemic to roughly 160 km of the Little Kern River and tributaries, where it was isolated from the rest of the Kern River basin by natural barriers (Christenson 1994; Behnke 2002). By 1973 their range had shrunk to five headwater streams in the basin (Lower Wet Meadows Creek, Deadman Creek, upper Soda Spring Creek, Willow Creek, and Fish Creek) plus an introduced population (originating from Rifle Creek) in Coyote Creek, a tributary to the Kern River (Ellis and Bryant 1920; Christenson 1984). It was determined later that the upper Coyote Creek population was genetically influenced by California golden trout (M. Stephens 2007). Excluding Coyote Creek, the 1973 distribution of Little Kern golden trout included about 16 km of habitat. Beginning in 1974, systematic efforts were made by DFG and other agencies to restore Little Kern golden trout to its historical range, by applying rotenone to streams and lakes in the drainage, constructing barriers to immigration of non-native trout, and rearing Little Kern Golden trout at the Kern River Planting Base near Kernville. Between 1974 and 1996, approximately 100 applications of piscicides were used to reduce introduced or hybridized populations, 27 fish barriers were used to isolate populations,

and nearly 80,000 fish were transplanted or moved to assist recovery efforts (Lusardi et al. 2015). The effort resulted in an apparent restoration of populations in about 51 km of stream plus introduction into three headwater lakes by 1998. Subsequent genetic studies suggest that coastal rainbow trout influence has been greatly reduced within the basin. Stephens (2007) found that 85% of the population showed less than 5% introgression with rainbow trout, suggesting beneficial results. However, data also indicate that Little Kern golden trout exhibit signs of significant genetic structuring and reduced genetic diversity associated with drift and inbreeding (Stephens 2007, Lusardi et al. 2015). Recent genetic studies have identified low (<2%) introgression levels in five subpopulations within the Little Kern basin including: upper North Fork Clicks Creek, Upper Clicks Creek, Trout Meadow Creek, Little Kern River above Broder's Cabin, and Little Kern River above Wet Meadows Creek (Stephens and May 2010).

**Trends in Abundance:** When Little Kern golden trout were at their minimum range (16 km of stream), their population was estimated at 4,500 fish (Christenson 1978). If it is assumed they currently persist in 50 km of small streams, with 300 fish age 1+ and older per km (500/mi; Christensen 1994), the total numbers are probably around 15,000 fish. However, densities at the subpopulation-level likely vary across the watershed and, consequently, their overall abundance may be less than these rough estimates. Stephens and May (2010) found five subpopulations showing less than 2% introgression and six others showed either low or high rainbow trout introgression estimates, depending on the type of genetic marker used (USFWS 2011). If only unhybridized fish are counted, then the number may be confined to 20 km or so of refuge streams, supporting perhaps 5,000-6,000 fish. The estimated number of spawning Little Kern Golden trout within each refuge subpopulation is unknown; spawner numbers may be small and limit long term persistence of some populations and/or negatively affect their genetic integrity.

**Factors Affecting Status**: Little Kern golden trout are largely confined to the headwaters of the Little Kern River in small, isolated, tributary streams. The streams in which they occur are on public lands administered by the Sequoia National Forest or Sequoia National Park. These disconnected subpopulations face genetic risks associated with lack of gene flow and small population sizes. Their isolation from one another likely promotes inbreeding, genetic drift, and further reductions in genetic variability. These factors may be contributing to limited effective population sizes and reductions in individual fitness.

*Alien species.* A principal threat is loss of genetic diversity, due to founder effects associated with reintroduction programs between 1974 and 1996. Little Kern golden trout remain threatened by hybridization with hatchery rainbow trout. Stephens and May (2010) found that several populations of Little Kern golden trout exhibited high levels of rainbow trout introgression ranging from 0.25-0.83 (% rainbow trout admixture), depending on the type of marker used. Thus, loss of genetic diversity continues to threaten their long-term persistence. Habitat loss from the region's long history of grazing, logging, and roads, as well as stochastic events such as floods, drought, and fire may increase local population extinction risks, especially considering current genetic status (Moyle 2002).

Fortunately, brown trout appear to have been removed from the basin and volitional movement upstream from the Kern River is limited by a series of large cascades in the lower portion of the river that serve as an effective fish barrier (C. McGuire, CDFW, pers. comm. 2016). Hatchery trout are no longer stocked in the basin (S. Stephens, CDFW, pers. comm.

2008). For a full discussion of broader threats and challenges facing fishes in the Kern basin, see the California golden trout account.

| Factor | Rating | Explanation |
|---|---|---|
| Major dams | n/a | All major dams outside native range of Little Kern golden trout. |
| Agriculture | n/a | |
| Grazing | Low | Ongoing threat to habitat but greatly reduced from the past. |
| Rural /residential development | n/a | |
| Urbanization | n/a | |
| Instream mining | n/a | |
| Mining | n/a | |
| Transportation | Low | Trails and off-road vehicle routes can cause sediment and pollution input into streams; however, most areas occupied are within designated wilderness. |
| Logging | Low | This is an important land use in the broader region but probably has no direct effect on Little Kern golden trout streams. |
| Fire | Medium | Can change watershed processes, cause siltation, and loss of habitat. Extensive fire could cause population vulnerability through reduction in habitat or mortality. Recent fires (e.g., Lion Fire) have directly impacted core conservation streams. |
| Estuary alteration | n/a | |
| Recreation | Low | Entire range is within Sequoia-Kings Canyon National Park and Sequoia National Forest. |
| Harvest | Low | Light fishing pressure; most fishing is catch and release. |
| Hatcheries | Low | Residual effects of hybridization with hatchery fish. Hatchery fish are no longer planted in the basin. |
| Alien species | High | Hybridized populations or remnant rainbow trout populations continue to threaten genetic integrity. |

**Table 1.** Major anthropogenic factors limiting, or potentially limiting, viability of populations of Little Kern golden trout. Factors were rated on a five-level ordinal scale where a factor rated "critical" could push a species to extinction in 3 generations or 10 years, whichever is less; a factor rated "high" could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated "medium" is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated "low" may reduce populations but extinction is unlikely as a result. A factor rated "n/a" has no known negative impact. Certainty of these judgments is high. See methods for explanation.

**Effects of Climate Change:** Climate change has altered Sierra precipitation and runoff patterns, with more precipitation falling as rain and runoff occurring earlier than historical averages. The southern Sierra Nevada, however, is the highest part of the mountain range which may at least partially offset substantial reductions in snowpack, as is predicted in the northern Sierra Nevada and other regions of the state. The autumn base flow period may be a particularly stressful

period for Little Kern golden trout because the Kern basin experiences reductions in groundwater recharge and extent of wetted habitat, along with warmer water temperatures. During drier years, low flow conditions may periodically lead to further disconnection of subpopulations. This may be particularly true in smaller headwater streams that support the most genetically intact populations and provide key over-summering habitat. Elimination of grazing and other activities that compact meadows (reducing their ability to store water) and reduce riparian cover and shade can mitigate, in part, for the effects of climate change. An increase in fire frequency or intensity could remove riparian vegetation and promote sedimentation. Moyle et al. (2013) rated Little Kern golden trout as critically vulnerable to climate change, with extinction likely in California in the next 100 years if present climate change trends continue.

**Status Score = 2.0 out of 5.0. High Concern.** The Little Kern golden trout has high a probability of disappearing in the next 50-100 years, despite major efforts to protect this unique subspecies. This vulnerability has long been recognized and serious management efforts to protect it began in 1975. The Little Kern River was included within the Golden Trout Wilderness Area in 1977. The subspecies was listed as threatened by USFWS in 1978 and a management plan was completed by CDFW in the same year (Christenson 1978) and revised in 1984. The Little Kern golden trout's listing status was reaffirmed in 2011 (USFWS 2011), though the nature of threats has changed. Recent genetic work suggests that, while hybridization with rainbow trout remains a concern, the threat has greatly been reduced through management actions and most populations now exhibit less than 5% introgression with rainbow trout.

CDFW, beginning in 2012, has performed the most comprehensive basin-wide population and habitat assessment in the Little Kern River drainage to date, including documentation, evaluation, and geo-referencing of all artificial and natural barriers. Tissues have been collected throughout the drainage and will be used in future genetic studies. However, Little Kern golden trout populations remain small and highly structured, with reduced heterozygosity due to inbreeding and genetic drift. Given recent advances in our understanding of the genetic status of the subspecies (Stephens 2007, Stephens and May 2010, Lusardi et al. 2015), the Little Kern golden trout management plan should be revised and updated.

| Metric | Score | Justification |
|---|---|---|
| Area occupied | 1 | Unhybridized populations occur in just 5 or 6 stream segments. With the exception of Coyote Creek (adjacent drainage), there are no other populations outside the Little Kern drainage. |
| Estimated adult abundance | 2 | Probably less than 5,000 adults in 5 isolated populations. |
| Intervention dependence | 3 | Requires intervention to maintain unhybridized populations, prevent invasions of alien trout, and promote population connectivity. |
| Tolerance | 3 | Presumably fairly tolerant, as are most Rainbow trout, but not tested. |
| Genetic risk | 1 | Significant as populations are fragmented. Ongoing threats from hybridization and loss of genetic diversity through inbreeding and genetic drift. |
| Climate change | 1 | Critically vulnerable to range reductions and habitat alteration from climate change. |
| Anthropogenic Threats | 3 | 1 High and 1 Medium threat. |
| Average | 2.0 | 14/7. |
| Certainty (1-4) | 4 | Recent publications and USFWS 5-year review. |

**Table 2.** Metrics for determining the status of Little Kern golden trout, where 1 is a poor value and 5 is excellent. Each metric was scored on a 1-5 scale, where 1 is a major negative factor contributing to status; 5 is a factor with no or positive effects on status; and 2-4 are intermediate values. Certainty of these judgments is high. See methods for explanation.

**Management Recommendations:** A detailed review of recommended management actions can be found in Lusardi et al. (2015). Some of the key management actions to improve the status of Little Kern golden trout include:

*Conduct further targeted genetic monitoring*. A genetic baseline of all presumed Little Kern golden trout within the Little Kern drainage must be established. While genetic monitoring has been conducted over the last several years, additional monitoring is necessary and should focus on identifying all unhybridized and remaining introgressed populations. Based on the outcomes of future analyses, draft a new genetic management plan specific to the Little Kern golden trout.

*Establish out-of-basin refuge populations*. Little Kern golden trout and their habitats are vulnerable to stochastic events such as fire, disease, climate change and flooding. While a single out-of-basin population exists adjacent to the Little Kern basin (Coyote Creek), additional refuge populations should be established. Such populations could also be used as sources for future introductions and provide essential population redundancy, serving as an 'insurance policy' against potential population losses within the native range.

*Use barriers strategically*. Based on genetic monitoring, continue to use structural barriers where necessary to prevent colonization and reproduction between Little Kern golden trout and introgressed individuals. It should be noted, however, that barriers can impair connectivity and gene flow between populations, potentially reducing genetic diversity. Evaluate existing locations of known barriers and, where possible, remove or alter redundant barriers to improve gene flow between populations.

*Eliminate grazing or use riparian fencing*. In key areas such as the Jordan grazing allotment and low gradient meadows such as Lion, Grey, and Loggy meadows, grazing should be eliminated or restricted significantly to improve meadow habitat condition and habitat resilience to climate change.

**New References:**

McGuire, C. 2016. Pers. comm. CDFW Fisheries Biologist (retired), Kernville, CA.

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Weaver, J. 2016. Pers. comm. CDFW Wild Trout Program Leader, Rancho Cordova, CA.

Lusardi, R., et al. 2015. "Threat evolution: negative feedbacks between management action and species recovery in threatened trout (*Salmonidae*)." *Reviews in Fish Biology and Fisheries*: 521-535.

Stephens, M. and B. May. 2010. "Final Report: Genetic Analysis of California Native Trout (Phase 2)." Report to California Department of Fish and Game. Genomic Variation Laboratory, University of California, Davis. 24 pp.

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