

**State of California
Department of Fish and Wildlife**

M e m o r a n d u m

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Subject: 2021 Butte Creek Spring-run Chinook Salmon Snorkel Survey

The annual Butte Creek spring-run Chinook salmon (*Oncorhynchus tshawytscha*) snorkel survey was conducted July 12 – 16, 2021 to estimate the number of spring-run Chinook salmon adults successfully returning to Butte Creek and holding over summer prior to spawning in the fall. The snorkel survey was conducted using a standard swimming snorkel methodology and covers Centerville Head Dam (CHD) to Parrot-Phelan Diversion Dam (PPDD) (Figure 1). Four reaches between Quartz Bowl Pool and PPDD were surveyed on four consecutive days, July 12-15. A fifth reach from CHD to Quartz Bowl Pool was conducted on July 16.

Data collection and analysis has been standardized for this survey since 2001.¹ The survey protocol requires each pool to be surveyed once by each crew member (either swimming the pool or observed from above the pool), and each crew member records a count separately for each pool. To increase accuracy of the count, snorkel surveys are conducted in an upstream to downstream direction, and the number of snorkelers entering a pool at a time is dictated by the width of the pool. This approach utilizes the swimming direction of the adult salmon to minimize double counting within a pool and prevents groups of fish from swimming around individual crewmembers and avoiding detection. Upon analysis of individual pool specific counts, uncertain or obvious outliers are excluded, and the estimated number of fish observed for an individual pool is calculated by averaging individual crewmember counts. The total

¹ Prior to 2001, each crew member developed an independent estimate for each holding pool, and before proceeding, a single estimate was made by group consensus and recorded in the field.

estimate of holding salmon is calculated by summing the averages for each pool. **The estimate for the 2021 adult snorkel survey was 12,252 salmon.** Table 1 displays the range and average number of adult spring-run Chinook salmon observed within each of the five reaches.

Table 1. Range and average number of spring-run Chinook salmon observed in each reach during the 2021 Butte Creek Spring-run Chinook salmon snorkel survey.

| Date | Reach | Range | Average | % Of Total |
|------|--|-----------------|---------------|------------|
| 7/12 | Quartz Bowl Pool to Helltown Bridge | 9,742-14,021 | 11,889 | 97.03% |
| 7/13 | Helltown Bridge to Quail Run Bridge | 343 - 379 | 361 | 2.95% |
| 7/14 | Quail Run Bridge to Centerville Covered Bridge | 1-3 | 2 | 0.02% |
| 7/15 | Covered Bridge to Parrot-Phelan Diversion Dam | 0 | 0 | 0% |
| 7/16 | Centerville Head Dam to Quartz Bowl Pool | 0 | 0 | 0% |
| | Totals | 10,086 - 14,403 | 12,252 | 100% |

A Vaki RiverWatcher Fish Counter (Vaki) has been installed in Butte Creek at Durham Mutual Fish Ladder since 2014 to monitor passage of adult spring-run returning to Butte Creek. The first spring-run documented to pass through the Vaki for the 2021 migration season occurred on February 20th. The Vaki was not operational for half of the spring-run migration season due to a component failure at the end of April, which resulted in an incomplete passage estimate. Prior to equipment failure, the Vaki detected a partial count of 7,813 salmon traveling upstream through the ladder and migrating into the summer holding habitat. Salmon were observed bypassing the fish ladder and ascending over Durham Mutual Dam on several occasions. As a result, passage counts underestimated the actual adult holding population in 2021. Historical Vaki data on Butte Creek demonstrates spring-run Chinook passage into upper Butte Creek can take place from February through June depending on the water year and flow. Historical data trends demonstrate variability with Vaki estimates when compared to snorkel and carcass survey estimates (Figure 2).

During late June and early July, critically low flows, and warm water temperatures (70°-73° F) resulted in a large proportion of the returning adult cohort to remain in the upper most four miles of Butte Creek’s holding habitat. Beginning July 6th, a notable rise in adult pre-spawn mortalities was documented. On July 13th, veterinarians from the CDFW Fish Health Laboratory collected a subset of spring-run carcass for necropsy. Pathological evaluation of sampled

spring-run mortalities identified severe columnaris disease (*Flavobacterium columnare*) as well as moderate ich (*Ichthyophthirius multifiliis*) parasite infestation contributing to the mortality of fish. Warmer water temperatures and reduced flows in Butte Creek favor development, acceleration, and facilitation of columnaris and ich pathogen transmission. Due to the timing of the pathogen outbreak, a number of pre-spawn mortalities had occurred prior to the snorkel survey. It should be noted that pre-spawn mortalities that took place both before and after the snorkel survey were not included in the estimate. The snorkel survey provides a snapshot in time of the estimated number of live spring-run salmon in Butte Creek and their holding patterns.

To quantitatively document and estimate the number of salmon that unsuccessfully spawned (pre-spawn mortalities) versus the number of salmon that successfully spawned (post-spawn carcass), two separate mark-recapture surveys (Cormack Jolly-Seber model) were performed in 2021. The pre-spawn survey initiated in June and processed all encountered pre-spawn mortalities on a weekly basis until spawning was observed. The results of this survey will estimate the size of the population that did not survive to spawn. Additional data collected during this survey, such as real time monitoring of critical water temperatures, can be used to inform water management decisions on Butte Creek. A second mark-recapture survey initiated mid-September when the first spawned female carcass was observed. The purpose of the annual carcass survey is to obtain a separate estimate of the number of spring-run that survived the summer holding season to successfully spawn. Since 2001, CDFW has used mark-recapture carcass surveys to monitor adult spring-run Chinook salmon populations in Butte Creek. Both surveys collect additional data including coded-wire tags (CWTs) from hatchery strays and biological samples (e.g., scales, tissue, otoliths) from a subset of carcasses for archive. Continued efforts to obtain adult holding estimates along with monitoring of water temperature and flow within Butte Creek provide valuable data used to assess long term trends and holding patterns for one of the few remaining wild spring-run Chinook salmon populations within the Central Valley.

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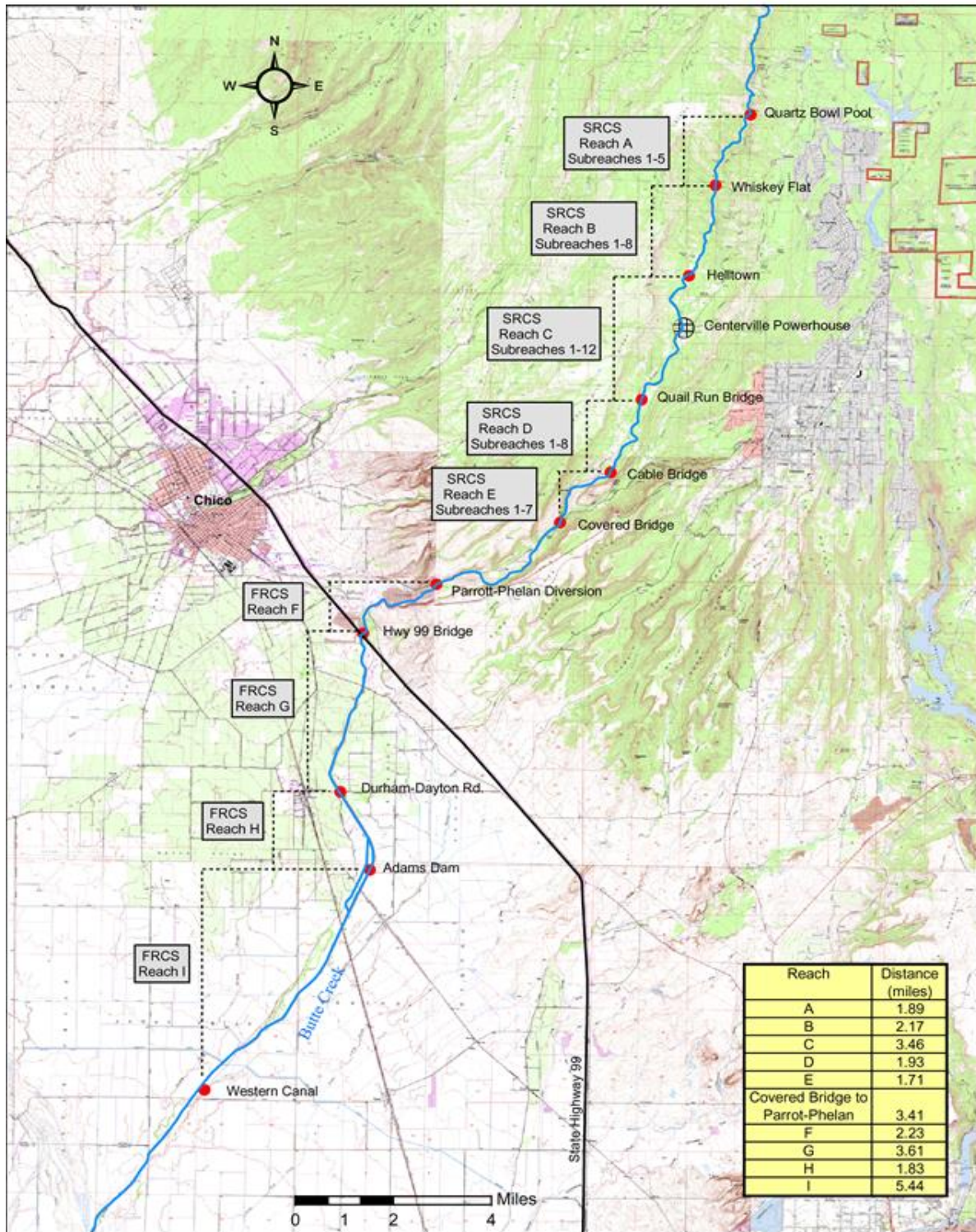


Figure 1. Map showing reaches and major physical features for both spring-run Chinook salmon and fall-run Chinook salmon spawning and holding areas on Butte Creek.

Butte Creek Spring Run Chinook Salmon Escapement Estimates 2001-2021

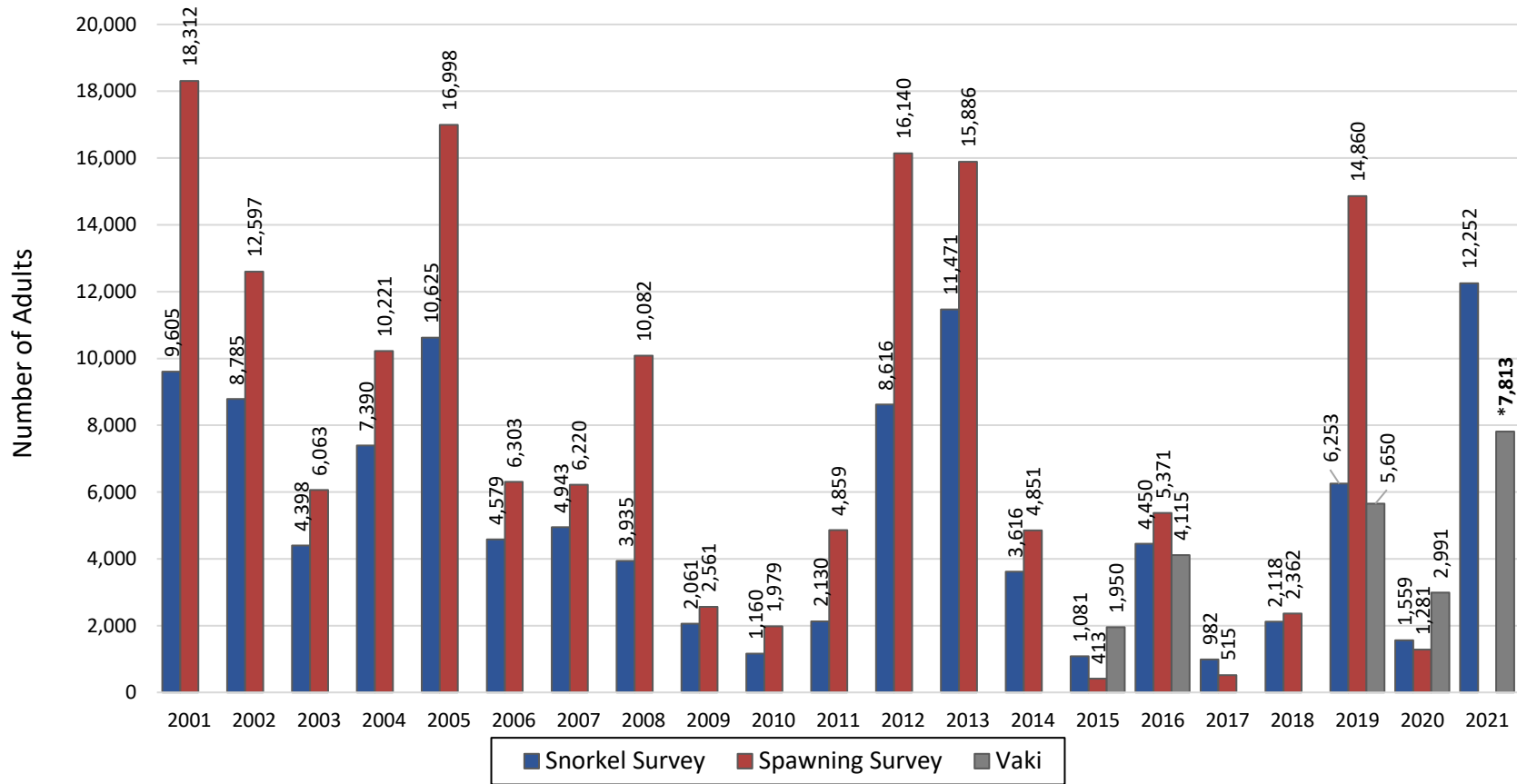


Figure 2. Butte Creek spring-run Chinook salmon escapement estimates from 2001-2021: snorkel survey (blue); carcass survey (red); and Vaki estimates (gray). * Vaki passage counts for 2021 were incomplete due to equipment failure. Passage counts are from February to the end of April 2021.

