

**California Department of Fish and Wildlife  
Inland Fisheries Assessment and Monitoring Program**

**Whiskeytown Lake  
Kokanee Fishery Evaluation – 2023**

**Region 1- Northern**

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## **Abstract**

Whiskeytown Lake, located in Shasta County, approximately 8 miles west of Redding, is a popular Kokanee Salmon (Kokanee) fishing destination. Kokanee spawn naturally in a few Whiskeytown Lake tributaries and supplemented by stocking when deemed necessary by the California Department of Fish and Wildlife (CDFW). Kokanee stocking has been sporadic in Whiskeytown Lake over the past three decades, but the most recent stocking event occurred in 2019 as a response to habitat loss associated with the 2018 Carr Fire. When stocking is necessary, Kokanee fingerlings come from the Little Truckee River or Taylor Creek as part of the CDFW's landlocked salmon stocking program. In the absence of a consistent stocking program, the Kokanee fishery at Whiskeytown Lake is increasingly dynamic and dependent upon habitat quality and conditions within the lake and supporting streams. Monitoring habitat and water quality, natural spawning, and angler use is crucial to ensuring the fishery remains productive. Angler creel surveys are one useful tool for assessing the condition of the sport fishery at Whiskeytown Lake.

This report outlines the 2023 Angler Creel Survey. The management goal for the Kokanee fishery at Whiskeytown Lake is a quality fishery, in which fish average 330 mm (13 inch) total length (TL). During the 2023 creel survey, the average Kokanee total length was 311.2 mm (12.3 inches). A total of 528 of the total 904 Kokanee caught (58.4%) during our survey period were measured. Overall, Kokanee anglers were generally satisfied with their fishing experience, the number of fish, fish health, and fish size. Future studies on zooplankton population dynamics and Kokanee recruitment rates at Whiskeytown Lake would provide additional information needed to develop a more comprehensive management strategy.

## **Introduction**

Whiskeytown Lake is a man-made lake formed by the completion of Whiskeytown Dam in 1963. The dam is owned and regulated by the United States Bureau of Reclamation as part of the Central Valley Project, providing irrigation water, flood control, and hydroelectric power generation. Whiskeytown National Recreation Area, managed by the National Park Service, is a 42,000-acre recreation area, providing opportunities for watersports including kayaking, wakeboarding, tubing, and sport fishing. There are a variety of sportfish found in the lake including Kokanee, Rainbow Trout, Largemouth Bass, Crappie, Bluegill, and Sacramento Pikeminnow. The CDFW began stocking Whiskeytown Lake with Kokanee in 1982 and supplemental stocking continues today as deemed necessary based on data collected by CDFW (Figure 1).

Kokanee have not been stocked in the lake since 2019 as Kokanee recruit to the fishery via natural spawning in tributary streams and appears to be self-sustaining. In 2019, 49,999 Kokanee fingerlings were stocked as a response to the 2018 Carr Fire, which burned 97% of Whiskeytown National Recreation Area, including the majority of key Kokanee spawning tributaries: Whiskey, Clear, and Brandy creeks. In 2019, there was a historic outbreak of the parasitic copepod (anchor worm) on Kokanee salmon in Whiskeytown Lake. With the absence of any empirical data, it has been assumed the anchor worm outbreak may have been partially due to the increase in the number of hosts made available from the stocking event. According to Ortega (Ortega et al., 2023), crowding of cold-water fishes into seasonal refuge habitats could increase parasite loads and cause declines in fitness. This, in addition to above average temperatures may explain the anchor worm outbreak in 2019. As a response, CDFW biologists began an adaptive management approach which includes supplemental stocking when needed based upon the data and relying on natural recruitment to fuel the sport fishery. This angler creel survey represents the first formal assessment of the sport fishery CDFW has performed. It is being conducted as directed by CDFW's Statewide Kokanee Management Plan.

Angler surveys or creels are assessments conducted to better understand angler use within a fishery and to track trends over time within a fishery. During typical angler surveys, anglers are asked a series of questions and measurements are obtained from their harvest when possible (voluntary). The data collected is then processed and used by fishery managers to create, direct, or revise management strategies and, or goals. This data also helps managers actively assess fishery needs, stocking evaluations, and potential regulation changes for the fishery. Collecting length and weight measurements are valuable data used to help assess distribution of size and condition throughout the fishery. Angler creel data collected through angler surveys are important information for fisheries biologists to determine fishery trends and inform adaptive management if necessary.

### ***Study Location***

Whiskeytown Lake is a man-made reservoir in the Shasta-Trinity National Forest, located in Shasta County, approximately 8 miles west of Redding, California. The lake is situated at 1,201 feet above sea level (Figure 2) and has a total capacity of 241,100 acre-feet of water. The maximum depth is 264 feet, surface area is 3,458 acres, and when full the lake has approximately 37 miles of shoreline. Whiskeytown Lake has three main tributaries, Clear, Whiskey, and Brandy creeks. Clear Creek flows out of Whiskeytown Dam downstream into the Sacramento

River providing spawning and rearing habitat for threatened Spring-run Chinook Salmon, Fall-run Chinook Salmon, and threatened Central Valley Steelhead. As part of the Central Valley Plan, the water in the lake is managed to provide cold water to threatened species downstream and as a reserve during dryer years. The lake is also managed for flood control, some irrigation, and provides hydroelectric power generation. Whiskeytown Lake fluctuates approximately 12 feet below full pool in the fall, with draw-down occurring October through December (CDEC, 2022). This minimal drawdown is conducted for flood control purposes.

## **Methods**

CDFW conducted access point angler surveys at two of the three boat ramps on Whiskeytown Lake. Surveys were conducted at Whiskey Creek boat launch and Oak Bottom boat launch from June 1, 2023, to September 20, 2023. A total of 41 surveys were completed during the survey period, adhering to a stratified random sampling schedule, which included 8 weekday surveys and 4 weekend surveys per month. Surveys were conducted by CDFW staff from about 0800h to 1300h. Surveys were cut short by an hour during times of excessive heat (over 100°F). The surveys were stratified between weekdays, weekends, and holidays to account for increased usage by anglers. Staff recorded relevant conditions data including date, weather conditions, time started, water temperature, ambient temperature, and an initial boat trailer count at the beginning of each survey. Anglers were surveyed after they had finished angling to ensure the results only included total angling effort for all angling trips. Data collected included: survey time, angler county, number of anglers in the boat, number of rods used, total hours fished, gear used, method of fishing, target species, total harvest, and number of fish released (separated by species). If the angler was from out of state, their state of residence was recorded instead of county. Additionally, anglers were asked a series of questions rating their satisfaction with the fishery on a scale of 1-5. Anglers were asked to provide a score for the number of fish they observed or caught, size of fish caught, health of the fish and overall satisfaction with the fishery. A rating of 1 meant the angler was very unsatisfied and a rating of 5 meant the angler was very satisfied. Anglers were also asked a preference question about the fishery pertaining to our management goals. Options were taken directly from department management criteria: fast action (F), quality (Q) or trophy (T). If the angler was unsuccessful that day, they were only asked about their overall satisfaction and their preference for fishery management.

Kokanee kept by anglers were inspected, measured, and weighed. Data collected on the Kokanee included: fork length (FL), weight in grams (g) and a relative condition score ranging from 1-3. A score of 1 meant the fish had 0 copepods and was very healthy, 2 meant the fish had <10 copepods and was healthy, 3 meant the fish had >10 copepods resulting in a plausibly unhealthy fish. If there were any abnormalities or interesting features on the Kokanee pictures were taken, and comments were recorded on the survey.

## **Results**

A total of 246 angler groups were interviewed, representing 479 individual anglers, and a total of 969.5 hours fished. Anglers targeted Kokanee approximately 96% of the time (n=235), Bass approximately 2.5% of the time (n=6), Rainbow Trout approximately 0.4% of the time (n=1), and other species were targeted 1.2% of the time (n=3) (Figure 3). Out of a total of 246 angler groups, approximately 75% of anglers were from Shasta County (n=181), approximately 9% of anglers were from Tehama County (n=22), approximately 3% of anglers were from Trinity County (n=8), and the remaining 13% of anglers were from other counties that each represented less than 3% of anglers (n=33) (Figure 4). Anglers targeted Kokanee most frequently with a total of 937 hours fished, followed by bass with 22 hours fished, Rainbow Trout with 3 hours fished and lastly, 7.5 hours fished for other species (Table 1). Out of all the fish species in Whiskeytown Lake, Kokanee were caught and harvested the most (n=1096), representing 904 harvested and 192 released, with a total of 1096 Kokanee caught. A total of 14 bass were caught but all of them were released. Additionally, a total of 28 Rainbow Trout were kept and 8 were released, with a total of 36 Rainbow Trout caught (Table 2). It is important to state the total number of Rainbow Trout caught is not representative of anglers who targeted them. Anglers who targeted Kokanee occasionally caught Rainbow Trout as bycatch, since Rainbow Trout can be caught trolling at similar depths as Kokanee. Catch per unit effort (CPUE) was calculated as the quotient of total number of Kokanee caught divided by the total hours fished. The calculated CPUE for Kokanee without expansion was 1.17 fish per hour. California fishing regulations allow anglers to use two rods if they purchase a two-rod stamp. Fishing with two rods is a popular strategy for Kokanee fishing. We accounted for this by recording the total rods per boat. The total rod number was divided by the number of anglers to give us an average rods per angler of 1.32. That average was then multiplied by the hours to give total rod hours observed. Catch was then divided by rod hours which resulted in CPUE of 0.88 fish per rod-hour.

Angler groups were asked a series of satisfaction questions rating 1-5 that was indicative to the entirety of the angler group, whether it was one individual or numerous individuals in the group. Satisfaction criteria results varied but on average, anglers were very satisfied with their overall experience fishing on Whiskeytown Lake, with a rating of 4.7 out of 5. The average response for quantity of fish was 3.8 out of 5. For the size of the fish, angler response averaged 3.5. Lastly, the average response for fish health was 4.6 or very satisfied (Figure 5). Additionally, anglers were asked to provide input on the type of fishery they preferred. The options were fast action (F), quality (Q), or trophy (T). The data showed that 8% of anglers preferred a fast-action fishery, (n=19), 66% preferred a quality fishery (n=162), 21% preferred trophy fishery (n=52) and 5% of anglers declined to answer (n=13) (Figure 6).

A total of 904 Kokanee were harvested and 528 of them were measured and weighed with fork length, later converted to total length ( $\#mm * 1.065$ ), and weight in grams (g). The Kokanee that were measured ranged from 223.65 mm (8.81 in) to 455.82 mm (17.96 in). The average size length was calculated at 312.42 mm (12.3 in) (Figure 7). Kokanee weights ranged from 137g to 1100g. Kokanee weights were not recorded until the 12<sup>th</sup> of August 2023. As a result, weights should not be used as a true representation of the Kokanee population during the creel. Weight numbers could be skewed due to possible increases in growth rate possibly attributed to increased food supply and warmer water temperatures during the summer. Each Kokanee measured or weighed was assigned a condition score based on the number of parasitic copepods and or wounds observed. A score of 1 meant the fish was relatively healthy and free of parasitic copepods, 2 corresponded to an insignificant presence of copepods (<10 wounds and or parasites), and a 3 denoted a significant presence of copepods (>10 wounds and or parasites) that may result in reduced fitness. The average condition or health score recorded during the survey was 1.10, suggesting the sample population was overall very healthy and free of parasitic anchor worms or copepods in 2023. Of the Kokanee sampled, 91% were given a score of 1 (n=496), 9% were given a score of 2 (n=47), and 1% of the Kokanee sampled were categorized as a 3 (n=4). Fulton's condition factor (K) is a useful way to show relative condition in salmonids (Fulton 1902). Condition factor (K) was calculated for all measured and weighed fish during the survey. Normal condition factors for salmonids range from 0.8-2.0 with K <0.8 being extremely poor condition, K=1.0-1.4 denoting poor to good condition, and K>1.6 meaning extremely good condition. Using this scale, the average Kokanee measured during the creel are considered healthy (average K=1.37) (Figure 8).

## Discussion

Whiskeytown Lake, the surrounding landscape, and the fisheries found within the lake were severely impacted by the Carr Fire in July 2018, but the results of this creel survey indicate the Kokanee fishery is on the rebound. The fishery is approaching the management goal of a quality fishery with an average total length close to 13 inches (2.3 in), and a CPUE over 1 fish per hour (1.3). Even in the absence of previous creel surveys, it is apparent the Kokanee fishery in Whiskeytown Lake is healthy and productive. Continued and improved monitoring of the fishery paired with recruitment monitoring will be key to managing the fishery into the future. Kokanee spawning surveys were conducted in 2023 and a final report will be produced from that effort. These paired analyses will provide management with an updated baseline for the Kokanee fishery, and a basis for management decisions. To better understand the population composition, it is recommended age structure analysis be conducted using Kokanee scales collected during creel surveys. It would also be wise to conduct a food-web analysis to gain a better understanding of potential factors affecting the Kokanee population. This creel assessment supports the “process-based” management approach already being implemented on the Whiskeytown Lake Kokanee fishery. It is the recommendation of these authors the department continues with the current approach of non-stocking unless intervention becomes necessary due to an unforeseen fish kill or substantial loss of spawning habitat.

## Tables

Table 1. The number of fish kept and released, separated by species, at Whiskeytown Lake 2023

| <b>Species</b> | <b>Kept</b> | <b>Released</b> | <b>Total</b> |
|----------------|-------------|-----------------|--------------|
| Kokanee        | 904         | 192             | 1096         |
| Bass           | 0           | 14              | 14           |
| Rainbow Trout  | 28          | 8               | 36           |
| Other          | NA          | NA              | NA           |

Table 2. The number of anglers, hours fished, and total rods used for each species at Whiskeytown Lake

| <b>Species</b> | <b>Anglers</b> | <b>Hours Fished</b> | <b>Rods Used</b> |
|----------------|----------------|---------------------|------------------|
| Kokanee        | 464            | 937                 | 614              |
| Bass           | 8              | 22                  | 11               |



|               |   |     |   |
|---------------|---|-----|---|
| Rainbow Trout | 2 | 3   | 2 |
| Other         | 5 | 7.5 | 8 |

**Figures**

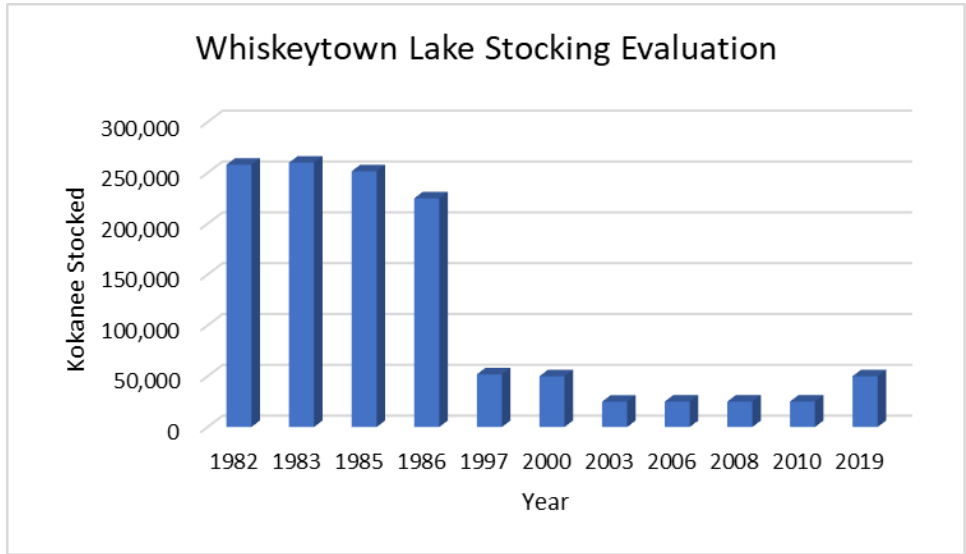


Figure 1. Stocking evaluation from 1982-2023. Note: there were no stocking augmentations in years not shown

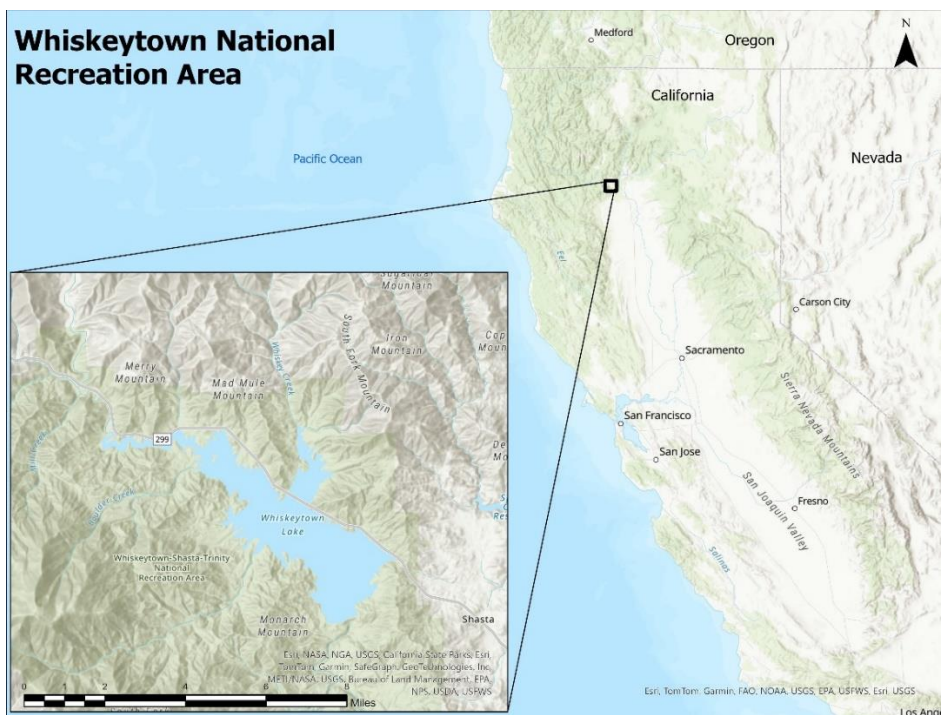


Figure 2. Map showing the location of Whiskeytown Lake.

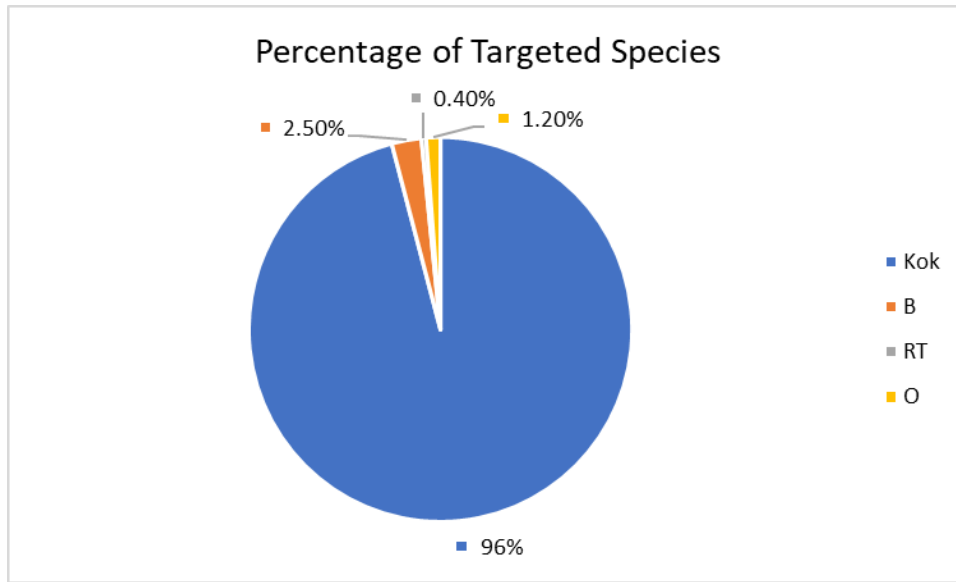


Figure 3. The percentage of anglers who targeted a specific species at Whiskeytown Lake

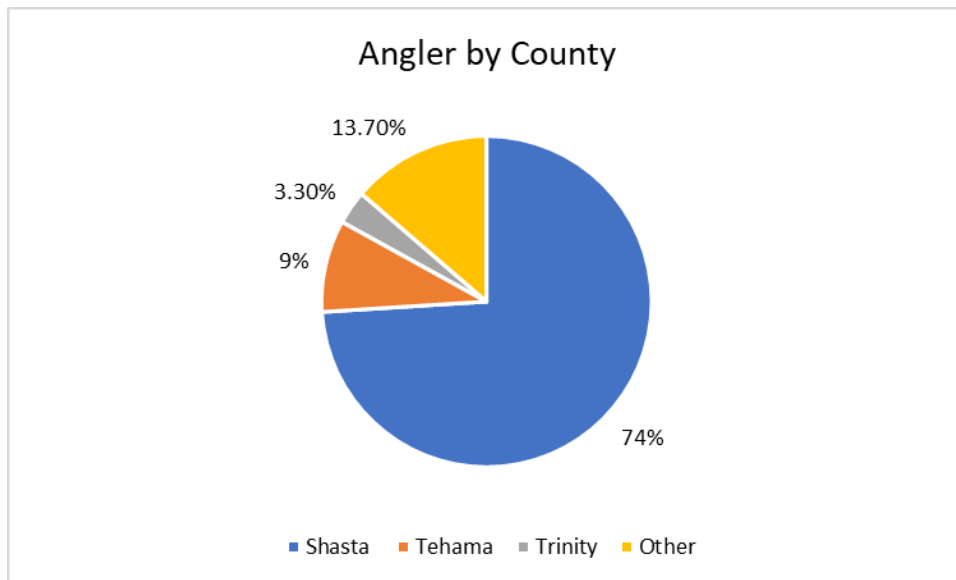


Figure 4. County residence of anglers at Whiskeytown Lake

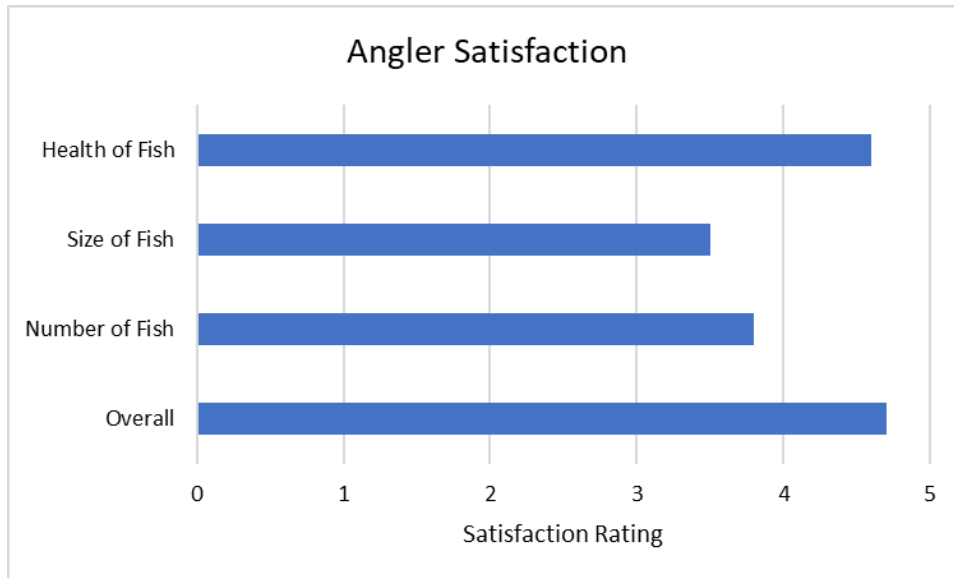


Figure 5. The average angler satisfaction levels for fish health, fish size, number of fish, and overall satisfaction with the fishery.

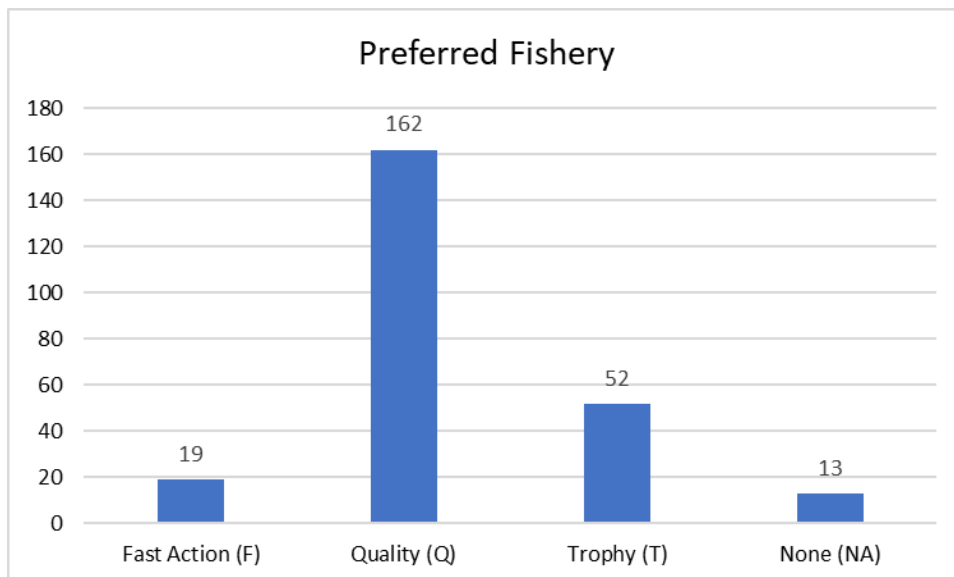


Figure 6. Anglers' preference for fishery management at Whiskeytown Lake

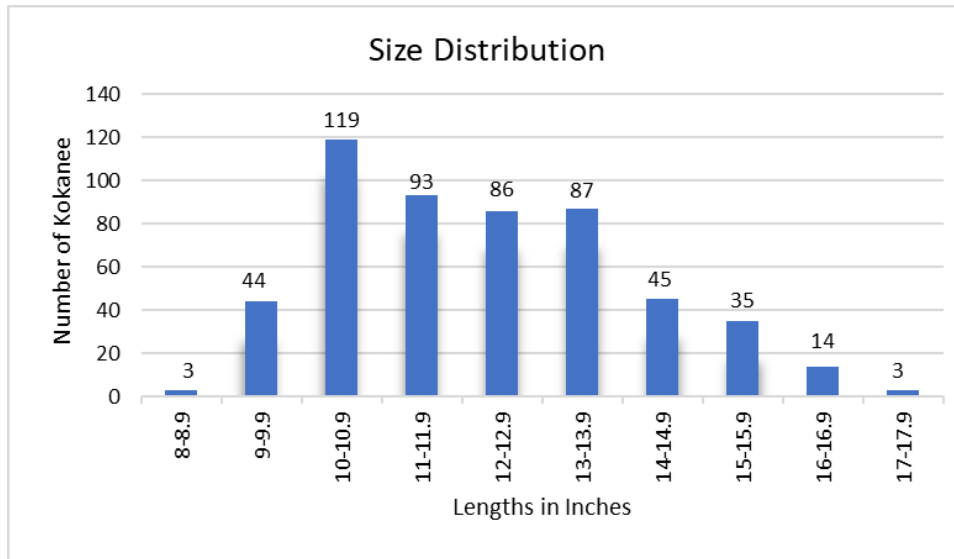


Figure 7. Size distribution of Kokanee Salmon at Whiskeytown Lake

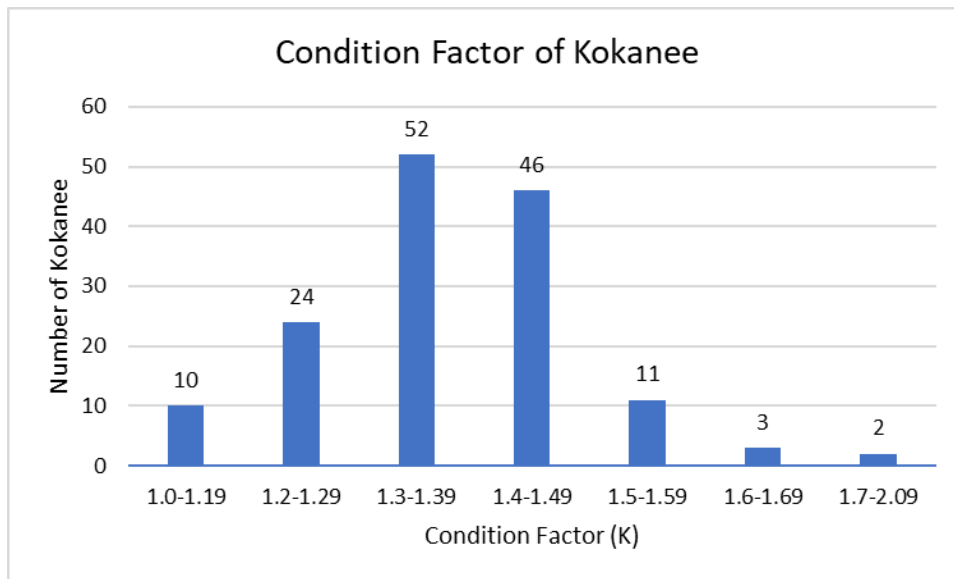


Figure 8. K value showing relationship between lengths and weight

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