Kings River, Below Pine Flat Dam: Report of Results from the Fall Population Electro-Fishing Survey, 2023

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EXECUTIVE SUMMARY

Long-term annual baseline fisheries monitoring within the lower Kings River is being conducted as part of the Kings River Fisheries Management Program (KRFMP) to determine (1) the assemblage, abundance, and condition of the fish community inhabiting the lower Kings River downstream of Pine Flat Dam; (2) overall fish biomass; (3) hatchery and "wild" rainbow trout abundance, distribution, and condition factor; and (4) the annual survival of rainbow trout populations. Initially this monitoring began as part of a Federal Energy Regulatory Commission (FERC) requirement for compliance with Item 4 of the Memorandum of Agreement between the California Department of Fish and Wildlife (CDFW) and the Kings River Conservation District (KRCD), for FERC Project No. 2741, but has continued as a part of the KRFMP. Different electro-fishing techniques have been used since 1983; mark-recapture surveys (1983-1989), single-pass census (1989-2006), and multi-pass depletion electro-fishing surveys (2007-present). Since 2007 the same sites have been sampled annually when conditions allow. For multi-pass depletion sampling, block seine nets are stretched across the river at both the upstream and downstream end of each sampling reach to prevent fish from immigrating or emigrating from the survey site during sampling. Multi-pass surveys allow for a more complete assessment of the species composition and abundance found in the sample site. Surveys are completed with KRFMP agency staff with local volunteers and college students.

Data collected during the Fall Population Electro-fishing Surveys provides a means to estimate population trends over time throughout the sample reach. For these surveys, species were collected, identified, and enumerated, providing a snapshot of the assemblage present in the Kings River between Pine Flat Dam and Highway 180. Results of the 2023 surveys are presented here. As the surveyed sites may not be representative of the 12.5-mile stretch of the Kings River immediately below Pine Flat Dam, results pertaining to catch-per-unit effort

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(CPUE), population estimates, and estimated fish per mile are presented based on individual sample sites rather than extrapolated to apply to the Kings River below Pine Flat Dam. However, results for overall fish assemblage, length-frequency of captured fish, and overall condition factor (K-factor) of captured trout are combined for the 2023 survey covered by this report. Influence of annual instream flow and temperature data while available at the U.S. Army Corps of Engineers (USACE) Bridge and Fresno Weir, and in situ habitat conditions, which was not measured, were excluded from this analysis. 2023 was a 265% water year, which resulted in 4.5-million-acre feet of runoff. Due to high instream flows and unsafe wading conditions, only three of the six historic sites were sampled. As such, surveys from 2023 are not comparable to those from prior years when all six sites were sampled.

In 2023, 2,192 fish were collected during the Fall Population Electro-fishing Survey, with eight of the fourteen species collected native to the watershed. Native fishes dominated the survey in abundance (97%) and biomass (78%), with introduced fish accounting for the remainder.

Surveyors utilized deliberate voltage adjustment of the electro-fishers by site for concurrence with water conductivity. It is not certain how this may have influenced catch efficiency. While catch results show populations of varied species fluctuate by site, the assemblage continues to be dominated by native Sacramento suckers, cyprinid species, lamprey, and sculpin. These fish most accurately meet the criteria for a low-elevation valley floor assemblage characterized by the pikeminnow-hardhead-sucker assemblage as described by Moyle (2002). While deep-bodied fishes such as bass were present, they made up less than two percent of the species assemblage. "Wild" trout were present, but were less than one percent of the species assemblage, as expected for a low elevation, low gradient, fish assemblage.

Catch results provided evidence of successful reproduction for native species as juvenile life stages were collected for all taxa, except three-spine stickleback. Three-spine stickleback

typically live no more than one year, and all members of the annual cohort would have reached adulthood by the time of the survey. Catch results also provided evidence that introduced non-native bass and possibly bluegill have successfully reproduced in the Kings River.

For each of the species captured in the Kings River, several different variables were calculated for each 300-foot sample site. Data imported into MicroFish 3.0 was used to generate total catch, population estimates and 95 percent confidence intervals, and total weight. Population estimates were further used to calculate the fish per mile. Length-weight regression analysis and Fulton's condition factor were both used to determine the overall health of all trout captured during the fall population electro-fishing surveys. For species collected during the survey, species composition, lengths of captured fish, and the ranges across the three sampled sites for population estimates, fish per mile, and biomass are summarized below in Table ES-1. Further discussion is provided elsewhere in this report.

Table ES-1. *Summary results, from the three sampled reaches, Fall Population Electro-fishing Survey.*

Species Collected	Species Composition (%)	Range across Survey Sites[1]			
		Population Estimates*	Fish per Mile (estimated)	Biomass (lb)	Length (in)
Sacramento Sucker	47.58	309-810	5,438-14,256	3.3-17.3	1-21
California Roach	17.24	17-270	299-4,752	0.2-2.9	1-5
Lamprey	10.54	14-452	246-7,955	0.1-1.9	3-8
Sculpin	8.53	24-139	422-2,446	0.3-2.5	2-6
Three-spine Stickleback	6.66	30-183	528-3,221	0.05-0.1	1-3
Sacramento Pikeminnow	6.07	20-63	352-1,109	0.1-0.2	1-4
Rainbow Trout - Hatchery[a]	1.14	0-22	0-387	0-10.6	8-16
Green Sunfish[a]	0.82	0-15	0-264	0-0.4	3-5
Rainbow Trout - "Wild"	0.73	4-6	70-106	1.5-2.8	7-14
Bluegill[a]	0.32	0-9	0-158	0-0.1	2-4
Bass[a]	0.18	0-4	0-70	0-0.2	4-6
Hardhead	0.09	0-2	0-35	No Data	~ 4
Brown Trout[a]	0.05	0-1	0-18	0-0.4	9.4
Catfish[a]	0.05	0-1	0-18	0-0.01	3.3

[1]Range of values across sampled reaches between Pine Flat Dam & Highway 180, this should not be interpreted as all of the fish between Pine Flat Dam and Highway 180

*Confidence intervals for each site are provided in the Results and Discussion section of this report

[a] Introduced (non-native to the watershed or hatchery reared trout)

Condition factor of collected trout was also examined. On average, trout captured during the electro-fishing survey in 2023 were found to be in good condition, with "wild" rainbow trout in slightly better condition than their hatchery counterparts, a reflection of excellent instream conditions.

Fluctuations in fish populations are normal. While native fish currently dominate the species assemblage throughout the Kings River below Pine Flat Dam, there may be years when release temperatures are warmer, and instream flows lesser and of longer duration which may provide better conditions for introduced non-native fish. Variations in species composition cannot be attributed to any single cause and most likely a combination of environmental and anthropogenic factors influences the fishery populations. The KRCD and the KRFMP will

continue monitoring and investigating environmental and population variables within the tailwater fishery.

INTRODUCTION

The Kings River Conservation District (KRCD), in cooperation with the California Department of Fish and Wildlife (CDFW) and the Kings River Water Association (KRWA), have conducted annual population surveys of rainbow trout (*Oncorhynchus mykiss*) and other fish inhabiting the lower Kings River downstream of Pine Flat Dam from 1983 to the present. The population monitoring began as part of a Federal Energy Regulatory Commission (FERC) requirement for compliance with Item 4 of the Memorandum of Agreement between CDFW and KRCD, for FERC Project No. 2741 and utilized by the Kings River Fisheries Management Program (KRFMP).

Numerous fish species inhabit the tailwater below Pine Flat Dam. Species detected during KRCD monitoring can be found in Table 1. While a great diversity of introduced species have been detected in the Kings River since monitoring began in 1983, native species continue to be most abundant. The fish assemblage present is best described as the low-elevation valley floor assemblage characterized by the pikeminnow-hardhead-sucker assemblage described by Moyle (2002). For this assemblage, Sacramento suckers and Sacramento pikeminnow are usually the most abundant fish. Hardhead are restricted to cooler waters with deep rock-bottomed pools, while other native fish present may include tule perch, speckled dace, California roach, riffle sculpin, and rainbow trout (Moyle 2002). Introduced species such as bass and sunfish are present, but only become abundant when dams stabilize flow regimes as native fish are better adapted for survival during periods of extreme high flows and extended cool flows (Moyle 2002).

Table 1. *Fish species detected during monitoring activities of the Kings River below Pine Flat Dam since 1983.*

Species (Scientific Name)	Native	Introduced[a]
Bluegill (*Lepomis macrochirus*)	-	Y
Black Bullhead (*Ameiurus melas*)	-	Y
Brook Trout (*Salvelinus fontinalis*)	-	Y
Brown Bullhead (*Ameiurus nebulosus*)	-	Y
Brown Trout (*Salmo trutta)*	-	Y
California Roach (*Lavinia symmetricus*)	Y	-
Common Carp (*Cyprinus carpio*)	-	Y
Golden Shiner (*Notemigonus crysoleucas*)	-	Y
Goldfish (*Carassius auratus*)	-	Y
Green Sunfish (*Lepomis cyanellus*)	-	Y
Hardhead[b] (*Mylopharodon conocephalus*)	Y	-
Kern Brook Lamprey[b] (*Lampetra hubbsi*)	Y	-
Largemouth Bass (*Micropterus salmoides*)	-	Y
Prickly Sculpin (*Cottus asper*)	Y	-
Rainbow Trout[c] (*Oncorhynchus mykiss*)	Y	Y
Riffle Sculpin[b] (*Cottus gulosus*)	Y	-
Sacramento Pikeminnow (*Ptychocheilus grandis*)	Y	-
Sacramento Sucker (*Catostomus occidentalis*)	Y	-
Smallmouth Bass (*Micropterus dolomieu*)	-	Y
Spotted Bass (*Micropterus punctulatus*)	-	Y
Three-spine Stickleback (*Gasterosteus aculeatus*)	Y	-
Western Mosquitofish (*Gambusia affinis*)	-	Y
White Catfish (*Ameiurus catus*)	-	Y

[a] Introduced (species non-native to the watershed or hatchery reared trout)

[b] CDFW species of special concern

[c] Phenotypic distinction between native and hatchery origin rainbow trout is not possible; abraded fins, typical from rearing in crowded raceways used to distinguish hatchery rainbow trout from "wild" rainbow trout in this study

Since 1983, electro-fishing surveys have repeatedly sampled multiple locations over the years (Appendix A: Table A1). Survey methods, reach length, and the type of data collected since then are summarized in Appendix A: Table A2. A multiple-pass mark-and-recapture electro-fishing survey was employed from 1983 through 1989. In 1990, the annual electro-fishing survey was modified to a single pass count of captured fish using only a single block seine net at the upstream end of each sample reach. The decision to change to a single pass survey was made due to an absence of trout detected in the late 1980's which was thought to be a result of extreme drought conditions (KRCD 1993). The single pass reaches were expanded in length to locate trout. Due to the change in survey methods, the single pass data collected from 1990 through 2006 serves as an index of relative abundance and does not reflect absolute population density. Extrapolating density estimates from the single pass data produces, at best, uncertain population abundance estimates that do not support rigorous statistical analysis.

In the fall of 2007 the Kings River Fisheries Management Program's Technical Steering Committee (TSC), which consists of representatives of the CDFW, KRCD, and KRWA, revised the electro-fishing survey protocol to a three-pass depletion technique with upstream and downstream block seines, which resulted in improved statistical rigor and the ability to estimate 95% confidence intervals on abundance estimates. Multi-pass surveys allow for more rigorous sampling and provide a more complete assessment of the species composition and abundance found in the sample site. This data can then be used to determine trends in the populations and condition of sampled fish species.

METHODS

Survey Area

Since 2007, when conditions permit, surveys have been conducted at two sites in each of the three uppermost management reaches of the Kings River (Figure 1). During the fall of 2023, due to the high preceding water year, minimum flows in the river were subject to Exhibit "D" conditions (KRFMP 1999), which is 250 cfs out of Pine Flat Dam. While ramping was approved by the ExCom to bring instream flows to the desired targets for safe wading, ramping windows in conjunction with water orders and available diversion points prevented some sites from being surveyed in 2023. Reach One, which consists of the section of river between Pine Flat Dam and Cobbles (Alta) Weir, is managed as a put-and-take trout fishery, permitting take of up to five trout daily. Reach One excludes the area above the U.S. Army Corps of Engineers (USACE) Bridge which has been closed to fishing by order of Homeland Security since September 2001. Additionally, within Reach One, the Thorburn Spawning Channel and a 200-foot radius from the channel exit are closed to fishing by CDFW regulations. This channel was part of a special study conducted in 2023, results of which can be found in Appendix N. There are no diversions by KRWA member units within this reach, which also receives uncontrolled inflows from the tributaries of Mill and Hughes Creeks. Reach Two is located between Cobbles (Alta) Weir and Fresno Weir while Reach Three consists of the portion of river from Fresno Weir to the Reedley Narrows gauging station. Both Reach Two and the portion of Reach Three above Highway 180 are managed as a catch-and-release trout fishery, with special regulations permitting zero take of trout and prohibitions on the use of bait and barbed hooks between Cobbles (Alta) Weir and the Highway 180 crossing. Reach Three is considered an opportunistic trout fishery as water temperatures downstream of Fresno Weir may not remain suitable for trout during the summer and fall in most years, and limited trout stocking occurs.

Several water diversions occur within Reach Two. The first diversion of Kings River water occurs at the Cobbles (Alta) Weir where the '76 Channel, operated by Alta Irrigation District, diverts water off the river's left bank and into the Alta Canal. Dennis Cut Weir, located downstream of Avocado Lake Park diverts water from the left bank into Dennis Cut. Gould Weir, two miles downstream of Cobbles (Alta) Weir, operated by Fresno Irrigation District, diverts water from the right bank into Gould and Enterprise Canals. At Fresno Weir, water is diverted on the right bank at two locations: by Fresno Irrigation District into the Fresno Canal, and the Consolidated Irrigation District into the Consolidated Canal. The Consolidated Canal is the largest single diversion on the King's River. Additionally, within Reach Two, immediately upstream of Fresno Weir, the Friant-Kern Canal crosses under the Kings River. On occasion, water deliveries via the Friant-Kern Canal are provided through the Kings River above Fresno Weir.

Within Reach One unsafe instream flows made electro-fishing at the Winton site infeasible. Winton is downstream of Winton County Park and adjacent to the Thorburn Spawning Channel. This site is a partial subset of the historic sampling site Winton Park Boulder. This site is characterized by a wide channel, large cobble, anthropogenically placed boulders, minimal streamside vegetation, and no tree cover. Alta was not surveyed due to river access being deemed unsafe to both staff and volunteers. Ingress and egress into the site has always been difficult due to the steepness of the slope from the road shoulder to river and the presence of fallen leaves. This was further compounded by high bank erosion during the 2023 water year, a continued high volume of illegal dumping, and a fallen oak tree which blocked not only the river access, but also the instream location for the left bank portion of the block net. Due to ongoing safety concerns with this site, the expectation is this site will ultimately be retired from the annual survey. A replacement will be sought once releases from the dam are within the 100-150 cfs range; the same instream flow conditions as the survey would be conducted under. Site Alta is a partial subset of the historic sampling site Alta Weir/Site A and

is upstream of Cobbles (Alta) Weir in the left-hand channel of the river. The bottom of the site is narrow, characterized by a deep run (three to four feet) and shallow riffle. Above the riffle the channel widens into a glide of moderate depth (two to three feet deep). The bottom consists primarily of medium sized cobble. Tree canopy provides shading throughout the glide.

Within Reach Two unsafe instream flows made electro-fishing at the Avo Boulder site infeasible. Upon arrival, it was determined that despite ramping, instream flows were still too high to safely conduct the survey. Because the survey also served as a lab period for the Reedley College Watershed Class, a short demonstration reach was established in an adjacent, wadable channel, to provide the students exposure to a multi-pass depletion survey. The results of this survey can be found in Appendix N. Avo Boulder is a partial subset of the historic sampling site Avocado Lake Boulder. This site is in the middle channel behind Avocado Lake Park. This site is characterized by large cobbles, many anthropogenically placed boulders, and some vegetative cover provided by trees. The site Avo Side is a partial subset of the historic sampling site Avocado Lake Side Channel and is on private property downstream of Avocado Lake Park. This site is characterized by large cobbles, many anthropogenically placed boulders, and extensive canopy cover provided by adjacent trees.

Within Reach Three electro-fishing occurred at the sites Greenbelt and Wildwood. Greenbelt is a partial subset of the historic sampling site County Park Land Boulder. This site is located near the bottom of Greenbelt County Park and is characterized by a wide channel with small to medium sized cobble and a few anthropogenically placed boulders. Some canopy cover is provided by mature trees along the left bank, minimal vegetative canopy cover is provided along the right bank. Most of the survey site is characterized by moderately deep water (two to three feet deep) throughout, a small riffle on the right bank near the top of the survey site, and a small deep pool (four to five feet deep) located along the left bank. The site Wildwood is a partial subset of the historic sampling site Wildwood. This site is in the Wildwood subdivision. This site underwent significant change during the high instream flows

in 2023. While the site was still characterized by small to medium sized cobble and extensive tree canopy, the channel has evolved into essentially two fast channels separated by a cobble bar during low flows, rather than the shallow glides and fast riffles present in more recent years. Immediately upstream of the electro-fishing site, a new riffle has been created, and the river has shifted as the left bank was eroded away.
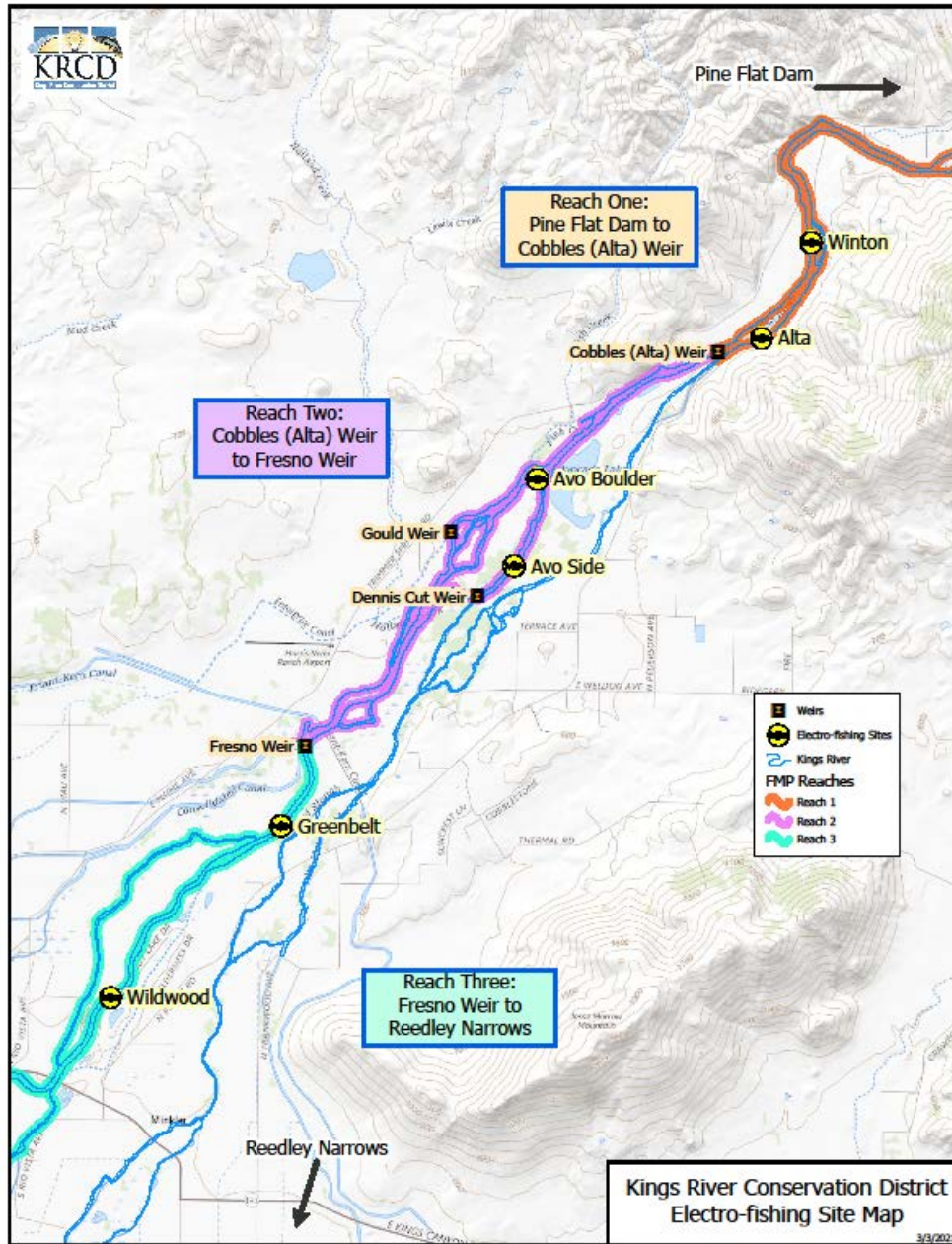
Figure 1. *Electro-fishing sites in the Kings River.*

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Survey Methods

In 2023, sampling occurred on three of the six days scheduled between November 28 and December 6 using standard three-pass depletion electro-fishing techniques (Reynolds 1996). Survey sites were approximately 300 feet in length and both the upstream and downstream ends of each survey reach were netted with ¼-inch mesh block seines to avoid fish immigration or emigration from the sampling reach. Both Smith-Root LR-24 and Smith-Root LR-20B electro-fisher backpack units were utilized in each survey reach.

From 2007 – 2011 electro-shocker settings were standardized at 350 volts, 10% Duty Cycle, and a 50Hz frequency. To safely maximize catch-per-unit effort (CPUE), tests were conducted using the LR-24 backpack electro-fisher prior to the 2012 population survey. These tests specifically targeted fish response in the presence of an electrical field. It was quickly determined that the previous settings (350 volts, 10% Duty Cycle, 50Hz Frequency) were not providing enough power to the water based on the Power Transfer Theory (Kolz 1989) for efficient power transfer resulting in fish escapement (fishes evading capture). The Power Transfer Theory states that power is efficiently transferred to the fish when the conductivity of the fish is equal to the conductivity of the water. The difference in conductivities is commonly referred to as "mismatch." By normalizing or standardizing the power curve, a constant transfer of power density ($\mu W/cm^3$) can be achieved (Kolz and Reynolds 1989) to increase power transfer to the fish to illicit the desired response.

By adjusting the electro-fisher settings, the voltage required to overcome the mismatch in conductivity between the water and the fish is achieved. Data collected from the LR-24 backpack electro-shockers internal voltmeter was used to generate a peak voltage goal chart (Table 2) based on water conductivity ($\mu S/m$) observed in the lower Kings River downstream of Pine Flat Dam. This chart has been used to guide shocker voltage settings since 2012. Additionally, a Duty Cycle of 20% and a frequency of 30Hz resulted in a high capture rate,

quick recovery time, and minimal mortality when compared to settings prior to 2012 and have been adopted for all surveys since.

Table 2. *Voltage goals for Smith-Root electro-shockers used for the Kings River Electro-fishing Population Surveys since 2012.*

SPC (µS/m)	Voltage Goal	SPC (µS/m)	Voltage Goal
10	1892	120	315
20	1032	130	304
30	745	140	295
40	602	150	287
50	516	170	273
60	459	200	258
70	418	250	241
80	387	300	229
90	363	400	215
100	344	600	201
110	328	800	194

Electro-fishing was conducted using six to eight, three-person crews and one or three data processing teams. Each crew consisted of a backpack electro-fisher operator, one or two netters, and a person with a five-gallon bucket to hold collected fish. Data processing teams consisted of one data recorder and one or two biologists. Volunteers and staff from KRCD, CDFW, KRWA, Reedley College, local irrigation districts, local anglers, and other members of the public participated in the surveys. After data collection was complete, captured fish were released outside of the netted survey reach. A minimum 30-minute hiatus was taken between passes.

During electro-fishing, releases from the dam are preferentially targeted between 100 and 150 cubic feet per second (cfs) (Appendix A: Table A3), as this allows for safe wading and effective capture of stunned fish. In some years, to allow for sampling to occur when the water

demand from downstream users exceeds safe flows for wading, releases from the dam are pulsed during electro-fishing following the ramping schedule outlined in the Framework Agreement (KRFMP 1999). Releases are ramped down at a predetermined time so that target flows at the sampling site are present during electro-fishing. Releases are then ramped up again in the afternoon to meet downstream water delivery needs. This ramping cycle prevents negative impacts on the fishery and allows for surveyors to safely enter the water and complete the sampling effort while still meeting the KRWA's obligation to its water users. In 2023 ExCom approved flow variances were utilized, as Exhibit "D" minimum flows of 250 cfs at Piedra were in effect (KRFMP 1999). The flow variance was not needed for the survey on November 30 at Avo Side and were successfully utilized on December 5th and 6th for surveys below Fresno Weir. Instream measurements at survey sites were completed each day by KRWA. All measurements were taken upstream, and near the electro-fishing site, except for Wildwood, which was measured at the same point as Greenbelt. This point is used by KRWA for checking flows over Fresno Weir. Instream measurements are provided in Table 3.

Table 3. *Date, survey site, date, instream flow as measured by KRWA morning of survey, and daily average instream flow from Pine Flat Reservoir.*

Date	Site	Measured (cfs)	Pine Flat Release (cfs daily avg)
30-Nov	Avo Side	96.4	358
5-Dec	Greenbelt	68.0	203
6-Dec	Wildwood	54.5	237

Data Collection

In the field, each fish was identified by a biologist to the lowest practical taxon, weighed to the nearest tenth of a gram, and total length measured to the nearest millimeter, except for trout which were measured to fork length and photographed. Rainbow trout were classified in the field as either hatchery trout or "wild" trout based on characteristics observed while in

hand. CDFW (2010) defines a wild trout as "A trout that was born in the wild and lives its life cycle in the wild, regardless of the origin of its parents." Since 1983 KRCD has used visual inspection of fin condition as the primary means to distinguish between "wild" and hatchery origin rainbow trout. Rainbow trout with fins in excellent condition were classified as "wild" rainbow trout while rainbow trout exhibiting missing or abraded fins were categorized as hatchery rainbow trout. Because of morphological similarity trout may be misclassified. There may be little morphological difference in rainbow trout assumed to have originated via natural in-river reproduction, the KRFMP incubator facility, were reared at Desert Springs Trout Farm under more natural conditions in cobble-bottomed raceways, or hatchery trout who have carried over from a past season.

Biological data was manually recorded on data sheets printed on waterproof paper. Raw capture data was later entered into an Excel spreadsheet. MicroFish 3.0 (Van Deventer 2006) was then used to determine total catch, biomass, maximum population estimates, and confidence intervals.

Catch-Per-Unit Effort

Catch-per-unit effort (CPUE) is a standardized measure of relative abundance used in fisheries management to assess changes in population abundance over time (Reynolds 1996, Chipps and Garvey 2007). This index is mathematically defined as:

$$C/f = N$$

where C is the number of each species caught per site, f is the amount of effort used, and N is the species catch rate (number per hour of effort). For this survey, effort (f) was measured as the collective time (seconds) that each shocker in the group was energized during the three survey passes at each site. Each backpack electro-fisher was equipped with a timer that recorded the number of seconds in operation. The total time was converted to hours and the

resulting CPUE was translated to "fish per hour." CPUE was calculated for each species collected.

Population Estimate

Maximum population estimates and 95% adjusted confidence intervals (CI) for each species were calculated for each sampled 300-foot site in MicroFish 3.0. These numbers are influenced by the removal pattern (number of fish of each species removed in each electro-fishing depletion pass) and sample size. Non-descending removal patterns in each pass and a small sample size may lead to population estimates with broader confidence intervals. In some instances, the lower value of the confidence interval may be negative. To correct for this negative value, MicroFish 3.0 provides an adjusted lower confidence interval.

Fish per Mile

Fish per mile is calculated using the maximum population estimate generated by MicroFish 3.0 for each species collected from the survey sites located between Pine Flat Dam and Highway 180. Each survey site equals 300 feet in length. This estimate can be used as an index to monitor changes in fish density.

Condition Factor

Fulton's condition factor (K-factor) is an index of an individual salmonid's body fitness and condition. The score is based upon a mathematical formula (Fulton 1904) which utilizes length (mm) and weight (g) parameters to determine the fitness of individuals within a population.

$$K = (W/L^3) \times 100{,}000$$

Fulton's K-factor allows for a quantitative assessment of the condition of an individual fish within a population, individual fish from different populations, and two or more populations from different localities (Barnham and Baxter 1998) with the assumption that heavier fish of a given length are in better condition (Bolger and Connolly 1989, Shah et al. 2011). A fish is said to be in better condition when the value of a Fulton's K-factor is more than 1.0 and in worse condition than an average individual of the same length, when its value is less than 1.0 (Shah et al. 2011).

Fulton's condition factor assumes isometric growth and may differ depending on the length of the fish. To further support K-factor results, length-weight relationship analysis was also conducted in Microsoft Excel for trout. For this analysis length-weight data was transformed using log base 10 (Log10). The data was plotted and a linear trendline applied. The slope of the trendline was calculated to determine fish condition. Because length and weight are interrelated, a logarithmic value between 2.5 and 3.5, but usually close to 3.0, is expected for fish populations in good condition (Sharma and Baht 2015). A value of 3.0 indicates fish are growing isometrically as opposed to allometrically. For values less than 3.0, weight is increasing at a slower rate relative to length, and for values greater than 3.0 weight is increasing at a faster rate relative to length (Sharma and Baht 2015). The R-squared (R^2) value of the trendline was calculated to determine goodness of fit to the data.

Reporting of Results

Annual electro-fishing reports, prior to 2021, presented results in a way which suggests sampled sites represent the 12.5-mile stretch of the Kings River below Pine Flat Dam, when these sites may not be representative. For this reason, results pertaining to CPUE, population estimates, and estimated fish per mile are presented based on the individual sample sites rather

than extrapolated to apply to the Kings River below Pine Flat Dam. However, results showing the overall fish assemblage, length-frequency of captured fish, and overall condition factor (K-factor) of captured trout have been combined for the survey covered in this report. Further, metric measurements for overall biomass by species and individual length data were entered into Excel and converted to the English system due to the increased familiarity of that system with American readers, the target audience, of this report. Conversion to the English system also ensured all measurements within this report were standardized. Past electro-fishing reports generated by the KRCD have typically used some combination of English and metric units, with fish per mile consistently reported while biomass measurements were in either metric units and/or metric and English units.

RESULTS AND DISCUSSION

A total of 2,192 fish were collected during the Fall Population Electro-fishing survey in 2023, with complete data collected for 2,143 fish which was entered into MicroFish 3.0 for further analysis. Species composition and CPUE reported here are reflective of the entire capture, while all other results are based only on the fish entered in MicroFish 3.0. Data for Avo Side may be skewed as both the upper and lower block nets partially collapsed while the survey was underway due to the accumulation of leaves in the nets and the depth and velocity of the water. The lower block net experienced approximately 25% collapse towards the end of the first pass, while approximately 75% of the upper net collapsed prior to the third pass beginning. Both nets were down for several minutes before the tripods could be reset and nets repositioned. While some fish may have moved in and out of the netted reach, they only had a brief window to do so, and in both instances, would have had to swim over the partially submerged nets and towards individuals working to reestablish the line.

As in prior years, native fish continued to dominate the survey in both abundance (97.4%) and biomass (78.0%), with the assemblage between Highway 180 and Pine Flat Dam dominated by native Sacramento sucker (47.6%), California roach (17.2%), lamprey (10.5%), and sculpin (8.5%) (Figure 2). Introduced fish made up 2.6% of the collected species abundance, with hatchery rainbow trout (1.1%) the most abundant introduced fish and green sunfish the most abundant introduced non-native fish (0.8%) (Figure 2). The presence and quantity of these fish suggest the assemblage immediately below Pine Flat Reservoir most accurately resembles that of the pikeminnow-hardhead-sucker assemblage described by Moyle (2002). While deep-bodied fishes such as bass were present, they comprised less than two percent of the species assemblage (Figure 2). Trout were present but were a small percentage of the species assemblage (Figure 2), as expected for a low elevation, low gradient, fish assemblage.
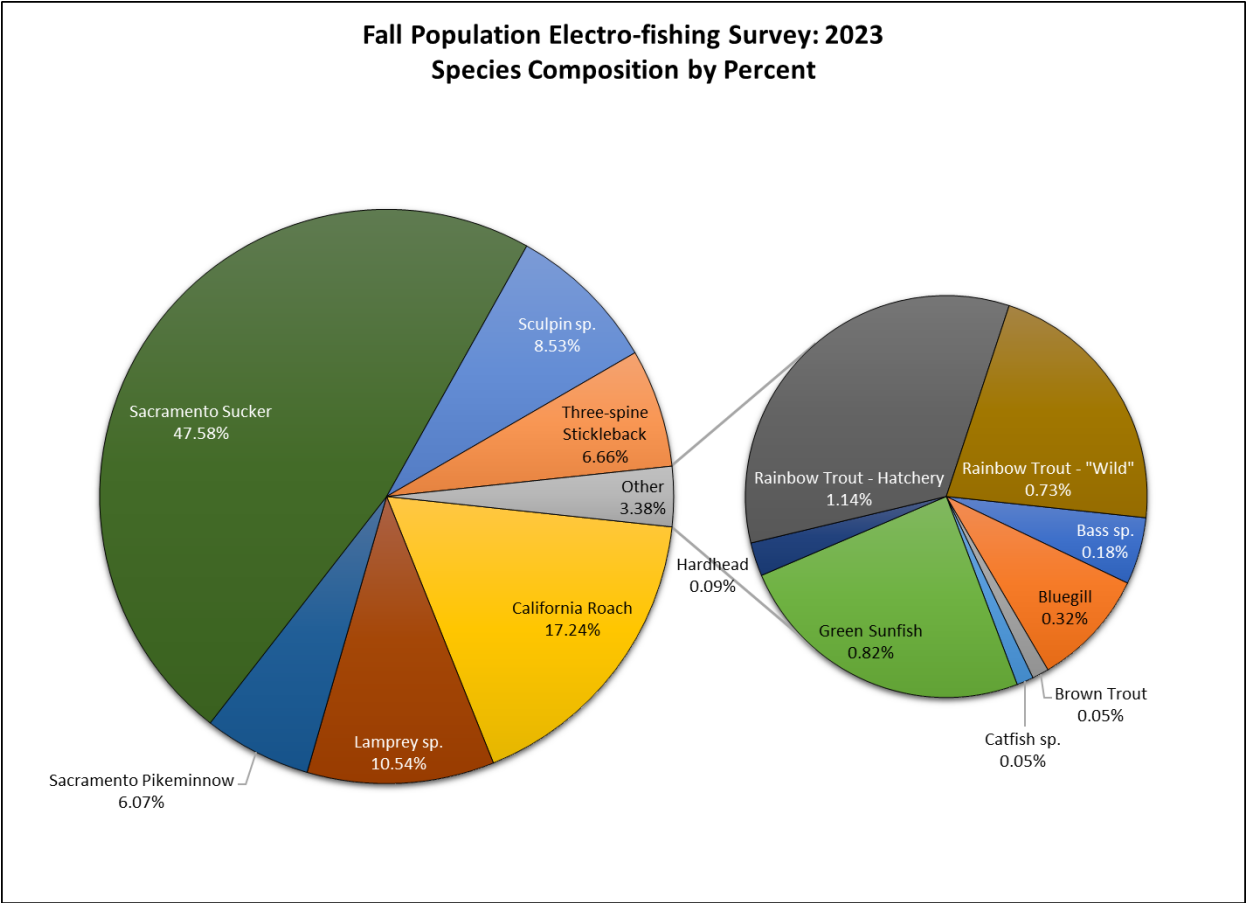
Figure 2. *Species Composition by percent abundance for fish collected during the Fall Population Electro-fishing Survey.*

Collected species represented eight families as shown in Table 4.

Table 4. *Families represented and species collected during the 2023 Fall Population Electro-fishing survey.*

Family	Species Collected
Catostomidae (Suckers)	Sacramento Sucker
Centrarchidae ("Black Basses")	Bass[a]
	Bluegill[a]
	Green Sunfish[a]
Cottidae (Sculpins)	Sculpin
Cyprinidae (Minnows)	California Roach
	Hardhead
	Sacramento Pikeminnow
Gasterosteidae (Sticklebacks)	Three-spine Stickleback
Ictaluridae (Catfishes)	Catfish[a]
Petromyzontidae (Lampreys)	Lamprey
Salmonidae (Trout)	Brown Trout[a]
	Rainbow Trout - Hatchery[a]
	Rainbow Trout - "Wild"

[a] Introduced (non-native to the watershed or hatchery reared trout)

Results for each species are summarized below by family. Figures and tables are provided for those species whose combined capture by family made up more than one percent of the catch in 2023. When figures or tables are not provided, they are summarized in the text and included in the appendix.

Catostomidae – Sucker Family

One thousand forty-three catostomids, represented by the Sacramento sucker were captured in 2023 (Appendix B), with data entered for 1,021 into MicroFish 3.0. A summary of results is presented in Table 5.

Table 5. *Catch-per-unit effort, population estimate, fish per mile, and biomass for Sacramento sucker collected during the Fall Population Electro-fishing Survey.*

	Sacramento Sucker, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	64.0	20.3	25.8
Population Estimate (95% CI, Lower Adjusted)	-	-	-	810 (680-940)	309 (198-420)	348 (309-387)
Fish per Mile (Estimated)	-	-	-	14,256	5,438	6,125
Biomass (Pounds)	-	-	-	17.3	3.8	3.3

Catch rates varied between sites, with the highest catch rate at Avo Side, the uppermost site surveyed, and similar catch rates at Greenbelt and Wildwood. Higher population estimates in Avo Side suggest that the site was more suitable for Sacramento sucker than those further downstream. Fish per mile estimates ranged from 5,438 fish per mile at Greenbelt to a high of 14,256 fish per mile at Avo Side. The lowest recorded biomass was 3 pounds in Wildwood, and the heaviest was 17 pounds in Avo Side.

Captured Sacramento suckers were most frequently juveniles; length at maturity is typically around 8 inches (Moyle 2002). Length ranged from 1 to 21 inches with 98% of captured fish smaller than 8 inches (Figure 3), providing evidence Sacramento suckers have been successful reproducing in the Kings River.
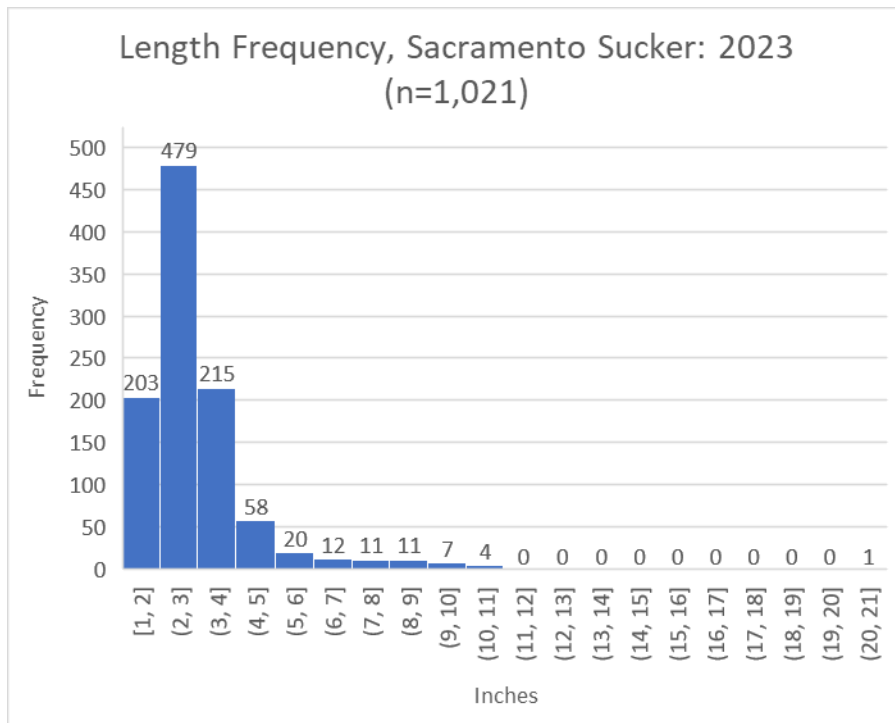
Figure 3. *Length-frequency of Sacramento sucker captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Sacramento suckers may be an important keystone species in the Kings River as they may also affect the invertebrate community and juveniles may be an important food source for piscivorous fish and wildlife (Moyle 2002). They may also act as ecosystem engineers through foraging activities. With the related Sonoran sucker (*C. insignis*) it has been found that foraging activities modify the structure of benthic sediment which, in turn, creates heterogeneity in the streambed, increases the magnitude of sediment and organic matter resuspension and redistribution, and influences the distribution and density of benthic invertebrates (Booth et al. 2019). Intraspecific competition with rainbow trout may also affect spawning success of trout. It has been observed that the related bridgelip sucker (*C. columbianus*) will spawn in rainbow trout redds, causing significant modification to substrate in trout redds prior to spawning (Murdoch et al. 2005).

Centrarchidae – "Black" Bass Family

Twenty-nine centrarchids, represented by 4 "black" bass, 7 bluegill, and 18 green sunfish were captured in 2023 (Appendix B), with data entered for all, but one green sunfish into MicroFish 3.0. A summary of results for bass is presented in Table 6, for bluegill in Table 7, and for green sunfish in Table 8.

Table 6. *Catch-per-unit effort, population estimate, fish per mile, and biomass for bass collected during the Fall Population Electro-fishing Survey.*

	Bass, November-December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.0	0.0	0.4
Population Estimate (95% CI, Lower Adjusted)	-	-	-	0 (0-0)	0 (0-0)	4 (4-5)
Fish per Mile (Estimated)	-	-	-	0	0	70
Biomass (Pounds)	-	-	-	0.0	0.0	0.2

Table 7. *Catch-per-unit effort, population estimate, fish per mile, and biomass for bluegill collected during the Fall Population Electro-fishing Survey.*

	Bluegill, November-December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.0	0.1	0.5
Population Estimate (95% CI, Lower Adjusted)	-	-	-	0 (0-0)	1 (1-1)	9 (9-9)
Fish per Mile (Estimated)	-	-	-	0	18	158
Biomass (Pounds)	-	-	-	0.0	0.03	0.1

Table 8. *Catch-per-unit effort, population estimate, fish per mile, and biomass for green sunfish collected during the Fall Population Electro-fishing Survey.*

	Green Sunfish, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.0	0.2	1.4
Population Estimate (95% CI, Lower Adjusted)	-	-	-	0 (0-0)	2 (2-15)	15 (15-17)
Fish per Mile (Estimated)	-	-	-	0	35	264
Biomass (Pounds)	-	-	-	0.0	0.07	0.4

Bass were captured only at Wildwood, CPUE was 0.4 fish per hour, with a population estimate of 4 fish (95% CI, lower CI adjusted, 4-5), and an estimated 70 fish per mile. Bass captured in Wildwood had a biomass of 0.2 pounds. Bluegill and green sunfish were captured at both Greenbelt and Wildwood, and for both species were more abundant at Wildwood. For bluegill in Wildwood, the CPUE was 0.5 fish per hour, with a population estimate of 9 fish (95% CI, lower CI adjusted, 9-9), and an estimated 158 fish per mile. Bluegill captured in Wildwood had a biomass of 0.1 pounds. For green sunfish in Wildwood, CPUE was 1.4 fish per hour, with a population estimate of 15 fish (95% CI, lower CI adjusted, 15-17), and an estimated 264 fish per mile. Green sunfish captured in Wildwood had a biomass of 0.4 pounds.

As surveys captured centrarchids only at the two sites below Fresno Weir, this suggests conditions below the weir were more suitable for them. In most years, this section of river consists of low gradient, decreased instream flows (KRFMP 1999) and warmer temperatures which are found in the late summer and early fall (KRCD 2021). In 2023, these conditions were unlikely to be present as the wet year required extended releases throughout the year, resulting in higher than typical instream flows, and instream temperatures were atypical of most years (KRCD 2021) in that they did not exceed 61°F though late September (KRFMP 2024). It's possible centrarchids residing instream below Fresno Weir had escaped from

flooded ponds which may have overflowed into the river or adjacent creeks. Most of the centrarchids captured were in the Wildwood site, which contains both an artificial lake, and a creek which runs through the residential area, potentially allowing movement of fish from these bodies of water into the river during periods of flooding.

High instream flows were experienced throughout the Kings River in 2023, so it was surprising to see the number of centrarchids captured during the survey. Bluegill and green sunfish are rarely detected in Kings River electro-fishing surveys (Appendix D). In 2023, green sunfish were the most abundant centrarchid captured. Bluegill were the second most abundant centrarchid captured. According to Moyle (2002) hybridization is common with green sunfish, and results in sterile males. It is suspected that a hybridized bluegill x green sunfish was captured in Greenbelt. Biologists on site were split as to if it was a hybrid or not and was ultimately classified as a bluegill for the analysis.

Captured centrarchids were primarily immature bass (Figure 4) and bluegill (Figure 5), and potentially mature green sunfish (Figure 6). Bass reach maturity between 6 and 13 inches, bluegill reach maturity between 4 and 6 inches, and green sunfish when they are between 2 and 3 inches long (Moyle 2002).
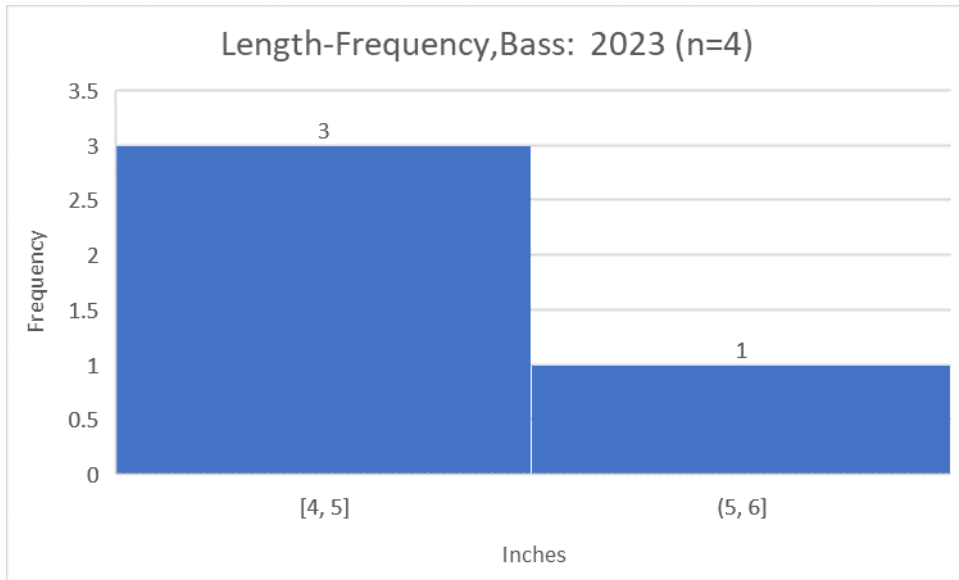
Figure 4. *Length-frequency of bass captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*
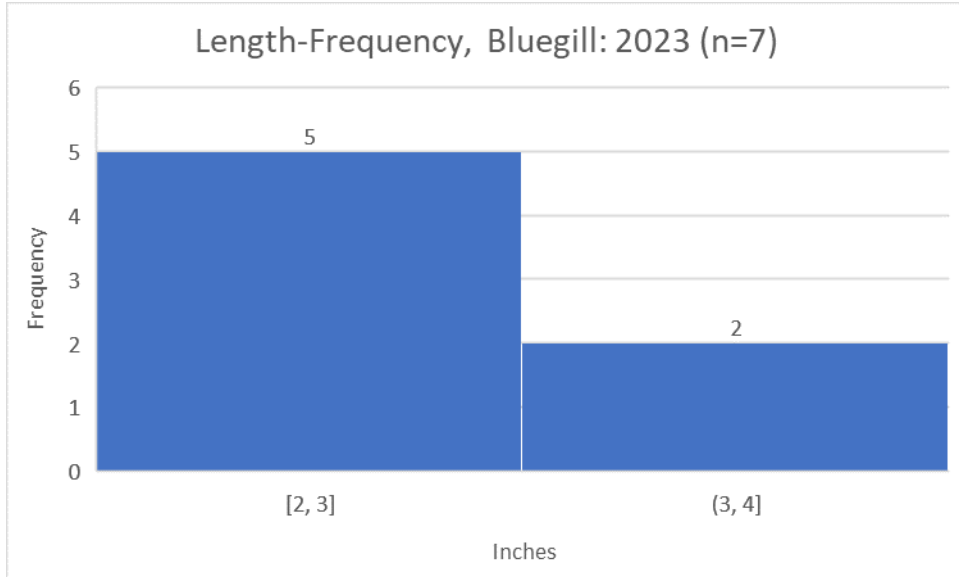
Figure 5. *Length-frequency of bluegill captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Figure 6. *Length-frequency of green sunfish captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Length of captured bass ranged from 4 to 6 inches (Figure 4). Spotted bass is the species primarily observed in Kings River. Foraging habits are dependent on fish length. Fish less than 3 inches typically feed on aquatic insects and crustaceans, fish 3 inches to 6 inches typically feed on aquatic and terrestrial insects, fish, and crayfish, while fish greater than 6 inches feed on crayfish and fish (Moyle 2002). Bass in the Kings River are known predators on resident fish and may be competitors for the same food as other resident insectivorous fish. If so, predation and competition may be mitigated through niche partitioning and the availability of cover habitat, although it is unknown if this is occurring, and if so, to what extent. Maturity is usually reached at a length of 6 to 13 inches (Moyle 2002). The age classes captured suggest bass may be successfully reproducing within the Kings River.

Cottidae – Sculpin Family

One hundred eighty-seven cottids, which include prickly sculpin, riffle sculpin, or their hybrids were captured (Appendix B), with data entered for 185 into MicroFish 3.0. A summary of results is presented in Table 9.

Table 9. *Catch-per-unit effort, population estimate, fish per mile, and biomass for sculpin collected during the Fall Population Electro-fishing Survey.*

	Sculpin, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	2.9	5.3	9.8
Population Estimate (95% CI, Lower Adjusted)	-	-	-	24 (24-26)	112 (50-260)	139 (111-168)
Fish per Mile (Estimated)	-	-	-	422	1,971	2,446
Biomass (Pounds)	-	-	-	0.3	1.0	2.5

Of the three sites surveyed in 2023, Greenbelt and Wildwood likely provide better habitat for sculpin than the Greenbelt site as there may be more appropriate cover habitat present as cobbles are prevalent throughout the channel bottom, and channel width is greater in those sites compared to Avo Side which is comparatively narrower, and contains areas of silty deposits. Within streams, cover is believed to be important for prickly sculpin, while for riffle sculpin, rocky substrates are important as cover is taken under rocks to avoid strong currents (Moyle 2002). Additionally, cobbles provide areas for sculpin to lie in wait for aquatic prey, spawning habitat, and habitat for the invertebrates they may prey on (McGinnis 2006). Fish per mile estimates ranged from 422 fish per mile at Avo Side to a high of 2,446 fish per mile at Wildwood. The lowest recorded biomass was 0.3 pounds in Avo Side, and the heaviest was 2.5 pounds in Wildwood.

Captured sculpin ranged from 2 to 5 inches (Figure 7). Sculpin typically reach maturity when they are between 1.6 to 2 inches long and breed at the end of their second year (Moyle 2002). This suggests all captured sculpin were potentially mature adults. Young-of-the-year sculpin may have been present but missed during electro-fishing sampling as their small size may cause them to be undetected, consumed by other piscivorous fish while in the holding container, or evade capture by slipping through the netting mesh.
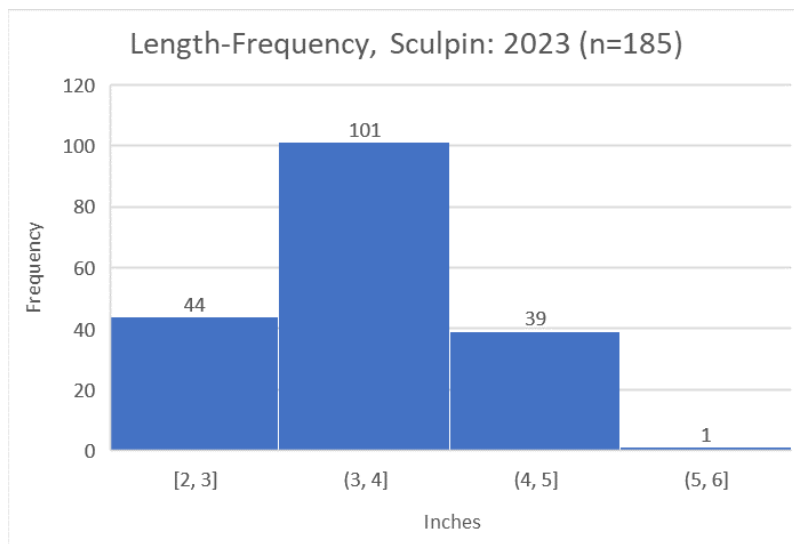
Figure 7. *Length-frequency of sculpin captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Cyprinidae – Minnow Family

Five hundred thirteen cyprinids, represented by 378 California roach, 2 hardhead, and 133 Sacramento pikeminnow were captured (Appendix B), with data entered for 369 California roach and 128 Sacramento pikeminnow into MicroFish 3.0. Unfortunately, both hardhead managed to escape before length and weight measurements were obtained, thus no

data was available to enter into MicroFish. A summary of results for California roach is presented in Table 10, for hardhead in Table 11, and for Sacramento pikeminnow in Table 12.

Table 10. *Catch-per-unit effort, population estimate, fish per mile, and biomass for California roach collected during the Fall Population Electro-fishing Survey.*

	California Roach, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	12.8	1.8	22.0
Population Estimate (95% CI, Lower Adjusted)	-	-	-	117 (110-126)	17 (17-20)	270 (250-290)
Fish per Mile (Estimated)	-	-	-	2,059	299	4,752
Biomass (Pounds)	-	-	-	0.8	0.2	2.9

Table 11. *Catch-per-unit effort, population estimate, fish per mile, and biomass for hardhead collected during the Fall Population Electro-fishing Survey.*

	Hardhead, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.0	0.2	0.0
Population Estimate (95% CI, Lower Adjusted)	-	-	-	0 (0-0)	2 (2-15)	0 (0-0)
Fish per Mile (Estimated)	-	-	-	0	35	0
Biomass (Pounds)	-	-	-	0.0	No Data	0.0

Table 12. *Catch-per-unit effort, population estimate, fish per mile, and biomass for Sacramento pikeminnow collected during the Fall Population Electro-fishing Survey.*

	Sacramento Pikeminnow, November-December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	7.2	5.1	1.9
Population Estimate (95% CI, Lower Adjusted)	-	-	-	63 (62-66)	54 (47-66)	20 (19-24)
Fish per Mile (Estimated)	-	-	-	1,109	950	352
Biomass (Pounds)	-	-	-	0.2	0.2	0.1

California roach were captured at each of the three sites sampled and were most abundant in Wildwood. In Wildwood, CPUE was 22.0 fish per hour, with a population estimate of 270 fish (95% CI, lower CI adjusted, 250-290), and an estimated 4,752 fish per mile. California roach captured in Wildwood had a biomass of 2.9 pounds. Hardhead were captured only at the Greenbelt site, CPUE was 0.2 fish per hour, with a population estimate of 2 fish (95% CI, lower CI adjusted, 2-15), and an estimated 35 fish per mile. Biomass for captured hardhead is unavailable as both fish escaped prior to being measured. Sacramento pikeminnow were captured at each of the three sites sampled and were most abundant at Avo Side. In Avo Side, CPUE was 7.2 fish per hour, with a population estimate of 63 fish (95% CI, lower CI adjusted, 62-66), and an estimated 1,109 fish per mile. Sacramento Pikeminnow captured in Avo Side had a biomass of 0.2 pounds.

Captured cyprinids were California roach of all age classes, immature hardhead, or immature Sacramento pikeminnow. For California roach, length ranged from 1 to 5 inches (Figure 8). Maturity is usually reached at the end of their second year when they are around 2 inches long (Moyle 2002), indicating 26% of the California roach collected were immature. The two captured hardhead were estimated to be between 3 and 4 inches in length prior to escaping back into the river, upstream of the survey reach. Hardhead reach maturity in their

third year when they are about 6-7 inches long, suggesting the hardhead captured in 2023 were likely immature. For Sacramento pikeminnow, length ranged from 1 to 4 inches (Figure 9). Sacramento pikeminnow reach maturity at the end of their third or fourth year at a length of 9 inches (Moyle 2002), suggesting all the Sacramento pikeminnow collected in 2023 were immature.
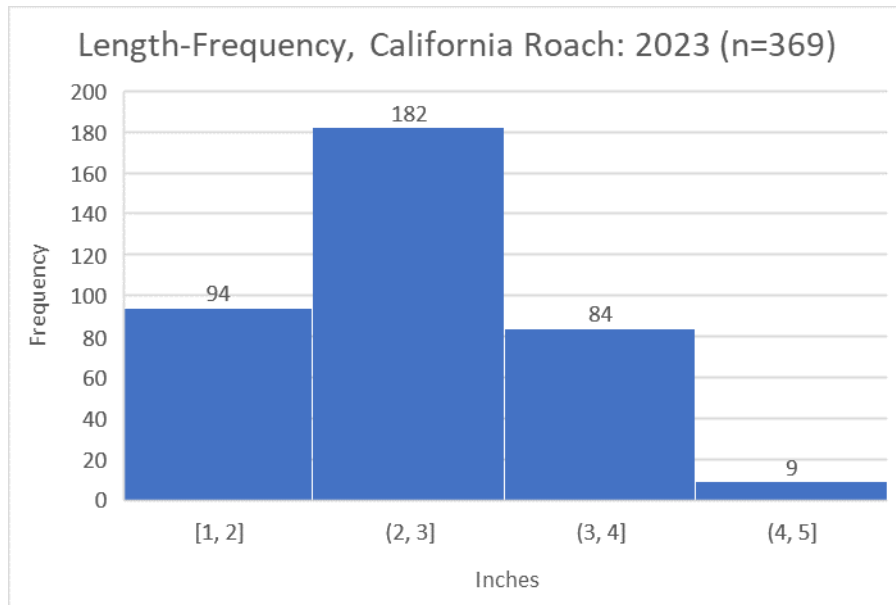
Figure 8. *Length-frequency of California roach captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*
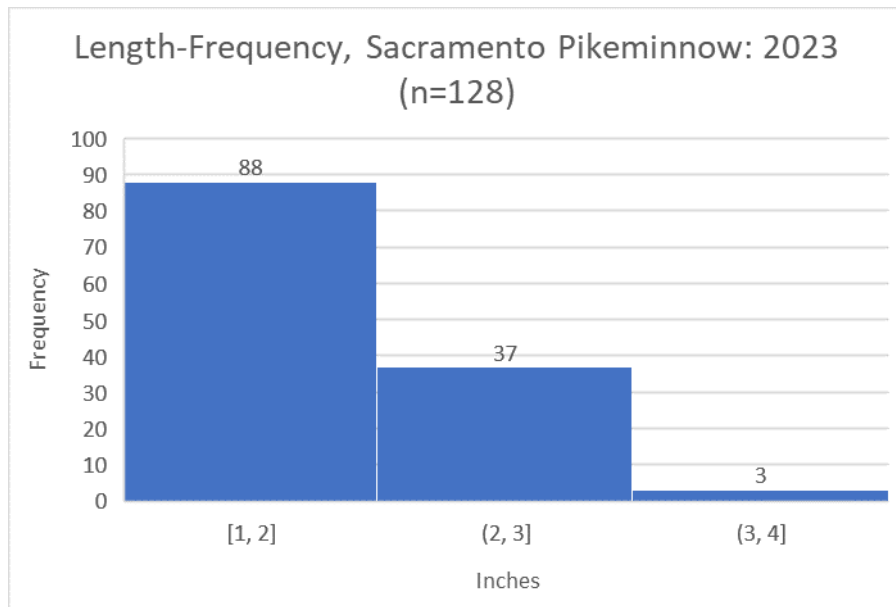
Figure 9. *Length-frequency of Sacramento pikeminnow captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Diet of Sacramento pikeminnow is dependent upon size. Sacramento pikeminnow smaller than 4 inches forage on aquatic insects, switching to fish and crayfish between 4 and 8 inches, and they are almost exclusively piscivorous once they reach 8 inches (Moyle 2002). This suggests that 80% of the Sacramento pikeminnow collected in 2023 may feed on similar foods as other insectivorous fish in the Kings River unless niche partitioning is occurring. There is evidence of little dietary overlap between Sacramento pikeminnow and salmonids due to habitat partitioning (Merz and Vanicek 1996). Under certain conditions, Sacramento pikeminnow has been found to not be a significant predator of salmonids (Vondracek and Moyle 1982). Under conditions where movements are not restricted, non-salmonids are primarily consumed (Moyle 2002). When movements are restricted by anthropogenic barriers in the summer it has been found that juvenile salmonids are preyed on more frequently (Tucker et al. 1998), suggesting diet is a function of what is available where Sacramento pikeminnow are present. The presence of immature age classes of California roach, hardhead,

and Sacramento pikeminnow are indicators that these species are successfully reproducing in the Kings River below Pine Flat Dam.

Gasterosteidae – Stickleback Family

One hundred forty-six gasterosteids, represented by the three-spine stickleback were captured (Appendix B), with data entered for 145 into MicroFish 3.0. A summary of results is presented in Table 13.

Table 13. *Catch-per-unit effort, population estimate, fish per mile, and biomass for three-spine stickleback collected during the Fall Population Electro-fishing Survey.*

	Three-spine Stickleback, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	3.2	5.5	5.8
Population Estimate (95% CI, Lower Adjusted)	-	-	-	30 (28-35)	89 (51-161)	183 (66-478)
Fish per Mile (Estimated)	-	-	-	528	1,566	3,221
Biomass (Pounds)	-	-	-	0.05	0.09	0.1

Capture rates were highest at the Wildwood site. High population estimates for this site suggest the habitat in that site is also favorable. Habitat data is not available, but the distribution of large cobbles provides a break against the faster instream flow, and shallow depth along the channel margin restricts predation by larger piscivorous fish. Fish per mile estimates ranged from 528 fish per mile at Avo Side to 3,221 fish per mile at Wildwood. The lowest recorded biomass was 0.05 pounds in Avo Side, and the heaviest was 0.1 pounds in Wildwood.

Length of captured three-spine stickleback ranged from 1 to 3 inches (Figure 10). Two inches is the typical size for freshwater sticklebacks, which rarely live longer than 1 year and shoal with similar sized cohorts (Moyle 2002).
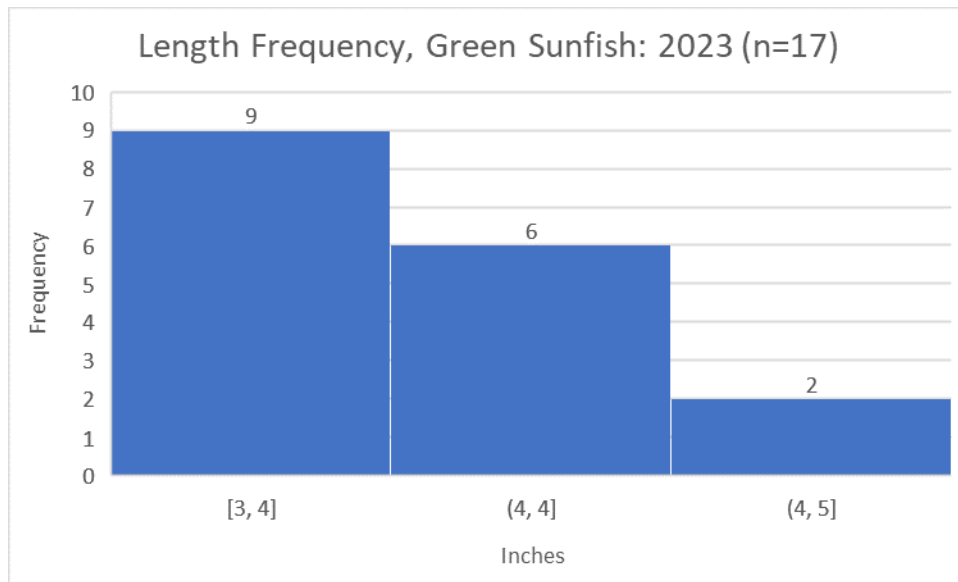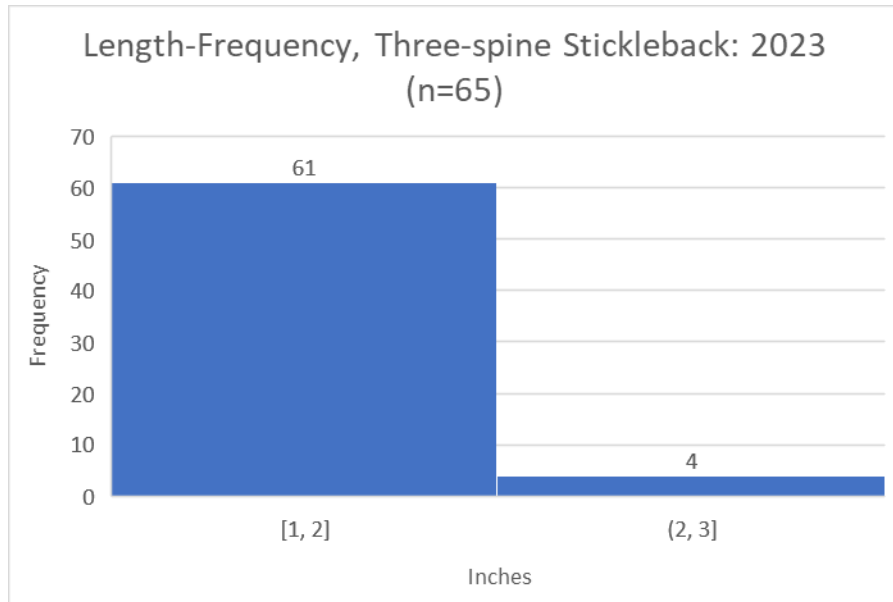

Figure 10. *Length-frequency of three-spine stickleback captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Ictaluridae – Catfish Family

One ictalurid, which was identified as a white catfish was captured (Appendix B) and entered into MicroFish 3.0. It was captured in the Avo Side site where CPUE was 0.1 fish per hour. The population estimate was 1 (95% CI, lower CI adjusted, 1-1) fish at the Avo Side site. Fish per mile was estimated at 18. Recorded biomass was 0.01 pounds, and it measured 3.3 inches. Catfish mature at 7 inches (Moyle 2002) indicating this catfish was immature.

Petromyzontidae – Lamprey Family

Two hundred thirty-one petromyzontids, represented in the Kings River by the Kern brook lamprey and possibly other lamprey species, were captured (Appendix B), with data entered for 228 into MicroFish 3.0. A summary of results is presented in Table 14.

Table 14. *Catch-per-unit effort, population estimate, fish per mile, and biomass for lamprey collected during the Fall Population Electro-fishing Survey.*

	Lamprey, November–December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	21.5	1.3	2.8
Population Estimate (95% CI, Lower Adjusted)	-	-	-	452 (185-805)	14 (12-22)	101 (31-405)
Fish per Mile (Estimated)	-	-	-	7,955	246	1,778
Biomass (Pounds)	-	-	-	1.9	0.1	0.3

Catch-per-unit effort and population estimates were highest in Avo Side site. This site is within a side channel which may provide habitat more suitable for spawning adults and the rearing of lamprey ammocetes. Ammocetes prefer reduced flows and areas with greater deposition of sand and mud, while adults require riffles with spawning gravel and rubble for cover (Moyle 2002). Fish per mile estimates ranged from 246 fish per mile in Greenbelt to a high of 7,955 fish per mile at Avo Side. The lowest recorded biomass was 0.1 pounds at Greenbelt, while the heaviest was 1.9 pounds in Avo Side.

Captured lamprey ranged from 3 to 8 inches (Figure 11). Non-parasitic adult lamprey, such as those found in the Kings River, are generally smaller following metamorphoses from the ammocetes stage (McGinnis 2006). It is unknown how many lamprey may have been adults as data collected in these surveys did not distinguish between ammocetes and adults.
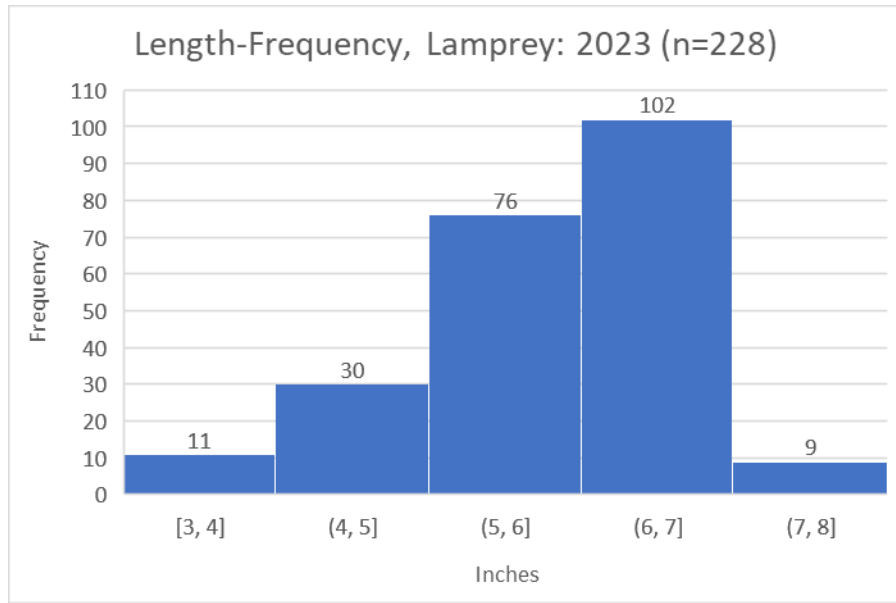
Figure 11. *Length-frequency of lamprey captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Salmonidae – Trout Family

Forty-two salmonids, represented by 1 brown trout, and 41 rainbow trout, of which 25 were classified as hatchery origin and 16 classified as "wild", were captured (Appendix B). Data for all, except 4 rainbow trout, with 3 classified as hatchery and 1 as "wild", were entered into MicroFish 3.0. A summary of results for the brown trout is presented in Table 15, for hatchery rainbow trout in Table 16, and for "wild" rainbow trout in

Table 17. It is possible that some hatchery rainbow trout were misclassified as "wild" rainbow trout. While presence or evidence of worn/abraded/missing fins is used in the field to distinguish between hatchery and "wild" trout, hatchery rainbow trout which have become resident may regenerate worn fins over time, possibly leading to misclassification. Also, no phenotypic distinction can be made between trout hatched in the incubator and those spawned instream. Due to the early age at release, five to seven weeks post-hatch, incubator-hatched trout rear under the same conditions as stream spawned trout, making fin condition an unreliable indicator of origin, thus increasing the potential for misclassification of these hatchery rainbow trout as "wild" rainbow trout.

Table 15. *Catch-per-unit effort, population estimate, fish per mile, and biomass for brown trout collected during the Fall Population Electro-fishing Survey.*

| | Brown Trout, November-December 2023 | | | | | |
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.1	0.0	0.0
Population Estimate (95% CI, Lower Adjusted)	-	-	-	1 (1-1)	0 (0-0)	0 (0-0)
Fish per Mile (Estimated)	-	-	-	18	0	0
Biomass (Pounds)	-	-	-	0.4	0.0	0.0

Table 16. *Catch-per-unit effort, population estimate, fish per mile, and biomass for hatchery rainbow trout collected during the Fall Population Electro-fishing Survey.*

| | Rainbow Trout - Hatchery, November-December 2023 | | | | | |
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	2.9	0.0	0.0
Population Estimate (95% CI, Lower Adjusted)	-	-	-	22 (22-23)	0 (0-0)	0 (0-0)
Fish per Mile (Estimated)	-	-	-	387	0	0
Biomass (Pounds)	-	-	-	10.6	0.0	0.0

Table 17. *Catch-per-unit effort, population estimate, fish per mile, and biomass for "wild" rainbow trout collected during the Fall Population Electro-fishing Survey.*

	Rainbow Trout - "Wild", November-December 2023					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	-	-	-	0.8	0.4	0.4
Population Estimate (95% CI, Lower Adjusted)	-	-	-	6 (6-9)	4 (4-6)	5 (5-5)
Fish per Mile (Estimated)	-	-	-	106	70	88
Biomass (Pounds)	-	-	-	1.5	2.1	2.8

For brown trout at Avo Side, CPUE was 0.1 fish per hour, with a population estimate of 1 fish (95% CI, lower CI adjusted, 1-1), and an estimated 18 fish per mile. Measured biomass was 0.4 pounds. For hatchery rainbow trout at Avo side, CPUE was 2.9 fish per hour, with a population estimate of 22 fish (95% CI, lower CI adjusted, 22-23), and an estimated 387 fish per mile. Measured biomass was 10.6 pounds. "Wild" rainbow trout were captured at all three sites. They were most abundant at Avo Side, CPUE was 0.8 fish per hour, with a population estimate of 6 fish (95% CI, lower adjusted, 6-9). For "wild" rainbow trout, measured biomass was greater at both sites downstream of Fresno Weir. Wildwood had the greatest measured biomass at 2.8 pounds, while Greenbelt had a measured biomass of 2.1 pounds.

While wild populations of brown trout do exist above Pine Flat Reservoir the single fish collected in 2023 at Avo Side, was likely the result of the stocking of fingerlings by CDFW in late August/early September 2022 below the reservoir. Wild brown trout are unlikely to be present below Pine Flat Dam unless they have passed through the dam. Fall water temperatures in the Kings River are generally not conducive to reproduction by brown trout which are fall spawners.

Hatchery rainbow trout were only captured at the Avo Side site in 2023. CDFW provides an annual allotment for trout stocking in the Kings River, and in 2017 the KRFMP

developed a supplemental rainbow trout stocking plan approved by the Executive Committee (ExCom) of the KRFMP in 2018 (KRFMP 2018). This plan was implemented in the fall of 2018 and consists of stocking up to 16,000 pounds (up to ˜48,000 fish) of either catchable or super-catchable sized rainbow trout annually between October and March. In the fall of 2020, the KRCD began purchasing additional fish to augment the KRFMP supplemental stocking program. Both the KRFMP and KRCD supplemental fish are in addition to those stocked regularly as part of the CDFW annual allotment and are released weekly during the supplemental stocking period at a ratio of 75% in the put-and-take zone between the USACE Bridge on Pine Flat Road and Cobbles (Alta) Weir, and the remaining 25% stocked into the catch-and-release zone behind Avocado Lake.

Catch-per-unit effort of brown trout and hatchery rainbow trout may be influenced by proximity to stocking location and the time between a stocking event and electro-fishing survey. Stocking locations range from 0.1 to 0.7 miles from the four sample sites above Fresno Weir. Below Fresno Weir the river is occasionally stocked; with the closest stocking location to an electro-fishing site being at Highway 180, 0.6 miles downstream of the southernmost sample site. Stocking by CDFW typically occurs on a weekly or bi-weekly basis so long as water temperatures are less than 70˚F. In 2023, supplemental stocking by both Calaveras Trout Farm and Desert Springs Trout Farm occurred prior to the electro-fishing survey. Fish stocking, prior to the survey, occurred by CDFW on November 27th and 28th, Calaveras Trout Farm on November 21, and Desert Springs Trout Farm on November 16.

Population estimates for hatchery rainbow trout may be lower than expected considering frequency of stocking events. Population estimates for "wild" rainbow trout may be overestimated due to the impossibility of separating incubator-hatched trout from those produced instream. While some instream production may occur, much of the substrate is unsuitable for successful spawning due to large size and armoring (Cramer Fish Sciences 2019).

At the two sites below Fresno Weir, only "wild" rainbow trout were captured. The presence of "wild" rainbow trout below Fresno Weir is testament that riverine conditions in 2023 were favorable for trout. Trout are rarely collected during the electro-fishing surveys at the two sites below Fresno Weir (Appendix K), which is not surprising, as downstream temperatures are often not conducive to trout in the summer and fall (KRFMP 2021).

Length-frequency of captured salmonids fell within expected ranges. The brown trout was 9.4 inches long. A subset of length-weight measures from brown trout fingerlings stocked between August 30 and September 2, 2022, provided by CDFW, ranged in length from 2-5 inches, indicating instream growth may have been as great as 4 to 7 inches between August 30, 2022 and November 30, 2023. For hatchery rainbow trout, lengths ranged from 8 to 16 inches (Figure 12), with 86% of the fish catchable sized (7-12 inches), and 14% super-catchable sized (12-19 inches). Both size classes were stocked in November. "Wild" rainbow trout ranged in length from 7 to 14 inches (Figure 13).
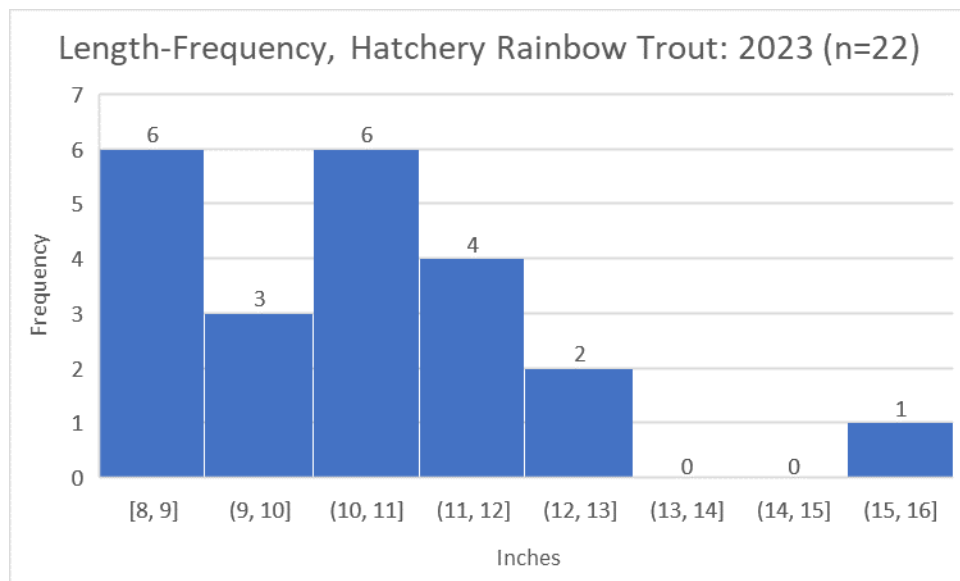
Figure 12. *Length-frequency of hatchery rainbow trout captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*
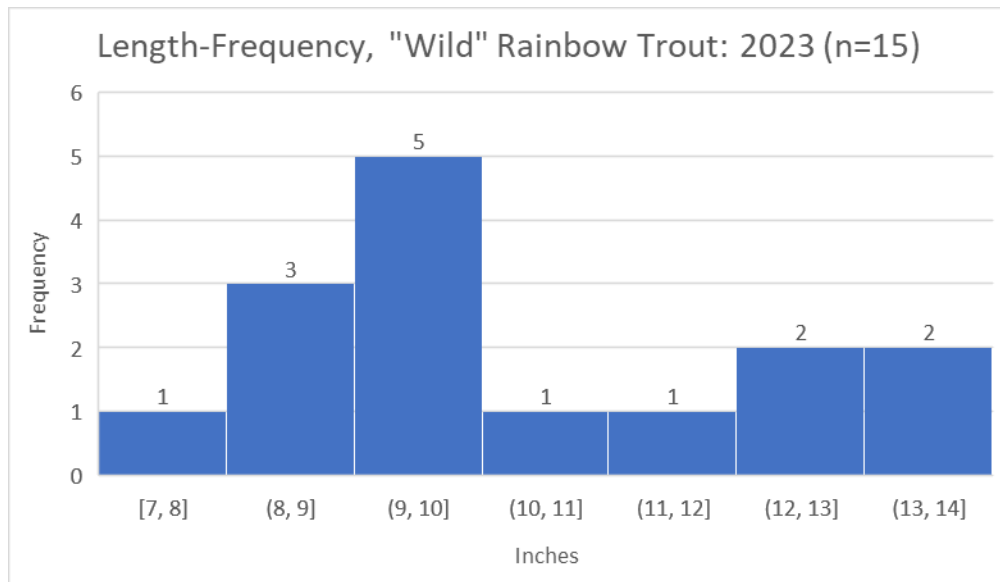
Figure 13. *Length-frequency of "wild" rainbow trout captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

The calculated Fulton's condition factor (K-factor) of individual captured salmonids ranged from less than one to greater than one. Minimum, maximum, and mean K-factor is presented in Table 18 for captured trout. The brown trout was captured in Avo Side and found to be in good condition with a K-factor of 1.3. Hatchery trout were captured only in Avo Side and overall were found to be in good condition (mean = 1.1, median 1.0). The K-factor, by site, for "wild" rainbow trout is presented in Figure 14. For "wild" rainbow trout, mean and median K-factor was 1.0 or greater in all surveyed sites indicating they were in overall good condition.

Table 18. *Minimum, maximum, mean, and median calculated Fulton's condition factor (K-factor) for trout captured during the Fall Population Electro-fishing Survey, 2023.*

Species	Sample Size	Condition Factor (K)			
	(n=)	Minimum	Maximum	Mean	Median
Brown Trout	1	1.3	1.3	1.3	1.3
Hatchery Rainbow Trout	22	0.8	2.0	1.1	1.0
"Wild" Rainbow Trout	15	0.9	1.3	1.1	1.1
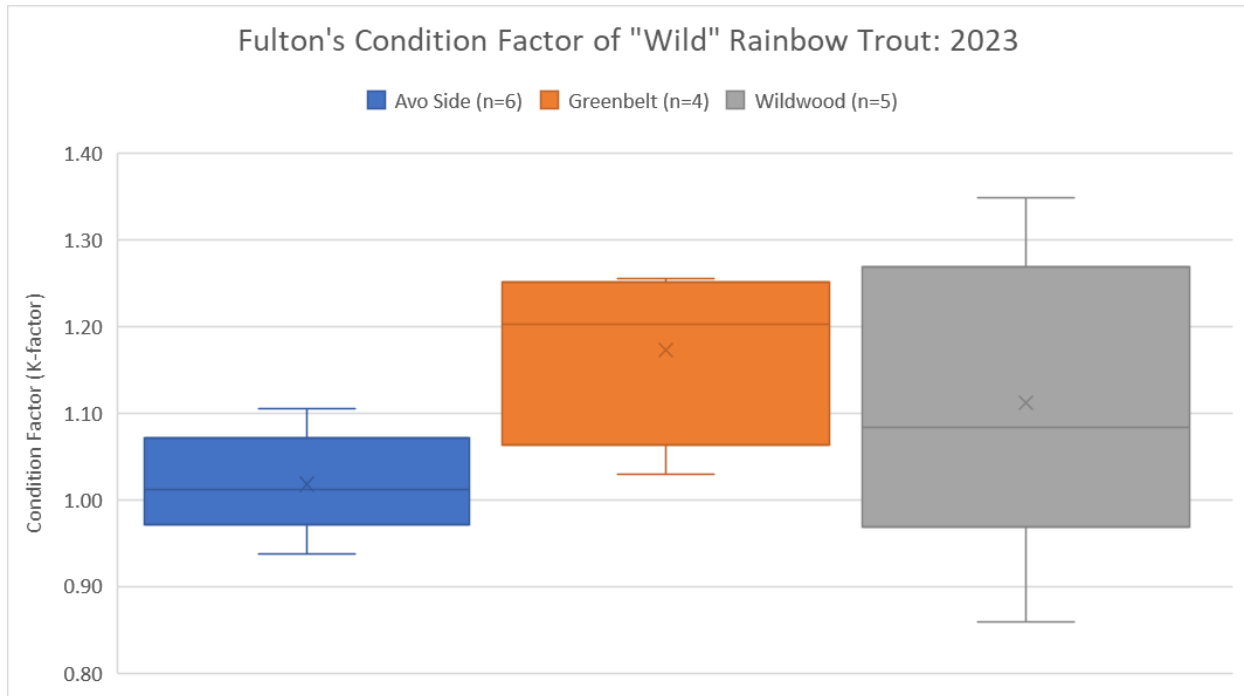
Figure 14. *Box plot of the calculated Fulton's K-factor by site for "wild" rainbow trout collected during the Fall Population Electro-fishing Survey. Outliers, mean, and median are indicated for each site.*

Regression analysis allows another means to look at condition factor by analyzing the relationship between length-weight data. With only one brown trout captured, regression-analysis data is not available, but for rainbow trout captured in the Kings River, the relationship between length-weight data indicated a positive relationship (Figure 15). For hatchery rainbow trout the regression slope was 2.43 (R^2 = 0.83) while "wild" rainbow trout had a regression slope of 2.85 (R^2 = 0.96), indicating the "wild" rainbow trout were in better condition than the hatchery trout. This better condition may be an artifact of the smaller sample size but may also be an indicator of the different conditions these fish experienced instream vs. the hatchery environment due to different thermal regimes, food availability and/or foraging success, competition, capacity, another variable not considered here, or some combination of variables.
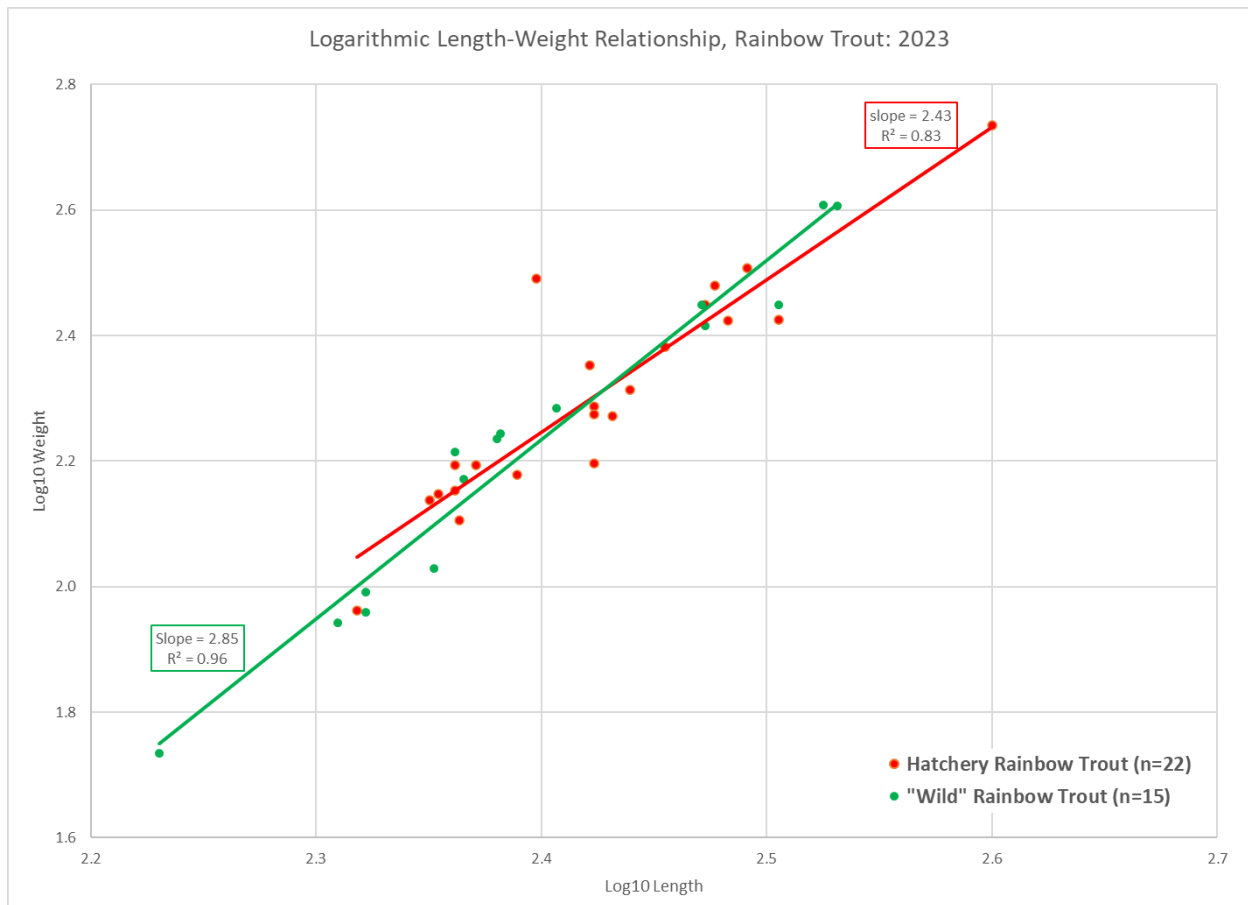
Figure 15. *Logarithmic length-weight relationship for hatchery rainbow trout and "wild" rainbow trout captured during the Fall Population Electro-fishing Survey.*

It would be hypothesized that hatchery reared trout would be in good condition as they have reared in an environment where they are fed artificial diets daily before release. For hatchery rainbow trout, individuals in poorer condition may reflect the length of time between the stocking event and time of capture. It has been suggested that the number of days from a stocking event to capture date may influence condition factor of hatchery rainbow trout due to poor adaptability to river conditions from the hatchery environment (Araki et al. 2008, Araki & Schmid 2010, Olla et al. 1998). As "wild" trout are resident in the river, and thus best adapted to local conditions, it would be hypothesized that condition at time of capture is reflective of riverine conditions either recently experienced or ongoing, such as survival through potentially unfavorable thermal conditions, variability in the availability of

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invertebrate prey, changes in energetic expenditures, changes in intraspecific interactions, responses to predator avoidance and/or angler pressure, or some other unconsidered variable. The good condition observed in "wild" rainbow trout is an indicator that instream conditions were excellent in 2023.

SUMMARY

Data collected during the 2023 Fall Population Electro-fishing Surveys provides a means to estimate populations throughout the lower Kings River sample reach (Pine Flat Dam to Highway 180). For these surveys, species were collected, identified, and enumerated, providing a snapshot of the assemblage present in the Kings River. Influence of annual instream flow and temperature data, while available at the USACE Bridge and Fresno Weir, and in situ habitat conditions, which was not measured, were excluded from this analysis.

In 2023, 2,192 fish were collected during the Fall Population Electro-fishing Survey, with eight of the fourteen species collected native to the watershed. Native fishes dominated the survey in abundance (97%) and biomass (78%), with introduced fish accounting for the remainder. Due to high instream flows, only three of the six historic sites were surveyed. Surveyors utilized deliberate voltage adjustment of the electro-fishers by site for concurrence with water conductivity. It is not certain how this may have influenced catch efficiency. While catch results show populations of varied species fluctuate by site, the assemblage continues to be dominated by native Sacramento suckers, cyprinid, lamprey, and sculpin species. These fish most accurately meet the criteria of the pikeminnow-hardhead-sucker assemblage as described by Moyle (2002) for low gradient reaches of California rivers such as the lower Kings River below Pine Flat Dam. While deep-bodied fish were present, they made up less than two percent of the species assemblage. "Wild" trout were present, but were less than one percent of the species assemblage, as expected for a low elevation, low gradient, fish assemblage.

Catch results provided evidence of successful reproduction for native species as juvenile life stages were collected for all taxa, except three-spine stickleback. Three-spine stickleback typically live no more than one year, and all members of the annual cohort would have reached adulthood by the time of the survey. Catch results also provided evidence that introduced non-native bass and possibly bluegill have successfully reproduced in the Kings River.

A summary of results from the 2023 Fall Population Electro-fishing Survey is provided in Table 19.

Table 19. *Summary results, Fall Population Electro-fishing Survey.*

| Species Collected | Species Composition (%) | Range across Survey Sites[1] | | | |
		Population Estimates[*]	Fish per Mile (estimated)	Biomass (lb)	Length (in)
Sacramento Sucker	47.58	309-810	5,438-14,256	3.3-17.3	1-21
California Roach	17.24	17-270	299-4,752	0.2-2.9	1-5
Lamprey	10.54	14-452	246-7,955	0.1-1.9	3-8
Sculpin	8.53	24-139	422-2,446	0.3-2.5	2-6
Three-spine Stickleback	6.66	30-183	528-3,221	0.05-0.1	1-3
Sacramento Pikeminnow	6.07	20-63	352-1,109	0.1-0.2	1-4
Rainbow Trout - Hatchery[a]	1.14	0-22	0-387	0-10.6	8-16
Green Sunfish[a]	0.82	0-15	0-264	0-0.4	3-5
Rainbow Trout - "Wild"	0.73	4-6	70-106	1.5-2.8	7-14
Bluegill[a]	0.32	0-9	0-158	0-0.1	2-4
Bass[a]	0.18	0-4	0-70	0-0.2	4-6
Hardhead	0.09	0-2	0-35	No Data	~ 4
Brown Trout[a]	0.05	0-1	0-18	0-0.4	9.4
Catfish[a]	0.05	0-1	0-18	0-0.01	3.3

[1]Range of values across sampled reaches between Pine Flat Dam & Highway 180, this should not be interpreted as all of the fish between Pine Flat Dam and Highway 180
[*]Confidence intervals for each site are provided in the Results and Discussion section of this report
[a] Introduced (non-native to the watershed or hatchery reared trout)

Trout origins can be difficult to distinguish and may cause some hatchery rainbow trout to be misclassified as "wild" rainbow trout. While fin condition is the primary means used to

distinguish these classes, hatchery rainbow trout which have become resident may resemble "wild" rainbow trout over time as worn fins regenerate. Also, no phenotypic distinction can be made between trout hatched in the incubator and those spawned instream. Due to the early age at release, four to five weeks post-hatch, incubator-hatched fry rear under the same conditions as wild trout fry which have emerged from the gravel, making fin condition an unreliable indicator of origin, thus increasing the potential for misclassification of these hatchery rainbow trout as "wild" rainbow trout.

Brown trout and rainbow trout were hatchery produced products stocked into the Kings River below Pine Flat Dam. In 2022, brown trout were stocked as fingerlings, while prior to the surveys, rainbow trout were stocked as sub-catchables, catchables and super-catchables (Appendix L) in 2023. The species, quantity, density, and size of these hatchery produced trout may be influenced by stocking practices. They are most commonly present in electro-fishing sites which are near regularly stocked locations above Fresno Weir. On average, trout captured during the electro-fishing survey in 2023 were found to be in good condition, with "wild" rainbow trout in slightly better condition than their hatchery counterparts, a reflection of excellent instream conditions.

The KRFMP should remain vigilant to invasive species. Live bait released by anglers could potentially become resident in the Kings River, providing additional competition for native species, and already established introduced species. Golden shiner (*Notemigonus crysoleucas*) (Table 1) and anecdotal observations of threadfin shad (*Dorosoma petenense*) indicate the potential for these bait species to be found in the Kings River below Pine Flat Dam. Invasive mollusks are another threat which could easily infiltrate the Kings River through the recreational use of Pine Flat Reservoir or the Kings River. Asian clams (*Corbicula fluminea*) are the only invasive mollusk currently known to be present in the Kings River watershed. Quagga (*Dreissena rostriformis bugensis*) and zebra mussels (*D. polymorpha*) have not been detected, although they may be introduced through their illegal use as bait, from wet

fishing gear containing larval life stages, or from boats transporting all life stages. Quagga mussels have become well established in several parts of southern California, while zebra mussels in California are believed to be present only in San Justo Reservoir.

Although New Zealand mudsnails (*Potamopyrgus antipodarum*) have not been detected in the Kings River, they are another threat which has been observed in many waterways in California, and due to their small size can be easily overlooked and accidentally transferred between watersheds by anglers and other recreational users. All these invasive mollusks have the potential to interfere with existing food webs, and severe mussel infestations can damage or interfere with the function of infrastructure located within a waterbody or dependent on receipt of water from that waterbody (CDFW 2021, USDA 2021a, USDA 2021b, USGS 2021). All users of the Kings River should take care not to transport these invaders from other water bodies into the Kings River by inspecting gear used in other watersheds for aquatic hitchhikers and/or drying and decontaminating gear prior to use.

Fluctuations in fish populations are normal. While native fish currently dominate the species assemblage throughout the Kings River below Pine Flat Dam, there may be years when release temperatures are warmer, and instream flows lesser and of longer duration which may provide better conditions for introduced non-native fish. Variations in species composition cannot be attributed to any single cause and most likely reflect a combination of environmental and anthropogenic factors influencing the fishery populations. The KRCD and the KRFMP will continue monitoring and investigating environmental and population variables within the tailwater fishery.

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APPENDIX A

Electro-fishing Sites, Survey Methods, and Reported Sampling Flows: 1983-2023

Table A1. *Electro-fishing survey sites in the Kings River, length of survey reach, year and sample methodology utilized.*

Reach Name	Location	Length (ft)	Mark-Recapture[1]	Single Pass Census[2]	Multi-Pass Depletion[3]
				Method & Year(s) Sampled	
Alta Weir (aka Site A)	Upstream of Alta Weir in side channel along south bank, separated from main channel by island	1,368	1983-1989	1990-2002, 2004-2006	-
Wonder Valley (aka Site B)	Halfway between Piedra Bridge & Mill Cr Confluence in a side channel along south bank	682	1983-1989	1990-2002, 2004-2006	-
Site C	Between Pine Flat (ACOE) Bridge and dam	869	1983		-
Avocado Lake Boulder	Behind Avocado Lake on south side of main fork	656	-	1989-2002, 2004-2006	-
County Park Land Boulder	Greenbelt Parkway	1,122	-	1989-2002, 2004-2006	-
Winton Park Boulder	Downstream of Winton Park	1,578	1989	989-2000, 2002, 2004-200	-
Avocado Lake Side Channel	Downstream of Avocado Lake and upstream of Dennis Cut diversion	820	-	1995-2002, 2004-2006	-
Wildwood Site	Off Trout Lake Drive in Wildwood Subdivision	820	-	1995-2002, 2004-2006	-
Alta	Subset of historic Alta Weir site (aka Site A)	300	-	-	2007-2016, 2018, 2021-2022
Avo Boulder	Subset of Avocado Lake Boulder site	300	-	-	2007-2016, 2018-2019, 2021-2022
Avo Side	Subset of Avocado Lake Side Channel site	300	-	-	2007-2019, 2021-2023
Avocado Test	Located behind northwest corner of Avocado Lake, upstream of Avocado Boulder site	300	-	-	2007 & 2010
Doyal's Test	Located behind Piedra Library, upstream of Piedra Bridge	300	-	-	2007 & 2010
Greenbelt	Subset of historic County Park Land Boulder site	300	-	-	2007-2019, 2021-2023
Large Woody Debris (LWD) Control	Located near Winton Park but upstream of Winton Park Boulder site	330	-	-	2007
Wildwood	Subset of historic Wildwood site	300	-	-	2007-2016, 2018-2019, 2021-2023
Winton	Subset of historic Winton Park Boulder site, west of Thorburn Spawning Channel	300	-	-	2007-2016, 2018-2019, 2021-2022

[1] sampling methodology used to determine population estimates, requires at a minimum 1 marking pass & 1 recapture pass

[2] sampling methodology used to obtain indices of abundance for a population

[3] sampling methodology used to determine population estimates through the removal of all biomass present within the sample reach

Table A2. *Electro-fishing surveys in the Kings River, number of sites sampled, sampling method, electro-fishing crews, passes, seine placement, determination of trout origin, species recorded, and species measured. A dash indicates no data, and NA denotes information was not available.*

Year[1,2]	Number of Sites	Total Distance	Sampling Method Utilized	Number of Electro-fishing Crews	Number of Passes	Block Seine Net Placement	"Wild" Trout Determinator	Species Recorded	Species Measured
1983	3	2,919	single census mark-recapture	3	2-3	Upstream & Downstream	fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1984	2	2,050	single census mark-recapture	2	2	Upstream & Downstream	fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1985	2	2,050	single census mark-recapture	2	1-2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1986	2	2,050	single census mark-recapture	2-3	2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1987	2	2,050	single census mark-recapture	3	1-2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1988	2	2,050	single census mark-recapture	2-3	2-3	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout $\geq$ 10 cm FL
1989	3	3,628	single census mark-recapture	3-4	2	Upstream & Downstream	color & fin condition	all trout, others noted	wild rainbow trout $\geq$ 10 cm FL
1989	3	3,356	single pass census	3-4	1	Upstream & Downstream	color & fin condition	all trout, others noted	wild rainbow trout $\geq$ 10 cm FL
1990	5	5,406	single pass census	2-3	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout $\geq$ 10 cm FL
1991	5	5,406	single pass census	3-4	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout $\geq$ 10 cm FL
1992	5	5,406	single pass census	2-4	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout $\geq$ 10 cm FL
1993	5	5,406	single pass census	3-4	1	Upstream & Downstream	color & fin condition, absence of tags/dyes	all species	all rainbow trout
1994	5	5,406	single pass census	4-5	1	Upstream & Downstream	color & fin condition, absence of tags/dyes	all species	all rainbow trout
1995	7	7,046	single pass census	3-5	1	Upstream Only	color & fin condition, absence of tags/dyes	all species	all rainbow trout
1996	7	7,046	single pass census	4-6	1	Upstream Only	color & fin condition, absence of tags/dyes	all species	all rainbow trout
1997	7	7,046	single pass census	3-5	1	Upstream Only	color & fin condition, absence of tags/dyes	all species	all rainbow trout
1998	7	7,046	single pass census	3-5	1	Upstream Only	color & fin condition, absence of tags/dyes, size	all species	all rainbow trout
1999	7	7,046	single pass census	3-5	1	Upstream Only	color & fin condition	all species	all rainbow trout
2000	7	7,046	single pass census	4-6	1	Upstream Only	color & fin condition	all species	all rainbow trout
2001	6	5,468	single pass census	5-6	1	Upstream Only	color & fin condition	all species	all rainbow trout
2002	7	7,046	single pass census	3-7	1	Upstream Only	color & fin condition	all species	all rainbow trout
2003	0	0	not sampled	-	-	-	-	-	-
2004	7	7,046	single pass census	3-6	1	Upstream Only	color & fin condition	all species	all rainbow trout
2005	7	7,046	single pass census	NA	1	Upstream Only	color & fin condition	all species	all rainbow trout
2006	7	7,046	single pass census	NA	1	Upstream Only	color & fin condition	all species	all rainbow trout
2007	9	2,730	mutli-pass depletion survey	5-7	3	Upstream & Downstream	fin condition	all species	all species
2008	6	1,800	mutli-pass depletion survey	6-7	3	Upstream & Downstream	fin condition	all species	all species
2009	6	1,800	mutli-pass depletion survey	6-8	3	Upstream & Downstream	fin condition	all species	all species
2010	8	2,400	mutli-pass depletion survey	5-7	3	Upstream & Downstream	fin condition	all species	all species
2011	6	1,800	mutli-pass depletion survey	4-6	3	Upstream & Downstream	fin condition	all species	all species
2012	6	1,800	mutli-pass depletion survey	5-8	3	Upstream & Downstream	fin condition	all species	all species
2013	6	1,800	mutli-pass depletion survey	5-6	3	Upstream & Downstream	fin condition	all species	all species
2014	6	1,800	mutli-pass depletion survey	7-9	3	Upstream & Downstream	fin condition	all species	all species
2015	6	1,800	mutli-pass depletion survey	5-7	3	Upstream & Downstream	fin condition	all species	all species
2016	6	1,800	mutli-pass depletion survey	5-7	3	Upstream & Downstream	fin condition, diploid blood cells	all species	all species
2017	2	600	mutli-pass depletion survey	8	3	Upstream & Downstream	fin condition, diploid blood cells	all species	all species
2018	6	1,800	mutli-pass depletion survey	6-7	3	Upstream & Downstream	color & fin condition	all species	all species
2019	5	1,500	mutli-pass depletion survey	6-7	3	Upstream & Downstream	color & fin condition	all species	all species
2021	6	1,800	mutli-pass depletion survey	5-6	3	Upstream & Downstream	fin condition	all species	all species
2022	6	1,800	mutli-pass depletion survey	6-8	3	Upstream & Downstream	fin condition	all species	all species
2023	3	900	mutli-pass depletion survey	7-9	3	Upstream & Downstream	fin condition	all species	all species

A-2

[1] from 2007-2011 shocker settings were standardized at 350 volts, 10% duty cycle, and 50 Hz frequency

[2] from 2012 onward shocker settings were set such that voltage utilized matched water conductivity, and were standardized with a 20% duty cycle, and 30 Hz frequency

Table A3. *Fall electro-fishing Survey Dates and Reported River Flows in the Kings River at the Army Corps of Engineer Bridge. NA denotes the survey occurred but the timeframe within the year is not available.*

Year	Survey Period	Flow (cfs)[1]	Notes
1983	Nov. 13 - Nov. 21	15 -47	flows reached 138 cfs during survey
1984	Nov. 20 - Nov. 21	41-45	
1985	Oct. 15 - Oct. 16	51-52	
1986	Nov. 5 - Nov. 14	72-73	
1987	Sep. 30 - Nov. 16	49-134	
1988	Nov. 1 - Nov. 2	54-59	
1989	Oct. 17 - Dec. 19	51-54	releases were at 761 cfs above survey reach
1990	Nov. 19 - Nov. 21	74-100	
1991	Nov. 18 - Nov. 22	49-59	
1992	Nov. 5 - Nov. 11	54-103	
1993	Nov. 22 - Dec. 1	39-92	
1994	Nov. 21 - Nov. 29	53-89	
1995	Nov. 27 - Dec. 1	98-100	
1996	Nov. 26 - Dec. 3	58-70	
1997	Nov. 13 - Nov. 18	100-196	
1998	Nov. 3 - Nov. 11	96-762	flows at 40 cfs at Greenbelt & Wildwood
1999	Nov. 9 - Nov. 15	132-156	
2000	Nov. 30 - Dec. 5	112-115	
2001	Nov. 27 - Nov. 30	101-102	
2002	Dec. 4 - Dec. 9	102	
2003	No Survey	-	
2004	Feb. 13 - Feb. 19	101-126	
2005	NA	-	
2006	NA	-	
2007	Nov. 5 - Nov. 16	107	
2008	Nov. 12 - Nov. 19	100-105	
2009	Nov. 9 - Nov. 17	100-268	flows ramped daily during e-fishing in order to achieve safe wading conditions
2010	Nov. 8 - Nov. 19	101-136	decreased flows by 35 cfs for shocking above Fresno Weir, all sampling at ~100 cfs
2011	Nov. 28 - Dec. 1	105	flows ramped daily during e-fishing in order to achieve safe wading conditions
2012	Nov. 11 - Nov. 20	100-115	
2013	Nov. 12 - Nov. 19	100	
2014	Nov. 12 - Nov. 19	100-150	
2015	Nov. 3 - Nov. 10	108	
2016	Nov. 9 - Nov. 18	105-116	
2017	Nov. 28 - Nov. 29	281-285	
2018	Nov. 1 - Nov. 8	124-149	
2019	Dec. 2 - Dec. 10	100-184	flows ramped daily during e-fishing in order to achieve safe wading conditions
2021	Nov. 29 - Dec. 7	100	
2022	Nov. 29 - Dec. 8	100-101	
2023	Nov 28. - Dec. 6	152-358	flows ramped Nov 29, Dec 5 & Dec 6 in effort to achieve safe wading conditions

[1] reported flows at ACOE Bridge (0.5 miles below Pine Flat Dam) as reported in the power plant morning report

APPENDIX B

Annual Population Survey, Species Composition: 2007-2023

Table B1: Species Composition 2007

Species Composition, November 2007*								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	3	3	20	22	143	53	**244**	4.5%
Lamprey sp.	1	202	5	136	3	4	**351**	6.5%
Rainbow Trout -	9	32	2	5	0	0	**48**	0.9%
Rainbow Trout - "Wild"	7	4	8	0	3	0	**22**	0.4%
Sacramento Pikeminnow	93	20	75	156	226	378	**948**	17.7%
Sacramento Sucker	326	454	390	248	288	315	**2,021**	37.6%
Sculpin sp.	375	450	175	211	209	242	**1,662**	30.9%
Three-spine Stickleback	8	31	7	16	0	13	**75**	1.4%
Total Fish Captured	**822**	**1,196**	**682**	**794**	**872**	**1,005**	5,371	
% of Total	**15%**	**22%**	**13%**	**15%**	**16%**	**19%**		**100%**

* nine sites sampled, but data shown represents only that from the six core sites sampled annually

Table B2: Species Composition 2008

Species Composition, November 2008								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	0	6	84	16	226	277	**609**	23.2%
Catfish sp.	0	0	1	0	1	0	**2**	0.1%
Lamprey sp.	2	47	5	75	2	0	**131**	5.0%
Rainbow Trout -	0	0	1	0	0	0	**1**	0.0%
Rainbow Trout - "Wild"	7	4	7	8	1	0	**27**	1.0%
Sacramento Pikeminnow	56	15	143	47	154	94	**509**	19.4%
Sacramento Sucker	82	157	227	99	103	16	**684**	26.0%
Sculpin sp.	151	133	133	71	29	39	**556**	21.2%
Three-spine Stickleback	0	36	20	19	0	31	**106**	4.0%
Western Mosquitofish	0	2	0	0	0	0	**2**	0.1%
Total Fish Captured	**298**	**400**	**621**	**335**	**516**	**457**	2,627	
% of Total	**11%**	**15%**	**24%**	**13%**	**20%**	**17%**		**100%**

Table B3: Species Composition 2009

Species Composition, November 2009								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	1	3	0	**4**	0.1%
Bluegill	0	0	0	0	1	0	**1**	0.0%
California Roach	0	93	30	6	52	347	**528**	19.2%
Catfish sp.	0	0	0	0	2	0	**2**	0.1%
Lamprey sp.	4	57	5	79	1	1	**147**	5.3%
Rainbow Trout -	3	1	0	0	0	0	**4**	0.1%
Rainbow Trout - "Wild"	5	1	11	2	0	0	**19**	0.7%
Sacramento Pikeminnow	14	48	60	29	88	152	**391**	14.2%
Sacramento Sucker	29	122	232	54	53	19	**509**	18.5%
Sculpin sp.	276	275	244	109	85	51	**1,040**	37.8%
Three-spine Stickleback	1	39	21	17	5	23	**106**	3.9%
Total Fish Captured	**332**	**636**	**603**	**297**	**290**	**593**	2,751	
% of Total	**12%**	**23%**	**22%**	**11%**	**11%**	**22%**		**100%**

Table B4: Species Composition 2010

Species Composition, November 2010*								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Brook Trout	1	7	0	1	0	0	9	0.3%
California Roach	6	19	51	5	69	401	551	21.0%
Lamprey sp.	0	57	7	28	1	5	98	3.7%
Rainbow Trout -	1	1	2	0	0	0	4	0.2%
Rainbow Trout - "Wild"	8	0	0	3	0	0	11	0.4%
Sacramento Pikeminnow	11	13	30	7	46	83	190	7.2%
Sacramento Sucker	41	189	122	42	14	62	470	17.9%
Sculpin sp.	439	272	195	96	78	87	1,167	44.4%
Three-spine Stickleback	17	59	4	0	0	46	126	4.8%
Total Fish Captured	524	617	411	182	208	684	2,626	
% of Total	20%	23%	16%	7%	8%	26%		100%

* eight sites sampled, but data shown represents only that from the six core sites sampled annually

Table B5: Species Composition 2011

Species Composition, November-December 2011								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	6	7	23	25	26	212	299	16.3%
Green Sunfish	1	0	0	0	0	0	1	0.1%
Lamprey sp.	0	48	17	90	0	0	155	8.5%
Rainbow Trout - Hatchery	0	0	6	3	0	0	9	0.5%
Rainbow Trout - "Wild"	0	3	5	2	0	0	10	0.5%
Sacramento Pikeminnow	33	22	9	2	12	8	86	4.7%
Sacramento Sucker	62	98	68	44	13	77	362	19.7%
Sculpin sp.	253	213	85	144	60	93	848	46.2%
Three-spine Stickleback	9	38	9	4	1	3	64	3.5%
Total Fish Captured	364	429	222	314	112	393	1,834	
% of Total	20%	23%	12%	17%	6%	21%		100%

Table B6: Species Composition 2012

Species Composition, November 2012								
	Winton	Alta	Avo Boulder	AvoSide	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	0	0	1	1	0.0%
California Roach	0	37	77	30	121	156	421	9.9%
Catfish sp.	0	0	0	0	1	1	2	0.0%
Lamprey Sp.	0	103	23	76	4	0	206	4.8%
Rainbow Trout - Hatchery	1	0	3	0	0	0	4	0.1%
Rainbow Trout - "Wild"	6	3	12	6	1	0	28	0.7%
Sacramento Pikeminnow	1	17	44	169	64	133	428	10.0%
Sacramento Sucker	107	396	336	244	98	510	1,691	39.6%
Sculpin Sp.	336	391	275	182	104	99	1,387	32.5%
Three-spine Stickleback	0	36	6	24	4	20	90	2.1%
Western Mosquitofish	0	0	0	9	0	0	9	0.2%
Total Fish Captured	451	983	776	740	397	920	4,267	
% of Total	11%	23%	18%	17%	9%	22%		100%

Table B7: Species Composition 2013

Species Composition, November 2013								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	0	5	0	**5**	0.1%
California Roach	0	52	179	248	220	444	**1,143**	19.0%
Catfish sp.	0	0	0	0	3	0	**3**	0.0%
Lamprey sp.	3	35	7	102	3	0	**150**	2.5%
Rainbow Trout - Hatchery	2	1	1	1	0	0	**5**	0.1%
Rainbow Trout - "Wild"	3	0	4	4	0	0	**11**	0.2%
Sacramento Pikeminnow	170	98	333	130	375	759	**1,865**	31.0%
Sacramento Sucker	355	257	256	73	51	162	**1,154**	19.2%
Sculpin sp.	493	188	291	188	176	130	**1,466**	24.4%
Three-spine Stickleback	15	64	6	10	15	101	**211**	3.5%
Western Mosquitofish	0	1	0	0	0	0	**1**	0.0%
Total Fish Captured	1,041	696	1,077	756	848	1,596	6,014	
% of Total	17%	12%	18%	13%	14%	27%		100%

Table B8: Species Composition 2014

Species Composition, November 2014								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	1	1	0	26	1	**29**	0.7%
California Roach	23	101	184	100	178	463	**1,049**	25.7%
Catfish sp.	2	0	2	2	15	0	**21**	0.5%
Lamprey sp.	2	109	40	207	3	1	**362**	8.9%
Rainbow Trout - Hatchery	0	0	1	0	0	0	**1**	0.0%
Sacramento Pikeminnow	173	48	261	57	117	284	**940**	23.1%
Sacramento Sucker	114	89	148	67	34	80	**532**	13.0%
Sculpin sp.	360	54	129	81	34	59	**717**	17.6%
Three-spine Stickleback	31	219	31	58	4	63	**406**	10.0%
Western Mosquitofish	0	1	0	2	3	14	**20**	0.5%
Total Fish Captured	705	622	797	574	414	965	4,077	
% of Total	17%	15%	20%	14%	10%	24%		100%

Table B9: Species Composition 2015

Species Composition, November 2015								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	1	0	1	55	4	61	1.4%
California Roach	33	183	292	211	73	720	1,512	35.3%
Catfish sp.	0	0	0	0	2	0	2	0.0%
Lamprey sp.	2	107	25	54	0	1	189	4.4%
Rainbow Trout - Hatchery	0	0	1	0	0	0	1	0.0%
Rainbow Trout - "Wild"	1	0	1	0	0	0	2	0.0%
Sacramento Pikeminnow	126	50	200	158	108	158	800	18.7%
Sacramento Sucker	422	371	289	200	24	23	1,329	31.0%
Sculpin sp.	160	7	27	4	7	6	211	4.9%
Three-spine Stickleback	48	31	14	20	0	9	122	2.8%
Western Mosquitofish	2	23	0	0	13	19	57	1.3%
Total Fish Captured	794	773	849	648	282	940	4,286	
% of Total	19%	18%	20%	15%	7%	22%		100%

Table B10: Species Composition 2016

Species Composition, November 2016								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	0	15	1	16	0.3%
Bluegill	0	0	0	0	1	0	1	0.0%
California Roach	11	327	359	167	89	580	1,533	25.9%
Green Sunfish	0	0	0	0	2	0	2	0.0%
Lamprey sp.	3	130	26	138	2	0	299	5.0%
Rainbow Trout - Hatchery	2	0	7	2	0	0	11	0.2%
Rainbow Trout - "Wild"	0	0	2	4	0	1	7	0.1%
Sacramento Pikeminnow	52	72	175	10	40	44	393	6.6%
Sacramento Sucker	539	391	634	207	488	556	2,815	47.5%
Sculpin sp.	210	27	24	4	37	1	303	5.1%
Three-spine Stickleback	92	78	95	129	6	118	518	8.7%
Western Mosquitofish	0	15	0	0	1	16	32	0.5%
Total Fish Captured	909	1,040	1,322	661	681	1,317	5,930	
% of Total	15%	18%	22%	11%	11%	22%		100%

Table B11: Species Composition 2017

Species Composition, November 2017*								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	-	-	-	0	3	-	3	0.2%
California Roach	-	-	-	99	170	-	269	19.8%
Green Sunfish	-	-	-	0	5	-	5	0.4%
Lamprey sp.	-	-	-	119	8	-	127	9.4%
Rainbow Trout - Hatchery	-	-	-	4	1	-	5	0.4%
Rainbow Trout - "Wild"	-	-	-	3	0	-	3	0.2%
Sacramento Pikeminnow	-	-	-	14	25	-	39	2.9%
Sacramento Sucker	-	-	-	322	166	-	488	36.0%
Sculpin sp.	-	-	-	150	156	-	306	22.6%
Three-spine Stickleback	-	-	-	29	82	-	111	8.2%
Total Fish Captured	-	-	-	740	616	-	1,356	
% of Total	-	-	-	55%	45%	-		100%

* only two sites sampled due to unsafe flows for surveying at other sites

Table B12: Species Composition 2018

Species Composition, November 2018								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	1	1	0	2	0.0%
California Roach	0	5	44	10	64	324	447	8.6%
Catfish sp.	0	0	0	0	1	0	1	0.0%
Hardhead	0	0	0	0	1	0	1	0.0%
Lamprey sp.	2	71	10	153	6	6	248	4.8%
Rainbow Trout - Hatchery	4	4	4	3	0	0	15	0.3%
Rainbow Trout - "Wild"	1	2	7	8	0	0	18	0.3%
Sacramento Pikeminnow	6	11	12	5	142	47	223	4.3%
Sacramento Sucker	422	390	387	375	174	360	2,108	40.4%
Sculpin sp.	713	651	142	172	239	143	2,060	39.5%
Three-spine Stickleback	13	10	16	32	15	10	96	1.8%
Total Fish Captured	1,161	1,144	622	759	643	890	5,219	
% of Total	22%	22%	12%	15%	12%	17%		100%

Table B13: Species Composition 2019

Species Composition, December 2019*								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
California Roach	0	-	11	25	8	84	128	7.3%
Catfish sp.	3	-	0	2	1	0	6	0.3%
Lamprey sp.	4	-	5	166	2	8	185	10.5%
Rainbow Trout - Hatchery	0	-	26	8	0	0	34	1.9%
Rainbow Trout - "Wild"	1	-	3	10	0	0	14	0.8%
Sacramento Pikeminnow	23	-	6	4	21	8	62	3.5%
Sacramento Sucker	44	-	174	155	53	158	584	33.1%
Sculpin sp.	339	-	67	168	69	68	711	40.3%
Three-spine Stickleback	8	-	13	9	5	5	40	2.3%
Total Fish Captured	**422**	**-**	**305**	**547**	**159**	**331**	**1,764**	
% of Total	**24%**	**-**	**17%**	**31%**	**9%**	**19%**		**100%**

* only five sites sampled due to adverse weather at Alta creating unsafe survey conditions

Table B14: Species Composition 2021

Species Composition, November-December 2021								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood[1]	Total	% of Total
Bass sp.	0	0	0	0	14	5	19	0.3%
Brook Trout	3	0	0	0	0	0	3	0.1%
California Roach	3	34	40	59	88	738	962	16.8%
Catfish sp.	0	0	0	0	2	0	2	0.0%
Lamprey sp.	4	167	32	124	7	11	345	6.0%
Rainbow Trout - Hatchery	2	10	12	26	4	1	55	1.0%
Rainbow Trout - "Wild"	3	1	8	1	0	0	13	0.2%
Sacramento Pikeminnow	293	221	139	76	238	749	1,716	29.9%
Sacramento Sucker	538	459	298	138	37	194	1,664	29.0%
Sculpin sp.	287	77	22	39	77	109	611	10.6%
Three-spine Stickleback	9	70	9	5	39	212	344	6.0%
Western Mosquitofish	0	0	0	0	0	4	4	0.1%
Total Fish Captured	**1,142**	**1,039**	**560**	**468**	**506**	**2,023**	**5,738**	
% of Total	**20%**	**18%**	**10%**	**8%**	**9%**	**35%**		**100%**

[1] net went partially down during the 2nd pass, reach integrity may have been compromised if fish entered/exited reach

Table B15: Species Composition 2022

Species Composition, November-December 2022								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt[1]	Wildwood[1]	Total	% of Total
Bass sp.	3	0	0	0	24	5	32	0.6%
Bluegill	0	0	0	0	1	0	1	0.0%
Brown Trout	2	0	4	1	0	0	7	0.1%
California Roach	2	88	174	217	43	423	947	17.0%
Catfish sp.	0	0	0	0	1	0	1	0.0%
Hardhead	0	0	0	0	2	55	57	1.0%
Lamprey sp.	4	123	39	94	13	2	275	4.9%
Rainbow Trout - Hatchery	0	0	4	7	0	0	11	0.2%
Rainbow Trout - "Wild"	1	0	0	1	0	0	2	0.0%
Sacramento Pikeminnow	137	115	205	119	322	381	1,279	22.9%
Sacramento Sucker	518	184	279	172	455	438	2,046	36.6%
Sculpin sp.	279	31	26	9	35	47	427	7.6%
Three-spine Stickleback	158	71	35	67	59	88	478	8.6%
Western Mosquitofish	1	3	0	0	7	11	22	0.4%
Total Fish Captured	1,105	615	766	687	962	1,450	5,585	
% of Total	20%	11%	14%	12%	17%	26%		100%

[1] net went partially down during the 1st pass, reach integrity may have been compromised if fish entered/exited reach

Table B15: Species Composition 2023

Species Composition, November-December 2023*								
	Winton	Alta	Avo Boulder	Avo Side[1]	Greenbelt	Wildwood	Total	% of Total
Bass sp.	-	-	-	0	0	4	4	0.18%
Bluegill	-	-	-	0	1	6	7	0.32%
Brown Trout	-	-	-	1	0	0	1	0.05%
California Roach	-	-	-	111	17	250	378	17.24%
Catfish sp.	-	-	-	1	0	0	1	0.05%
Green Sunfish	-	-	-	0	2	16	18	0.82%
Hardhead	-	-	-	0	2	0	2	0.09%
Lamprey sp.	-	-	-	187	12	32	231	10.54%
Rainbow Trout - Hatchery	-	-	-	25	0	0	25	1.14%
Rainbow Trout - "Wild"	-	-	-	7	4	5	16	0.73%
Sacramento Pikeminnow	-	-	-	63	48	22	133	6.07%
Sacramento Sucker	-	-	-	557	192	294	1,043	47.58%
Sculpin sp.	-	-	-	25	50	112	187	8.53%
Three-spine Stickleback	-	-	-	28	52	66	146	6.66%
Western Mosquitofish	-	-	-	0	0	0	0	0.00%
Total Fish Captured	0	0	0	1,005	380	807	2,192	
% of Total	0%	0%	0%	46%	17%	37%		100%

* only three sites sampled due to unsafe survey conditions

[1] bottom net went partially down toward the end of the 2nd pass, and top net partially down prior to beginning 3rd pass, reach integrity may have been compromised if fish entered/exited reach

APPENDIX C

Catostomidae – Sucker Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table C1: Catch-per-unit Effort – Sacramento Sucker

Catch-per-Unit Effort (CPUE), Sacramento Sucker							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	42.8	50.5	52.4	34.7	32.7	44.7	**43.0**
2008	12.0	26.8	34.4	17.5	13.5	2.4	**17.4**
2009	3.8	18.0	25.6	9.1	5.9	3.1	**11.4**
2010	4.8	29.7	17.7	10.1	2.7	8.4	**12.2**
2011	7.5	20.9	8.0	9.8	2.0	10.4	**9.1**
2012	13.7	34.2	39.6	32.6	12.3	65.4	**33.1**
2013	51.0	40.5	37.3	11.4	6.6	19.9	**27.2**
2014	10.7	11.3	19.7	7.6	4.8	10.4	**10.7**
2015	50.1	51.1	35.7	36.8	3.4	2.8	**29.9**
2016	73.8	73.7	95.0	40.2	78.4	91.7	**76.7**
2017	-	-	-	40.6	17.4	-	**27.9**
2018	34.5	52.3	61.1	58.8	23.6	41.3	**43.5**
2019	5.0	-	28.7	22.3	7.0	23.3	**16.1**
2021	54.4	53.6	49.1	25.6	4.5	21.7	**35.4**
2022	50.0	28.3	34.8	24.2	45.4	38.7	**38.4**
2023	-	-	-	64.0	20.3	25.8	**35.3**

Table C2: Population Estimates – Sacramento Sucker

Population Estimate (95% CI, Lower CI Adjusted), Sacramento Sucker						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	838 (326-1,373)	535 (494-576)	573 (466-680)	372 (372-372)	344 (309-379)	368 (336-400)
2008	107 (82-138)	231 (162-300)	261 (236-286)	112 (99-127)	119 (103-136)	25 (16-55)
2009	35 (29-48)	141 (122-160)	257 (238-276)	64 (54-79)	64 (53-81)	28 (19-54)
2010	42 (41-46)	207 (192-222)	162 (122-202)	45 (42-51)	14 (14-15)	133 (62-278)
2011	93 (93-93)	112 (98-128)	88 (68-115)	54 (44-71)	14 (13-19)	156 (77-293)
2012	128 (107-150)	466 (428-504)	415 (369-461)	319 (267-371)	109 (98-122)	765 (765-765)
2013	450 (396-504)	268 (258-278)	296 (269-323)	88 (73-107)	69 (51-98)	202 (168-236)
2014	121 (114-130)	100 (89-113)	174 (151-197)	71 (67-78)	34 (34-36)	93 (80-109)
2015	538 (477-599)	536 (438-634)	366 (317-415)	268 (215-321)	24 (24-26)	25 (23-31)
2016	844 (685-1,003)	556 (462-650)	1034 (836-1,232)	291 (225-357)	574 (532-616)	827 (639-961)
2017	-	-	-	361 (337-385)	197 (171-223)	-
2018	595 (500-690)	510 (444-576)	517 (445-589)	552 (446-658)	215 (182-248)	506 (420-592)
2019	66 (66-66)	-	210 (181-239)	201 (161-241)	102 (53-201)	401 (158-762)
2021	444 (419-469)	549 (504-594)	367 (321-413)	171 (140-202)	39 (37-44)	63 (50-84)
2022	697 (609-785)	208 (184-232)	403 (309-497)	213 (179-247)	486 (464-508)	231 (230-234)
2023	-	-	-	810 (680-940)	309 (198-420)	348 (309-387)

Table C3: Estimated Fish per Mile – Sacramento Sucker

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	14,749	9,416	10,085	6,547	6,054	6,477	**8,888**
2008	1,883	4,066	4,594	1,971	2,094	440	**2,508**
2009	616	2,482	4,523	1,126	1,126	493	**1,728**
2010	739	3,643	2,851	792	246	2,341	**1,769**
2011	1,637	1,971	1,549	950	246	2,746	**1,517**
2012	2,253	8,202	7,304	5,614	1,918	13,464	**6,459**
2013	7,920	4,717	5,210	1,549	1,214	3,555	**4,027**
2014	2,130	1,760	3,062	1,250	598	1,637	**1,739**
2015	9,469	9,434	6,442	4,717	422	440	**5,154**
2016	14,854	9,786	18,198	5,122	10,102	14,555	**12,103**
2017	-	-	-	6,354	3,467	-	**4,910**
2018	10,472	8,976	9,099	9,715	3,784	8,906	**8,492**
2019	1,162	-	3,696	3,538	1,795	7,058	**3,450**
2021	7,814	9,662	6,459	3,010	686	1,109	**4,790**
2022	12,267	3,661	7,093	3,749	8,554	4,066	**6,565**
2023	-	-	-	14,256	5,438	6,125	**8,606**

Table C4: Biomass (pounds) – Sacramento Sucker

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	1.6	2.1	213.7	1.3	80.3	5.1	**304.1**
2008	8.7	2.8	178.7	3.5	126.3	0.8	**320.7**
2009	7.4	3.8	198.8	4.5	48.7	3.9	**267.1**
2010	12.5	4.8	69.1	12.6	4.3	0.9	**104.2**
2011	2.9	2.1	50.1	13.2	2.8	0.8	**72.0**
2012	2.5	5.3	83.7	17.2	3.5	8.4	**120.6**
2013	8.0	2.5	64.1	18.8	1.8	6.2	**101.4**
2014	6.7	3.2	48.3	11.7	17.9	6.2	**94.0**
2015	8.7	3.6	66.8	28.4	23.2	7.8	**138.4**
2016	15.0	4.2	37.1	12.0	5.2	11.2	**84.7**
2017	-	-	-	18.3	2.7	-	**21.0**
2018	6.9	6.9	41.0	26.5	2.7	9.8	**93.9**
2019	0.5	-	95.4	10.2	1.7	6.4	**114.2**
2021	3.1	3.0	182.4	40.2	20.0	2.3	**251.1**
2022	7.3	1.7	96.0	30.4	5.5	5.5	**146.4**
2023	-	-	-	17.3	3.8	3.3	**24.4**

APPENDIX D

Centrarchidae – Sunfish, Crappie, and "Black" Bass Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table D1a: Catch-per-unit Effort – Bass

Catch-per-Unit Effort (CPUE), Bass							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2009	0.0	0.0	0.0	0.2	0.3	0.0	**0.1**
2012	0.0	0.0	0.0	0.0	0.0	0.1	**0.0**
2013	0.0	0.0	0.0	0.0	0.6	0.0	**0.1**
2014	0.0	0.1	0.1	0.0	3.6	0.1	**0.6**
2015	0.0	0.1	0.0	0.2	7.9	0.5	**1.4**
2016	0.0	0.0	0.0	0.0	2.4	0.2	**0.4**
2017	-	-	-	0.0	0.3	-	**0.2**
2018	0.0	0.0	0.0	0.2	0.1	0.0	**0.0**
2021	0.0	0.0	0.0	0.0	1.7	0.6	**0.4**
2022	0.3	0.0	0.0	0.0	2.4	0.4	**0.6**
2023	-	-	-	0.0	0.0	0.4	**0.1**

Table D1b: Catch-per-unit Effort – Bluegill

Catch-per-Unit Effort (CPUE), Bluegill							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2009	0.0	0.0	0.0	0.0	0.1	0.0	**0.0**
2016	0.0	0.0	0.0	0.0	0.2	0.0	**0.0**
2022	0.0	0.0	0.0	0.0	0.1	0.0	**0.0**
2023	-	-	-	0.0	0.1	0.5	**0.2**

Table D1c: Catch-per-unit Effort – Green Sunfish

Catch-per-Unit Effort (CPUE), Green Sunfish							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2011	0.1	0.0	0.0	0.0	0.0	0.0	**0.0**
2016	0.0	0.0	0.0	0.0	0.3	0.0	**0.1**
2017	-	-	-	0.0	0.5	-	**0.3**
2023	-	-	-	0.0	0.2	1.4	**0.6**

Table D2a: Population Estimates – Bass

Population Estimate (95% CI, Lower CI Adjusted), Bass						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2009	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	3 (3-4)	0 (0-0)
2012	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)
2013	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	5 (5-6)	0 (0-0)
2014	0 (0-0)	1 (1-1)	1 (1-1)	0 (0-0)	27 (26-31)	1 (1-1)
2015	0 (0-0)	1 (1-1)	0 (0-0)	1 (1-1)	56 (55-59)	4 (4-6)
2016	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	15 (15-17)	1 (1-1)
2017	-	-	-	0 (0-0)	3 (3-4)	-
2018	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	1 (1-1)	0 (0-0)
2021	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	12 (12-14)	4 (4-6)
2022	3 (3-4)	0 (0-0)	0 (0-0)	0 (0-0)	24 (22-30)	13 (5-95)
2023	-	-	-	0 (0-0)	0 (0-0)	4 (4-5)

Table D2b: Population Estimates – Bluegill

	Population Estimate (95% CI, Lower CI Adjusted), Bluegill					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2009	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2016	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2022	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2023	-	-	-	0 (0-0)	1 (1-1)	9 (9-9)

Table D2c: Population Estimates – Green Sunfish

	Population Estimate (95% CI, Lower CI Adjusted), Green Sunfish					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2011	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
2016	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-15)	0 (0-0)
2017	-	-	-	0 (0-0)	5 (5-6)	-
2023	-	-	-	0 (0-0)	2 (2-15)	15 (15-17)

Table D3a: Estimated Fish per Mile – Bass

	Estimated Fish per Mile, Bass						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2009	0	0	0	18	53	0	12
2012	0	0	0	0	0	18	3
2013	0	0	0	0	88	0	15
2014	0	18	18	0	475	18	88
2015	0	18	0	18	986	70	182
2016	0	0	0	0	264	18	47
2017	-	-	-	0	53	-	26
2018	0	0	0	18	18	0	6
2021	0	0	0	0	211	70	47
2022	53	0	0	0	422	229	117
2023	-	-	-	0	0	70	23

Table D3b: Estimated Fish per Mile – Bluegill

	Estimated Fish per Mile, Bluegill						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2009	0	0	0	0	18	0	3
2016	0	0	0	0	18	0	3
2022	0	0	0	0	18	0	3
2023	-	-	-	0	18	158	59

Table D3c: Estimated Fish per Mile – Green Sunfish

	Estimated Fish per Mile, Green Sunfish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2011	18	0	0	0	0	0	3
2016	0	0	0	0	35	0	6
2017	-	-	-	0	88	-	44
2023	-	-	-	0	35	264	100

Table D4a: Biomass (pounds) – Bass

	Biomass (lbs), Bass						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2009	0.000	0.000	0.000	0.007	0.204	0.000	0.21
2012	0.000	0.000	0.000	0.000	0.000	0.021	0.02
2013	0.000	0.000	0.000	0.000	0.254	0.000	0.25
2014	0.000	0.014	0.006	0.000	0.617	0.024	0.66
2015	0.000	0.075	0.000	0.218	1.358	0.123	1.77
2016	0.000	0.000	0.000	0.000	0.477	0.045	0.52
2017	-	-	-	0.000	1.079	-	1.08
2018	0.000	0.000	0.000	0.002	0.139	0.000	0.14
2021	0.000	0.000	0.000	0.000	0.315	0.119	0.43
2022	0.027	0.000	0.000	0.000	0.780	0.144	0.95
2023	-	-	-	0.000	0.000	0.175	0.17

Table D4b: Biomass (pounds) – Bluegill

	Biomass (lbs), Bluegill						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2009	0.00	0.00	0.00	0.00	0.04	0.00	0.04
2016	0.00	0.00	0.00	0.00	0.03	0.00	0.03
2022	0.00	0.00	0.00	0.00	0.01	0.00	0.01
2023	-	-	-	0.00	0.03	0.11	0.14

Table D4c: Biomass (pounds) – Green Sunfish

	Biomass (lbs), Green Sunfish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2011	0.01	0.00	0.00	0.00	0.00	0.00	0.01
2016	0.00	0.00	0.00	0.00	0.10	0.00	0.10
2017	-	-	-	0.00	0.48	-	0.48
2023	-	-	-	0.00	0.07	0.42	0.49

APPENDIX E

Cottidae – Sculpin Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table E1: Catch-per-unit Effort – Sculpin

	Catch-per-Unit Effort (CPUE), Sculpin						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	49.2	50.1	23.5	29.5	23.7	34.3	**35.3**
2008	22.2	22.7	20.2	12.5	3.8	5.8	**14.2**
2009	35.9	40.5	26.9	18.5	9.5	8.4	**23.4**
2010	51.7	42.7	28.2	23.0	14.8	11.8	**30.3**
2011	30.7	45.3	10.0	32.1	9.3	12.6	**21.3**
2012	43.0	33.7	32.4	24.3	13.1	12.7	**27.1**
2013	70.8	29.6	42.5	29.4	22.8	16.0	**34.6**
2014	33.8	6.8	17.2	9.2	4.8	7.7	**14.4**
2015	19.0	1.0	3.3	0.7	1.0	0.7	**4.8**
2016	28.8	5.1	3.6	0.8	5.9	0.2	**8.3**
2017	-	-	-	18.9	16.3	-	**17.5**
2018	58.3	87.4	22.4	27.0	32.4	16.4	**42.5**
2019	38.2	-	11.1	24.1	9.1	10.0	**19.6**
2021	29.0	9.0	3.6	7.2	9.4	12.2	**13.0**
2022	26.9	4.8	3.2	1.3	3.5	4.1	**8.0**
2023	-	-	-	2.9	5.3	9.8	**6.3**

Table E2: Population Estimates – Sculpin

	Population Estimate (95% CI, Lower CI Adjusted), Sculpin					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	437 (403-471)	617 (530-704)	201 (179-223)	350 (228-472)	219 (210-228)	353 (271-435)
2008	176 (154-198)	175 (135-215)	147 (133-161)	73 (71-78)	29 (29-31)	58 (58-58)
2009	330 (295-365)	384 (310-458)	268 (250-286)	137 (109-166)	90 (85-97)	95 (51-183)
2010	528 (483-573)	332 (293-371)	239 (205-273)	101 (96-108)	85 (78-95)	93 (87-101)
2011	326 (276-376)	229 (216-242)	87 (85-91)	159 (145-173)	259 (60-1,068)	150 (93-224)
2012	372 (350-394)	469 (427-511)	302 (283-321)	214 (188-240)	130 (104-158)	125 (99-154)
2013	540 (516-564)	191 (188-195)	307 (295-319)	215 (193-237)	195 (179-211)	152 (131-173)
2014	395 (374-416)	61 (54-72)	141 (129-154)	107 (81-139)	36 (34-41)	63 (59-70)
2015	164 (160-170)	10 (10-10)	27 (27-29)	8 (4-50)	7 (7-9)	6 (6-10)
2016	230 (214-246)	30 (27-38)	26 (24-32)	4 (4-5)	37 (37-39)	1 (1-1)
2017	-	-	-	172 (152-192)	163 (156-171)	-
2018	877 (812-942)	799 (737-861)	156 (142-170)	209 (179-239)	261 (244-278)	165 (145-185)
2019	455 (386-524)	-	68 (67-71)	214 (176-252)	71 (69-75)	144 (68-291)
2021	239 (232-246)	95 (77-118)	29 (22-47)	40 (39-43)	93 (77-113)	92 (67-127)
2022	338 (300-376)	37 (31-50)	41 (26-79)	10 (9-16)	35 (35-37)	33 (33-34)
2023	-	-	-	24 (24-26)	112 (50-260)	139 (111-168)

Table E3: Estimated Fish per Mile – Sculpin

			Estimated Fish per Mile, Sculpin				
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	7,691	10,859	3,538	6,160	3,854	6,213	6,386
2008	3,098	3,080	2,587	1,285	510	1,021	1,930
2009	5,808	6,758	4,717	2,411	1,584	1,672	3,825
2010	9,293	5,843	4,206	1,778	1,496	1,637	4,042
2011	5,738	4,030	1,531	2,798	4,558	2,640	3,549
2012	6,547	8,254	5,315	3,766	2,288	2,200	4,729
2013	9,504	3,362	5,403	3,784	3,432	2,675	4,693
2014	6,952	1,074	2,482	1,883	634	1,109	2,355
2015	2,886	176	475	141	123	106	651
2016	4,048	528	458	70	651	18	962
2017	-	-	-	3,027	2,869	-	2,948
2018	15,435	14,062	2,746	3,678	4,594	2,904	7,237
2019	8,008	-	1,197	3,766	1,250	2,534	3,351
2021	4,206	1,672	510	704	1,637	1,619	1,725
2022	5,949	651	722	176	616	581	1,449
2023	-	-	-	422	1,971	2,446	1,613

Table E4: Biomass (pounds) – Sculpin

			Biomass (lbs), Sculpin				
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	7.04	5.40	3.33	2.99	4.04	3.38	26.2
2008	2.80	1.67	3.40	0.98	0.48	0.80	10.1
2009	4.52	2.74	3.61	1.62	1.58	1.62	15.7
2010	8.94	3.42	4.36	1.62	2.11	2.38	22.8
2011	5.36	2.50	2.22	2.76	1.37	2.45	16.7
2012	6.08	4.23	3.51	1.89	1.84	1.99	19.5
2013	8.17	1.63	4.59	1.93	2.16	1.97	20.5
2014	5.85	0.73	1.93	1.19	0.60	1.17	11.5
2015	3.50	0.15	0.50	0.08	0.20	0.18	4.6
2016	4.27	0.33	0.55	0.08	0.77	0.04	6.0
2017	-	-	-	1.30	1.80	-	3.1
2018	9.66	4.78	2.08	2.01	3.76	3.38	25.7
2019	4.19	-	0.94	1.47	0.91	1.81	9.3
2021	2.98	0.86	0.35	0.47	1.45	1.79	7.9
2022	4.37	0.29	0.52	0.12	0.77	0.71	6.8
2023	-	-	-	0.32	1.01	2.50	3.8

APPENDIX F

Cyprinidae – Minnow Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table F1a: Catch-per-unit Effort – California Roach

Catch-per-Unit Effort (CPUE), California Roach							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	0.4	0.3	2.7	3.1	16.2	7.5	**5.2**
2008	0.0	1.0	12.7	2.8	29.5	41.3	**15.5**
2009	0.0	13.7	3.3	1.0	5.8	56.9	**11.9**
2010	0.7	3.0	7.4	1.2	13.1	54.5	**14.3**
2011	0.7	1.5	2.7	5.6	4.0	28.8	**7.5**
2012	0.0	3.2	9.1	4.0	15.2	20.0	**8.2**
2013	0.0	8.2	26.1	38.7	28.5	54.6	**27.0**
2014	2.2	12.8	24.5	11.4	25.0	60.3	**21.1**
2015	3.9	25.2	36.1	38.9	10.5	87.6	**34.1**
2016	1.5	61.6	53.8	32.4	14.3	95.7	**41.8**
2017	-	-	-	12.5	17.8	-	**15.4**
2018	0.0	0.7	6.9	1.6	8.7	37.1	**9.2**
2019	0.0	-	1.8	3.6	1.1	12.4	**3.5**
2021	0.3	4.0	6.6	11.0	10.7	82.7	**20.4**
2022	0.2	13.5	21.7	30.6	4.3	37.3	**17.8**
2023	-	-	-	12.8	1.8	22.0	**12.8**

Table F1b: Catch-per-unit Effort – Hardhead

Catch-per-Unit Effort (CPUE), Hardhead							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2018	0.0	0.0	0.0	0.0	0.1	0.0	**0.0**
2022	0.0	0.0	0.0	0.0	0.2	4.9	**1.1**
2023	-	-	-	0.0	0.2	0.0	**0.1**

Table F1c: Catch-per-unit Effort – Sacramento Pikeminnow

Catch-per-Unit Effort (CPUE), Sacramento Pikeminnow							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	12.2	2.2	10.1	21.8	25.6	53.6	**20.2**
2008	8.2	2.6	21.7	8.3	20.1	14.0	**13.0**
2009	1.8	7.1	6.6	4.9	9.8	24.9	**8.8**
2010	1.3	2.0	4.3	1.7	8.7	11.3	**4.9**
2011	4.0	4.7	1.1	0.4	1.9	1.1	**2.2**
2012	0.1	1.5	5.2	22.6	8.0	17.1	**8.4**
2013	24.4	15.4	48.6	20.3	48.6	93.4	**44.0**
2014	16.2	6.1	34.7	6.5	16.4	37.0	**18.9**
2015	15.0	6.9	24.7	29.1	15.5	19.2	**18.0**
2016	7.1	13.6	26.2	1.9	6.4	7.3	**10.7**
2017	-	-	-	1.8	2.6	-	**2.2**
2018	0.5	1.5	1.9	0.8	19.3	5.4	**4.6**
2019	2.6	-	1.0	0.6	2.8	1.2	**1.7**
2021	29.6	25.8	22.9	14.1	28.9	83.9	**36.5**
2022	13.2	17.7	25.6	16.8	32.1	33.6	**24.0**
2023	-	-	-	7.2	5.1	1.9	**4.5**

Table F2a: Population Estimates – California Roach

Population Estimate (95% CI, Lower CI Adjusted), California Roach						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	3 (3-3)	3 (3-3)	20 (20-21)	82 (22-437)	177 (146-208)	57 (53-64)
2008	0 (0-0)	6 (6-8)	126 (126-126)	46 (16-211)	253 (233-273)	504 (317-691)
2009	0 (0-0)	150 (93-224)	45 (45-45)	6 (6-7)	58 (52-68)	440 (386-494)
2010	6 (6-7)	22 (19-31)	79 (51-127)	5 (5-6)	75 (69-84)	564 (473-655)
2011	18 (6-140)	7 (7-7)	24 (23-28)	39 (25-75)	41 (26-79)	390 (220-560)
2012	0 (0-0)	39 (37-44)	116 (116-116)	45 (45-45)	146 (121-171)	514 (156-1203)
2013	0 (0-0)	54 (52-58)	198 (182-214)	263 (251-275)	297 (240-354)	479 (459-499)
2014	26 (23-34)	152 (152-152)	255 (196-314)	104 (100-110)	240 (189-291)	522 (492-552)
2015	34 (33-38)	189 (183-196)	350 (314-386)	253 (222-284)	113 (73-170)	1060 (914-1,206)
2016	11 (11-12)	376 (347-405)	491 (414-568)	283 (167-399)	114 (89-143)	922 (748-1,096)
2017	-	-	-	118 (99-139)	197 (174-220)	-
2018	0 (0-0)	6 (5-15)	70 (44-120)	11 (10-16)	96 (96-96)	513 (385-641)
2019	0 (0-0)	-	12 (11-18)	105 (25-601)	10 (8-21)	154 (84-261)
2021	3 (3-3)	34 (34-36)	50 (39-70)	58 (57-61)	144 (83-233)	307 (300-314)
2022	2 (2-15)	96 (86-108)	182 (168-196)	342 (238-446)	42 (42-43)	246 (242-251)
2023	-	-	-	117 (110-126)	17 (17-20)	270 (250-290)

Table F2b: Population Estimates – Hardhead

Population Estimate (95% CI, Lower CI Adjusted), Hardhead						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2018	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2022	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-15)	32 (32-33)
2023	-	-	-	0 (0-0)	2 (2-15)	0 (0-0)

Table F2c: Population Estimates – Sacramento Pikeminnow

Population Estimate (95% CI, Lower CI Adjusted), Sacramento Pikeminnow						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	113 (93-136)	27 (20-46)	112 (112-112)	170 (157-183)	381 (248-514)	1,441 (378-2,952)
2008	91 (56-151)	15 (15-17)	389 (143-800)	53 (47-63)	160 (154-167)	141 (141-141)
2009	14 (14-15)	65 (48-93)	154 (60-385)	31 (29-37)	114 (88-145)	181 (155-207)
2010	14 (11-26)	13 (13-15)	40 (30-62)	7 (7-9)	59 (46-81)	108 (83-138)
2011	50 (50-50)	23 (22-27)	10 (9-16)	2 (2-7)	18 (18-18)	8 (8-10)
2012	1 (1-1)	21 (17-33)	46 (44-51)	254 (254-254)	69 (64-77)	531 (133-1,533)
2013	239 (179-299)	164 (98-250)	370 (347-393)	183 (130-236)	1,255 (375-2,630)	908 (851-965)
2014	214 (181-247)	55 (48-67)	324 (282-366)	86 (86-86)	150 (117-183)	329 (300-358)
2015	141 (126-156)	247 (50-1,250)	501 (200-893)	185 (162-208)	175 (108-256)	161 (158-166)
2016	78 (78-78)	78 (72-87)	232 (185-279)	10 (10-11)	56 (40-86)	66 (66-66)
2017	-	-	-	25 (14-69)	29 (25-39)	-
2018	6 (6-8)	14 (11-26)	27 (12-105)	5 (5-8)	156 (142-170)	59 (47-79)
2019	59 (23-205)	-	8 (6-22)	8 (4-50)	22 (21-26)	9 (8-15)
2021	368 (368-368)	464 (221-719)	198 (198-198)	114 (114-114)	334 (262-406)	421 (388-454)
2022	250 (134-391)	120 (112-130)	242 (207-277)	168 (119-219)	334 (320-348)	243 (231-255)
2023	-	-	-	63 (62-66)	54 (47-66)	20 (19-24)

Table F3a: Estimated Fish per Mile – California Roach

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
			Estimated Fish per Mile, California Roach				
2007	53	53	352	1,443	3,115	1,003	**1,003**
2008	0	106	2,218	810	4,453	8,870	**2,743**
2009	0	2,640	792	106	1,021	7,744	**2,050**
2010	106	387	1,390	88	1,320	9,926	**2,203**
2011	317	123	422	686	722	6,864	**1,522**
2012	0	686	2,042	792	2,570	9,046	**2,523**
2013	0	950	3,485	4,629	5,227	8,430	**3,787**
2014	458	2,675	4,488	1,830	4,224	9,187	**3,810**
2015	598	3,326	6,160	4,453	1,989	18,656	**5,864**
2016	194	6,618	8,642	4,981	2,006	16,227	**6,445**
2017	-	-	-	2,077	3,467	-	**2,772**
2018	0	106	1,232	194	1,690	9,029	**2,042**
2019	0	-	211	1,848	176	2,710	**989**
2021	53	598	880	1,021	2,534	5,403	**1,748**
2022	35	1,690	3,203	6,019	739	4,330	**2,669**
2023	-	-	-	2,059	299	4,752	**2,370**

Table F3c: Estimated Fish per Mile – Hardhead

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
			Estimated Fish per Mile, Hardhead				
2018	0	0	0	0	18	0	**3**
2022	0	0	0	0	35	563	**100**
2023	-	-	-	0	35	0	**12**

Table F3c: Estimated Fish per Mile – Sacramento Pikeminnow

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
			Estimated Fish per Mile, Sacramento Pikeminnow				
2007	1,989	475	1,971	2,992	6,706	25,362	**6,582**
2008	1,602	264	6,846	933	2,816	2,482	**2,490**
2009	246	1,144	2,710	546	2,006	3,186	**1,640**
2010	246	229	704	123	1,038	1,901	**707**
2011	880	405	176	35	317	141	**326**
2012	18	370	810	4,470	1,214	9,346	**2,705**
2013	4,206	2,886	6,512	3,221	22,088	15,981	**9,149**
2014	3,766	968	5,702	1,514	2,640	5,790	**3,397**
2015	2,482	4,347	8,818	3,256	3,080	2,834	**4,136**
2016	1,373	1,373	4,083	176	986	1,162	**1,525**
2017	-	-	-	440	510	-	**475**
2018	106	246	475	88	2,746	1,038	**783**
2019	1,038	-	141	141	387	158	**373**
2021	6,477	8,166	3,485	2,006	5,878	7,410	**5,570**
2022	4,400	2,112	4,259	2,957	5,878	4,277	**3,981**
2023	-	-	-	1,109	950	352	**804**

Table F4a: Biomass (pounds) – California Roach

| Year | Biomass (lbs), California Roach | |
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.00	0.00	0.28	0.17	1.67	0.35	2.5
2008	0.00	0.07	1.06	0.14	2.10	1.45	4.8
2009	0.00	1.29	0.42	0.08	0.41	2.51	4.7
2010	0.02	0.59	0.80	0.12	0.55	3.08	5.2
2011	0.06	0.13	0.59	0.53	0.49	2.66	4.5
2012	0.00	0.63	0.97	0.22	0.92	1.06	3.8
2013	0.00	0.20	1.47	1.77	2.01	2.88	8.3
2014	0.04	0.32	2.13	0.48	1.75	3.83	8.5
2015	0.12	0.42	2.93	1.69	0.53	4.41	10.1
2016	0.03	1.08	4.15	1.48	0.60	3.24	10.6
2017	-	-	-	0.92	0.89	-	1.8
2018	0.00	0.06	0.51	0.15	0.32	3.20	4.2
2019	0.00	-	0.17	0.24	0.08	0.85	1.3
2021	0.01	0.21	0.34	0.35	0.66	2.40	4.0
2022	0.00	0.31	1.76	2.24	0.37	1.94	6.6
2023	-	-	-	0.79	0.18	2.88	3.9

Table F4b: Biomass (pounds) – Hardhead

| Year | Biomass (lbs), Hardhead | |
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2018	0.00	0.00	0.00	0.00	0.03	0.00	0.03
2022	0.00	0.00	0.00	0.00	0.01	0.12	0.13
2023	-	-	-	0.00	No Data	0.00	No Data

Table F4c: Biomass (pounds) – Sacramento Pikeminnow

| Year | Biomass (lbs), Sacramento Pikeminnow | |
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.25	0.05	1.62	0.27	0.94	1.16	4.3
2008	0.31	0.21	9.99	0.33	2.37	0.83	14.0
2009	0.32	1.56	4.80	0.64	1.17	2.56	11.0
2010	0.23	0.59	3.26	0.10	0.77	0.94	5.9
2011	0.19	0.08	0.38	0.14	0.23	0.19	1.2
2012	0.00	0.37	1.21	0.18	0.30	0.62	2.7
2013	0.55	0.83	7.84	0.96	1.98	5.57	17.7
2014	1.20	1.32	9.42	0.75	1.29	4.21	18.2
2015	0.55	0.39	3.24	1.37	1.06	1.79	8.4
2016	0.33	0.72	6.04	0.25	0.41	0.49	8.2
2017	-	-	-	0.06	0.31	-	0.4
2018	0.03	0.31	0.86	0.03	0.38	0.55	2.2
2019	0.11	-	1.14	0.02	0.26	0.11	1.6
2021	0.67	0.60	2.81	0.92	1.67	3.91	10.6
2022	0.77	0.65	4.61	1.87	2.48	3.52	13.9
2023	-	-	-	0.2	0.2	0.1	0.6

APPENDIX G

Gasterosteidae – Stickleback Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table G1: Catch-per-unit Effort – Three-spine Stickleback

Catch-per-Unit Effort (CPUE), Three-spine Stickleback							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	1.0	3.5	0.9	2.2	0.0	1.8	**1.6**
2008	0.0	6.1	3.0	3.3	0.0	1.9	**2.2**
2009	0.1	5.7	2.3	2.9	0.6	3.8	**2.4**
2010	2.0	9.3	0.6	0.0	0.0	6.2	**3.3**
2011	1.1	8.1	1.1	0.9	0.2	0.4	**1.6**
2012	0.0	3.1	0.7	3.2	0.5	2.6	**1.8**
2013	2.2	10.1	0.9	1.6	1.9	12.4	**5.0**
2014	2.9	27.7	4.1	6.6	0.6	8.2	**8.2**
2015	5.7	4.3	1.7	3.7	0.0	1.1	**2.8**
2016	12.6	14.7	14.2	25.0	1.0	19.5	**14.1**
2017	-	-	-	3.7	8.6	-	**6.4**
2018	1.1	1.3	2.5	5.0	2.0	1.1	**2.0**
2019	0.9	-	2.1	1.3	0.7	0.7	**1.1**
2021	0.9	8.2	1.5	0.9	4.7	23.8	**7.3**
2022	15.3	10.9	4.4	9.4	5.9	7.8	**9.0**
2023	-	-	-	3.2	5.5	5.8	**4.9**

Table G2: Population Estimates – Three-spine Stickleback

Population Estimate (95% CI, Lower CI Adjusted), Three-spine Stickleback						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	12 (12-12)	46 (46-46)	7 (7-10	21 (16-37)	0 (0-0)	22 (13-58)
2008	0 (0-0)	36 (36-37)	27 (20-46)	25 (19-42)	0 (0-0)	101 (31-405)
2009	1 (1-1)	58 (58-58)	33 (21-67)	21 (17-33)	5 (5-7)	25 (23-31)
2010	20 (17-29)	122 (59-250)	4 (4-9)	`	0 (0-0)	69 (69-69)
2011	40 (9-360)	50 (38-72)	9 (9-11)	4 (4-7)	1 (1-1)	3 (3-8)
2012	0 (0-0)	54 (54-54)	6 (6-10)	36 (36-36)	4 (4-4)	30 (30-30)
2013	15 (15-17)	64 (64-64)	6 (6-6)	10 (10-11)	28 (15-79)	150 (101-208)
2014	46 (46-46)	258 (230-286)	55 (31-115)	60 (58-64)	6 (6-6)	151 (63-349)
2015	75 (48-124)	31 (31-32)	21 (21-21)	20 (20-21)	0 (0-0)	40 (9-390)
2016	158 (92-249)	117 (78-170)	142 (142-142)	559 (129-1,750)	6 (6-10)	175 (118-237)
2017	-	-	-	57 (152-192)	116 (82-159)	-
2018	20 (20-20)	10 (10-12)	24 (24-24)	107 (32-436)	28 (15-79)	12 (10-21)
2019	9 (8-15)	-	13 (13-15)	14 (14-14)	5 (5-5)	6 (5-15)
2021	6 (6-7)	102 (70-147)	12 (9-26)	5 (5-7)	87 (37-233)	221 (171-271)
2022	551 (156-1,364)	85 (70-105)	52 (52-52)	168 (67-398)	66 (59-77)	45 (45-47)
2023	-	-	-	30 (28-35)	89 (51-161)	183 (66-478)

Table G3: Estimated Fish per Mile – Three-spine Stickleback

			Estimated Fish per Mile, Three-spine Stickleback				
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	211	810	123	370	0	387	317
2008	0	634	475	440	0	1,778	554
2009	18	1,021	581	370	88	440	419
2010	352	2,147	70	0	0	1,214	631
2011	704	880	158	70	18	53	314
2012	0	950	106	634	70	528	381
2013	264	1,126	106	176	493	2,640	801
2014	810	4,541	968	1,056	106	2,658	1,690
2015	1,320	546	370	352	0	704	549
2016	2,781	2,059	2,499	9,838	106	3,080	3,394
2017	-	-	-	1,003	2,042	-	1,522
2018	352	176	422	1,883	493	211	590
2019	158	-	229	246	88	106	165
2021	106	1,795	211	88	1,531	3,890	1,270
2022	9,698	1,496	915	2,957	1,162	792	2,837
2023	-	-	-	528	1,566	3,221	1,772

Table G4: Biomass (pounds) – Three-spine Stickleback

			Biomass (lbs), Three-spine Stickleback				
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.015	0.045	0.008	0.018	0.000	0.022	0.1
2008	0.000	0.091	0.043	0.017	0.000	0.061	0.2
2009	0.000	0.064	0.058	0.022	0.003	0.037	0.2
2010	0.025	0.101	0.006	0.000	0.000	0.087	0.2
2011	0.021	0.071	0.033	0.006	0.002	0.008	0.1
2012	0.000	0.042	0.011	0.023	0.004	0.023	0.1
2013	0.021	0.080	0.008	0.010	0.022	0.159	0.3
2014	0.043	0.317	0.050	0.059	0.009	0.085	0.6
2015	0.096	0.038	0.022	0.027	0.000	0.018	0.2
2016	0.189	0.059	0.175	0.365	0.007	0.242	1.0
2017	-	-	-	0.065	0.136	-	0.2
2018	0.015	0.014	0.028	0.048	0.024	0.016	0.1
2019	0.013	-	0.024	0.018	0.009	0.006	0.1
2021	0.008	0.097	0.015	0.005	0.065	0.268	0.5
2022	0.233	0.115	0.065	0.114	0.111	0.077	0.7
2023	-	-	-	0.054	0.090	0.127	0.3

APPENDIX H

Ictaluridae – Catfish Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table H1: Catch-per-unit Effort – Catfish

Catch-per-Unit Effort (CPUE), Catfish							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2008	0.00	0.00	0.15	0.00	0.13	0.00	**0.05**
2009	0.00	0.00	0.00	0.00	0.22	0.00	**0.04**
2012	0.00	0.00	0.00	0.00	0.13	0.13	**0.04**
2013	0.00	0.00	0.00	0.00	0.39	0.00	**0.07**
2014	0.19	0.00	0.27	0.23	2.10	0.00	**0.42**
2015	0.00	0.00	0.00	0.00	0.29	0.00	**0.05**
2018	0.00	0.00	0.00	0.00	0.14	0.00	**0.02**
2019	0.34	–	0.00	0.29	0.13	0.00	**0.17**
2021	0.00	0.00	0.00	0.00	0.24	0.00	**0.04**
2022	0.00	0.00	0.00	0.00	0.10	0.00	**0.02**
2023	–	–	–	0.11	0.00	0.00	**0.03**

Table H2: Population Estimates – Catfish

Population Estimate (95% CI, Lower CI Adjusted), Catfish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2008	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)	1 (1-1)	0 (0-0)
2009	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-15)	0 (0-0)
2012	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	1 (1-1)
2013	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	3 (3-8)	0 (0-0)
2014	2 (2-26)	0 (0-0)	2 (2-15)	2 (2-15)	15 (15-17)	0 (0-0)
2015	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-7)	0 (0-0)
2018	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2019	3 (3-4)	–	0 (0-0)	2 (2-2)	1 (1-1)	0 (0-0)
2021	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-15)	0 (0-0)
2022	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)
2023	–	–	–	1 (1-1)	0 (0-0)	0 (0-0)

Table H3: Estimated Fish per Mile – Catfish

Estimated Fish per Mile, Catfish							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2008	0	0	18	0	18	0	**6**
2009	0	0	0	0	35	0	**6**
2012	0	0	0	0	18	18	**6**
2013	0	0	0	0	53	0	**9**
2014	35	0	35	35	264	0	**62**
2015	0	0	0	0	35	0	**6**
2018	0	0	0	0	18	0	**3**
2019	53	–	0	35	18	0	**21**
2021	0	0	0	0	35	0	**6**
2022	0	0	0	0	18	0	**3**
2023	–	–	–	18	0	0	**6**

Table H4: Biomass (pounds) – Catfish

Year	Biomass (lbs), Catfish							Total
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood		
2008	0.000	0.000	0.005	0.000	0.004	0.000		**0.009**
2009	0.000	0.000	0.000	0.000	0.777	0.000		**0.777**
2012	0.000	0.000	0.000	0.000	0.002	0.032		**0.034**
2013	0.000	0.000	0.000	0.000	0.012	0.000		**0.012**
2014	0.007	0.000	0.004	0.004	0.120	0.000		**0.136**
2015	0.000	0.000	0.000	0.000	0.017	0.000		**0.017**
2018	0.000	0.000	0.000	0.000	0.871	0.000		**0.871**
2019	0.039	–	0.000	0.023	0.011	0.000		**0.073**
2021	0.000	0.000	0.000	0.000	0.392	0.000		**0.392**
2022	0.000	0.000	0.000	0.000	0.793	0.000		**0.793**
2023	–	–	–	0.014	0.000	0.000		**0.014**

APPENDIX I

Petromyzontidae – Lamprey Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table I1: Catch-per-unit Effort – Lamprey

Catch-per-Unit Effort (CPUE), Lamprey							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	0.1	22.5	0.7	19.0	0.3	0.6	**7.5**
2008	0.3	8.0	0.8	13.2	0.3	0.0	**3.3**
2009	0.5	8.4	0.6	13.4	0.1	0.2	**3.3**
2010	0.0	9.0	1.0	6.7	0.2	0.7	**2.5**
2011	0.0	10.2	2.0	20.1	0.0	0.0	**3.9**
2012	0.0	8.9	2.7	10.2	0.5	0.0	**4.0**
2013	0.4	5.5	1.0	15.9	0.4	0.0	**3.5**
2014	0.2	13.8	5.3	23.6	0.4	0.1	**7.3**
2015	0.2	14.7	3.1	9.9	0.0	0.1	**4.3**
2016	0.4	24.5	3.9	26.8	0.3	0.0	**8.1**
2017	-	-	-	15.0	0.8	-	**7.3**
2018	0.2	9.5	1.6	24.0	0.8	0.7	**5.1**
2019	0.5	-	0.8	23.8	0.3	1.2	**5.1**
2021	0.4	19.5	5.3	23.0	0.9	1.2	**7.3**
2022	0.4	18.9	4.9	13.3	1.3	0.2	**5.2**
2023	-	-	-	21.5	1.3	2.8	**7.8**

Table I2: Population Estimates – Lamprey

Population Estimate (95% CI, Lower CI Adjusted), Lamprey						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	1 (1-1)	407 (202-624)	5 (5-6)	204 (204-204)	3 (3-6)	8 (4-50)
2008	2 (2-2)	70 (70-70)	6 (5-15)	112 (112-112)	2 (2-7)	0 (0-0)
2009	4 (4-5)	86 (86-86)	5 (5-8)	118 (118-118)	1 (1-1)	1 (1-1)
2010	0 (0-0)	141 (57-346)	7 (7-10)	42 (42-42)	1 (1-1)	13 (5-95)
2011	0 (0-0)	49 (48-52)	27 (17-60)	135 (135-135)	0 (0-0)	0 (0-0)
2012	0 (0-0)	154 (154-154)	24 (23-28)	114 (114-114)	4 (4-4)	0 (0-0)
2013	3 (3-4)	35 (35-35)	7 (7-8)	104 (102-108)	5 (3-32)	0 (0-0)
2014	3 (3-3)	164 (164-164)	43 (40-50)	210 (207-215)	5 (3-32)	1 (1-1)
2015	2 (2-15)	160 (160-160)	38 (38-38)	54 (54-54)	0 (0-0)	1 (1-1)
2016	3 (3-6)	165 (132-198)	35 (26-56)	386 (138-819)	2 (2-7)	0 (0-0)
2017	-	-	-	362 (119-858)	10 (8-21)	-
2018	2 (2-2)	81 (71-94)	10 (10-11)	181 (157-205)	6 (6-10)	9 (9-9)
2019	6 (6-6)	-	8 (8-8)	228 (174-282)	2 (2-15)	12 (12-12)
2021	4 (4-7)	249 (249-249)	48 (48-48)	164 (122-206)	11 (7-35)	4 (4-9)
2022	4 (4-9)	262 (121-469)	58 (58-58)	136 (136-136)	31 (13-125)	2 (2-7)
2023	-	-	-	452 (185-805)	14 (12-22)	101 (31-405)

Table I3: Estimated Fish per Mile – Lamprey

				Estimated Fish per Mile, Lamprey			
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	18	7,163	88	3,590	53	141	1,842
2008	35	1,232	106	1,971	35	0	563
2009	70	1,514	88	2,077	18	18	631
2010	0	2,482	123	739	18	229	598
2011	0	862	475	2,376	0	0	619
2012	0	2,710	422	2,006	70	0	868
2013	53	616	123	1,830	88	0	452
2014	53	2,886	757	3,696	88	18	1,250
2015	35	2,816	669	950	0	18	748
2016	53	2,904	616	6,794	35	0	1,734
2017	-	-	-	6,371	176	-	3,274
2018	35	1,426	176	3,186	106	158	848
2019	106	-	141	4,013	35	211	901
2021	70	4,382	845	2,886	194	70	1,408
2022	70	4,611	1,021	2,394	546	35	1,446
2023	-	-	-	7,955	246	1,778	3,326

Table I4: Biomass (pounds) – Lamprey

				Biomass (lbs), Lamprey			
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.009	1.761	0.051	0.880	0.030	0.040	2.8
2008	0.019	0.676	0.173	0.558	0.036	0.000	1.5
2009	0.038	0.501	0.035	0.681	0.007	0.006	1.3
2010	0.000	0.608	0.062	0.291	0.003	0.044	1.0
2011	0.000	0.437	0.218	1.068	0.000	0.000	1.7
2012	0.000	0.746	0.276	0.524	0.035	0.000	1.6
2013	0.030	0.262	0.063	0.904	0.023	0.000	1.3
2014	0.016	0.785	0.348	1.713	0.028	0.028	2.9
2015	0.022	0.647	0.295	0.434	0.000	0.008	1.4
2016	0.028	0.679	0.260	1.437	0.015	0.000	2.4
2017	-	-	-	0.997	0.039	-	1.0
2018	0.004	0.634	0.128	1.132	0.047	0.038	2.0
2019	0.025	-	0.065	1.326	0.006	0.039	1.5
2021	0.012	0.685	0.316	0.733	0.049	0.018	1.8
2022	0.022	0.544	0.325	0.570	0.099	0.020	1.6
2023	-	-	-	1.948	0.147	0.263	2.4

APPENDIX J

Poecillidae – Livebearer Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table J1: Catch-per-unit Effort – Western Mosquitofish

	Catch-per-Unit Effort (CPUE), Western Mosquitofish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2008	0.0	0.3	0.0	0.0	0.0	0.0	**0.1**
2012	0.0	0.0	0.0	1.2	0.0	0.0	**0.2**
2013	0.0	0.2	0.0	0.0	0.0	0.0	**0.0**
2014	0.0	0.1	0.0	0.2	0.4	1.8	**0.4**
2015	0.2	3.2	0.0	0.0	1.9	2.3	**1.3**
2016	0.0	2.8	0.0	0.0	0.2	2.6	**0.9**
2021	0.0	0.0	0.0	0.0	0.0	0.4	**0.1**
2022	0.1	0.5	0.0	0.0	0.7	1.0	**0.4**

Table J2: Population Estimates – Western Mosquitofish

	Population Estimate (95% CI, Lower CI Adjusted), Western Mosquitofish					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2008	0 (0-0)	2 (2-2)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
2012	0 (0-0)	0 (0-0)	0 (0-0)	9 (9-11)	0 (0-0)	0 (0-0)
2013	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
2014	0 (0-0)	1 (1-1)	0 (0-0)	2 (2-7)	3 (3-8)	14 (14-14)
2015	2 (2-2)	23 (23-24)	0 (0-0)	0 (0-0)	20 (20-20)	19 (19-20)
2016	0 (0-0)	17 (15-24)	0 (0-0)	0 (0-0)	1 (1-1)	21 (16-37)
2021	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-7)
2022	1 (1-1)	3 (3-6)	0 (0-0)	0 (0-0)	11 (7-35)	11 (11-13)

Table J3: Estimated Fish per Mile – Western Mosquitofish

	Estimated Fish per Mile, Western Mosquitofish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2008	0	35	0	0	0	0	**6**
2012	0	0	0	158	0	0	**26**
2013	0	18	0	0	0	0	**3**
2014	0	18	0	35	53	246	**59**
2015	35	405	0	0	352	334	**188**
2016	0	299	0	0	18	370	**114**
2021	0	0	0	0	0	35	**6**
2022	18	53	0	0	194	194	**76**

Table J4: Biomass (pounds) – Western Mosquitofish

	Biomass (lbs), Western Mosquitofish						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2008	0.0000	0.0007	0.0000	0.0000	0.0000	0.0000	**0.0007**
2012	0.0000	0.0000	0.0000	0.0053	0.0000	0.0000	**0.0053**
2013	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	**0.0002**
2014	0.0000	0.0004	0.0000	0.0013	0.0049	0.0117	**0.0183**
2015	0.0004	0.0137	0.0000	0.0000	0.0119	0.0163	**0.0423**
2016	0.0000	0.0082	0.0000	0.0000	0.0002	0.0060	**0.0143**
2021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	**0.0020**
2022	0.0004	0.0040	0.0000	0.0000	0.0037	0.0172	**0.0254**

APPENDIX K

Salmonidae – Trout & Salmon Family

Multi-pass Depletion Summary Data: Fall, 2007-2023

For the following tables, a dashed line indicates the site was not sampled.

Table K1a: Catch-per-unit Effort – Brook Trout

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
Catch-per-Unit Effort (CPUE), Brook Trout
2010	0.1	1.1	0.0	0.2	0.0	0.0	**0.2**
2021	0.3	0.0	0.0	0.0	0.0	0.0	**0.1**

Table K1b: Catch-per-unit Effort – Brown Trout

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2022	0.2	0.0	0.5	0.1	0.0	0.0	**0.13**
2023	–	–	–	0.1	0.0	0.0	**0.03**

Catch-per-Unit Effort (CPUE), Brown Trout

Table K1c: Catch-per-unit Effort – Hatchery Rainbow Trout

Catch-per-Unit Effort (CPUE), Rainbow Trout - Hatchery

Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	1.2	3.6	0.3	0.7	0.0	0.0	**1.0**
2008	0.0	0.0	0.2	0.0	0.0	0.0	**0.0**
2009	0.4	0.1	0.0	0.0	0.0	0.0	**0.1**
2010	0.1	0.2	0.3	0.0	0.0	0.0	**0.1**
2011	0.0	0.0	0.7	0.7	0.0	0.0	**0.2**
2012	0.1	0.0	0.4	0.0	0.0	0.0	**0.1**
2013	0.3	0.2	0.1	0.2	0.0	0.0	**0.1**
2014	0.0	0.0	0.1	0.0	0.0	0.0	**0.0**
2015	0.0	0.0	0.1	0.0	0.0	0.0	**0.0**
2016	0.3	0.0	1.0	0.4	0.0	0.0	**0.3**
2017	–	–	–	0.5	0.1	–	**0.3**
2018	0.3	0.5	0.6	0.5	0.0	0.0	**0.3**
2019	0.0	–	4.3	1.1	0.0	0.0	**0.9**
2021	0.2	1.2	2.0	4.8	0.5	0.1	**1.2**
2022	0.0	0.0	0.5	1.0	0.0	0.0	**0.2**
2023	–	–	–	2.9	0.0	0.0	**0.5**

Table K1d: Catch-per-unit Effort – "Wild" Rainbow Trout

Catch-per-Unit Effort (CPUE), Rainbow Trout - "Wild"							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	0.9	0.4	1.1	0.0	0.3	0.0	**0.5**
2008	1.0	0.7	1.1	1.4	0.1	0.0	**0.7**
2009	0.7	0.1	1.2	0.3	0.0	0.0	**0.4**
2010	0.9	0.0	0.0	0.7	0.0	0.0	**0.3**
2011	0.0	0.6	0.6	0.4	0.0	0.0	**0.3**
2012	0.8	0.3	1.4	0.8	0.1	0.0	**0.6**
2013	0.4	0.0	0.6	0.6	0.0	0.0	**0.3**
2015	0.1	0.0	0.1	0.0	0.0	0.0	**0.1**
2016	0.0	0.0	0.3	0.8	0.0	0.2	**0.2**
2017	-	-	-	0.4	0.0	-	**0.2**
2018	0.1	0.3	1.1	1.3	0.0	0.0	**0.4**
2019	0.1	-	0.5	1.4	0.0	0.0	**0.4**
2021	0.3	0.1	1.3	0.2	0.0	0.0	**0.3**
2022	0.1	0.0	0.0	0.1	0.0	0.0	**0.0**
2023	-	-	-	0.8	0.4	0.4	**0.5**

Table K2a: Population Estimates – Brook Trout

Population Estimate (95% CI, Lower CI Adjusted), Brook Trout						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2010	1 (1-1)	7 (7-7)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)
2021	3 (3-4)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

Table K2b: Population Estimates – Brown Trout

Population Estimate (95% CI, Lower CI Adjusted), Brown Trout						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2022	2 (2-7)	0 (0-0)	8 (4-50)	1 (1-1)	0 (0-0)	0 (0-0)
2023	-	-	-	1 (1-1)	0 (0-0)	0 (0-0)

Table K2c: Population Estimates – Hatchery Rainbow Trout

	Population Estimate (95% CI, Lower CI Adjusted), Hatchery Rainbow Trout					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	9 (9-10)	40 (32-56)	2 (2-15)	8 (8-8)	0 (0-0)	0 (0-0)
2008	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)
2009	3 (3-3)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
2010	1 (1-1)	1 (1-1)	2 (2-2)	0 (0-0)	0 (0-0)	0 (0-0)
2011	0 (0-0)	0 (0-0)	6 (6-7)	3 (3-6)	0 (0-0)	0 (0-0)
2012	1 (1-1)	0 (0-0)	3 (3-4)	0 (0-0)	0 (0-0)	0 (0-0)
2013	2 (2-7)	1 (1-1)	1 (1-1)	1 (1-1)	0 (0-0)	0 (0-0)
2014	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)
2015	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)
2016	2 (2-2)	0 (0-0)	7 (7-8)	2 (2-2)	0 (0-0)	0 (0-0)
2017	-	-	-	4 (4-6)	1 (1-1)	-
2018	4 (4-4)	4 (4-4)	4 (4-6)	3 (3-4)	0 (0-0)	0 (0-0)
2019	0 (0-0)	-	41 (26-79)	13 (8-40)	0 (0-0)	0 (0-0)
2021	2 (2-26)	10 (10-12)	11 (11-14)	27 (25-33)	4 (4-9)	1 (1-1)
2022	0 (0-0)	0 (0-0)	4 (4-4)	7 (7-8)	0 (0-0)	0 (0-0)
2023	-	-	-	22 (22-23)	0 (0-0)	0 (0-0)

Table K2d: Population Estimates – "Wild" Rainbow Trout

	Population Estimate (95% CI, Lower CI Adjusted), "Wild" Rainbow Trout					
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
2007	24 (7-200)	4 (4-5)	8 (8-10)	0 (0-0)	3 (3-8)	0 (0-0)
2008	7 (7-10)	4 (4-7)	7 (7-9)	8 (8-10)	1 (1-1)	0 (0-0)
2009	5 (5-6)	1 (1-1)	11 (11-13)	2 (2-26)	0 (0-0)	0 (0-0)
2010	8 (8-10)	0 (0-0)	0 (0-0)	3 (3-8)	0 (0-0)	0 (0-0)
2011	0 (0-0)	3 (3-8)	5 (5-8)	2 (2-7)	0 (0-0)	0 (0-0)
2012	18 (6-140)	3 (3-8)	12 (12-14)	9 (9-9)	1 (1-1)	0 (0-0)
2013	3 (3-8)	0 (0-0)	4 (4-6)	4 (4-6)	0 (0-0)	0 (0-0)
2015	1 (1-1)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)	0 (0-0)
2016	0 (0-0)	0 (0-0)	2 (2-2)	4 (4-6)	0 (0-0)	1 (1-1)
2017	-	-	-	3 (3-8)	0 (0-0)	-
2018	1 (1-1)	2 (2-2)	7 (7-10)	8 (8-9)	0 (0-0)	0 (0-0)
2019	1 (1-1)	-	3 (3-8)	10 (10-11)	0 (0-0)	0 (0-0)
2021	3 (3-6)	1 (1-1)	8 (8-10)	1 (1-1)	0 (0-0)	0 (0-0)
2022	1 (1-1)	0 (0-0)	0 (0-0)	1 (1-1)	0 (0-0)	0 (0-0)
2023	-	-	-	6 (6-9)	4 (4-6)	5 (5-5)

Table K3a: Estimated Fish per Mile – Brook Trout

	Estimated Fish per Mile, Brook Trout						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2010	18	123	0	18	0	0	26
2021	53	0	0	0	0	0	9

Table K3b: Estimated Fish per Mile – Brown Trout

	Estimated Fish per Mile, Brown Trout						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2022	35	0	141	18	0	0	32
2023	-	-	-	18	0	0	6

Table K3c: Estimated Fish per Mile – Hatchery Rainbow Trout

	Estimated Fish per Mile, Rainbow Trout - Hatchery						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	158	704	35	141	0	0	173
2008	0	0	18	0	0	0	3
2009	53	18	0	0	0	0	12
2010	18	18	35	0	0	0	12
2011	0	0	106	53	0	0	26
2012	18	0	53	0	0	0	12
2013	35	18	18	18	0	0	15
2014	0	0	18	0	0	0	3
2015	0	0	18	0	0	0	3
2016	35	0	123	35	0	0	32
2017	-	-	-	70	18	-	44
2018	70	70	70	53	0	0	44
2019	0	-	722	229	0	0	190
2021	35	176	194	475	70	18	161
2022	0	0	70	123	0	0	32
2023	-	-	-	387	0	0	129

Table K3d: Estimated Fish per Mile – "Wild" Rainbow Trout

	Estimated Fish per Mile, Rainbow Trout - "Wild"						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Overall
2007	422	70	141	0	53	0	114
2008	123	70	123	141	18	0	79
2009	88	18	194	35	0	0	56
2010	141	0	0	53	0	0	32
2011	0	53	88	35	0	0	29
2012	317	53	211	158	18	0	126
2013	53	0	70	70	0	0	32
2015	18	0	18	0	0	0	6
2016	0	0	35	70	0	18	21
2017	-	-	-	53	0	-	26
2018	18	35	123	141	0	0	53
2019	18	-	53	176	0	0	49
2021	53	18	141	18	0	0	38
2022	18	0	0	18	0	0	6
2023	-	-	-	106	70	88	88

Table K4a: Biomass (pounds) – Brook Trout

	Biomass (lbs), Brook Trout						
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2010	2.0	16.4	0.0	1.3	0.0	0.0	19.7
2021	2.2	0.0	0.0	0.0	0.0	0.0	2.2

Table K4b: Biomass (pounds) – Brown Trout

Biomass (lbs), Brown Trout							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2022	0.12	0.00	0.26	0.04	0.00	0.00	**0.4**
2023	-	-	-	0.41	0.00	0.00	**0.4**

Table K4c: Biomass (pounds) – Hatchery Rainbow Trout

Biomass (lbs), Rainbow Trout - Hatchery							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.56	2.35	0.16	0.44	0.00	0.00	**3.5**
2008	0.00	0.00	0.87	0.00	0.00	0.00	**0.9**
2009	1.54	0.48	0.00	0.00	0.00	0.00	**2.0**
2010	0.53	0.60	1.63	0.00	0.00	0.00	**2.8**
2011	0.00	0.00	7.39	2.47	0.00	0.00	**9.9**
2012	0.58	0.00	0.93	0.00	0.00	0.00	**1.5**
2013	0.85	0.64	0.14	0.15	0.00	0.00	**1.8**
2014	0.00	0.00	0.19	0.00	0.00	0.00	**0.2**
2015	0.00	0.00	1.18	0.00	0.00	0.00	**1.2**
2016	1.59	0.00	5.67	0.95	0.00	0.00	**8.2**
2017	-	-	-	3.37	1.58	-	**4.9**
2018	2.66	1.32	4.61	0.84	0.00	0.00	**9.4**
2019	0.00	-	9.03	2.47	0.00	0.00	**11.5**
2021	0.12	2.53	6.77	1.49	0.37	0.05	**11.3**
2022	0.00	0.00	2.37	4.49	0.00	0.00	**6.9**
2023	-	-	-	10.56	0.00	0.00	**10.6**

Table K4d: Biomass (pounds) – "Wild" Rainbow Trout

Biomass (lbs), Rainbow Trout - "Wild"							
Year	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total
2007	0.53	0.21	5.33	0.00	0.14	0.00	**6.2**
2008	0.72	0.20	0.72	0.80	0.06	0.00	**2.5**
2009	1.01	0.11	2.84	0.51	0.00	0.00	**4.5**
2010	0.89	0.00	0.00	0.73	0.00	0.00	**1.6**
2011	0.00	0.38	5.79	0.51	0.00	0.00	**6.7**
2012	0.54	0.18	1.36	1.15	1.65	0.00	**4.9**
2013	0.42	0.00	0.53	0.45	0.00	0.00	**1.4**
2015	0.59	0.00	0.06	0.00	0.00	0.00	**0.7**
2016	0.00	0.00	0.74	0.62	0.00	0.66	**2.0**
2017	-	-	-	0.99	0.00	-	**1.0**
2018	0.07	0.18	1.28	0.88	0.00	0.00	**2.4**
2019	0.10	-	4.46	2.11	0.00	0.00	**6.7**
2021	0.17	0.05	0.45	0.06	0.00	0.00	**0.7**
2022	0.05	0.00	0.00	0.16	0.00	0.00	**0.2**
2023	-	-	-	1.54	2.08	2.82	**6.4**

APPENDIX L

Trout Stocking Information: 2007-2023

Table L1. *Number of trout stocked by CDFW in the Kings River below Pine Flat Dam, per year and size class, since 2007. Rainbow trout are most commonly stocked, but brook trout, brown trout and golden trout may also be stocked.*

Year	Fingerling	Sub-Catchable	Catchable	Super-Catchable	Trophy	Total Fish
2007	0	25,000	31,264	1,891	1,127	59,282
2008	14,592	2,410	25,328	2,610	1,980	46,920
2009	0	34,579	30,680	2,658	1,492	69,409
2010	10	26,720	34,666	3,775	210	65,381
2011	2,774	27,848	31,088	3,863	0	65,573
2012	22,654	0	33,615	3,655	439	60,363
2013	0	50,219	23,706	3,959	930	78,814
2014	0	30,960	24,967	5,124	0	61,051
2015	0	27,092	11,080	2,509	0	40,681
2016	60	0	36,396	5,822	0	42,278
2017	8,736	0	8,310	5,127	543	22,716
2018	0	0	27,647	833	1,029	29,509
2019	0	43,485	52,303	2,373	0	98,161
2020	0	34,031	53,635	695	0	88,361
2021	0	24,990	23,080	1,625	789	50,484
2022	80,031	0	26,310	2,962	0	109,303
2023	0	25,000	19,970	373	248	45,591

Table L2. *Number of supplemental trout stocked in the Kings River below Pine Flat Dam, per year and size class, since 2018.*

Year	Catchable	Super-	Total Fish
2018-2019	49,800	0	49,800
2019-2020	49,870	0	49,870
2020-2021	40,304	5,192	45,496
2021-2022	34,675	0	34,675
2022-2023	40,554	0	40,554

Table L3. *Stocking information for the Trout Incubator Program since 2006. Shows number of eggs incubated by year and estimated number of fry released. A question mark indicates no information is available. From 2007 through 2012 rainbow trout eggs were hatched in streamside incubators. Since 2012 they have been hatched in the incubator building.*

Fiscal Year	Eggs Incubated (#)	Fry Released (Est #)
2006-2007	166,000	87,500
2007-2008	150,000	?
2008-2009	300,000	?
2009-2010	300,000	?
2010-2011	150,000	?
2011-2012	150,000	?
2012-2013	482,000	?
2013-2014	300,000	?
2014-2015	300,000	?
2015-2016	304,000	90,000[a]
2016-2017	324,000	210,000
2017-2018	370,000	214,000
2018-2019	232,000	149,000
2019-2020	331,000	202,000
2020-2021	205,000	123,000
2021-2022	220,000	167,000
2022-2023	242,000	147,000

[a] - actual release higher, estimate provided is from only one of three incubation runs in the fiscal year

APPENDIX M

Water Year Information: 2007-2023

Table M1: *Annual Runoff in the Kings River watershed and percentage of average per water year. Water year runs from October 1 through September 30.*

Water Year	Annual Runoff (Acre Feet)	Water Year (%)
2007	679,000	40
2008	1,216,000	72
2009	1,348,000	80
2010	2,062,000	122
2011	3,318,000	196
2012	826,000	49
2013	691,000	41
2014	537,000	32
2015	361,000	21
2016	1,253,000	74
2017	4,096,000	242
2018	1,275,000	75
2019	2,177,000	171
2020	913,000	54
2021	396,000	23
2022	786,000	47
2023	4,510,000	265

APPENDIX N

Special Studies: 2023

Thorburn Channel

The Thorburn Channel is an anthropogenic, 2,200-foot-long channel located on private property which KRCD has been granted a 50-year easement to. Fishing within the channel is closed year-round, as well as the 200' radius of the confluence with the Kings River. Construction was completed in 2000 to provide spawning and rearing habitat for fish in the Kings River. A headgate structure was installed to control instream flows entering from the Kings River, spawning gravel and large woody debris features were placed, and a k-rail was installed to facilitate a rearing pool before the channel empties back into the Kings River. Since 2000, there have been several large flood releases, which have resulted in heavy sediment deposition within the channel.

The survey occurred in a portion of the Thorburn Channel which has been proposed for habitat enhancement. Data provided will serve as part of pre-activity monitoring for the proposed project, which seeks to improve stream flow through improved functionality by removal of the current headgate structure, removal of accumulated sediment deposits, and through additional modifications to the present channel configuration which may prevent or limit sediment deposition in the future. The survey reach was 300 feet long, and instream flows, as measured immediately upstream of the surveyed reach were 0.04 cfs as measured by KRWA at the time of the survey on November 28, 2023. The reach was characterized by shallow water, ranging from 1 to 8 inches deep, with flowing water in the channel ranging from approximately 1 to 6 feet wide, emergent vegetation and large woody debris and some boulders were present throughout the reach. Soft, and occasionally deep fine sediment was the most dominant substrate, although some small gravel was observed in a few locations in the thalweg, and some large cobble was present.

A total of 112 fish, representing four species, were collected during the survey with data entered into MicroFish 3.0 for further analysis. Results are found below in Tables N1 and N2. Native fish dominated the survey in both abundance (99.1%) and biomass (99.6%). The

species assemblage was dominated by native three-spine stickleback (58.0%) and Sacramento sucker (37.5%) (Table N1).

Table N1: *Species collected, species composition, and catch-per-unit effort, Thorburn Channel.*

Thorburn Channel: November 28, 2023			
Species Collected	Captured (#)	Species Composition (%)	Catch-per-unit Effort (per hour)
Three-spine Stickleback	65	58.0	55.0
Sacramento Sucker	42	37.5	35.5
Sacramento Pikeminnow	4	3.6	3.4
Western Mosquitofish	1	0.9	0.8

Table N2: *Population Estimate, Fish per Mile, Biomass, and lengths of fish collected at the Thorburn Channel.*

Thorburn Channel: November 28, 2023				
Species Collected	Population Estimate (95% CI, Lower Adjusted)	Fish per Mile (Estimated)	Biomass (Pounds)	Lengths (in)
Three-spine Stickleback	98 (98-98)	1,725	0.078	1-3
Sacramento Sucker	44 (42-49)	774	0.076	1-2
Sacramento Pikeminnow	4 (4-5)	70	0.008	1-2
Western Mosquitofish	1 (1-1)	18	0.001	1.2

The presence and quantity of these fish suggest, at the time of the survey, the Thorburn Channel was providing adequate habitat for juvenile Sacramento suckers and Sacramento pikeminnow, as well as mature three-spine stickleback and western mosquitofish. The extent of shallow and slow-moving water which was present within the channel during the survey would have effectively prevented large piscivorous fish from being present, and emergent vegetation helped provide cover from predators. Stickleback rarely live longer than 1-year, and one captured stickleback was observed to be gravid when examined in hand, suggesting appropriate spawning habitat was present in the channel. The observed western mosquitofish was potentially an adult, as males reach maturity at 0.75 inches and females are usually 1 inch

at first pregnancy (Moyle 2002). It is unknown if there is a self-sustaining resident population currently within the Thorburn Channel, or if they were introduced in 2023 by the Consolidated Mosquito Abatement District whose service area includes the Kings River downstream of Pine Flat Dam. Under their program, at the request of the landowner, areas of standing water are stocked with mosquitofish as a means of vector control.

Continued annual monitoring of this site is foreseen to document instream changes in the fish assemblage over time. This monitoring will provide both pre-activity and post-project changes in the assemblage observed as conditions within the channel are anthropogenically altered to improve streamflow, and through the resulting channel function in subsequent years.

Avo Boulder - Demonstration

This survey occurred in a wadeable, adjacent channel to the Avo Boulder electro-fishing site (Figure 1). Instream flows, as measured immediately upstream in the main channel, were 73 cfs as measured by KRWA at the time of the survey. This was a demonstration electro-fishing survey for the laboratory portion of the Reedley College Watershed Class to learn how to set up the survey reach, practice conducting a multi-pass depletion survey, learn what data is collected, and learn fish identification. As this was only a demonstration, block nets were established 80 feet apart in a channel which was safely wadable and only two passes conducted. After the second pass, in the limited time available, students were provided with a demonstration how to measure collected fish and record data, and they learned how to identify the fish collected on their survey. Once the students left, the remaining fish were tallied. As complete data was recorded for only a small portion of fish (16.5%), and not for all species observed, calculations of biomass, population estimates, and fish per mile was not determined. A total of 157 fish were collected, results of which are found in Table N3.

Table N3: *Species collected, species composition, and catch-per-unit effort, Avo Boulder - Demonstration.*

Avo Boulder - Demonstration, November 29, 2023			
Species Collected	Captured (#)	Species Composition (%)	Catch-per-unit Effort (per hour)
California Roach	46	29.3%	30.3
Sacramento Pikeminnow	43	27.4%	28.3
Sacramento Sucker	30	19.1%	19.7
Rainbow Trout - Hatchery	18	11.5%	11.8
Sculpin sp.	15	9.6%	9.9
Three-spine Stickleback	3	1.9%	2.0
Rainbow Trout - "Wild"	2	1.3%	1.3