Kings River, Below Pine Flat Dam: Report of Results from the Fall Population Electro-fishing Survey, 2022

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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 2022 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 (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 2022 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.

In 2022, 5,585 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 (99%) and biomass (95%), 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, and sculpin. These fish most accurately meet the criteria of the pikeminnow-hardhead-sucker assemblage as described by Moyle (2002). While deep-bodied fishes such as bass were present, they made up less than one 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 could reproduce 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 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, Fall Population Electro-fishing Survey.*

Species Collected	Species Composition (%)	Range across Survey Sites[!] Population Estimates*	Fish per Mile (estimated)	Biomass (lbs)	Captured Lengths (in)
Sacramento Sucker	36.63	208-697	3,661-12,267	1.7-96.0	2-22
Sacramento Pikeminnow	22.90	168-334	2,112-5,878	0.7-4.6	0.4-9
California Roach	16.96	2-342	35-6,019	0.002-2.2	1-6
Three-spine Stickleback	8.56	45-551	792-9,698	0.07-0.2	1-2
Sculpin	7.65	10-338	176-5,949	0.1-4.4	2-5
Lamprey	4.92	2-262	35-4,611	0.02-0.6	1-7
Hardhead	1.02	0-32	0-563	0-0.1	2-4
Bass[a]	0.57	0-24	0-422	0-0.8	3-10
Western Mosquitofish[a]	0.39	0-11	0-194	0-0.02	1-3
Rainbow Trout - Hatchery[a]	0.20	0-7	0-123	0-4.5	8-15
Brown Trout[a]	0.13	0-8	0-141	0-0.3	5-7
Rainbow Trout - "Wild"	0.04	0-1	0-18	0-0.2	5-8
Bluegill[a]	0.02	0-1	0-18	0-0.01	2.8
Catfish[a]	0.02	0-1	0-18	0-0.8	12.6

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

[*]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. While Fulton′s condition factor suggested ″wild″ rainbow trout were in worse condition than the hatchery produced brown trout and rainbow trout, length-weight regression analysis indicated all trout were in excellent condition at the time of capture. This is not surprising as hatchery reared trout rear in an environment where they are fed artificial diets daily before release, while condition of resident fish will be reflective of survival through recent riverine conditions including thermal conditions, prey availability, energetic expenditures, intraspecific interactions, predator avoidance and/or angler pressure, or some other unconsidered variable.

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 population. 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 that of 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 several 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

Electro-fishing was performed at two sampling sites within each of the three uppermost management reaches of the lower Kings River (Figure 1). 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. 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 electro-fishing occurred at the sites Winton and Alta. 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. 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 electro-fishing occurred at the sites Avo Boulder and Avo Side. 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 is characterized by small to medium sized cobble, shallow glides, fast riffles, and extensive tree canopy.

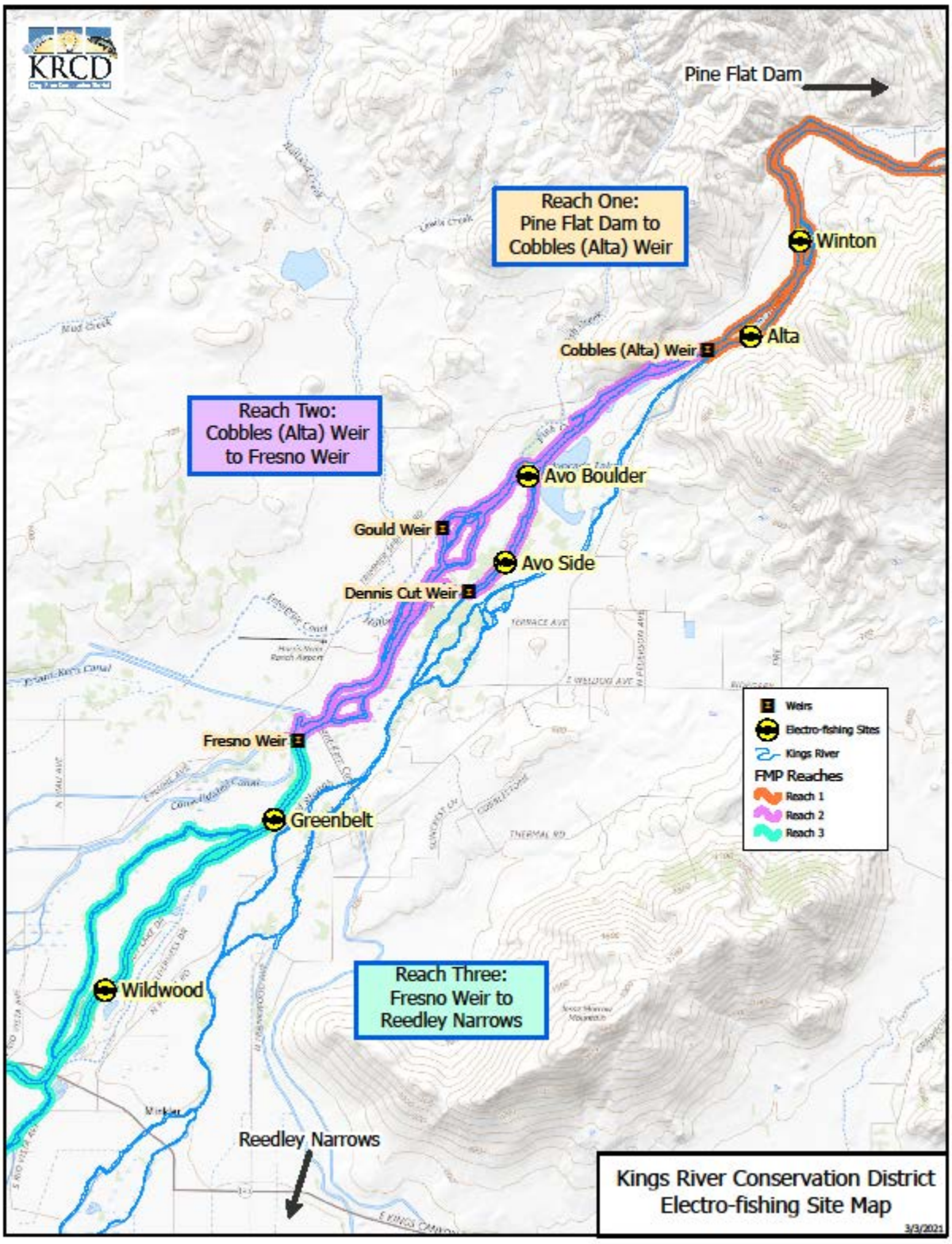

Figure 1. *Electro-fishing sites in the Kings River.*

Survey Methods

In 2022 sampling occurred over six days between November 29 and December 8 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 escape (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

2022 pulsed flows were not utilized as Exhibit "C" minimum flows of 100 cfs were in effect with no additional water orders planned over the survey period.

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. 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

Prior annual electro-fishing reports 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 5,585 fish were collected during the Fall Population Electro-fishing survey in 2022, with complete data collected for 4,894 fish which was entered into MicroFish 3.0 for further analysis. In Wildwood, both quantity of collected fish and time restraints due to the onset of sunset forced surveyors to resort to tallying fish. As a result, 87% of the fish collected at Wildwood were fully sampled. 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, and thus is underreported for Wildwood. Data for Wildwood also has an additional confounding factor as the upper and lower block nets partially collapsed while the first pass was underway. About 1% of the upper net collapsed, and about 10% of the lower net. Within two minutes of collapse the upper net had been pulled back above the water surface and was physically held in place by a data recorder until the pass could be completed, and an additional tripod placed to further support the block net as water was faster and the channel deeper at the point of collapse. The lower net blew over in shallow water, and the tripods were easily righted within five minutes at the end of the first pass. 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.

As in prior years, native fish continued to dominate the survey in both abundance (98.6%) and biomass (95.1%), with the assemblage between Highway 180 and Pine Flat Dam dominated by native Sacramento sucker (36.6%), Sacramento pikeminnow (22.9%), California roach (17%) and three-spine stickleback (8.6%) (Figure 2). Introduced fish made up 1.3% of the collected species abundance, with hatchery rainbow trout (0.2%) the most abundant introduced fish and bass the most abundant introduced non-native fish (0.6%) (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 one 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.

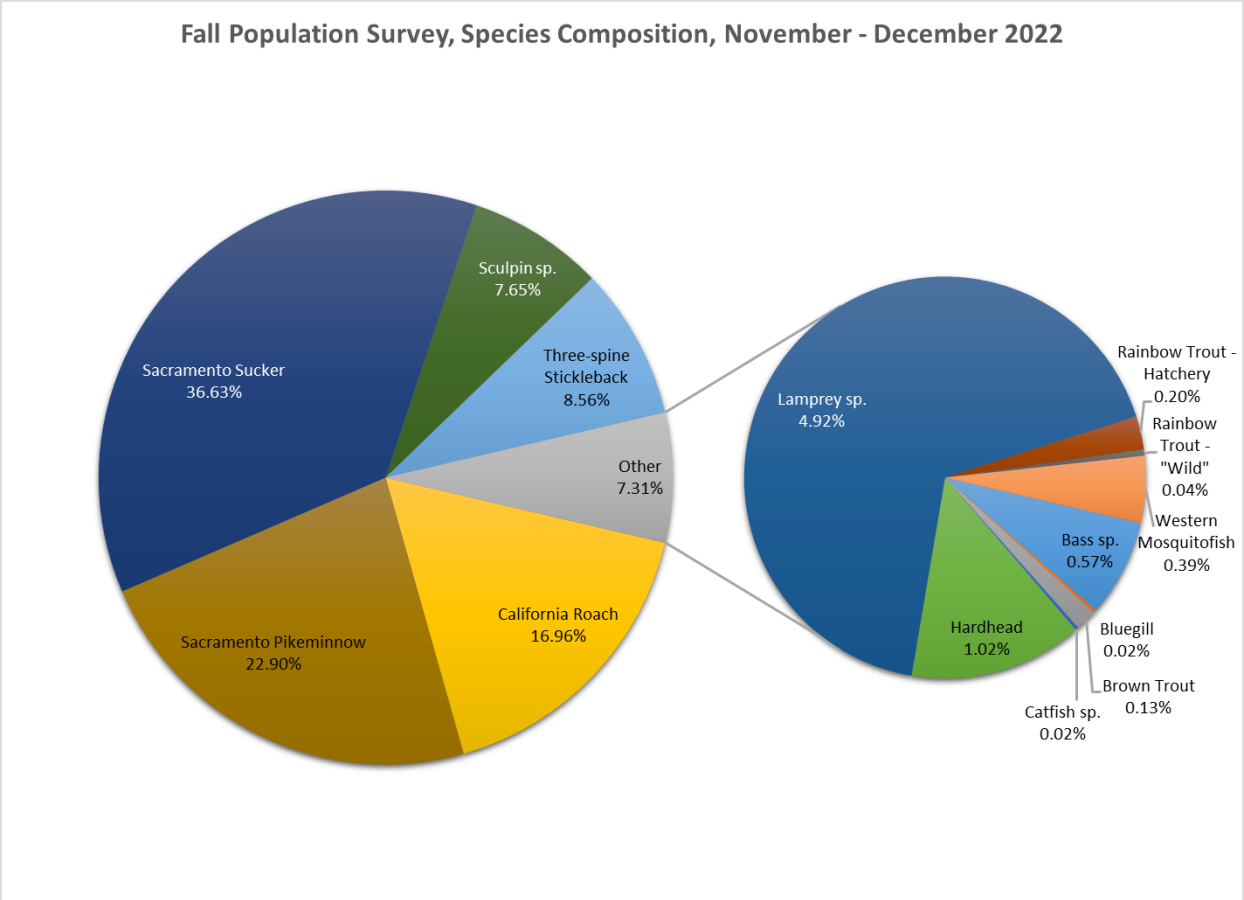

Figure 2. ***Species Composition by percent abundance for fish collected during the Fall Population Electro-fishing Survey.***

Collected species represented nine families as shown in Table 3.

Table 3. *Families represented and species collected during the Fall Population Electro-fishing survey.*

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

[a] Introduced (non-native to the watershed or hachery 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 2022. When figures or tables are not provided, they are summarized in the text and included in the appendix.

Catostomidae – Sucker Family

Two thousand forty-six catostomids, represented by the Sacramento sucker were captured in 2022 (Appendix B), with data entered for 1,812 into MicroFish 3.0. A summary of results is presented in Table 4.

Table 4. *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 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	50.0	28.3	34.8	24.2	45.4	38.7
Population Estimate (95% CI, Lower Adjusted)	697 (609-785)	208 (184-232)	403 (309-497)	213 (179-247)	486 (464-508)	231 (230-234)
Fish per Mile (Estimated)	12,267	3,661	7,093	3,749	8,554	4,066
Biomass (Pounds)	7.3	1.7	96.0	30.4	5.5	5.5

Catch rates varied between sites, with the highest catch rate at Winton, the uppermost survey site, and similar catch rates at Alta and Avo Side, with the lowest catch rate at Avo Side. Higher population estimates in Winton suggest that site was more suitable for Sacramento sucker than those further downstream. Fish per mile estimates ranged from 3,661 fish per mile at Alta to a high of 12,267 fish per mile at Winton. The lowest recorded biomass was 1.7 pounds in Alta, and the heaviest was 96 pounds in Avo Boulder. While the greatest biomass was collected in Avo Boulder, this site ranked third in sample size (n=271). Winton (n=515) and Greenbelt (n=445) both had larger sample sizes, but biomass was much lower, indicating the capture at Avo Boulder was comprised of larger fish. This may indicate habitat at Avo Boulder is more suitable for the larger Sacramento suckers than smaller size classes.

Captured Sacramento suckers were most frequently juveniles; length at maturity is typically around 8 inches (Moyle 2002). Length ranged from 2 to 22 inches with 94% of captured fish smaller than 8 inches (Figure 3), providing evidence Sacramento suckers have been successful reproducing in the Kings River.

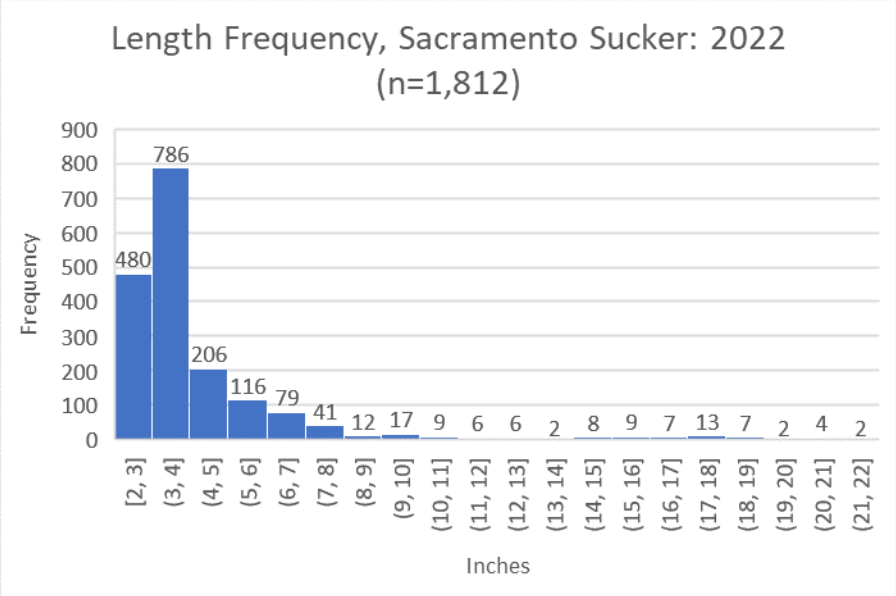

Figure 3. *Length-frequency of Sacramento sucker captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

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

Thirty-three centrarchids, represented by 32 "black" bass, and 1 bluegill were captured in 2022 (Appendix B), with data entered for 30 bass and the bluegill into MicroFish

3.0. A full summary of results for bass and bluegill can be found in Appendix D. Results for the sites with the highest CPUE, population estimate, fish per mile, and biomass for the "black" basses and bluegill collected are summarized below.

Twenty-nine of the captured bass were identified as spotted bass, three others were identified as smallmouth bass. Bass were captured at the site closest to the dam, but primarily at the two sites below Fresno Weir, suggesting conditions below the weir may be more suitable for them due to the low gradient, decreased instream flows (KRFMP 1999) and the warmer temperatures which are found in the late summer and early fall (KRCD 2021). Spotted bass in streams prefer warm water in low-gradient sections of rivers, slower water than smallmouth bass, and faster water than largemouth bass (Moyle 2002). Catch-per-unit effort was highest in Greenbelt at 2.39 fish per hour, where the population estimate was 24 (95% CI, lower CI adjusted, 22-30) fish, and fish per mile was estimated at 422 fish. Recorded biomass at Greenbelt was 0.2 pounds.

Length of captured bass ranged from 3 to 10 inches. For spotted bass, 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 can successfully reproduce within the Kings River.

The bluegill was collected at Greenbelt. Catch-per-unit effort was 0.1 fish per hour, population estimate was 1 (95% CI, lower CI adjusted, 1-1) fish, and fish per mile was estimated at 18 fish. Recorded biomass was 0.01 pounds and was 2.8 inches long. It is believed there is a small population of bluegill in the Kings River as they have only been found in the Greenbelt site on two prior occasions (2009 & 2016). Including 2022, only three have been captured during electro-fishing surveys since 2007 (Appendix B), and all during drought years. Bluegill may have been more detectable in surveys during the drought period as decreased flows may have allowed them to successfully populate greater reaches of the river and/or flows and temperatures may have been more suitable.

Cottidae – Sculpin Family

Four hundred twenty-seven cottids, which include prickly sculpin, riffle sculpin, or their hybrids were captured (Appendix B), with data entered for 413 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 sculpin collected during the Fall Population Electro-fishing Survey.*

	Sculpin, November-December 2022					
	Winton	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**
Catch-per-unit Effort (per hour)	26.9	4.8	3.2	1.3	3.5	4.1
Population Estimate (95% CI, Lower Adjusted)	338 (300-376)	37 (31-50)	41 (26-79)	10 (9-16)	35 (35-37)	33 (33-34)
Fish per Mile (Estimated)	5,949	651	722	176	616	581
Biomass (Pounds)	4.4	0.3	0.5	0.1	0.8	0.7

Catch rates at Winton were five to twenty-one times greater than at any other site sampled in 2022. Sculpin are most abundant in cold-water (Moyle 2002). High population estimates at Winton suggests that site was more suitable for sculpin than other sampled sites. It is unknown if water temperatures may have been more favorable for sculpin in this site as they were closer to the dam, and instream temperatures in the summer and fall increase as distance from the dam increases, or if Winton provides better habitat as there is a greater extent of cover habitat than other surveyed sites in the Kings River; the bottom is fully cobbled, and the channel width is greater. 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 176 fish per mile at Avo Side to a high of 5,949 fish per mile at Winton. The lowest recorded biomass was 0.1 pounds in Avo Side, and the heaviest was 4 pounds in Winton.

Captured sculpin ranged from 2 to 5 inches (Figure 4). 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.

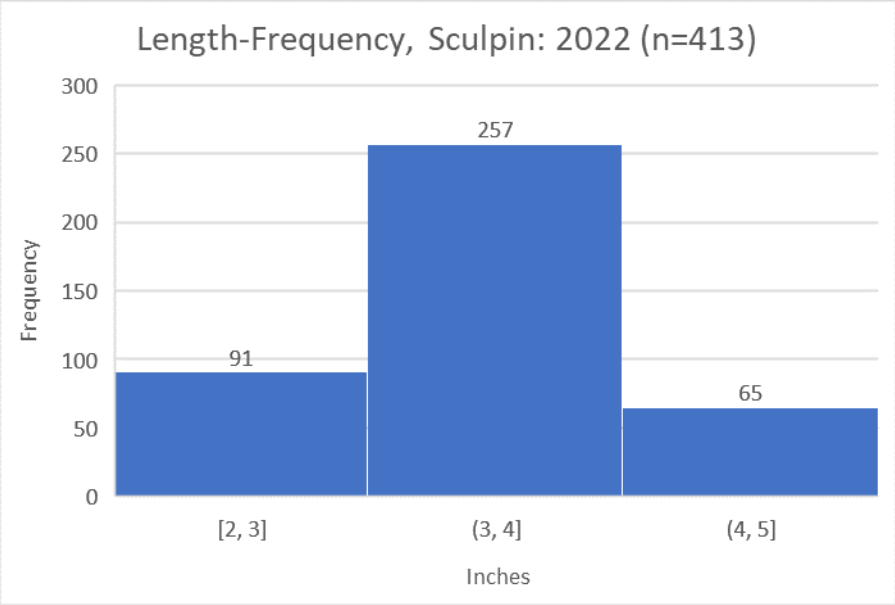

Figure 4. ***Length-frequency of sculpin captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.***

Cyprinidae – Minnow Family

Two thousand two hundred eighty-three cyprinids, represented by 947 California roach, 57 hardhead, and 1,279 Sacramento pikeminnow were captured (Appendix B), with data entered for 755 California roach, 34 hardhead, and 1,104 Sacramento pikeminnow into MicroFish 3.0. A summary of results for California roach is presented in Table 6, for hardhead in Table 7, and for Sacramento pikeminnow in Table 8.

Table 6. *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 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.2	13.5	21.7	30.6	4.3	37.3
Population Estimate (95% CI, Lower Adjusted)	2 (2-15)	96 (86-108)	182 (168-196)	342 (238-446)	42 (42-43)	246 (242-251)
Fish per Mile (Estimated)	35	1,690	3,203	6,019	739	4,330
Biomass (Pounds)	0.002	0.3	1.8	2.2	0.4	1.9

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

	Hardhead, November-December 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.0	0.0	0.0	0.0	0.2	4.9
Population Estimate (95% CI, Lower Adjusted)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	2 (2-15)	32 (32-33)
Fish per Mile (Estimated)	0	0	0	0	35	563
Biomass (Pounds)	0.0	0.0	0.0	0.0	0.005	0.1

Table 8. *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 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	13.2	17.7	25.6	16.8	32.1	33.6
Population Estimate (95% CI, Lower Adjusted)	250 (134-391)	120 (112-130)	242 (207-277)	168 (119-219)	334 (320-348)	243 (231-255)
Fish per Mile (Estimated)	4,400	2,112	4,259	2,957	5,878	4,277
Biomass (Pounds)	0.8	0.7	4.6	1.9	2.5	3.5

Catch-per-unit effort was highest in the Wildwood site, suggesting that this site contains the most suitable habitat, of the six sites sampled, for the three species of cyprinid captured. The Wildwood site is the most downstream site sampled. The Winton site, which is the most upstream site sampled returned the lowest CPUE for both California roach and

Sacramento pikeminnow. While CPUE was low for both species, the CPUE indicates that the Winton site may provide more appropriate habitat for Sacramento pikeminnow than California roach. Hardhead were found only at the two sites downstream of Fresno Weir, which also experience the lowest annual instream flows (KRFMP 1999) and highest water temperatures during the late spring, summer, and early fall months. This would suggest conditions in those sites are most conducive for them.

Population estimates for California roach were highest at Avo Side, for hardhead at Wildwood, and at Greenbelt for Sacramento pikeminnow. It is not surprising that hardhead and Sacramento pikeminnow were most abundant downstream of Fresno Weir as habitat conditions and the warmer temperatures found in the summer and fall due to the distance downstream from the dam may be more favorable for the life histories of these species. Hardhead prefer streams with summer temperatures that exceed 68°F, with optimal temperature being 75-82°F (Moyle 2002). They prefer deep pools and runs with sand-gravel-boulder substrates and slow flows. They tend to be absent from streams with introduced species, particularly where centrarchids are dominant, or from waters with severe anthropogenic modifications (Moyle 2002). The greater presence of hardhead in Wildwood suggests that it may provide preferable habitat for hardhead over Greenbelt. Sacramento pikeminnow can tolerate temperatures up to 82˚F (Moyle 2002).

Fish per mile estimates for California roach ranged from 35 fish per mile at Winton to a high of 6,019 fish per mile at Avo Side. For hardhead, fish per mile estimates ranged from 0 at all sites above Fresno Weir to a high of 563 fish per mile at Wildwood. For Sacramento pikeminnow, fish per mile estimates ranged from 2,112 fish per mile at Alta to a high of 5,878 fish per mile at Greenbelt.

For California roach, the lowest recorded biomass was 0.002 pounds in Winton, and the heaviest was 2 pounds in Wildwood. For hardhead, the greatest biomass collected was 0.1 pounds in Wildwood. For Sacramento pikeminnow, the lowest recorded biomass was 0.7 pounds in Alta, and the heaviest was 4.6 pounds in Avo Boulder. For Sacramento pikeminnow, the Avo Boulder site had a smaller sample size (n=196) than Greenbelt (n=314) or Wildwood (n=229), and yet had a biomass which was greater than at either of those sites. This indicates larger pikeminnow made up a component of the capture in Avo Boulder and suggests habitat in this site may be more suitable for larger pikeminnow than the other sampled sites.

Captured cyprinids were California roach of all age classes, immature hardhead, or immature Sacramento pikeminnow. For California roach, length ranged from 1 to 6 inches (Figure 5). Maturity is usually reached at the end of their second year when they are around 2 inches long (Moyle 2002), indicating 8% of the California roach collected were immature. For hardhead, length ranged from 2-4 inches (Figure 6). Hardhead reach maturity in their third year when they are about 6-7 inches long, suggesting all hardhead captured in 2022 were immature. For Sacramento pikeminnow, length ranged from 0.4 to 9 inches (Figure 7). 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 2022 were immature.

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 2022 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.

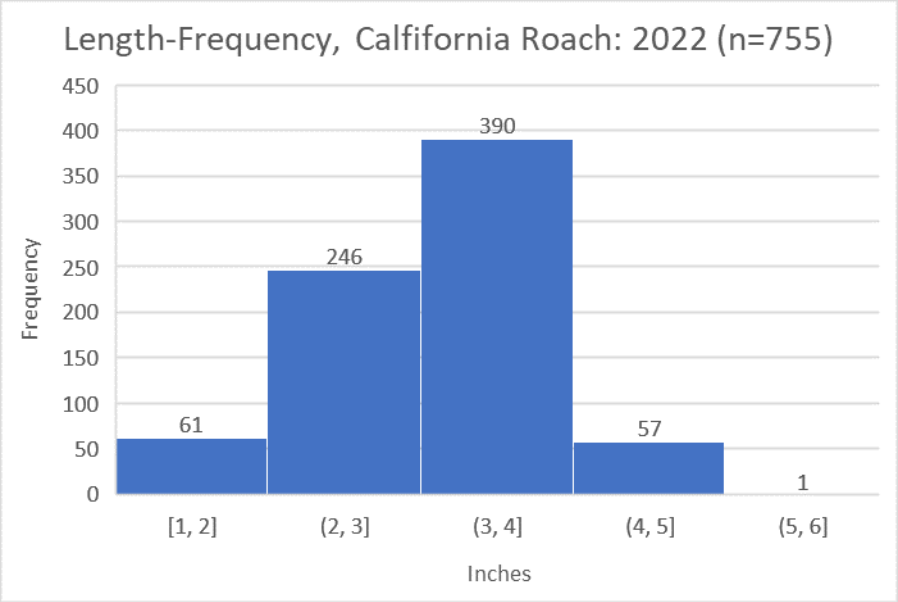

Figure 5. *Length-frequency of California roach captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

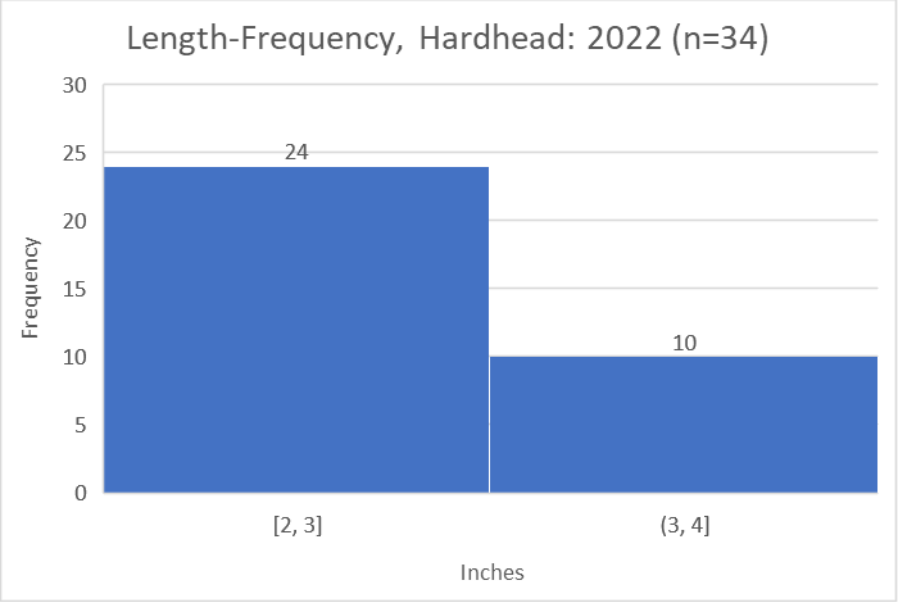

Figure 6. *Length-frequency of hardhead captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

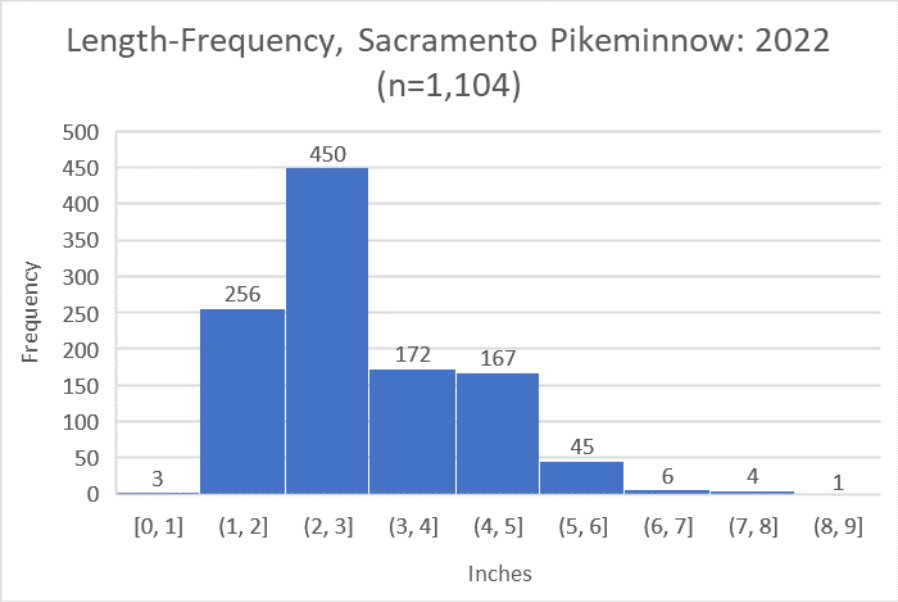

Figure 7. *Length-frequency of Sacramento pikeminnow captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Gasterosteidae – Stickleback Family

Four hundred seventy-eight gasterosteids, represented by the three-spine stickleback were captured (Appendix B), with data entered for 432 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 three-spine stickleback collected during the Fall Population Electro-fishing Survey.*

	Three-spine Stickleback, November-December 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	15.3	10.9	4.4	9.4	5.9	7.8
Population Estimate (95% CI, Lower Adjusted)	551 (156-1,364)	85 (70-105)	52 (52-52)	168 (67-398)	66 (59-77)	45 (45-47)
Fish per Mile (Estimated)	9,698	1,496	915	2,957	1,162	792
Biomass (Pounds)	0.2	0.1	0.07	0.1	0.1	0.08

Capture rates were highest at the Winton site. High population estimates for this site suggest the habitat in that site is also favorable. Habitat data is not available, but the edge of the Winton site has been observed as being well suited for three-spine stickleback due to the extent of shallow and slow-moving water created along most of the shoreline due to the distribution of large cobbles that provide a break against the faster instream flow, and depth of water restricts predation by larger piscivorous fish. Fish per mile estimates ranged from 792 fish per mile at Wildwood to 9,698 fish per mile at Winton. The lowest recorded biomass was 0.07 pounds in Avo Boulder, and the heaviest was 0.2 pounds in Winton.

Length of captured three-spine stickleback ranged from 1 to 2 inches. Two inches is the typical size for freshwater sticklebacks, which rarely live longer than 1 year and shoal with similar sized cohorts (Moyle 2002).

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 Greenbelt site where CPUE was 0.1 fish per hour. The population estimate was 1 (95% CI, lower CI adjusted, 1-1) fish at the Greenbelt site. Fish per mile was estimated at 18. Recorded biomass was 0.8 pounds, and it measured 12.6 inches. Catfish mature at 7 inches (Moyle 2002) indicating this catfish was an adult. Reduced flows over Fresno Weir and the warmer temperatures downstream during the late spring, summer, and fall may increase habitat suitability for catfish. Temperatures over 70˚F are preferred for spawning, and habitats with slow currents are preferred (Moyle 2002).

Petromyzontidae – Lamprey Family

Two hundred seventy-five petromyzontids, represented in the Kings River by the Kern brook lamprey and possibly other lamprey species, were captured (Appendix B), with data entered for 270 into MicroFish 3.0. A summary of results is presented in Table 10.

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

	Lamprey, November-December 2022					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.4	18.9	4.9	13.3	1.3	0.2
Population Estimate (95% CI, Lower Adjusted)	4 (4-9)	262 (121-469)	58 (58-58)	136 (136-136)	31 (13-125)	2 (2-7)
Fish per Mile (Estimated)	70	4,611	1,021	2,394	546	35
Biomass (Pounds)	0.02	0.5	0.3	0.6	0.1	0.02

Catch-per-unit effort was highest in the Alta and Avo Side sites. Population estimates at Alta and Avo Side were higher than other sites suggesting habitat in those two sites may be more suitable for lamprey. These two sites are within side channels 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 35 fish per mile in Wildwood to a high of 4,611 fish per mile at Alta. The lowest recorded biomass was 0.02 pounds at both Winton and Wildwood, while the heaviest was 0.6 pounds in Avo Side.

Captured lamprey ranged from 1 to 7 inches (Figure 8). 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 lampreys may have been adults as data collected in these surveys did not distinguish between ammocetes and adults.

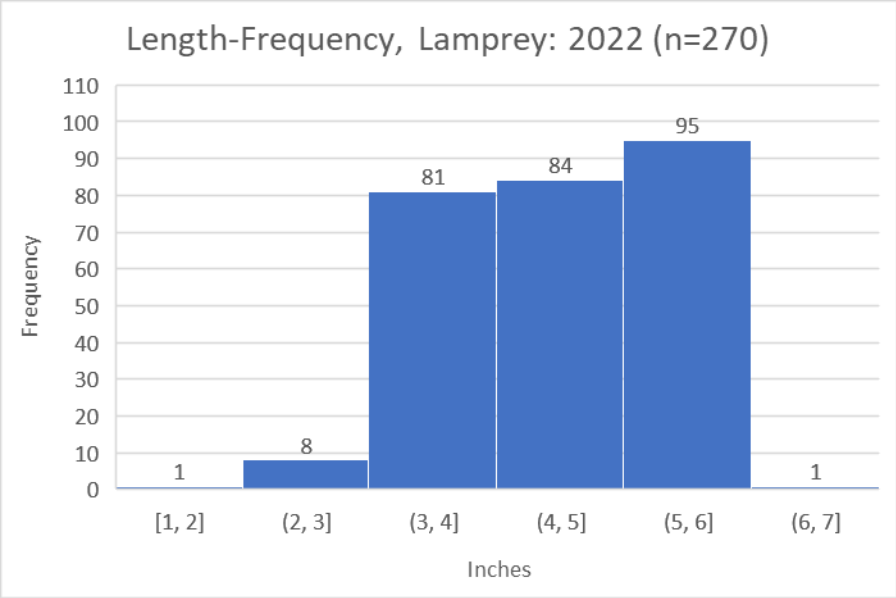

Figure 8. *Length-frequency of lamprey captured during the Fall Population Electro-fishing Survey. The number of fish in each size class is shown.*

Poecillidae – Livebearer Family

Twenty-two poecillids, represented by the western mosquitofish were captured (Appendix B), and entered into MicroFish 3.0. Western mosquitofish were captured in all sites except Avo Boulder and Avo Side. The highest CPUE was 0.97 fish per hour in Wildwood. Population estimates in both Greenbelt and Wildwood were 11 (95% CI, lower CI adjusted, 7-35, and 11-13 respectively) fish. Fish per mile was estimated at 194 fish per mile in both Greenbelt and Wildwood. The greatest recorded biomass was 0.02 pounds in Wildwood. Captured western mosquitofish were 1 to 3 inches in length, making them all adults. 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 in the river or if the collected fish were released into the river from a location where mosquitofish were stocked 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. Rural properties adjacent to the river, as well as the Wildwood subdivision which

contains a lake, may provide opportunities for residents to transfer abatement stocked fish into the river.

Salmonidae – Trout Family

Twenty salmonids, represented by 7 brown trout, 13 rainbow trout, of which 11 were classified as hatchery origin and 2 classified as "wild", were captured (Appendix B). Data for all was entered into MicroFish 3.0. 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. A full summary of results for brown trout, hatchery rainbow trout, and "wild" rainbow trout can be found in Appendix K.

While wild populations of brown trout do exist above Pine Flat Reservoir, the fish collected in 2022 were likely the result of the stocking of fingerlings by CDFW in late August/early September 2022 as conditions below Pine Flat Dam are not conducive to reproduction by brown trout which are fall spawners. Results for the sites with the highest CPUE, population estimate, fish per mile, and biomass for each salmonid species collected are summarized below.

No salmonids were collected at Alta, or the two sites below Fresno Weir (Greenbelt and Wildwood). It was not surprising that trout were absent below Fresno Weir as downstream temperatures are often not conducive to trout in the summer and fall (KRFMP 2021). For hatchery stocked fish, Avo Boulder was the site of greatest abundance for brown trout, and Avo Side for hatchery rainbow trout. For brown trout at Avo Boulder, CPUE was 0.5 fish per hour, with a population estimate of 8 fish (95% CI, lower CI adjusted, 4-50), an estimated 141 fish per mile, and biomass of 0.3 pounds. For hatchery rainbow trout at Avo side, CPUE was 0.99 fish per hour, with a population estimate of 7 fish (95% CI, lower CI adjusted, 7-8), an

estimated 123 fish per mile, and biomass of 4.5 pounds. "Wild" rainbow trout were collected at both Avo Side and at Winton, with the greater CPUE at Avo Side of 0.14 fish per hour. Population estimates for both sites were 1 (95% CI, lower CI adjusted, 1-1) and fish per mile was estimated at 18 for both sites. The greater biomass was collected at Avo Side of 0.2 pounds.

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 2022, supplemental stocking by Desert Springs Trout Farm occurred two to three times a month. Due to warm instream temperatures, stocking was not initiated until mid-November. As a result, supplemental stocking occurred only once, on November 18, prior to the electro-fishing survey.

Additionally, in late August and early September, CDFW stocked fingerling brown trout into the Kings River below Pine Flat Dam. Catchable-sized hatchery rainbow trout were present at the Avo Boulder and Avo Side electro-fishing sites. Electro-fishing site Avo Boulder is both 0.15 and 0.5 miles downstream of trout stocking locations, while Avo Side is 0.25 miles downstream of a stocking location. It was surprising that hatchery rainbow trout were not found in the Alta site, as it lies only 0.1 miles upstream of a stocking location. Sub-catchable

brown trout were found at both Avo Boulder and Avo Side, in addition to Winton. The Winton site is about 0.5 mile below the nearest stocking location.

Population estimates for hatchery rainbow trout may be lower than expected considering frequency of stocking events. A variety of factors may contribute to low population estimates such as: 1) poor dispersal from stocking locations, 2) angler pressure is high, 3) high predation by piscivorous fish & wildlife, 4) survival of hatchery trout upon release is poor, or 5) some combination of these factors. 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).

Length-frequency of captured salmonids fell within expected ranges. Brown trout ranged from 5 to 7 inches. A subset of length-weight measures from August 26, provided by CDFW, indicated the brown trout fingerlings stocked between August 30 and September 2 ranged in length from 2-5 inches, indicating instream growth may have been as great as 2 to 3 inches between August 30 and December 8. For hatchery rainbow trout, lengths ranged from 8 to 15 inches; catchable sized trout released in November were expected to be under 16 inches in length. "Wild" rainbow trout ranged in length from 5 to 8 inches. While no adult "wild" rainbow trout were located during the 2022 survey this should not be interpreted to indicate none are present in the river below Pine Flat Dam, as only 2.7% of the river is sampled between the dam and Highway 180, leaving most of the river unsampled and missing "wild" trout which may be present within the unsampled area. Hellmair et al (2020) found that the abundance of trout detected via their snorkel survey of the Kings River between Pine Flat Dam and Highway 180 in November 2019 was higher than that estimated by the electro-fishing survey conducted by KRCD a few weeks later; and attributed the lower population abundance due of the electro-fishing survey due to the spatially limited sections of river sampled. While the snorkel survey was unable to distinguish between hatchery and "wild" rainbow trout, it is possible trout of both classifications were present.

The calculated Fulton's condition factor (K-factor) of individual captured salmonids ranged from worse (less than one) to good (greater than one). For both brown and hatchery rainbow trout the mean K-factor was 1.0, while "wild" rainbow trout had a mean K-factor of 0.8. Regression analysis allows another means to look at condition factor by analyzing the

relationship between length-weight data. For all trout collected in the Kings River the relationship between length-weight data indicated a positive relationship, and all trout had a regression slope greater than 2.5 (brown trout: slope = 3.92, R^2 = 0.91; hatchery rainbow trout, slope = 3.04, R^2 = 0.96; ‘‘wild’’ rainbow trout, slope = 2.88, R^2 = 1). While sample size was small, length-weight regression data indicates trout were in excellent condition.

It is not surprising that condition of the hatchery reared trout is better than that of the ‘‘wild’’ trout. 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. 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 recently unfavorable thermal conditions, reduced invertebrate prey availability, increased energetic expenditures, increased intraspecific interactions, increased predator avoidance or angler pressure, or some other unconsidered variable.

SUMMARY

Data collected during the 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 2022, 5,585 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 (99%) and biomass (95%), 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, and sculpin. 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 one 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 could reproduce in the Kings River.

A summary of results from the 2022 Fall Population Electro-fishing Survey is provided in Table 11.

Table 11. *Summary results, Fall Population Electro-fishing Survey.*

Species Collected	Species Composition (%)	Range across Survey Sites[!] Population Estimates*	Fish per Mile (estimated)	Biomass (lbs)	Captured Lengths (in)
Sacramento Sucker	36.63	208-697	3,661-12,267	1.7-96.0	2-22
Sacramento Pikeminnow	22.90	168-334	2,112-5,878	0.7-4.6	0.4-9
California Roach	16.96	2-342	35-6,019	0.002-2.2	1-6
Three-spine Stickleback	8.56	45-551	792-9,698	0.07-0.2	1-2
Sculpin	7.65	10-338	176-5,949	0.1-4.4	2-5
Lamprey	4.92	2-262	35-4,611	0.02-0.6	1-7
Hardhead	1.02	0-32	0-563	0-0.1	2-4
Bass[a]	0.57	0-24	0-422	0-0.8	3-10
Western Mosquitofish[a]	0.39	0-11	0-194	0-0.02	1-3
Rainbow Trout - Hatchery[a]	0.20	0-7	0-123	0-4.5	8-15
Brown Trout[a]	0.13	0-8	0-141	0-0.3	5-7
Rainbow Trout - "Wild"	0.04	0-1	0-18	0-0.2	5-8
Bluegill[a]	0.02	0-1	0-18	0-0.01	2.8
Catfish[a]	0.02	0-1	0-18	0-0.8	12.6

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

[*] 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 rainbow trout were stocked as catchables and super-catchables (Appendix L). 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.

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: 1983-2022

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

			Method & Year(s) Sampled		
Reach Name	Location	Length (ft)	Mark-Recapture[1]	Single Pass Census[2]	Multi-Pass Depletion[3]
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	1989-2000, 2002, 2004-2006	-
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, 2021-2022
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, 2021-2022
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, 2021-2022
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 Sampled	Total Distance Sampled (ft)	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 ≥ 10 cm FL
1984	2	2,050	single census mark-recapture	2	2	Upstream & Downstream	fin condition	all trout	wild rainbow trout ≥ 10 cm FL
1985	2	2,050	single census mark-recapture	2	1-2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout ≥ 10 cm FL
1986	2	2,050	single census mark-recapture	2-3	2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout ≥ 10 cm FL
1987	2	2,050	single census mark-recapture	3	1-2	Upstream & Downstream	color & fin condition	all trout	wild rainbow trout ≥ 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 ≥ 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 ≥ 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 ≥ 10 cm FL
1990	5	5,406	single pass census	2-3	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout ≥ 10 cm FL
1991	5	5,406	single pass census	3-4	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout ≥ 10 cm FL
1992	5	5,406	single pass census	2-4	1	Upstream & Downstream	color & fin condition	all species	wild rainbow trout ≥ 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

[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. *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. Note that dates of the all Spring Population Electro-fishing Surveys are excluded here.*

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	

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

APPENDIX B

Species Composition: 2007-2022

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 - "Wild"	7	4	8	0	3	0	22	0.4%
Rainbow Trout - Hatchery	9	32	2	5	0	0	48	0.9%
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 - "Wild"	7	4	7	8	1	0	27	1.0%
Rainbow Trout - Hatchery	0	0	1	0	0	0	1	0.0%
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 - "Wild"	5	1	11	2	0	0	19	0.7%
Rainbow Trout - Hatchery	3	1	0	0	0	0	4	0.1%
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 - "Wild"	8	0	0	3	0	0	**11**	**0.4%**
Rainbow Trout - Hatchery	1	1	2	0	0	0	**4**	**0.2%**
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 - "Wild"	0	3	5	2	0	0	**10**	**0.5%**
Rainbow Trout - Hatchery	0	0	6	3	0	0	**9**	**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 - "Wild"	3	0	4	4	0	0	**11**	**0.2%**
Rainbow Trout - Hatchery	2	1	1	1	0	0	**5**	**0.1%**
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 - "Wild"	1	0	1	0	0	0	**2**	**0.0%**
Rainbow Trout - Hatchery	0	0	1	0	0	0	**1**	**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 - "Wild"	0	0	2	4	0	1	**7**	**0.1%**
Rainbow Trout - Hatchery	2	0	7	2	0	0	**11**	**0.2%**
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 - "Wild"	-	-	-	3	0	-	**3**	**0.2%**
Rainbow Trout - Hatchery	-	-	-	4	1	-	**5**	**0.4%**
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 - "Wild"	1	2	7	8	0	0	**18**	**0.3%**
Rainbow Trout - Hatchery	4	4	4	3	0	0	**15**	**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 - "Wild"	1	-	3	10	0	0	**14**	**0.8%**
Rainbow Trout - Hatchery	0	-	26	8	0	0	**34**	**1.9%**
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!**	**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%**

! 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

APPENDIX C

Catostomidae – Sucker Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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**

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)

Table C3: Estimated Fish per Mile – Sacramento Sucker

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**

Table C4: Biomass (pounds) – Sacramento Sucker

Biomass (lbs), 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**

APPENDIX D

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

Multi-pass Depletion Summary Data: Fall, 2007-2022

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**

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**

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**

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)

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)

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)	-

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**

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**

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**

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**

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**

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**

APPENDIX E

Cottidae – Sculpin Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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**

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)

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**

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**

APPENDIX F

Cyprinidae – Minnow Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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

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

0.4	0.3	2.7	3.1	16.2	7.5	**5.2**
0.0	1.0	12.7	2.8	29.5	41.3	**15.5**
0.0	13.7	3.3	1.0	5.8	56.9	**11.9**
0.7	3.0	7.4	1.2	13.1	54.5	**14.3**
0.7	1.5	2.7	5.6	4.0	28.8	**7.5**
0.0	3.2	9.1	4.0	15.2	20.0	**8.2**
0.0	8.2	26.1	38.7	28.5	54.6	**27.0**
2.2	12.8	24.5	11.4	25.0	60.3	**21.1**
3.9	25.2	36.1	38.9	10.5	87.6	**34.1**
1.5	61.6	53.8	32.4	14.3	95.7	**41.8**
-	-	-	12.5	17.8	-	**15.4**
0.0	0.7	6.9	1.6	8.7	37.1	**9.2**
0.0	-	1.8	3.6	1.1	12.4	**3.5**
0.3	4.0	6.6	11.0	10.7	82.7	**20.4**
0.2	13.5	21.7	30.6	4.3	37.3	**17.8**

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**

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**

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)

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)

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)

Table F3a: Estimated Fish per Mile – California Roach

Estimated Fish per Mile, California Roach							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
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**

Table F3c: Estimated Fish per Mile – Hardhead

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

Table F3c: Estimated Fish per Mile – Sacramento Pikeminnow

Estimated Fish per Mile, Sacramento Pikeminnow							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
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**

Table F4a: Biomass (pounds) – California Roach

Biomass (lbs), California Roach							
Year	**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**

Table F4b: Biomass (pounds) – Hardhead

Biomass (lbs), Hardhead							
Year	**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**

Table F4c: Biomass (pounds) – Sacramento Pikeminnow

Biomass (lbs), Sacramento Pikeminnow							
Year	**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**

APPENDIX G

Gasterosteidae – Stickleback Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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**

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)

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**

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**

APPENDIX H

Ictaluridae – Catfish Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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	0.0	0.0	0.2	0.0	0.1	0.0	**0.1**
2009	0.0	0.0	0.0	0.0	0.2	0.0	**0.0**
2012	0.0	0.0	0.0	0.0	0.1	0.1	**0.0**
2013	0.0	0.0	0.0	0.0	0.4	0.0	**0.1**
2014	0.2	0.0	0.3	0.2	2.1	0.0	**0.4**
2015	0.0	0.0	0.0	0.0	0.3	0.0	**0.1**
2018	0.0	0.0	0.0	0.0	0.1	0.0	**0.0**
2019	0.3	-	0.0	0.3	0.1	0.0	**0.2**
2021	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**

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)

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**

Table H4: Biomass (pounds) – Catfish

Biomass (lbs), Catfish							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2008	0.000	0.000	0.005	0.000	0.004	0.000	**0.01**
2009	0.000	0.000	0.000	0.000	0.777	0.000	**0.78**
2012	0.000	0.000	0.000	0.000	0.002	0.032	**0.03**
2013	0.000	0.000	0.000	0.000	0.012	0.000	**0.01**
2014	0.007	0.000	0.004	0.004	0.120	0.000	**0.14**
2015	0.000	0.000	0.000	0.000	0.017	0.000	**0.02**
2018	0.000	0.000	0.000	0.000	0.871	0.000	**0.87**
2019	0.039	-	0.000	0.023	0.011	0.000	**0.07**
2021	0.000	0.000	0.000	0.000	0.392	0.000	**0.39**
2022	0.000	0.000	0.000	0.000	0.793	0.000	**0.79**

APPENDIX I

Petromyzontidae – Lamprey Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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**

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)

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**

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**

APPENDIX J

Poecillidae – Livebearer Family

Multi-pass Depletion Summary Data: Fall, 2007-2022

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, 2007-2022

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

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

Catch-per-Unit Effort (CPUE), Brook Trout							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
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

Catch-per-Unit Effort (CPUE), 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	**0.1**

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**

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**

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)

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)

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)

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**

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**

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**

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**

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**

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**

APPENDIX L

Trout Stocking Information: 2007-2022

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

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-Catchable	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

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

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

APPENDIX M

Water Year Information: 2007-2022

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