Kings River, Below Pine Flat Dam: Report of Results from the Fall Population Electro-fishing Survey, 2021

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May 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 the assistance of 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 2021 surveys, November 29 through December 7, 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 2021 survey covered by this report. Influence of annual instream flow and temperature data while available at both the USACE Bridge and Fresno Weir, as well as in

situ habitat conditions, which was not measured, were excluded from this analysis. In 2021, 5,738 fish were collected during the Fall Population Electro-fishing Survey, with seven of the twelve species collected native to the watershed. Native fishes dominated the survey in abundance (98.5%) and biomass (95%), with introduced fish accounting for the remainder. In 2021 the KRFMP 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 different 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 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 both juvenile and adult life stages were collected for most taxa during the survey. Exceptions being the lack of immature three-spine stickleback and adult "wild" rainbow trout captured on the survey. 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. A lack of adult "wild" rainbow trout should not be interpreted to mean they are absent from 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, thus missing "wild" trout which may be present within the unsampled area. Catch results suggested that introduced non-native bass and catfish were able to successfully 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 per year. 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 2021 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, 2021.*

Species Collected	Species Composition (%)	Range across Survey Sites			Captured Lengths (in)
		Population Estimates*	Fish per Mile (estimated)	Biomass (lbs)	
Sacramento Pikeminnow	29.91	114-464	2,006-8,166	0.6-4	1-15
Sacramento Sucker	29.00	39-549	686-9,662	3-182	1-22
California Roach	16.77	3-307	53-5,403	0.01-2	1-5
Sculpin	10.65	29-239	510-4,206	0.4-3	1-5
Lamprey	6.01	4-249	70-4,382	0.01-0.7	1-6
Three-spine Stickleback	6.00	5-221	88-3,890	0.005-0.3	1-2
Rainbow Trout - Hatchery[a]	0.96	1-27	18-475	0.05-7	4-14
Bass[a]	0.33	0-12	0-211	0-0.1	2-6
Rainbow Trout - "Wild"	0.23	0-8	0-141	0-0.5	5-6
Western Mosquitofish[a]	0.07	0-2	0-35	0-0.002	1
Brook Trout[a]	0.05	0-3	0-53	0-2	12-13
Catfish[a]	0.03	0-2	0-35	0-0.4	2-9

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

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

Condition factor of collected trout was also examined. Length-weight regression analysis and calculations using Fulton′s condition factor indicated both brook trout and hatchery rainbow trout were in good condition at the time of capture. Length-weight regression analysis and calculations using Fulton′s condition factor indicated ‘‘wild’’ rainbow trout were in poorer condition than hatchery rainbow trout at the time of capture.

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 which have been 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 (anthropogenic introductions non-native to the watershed or hatchery trout)

[b] CDFW species of special concern

[c] Distinction between native trout and those of hatchery descent not possible without genetic analysis

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. As a result of the change in survey methods the single pass data collected from 1990 through 2006 serve as an index of relative abundance and do 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, the KRCD, and the KRWA revised the electro-fishing survey protocol to a multi-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, excluding 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 also closed to fishing by CDFW regulations. There are no diversions by KRWA member units in Reach One which also receives uncontrolled inflows from the tributaries of Mill and Hughes Creeks. Both Reach Two and the upper portion of Reach Three 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 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. This reach 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 which is conveyed to the Alta Canal. Dennis Cut Weir, located downstream of Avocado Lake Park diverts water from the left bank of the Dennis Cut channel. 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 located downstream of Winton County Park and is 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 cobble, many anthropogenically placed boulders, and some vegetative cover is provided by trees. The site Avo Side is a partial subset of the historic sampling site Avocado Lake Side Channel and is located on private property downstream of Avocado Lake Park. This site is characterized

by large cobble, many anthropogenically placed boulders, and extensive canopy cover is 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.

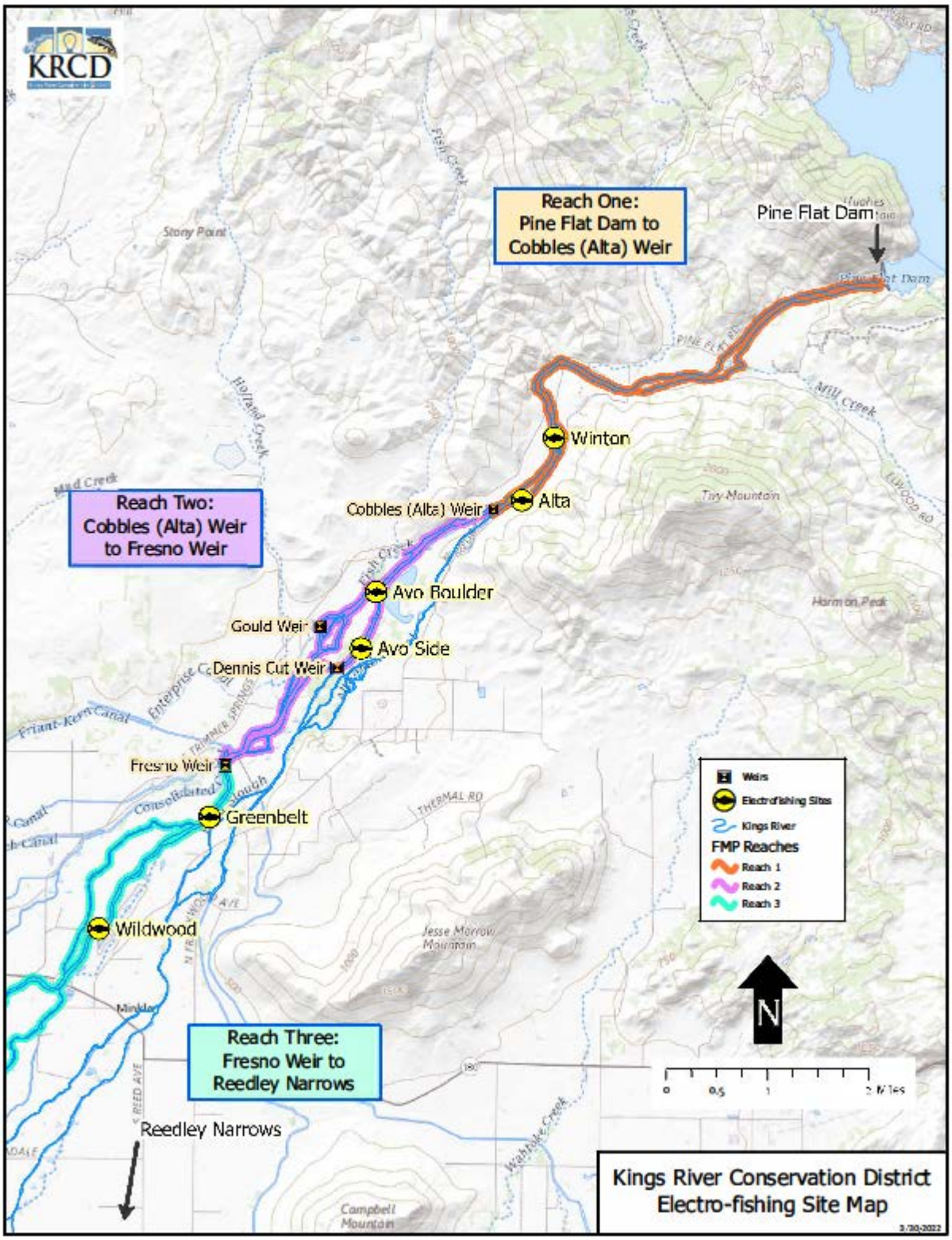

Figure 1. *Electro-fishing sites in the Kings River, 2021.*

Survey Methods

In 2021 sampling occurred over six days between November 29 and December 7 using standard multiple-pass depletion electro-fishing techniques (Reynolds 1996). Survey sites were 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. Four to nine electro-fisher backpack units were utilized in each survey reach. Electro-fisher backpack models operated in 2021 consisted of the Smith-Root LR-24 and/or Smith-Root LR-20B.

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 five to six, 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

2021 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 1 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 Calaveras 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 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 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). Box plots were used to present information pertaining to K-factor by site. In the box plots presented in this report, the box indicates the condition factor for 50% of collected fish, and the range of condition factors 25% to 75% for all collected fish. Outliers are indicated by points outside of the 25% to 75% range, an "X" indicates the mean, and the median is represented by a line within the box.

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 have presented results in a manner which suggests sampled sites are representative of the 12.5-mile stretch of the Kings River below Pine Flat Dam, when these sites may in fact 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 has 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 5,738 fish were collected during the Fall Population Electro-fishing survey in 2021, with complete data collected for 4,391 fish which was entered into MicroFish 3.0 for further analysis. In two sites, Winton and 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, 79% of the fish collected at Winton and 47% 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 these two sites. Data for Wildwood also has an additional confounding factor as the upper block net partially collapsed while the second pass was underway. While only 10-15% of the net collapsed, and the net was mostly back into position within a couple of minutes, it took about 30 minutes to properly re-rock the bottom of the net, set additional tripods to counter the faster current in that section, and remove accumulated leaves which had caused the net to fail. It is unknown how many previously excluded fish entered the reach, or if fish captured during pass one and released above the net had reentered, but the number is believed to be low. Fish already counted were being released approximately 35 feet upstream and diagonal from the failed net. Previously excluded fish near the downed net may have passed into the reach as a result of flow and/or avoidance response to people recovering the downed net, but likewise, with multiple people engaged in restoring the net it may also have spooked fish upstream of the breach.

As in prior years, native fish continued to dominate the survey in both abundance (98.6%) and biomass (95%), with the assemblage between Highway 180 and Pine Flat Dam

dominated by native Sacramento pikeminnow (29.9%), Sacramento suckers (29%), California Roach (16.8%) and sculpins (10.7%) (Figure 2). Introduced fish made up 1.4% of the collected species abundance, with hatchery rainbow trout (0.96%) the most abundant introduced fish and bass the most abundant introduced non-native fish at (0.3%) (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 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.

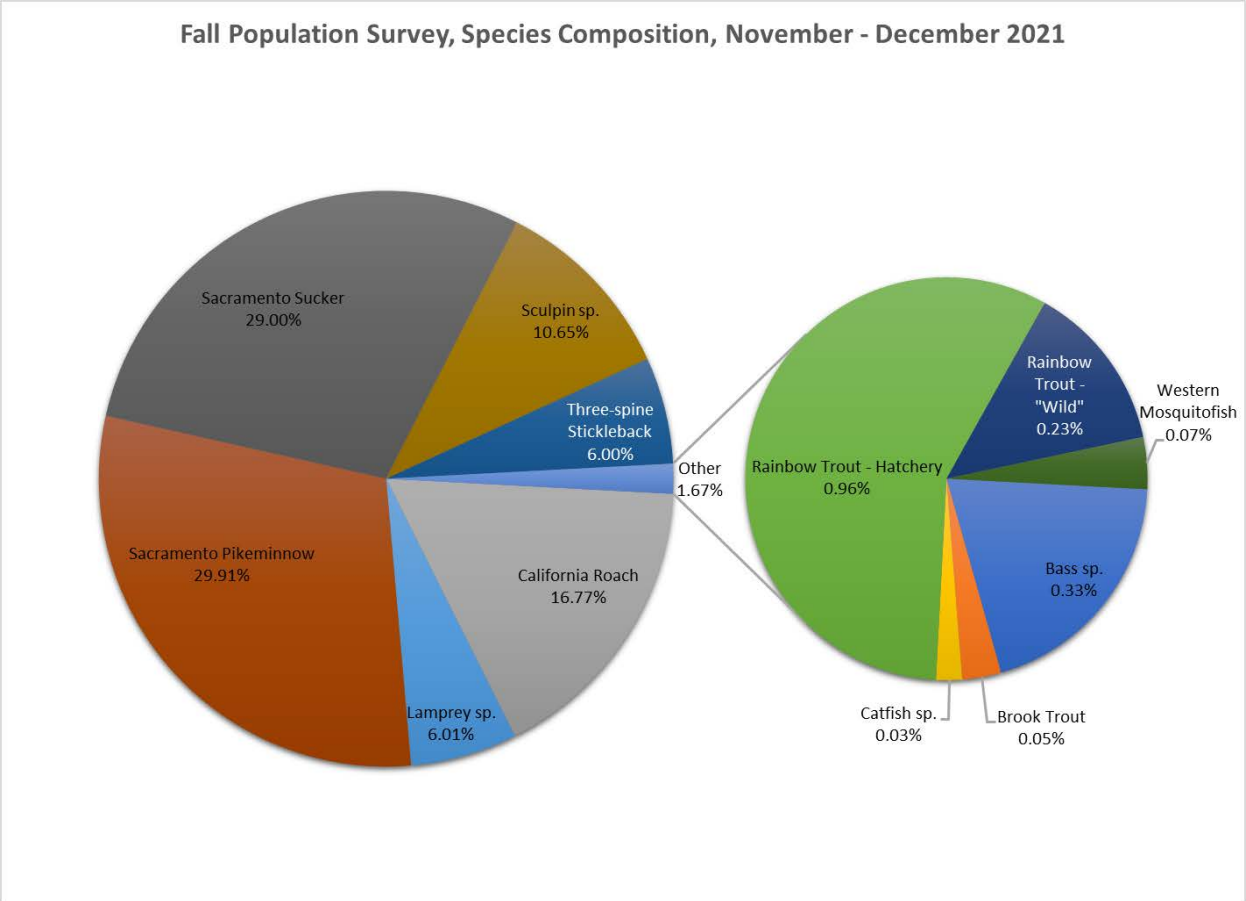

Figure 2. *Species Composition by percent abundance for fish collected during the Fall Population Electro-fishing Survey, 2021.*

Collected species represented nine families as shown in Table 3.

Table 3. *Families represented and species collected during the 2021 Fall Population Electro-fishing survey.*

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

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

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 2021. When figures or tables are not provided, they are summarized in the text and included in the appendix.

Catostomidae – Sucker Family

One thousand six hundred and sixty-four catostomids, represented by the Sacramento sucker were captured in 2021 (Appendix B), with data entered for 1,375 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 2021 Fall Population Electro-fishing Survey.*

	Sacramento Sucker, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	54.43	53.64	49.10	25.64	4.50	21.74
Population Estimate (95% CI, Lower Adjusted)	444 (419-469)	549 (504-594)	367 (321-413)	171 (140-202)	39 (37-44)	63 (50-84)
Fish per Mile (Estimated)	7,814	9,662	6,459	3,010	686	1,109
Biomass (Pounds)	3.11	3.04	182.39	40.25	20.02	2.29

Catch rates varied between sites, with the highest and most similar catch rates at the three survey sites closest to the dam, similar catch rates at Avo Side and Wildwood, and the lowest catch rate at the Greenbelt site. Higher population estimates in the uppermost survey sites suggests those sites are more suitable for Sacramento sucker than those further downstream. Fish per mile estimates ranged from 686 fish per mile at Greenbelt to a high of 9,662 fish per mile at Alta. The lowest recorded biomass was 2 pounds in Wildwood, and the heaviest was 182 pounds in Avo Boulder. While the greatest biomass was collected in Avo Boulder, this site ranked third in sample size (n=294). Winton (n=399) and Alta (n=458) both had larger sample sizes, but biomass was much lower, indicating the capture there was comprised of many small 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 1 to 22 inches with 87% of captured fish smaller than 8 inches (Figure 3), providing evidence Sacramento suckers have been successful reproducing in the Kings River.

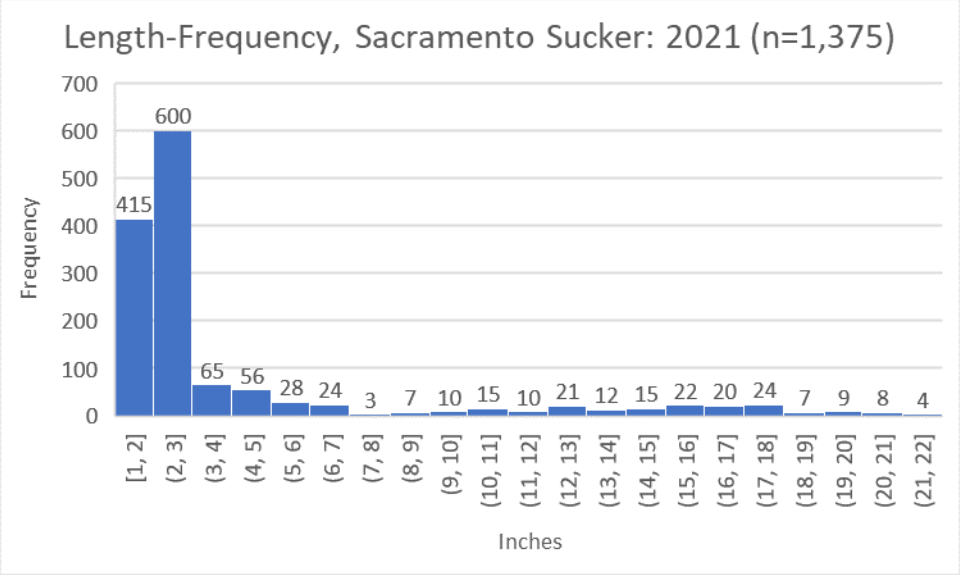

Figure 3. ***Length-frequency of Sacramento sucker captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.***

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

Nineteen centrarchids, representing the "black" basses were captured in 2021 (Appendix B), with data entered for 16 into MicroFish 3.0. Seventeen of the captured bass were identified as spotted bass, two others were unidentified to species. Captures of bass

occurred only at the two sites below Fresno Weir, suggesting conditions there may be more suitable for them due to the low-gradient, decreased instream flows below the weir (KRFMP 1999) and the warmer temperatures which are found in the late summer and early fall (KRCD 2021). Spotted bass residing in streams prefer warm water in low-gradient sections of rivers, and prefer slower water than smallmouth bass, and faster water than largemouth bass (Moyle 2002). In Greenbelt, CPUE was 1.7 fish per hour, the population estimate was 12 (95% CI, lower CI adjusted, 12-14) fish, fish per mile was estimated at 211 fish per mile, and recorded biomass was 0.3 pounds. In Wildwood, CPUE was 0.56 fish per hour, the population estimate was 4 (95% CI, lower CI adjusted, 4-6), fish per mile was estimated at 70 fish per mile, and recorded biomass was 0.1 pounds. 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). Length of captured bass ranged from 2 to 6 inches indicating bass may be competitors for the same food as other resident insectivorous fish. If so, competition may be mitigated through niche partitioning, 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.

Cottidae – Sculpin Family

Six hundred and eleven cottids, which may be represented in the Kings River by prickly sculpin, riffle sculpin, or their hybrids were captured in 2021 (Appendix B), with data entered for 514 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 2021 Fall Population Electro-fishing Survey.*

	Sculpin, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	29.03	9.00	3.62	7.25	9.36	12.21
Population Estimate (95% CI, Lower Adjusted)	239 (232-246)	95 (77-118)	29 (22-47)	40 (39-43)	93 (77-113)	92 (67-127)
Fish per Mile (Estimated)	4,206	1,672	510	704	1,637	1,619
Biomass (Pounds)	2.98	0.86	0.35	0.47	1.45	1.79

Catch rates at Winton were twice as high as at Wildwood, three times greater at Alta, Avo Side, and Greenbelt, and ten times higher than at Avo Boulder. Sculpin are most abundant in cold-water (Moyle 2002). High population estimates at Winton suggests that site was more suitable for sculpin than the other sampled sites. It may provide 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 the presence of cover is believed to be very important for prickly sculpin, while for riffle sculpin the presence of 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). Low population estimates at Avo Boulder and Avo Side suggest those sites are the least suitable of the sites sampled for sculpin, and this may largely be due to the overall narrowness of those sample sites and thus decreased cobble habitat. Fish per mile estimates ranged from 510 fish per mile at Avo Boulder to a high of 4,206 fish per mile at Winton. The lowest recorded biomass was 0.4 lbs in Avo Boulder, and the heaviest was 3 pounds in Winton. Alta and Greenbelt had the same sample size (n=77), and yet biomass in Greenbelt was greater, indicating the overall presence of larger sculpin in Greenbelt. Wildwood, while having a smaller sample size (n=67) than either Alta or Greenbelt, provided the second highest biomass collected in 2021.

Captured sculpin ranged in length from 1 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). Of the 514 sculpin which were measured, all but 7 fish was larger than 2 inches, indicating that all other measured sculpin were potentially mature adults. Additional 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.

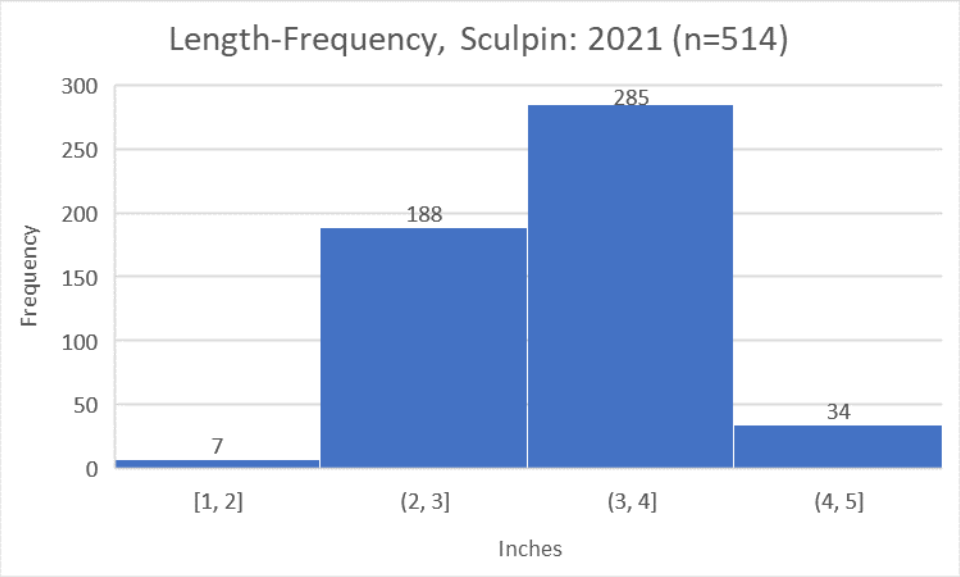

Figure 4. *Length-frequency of sculpin captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.*

Cyprinidae – Minnow Family

Two thousand six hundred and seventy-eight cyprinids, represented by 962 California roach and 1,716 Sacramento pikeminnow were captured in 2021 (Appendix B), with data entered for 516 California roach and 1,272 Sacramento pikeminnow into MicroFish 3.0. A summary of results for California roach is presented in Table 6, and for Sacramento pikeminnow in Table 7.

Table 6. *Catch-per-unit effort, population estimate, fish per mile, and biomass for California roach collected during the 2021 Fall Population Electro-fishing Survey.*

	California Roach, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.30	3.97	6.59	10.96	10.69	82.68
Population Estimate (95% CI, Lower Adjusted)	3 (3-3)	34 (34-36)	50 (39-70)	58 (57-61)	144 (83-233)	307 (300-314)
Fish per Mile (Estimated)	53	598	880	1,021	2,534	5,403
Biomass (Pounds)	0.01	0.21	0.34	0.35	0.66	2.40

Table 7. *Catch-per-unit effort, population estimate, fish per mile, and biomass for Sacramento pikeminnow collected during the 2021 Fall Population Electro-fishing Survey.*

	Sacramento Pikeminnow, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	29.64	25.83	22.90	14.12	28.92	83.92
Population Estimate (95% CI, Lower Adjusted)	368 (368-368)	464 (221-719)	198 (198-198)	114 (114-114)	334 (262-406)	421 (388-454)
Fish per Mile (Estimated)	6,477	8,166	3,485	2,006	5,878	7,410
Biomass (Pounds)	0.67	0.60	2.81	0.92	1.67	3.91

Catch-per-unit effort for both California roach and Sacramento pikeminnow was highest in Wildwood, where catch rates were similar for both species. Similar catch rates for both species also occurred at Avo Side, while in all other sample sites, the CPUE was three to twenty-nine times greater for Sacramento pikeminnow than California Roach; a reflection of the overall abundance of Sacramento pikeminnow throughout the Kings River between Pine Flat Dam and Highway 180. The high catch rates observed at Wildwood, which is the furthest downstream site sampled, suggests this site is well suited for both species of minnows, while the low catch rate at Winton, the furthest upstream sampled site, is more suitable for Sacramento pikeminnow than California roach.

Population estimates for California roach were highest downstream of Fresno Weir and were highest for Sacramento pikeminnow in Wildwood. 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. California roach can tolerate

temperatures up to 95˚F while Sacramento pikeminnow can tolerate temperatures up to 82˚F (Moyle 2002).

For California roach fish per mile estimates ranged from 53 fish per mile at Winton to a high of 5,403 fish per mile at Wildwood. For Sacramento pikeminnow, fish per mile estimates ranged from 2,006 fish per mile at Avo Side to a high of 8,166 fish per mile at Alta.

For California roach, the lowest recorded biomass was 0.01 pounds in Winton, and the heaviest was 2 pounds in Wildwood. For Sacramento pikeminnow, the lowest recorded biomass was 0.6 pounds in Alta, and the heaviest was 4 pounds in Wildwood. For Sacramento pikeminnow, the Avo Boulder site had a smaller sample size (n=132) than Alta, Greenbelt, or Winton sites, and yet had a biomass which was three to five times greater than any 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 them than other sampled sites.

Captured cyprinids were most frequently California roach or small Sacramento pikeminnow. For California roach, length ranged from 1 to 5 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 in 2021 were immature. For Sacramento pikeminnow, length ranged from 1 to 15 inches (Figure 6). Sacramento pikeminnow reach maturity at the end of their third or fourth year at a length of 9 inches (Moyle 2002), indicating 99.7% of the Sacramento pikeminnow collected in 2021 were immature. Diet of Sacramento pikeminnow is largely dependent upon size. Sacramento pikeminnow smaller than 4 inches forage primarily on aquatic insects, and switch to fish and crayfish when between 4 and 8 inches, they are almost exclusively piscivorous once they reach a length of 8 inches (Moyle 2002). This suggests that 91% of the Sacramento pikeminnow collected in 2021 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). And, despite their reputation, Sacramento pikeminnow have 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 taken more frequently (Tucker et al. 1998), suggesting diet is largely a function of what is available where Sacramento pikeminnow are present. The presence of immature age classes of

California roach and Sacramento pikeminnow are both indicators that these species are successfully reproducing in the Kings River.

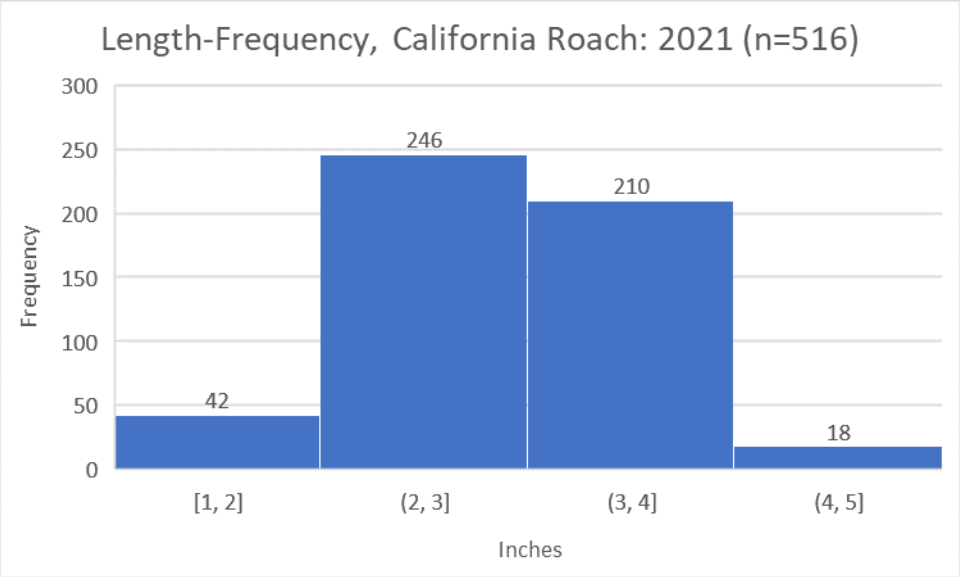

Figure 5. *Length-frequency of California roach captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.*

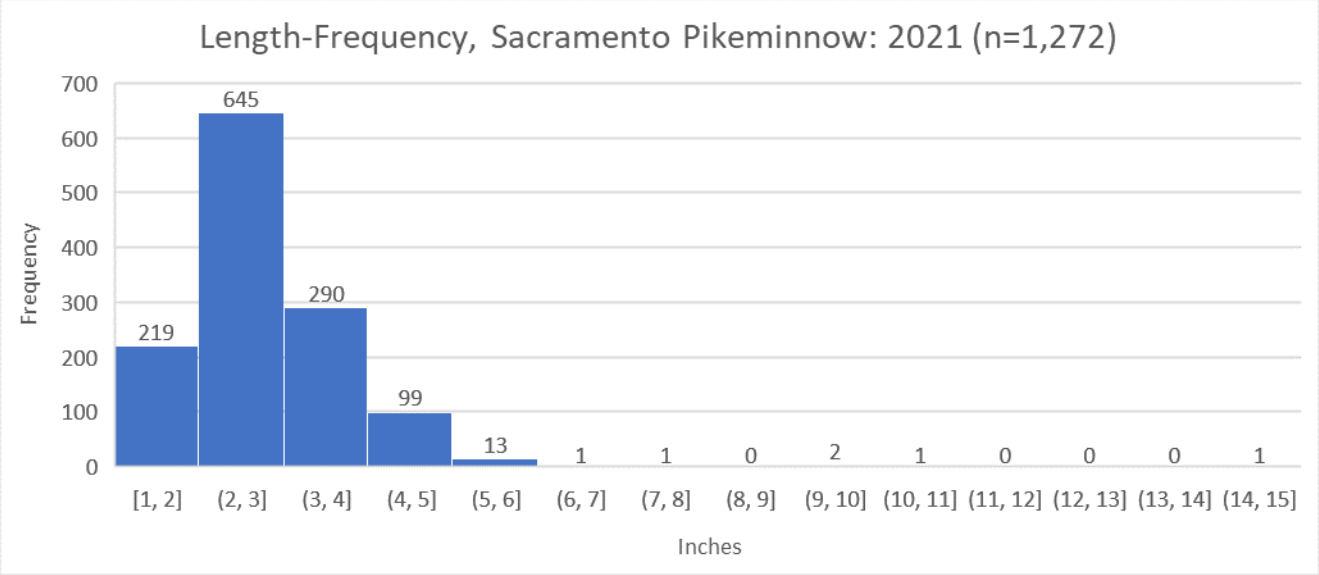

Figure 6. *Length-frequency of Sacramento pikeminnow captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.*

Gasterosteidae – Stickleback Family

Three hundred and forty-four gasterosteids, represented by the three-spine stickleback were captured in 2021 (Appendix B), with data entered for 290 into MicroFish 3.0. A summary of results is presented in Table 8.

Table 8. *Catch-per-unit effort, population estimate, fish per mile, and biomass for three-spine stickleback collected during the 2021 Fall Population Electro-fishing Survey.*

	Three-spine Stickleback, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.91	8.18	1.48	0.93	4.74	23.75
Population Estimate (95% CI, Lower Adjusted)	6 (6-7)	102 (70-147)	12 (9-26)	5 (5-7)	87 (37-233)	221 (171-271)
Fish per Mile (Estimated)	106	1,795	211	88	1,531	3,890
Biomass (Pounds)	0.008	0.097	0.015	0.005	0.065	0.268

Capture rates were highest in both the Alta and Wildwood sites. Habitat data is not available, but the Alta site has been observed as being well suited for three-spine stickleback, having extensive shallow habitat with slow-moving water and suitable spawning substrate present. High population estimates for Wildwood suggest the habitat in that site is also favorable. Fish per mile estimates ranged from 88 fish per mile at Avo Side to 3,890 fish per mile at Wildwood. The lowest recorded biomass was 0.005 pounds in Avo Side, and the heaviest was 0.3 pounds in Wildwood.

Length of captured three-spine stickleback ranged from 1 to 2 inches. Two inches is the typical size for freshwater sticklebacks. Sticklebacks rarely live longer than 1 year and shoal with similar sized cohorts. Some sticklebacks have been known to live for two or three years, and obtain larger sizes, but they are an exception (Moyle 2002).

Ictaluridae – Catfish Family

Two ictalurids, represented in the Kings River by several bullhead species and white catfish were captured in 2021 (Appendix B) and entered into MicroFish 3.0. Catfish were captured only in the Greenbelt site where CPUE was 0.24 fish per hour. The population

estimate was 2 (95% CI, lower CI adjusted, 2-15) fish per site. Fish per mile was estimated at 35 fish per mile. Recorded biomass was 0.4 pounds. Length of captured catfish ranged from 2 to 9 inches. Catfish mature at 7 inches (Moyle 2002), indicating the second catfish captured was a juvenile. The presence of juvenile catfish on the 2021 survey suggests they may successfully spawn in the Kings River when conditions are favorable. 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

A total of 345 petromyzontids, represented in the Kings River by the Kern brook lamprey and possibly other lamprey species, were captured in 2021 (Appendix B), with data entered for 335 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 lamprey collected during the 2021 Fall Population Electro-fishing Survey.*

	Lamprey, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.40	19.52	5.27	23.04	0.85	1.23
Population Estimate (95% CI, Lower Adjusted)	4 (4-7)	249 (249-249)	48 (48-48)	164 (122-206)	11 (7-35)	4 (4-9)
Fish per Mile (Estimated)	70	4,382	845	2,886	194	70
Biomass (Pounds)	0.01	0.69	0.32	0.73	0.05	0.02

Catch-per-unit effort was highest in the Alta and Avo Side sites which were 19 to 23 times greater than in sites Greenbelt, Wildwood, and Winton which had similar catch rates. 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 70 fish per mile in both Wildwood and Winton to a high

of 4,382 fish per mile at Alta. The lowest recorded biomass was 0.01 pounds in Winton, while the heaviest was 0.7 pounds in Avo Side.

Captured lamprey ranged from 1 to 6 inches (Figure 7). Non-parasitic adult lamprey, such as 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 on these surveys did not distinguish between ammocetes and adults, although both life stages were observed during the 2021 survey.

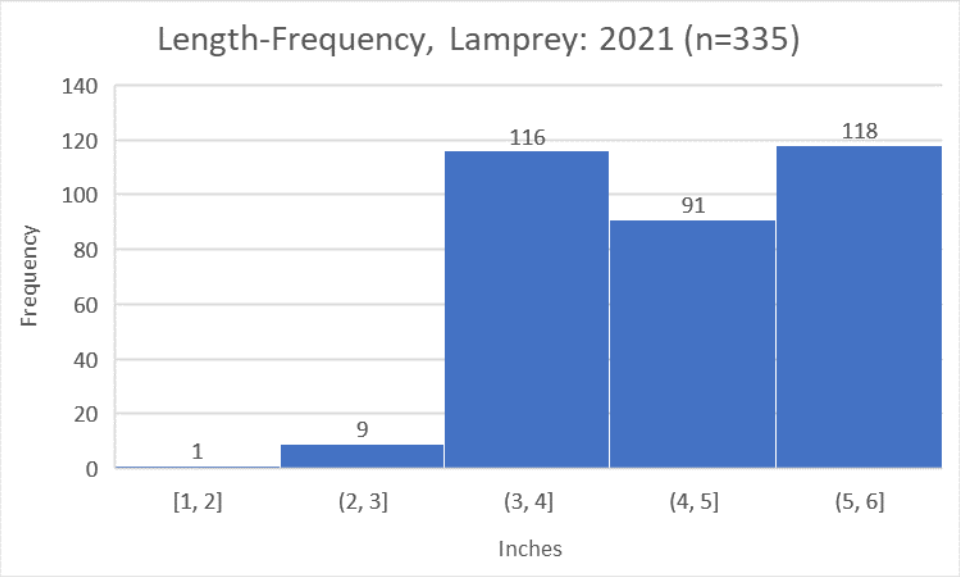

Figure 7. *Length-frequency of lamprey captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.*

Poecillidae – Livebearer Family

Four poecillids, represented by the western mosquitofish were captured in 2021 (Appendix B), with data entered for 2 into MicroFish 3.0. Western mosquitofish were only captured in Wildwood where CPUE was 0.45 fish per hour. Population estimate was 2 (95% CI, lower CI adjusted, 2-7) fish. Fish per mile was estimated at 106 fish per mile. Recorded biomass was 0.002 lbs. Captured western mosquitofish were 1 inch 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

Seventy-one salmonids, represented by 3 brook trout, 68 rainbow trout, of which 55 were classified as hatchery origin and 13 were classified as "wild" were captured in 2021 (Appendix B). Data for all, except 2 hatchery rainbow trout which escaped, was entered into MicroFish 3.0. A summary of results for brook trout is presented in Table 10, for hatchery rainbow trout in Table 11, and for "wild" rainbow trout in Table 12. It is possible that some hatchery rainbow trout were misclassified as "wild" rainbow trout. While fin condition and/or the presence/absence of an adipose fin are used in the field to distinguish between hatchery and "wild" trout, hatchery rainbow trout which have become resident may take on coloration like "wild" rainbow trout and worn fins will regenerate over time, possibly leading to misclassification. There is also the possibility that Calaveras reared trout, which rear in cobble-bottomed raceways, may have more similar characteristics to "wild" trout than those reared in traditional concrete raceways, leading to misclassification. Additionally, no phenotypic distinction can be made between trout hatched in the incubator and those which were spawned instream. Due to the young age at release, five to seven weeks post-hatch, incubator-hatched trout rear under the same conditions as stream spawned trout, making fin condition and color an unreliable indicator of origin, thus increasing the potential for misclassification of these hatchery rainbow trout as "wild" rainbow trout.

Table 10. *Catch-per-unit effort, population estimate, fish per mile, and biomass for brook trout collected during the 2021 Fall Population Electro-fishing Survey.*

	Brook Trout, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.30	0.00	0.00	0.00	0.00	0.00
Population Estimate (95% CI, Lower	3 (3-4)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Fish per Mile (Estimated)	53	0	0	0	0	0
Biomass (Pounds)	2.21	0.00	0.00	0.00	0.00	0.00

Table 11. *Catch-per-unit effort, population estimate, fish per mile, and biomass for hatchery rainbow trout collected during the 2021 Fall Population Electro-fishing Survey.*

	Hatchery Rainbow Trout, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.20	1.17	1.98	4.83	0.49	0.11
Population Estimate (95% CI, Lower	2 (2-26)	10 (10-12)	11 (11-14)	27 (25-33)	4 (4-9)	1 (1-1)
Fish per Mile (Estimated)	35	176	194	475	70	18
Biomass (Pounds)	0.12	2.53	6.77	1.49	0.37	0.05

Table 12. *Catch-per-unit effort, population estimate, fish per mile, and biomass for "wild" rainbow trout collected during the 2021 Fall Population Electro-fishing Survey.*

	"Wild" Rainbow Trout, November-December 2021					
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood
Catch-per-unit Effort (per hour)	0.30	0.12	1.32	0.19	0.00	0.00
Population Estimate (95% CI, Lower	3 (3-6)	1 (1-1)	8 (8-10)	1 (1-1)	0 (0-0)	0 (0-0)
Fish per Mile (Estimated)	53	18	141	18	0	0
Biomass (Pounds)	0.17	0.05	0.45	0.06	0.00	0.00

CDFW provides an annual allotment for trout stocking in the Kings River, and in 2017 the KRFMP developed a supplemental rainbow trout stocking plan which was 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 brook trout and hatchery rainbow trout may be influenced by proximity to stocking location as well as the time between a stocking event and electro-fishing survey. Stocking locations range from 0.1 to 0.7 miles away from the four sample sites located 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. Stocking by Calaveras Trout Farm occurs on a weekly basis during the late fall through early spring, beginning once water temperatures are less than or equal to 65˚F. Beginning in July 2021 CDFW began stocking brook trout exclusively, except for a sub-catchable sized hatchery rainbow trout plant in early November. Brook trout are not typically stocked by CDFW into the Kings River except when they have reached the end of their usage as biological cleaners or as broodstock at the San Joaquin Hatchery. CDFW has made the decision to take brook trout out of production at the hatchery; subsequently stocking those fish into the Kings River. All brook trout stocked by CDFW were catchable-size or larger. At the time of the survey, only Calaveras Trout Farm was stocking catchable-sized rainbow trout, which had resumed weekly supplemental stocking beginning November 15. Brook trout were captured only in Winton, which lies approximately 0.5 miles downstream of the nearest trout stocking location. Catchable-sized hatchery rainbow trout were present at the Alta and Avo Boulder electro-fishing sites. Electro-fishing site Alta is approximately 0.1 miles upstream of a trout stocking location, while Avo Boulder is both 0.15 and 0.5 miles downstream of trout stocking locations. In all sites sub-catchable sized hatchery rainbow trout were found, indicating successful dispersal from stocking locations above Fresno Weir.

Population estimates for hatchery rainbow trout may be lower than expected considering frequency of stocking events. Low population estimates suggest: 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).

Fish per mile for brook trout was estimated at 53 fish per mile at Winton. For hatchery rainbow trout fish per mile estimates ranged from 18 fish per mile at Wildwood to a high of 475 fish per mile at Avo Side. For "wild" rainbow trout no fish were located at the two sites below Fresno Weir, to a high of 141 fish per mile at Avo Boulder.

Biomass of hatchery produced trout will be influenced most by the size of fish being stocked, amount of time they have been in river, and ability to adapt to riverine conditions. For brook trout the recorded biomass was 2.2 pounds in Winton. For hatchery rainbow trout the lowest collected biomass was 0.05 pounds in Wildwood, and the heaviest was 6.8 pounds in Avo Boulder. For "wild" rainbow trout the heaviest collected biomass was 0.4 pounds in Avo Boulder.

Length-frequency of captured salmonids fell within expected ranges. Brook trout ranged in length from 12 to 13 inches, the estimated size at release from the hatchery. For hatchery rainbow trout, length ranged from 4 to 14 inches (Figure 8), with 83% of the captured fish being sub-catchables. On November 8, CDFW released approximately 24,990 sub-catchable trout into the Kings River which were estimated to be no larger than 7 inches at the time of release. Catchable sized trout released in November were expected to be under 16 inches in length. For "wild" rainbow trout, length ranged from 5 to 6 inches. While no adult "wild" rainbow trout were located during the 2021 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.

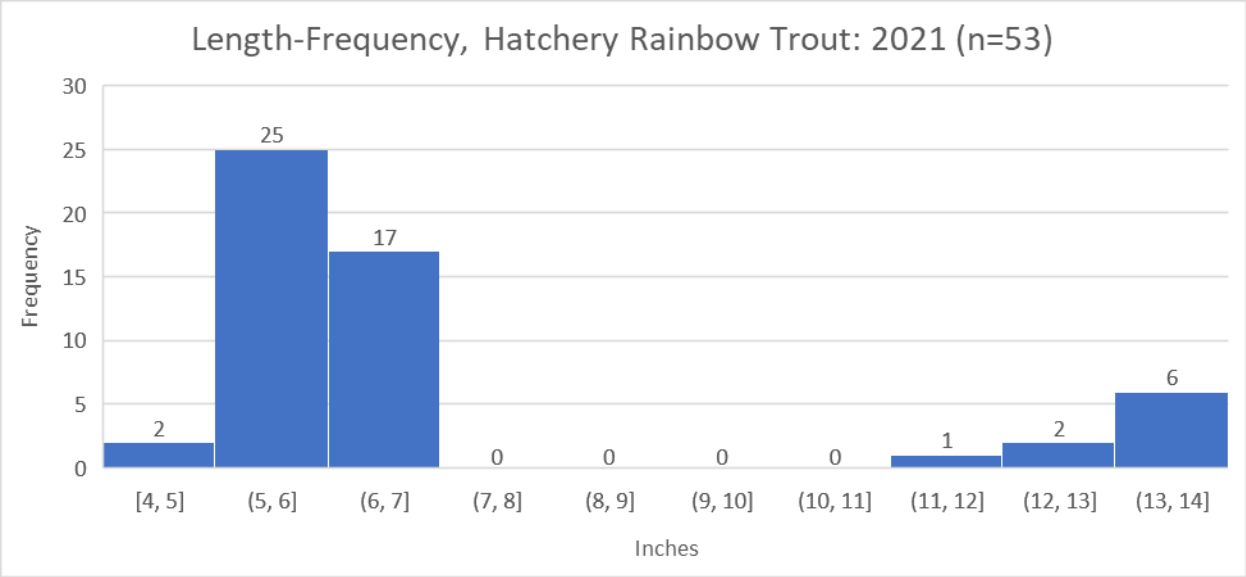

Figure 8. ***Length-frequency of hatchery rainbow trout captured during the Fall Population Electro-fishing Survey, 2021. The number of fish in each size class is shown.***

The calculated Fulton's condition factor (K-factor) of individual captured salmonids ranged from poor (less than one) to good (greater than one). Minimum, maximum, and mean K-factor is presented in Table 13 for captured trout. Brook trout were captured only in Winton and found to be in good condition (mean = 1.1, median 1.0) (Table 13). The K-factor, by site, for hatchery rainbow trout and "wild" rainbow trout is presented in Figure 9 and Figure 10 respectively. For hatchery rainbow trout, mean and median K-factor is 1.0 or greater in only Avo Boulder (mean = 1.06, median = 1.12) and Greenbelt (mean = 1.05, median = 1.08) (Figure 9). All "wild" rainbow trout, captured in the Kings River had K-factor values less than 1.0 (Figure 10).

Table 13. *Minimum, maximum, mean, and median calculated Fulton's condition factor (K-factor) for trout captured during the Fall Population Electro-fishing Survey, 2021.*

Species	Sample Size	Condition Factor			
	(n=)	Minimum	Maximum	Mean	Median
Brook Trout	3	1.0	1.2	1.1	1.0
Hatchery Rainbow Trout	53	0.6	1.6	1.0	0.9
"Wild" Rainbow Trout	13	0.7	0.9	0.9	0.9

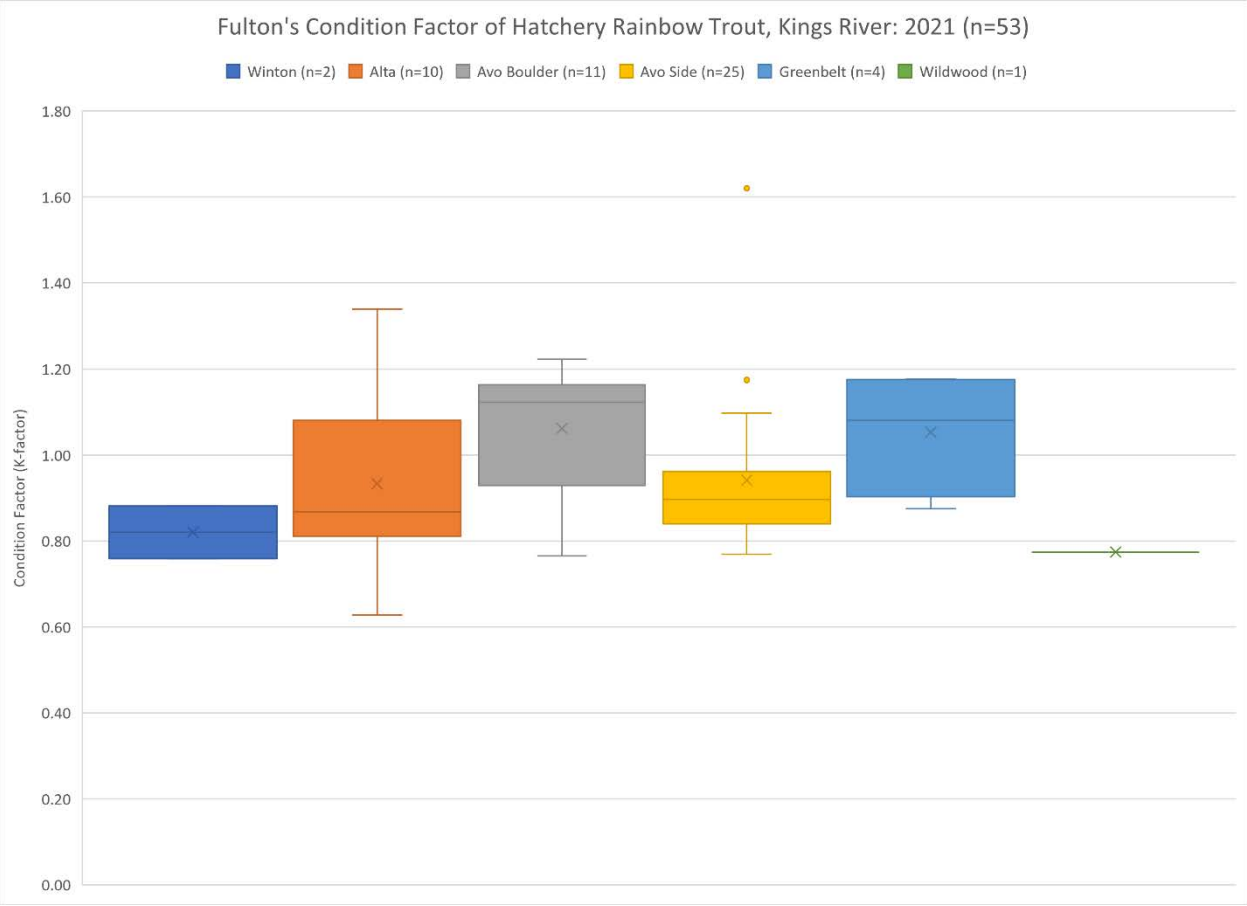

Figure 9. *Box plot of the calculated Fulton's K-factor by site for hatchery rainbow trout collected during the Fall Population Electro-fishing Survey, 2021. Outliers, mean, and median are indicated for each site.*

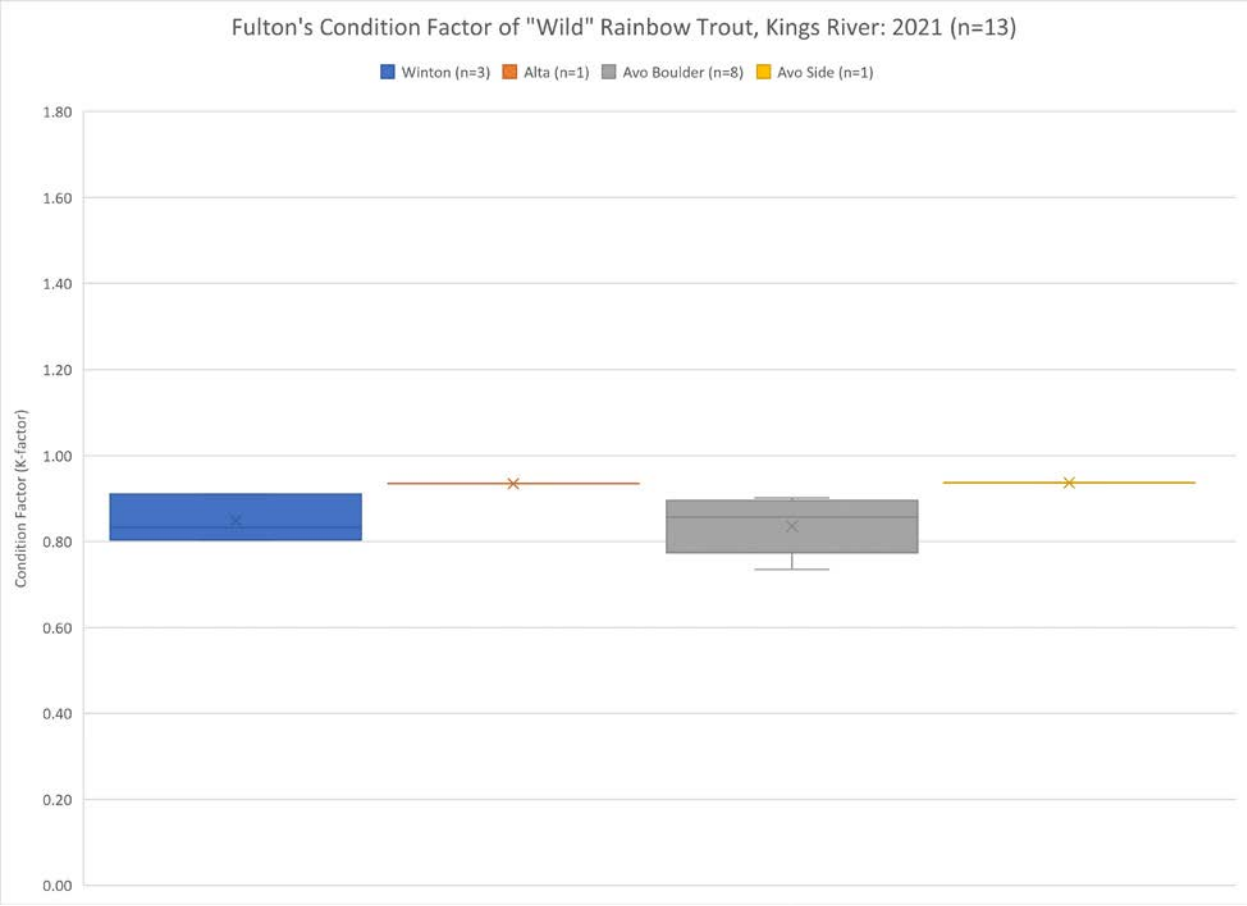

Figure 10. ***Box plot of the calculated Fulton's K-factor by site for "wild" rainbow trout collected during the Fall Population Electro-fishing Survey, 2021. Outliers, mean, and median are indicated for each site.***

Regression analysis allows another means to look at condition factor by analyzing the relationship between length-weight data. The relationship between length-weight data for the Kings River indicates a positive relationship for trout in the Kings River (Figure 11). For both brook trout and hatchery rainbow trout the regression slope is between 2.5 and 3.5 indicating these salmonids are in good condition. For brook trout the regression slope was 2.56 (R^2 = 0.67) and for hatchery rainbow trout was 3.27 (R^2 = 0.98). For "wild" rainbow trout, the regression slope was less than 2.5 (slope = 2.10, R^2 = 0.90), indicating these fish were in reduced condition compared to hatchery trout. This poorer condition may be an artifact of the small sample size, but also may be an indicator of the different conditions those fish experienced instream vs. the hatchery environment due to different thermal regimes, food availability, another variable not considered here, or some combination of variables.

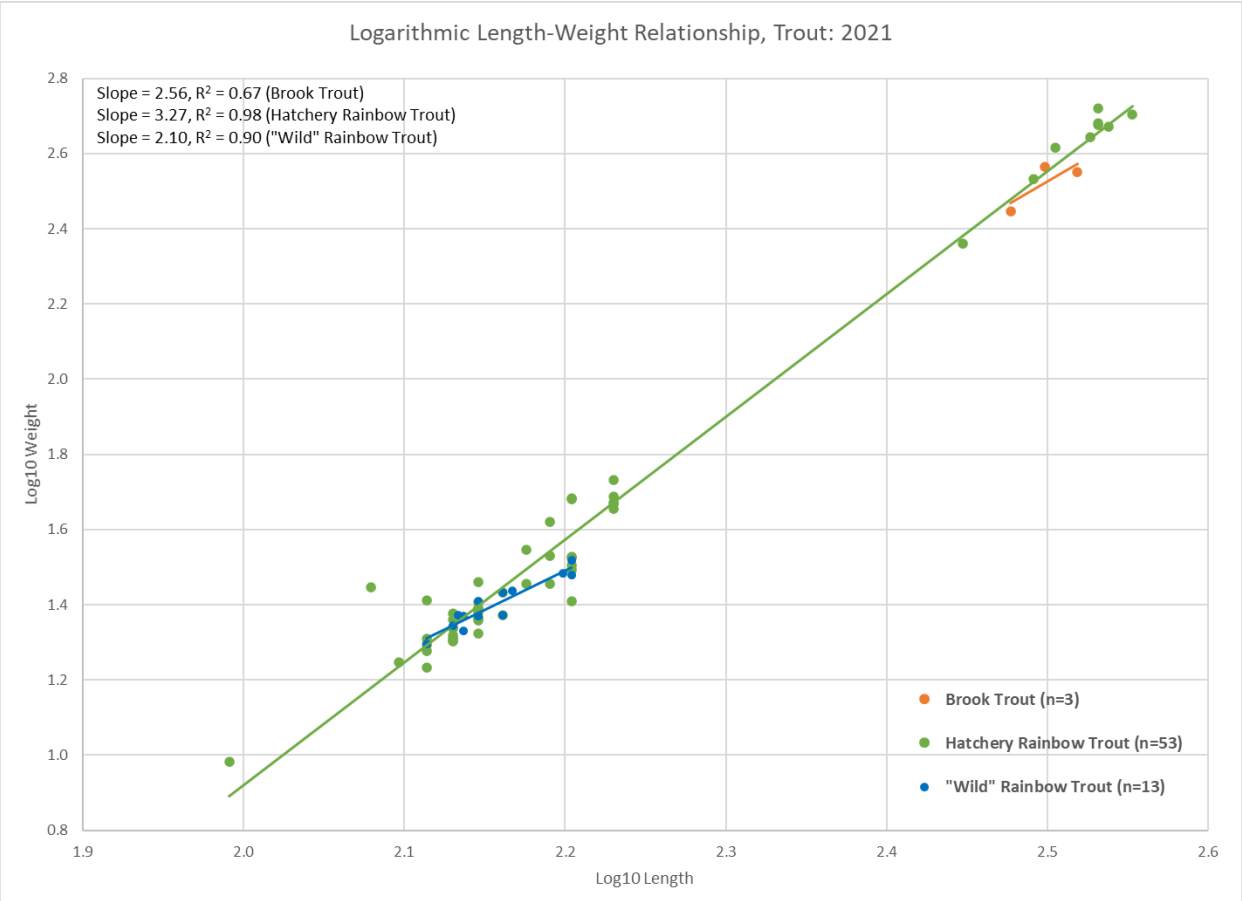

Figure 11. ***Logarithmic length-weight relationship for brook trout, hatchery rainbow trout, and "wild" rainbow trout captured during the Fall Population Electro-fishing Survey, 2021.***

It would be hypothesized that hatchery rainbow trout would be in good condition as they have reared in an environment where they are fed artificial diets at regular intervals daily prior to release. For hatchery rainbow trout, individuals in poorer condition may reflect the length of time between the stocking event and time of capture. It has been suggested that the number of days from a stocking event to capture date may influence condition factor of hatchery rainbow trout due to poor adaptability to river conditions from the hatchery environment (Araki et al. 2008, Araki & Schmid 2010, Olla et al. 1998). As "wild" trout are resident in the river, and thus best adapted to local conditions, it would be hypothesized that condition at time of capture is reflective of riverine conditions either recently experienced or ongoing, such as survival through recently unfavorable thermal conditions, 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 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. Influence of annual instream flow and temperature data while available at both the USACE Bridge and Fresno Weir, as well as in situ habitat conditions, which was not measured, were excluded from this analysis.

In 2021, 5,738 fish were collected during the Fall Population Electro-fishing Survey, with seven of the twelve species collected native to the watershed. Native fishes dominated the survey in abundance (98.5%) and biomass (95%), with introduced fish accounting for the remainder. In 2021 the KRFMP 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 different 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 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 both juvenile and adult life stages were collected for most taxa during the survey. Exceptions being the lack of immature three-spine stickleback and adult "wild" rainbow trout captured in the survey. 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. A lack of adult "wild" rainbow trout should not be interpreted to mean they are absent from 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, thus missing "wild" trout which may be present within the

unsampled area.. Catch results suggested that introduced non-native bass and catfish were able to successfully reproduce in the Kings River.

A summary of results from the 2021 Fall Population Electro-fishing Survey is provided in Table 14.

Table 14. *Summary results, Fall Population Electro-fishing Survey, 2021.*

Species Collected	Species Composition (%)	Range across Survey Sites			Captured Lengths (in)
		Population Estimates*	Fish per Mile (estimated)	Biomass (lbs)	
Sacramento Pikeminnow	29.91	114-464	2,006-8,166	0.6-4	1-15
Sacramento Sucker	29.00	39-549	686-9,662	3-182	1-22
California Roach	16.77	3-307	53-5,403	0.01-2	1-5
Sculpin	10.65	29-239	510-4,206	0.4-3	1-5
Lamprey	6.01	4-249	70-4,382	0.01-0.7	1-6
Three-spine Stickleback	6.00	5-221	88-3,890	0.005-0.3	1-2
Rainbow Trout - Hatchery[a]	0.96	1-27	18-475	0.05-7	4-14
Bass[a]	0.33	0-12	0-211	0-0.1	2-6
Rainbow Trout - "Wild"	0.23	0-8	0-141	0-0.5	5-6
Western Mosquitofish[a]	0.07	0-2	0-35	0-0.002	1
Brook Trout[a]	0.05	0-3	0-53	0-2	12-13
Catfish[a]	0.03	0-2	0-35	0-0.4	2-9

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

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

Sacramento suckers made up 29% of the catch in 2021. Population estimates per site ranged from 39 (95% CI, lower CI adjusted, 37-44) to 549 (95% CI, lower CI adjusted, 504-594) fish. Estimated fish per mile per site ranged from 686 to 9,662, and biomass ranged from 3 to 182 pounds. Lengths of captured fish ranged from 1 to 22 inches.

Sculpin made up 11% of the catch in 2021. Population estimates per site ranged from 29 (95% CI, lower CI adjusted, 22-47) to 239 (95% CI, lower CI adjusted, 232-246) fish. Estimated fish per mile per site ranged from 510 to 4,206, and biomass ranged from 0.4 to 3 pounds. Lengths of captured fish ranged from 1 to 5 inches.

In 2021 the native cyprinid species of California roach and Sacramento pikeminnow made up 17% and 30% of the catch respectively. California roach population estimates per site ranged from 3 (95% CI, lower CI adjusted, 3-3) to 307 (95% CI, lower CI adjusted, 300-314) fish. Estimated fish per mile per site ranged from 53 to 5,403, and biomass ranged from 0.01 to 2 pounds. Lengths of captured fish ranged from 1 to 5 inches. Sacramento pikeminnow population estimates ranged from 114 (95% CI, lower CI adjusted, (114-114) to 464 (95%,

lower CI adjusted, 221-719) fish. Estimated fish per mile per site ranged from 2,006 to 8,166, and biomass ranged from 0.6 to 4 pounds. Lengths of captured fish ranged from 1 to 15 inches.

Three-spine stickleback made up 6% of the catch in 2021. Population estimates per site ranged from 5 (95% CI, lower CI adjusted, 5-7) to 221 (95% CI, lower CI adjusted, 171-271) fish Estimated fish per mile per site ranged from 88 to 3,890, and biomass ranged from 0.005 to 0.3 pounds. Lengths of captured fish ranged from 1 to 2 inches.

Lamprey made up 6% of the catch in 2021. Population estimates per site ranged from 4 (95% CI, lower CI adjusted, 4-9) to 249 (95% CI, lower CI adjusted, 249-249) fish. Estimated fish per mile per site ranged from 70 to 4,382, and biomass ranged from 0.01 to 0.7 pounds. Lengths of captured fish ranged from 1 to 6 inches.

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. Trout reared by Calaveras Trout Farm under more natural conditions in cobble-bottomed raceways may also lead to misclassification. Additionally, no phenotypic distinction can be made between trout hatched in the incubator and those which were spawned instream. Due to the young 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.

Brook trout and hatchery rainbow trout are hatchery products stocked into the Kings River below Pine Flat Dam. They may be stocked as fingerlings, sub-catchables, catchables, super-catchables, and trophy trout, although not all size classes or species are stocked in all years (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.

Brook trout made up 0.05% of the catch in 2021. Population estimates per site ranged from 0 (95% CI, lower CI adjusted, 0-0) to 3 (95% CI, lower CI adjusted, 3-4) fish. Estimated fish per mile per site ranged from 0 to 53, and biomass ranged from 0 to 2 pounds. Lengths of captured fish ranged from 12 to 13 inches. Length-weight regression analysis and

calculations using Fulton's condition factor indicated brook trout in the Kings River were in good condition.

Hatchery rainbow trout made up 0.96% of the catch in 2021. Population estimates per site ranged from 1 (95% CI, lower CI adjusted, 1-1) to 27 (95% CI, lower CI adjusted, 25-33) fish. Estimated fish per mile per site ranged from 18 to 475, and biomass ranged from 0.05 to 7 pounds. Lengths of captured fish ranged from 4 to 14 inches, with 83% of the captured fish being sub-catchables. Length-weight regression analysis and calculations using Fulton's condition factor indicate hatchery rainbow trout in the Kings River were in good condition.

"Wild" rainbow trout made up 0.2% of the catch in 2021. Population estimates per site ranged from 0 (95% CI, lower CI adjusted, 0-0) to 8 (95% CI, lower CI adjusted, 8-10) fish. Estimated fish per mile per site ranged from 0 to 141, and biomass ranged from 0 to 0.5 pounds. Lengths of captured fish ranged from 5 to 6 inches. Length-weight regression analysis and calculations using Fulton's condition factor indicated "wild" rainbow trout in the Kings River were in poorer condition than hatchery rainbow trout at time of capture.

Of the introduced non-native fish, bass of the *Micropterus* genera were most abundant. In 2021 bass made up 0.3% of the catch. Population estimates per site ranged from 0 (95% CI, lower CI adjusted, 0-0) to 12 (95% CI, lower CI adjusted, 12-14) fish. Estimated fish per mile per site ranged from 0 to 211, and biomass ranged from 0 to 0.1 pounds. Lengths of captured fish ranged from 2 to 6 inches. Also detected in 2021 were catfish (0.03%) and western mosquitofish (0.07%).

The KRFMP should continue to remain vigilant to the presence of 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 to not 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: 1983-2021

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
Avo Boulder	Subset of Avocado Lake Boulder site	300	-	-	2007-2016, 2018-2019, 2021
Avo Side	Subset of Avocado Lake Side Channel site	300	-	-	2007-2019, 2021
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
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
Winton	Subset of historic Winton Park Boulder site, west of Thorburn Spawning Channel	300	-	-	2007-2016, 2018-2019, 2021

[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

[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	

[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: 2007-2021

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

APPENDIX C

Catastomidae – Sucker Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	42.78	50.55	52.35	34.73	32.69	44.67	**42.95**
2008	12.05	26.77	34.42	17.45	13.46	2.39	**17.41**
2009	3.77	17.95	25.60	9.15	5.93	3.12	**11.44**
2010	4.83	29.70	17.66	10.07	2.66	8.42	**12.19**
2011	7.52	20.86	7.97	9.82	2.02	10.45	**9.11**
2012	13.68	34.16	39.61	32.60	12.32	65.43	**33.07**
2013	50.99	40.49	37.35	11.40	6.60	19.94	**27.21**
2014	10.69	11.26	19.69	7.63	4.77	10.42	**10.71**
2015	50.13	51.06	35.69	36.84	3.45	2.80	**29.94**
2016	73.84	73.72	94.99	40.15	78.36	91.74	**76.66**
2017	-	-	-	40.57	17.39	-	**27.92**
2018	34.49	52.33	61.11	58.78	23.62	41.26	**43.47**
2019	4.95	-	28.72	22.27	6.99	23.28	**16.10**
2021	54.43	53.64	49.10	25.64	4.50	21.74	**35.37**

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)

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**

Table C4: Biomass (pounds) – Sacramento Sucker

Biomass (lbs), Sacramento Sucker							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	1.633	2.121	213.663	1.287	80.306	5.104	**304.113**
2008	8.658	2.839	178.663	3.512	126.274	0.766	**320.713**
2009	7.367	3.810	198.847	4.453	48.717	3.938	**267.133**
2010	12.506	4.788	69.056	12.619	4.300	0.900	**104.168**
2011	2.921	2.148	50.057	13.188	2.809	0.843	**71.967**
2012	2.526	5.256	83.659	17.235	3.490	8.385	**120.552**
2013	7.977	2.482	64.066	18.842	1.774	6.219	**101.360**
2014	6.729	3.205	48.276	11.677	17.894	6.177	**93.958**
2015	8.656	3.576	66.765	28.393	23.193	7.801	**138.383**
2016	14.999	4.223	37.121	11.987	5.163	11.249	**84.743**
2017	-	-	-	18.282	2.691	-	**20.973**
2018	6.936	6.898	40.975	26.547	2.705	9.848	**93.908**
2019	0.517	-	95.351	10.224	1.705	6.405	**114.201**
2021	3.114	3.043	182.394	40.247	20.023	2.287	**251.109**

APPENDIX D

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

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	0.00	0.00	0.00	0.17	0.34	0.00	**0.09**
2012	0.00	0.00	0.00	0.00	0.00	0.13	**0.02**
2013	0.00	0.00	0.00	0.00	0.65	0.00	**0.12**
2014	0.00	0.13	0.13	0.00	3.65	0.13	**0.58**
2015	0.00	0.14	0.00	0.18	7.91	0.49	**1.37**
2016	0.00	0.00	0.00	0.00	2.41	0.16	**0.44**
2017	-	-	-	0.00	0.31	-	**0.17**
2018	0.00	0.00	0.00	0.16	0.14	0.00	**0.04**
2021	0.00	0.00	0.00	0.00	1.70	0.56	**0.40**

Table D1b: Catch-per-unit Effort – Bluegill

Catch-per-Unit Effort (CPUE), Bluegill							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
2009	0.00	0.00	0.00	0.00	0.11	0.00	**0.02**
2016	0.00	0.00	0.00	0.00	0.16	0.00	**0.03**

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	0.12	0.00	0.00	0.00	0.00	0.00	**0.03**
2016	0.00	0.00	0.00	0.00	0.32	0.00	**0.05**
2017	-	-	-	0.00	0.52	-	**0.29**

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)

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)

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**

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**

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	**0.211**
2012	0.000	0.000	0.000	0.000	0.000	0.021	**0.021**
2013	0.000	0.000	0.000	0.000	0.254	0.000	**0.254**
2014	0.000	0.014	0.006	0.000	0.617	0.024	**0.662**
2015	0.000	0.075	0.000	0.218	1.358	0.123	**1.774**
2016	0.000	0.000	0.000	0.000	0.477	0.045	**0.522**
2017	-	-	-	0.000	1.079	-	**1.079**
2018	0.000	0.000	0.000	0.002	0.139	0.000	**0.140**
2021	0.000	0.000	0.000	0.000	0.315	0.119	**0.434**

Table D4b: Biomass (pounds) – Bluegill

Biomass (lbs), Bluegill							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2009	0.000	0.000	0.000	0.000	0.045	0.000	**0.045**
2016	0.000	0.000	0.000	0.000	0.026	0.000	**0.026**

Table D4c: Biomass (pounds) – Green Sunfish

Biomass (lbs), Green Sunfish							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2011	0.007	0.000	0.000	0.000	0.000	0.000	**0.007**
2016	0.000	0.000	0.000	0.000	0.102	0.000	**0.102**
2017	-	-	-	0.000	0.476	-	**0.476**

APPENDIX E

Cottidae – Sculpin Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	49.21	50.10	23.49	29.55	23.72	34.32	**35.32**
2008	22.18	22.67	20.16	12.52	3.79	5.82	**14.15**
2009	35.92	40.47	26.92	18.46	9.51	8.37	**23.38**
2010	51.67	42.74	28.23	23.02	14.80	11.82	**30.26**
2011	30.69	45.34	9.96	32.13	9.34	12.62	**21.33**
2012	42.96	33.73	32.42	24.32	13.08	12.70	**27.13**
2013	70.81	29.62	42.46	29.37	22.79	16.00	**34.57**
2014	33.76	6.83	17.16	9.22	4.77	7.68	**14.43**
2015	19.01	0.96	3.33	0.74	1.01	0.73	**4.75**
2016	28.77	5.09	3.60	0.78	5.94	0.16	**8.25**
2017	-	-	-	18.90	16.35	-	**17.51**
2018	58.27	87.35	22.42	26.96	32.45	16.39	**42.48**
2019	38.17	-	11.06	24.13	9.10	10.02	**19.60**
2021	29.03	9.00	3.62	7.25	9.36	12.21	**12.99**

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)

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**

Table E4: Biomass (pounds) – Sculpin

Biomass (lbs), Sculpin							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	7.037	5.396	3.328	2.993	4.040	3.375	**26.169**
2008	2.798	1.672	3.396	0.976	0.475	0.796	**10.114**
2009	4.517	2.741	3.608	1.623	1.579	1.619	**15.688**
2010	8.944	3.422	4.365	1.620	2.111	2.376	**22.838**
2011	5.359	2.504	2.219	2.761	1.371	2.452	**16.666**
2012	6.080	4.231	3.514	1.890	1.837	1.992	**19.543**
2013	8.172	1.634	4.592	1.931	2.163	1.972	**20.464**
2014	5.846	0.730	1.926	1.190	0.605	1.168	**11.464**
2015	3.503	0.151	0.502	0.077	0.195	0.176	**4.605**
2016	4.267	0.335	0.547	0.076	0.768	0.036	**6.029**
2017	-	-	-	1.303	1.797	-	**3.100**
2018	9.656	4.782	2.077	2.011	3.757	3.381	**25.663**
2019	4.188	-	0.940	1.467	0.910	1.813	**9.318**
2021	2.978	0.862	0.350	0.465	1.448	1.790	**7.893**

APPENDIX F

Cyprinidae – Minnow Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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

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

Catch-per-Unit Effort (CPUE), California Roach							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
2007	0.39	0.33	2.68	3.08	16.23	7.52	**5.19**
2008	0.00	1.02	12.74	2.82	29.54	41.34	**15.5**
2009	0.00	13.69	3.31	1.02	5.82	56.94	**11.87**
2010	0.71	2.99	7.38	1.20	13.09	54.46	**14.29**
2011	0.73	1.49	2.70	5.58	4.05	28.76	**7.52**
2012	0.00	3.19	9.08	4.01	15.21	20.01	**8.23**
2013	0.00	8.19	26.12	38.74	28.49	54.65	**26.95**
2014	2.16	12.77	24.48	11.38	24.97	60.30	**21.11**
2015	3.92	25.18	36.06	38.86	10.49	87.58	**34.06**
2016	1.51	61.65	53.79	32.39	14.29	95.70	**41.75**
2017	-	-	-	12.47	17.81	-	**15.39**
2018	0.00	0.67	6.95	1.57	8.69	37.14	**9.22**
2019	0.00	-	1.82	3.59	1.06	12.37	**3.53**
2021	0.30	3.97	6.59	10.96	10.69	82.68	**20.45**

Table F1b: Catch-per-unit Effort – Hardhead

Catch-per-Unit Effort (CPUE), Hardhead							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Overall**
2018	0.00	0.00	0.00	0.00	0.14	0.00	**0.02**

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	12.20	2.23	10.07	21.85	25.65	53.60	**20.15**
2008	8.23	2.56	21.68	8.29	20.13	14.03	**12.95**
2009	1.82	7.06	6.62	4.91	9.85	24.94	**8.79**
2010	1.29	2.04	4.34	1.68	8.73	11.27	**4.93**
2011	4.00	4.68	1.05	0.45	1.87	1.09	**2.16**
2012	0.13	1.47	5.19	22.58	8.05	17.06	**8.37**
2013	24.42	15.44	48.58	20.31	48.56	93.42	**43.97**
2014	16.22	6.07	34.73	6.49	16.41	36.99	**18.92**
2015	14.97	6.88	24.70	29.10	15.52	19.22	**18.02**
2016	7.12	13.57	26.22	1.94	6.42	7.26	**10.7**
2017	-	-	-	1.76	2.62	-	**2.23**
2018	0.49	1.48	1.89	0.78	19.28	5.39	**4.6**
2019	2.59	-	0.99	0.57	2.77	1.18	**1.71**
2021	29.64	25.83	22.90	14.12	28.92	83.92	**36.47**

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)

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)

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)

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**

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**

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**

Table F4a: Biomass (pounds) – California Roach

Biomass (lbs), California Roach							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	0.003	0.003	0.284	0.168	1.668	0.352	**2.478**
2008	0.000	0.065	1.056	0.136	2.098	1.447	**4.803**
2009	0.000	1.288	0.420	0.078	0.411	2.513	**4.710**
2010	0.021	0.593	0.802	0.116	0.548	3.076	**5.156**
2011	0.061	0.127	0.595	0.527	0.493	2.660	**4.461**
2012	0.000	0.632	0.968	0.217	0.917	1.062	**3.795**
2013	0.000	0.204	1.468	1.774	2.013	2.877	**8.336**
2014	0.038	0.319	2.131	0.483	1.752	3.827	**8.550**
2015	0.120	0.416	2.929	1.686	0.529	4.413	**10.093**
2016	0.031	1.083	4.154	1.482	0.599	3.237	**10.586**
2017	-	-	-	0.919	0.886	-	**1.805**
2018	0.000	0.056	0.508	0.150	0.322	3.196	**4.232**
2019	0.000	-	0.171	0.235	0.084	0.850	**1.341**
2021	0.010	0.211	0.338	0.346	0.663	2.403	**3.972**

Table F4b: Biomass (pounds) – Hardhead

Biomass (lbs), Hardhead							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2018	0.000	0.000	0.000	0.000	0.028	0.000	**0.028**

Table F4c: Biomass (pounds) – Sacramento Pikeminnow

Biomass (lbs), Sacramento Pikeminnow							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	0.252	0.052	1.617	0.271	0.939	1.161	**4.292**
2008	0.308	0.215	9.991	0.330	2.368	0.830	**14.042**
2009	0.324	1.556	4.803	0.642	1.167	2.556	**11.049**
2010	0.230	0.591	3.262	0.098	0.769	0.939	**5.888**
2011	0.187	0.084	0.381	0.135	0.231	0.192	**1.210**
2012	0.003	0.368	1.215	0.178	0.302	0.617	**2.683**
2013	0.550	0.833	7.842	0.963	1.976	5.568	**17.733**
2014	1.201	1.321	9.415	0.755	1.294	4.208	**18.194**
2015	0.547	0.394	3.243	1.370	1.056	1.786	**8.396**
2016	0.327	0.718	6.043	0.249	0.414	0.488	**8.239**
2017	-	-	-	0.056	0.309	-	**0.365**
2018	0.028	0.310	0.859	0.028	0.380	0.554	**2.160**
2019	0.106	-	1.139	0.021	0.257	0.111	**1.634**
2021	0.028	0.310	0.859	0.028	0.380	0.554	**2.160**

APPENDIX G

Gasterosteidae – Stickleback Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	1.05	3.45	0.94	2.24	0.00	1.84	**1.59**
2008	0.00	6.14	3.03	3.35	0.00	1.94	**2.24**
2009	0.13	5.74	2.32	2.88	0.56	3.77	**2.38**
2010	2.00	9.27	0.58	0.00	0.00	6.25	**3.27**
2011	1.09	8.09	1.05	0.89	0.16	0.41	**1.61**
2012	0.00	3.11	0.71	3.21	0.50	2.57	**1.76**
2013	2.15	10.08	0.88	1.56	1.94	12.43	**4.97**
2014	2.91	27.70	4.12	6.60	0.56	8.20	**8.17**
2015	5.70	4.27	1.73	3.68	0.00	1.09	**2.75**
2016	12.60	14.71	14.23	25.02	0.96	19.47	**14.11**
2017	-	-	-	3.65	8.59	-	**6.35**
2018	1.06	1.34	2.53	5.02	2.04	1.15	**1.98**
2019	0.90	-	2.15	1.29	0.66	0.74	**1.1**
2021	0.91	8.18	1.48	0.93	4.74	23.75	**7.31**

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)

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**

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	**0.108**
2008	0.000	0.091	0.043	0.017	0.000	0.061	**0.213**
2009	0.000	0.064	0.058	0.022	0.003	0.037	**0.184**
2010	0.025	0.101	0.006	0.000	0.000	0.087	**0.219**
2011	0.021	0.071	0.033	0.006	0.002	0.008	**0.142**
2012	0.000	0.042	0.011	0.023	0.004	0.023	**0.103**
2013	0.021	0.080	0.008	0.010	0.022	0.159	**0.299**
2014	0.043	0.317	0.050	0.059	0.009	0.085	**0.564**
2015	0.096	0.038	0.022	0.027	0.000	0.018	**0.200**
2016	0.189	0.059	0.175	0.365	0.007	0.242	**1.037**
2017	-	-	-	0.065	0.136	-	**0.200**
2018	0.015	0.014	0.028	0.048	0.024	0.016	**0.146**
2019	0.013	-	0.024	0.018	0.009	0.006	**0.069**
2021	0.008	0.097	0.015	0.005	0.065	0.268	**0.457**

APPENDIX H

Ictaluridae – Catfish Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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

Table H1: Catch-per-unit Effort – Catfish

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

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)

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**

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	**0.009**
2009	0.000	0.000	0.000	0.000	0.777	0.000	**0.777**
2012	0.000	0.000	0.000	0.000	0.002	0.032	**0.034**
2013	0.000	0.000	0.000	0.000	0.012	0.000	**0.012**
2014	0.007	0.000	0.004	0.004	0.120	0.000	**0.136**
2015	0.000	0.000	0.000	0.000	0.017	0.000	**0.017**
2018	0.000	0.000	0.000	0.000	0.871	0.000	**0.871**
2019	0.039	-	0.000	0.023	0.011	0.000	**0.073**
2021	0.000	0.000	0.000	0.000	0.871	0.000	**0.871**

APPENDIX I

Petromyzontidae – Lamprey Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	0.13	22.49	0.67	19.05	0.34	0.57	**7.46**
2008	0.29	8.01	0.76	13.22	0.26	0.00	**3.33**
2009	0.52	8.39	0.55	13.38	0.11	0.16	**3.31**
2010	0.00	8.96	1.01	6.72	0.19	0.68	**2.54**
2011	0.00	10.22	1.99	20.08	0.00	0.00	**3.9**
2012	0.00	8.88	2.71	10.15	0.50	0.00	**4.03**
2013	0.43	5.51	1.02	15.94	0.39	0.00	**3.54**
2014	0.19	13.79	5.32	23.56	0.42	0.13	**7.29**
2015	0.24	14.72	3.09	9.95	0.00	0.12	**4.26**
2016	0.41	24.51	3.90	26.77	0.32	0.00	**8.14**
2017	-	-	-	14.99	0.84	-	**7.27**
2018	0.16	9.53	1.58	23.98	0.81	0.69	**5.11**
2019	0.45	-	0.83	23.85	0.26	1.18	**5.1**
2021	0.40	19.52	5.27	23.04	0.85	1.23	**7.33**

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)

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**

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	**2.770**
2008	0.019	0.676	0.173	0.558	0.036	0.000	**1.462**
2009	0.038	0.501	0.035	0.681	0.007	0.006	**1.269**
2010	0.000	0.608	0.062	0.291	0.003	0.044	**1.008**
2011	0.000	0.437	0.218	1.068	0.000	0.000	**1.723**
2012	0.000	0.746	0.276	0.524	0.035	0.000	**1.581**
2013	0.030	0.262	0.063	0.904	0.023	0.000	**1.281**
2014	0.016	0.785	0.348	1.713	0.028	0.028	**2.918**
2015	0.022	0.647	0.295	0.434	0.000	0.008	**1.407**
2016	0.028	0.679	0.260	1.437	0.015	0.000	**2.419**
2017	-	-	-	0.997	0.039	-	**1.035**
2018	0.004	0.634	0.128	1.132	0.047	0.038	**1.981**
2019	0.025	-	0.065	1.326	0.006	0.039	**1.461**
2021	0.012	0.685	0.316	0.733	0.049	0.018	**1.814**

APPENDIX J

Poecillidae – Livebearer Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	0.00	0.34	0.00	0.00	0.00	0.00	**0.05**
2012	0.00	0.00	0.00	1.20	0.00	0.00	**0.18**
2013	0.00	0.16	0.00	0.00	0.00	0.00	**0.02**
2014	0.00	0.13	0.00	0.23	0.42	1.82	**0.4**
2015	0.24	3.17	0.00	0.00	1.87	2.31	**1.28**
2016	0.00	2.83	0.00	0.00	0.16	2.64	**0.87**
2021	0.00	0.00	0.00	0.00	0.00	0.45	**0.09**

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)

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**

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**

APPENDIX K

Salmonidae – Trout & Salmon Family

Multi-pass Depletion Summary Data: Fall, 2007-2021

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	0.12	1.10	0.00	0.24	0.00	0.00	**0.23**
2021	0.30	0.00	0.00	0.00	0.00	0.00	**0.06**

Table K1b: 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	1.18	3.56	0.27	0.70	0.00	0.00	**1.02**
2008	0.00	0.00	0.15	0.00	0.00	0.00	**0.03**
2009	0.39	0.15	0.00	0.00	0.00	0.00	**0.09**
2010	0.12	0.16	0.29	0.00	0.00	0.00	**0.1**
2011	0.00	0.00	0.70	0.67	0.00	0.00	**0.23**
2012	0.13	0.00	0.35	0.00	0.00	0.00	**0.08**
2013	0.29	0.16	0.15	0.16	0.00	0.00	**0.12**
2014	0.00	0.00	0.13	0.00	0.00	0.00	**0.02**
2015	0.00	0.00	0.12	0.00	0.00	0.00	**0.02**
2016	0.27	0.00	1.05	0.39	0.00	0.00	**0.3**
2017	-	-	-	0.50	0.10	-	**0.29**
2018	0.33	0.54	0.63	0.47	0.00	0.00	**0.31**
2019	0.00	-	4.29	1.15	0.00	0.00	**0.94**
2021	0.20	1.17	1.98	4.83	0.49	0.11	**1.17**

Table K1c: 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	0.92	0.45	1.07	0.00	0.34	0.00	**0.47**
2008	1.03	0.68	1.06	1.41	0.13	0.00	**0.69**
2009	0.65	0.15	1.21	0.34	0.00	0.00	**0.43**
2010	0.94	0.00	0.00	0.72	0.00	0.00	**0.29**
2011	0.00	0.64	0.59	0.45	0.00	0.00	**0.25**
2012	0.77	0.26	1.41	0.80	0.13	0.00	**0.55**
2013	0.43	0.00	0.58	0.62	0.00	0.00	**0.26**
2015	0.12	0.00	0.12	0.00	0.00	0.00	**0.05**
2016	0.00	0.00	0.30	0.78	0.00	0.16	**0.19**
2017	-	-	-	0.38	0.00	-	**0.17**
2018	0.08	0.27	1.11	1.25	0.00	0.00	**0.37**
2019	0.11	-	0.50	1.44	0.00	0.00	**0.39**
2021	0.30	0.12	1.32	0.19	0.00	0.00	**0.28**

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 – 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)

Table K2c: 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)

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 – 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**

Table K3c: 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**

Table K4a: Biomass (pounds) – Brook Trout

Biomass (lbs), Brook Trout							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2010	2.022	16.375	0.000	1.274	0.000	0.000	**19.670**
2021	2.210	0.000	0.000	0.000	0.000	0.000	**2.210**

Table K4b: Biomass (pounds) – Hatchery Rainbow Trout

Biomass (lbs), Rainbow Trout - Hatchery							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	0.557	2.349	0.158	0.439	0.000	0.000	**3.502**
2008	0.000	0.000	0.866	0.000	0.000	0.000	**0.866**
2009	1.545	0.479	0.000	0.000	0.000	0.000	**2.024**
2010	0.535	0.601	1.632	0.000	0.000	0.000	**2.767**
2011	0.000	0.000	7.393	2.466	0.000	0.000	**9.859**
2012	0.583	0.000	0.929	0.000	0.000	0.000	**1.512**
2013	0.855	0.645	0.144	0.147	0.000	0.000	**1.791**
2014	0.000	0.000	0.190	0.000	0.000	0.000	**0.190**
2015	0.000	0.000	1.179	0.000	0.000	0.000	**1.179**
2016	1.588	0.000	5.674	0.947	0.000	0.000	**8.209**
2017	-	-	-	3.368	1.576	-	**4.944**
2018	2.663	1.324	4.607	0.844	0.000	0.000	**9.439**
2019	0.000	-	9.029	2.471	0.000	0.000	**11.500**
2021	0.116	2.530	6.773	1.491	0.372	0.052	**11.335**

Table K4c: Biomass (pounds) – "Wild" Rainbow Trout

Biomass (lbs), Rainbow Trout - "Wild"							
Year	**Winton**	**Alta**	**Avo Boulder**	**Avo Side**	**Greenbelt**	**Wildwood**	**Total**
2007	0.532	0.205	5.331	0.000	0.143	0.000	**6.212**
2008	0.718	0.205	0.719	0.796	0.063	0.000	**2.501**
2009	1.008	0.109	2.843	0.511	0.000	0.000	**4.471**
2010	0.892	0.000	0.000	0.731	0.000	0.000	**1.624**
2011	0.000	0.378	5.792	0.510	0.000	0.000	**6.679**
2012	0.543	0.178	1.365	1.146	1.648	0.000	**4.879**
2013	0.418	0.000	0.528	0.447	0.000	0.000	**1.393**
2015	0.591	0.000	0.062	0.000	0.000	0.000	**0.653**
2016	0.000	0.000	0.736	0.615	0.000	0.655	**2.007**
2017	-	-	-	0.993	0.000	-	**0.993**
2018	0.066	0.183	1.278	0.878	0.000	0.000	**2.404**
2019	0.100	-	4.463	2.112	0.000	0.000	**6.675**
2021	0.171	0.052	0.449	0.057	0.000	0.000	**0.729**

APPENDIX L

Trout Stocking Information: 2007-2021

Table L1. *Number of trout stocked by CDFW in the Kings River below Pine Flat Dam, per year and size class, 2007-2021.*

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

Table L2. *Number of supplemental trout stocked in the Kings River below Pine Flat Dam, per year and size class, 2007-2021.*

Year	Catchable	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

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

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

APPENDIX M

Water Year Information: 2007-2021

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