TECHNICAL MEMORANDUM ◦ DECEMBER 2023

2023 Chorro Creek Pikeminnow Suppression Efforts

PREPARED FOR

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Cover photos: Efishing crew on Chorro Creek (top left), sculpin (top right), pikeminnow with Sacramento sucker found in stomach (bottom left) steelhead (bottom right).

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1 INTRODUCTION

Pikeminnow captured in Chorro Creek with a Sacramento sucker found in the stomach.

The Chorro Creek watershed supports a native population of steelhead (*Oncorhynchus mykiss*) along with a population of introduced Sacramento Pikeminnow (*Ptychocheilus grandis*). To benefit native steelhead (in the Chorro Creek watershed, a Sacramento Pikeminnow Management Plan (Management Plan) was developed for the Chorro Creek watershed in 2017 (Stillwater Sciences 2017). The Management Plan was developed with input from a diverse technical advisory committee ranging from local biologists to pikeminnow experts to specifically address the following recovery actions included in the South-Central California Coast Steelhead Recovery Plan: "develop and implement non-native species monitoring program to track status and impacts of non-native species of plants and animals on all steelhead life history stages, particularly rearing juveniles (NMFS 2013)." The Management Plan was partially funded and partially implemented from 2017 through 2020. In 2021, the Morro Bay National Estuary Program (MBNEP) was awarded sufficient funding to fully implement the Management Plan for three years (2021 – 2023) through the California Department of Fish and Wildlife (CDFW) Proposition 1 Restoration Grant Program. Additional effort was implemented in 2023 through concurrent studies occurring within the watershed including increased pikeminnow suppression and fish population monitoring within the Camp San Luis Obispo military base funded by the California State Military Department and sampling in tributaries under a mark-recapture study of steelhead using Passive Integrated Transponder (PIT) tags funded by the MBNEP. This report summarizes all stream capture data from the 2023 surveys and compares the results to data collected from 2017 through 2022.

1.1 Study Area

The Study Area for 2023 pikeminnow suppression efforts includes mainstem Chorro Creek from the tidal extent of Morro Bay upstream to Chorro Reservoir, as well as within San Luisito Creek, a tributary to Chorro Creek. The Study Area was divided into Study Reaches based primarily on access and landownership. The Study Reaches sampled in 2023 included Chorro Flats, Chorro Creek Ecological Reserve (CCER), Cal Poly, CDFW downstream of the Water Treatment Plant (d/s of WTP), CDFW upstream of the WTP (CDFW u/s of WTP), Camp San Luis Obispo (Camp SLO), California Men's Colony (CMC), and San Luisito (Figure 1). Within each Study Reach, sampling was conducted using either multi-pass electrofishing, single-pass electrofishing or angling. Multi-pass electrofishing locations sampled in 2023 are listed by Study Reach in Table 1. In addition, environmental DNA (eDNA) sampling was conducted within Chorro Reservoir in 2023.

Figure 1. Study Area and high priority sampling locations within Study Reaches of Chorro Creek.

Table 1. Study Reaches and multi-pass electrofishing locations sampled in 2023.

Study Reach	Multi-Pass Electrofishing Location
San Luisito	SL2
	SL1
CMC	TA4
Camp SLO	TA3[1]
	TA2
	TA1
CDFW u/s of WTP	--[2]
CDFW d/s of WTP	--[2]
Cal Poly	14.1
	14
	9.1
CCER	28
	25
	22.1
Chorro Flats	CF6
	CF5
	CF4
	CF3

[1] Site name updated in 2023 from CS1 to TA3.

[2] No multi-pass electrofishing location has been established. Sampled using single pass electrofishing.

2 METHODS

Pikeminnow suppression efforts utilize a combination of sampling techniques including snorkeling, backpack electrofishing (multi-pass and single pass), and angling as described in the Management Plan (Stillwater Sciences 2017). Most sampling efforts were conducted during the fall when stream flows are at their lowest and pikeminnow are concentrated into smaller areas. The majority of the habitat in Chorro Creek during this time of year is less than 1.2 meters (m) in depth, which facilitates efficient pikeminnow capture with a backpack electrofisher (Adams et al. 2011). eDNA sampling in Chorro Reservoir, however, was conducted in the spring to assess pikeminnow presence after reservoir suppression efforts conducted in 2022 (Stillwater Sciences 2022). Details of the approach are described below.

2.1 Snorkeling

Snorkeling was conducted within Study Reaches with multi-pass electrofishing locations to inform fish suppression efforts and prioritize sampling locations. Two snorkelers conducted single pass snorkel surveys moving in an upstream direction. Fish species observed were identified to species, assigned to a size bin (based on total length), and enumerated.

2.2 Multi-Pass Electrofishing

Multi-pass backpack electrofishing was conducted in habitat units previously selected for long term monitoring. Multi-pass electrofishing was conducted following methods by Pollock and Otto (1983) with the intention to capture as many pikeminnow as feasible, and to estimate habitat-unit specific density from which to determine the density of both steelhead and pikeminnow. Block nets were installed at the upstream and downstream ends of each multi-pass sampling unit to prevent migration in and out of the unit and to facilitate an accurate assessment of sample populations. Two biologists with Smith Root LR-24 backpack electrofishers and two or three netters began at the downstream block net and proceeded upstream, working closely together. As fish were captured (netted), they were placed in buckets with aerated stream water until the completion of the pass. A minimum of three passes were conducted within each multi-pass electrofishing location. If there was poor depletion after three passes, a fourth pass was performed.

All captured pikeminnow and steelhead were identified to species and measured to both standard length (SL) and fork length (FL). Other fish species captured were identified to species, enumerated, and a subset of up to 25 individuals were measured to SL and FL. All pikeminnow captured were humanely euthanized using methods included in the American Veterinary Medical Association (AVMA 2013) guidelines and all other fish were returned to the stream after measuring.

2.3 Single Pass Electrofishing

Single pass backpack electrofishing was conducted in Chorro Creek Study Reaches to remove pikeminnow, increase sample size for various habitat unit types, and document species distribution patterns and relative abundance for pikeminnow and steelhead. For locations sampled using single pass backpack electrofishing, two biologists with Smith Root LR-24 backpack electrofishers and two or three netters began at the downstream end of the habitat unit and proceeded upstream either to the top of the unit or through multiple units within a stream section. As fish were captured (netted), they were placed in buckets with aerated stream water. Once enough fish were captured or over 100 m of stream was sampled, fish were processed as discussed above in Section 2.2.

Electrofishing crew in Chorro Creek

2.4 Angling

Angling was conducted in locations previously identified as pikeminnow "hot spots" where subadult/adult pikeminnow (fish >180 mm SL) were previously observed in high abundance and where habitat conditions limit the effectiveness of backpack electrofishing due to depths >1.2 m or a combination of water depth and extensive cover (e.g., log jams and overhanging branches). Angling was conducted by one or two biologists using artificial lures with barbless hooks. All fish captured during angling were processed as discussed above in Section 2.2.

Large adult pikeminnow captured in Chorro Creek

2.5 eDNA Sampling

Water samples were collected from locations within Chorro Reservoir during the spring of 2023 and tested for pikeminnow DNA. Five water samples were collected including three locations in the main body of Chorro Reservoir, one where Chorro Creek flows into the reservoir, and one at the reservoir outlet. A field blank (distilled water) was also collected and tested for pikeminnow DNA to detect contamination associated with field collection practices. The water samples were immediately placed in a cooler on ice and sent to Cal Poly Humboldt for analysis.

Upon receiving the water samples, Cal Poly Humboldt immediately filtered the water over a cellulose nitrate filter. The samples were tested for pikeminnow DNA using an assay developed by Brandl et al. (2014). A PCR negative control (distilled water) and positive control (a tissue sample extracted from pikeminnow) were also tested.

2.6 Analysis

Fish capture data from the 2023 sampling effort were compared with results from previous sampling efforts conducted from 2017–2022 to assess trends in abundance and distribution. A length frequency histogram was generated to estimate pikeminnow and steelhead age classes based on fish size. Relative abundance for steelhead and pikeminnow was standardized to a unit length of 100 m by dividing the number of fish captured by the habitat unit length sampled during a given year, then multiplied by 100 m. Fish density estimates with 95% confidence intervals were calculated at habitat units surveyed by multiple pass depletion between 2017–2023 for steelhead and pikeminnow using the FSA: Fisheries Stock Assessment package, implemented in R (Ogle et al. 2020, R Core Team 2020).

3 RESULTS

A total of 2,075 pikeminnow have been removed from Chorro Creek during suppression efforts from 2017–2023, with 1,027 captured in 2023 alone (Table 2). The dramatic increase in the number of pikeminnow captured in 2023 was due to a high proportion of young-of-the-year (YOY) individuals with over 80% of the pikeminnow captured measuring less than 70 mm SL. The ratio of steelhead to all age classes of pikeminnow captured in 2023 was 3:10 which is much higher than in 2017 when the ratio of steelhead to pikeminnow captured was 1:10 but lower than the goal of 1:1 specified in the Management Plan (Table 2). Although the ratio of steelhead to all

age classes of pikeminnow has been variable across survey years, the ratio of steelhead to piscivorous sized pikeminnow (> 200 mm SL) has increased substantially since suppression efforts began in 2017; from 15:10 in 2017 to 60:10 in 2023 (Table 2).

Table 2. Fish captured and ratio of pikeminnow to steelhead in Chorro Creek during sampling conducted in 2017–2023.

Native or Introduced	Species	2017	2018	2019	2020	2021	2022	2023	Total
Native	Steelhead	23	107	260	479	238	188	354	**1,649**
	Speckled dace	122	99	317	255	208	162	1,175	**2,338**
	Three-spine stickleback	134	39	69	45	365	218	753	**1,623**
	Prickly sculpin	0	0	0	0	0	2	72	**74**
Introduced	Pikeminnow	224	88	218	117	191	209	1,027	**2,075**
	Sacramento sucker	180	26	173	146	935	273	2,648	**3,789**
	Largemouth bass	0	2	0	0	0	2	22	**26**
	Bluegill	0	0	2	0	39	21	103	**165**
	Green sunfish	0	0	0	1	0	0	0	**1**
	Mosquitofish	0	0	0	0	14	10	0	**24**
Total		**683**	**361**	**1,039**	**1,043**	**1,990**	**1,088**	**6,155**	**11,762**
Ratio of steelhead to pikeminnow (all age classes)		**1:10**	**12:10**	**12:10**	**41:10**	**12:10**	**9:10**	**3:10**	**8:10**
Ratio of steelhead to piscivorous pikeminnow (> 200 mm SL)		**15:10**	**40:10**	**79:10**	**141:10**	**61:10**	**32:10**	**60:10**	**63:10**

3.1 Age Class

Pikeminnow captured in 2023 ranged in length from 28 mm SL to 420 mm SL and steelhead ranged from 51 mm SL to 265 mm SL. Pikeminnow less than or equal to 70 mm SL are estimated to be young-of-year (YOY), while steelhead less than or equal to 120 mm SL are estimated to be YOY, based on the length frequency distribution of fish captured (Figure 2) and age-classes reported in literature (Moyle 2002, Bell et al. 2011, Hayes et al. 2008). Most steelhead captured in 2023 were YOY (40%) and age 1+ (42%) with some older individuals up to age 3+ while more than 80% of the pikeminnow captured were aged YOY. The remaining pikeminnow age class structure showed a typical distribution with fewer numbers of individuals from each succeeding age class: approximately 10% were aged 1+, 8% were aged 2+ or more, and a few pikeminnow were likely over age 4+ (Figure 2). The proportion of pikeminnow YOY across survey years was highest in 2017 (90%), followed by 2023 (81%), and was lowest in 2022 (21%). Pikeminnow recruitment appears to be highly variable across survey years and is likely dependent on hydrologic conditions and other environmental factors (Georgakakos 2020).

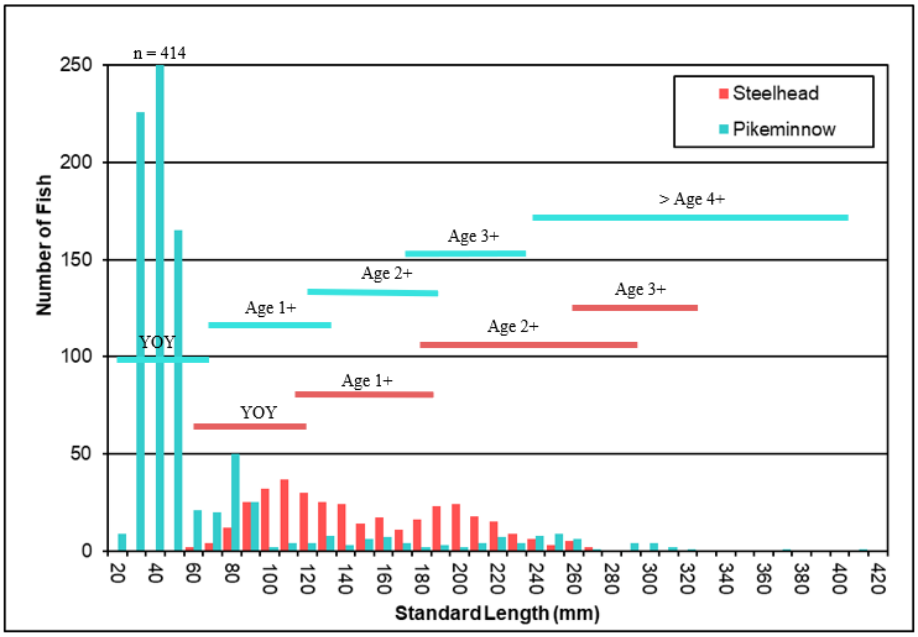

Figure 2. Length frequency distribution for pikeminnow and steelhead captured in 2023.

3.2 Composition

Eight fish species were captured in Chorro Creek during the 2023 sampling effort. Native species included steelhead, speckled dace (*Rhinichthys osculus***)**, three-spine stickleback (*Gasterosteus aculeatus*), and prickly sculpin (*Cottus asper*) while non-native species included pikeminnow, Sacramento sucker (*Catostomus occidentalis*), largemouth bass (*Micropterus salmoides*), and bluegill (*Lepomis macrochirus*) (Figure 3). Although pikeminnow capture numbers were the highest in 2023, the overall percent composition was relatively similar to prior survey years (Figure 3). Despite having captured the second highest number of steelhead across survey years, steelhead overall percent composition was the second lowest across survey years (Figure 3). Overall fish species composition in 2023 was dominated by Sacramento sucker and speckled dace, which comprised over half of the total catch (Figure 3).

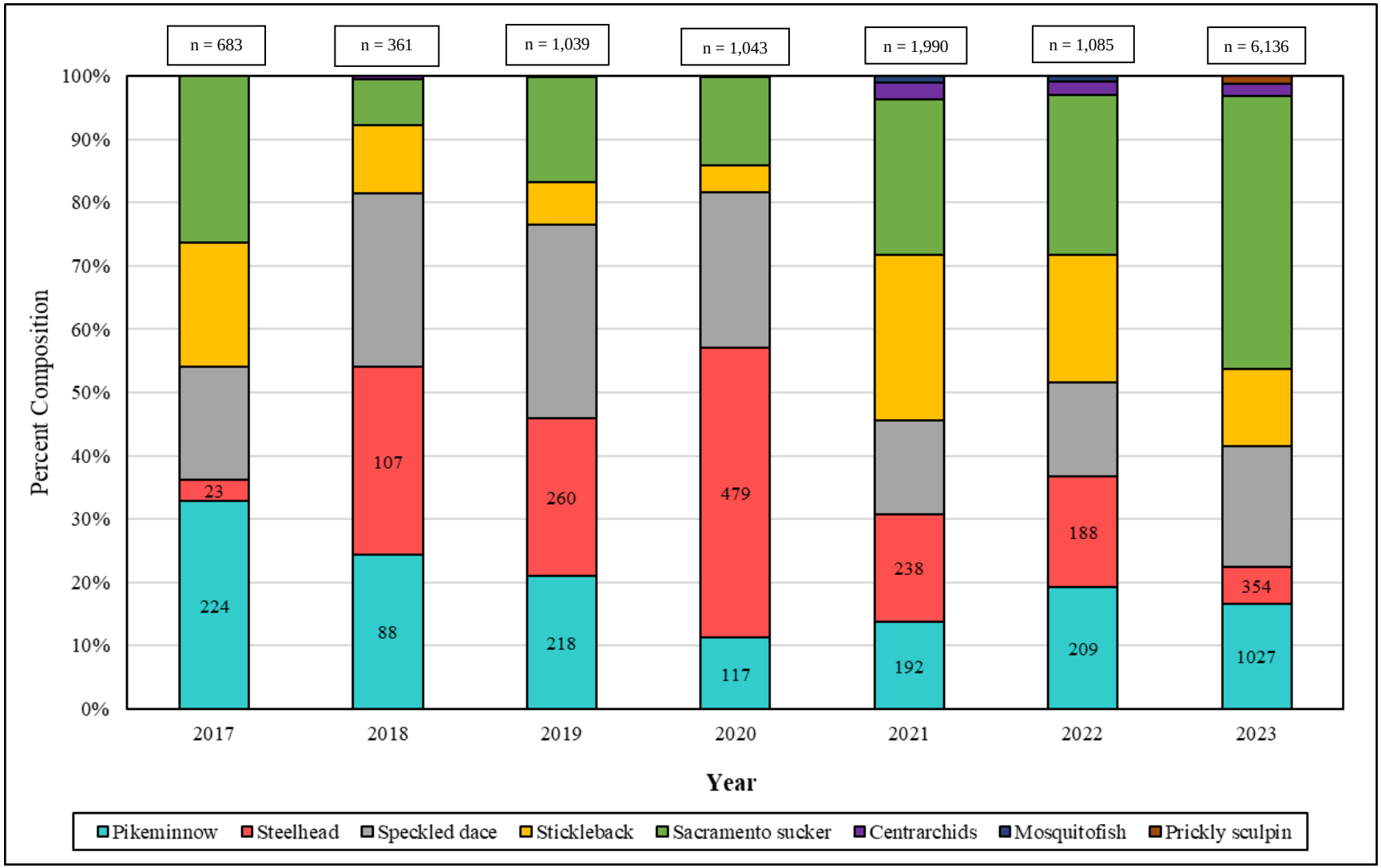

Figure 3. Percent composition for fish captured in Chorro Creek during sampling conducted in 2017–2023.
Note: centrarchids includes bluegill and bass.

3.3 Distribution

In general, pikeminnow distribution appears to be concentrated in the middle and upper Study Reaches. Pikeminnow snorkel observations were highest in the Cal Poly Study Reach while steelhead observations were highest in the CCER Study Reach (Table 3). Steelhead showed a similar distribution between most Study Reaches, with the following exceptions. The highest numbers of steelhead were captured in the downstream most Study Reach (i.e., Chorro Flats) and in San Luisito Creek while the lowest number of steelhead were captured at the upstream most Study Reach (i.e., CMC) (Figure 4). Pikeminnow capture numbers generally increased at each subsequent upstream Study Reach until Camp SLO, where pikeminnow numbers decreased. Backpack electrofishing efforts conducted in the CMC Study Reach resulted in high numbers of pikeminnow but only three steelhead captured (Figure 4). No steelhead had been captured in the CMC Study Reach in previous years.

Table 3. Fish species observations by Study Reach during snorkel surveys, 2023.

Snorkel Reach	Pikeminnow			Steelhead			
	≤200 mm	>200 mm	Total	≤100 mm	101–200 mm	201–300 mm	Total
Chorro Flats	4	0	**4**	5	5	1	**11**
CCER	0	0	**0**	8	15	0	**23**
Cal Poly	37	24	**61**	1	2	4	**7**
Camp SLO	3	14	**17**	0	0	11	**11**

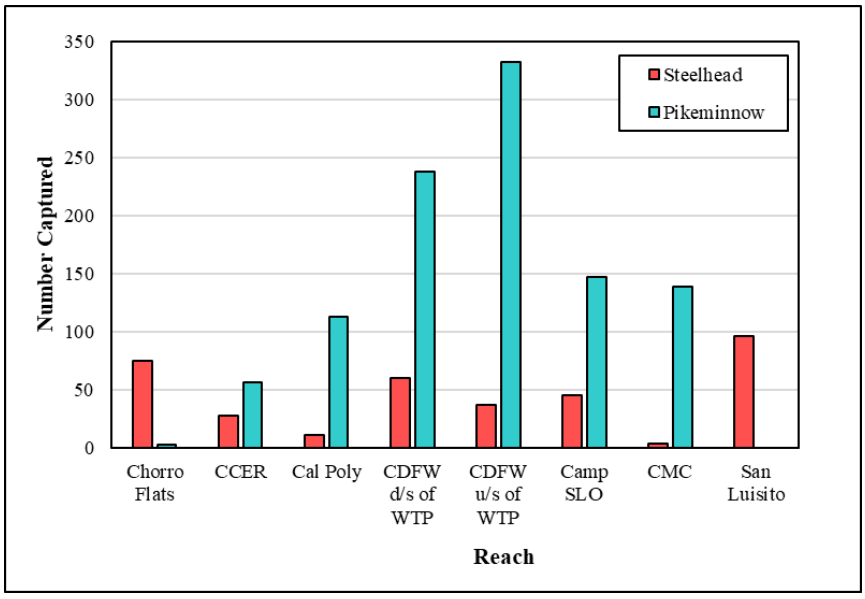

Figure 4. Steelhead and pikeminnow catch numbers (all methods) by Study Reach (from downstream [left] to upstream [right], and San Luisito Creek, 2023.

3.4 Abundance and Density

Juvenile steelhead captured in Chorro Creek

Pikeminnow abundance and density increased in 2023, largely due to an increase in the number of YOY pikeminnow captured (Figure 5). Pikeminnow abundance was highest in the CDFW u/s of the WTP Study Reach, followed by the Cal Poly Study Reach (Figure 5). Pikeminnow densities were highest at the Cal Poly 9.1 site followed by the Camp SLO TA2 site, a site that had not previously been sampled prior to 2023. In 2023, pikeminnow less than 70 mm SL were more abundant than steelhead of the same size class, whereas steelhead greater than 70 mm SL were more abundant than pikeminnow of the same size class (Figure 5). Steelhead abundance and density in 2023 was slightly lower than most other years of sampling (Figure 5 and Figure 6). Steelhead abundance was highest in the San Luisito Creek Study Reach, followed by the Chorro Flats Study Reach (Figure 5) and steelhead densities were also highest in the San Luisito Creek Study Reach sites. However, within the mainstem Chorro Creek Study Reaches, steelhead densities were highest within the CCER Study Reach Sites (Figure 6).

Pikeminnow abundance fluctuated between years and was most apparent in pikeminnow less than 70 mm SL (Figure 5). Steelhead abundance also fluctuated between years but was lowest during 2017 when only a few fish greater than 70 mm SL were captured (Figure 6).

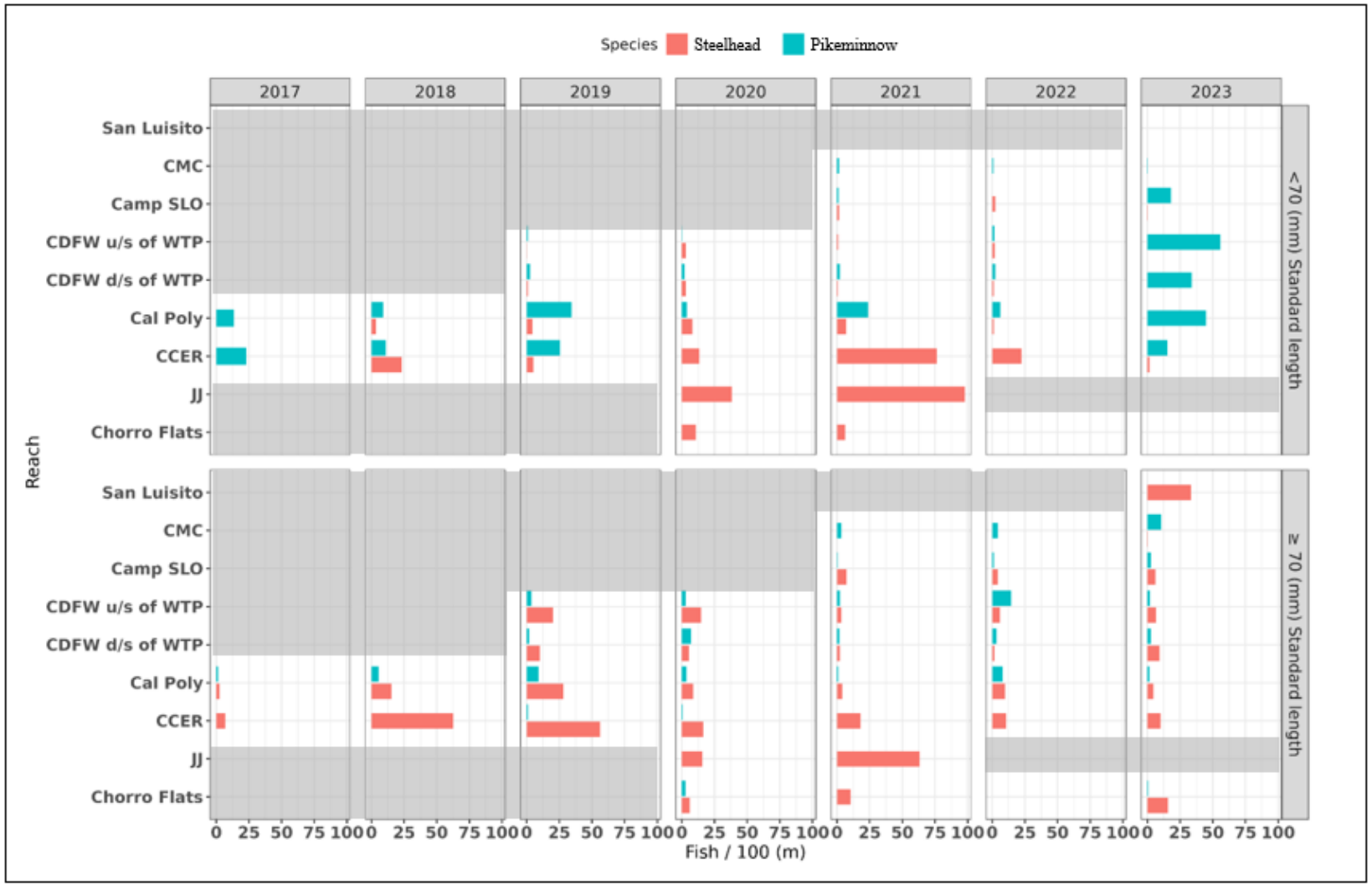

Figure 5. Relative abundance of steelhead and pikeminnow by Study Reach based on single pass electrofishing (single pass includes 1st pass from multi-pass locations and single pass locations) conducted in Chorro Creek from 2017–2023.

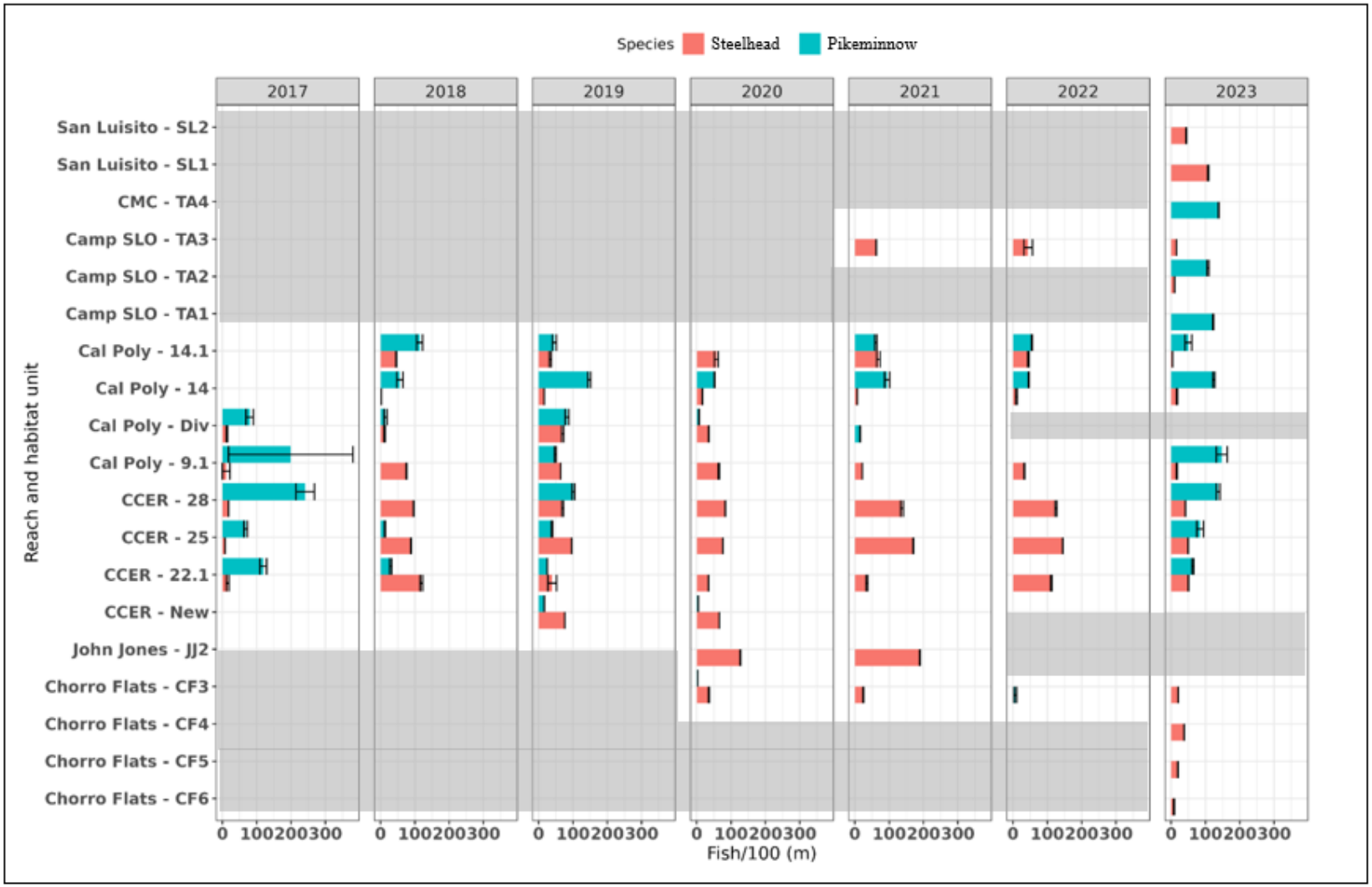

Figure 6. Estimated density for pikeminnow and steelhead with 95% C.I.s for multi-pass backpack electrofishing units in Chorro Creek 2017-2023.

3.5 eDNA Sampling

Pikeminnow DNA was not detected in any of the five water samples collected during the Spring eDNA sampling effort. The results suggest that previous pikeminnow suppression efforts within Chorro Reservoir were likely successful in eradicating pikeminnow from Chorro Reservoir.

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