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TECHNICAL MEMORANDUM

DATE: January 8, 2025

TO: Carolyn Geraghty, Morro Bay National Estuary Program

FROM: Matt McKechnie, Stillwater Sciences

SUBJECT: 2024 Chorro Creek Pikeminnow Suppression

1 INTRODUCTION

Chorro Creek, a tributary to Morro Bay, supports federally threatened steelhead/rainbow trout (*Oncorhynchus mykiss*, hereafter referred to as steelhead) belonging to the South-Central California Coast Distinct Population Segment and a population of non-native Sacramento pikeminnow (*Ptychocheilus grandis*, hereafter referred to as pikeminnow). The steelhead population in Chorro Creek is of particular value to the Distinct Population Segment, owing in large part to unique aspects of the watershed in the region, including perennial flows and the absence of lagoon sandbars. These characteristics allow steelhead, both adults and smolts, year-round migratory opportunities between the creek and Morro Bay, a large, productive estuary.

Pikeminnow with a juvenile Sacramento sucker found in its stomach

Non-native piscivores, especially pikeminnow, pose a significant threat to the recovery of native salmonids throughout the state of California (CDFW 2008). Non-native piscivores have deleterious effects on nearly all salmonid life stages through both direct and indirect interactions. Pikeminnow have been documented to compete with and prey on juvenile steelhead, and pikeminnow greater than 200 millimeter (mm) (standard length [SL]) feed almost exclusively on fish and crayfish, although pikeminnow less than 100 mm SL have been documented to consume fish as well (Nakamoto and Harvey 2003, Brown and Moyle 1997, Stillwater Sciences 2023). Jarrett et al. (2019) determined pikeminnow predation on steelhead to be substantial within Chorro Creek, finding that nearly 20% of captured pikeminnow had consumed steelhead within approximately 17 hours of capture.

Stillwater Sciences, in collaboration with the Morro Bay National Estuary Program, California Conservation Corps, the Watersheds Stewards Program, and the California Military Department at Camp San Luis Obispo, has been conducting pikeminnow suppression efforts in the watershed since 2017. This report summarizes fish capture data from the 2024 pikeminnow suppression effort and compares the results with data collected from 2017 through 2023.

1.1 Study Area

The Study Area for 2024 pikeminnow suppression efforts includes mainstem Chorro Creek from the tidal extent of Morro Bay upstream to Chorro Reservoir. The Study Area was divided into Study Reaches based primarily on access and landownership. Within each Study Reach, sampling was conducted using either multiple-pass or single-pass electrofishing. Multiple-pass electrofishing locations (index sites) sampled in 2024 were renamed to standardize the naming convention and better convey location within the watershed (Table 1). The Study Reaches sampled in 2024 included Chorro Flats, Chorro Creek Ecological Reserve, Cal Poly, California Department of Fish and Wildlife downstream of the wastewater treatment plant, Camp San Luis Obispo, and the California Men's Colony (Figure 1).

Table 1. Study Reaches and index sites sampled in 2024.

Study Reach	Index Site ID	Updated Index Site IDs
Chorro Flats	CF6	CC01
	CF5	CC02
	CF4	CC03
	CF3	CC04
Chorro Creek Ecological Reserve	22.1	CC07
	25	CC08
	28	CC09
Cal Poly	9.1	CC10
	14	CC12
	14.1	CC13
California Department of Fish and Wildlife	--[a]	--[a]
Camp San Luis Obispo	TA1	CC14
	TA2	CC15
	TA3	CC16
California Men's Colony	TA4	CC17

[a] No multiple-pass electrofishing location has been established. Sampled using single-pass electrofishing.

Figure 1. Study Area and index sites sampled in 2024.

2 METHODS

2.1 Snorkel Surveys

The California Conservation Corps conducted snorkel surveys within Study Reaches with index sites prior to electrofishing surveys to guide pikeminnow suppression efforts to locations with high pikeminnow abundance. 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 [TL]), and enumerated. Surveyors documented locations with high pikeminnow densities, and these locations were prioritized for sampling.

2.2 Multiple-Pass Electrofishing

Multiple-pass electrofishing was conducted following methods by Pollock and Otto (1983), wherein captured fish are temporarily removed from the sample site during sequential passes and returned to the stream once sampling is completed. Block nets were installed at the upstream and downstream extent of each index site to prevent migration into or out of the site and 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, they were placed in buckets with aerated stream water until the completion of the pass. A minimum of three passes were conducted within each index site. If there was poor depletion after three passes, a fourth pass was performed.

Captured steelhead and pikeminnow were identified to species and measured to SL and fork length (FL). Other captured fish species were identified to species and enumerated, and a subset of up to 25 individuals was measured to SL and FL. All captured pikeminnow and other non-native piscivorous fish species 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 they were measured.

Index site within the Chorro Creek Ecological Reserve Study Reach

2.3 Single-Pass Electrofishing

Single-pass electrofishing was used to remove pikeminnow and document species distribution patterns for and relative abundance of steelhead and pikeminnow. 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 until enough fish were captured or 100 meters of stream were sampled. As fish were captured, they were placed in buckets with aerated stream water. Fish were processed as described in Section 2.2.

3 ANALYSIS

Fish capture data from multiple-pass electrofishing were used to assess trends in abundance and distribution within index sites. A length frequency histogram was generated to estimate steelhead and pikeminnow age classes based on fish size. Depletion data from multiple-pass electrofishing were used to estimate density of steelhead and pikeminnow within index sites. Fish density estimates with 95% confidence intervals were calculated for each index site and suppression year using the Fisheries Stock Assessment package (Ogle et al. 2020, R Core Team 2020).

4 RESULTS

In 2024, 10 days of pikeminnow suppression efforts were conducted in Chorro Creek, resulting in the capture of 1,577 fish from eight different species (Table 2). Captured non-native piscivores included 596 pikeminnow, 13 largemouth bass (*Micropterus salmoides*), and 52 bluegill (*Lepomis macrochirus*) (Table 2). The ratio of steelhead to pikeminnow increased slightly, from 1:3 in 2023 to 2:3 in 2024, likely due to the decreased number of young-of-the-year (YOY) pikeminnow captured.

Steelhead captured in the Cal Poly Study Reach

Table 2. Captured fish and ratio of steelhead to pikeminnow in Chorro Creek during sampling conducted in 2017–2024.

Native or Non-native	Species	2017	2018	2019	2020	2021	2022	2023	2024	Total
Native	Steelhead	23	107	260	479	238	188	258	409	**1,962**
	Speckled dace	122	99	317	255	208	162	1,175	282	**2,620**
	Three-spine stickleback	134	39	69	45	365	218	753	85	**1,708**
	Sculpin	0	0	0	0	0	2	72	8	**82**
Non-native	Pikeminnow	224	88	218	117	191	209	1,027	596	**2,670**
	Sacramento sucker	180	26	173	146	935	273	2,648	132	**4,513**
	Largemouth bass	0	2	0	0	0	2	22	13	**39**
	Bluegill	0	0	2	0	39	21	103	52	**217**
	Green sunfish	0	0	0	1	0	0	0	0	**1**
	Mosquitofish	0	0	0	0	14	10	0	0	**24**
Total		**683**	**361**	**1,039**	**1,043**	**1,990**	**1,085**	**6,058**	**1,577**	**13,836**
Ratio of steelhead to pikeminnow (all age classes)		1:11	2:1	2:3	5:1	2:1	3:1	1:3	2:3	**3:4**

4.1 Length Frequency and Age-Class Distribution

Pikeminnow ≤ 70 mm SL and steelhead ≤ 120 mm FL were estimated to be YOY, based on the length frequency distribution of captured fish (Figure 2) and age-classes reported in literature (Moyle 2002, Bell et al. 2011, Hayes 2008). Pikeminnow captured in 2024 ranged in length from 30 to 330 mm SL, and steelhead ranged from 57 to 302 mm FL. Most steelhead captured in 2024 were YOY (69%) and age 1+ (28%) with some older individuals up to age 3+. The number of captured YOY pikeminnow decreased in 2024 compared with 2023, while the number of captured YOY steelhead increased in 2024 compared with 2023. The majority of captured pikeminnow were YOY (51%), and the population showed a typical age-class distribution, with fewer numbers of individuals from each succeeding age class (Figure 2).

Adult pikeminnow captured in Chorro Creek

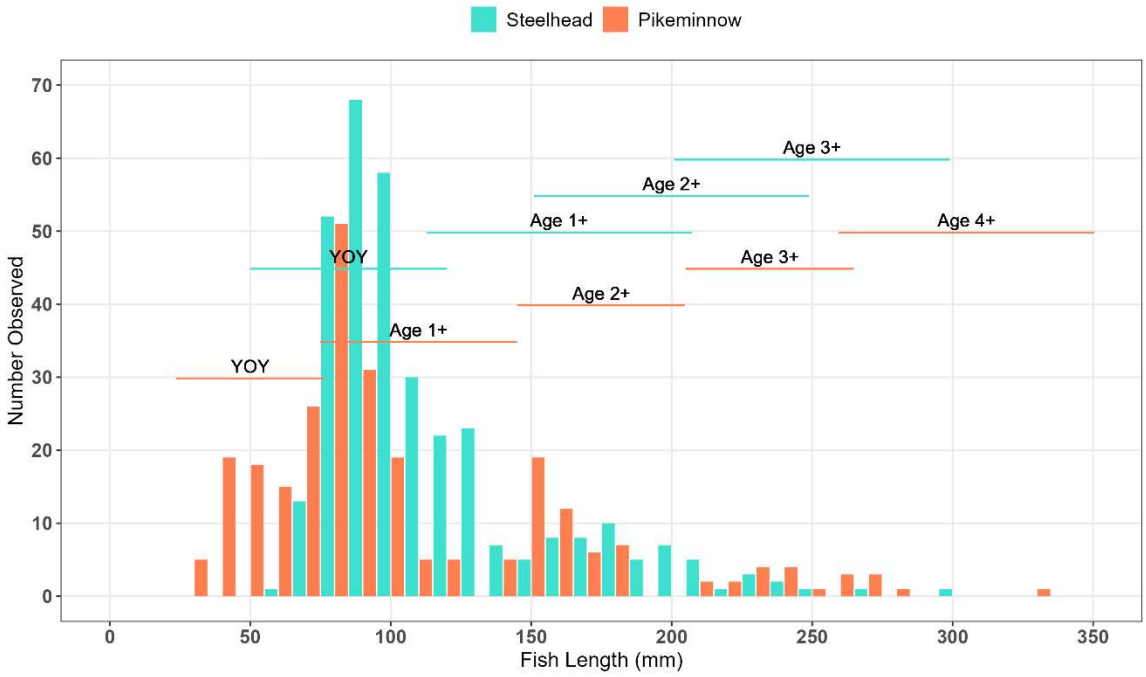
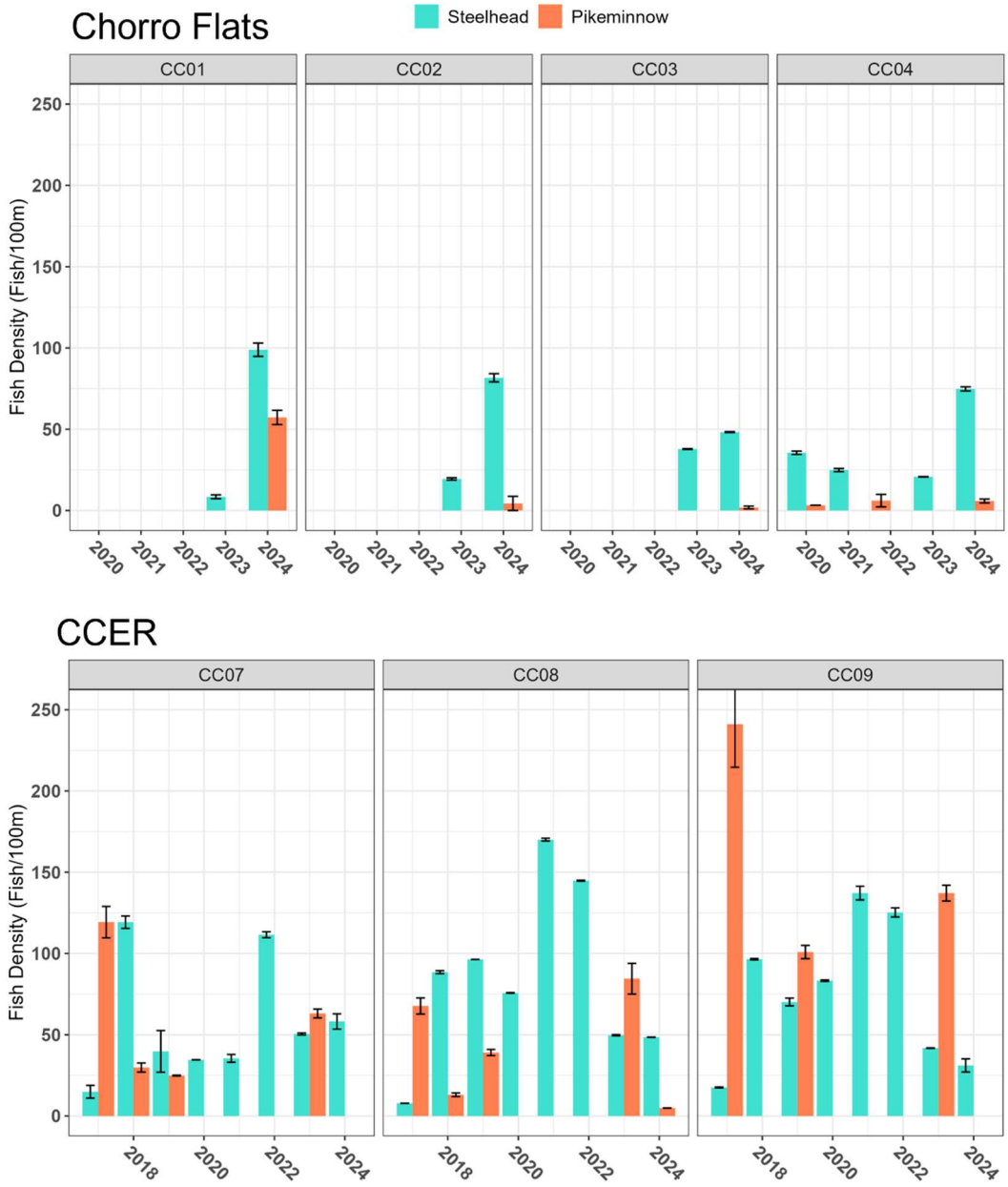


Figure 2. Length frequency and age-class distribution of captured steelhead and pikeminnow during suppression efforts in 2024.

4.2 Abundance and Density

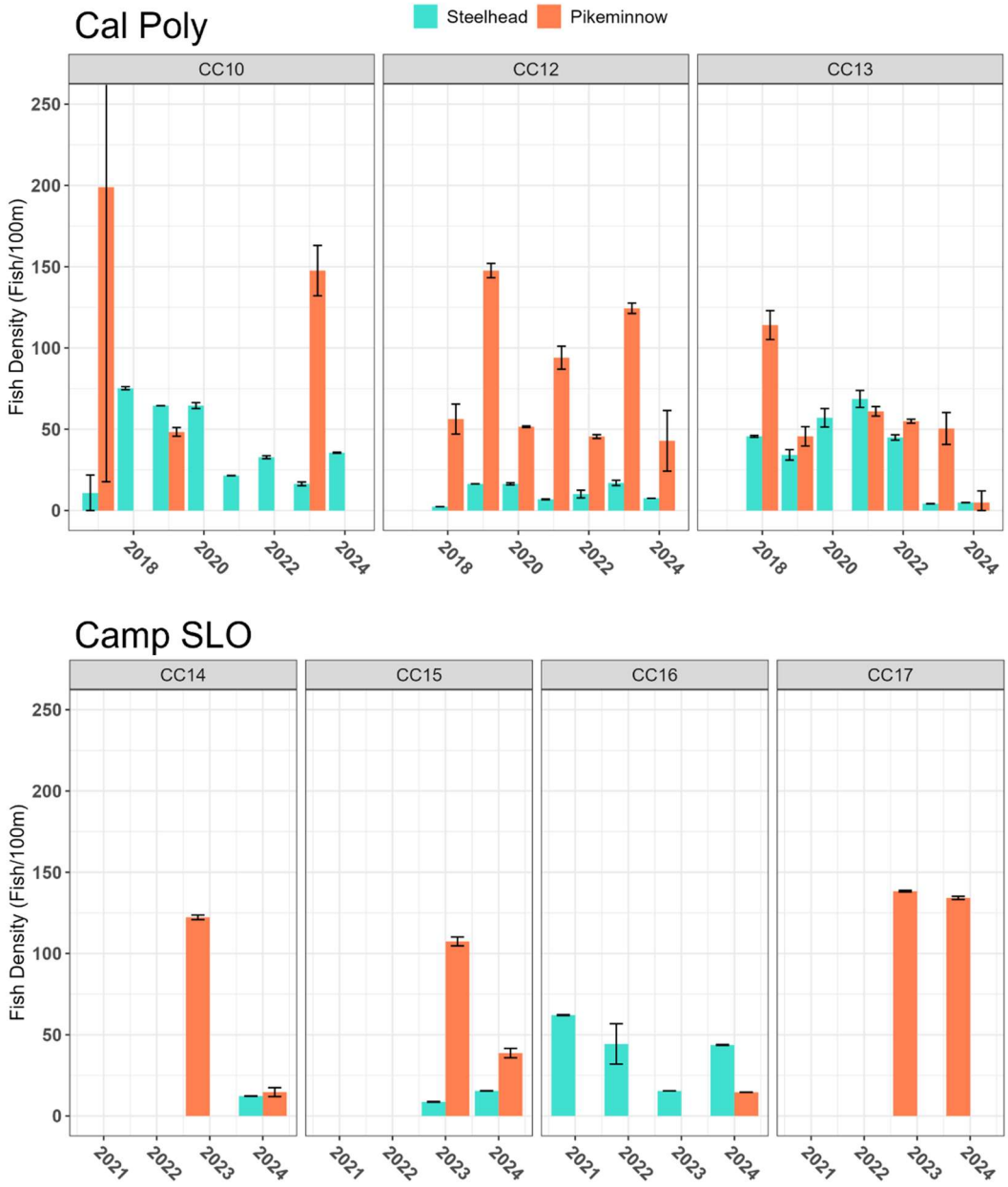
From 2023 to 2024, steelhead densities generally increased at most index sites and were highest at index sites in the Chorro Flats Study Reach (Figures 3 and 4). Steelhead densities generally decreased in the upstream direction, while pikeminnow densities increased (Figures 3 and 4). Pikeminnow were captured at 11 of the 14 index sites sampled in 2024 and were more broadly distributed across index sites in 2024 compared with 2023 (Figures 3 and 4). However, pikeminnow densities were lower in 2024 than in 2023 at most index sites sampled, and densities decreased substantially at index sites in the Chorro Creek Ecological Reserve, Cal Poly, and Camp San Luis Obispo Study Reaches (Figures 3 and 4). Steelhead were captured at 13 of the 14 index sites sampled in 2024. However, steelhead are rare in Chorro Creek upstream of Kern Avenue near the California Men's Colony, with only three captured during single-pass electrofishing and none observed within index site CC17.

Habitat conditions at index site CC17



Note: In 2017, the upper confidence interval for pikeminnow at index site CC09 was 268.

Figure 3. Estimated density for steelhead and pikeminnow with 95% confidence intervals for index sites in the Chorro Flats and Chorro Creek Ecological Reserve Study Reaches.



Note: In 2017, the upper confidence interval for pikeminnow at index site CC10 was 380.

Figure 4. Estimated density for steelhead and pikeminnow with 95% confidence intervals for index sites in the Cal Poly and Camp San Luis Obispo Study Reaches.

5 DISCUSSION

Stillwater Sciences' pikeminnow suppression work in the Chorro Creek watershed has shown that pikeminnow abundance tends to increase in the upper portion of the watershed, beginning just downstream of the wastewater treatment plant and increasing in the upstream direction on Camp San Luis Obispo and the California Men's Colony. Portions of these Study Reaches were sampled for the first time in 2023 and 2024, filling in gaps in understanding pikeminnow distribution within the Study Area. Stillwater Sciences continues to observe a high abundance of pikeminnow in the upstream portion of the Study Area, especially in the California Men's Colony Study Reach.

In general, pikeminnow density estimates show an overall decline within the index sites in 2024 compared with 2023 with a subsequent increase in steelhead densities. Data from suppression efforts over the 2017 to 2024 period indicate rainfall is a significant predictor of YOY pikeminnow densities, with pikeminnow exhibiting high levels of recruitment during years with higher rainfall (Stillwater Sciences 2024). This trend could explain why higher densities of YOY pikeminnow were observed in 2023 when compared with densities in 2024. Data from suppression efforts over the 2017 to 2024 period have shown that steelhead densities within index sites generally increase after the initiation of suppression; however, densities tend to fluctuate during each subsequent suppression year (Stillwater Sciences 2024). As such, there tends to be diminishing returns from sampling index locations after the first round of suppression in terms of increasing steelhead densities. Nonetheless, results suggest that suppression efforts are benefiting the steelhead population in Chorro Creek.

6 RECOMMENDATIONS

The results from the 2024 Chorro Creek pikeminnow suppression suggest that suppression efforts are benefiting the steelhead population in Chorro Creek. Stillwater Sciences recommends implementing the following actions to refine the management approach to achieve a more effective management strategy assuming similar budget and resources:

- Continue to conduct annual suppression activities to limit the pikeminnow population and support steelhead recovery;
- Consider bi-annual or less frequent index site monitoring instead of annual monitoring and reallocate resources for increased effort over a broader area;
- Increase the spatial scale of single-pass electrofishing to include the full extent of Chorro Creek upstream of the Cal Poly Study Reach where pikeminnow abundance is highest; and
- Identify areas with high pikeminnow abundance and prioritize those locations for higher intensity electrofishing.

7 REFERENCES

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