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2020 Chorro Creek Pikeminnow Suppression



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Cover photos: Chorro Creek riffle habitat (top left), juvenile steelhead (top right), adult Sacramento pikeminnow (bottom right) and backpack electrofishing crew in Chorro Creek (bottom right).

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1 INTRODUCTION

In 2017 a Sacramento Pikeminnow (*Ptychocheilus grandis*) Management Plan (Management Plan) was developed to benefit native steelhead (*Oncorhynchus mykiss*) with input from a diverse technical advisory committee ranging from local biologists to pikeminnow experts (Stillwater Sciences 2017). The Management Plan has yet to be fully funded but has been partially implemented each year since beginning in 2017 and continuing through 2020. While limited funding has prevented full implementation of the Management Plan, the number of juvenile steelhead captured has increased substantially following the Sacramento pikeminnow (pikeminnow) management that has been conducted to date. Furthermore, genetic testing of the gut contents from pikeminnow captured in Chorro Creek suggests that predation on juvenile steelhead by pikeminnow is much higher than previously estimated (Jarrett et al. 2019). The Management Plan and implementation efforts have specifically addressed a recovery action that was 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).”

2 BACKGROUND

This project builds off pikeminnow removal efforts conducted from 2005 through 2008 in Chorro Reservoir (HTC 2008) and efforts conducted from 2008–2011 in Chorro Creek (Halligan and Otte 2011). Pikeminnow removal efforts within Chorro Reservoir have been largely successful, with 31 adult pikeminnow removed between 2005 and 2009, and a single large female pikeminnow removed during gill netting conducted in 2017 (Table 1) (Stillwater Sciences 2017).

Table 1. Catch per unit effort (CPUE) by sample year and season in Chorro Reservoir. Fall 2006 through spring 2008 data are from HTC (2008). Spring 2009 data source is Halligan and Otte (2011).

Season	Year	Pikeminnow removed	Nets used ^a	Hours sampling	Total Net hours	Net days ^b	CPUE
Fall	2006	19	6	264	1,584	66	0.29
Spring	2007	5	9.5	240	2,280	95	0.05
Fall	2007	5	10.5	312	3,276	137	0.04
Spring	2008	2	14.5	408	5,916	247	0.01
Spring ^c	2009	0	9	-- ^c	3,456 ^d	144	0.00
Spring	2017	1	8.6	99	851	35	0.03

^a Nets used is based on 30 m of net (e.g., one -15 m net equals 0.5 nets used).

^b Net days equals sampling hours divided by 24 hours, multiplied by the number of nets used.

^c Values from Haligan and Otte (2011)

^d Halligan and Otte (2011) report 9 nets were used for 16 days but hour were not reported, therefore, hours sampling was estimated to be 24 hours

This report summarizes results from 2020 suppression efforts in Chorro Creek and compares to sampling results from suppression efforts conducted in 2017, 2018, and 2019.

2.1 Study Area

The Study Area for pikeminnow suppression in the Chorro Creek watershed includes Chorro Reservoir, mainstem Chorro Creek from Chorro Reservoir downstream to the tidal extent of Morro Bay, and certain tributaries including Dairy Creek, Pennington Creek, Walters Creek, San Luisito Creek, and San Bernardo Creek. In 2020 sampling was conducted within mainstem Chorro Creek over a larger portion of the Study Area compared to previous years when sampling was primarily limited to the mid-section of Chorro Creek within the Chorro Creek Ecological Reserve (CCER) and Cal Poly Reaches (Figure 1). Study reaches sampled in 2020 included Chorro Flats, JJ, CCER, Cal Poly, California Department of Fish and Wildlife (CDFW) downstream of the Water Treatment Plant (WTP), and CDFW upstream of WTP (Figure 1).

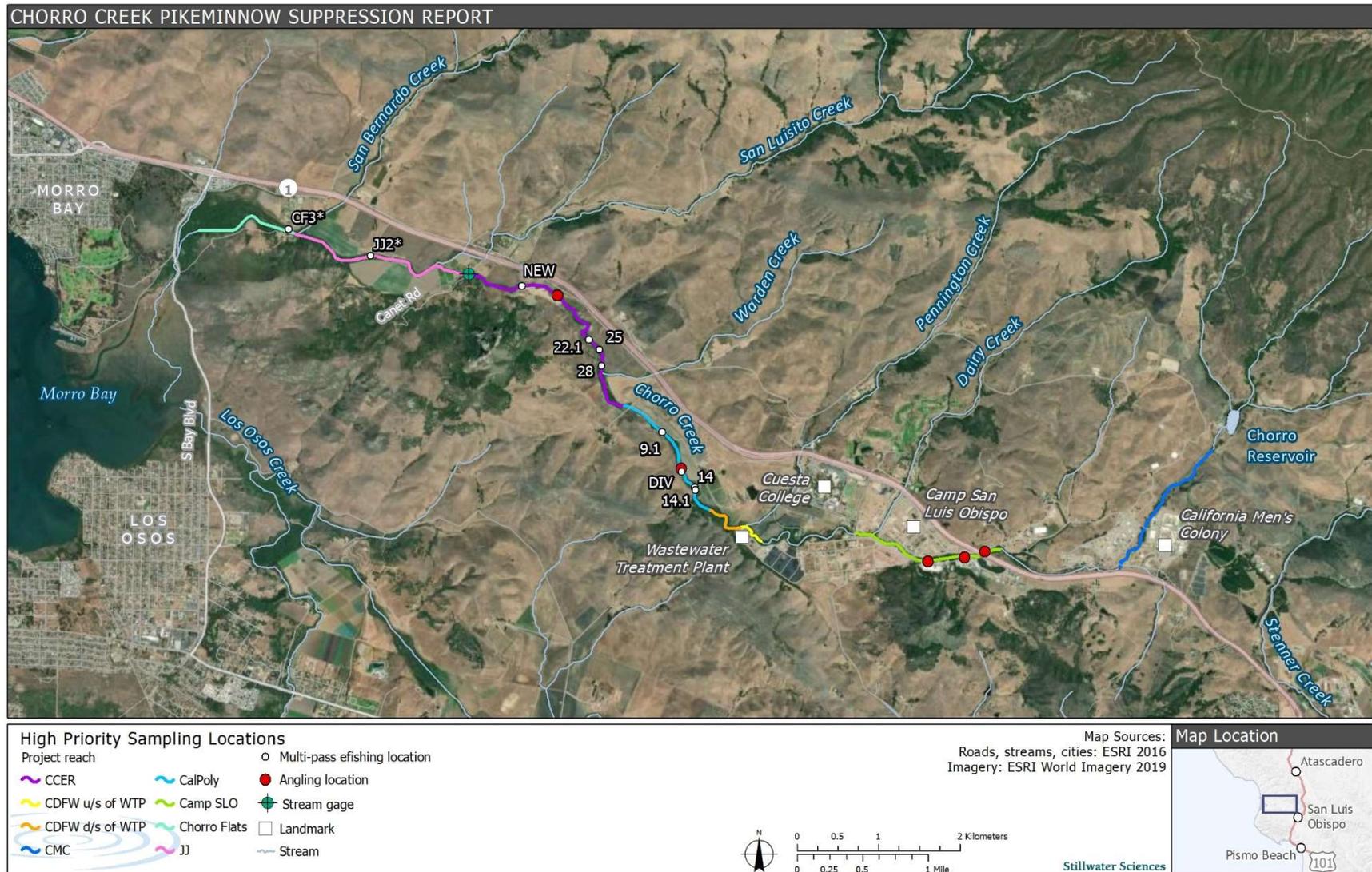


Figure 1. Study Area and high priority sampling locations within study reaches of Chorro Creek.

3 METHODS

Fish suppression and monitoring efforts were conducted in previously established study reaches that were primarily delineated based on access and landownership as opposed to channel characteristics. Pikeminnow suppression was conducted using multi-pass and single pass backpack electrofishing and angling in targeted pool locations as described in the Management Plan (Stillwater Sciences 2017).

3.1 Multi-Pass Electrofishing

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 during this time of year is less than 1.2 m in depth, which facilitates efficient removal with a backpack electrofisher (Adams et al. 2011).

Multi-pass backpack electrofishing was conducted in habitat units previously selected for long term monitoring units, and within two newly established long term monitoring units. Multi-pass electrofishing was conducted following methods by Pollock and Otto (1983) to: (a) increase capture effectiveness and (b) estimate habitat-unit specific density from which to determine the abundance 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 and periodically transferred to a live-car until the completion of the pass. A minimum of three passes were conducted within each segment. If there was poor depletion after three passes, a fourth pass was performed.

All fish captured were identified to species and measured to both standard length (SL) and fork length (FL). Pikeminnow were humanely euthanized using methods included in the American Veterinary Medical Association (AMVA 2013) guidelines, and all other fish were returned to the stream after measuring. Gut content analysis was conducted on all pikeminnow over approximately 150 millimeter (mm) (SL), which involved dissecting the fish's stomach and visually identifying any objects observed in the stomach.

3.2 Single Pass Electrofishing

Single pass backpack electrofishing was conducted in Chorro Creek Study Reaches to remove pikeminnow and increase sample size for various habitat unit types and better understand 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 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 meters (m) of stream was sampled, fish were processed as discussed above in Section 3.1.

3.3 Angling

Angling was conducted in locations previously identified as pikeminnow “hot spots” where subadult/adult pikeminnow (fish >180 mm SL) were captured with angling and where habitat conditions limit the effectiveness of backpack electrofishing due to depths >4 ft 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 3.1.

3.4 Analysis

Fish capture numbers from the 2020 sampling effort were compared with results from previous sampling efforts conducted from 2017–2019 to assess trends in abundance and distribution. A length frequency histogram was generated to estimate young-of-year pikeminnow and steelhead from older age class fish. Abundance estimates with 95% C.I.s (confidence intervals) were calculated at eight habitat units surveyed by multiple pass depletion between 2017–2020 for each species and size class (YOY and ≥ 70 mm) using the FSA: Fisheries Stock Assessment package, implemented in R (Ogle et al. 2020, R Core Team 2020). Estimated densities (fish/100 m) were calculated by dividing the abundance estimate by the habitat unit length sampled during a given year, then multiplied by 100 m.

4 RESULTS

4.1 Age Class

A total of 647 pikeminnow captured in Chorro Creek during surveys conducted during 2017–2020. Of those pikeminnow, 96 were over 200 mm SL (Table 2). The size ranges of pikeminnow and steelhead captured in Chorro Creek between 2017–2020 include multiple age classes of pikeminnow and steelhead. The vast majority of individuals from both species are within the young-of-year (YOY) age class. However, several age classes were observed with some pikeminnow likely to be over age 5+ and steelhead likely to be over age 3+ (Figure 2).

Table 2. Total catch of pikeminnow based on size in Chorro Creek during surveys conducted in 2017-2020.

Pikeminnow length	Total count
<200 mm SL	551
≥ 200 mm SL	96
Total	647

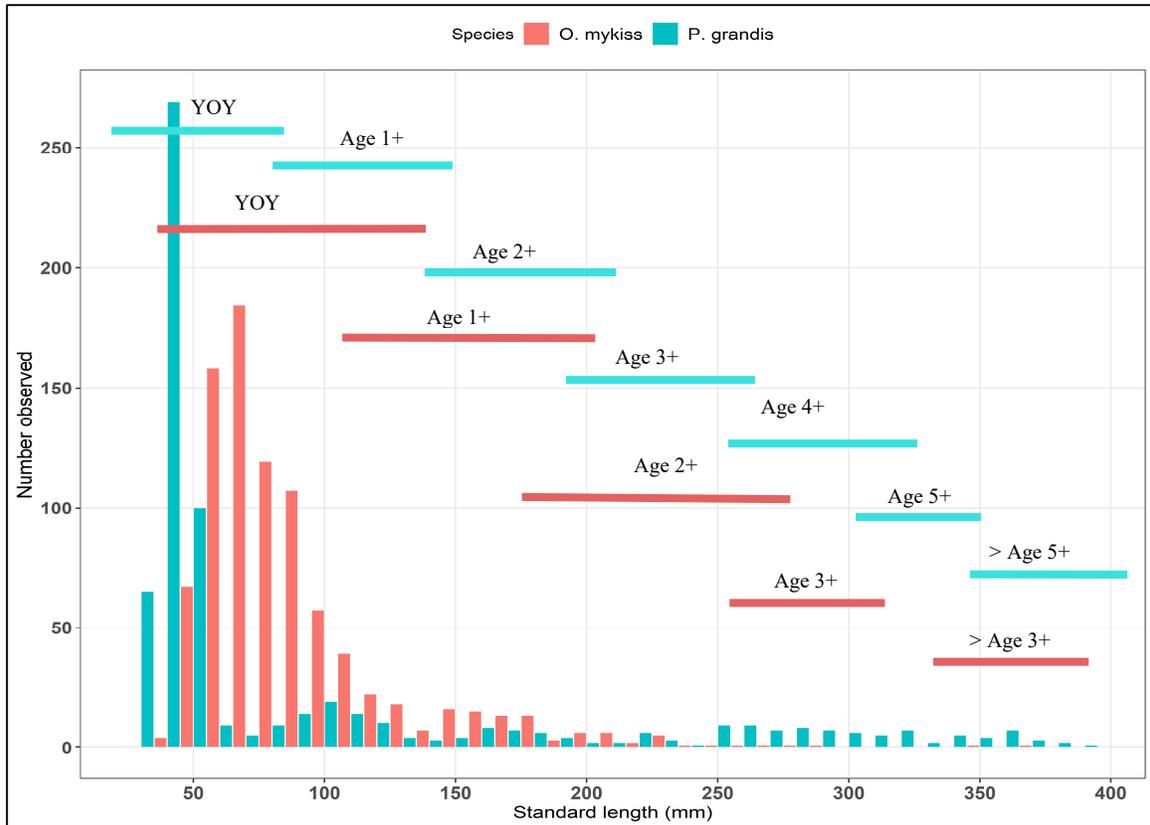


Figure 2. Length frequency distribution for pikeminnow and steelhead captured during 2017-2020. Age classes for pikeminnow are based on Moyle 2002, and for steelhead are based on Bell et al. 2011, and Hayes et al. 2008.

4.2 Distribution and Abundance

Pikeminnow and steelhead distribution and abundance were assessed using fish capture data from backpack electrofishing in Chorro Creek. Sampling was limited in 2017 and 2018 to the CCER and the CalPoly Study Reaches where the highest abundance of pikeminnow was previously observed during suppression efforts (Halligan and Otte 2011) and snorkel surveys (California Conservation Corps, unpublished). Sampling was expanded in 2019 and 2020 to include two CDFW reaches. In 2020, two additional reaches downstream of CCER were sampled. (Chorro Flats and John Jones).

Six species of fish were consistently captured and a small number of Centrarchids (bass and sunfish) were caught during most years (Figure 3). Pikeminnow abundance fluctuated between years with the highest abundance observed in 2019 and the lowest in 2020 and was most apparent in pikeminnow less than 70 mm SL (Table 3). The ratio of pikeminnow to steelhead was nearly 10 to 1 during 2017; however, steelhead were more abundant all other years. Pikeminnow were observed in all reaches where sampling occurred each year; however, higher abundance was observed in the upstream locations. Steelhead abundance also fluctuated between years but was lowest during 2017 when only a few fish greater than 70 mm SL were observed. Steelhead were observed in all reaches where sampling occurred each year; however, higher abundance was observed in the downstream locations (Figure 4).

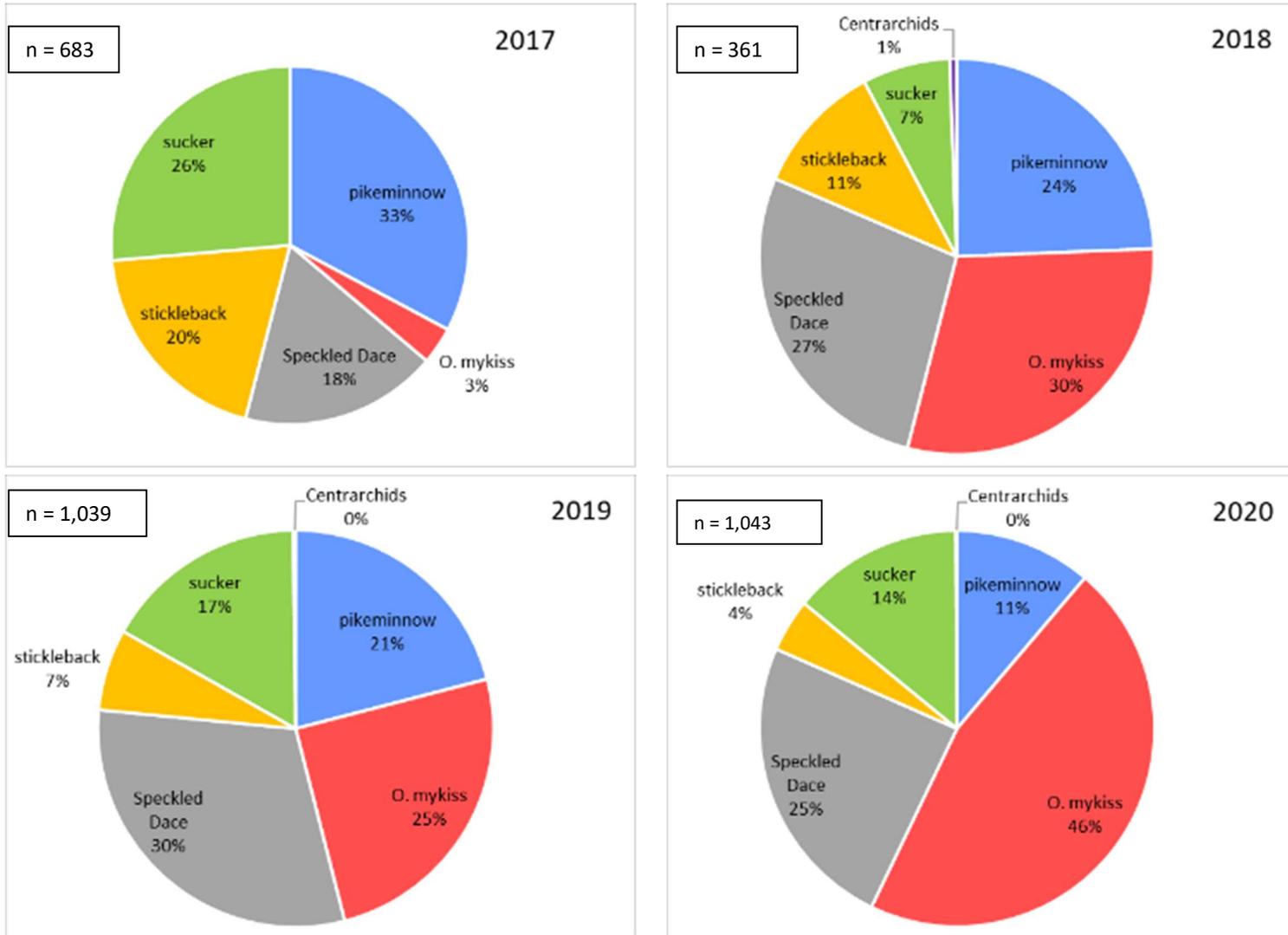


Figure 3. Percent composition for fish captured in Chorro Creek during sampling conducted in 2017-2020.

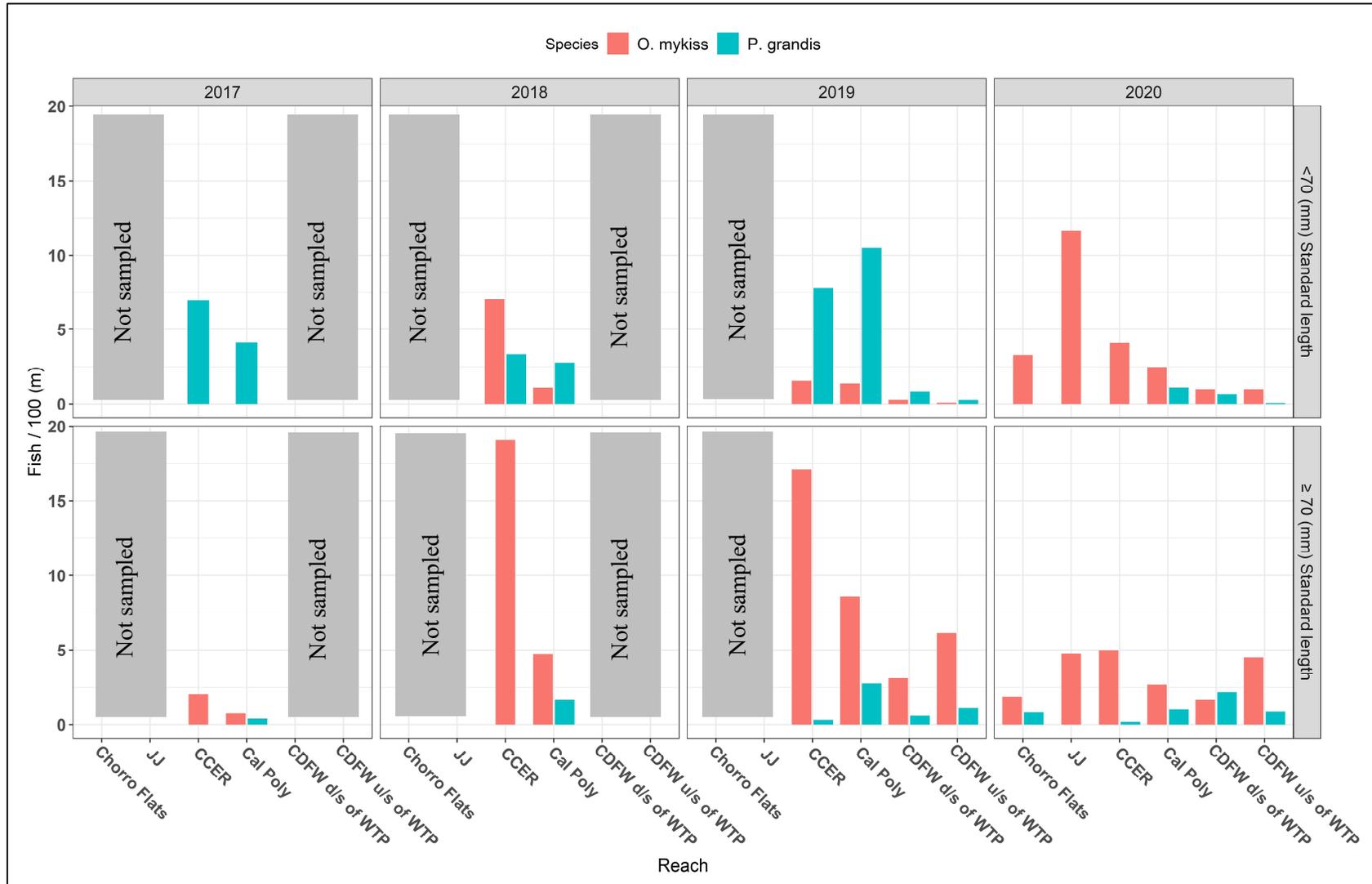


Figure 4. Relative abundance steelhead and pikeminnow based on single pass electrofishing (single pass includes 1st pass from multi-pass locations and single pass locations). Habitat units are ordered from downstream (left) to upstream (right).

Table 3. Fish captured and ratio of pikeminnow to steelhead in Chorro Creek during sampling conducted in 2017-2020.

Species	2017	2018	2019	2020	Total
Pikeminnow	224	88	218	117	647
Steelhead	23	107	260	479	869
Speckled dace	122	99	317	255	793
Three-spine stickleback	134	39	69	45	287
Sacramento sucker	180	26	173	146	525
Largemouth bass	0	2	0	0	2
Bluegill	0	0	2	0	2
Green sunfish	0	0	0	1	1
Total	683	361	1,039	1,043	3,126
Ratio of steelhead to pikeminnow	1:10	10:8	10:8	5:1	10:7

4.3 Density

Pikeminnow density fluctuated between years but was highest during the first year of sampling (2017) and lowest during in 2020. Higher densities of pikeminnow tended toward the upstream units sampled each year (Figure 5). Steelhead density was lowest in 2017 and highest during 2020. Fish smaller than 70 mm SL made up the greatest proportion of pikeminnow density at each site while steelhead had higher densities for fish larger than 70 mm SL. In 2017 no steelhead were observed that were less than 70 mm SL (Figure 6). The ratio of steelhead to pikeminnow based on estimated fish per 100 m ranged from 1 steelhead for every 14 pikeminnow in 2017, to 6 steelhead for every pikeminnow in 2020 (Table 4).

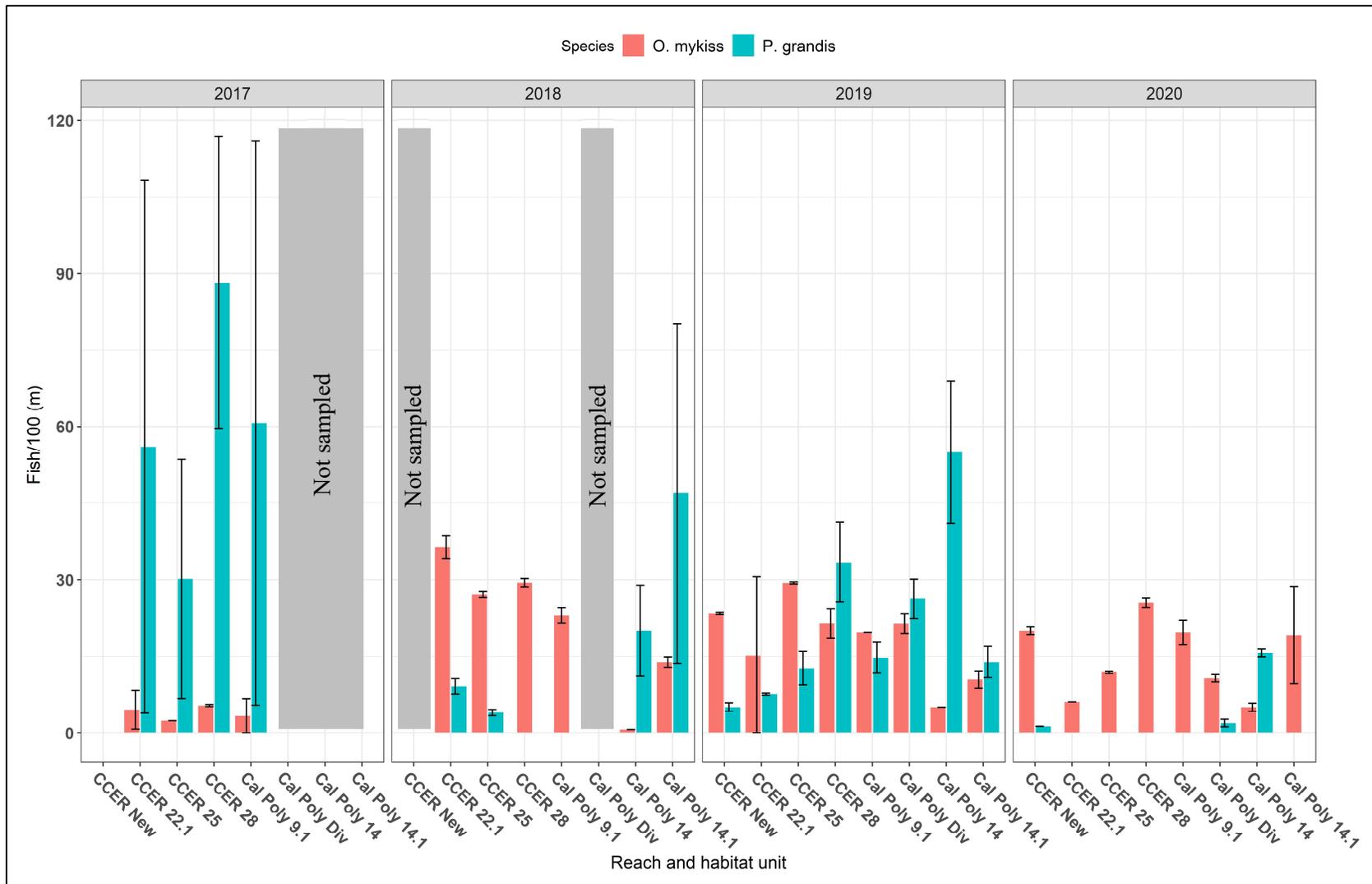


Figure 5. Estimated density for pikeminnow and steelhead with 95% C.I.s for multi-pass backpack electrofishing units in Chorro Creek 2017-2020. Habitat units are ordered from downstream (left) to upstream (right).

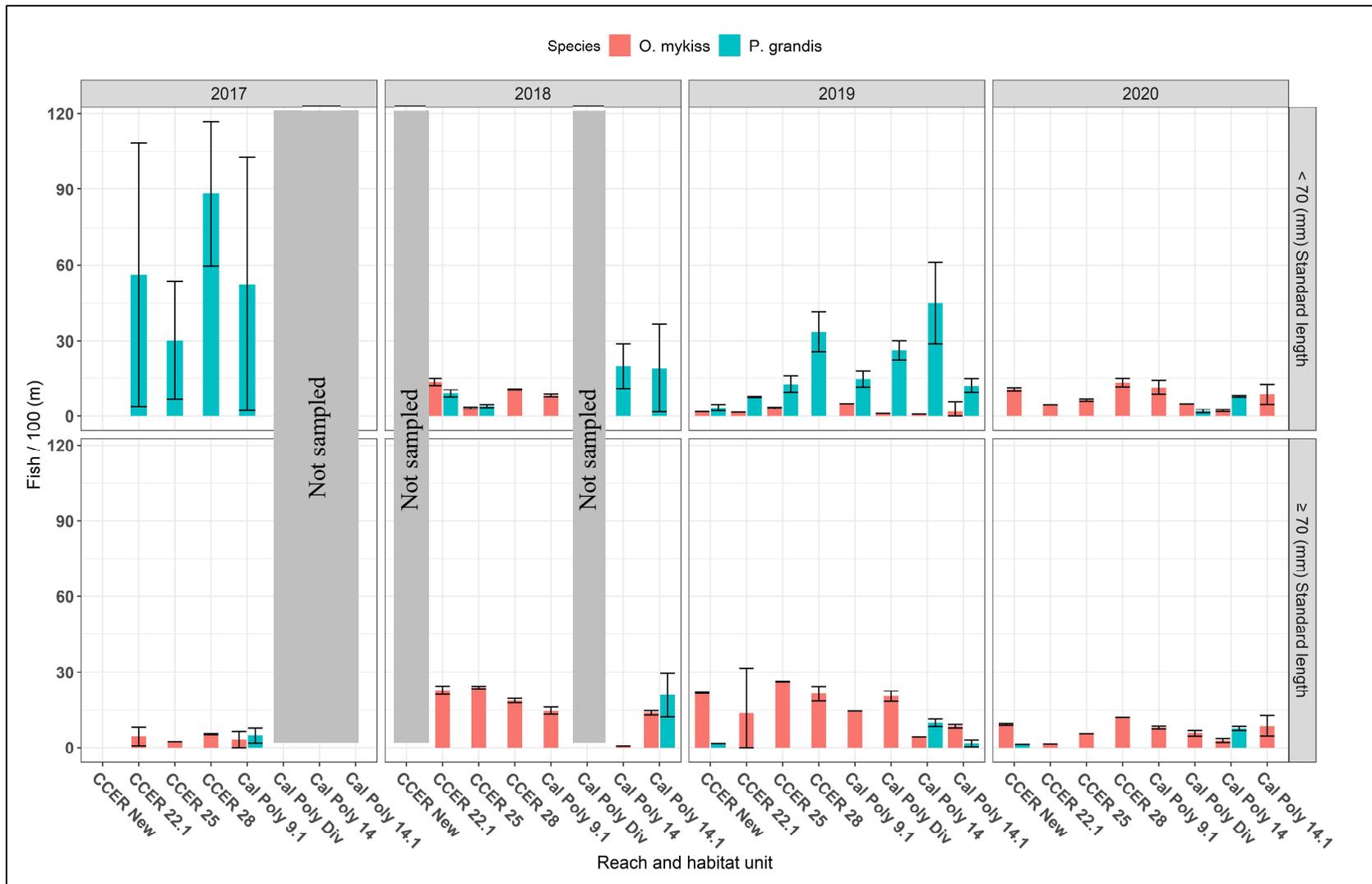


Figure 6. Estimated density for pikeminnow and steelhead by size class with 95% C.I.s for multi-pass backpack electrofishing units in Chorro Creek 2017-2020. Habitat units are ordered from downstream (left) to upstream (right).

Table 4. Ratio of steelhead to pikeminnow based on estimated fish per 100 m at locations sampled using multi-pass backpack electrofishing units sampled in the CCER and CalPoly Study Reaches in Chorro Creek 2017-2020.

Species	CCER Reach				CalPoly Reach				Total
	New	22.1	25	28	9.1	14	14.1	Div	
2017									
Steelhead	na	15	8	18	11	na	na	na	51
Pikeminnow	na	184	99	289	188	na	na	na	760
Steelhead to pikeminnow ratio	na	1:12	1:13	1:17	18:1	na	na	na	1:14
2018									
Steelhead	na	119	89	96	75	2	46	na	428
Pikeminnow	na	30	13	0	0	66	131	na	240
Steelhead to pikeminnow ratio	na	4:1	7:1	**	**	1:33	1:3	na	2:1
2019									
Steelhead	77	50	96	70	65	16	34	70	478
Pikeminnow	16	25	42	110	48	180	46	86	553
Steelhead to pikeminnow ratio	5:1	2:1	2:1	2:1	13:1	1:11	8:10	8:10	9:10
2020									
Steelhead	66	20	39	83	65	16	57	35	381
Pikeminnow	4	0	0	0	0	52	0	6	62
Steelhead to pikeminnow ratio	15:1	**	**	**	**	3:10	**	6:1	6:1

na indicates location not sampled.

** no ratio due to zero count for either steelhead or pikeminnow.

5 DISCUSSION

Initial targets for success included in the Management Plan (Stillwater Sciences 2017) are:

- Less than 3 adult (> 200 mm SL) pikeminnow captured annually in Chorro Reservoir with an annual effort of at least 200 net-hours¹ of sampling;
- Less than 20 sub-adult/adult (> 200 mm SL)² pikeminnow observed annually in comprehensive snorkel surveys in Chorro Creek and tributaries; and
- Ratio of steelhead (all ages) to pikeminnow (all ages) of $\geq 1:1$ in habitat units sampled with multiple pass electrofishing.

The success criteria for Chorro Reservoir were met in 2017 when 1 pikeminnow was captured after 861 net hours of sampling (Table 1). Comprehensive snorkel surveys have not been conducted since 2016 when 30 sub-adult/adult pikeminnow were observed (California Conservation Corps, unpublished data). The success criteria for the ratio of steelhead to pikeminnow has been met during two out of four years based on density estimates at locations sampled using multi-pass electrofishing (Table 4), and during three out of four years based on total fish captured (Table 3). In particular, the ratio of steelhead to pikeminnow began with approximately one steelhead for every fourteen pikeminnow at multi-pass electrofishing units and in 2020 the ratio was estimated to be six steelhead for every one pikeminnow (Table 4) and a similar reversal can be seen in the total catch numbers where there was one steelhead for every ten pikeminnow in 2017 and five steelhead for every pikeminnow in 2020 (Table 3).

During four years of partial implementation of the management plan, a total of 96 subadult/adult pikeminnow (fish over 200 mm FL) along with over 500 hundred smaller pikeminnow have been removed from Chorro Creek (Table 2). Following the initiation of suppression efforts in 2017 steelhead numbers had a sharp increase and have remained consistently above the levels observed in 2017; however, pikeminnow numbers have fluctuated between sampling years (Table 3). Fluctuations in pikeminnow abundance appear to be driven primarily by YOY numbers while older pikeminnow are consistently observed in low abundance (Figure 6).

In 2020 very low numbers of pikeminnow were captured during sampling in Chorro Creek and nearly all pikeminnow were captured from the upper study reaches. Conversely, steelhead abundance was highest in the downstream study reaches. The limited distribution of pikeminnow observed in 2020 may be a sign of successful management in the lower reaches, while recruitment is still occurring in upstream reaches. 2020 also had very low stream flow compared to other years during the 2017–2020 sampling period (Figure 7). Low flows may have restricted pikeminnow movement in Chorro Creek, resulting in lower abundance in lower reaches.

While pikeminnow suppression in Chorro Reservoir has likely nearly removed the source population in the watershed, suitable habitat exists just downstream of the reservoir up to the upstream end of the study reach. Future sampling efforts will be expanded to include as much of the upstream reaches of the Study Area as possible given landowner access.

¹ Net hours equals the number of hours of sampling multiplied by the number of nets used (e.g., 200 net hours equals 20 hrs x 10 nets)

² 200 mm corresponds with the length at which pikeminnow diet becomes almost exclusively comprised of fish and crayfish (Brown and Brasher 1995) and it is below the length of reproductive age fish (220-250mm) reported in Moyle 2002.

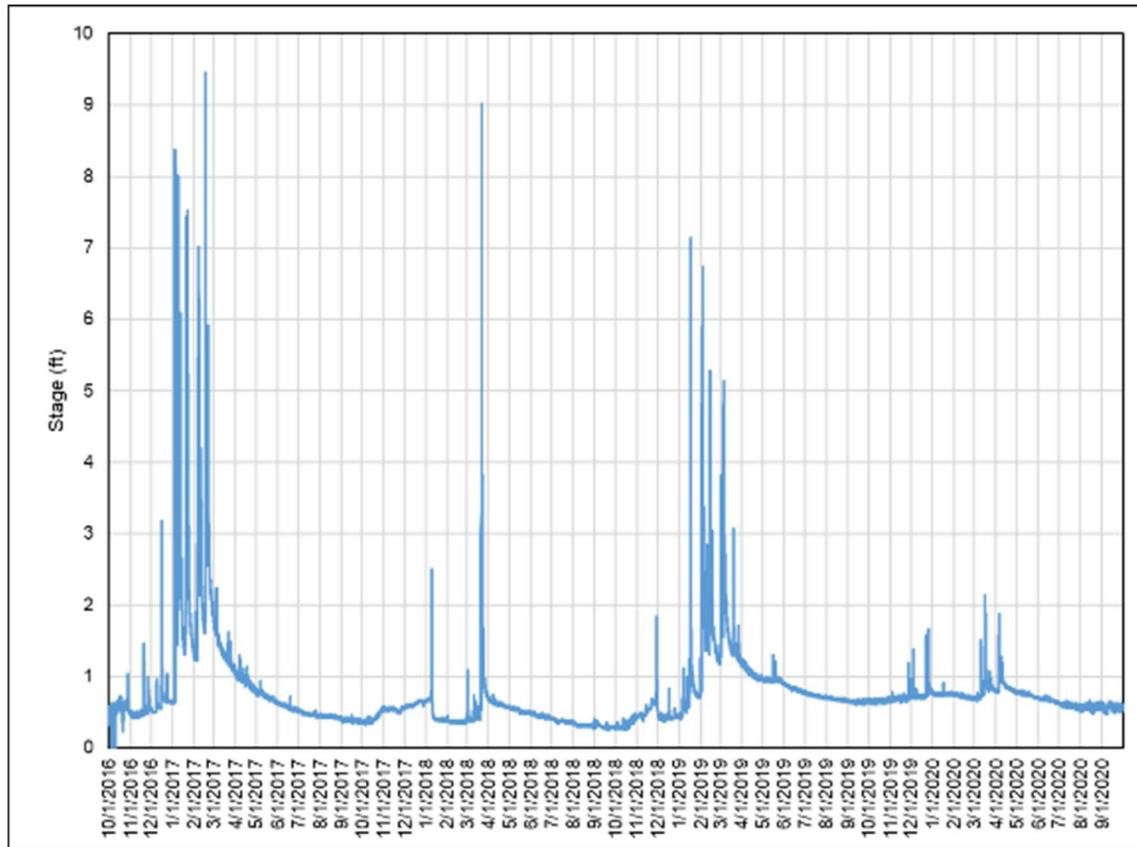


Figure 7. Chorro Creek water surface stage elevations at Canet Road from October 2015 through October 2020.

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