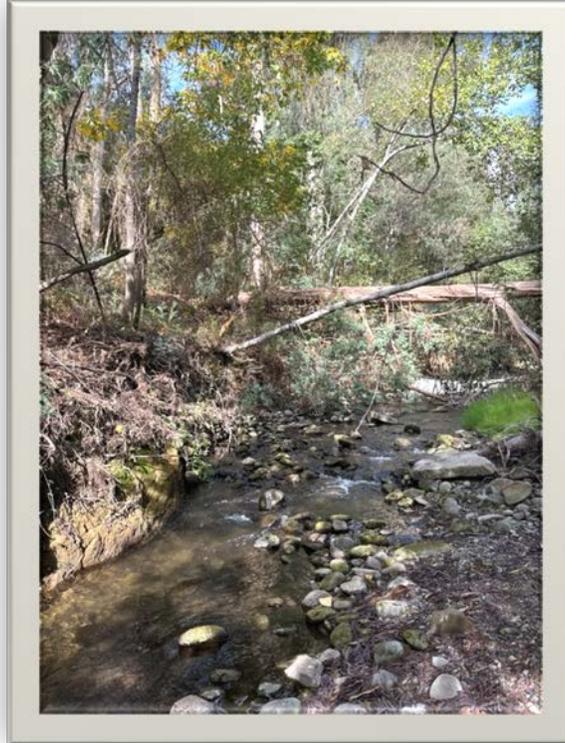# 2024 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds

Prepared for:

City of Watsonville,
275 Main Street, Suite 400
Watsonville, CA 95076

Pajaro Valley Water Management Agency
36 Brennan Street
Watsonville, CA 95076

Prepared by:
Mike Podlech, Aquatic Ecologist

With Field Assistance From:
Kittleson Environmental Consulting

January 10, 2024

Executive Summary

The City of Watsonville operates two surface water diversion facilities in the Corralitos Creek watershed in the Salsipuedes Creek basin of the lower Pajaro River valley. The Pajaro Valley Water Management Agency is currently completing construction of a surface water diversion facility at College Lake within the Salsipuedes Creek basin. The two entities jointly fund an annual fish population assessment within the basin as part of countywide steelhead monitoring efforts. Fish surveys and habitat assessments are conducted in late summer/early fall at seven sampling sites in the Corralitos Creek watershed and one site in the Casserly Creek watershed upstream of College Lake.

In 2024, streamflows within the study area consistently remained above the long-term average through the entire adult steelhead migration, spawning, and emergence periods, creating almost ideal hydrologic conditions for steelhead as streamflows remained elevated but did not reach levels that would be expected to result in significant redd (egg nest) scour and/or significant flushing of fry. Compared to 2023, total juvenile steelhead densities increased at seven of eight sampling sites in 2024, with some of the increases being multiple-fold. Lower Corralitos Creek and Casserly Creek sampling sites, in particular, were seeded with some of the highest densities of young-of-the-year (age 0) steelhead since 2019. Shingle Mill Creek, the only outlier to increased juvenile densities, is the upstream-most site in the Corralitos Creek watershed and is located above relatively steep channel gradient sections. Anadromous spawning may only extend this far upstream in the watershed in very wet years, and the Shingle Mill population may be sustained by low levels of resident trout spawning during drought and normal water years.

Background

The City of Watsonville (City) owns and operates water diversion facilities on Corralitos Creek and Browns Creek in the Salsipuedes Creek watershed, tributary to the Pajaro River in Santa Cruz County. As part of prior permit obligations for the operation of the diversion facilities, the City has been funding annual assessments of juvenile steelhead (*Oncorhynchus mykiss*) densities in the watershed. Since 2020, the City has voluntarily continued its commitment toward countywide steelhead monitoring efforts.

The Pajaro Valley Water Management Agency (PV Water) is currently constructing the College Lake Integrated Resources Management Project. Upon expected completion in spring 2025, the project will divert up to 3,000 acre-feet of water annually from College Lake, located on Salsipuedes Creek, for treatment, transmission, and distribution for agricultural irrigation. College Lake is a naturally occurring, seasonally wet depression that receives water inflows from the Green Valley, Casserly, and Hughes creeks sub-watersheds. College Lake provides seasonal juvenile steelhead rearing habitat (Podlech, 2011) and Casserly Creek is known to support a steelhead population (Smith, 2010; Alley 2017). In an effort to build upon existing baseline steelhead population data upstream of College Lake, PV Water has been funding fish surveys at a previously sampled site on Casserly Creek since 2020. This report summarizes the results of the 2024 juvenile steelhead densities assessments in the Corralitos Creek and Casserly Creek watersheds.

Methods

Sampling Sites

Fish surveys were conducted at seven sampling sites in the Corralitos Creek watershed and one site in the Casserly Creek watershed on six days between September 23 and October 11, 2024. Sampling sites were selected in 2018 and are located in the vicinity of sites previously sampled by D. W. Alley & Associates (Alley) as part of the annual *Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds* monitoring program conducted for the County of Santa Cruz (County) and its partners. Individual sampling sites were selected to be representative of overall stream reach characteristics. Sampling site locations are summarized in Table 1 and depicted in Figures 1 and 2.

TABLE 1

2024 SAMPLING SITES IN THE CORRALITOS CREEK AND CASSERLY CREEK WATERSHEDS

| Sampling Site	Site ID	Coordinates (UTM)	Alley Site ID
Corralitos Creek below Browns Creek confluence	**CO-0**	10 N 0606456 4094453	Corralitos #0
Corralitos Creek downstream of diversions site	**CO-1**	10 N 0606093 4096068	Corralitos #1
Corralitos Creek upstream of diversions site	**CO-3**	10 N 0605739 4096633	Corralitos #3
Corralitos Creek downstream of Shingle Mill Gulch	**CO-9**	10 N 0605083 4100092	Corralitos #9
Browns Creek downstream of diversions site	**BR-1**	10 N 0607660 4097304	Browns Valley #1
Browns Creek upstream of diversions site	**BR-2**	10 N 0608348 4098264	Browns Valley #2
Shingle Mill Gulch downstream of Grizzly Flat	**SM-3**	10 N 0606599 4100478	Shingle Mill #3
Casserly Creek downstream of Mt Madonna Rd.	**CA-3**	10 N 0612189 4094311	Casserly #3
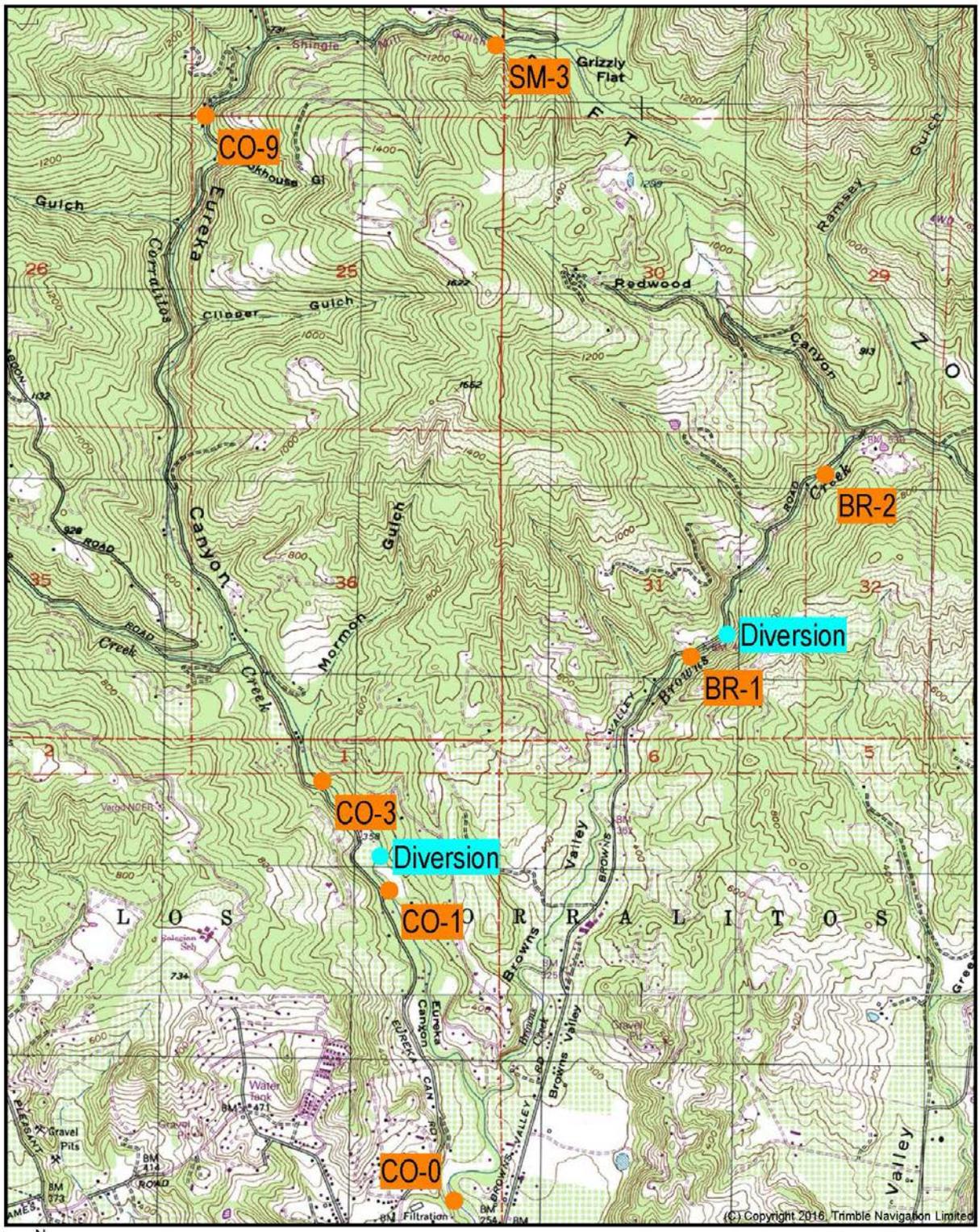
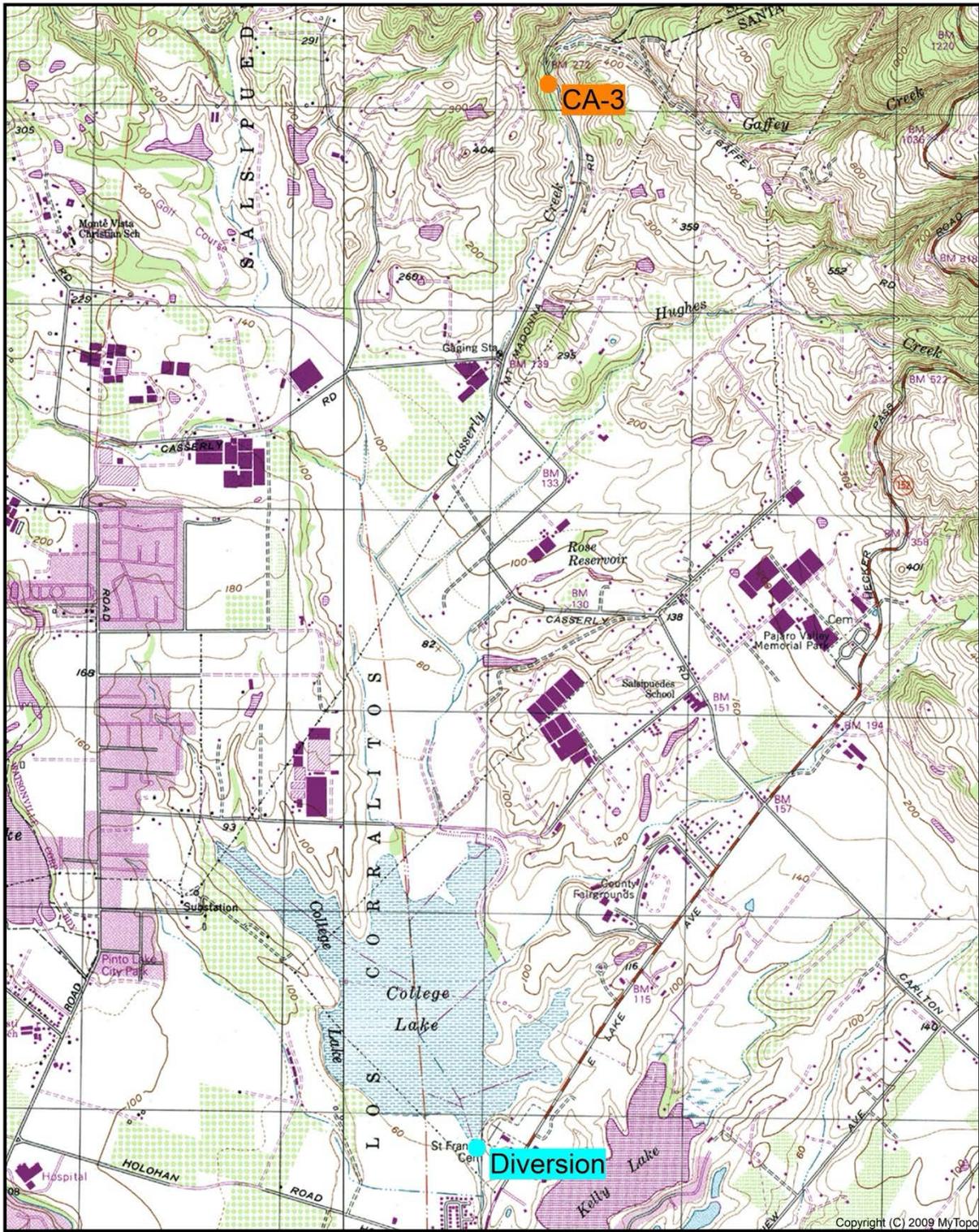Figure 1. Sampling Sites in the Corralitos Creek Watershed

Figure 2. Sampling Site in the Casserly Creek Watershed

Habitat Assessments

Basic aquatic habitat assessments were conducted at each site using the Level II habitat typing protocol described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi *et al.* 2010). Level II habitat typing simply classifies habitat units into riffles, flatwater, and pools, which are the three broad habitat types offering different ecological function for fisheries resource (see *Habitat Type and Stream Dimension* below).

Habitat Type and Stream Dimension

The habitat inventory assesses the amount and quality of different habitat types within each reach. Habitat dimensions (depth, area) and type (pool, riffle, flatwater) influence the ability of a stream to support salmonid populations. Riffle habitats are important for production of aquatic insects and other organisms used as food sources. Riffles can also provide habitat for younger age classes of salmonids and can be good foraging areas if they are sufficiently deep. Flatwater runs and glides can also be used for foraging and can support greater numbers of rearing juveniles depending on depth and cover characteristics. Flatwater habitats also tend to have areas where velocity and substrate characteristics are suitable for spawning. Pools are important because they provide habitat during the summer low flow period and during periodic droughts. Deeper pools with good cover characteristics provide important habitat for adult resident trout and yearling-and-older juvenile steelhead. Although these fish may inhabit pools with mean depths in the range of 0.5 to 1.5 ft in small streams, they generally occur at greater densities in streams with more pools in the 1.5 to 2.5-ft or deeper mean depth range. Pool tail-outs serve as important spawning sites if conditions are suitable (i.e., gravel/cobble substrates with low levels of embeddedness).

Shelter Characteristics

There are numerous potential predators on juvenile salmonids inhabiting streams, and the presence of adequate cover, or shelter, can greatly influence survival rates. Instream and overhead cover in the form of undercut banks, tree trunks and branches (whether alive or dead), grasses, herbs, and shrubs, floating or rooted aquatic vegetation, cobbles and boulders, bedrock ledges, and surface turbulence can inhibit the ability of predators to see and capture juvenile salmonids. The proportion of each pool unit that was influenced by some type of shelter was estimated as a percentage of the total surface area of the unit. Shelter ratings range from 0-300 and are expressed as mean values by habitat types within a stream. A pool shelter rating of at least 100 is desirable for salmonids.

Substrate Conditions

Substrate conditions influence spawning and egg incubation, cover for juveniles, and production of aquatic invertebrates important in the aquatic food chain. Steelhead rely on relatively loose, clean gravel substrate with low amounts of fine sediments for reproduction. Larger substrate such as cobbles and boulders can provide hiding areas for juveniles of many species including trout. Fine sediments (silt and sand) present in excessive amounts fill spaces between the larger substrate elements and reduce its ability to support invertebrate production, spawning, and escape cover. A number of criteria are used to describe substrate compositions occurring in streams and assess suitability for different life stages of anadromous salmonids. The most detailed methods involve bulk sampling of the streambed and characterization of the complete range of sediment size classes. A simpler method, included in the Flosi

et al. (2010) habitat assessment protocol, involves estimating cobble embeddedness, which is defined as the average proportion of individual cobbles embedded in fine substrate materials. Embeddedness is typically estimated in pool tail-outs, the preferred spawning location of adult salmonids. Fish density, particularly for juvenile salmonids, is generally reduced as embeddedness increases, but steelhead appear to be less sensitive than some other species. Embeddedness is rated on a scale of 1 to 4 in 25% ranges. Embeddedness measured to be 25% or less (i.e., rating of 1) is considered best for the spawning needs of steelhead. Additionally, a value of 5 is assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size (e.g., boulder).

Riparian Conditions

The condition of the riparian corridor adjacent to a stream is an important factor in salmonid habitat quality. Riparian vegetation helps support some of the insects consumed by juveniles, provides cover from predators, and limits solar radiation to streams, keeping water temperatures cool. Tree roots stabilize streambanks and create habitat structure, and fallen trees create instream cover and refugia for juvenile fish to reside during high velocity flows. During the habitat assessment, the proportion of the channel shaded by deciduous and coniferous tree canopy was estimated. In general, canopy densities of 80% or more are desirable. However, limited openings in the canopy provide important foraging habitat, particularly for salmonid fry.

Fish Surveys

Fish surveys were conducted using standard electrofishing techniques (e.g., Temple and Pearsons 2007) and in accordance with the *Guidelines for Electrofishing Water Containing Salmonids Listed Under the Endangered Species Act* (NMFS 2000) and conditions set forth in the County's Endangered Species Act Section 10(a)(1)(a) scientific research permit #15824-3R. Block nets were set at the upstream and downstream ends of the sampling reaches, and standard water quality parameters (water temperature, dissolved oxygen, and specific conductivity) were measured using a YSI model 85 digital multipurpose meter. Using a standard multi-pass depletion method, repeated (2-3) electrofishing passes were made with a Smith-Root Model LR-24 backpack electrofisher and dipnets. Captured fish were placed in 5-gallon buckets containing stream water and battery-powered aerators. All captured salmonids were counted, measured to fork length (FL), and returned to the same stream reach where they were caught. Qualitative abundance estimates were noted for non-salmonid fish and amphibian species. Standard lengths (SL) of all captured steelhead were also measured for comparison to previous sampling conducted by Alley (2017).

Statistical population estimates for each sampling site were calculated using the Microfish 3.0 software (Van Deventer and Platts 1989). Total densities (number of fish/100 ft of channel) of juvenile steelhead were calculated based on the statistical population estimates and sampling site lengths. Densities of age 0 (young-of-the-year) and age 1+ (yearling-and-older) steelhead were calculated from the statistical population estimates based on their respective proportion (percentage) of occurrence within the sample.

Accurate age determinations of juvenile salmonids require scale analysis, which was beyond the scope of this effort. However, age class thresholds can also be determined fairly accurately from bimodal length-frequency distributions if a sufficiently large sample size is available. As this was not the case at

some sites (e.g., Shingle Mill Gulch #3), age class cutoffs were determined based on a combination of bimodal length-frequency distributions, professional experience conducting other long-term steelhead monitoring programs, and methods applied by other researchers in Santa Cruz County (e.g., Alley 2017; Sogard *et al.* 2009). For example, Alley (2017) generally classifies juvenile steelhead from non-mainstem San Lorenzo River sites as age 0 if SL is less than 75 mm. In a multi-year study of seasonal patterns of abundance, growth, and site fidelity of juvenile steelhead in the Soquel Creek watershed, Sogard *et al.* (2009) found that age 0 steelhead were generally less than 90 mm FL in October. Based on our observed length-frequency distributions and Sogard *et al.* (2009), we classified juvenile steelhead in the more open, low-gradient sites (i.e., Corralitos Creek #0 through #3) as age 0 if they were less than 90 mm FL, but in the more shaded upper watershed sites (i.e., Shingle Mill Gulch #3, and Brown Creek #1 and #2), 85 mm FL was generally used as the breakpoint between age 0 and age 1+ unless clear bimodal distributions suggested otherwise. This age classification scheme compares favorably to the bimodal distributions of standard-length frequencies and the Alley (2017) 75 mm SL breakpoint. In most cases, there was a clear demarcation between size modes of age 0 and age 1+ fish, but a presumably small number of fish may have been incorrectly aged. Due to limited sample sizes, no attempt was made to segregate older fish into age 2 or age 3 categories and these fish were instead classified into the age 1+ category.

Results

The results of the September/October 2024 habitat assessments and fish surveys are presented below. Table 2 summarizes the results of basic water quality measurements collected immediately prior to fish sampling at each site. Table 3 summarizes habitat conditions at the sampling sites, and Table 4 lists juvenile steelhead density estimates. Figure 3 depicts the relative proportions of age 0 and age 1+ steelhead captured at each site, and Figure 4 presents length-frequency histograms for each site. Figures 5 and 6 compare total juvenile and age 0 densities, respectively, for 2016 through 2024. The 2016 and 2017 density estimates are derived from Alley (2017, 2018). Absolute juvenile steelhead density estimates for 2018 through 2024 may not be directly comparable to 2016-2017 estimates due to slight differences in sampling methodology and site locations, but overall density trends across the eight sampling years accurately reflect actual population dynamics. Representative photographs of the sampling sites are provided in Appendix A.

Water year 2024 was characterized by relatively frequent occurrences of moderate precipitation events. The California Data Exchange Center (CDEC 2024) Watsonville Water (WTW) site reports a total of 22.77 inches of precipitation for the water year. PV Water (2022) classifies water years with total precipitation between 17.52 inches and 24.43 inches as "average". The numerous moderate precipitation events maintained streamflow in Corralitos Creek above long-term averages from mid-December 2023 through spring and summer 2024.

Corralitos Creek #0 (CO-0)

Sampling site CO-0 is located on Corralitos Creek downstream of the Browns Creek confluence (Figure 1) at the head of a low-gradient (1-2%) alluvial valley that typically dries out during summer months. The total channel length of the assessment reach in 2024 was 172 ft (Table 3). Based on percent total length,

CO-0 consisted of 50% pool habitat, 26% riffle and 24% flatwater (step-run). In contrast, flatwater was the dominant habitat type in 2023, but aggradation of coarse substrates along a portion of the sampling site has created a riffle (Photo 1) while scour in a different part has resulted in the formation of a second pool. Based on the total length and mean widths of the habitat units, the total wetted area of the sampling site at the time of the assessment was estimated at 2,504 ft^2, essentially unchanged from the 2023 wetted area of 2,431 ft^2. Four Level II habitat units (two pools, one flatwater, one riffle) were sampled at CO-0. The pools in this reach had a mean depth of 0.8 ft, a maximum depth of 1.4 ft, and a residual depth of 1.0 ft. These measurements are representative of pool scour compared to 2023 when significant pool aggradation was observed. Pool tail substrates were dominated by large cobble and boulders, and embeddedness in the cobble-dominated tail-out was 25-50%. The mean pool shelter rating was 13, representative of low shelter abundance consisting of minor amounts of boulders, bedrock ledge, and some root mass. Large cobbles were the dominant substrate type throughout the sampling reach. Canopy cover was estimated at 15% and composed entirely (100%) of hardwood species.

The overall juvenile steelhead population estimate for CO-0 was 54, for a total juvenile steelhead density of 31.4 fish/100 ft (Table 4), representing an 850% increase from the 2023 estimate of 3.3 fish/100 ft and the highest density recorded at this site in since 2019 (Figure 5). Of the juvenile steelhead captured at CO-0, 71.7% were age 0 fish (33.3% in 2023) and 28.3% were age 1+ fish (66.7% in 2023) (Figure 3). Estimated age class densities (Table 4) were 22.5 fish/100 ft for age 0 steelhead (1.1 fish/100 ft in 2023) and 8.9 fish/100 ft for age 1+ steelhead (2.2 fish/100 ft in 2023), indicating that the large year-over-year increase in the total density was almost entirely due to 2024 reproduction. The vast increase in steelhead densities likely resulted from a combination of factors, including favorable streamflow conditions (i.e., elevated but not excessive) throughout the spawning, incubation, and emergence phases of the life-cycle, as well as the observed increase in summer rearing habitat in the form of additional residual pool depths.

Sculpins (*Cottus* sp.) were again relatively abundant at CO-0 and appeared to be represented by two species, riffle sculpin (*C. gulosus*) and coastrange sculpin (*C. aleuticus*). Sacramento suckers (*Catostomus occidantalis*) were moderately abundant. Unlike prior years, no Pacific lamprey (*Entosphenus tridentatus*) ammocoetes were captured at CO-0 in 2023 and 2024. Non-native signal crayfish (*Pacifastacus leniusculus*) were again present at CO-0.

Corralitos Creek #1 (CO-1)

Sampling site CO-1 is located within a low-gradient (1-2%) reach of Corralitos Creek downstream of the City's diversion facility (Figure 1). Substantial treefall into the regular sampling reach necessitated an upstream shift in the sampling site by approximately 130 ft, such that the upstream end of the reach in 2023 formed the downstream end in 2024. While the habitat characteristics of the previous and new sampling reaches were similar (e.g., dominated by pool habitat), overall channel widths and depths are greater at the new site and provide substantially more deep-water habitat that favors older (i.e., age 1+) steelhead over young-of-the-year juveniles. This reach of Corralitos Creek frequently undergoes marked morphologic changes (e.g., Podlech 2023).

The total channel length of the assessment reach in 2024 was 132 ft (Table 3) of which 83% were pool

habitat and 17% riffle. Based on the total length and mean widths of the habitat units, the wetted area of the reach at the time of the assessment was estimated at 2,732 ft^2, a minor (10%) decrease from the 2023 estimate of 3,048 ft^2. Although the overall surface area of the sampling site decreased somewhat due to a decrease in reach length from the upstream shift in site location, habitat *volume* increased substantially due to an approximately 5-ft increase in the average width of deep pool habitat in 2024 compared to 2023. Two Level II habitat units (one riffle, one pool) were sampled at CO-1. The large pool had a mean depth of 1.8 ft, a maximum depth of 3.4 ft, and a residual depth of 3.0 ft. The dominant pool tail-out substrate now consists of boulders and therefore does not provide suitable spawning habitat. Although large and deep, the pool's shelter rating (20) is low, consisting primarily of shallow bedrock ledges and a few large boulders. While these features provide excellent shelter, they occupy only a small fraction of the overall surface area/volume of the pool, thereby resulting in a low rating. Sand was the dominant substrate type in the pool and large cobbles were the dominant substrate in the riffle. Average canopy cover was estimated at 45% and composed entirely (100%) of hardwood species.

The overall juvenile steelhead population estimate for CO-1 was 39, and the total juvenile steelhead density was 29.5 fish/100 ft (Table 4), an almost 200% increase over the 2023 estimate of 9.9 fish/100 ft and the highest density observed at this site since 2018 (Figure 5). Of the juvenile steelhead captured at CO-1 in 2024, only 22.9% were age 0 fish (0% in 2023) and 77.1% were age 1+ fish (100% in 2023) (Figure 3). Estimated age class densities (Table 4) were 6.8 fish/100 ft for age 0 steelhead (0 fish/100 ft in 2023) and 22.8 fish/100 ft for age 1+ steelhead (9.9 fish/100 ft in 2023). As noted above, the increase in deep pool habitat availability at the new CO-1 sampling site favors older juveniles more than young-of-the-year fish that may be preyed upon by older fish in this setting, especially given the limited shelter availability. However, it should be noted that no age 0+ steelhead at all were captured at CO-1 in 2023, which at the time was also assumed to have been the result of predation by older juvenile steelhead within a large pool lacking shelter (Podlech 2023).

Sculpins were moderately abundant at CO-1. Several large (200+ mm SL) Sacramento suckers, one California roach (*Hesperoleucus symmetricus*), and six Sacramento pikeminnows (*Ptychocheilus grandis*) were also present. Although known to occur in the lower Pajaro River watershed, pikeminnows had not been observed in the Corralitos Creek subbasin since monitoring was initiated in 2016. Unlike prior years, no lamprey ammocoetes were captured at CO-1 in 2024.

Corralitos Creek #3 (CO-3)

Sampling site CO-3 is located within a moderate gradient (2-3%) reach of Corralitos Creek upstream of the City's diversion facility (Figure 1). The total channel length of the assessment reach in 2024 was 231 ft (Table 3), down from 270 ft in 2023 due to the elimination of a flatwater unit. Based on percent total length, CO-3 in 2024 consisted of 25% riffle and 75% pool habitat. Based on the total length and mean widths of the habitat units, the total wetted area of the reach at the time of the assessment was estimated at 3,233 ft^2, an approximately 10% decrease from the 2023 estimate of 3,613 ft^2 resulting from the shortening of the sample reach. Four Level II habitat units (two riffles, two pools) were sampled at CO-3. The two pools in the 2024 sampling reach had a combined mean depth of 1.4 ft, a maximum depth of 3.2 ft, and a maximum residual depth of 2.7 ft, indicative of moderate scour since 2023. Dominant pool tail-out substrates consisted of large cobbles and boulders with an embeddedness ratings of 25-

50%, representative of fair spawning conditions, at the cobble tailout. The mean shelter rating for the pools was 15, representative of very low shelter abundance. Shelter at CO-3 consists of undercut banks and root masses providing complex refuge habitat where present, but the relative proportion of pool habitat with shelter availability is limited. Sand was the dominant substrate type in the pools while the riffles are dominated by large cobbles and boulders. Canopy cover was estimated at 80%, consisting of approximately 85% hardwood and 15% conifer species.

The overall juvenile steelhead population estimate for CO-3 was 52, and the total juvenile steelhead density was 22.5 fish/100 ft (Table 4), a greater than 300% increase from the 2023 estimate of 5.6 fish/100 ft (Figure 5). Of the juvenile steelhead captured at CO-3, 57.8% were age 0 fish and 42.2% were age 1+ fish (Figure 3). Estimated age class densities in 2024 were 13.0 fish/100 ft for age 0 steelhead (0.7 in 2023) and 9.5 fish/100 ft for age 1+ steelhead (4.8 in 2023) (Table 4). Similar to CO-0, the large increase in age 0 densities likely resulted from a combination of factors, including favorable streamflows during spawning, incubation, and emergence periods.

Sculpins were present in moderate numbers and Sacramento suckers in low numbers. No lamprey ammocetes were observed at CO-3 in 2024, but one Sacramento pikeminnow was present at this site located upstream of the City's intake structure and fish ladder. Non-native signal crayfish were also present.

It should be noted that staff from the California Department of Fish and Wildlife (CDFW) and the Monterey Bay Salmon and Trout Project (MBSTP) conducted juvenile steelhead rescue operations within a dry-back reach between the Browns Valley Road and the Varni Road crossings in July and August 2024. A total of 416 juvenile steelhead and 8 lamprey ammocetes were captured and relocated to Corralitos Creek in the vicinity of the Rider Creek confluence (Cochran 2024), located approximately 0.5 mile upstream of CO-3. Most of the steelhead rescued were age 0 steelhead. The 2024 density estimate at CO-3 may have been raised somewhat if some of the rescued steelhead dispersed into the sampling reach prior to the survey.

Corralitos Creek #9 (CO-9)

Sampling site CO-9 is located in the upper Corralitos Creek watershed approximately 0.3 miles downstream of the Shingle Mill Gulch confluence (Figure 1). The gradient in this reach is considerably steeper (6%) than at CO-0 through CO-3. The total channel length of the assessment reach in 2024 was 125 ft (Table 3), comparable to 2023. Based on percent total length, CO-9 consisted of 55% flatwater (step-run) and 45% pool habitat. The total wetted area of the reach at the time of the assessment was estimated at 1,307 ft^2, comparable to the 2023 estimate of 1,444 ft^2. Two Level II habitat units (one flatwater, one pool) were sampled at CO-9. The pool in this reach had a mean depth of 1.5 ft (0.9 ft in 2023), a maximum depth of 1.8 ft (2.0 in 2023) and a residual depth of 1.6 ft (identical to 2023). The pool tail-out continues to be comprised of boulders and therefore does not provide spawning habitat. The mean shelter rating for the pool was 60, representative of relatively low shelter availability. Shelter consisted entirely of large boulders that, combined with the still significant depth of the pool, provided high quality habitat for age 1+ steelhead. Canopy cover was estimated at 65%, composed almost entirely (90%) of hardwood species.

The overall juvenile steelhead population estimate for CO-9 was 60, and the total juvenile steelhead density was 48.0 fish/100 ft (Table 4), a modest (19%) increase over the 2023 density of 40.5 fish/100 ft (Figure 5). This represents the sixth consecutive year that CO-9 has had the highest total juvenile density of the eight sampling sites. Of the steelhead captured at CO-9 in 2024, 61.5% were age 0 fish (77.3% in 2023) and 38.5% were age 1+ fish (22.7% in 2023) (Figure 3). Estimated age class densities were 29.5 fish/100 ft for age 0 steelhead (31.3 in 2023) and 18.5 fish/100 ft for age 1+ steelhead (9.2 in 2023) (Table 4). Age 0 steelhead densities in 2024 remained essentially unchanged from 2023 while the age 1+ density roughly doubled. As noted previously, the large pool at this site provides high quality habitat for older fish, some of which may assume a resident life history tactic.

In addition to juvenile steelhead, one sculpin, one California newt (*Taricha torosa*), and one California giant salamander (*Dicamptodon ensatus*) larva were present at CO-9 in 2024.

Shingle Mill Gulch #3 (SM-3)

Sampling site SM-3 is located on Shingle Mill Gulch, tributary to Corralitos Creek, upstream of the third Eureka Canyon Road crossing and downstream of Grizzly Flat (Figure 1). Although located in the upper Corralitos Creek watershed, the gradient of the sampling reach is relatively low at approximately 2%. The total channel length of the assessment reach in 2024 was 140 ft (Table 3), comparable to 2023. Based on percent total length, SM-3 consisted of 33% riffle and 67% pool habitat. In past years, a long riffle separated two pools, but much of this riffle was deepened into a flatwater in 2023. In 2024, this area has further deepened into a shallow pool. Based on the total length and mean widths of the habitat units, the total wetted area of the reach at the time of the assessment was estimated at 935 ft^2, a modest (9%) increase over the 2023 estimate of 855 ft^2. Four Level II habitat units (two riffles, two pools) were sampled at SM-3. The pools in the reach had a combined mean depth of 0.8 ft, a maximum depth of 2.2 ft, and a residual depth of 2.1 ft. Dominant pool tail-out substrates at both pools consisted of small cobble with embeddedness ratings of 0-25% and 25-50%, representative of good to fair spawning conditions. The combined mean shelter rating for the pools was 65, comprised primarily of root masses and small woody debris. Coarse substrates dominate the riffles while small cobbles and silt are the dominant substrate types in the pools. Canopy cover was estimated at 85%, composed primarily (80%) of conifer species.

The overall juvenile steelhead population estimate for SM-3 was 6, and the total juvenile steelhead density was 4.3 fish/100 ft, a 72% decrease from the 2023 density of 15.6 fish/100 ft (Table 4). SM-3 was the only sampling site at which the total juvenile density of steelhead decreased in 2024 compared to the previous year (Figure 5). Of the juvenile steelhead captured at SM-3, 50.0% were age 0 fish (89.5% in 2023) and 50.0% were age 1+ fish (10.5% in 2023) (Figure 3). Estimated age class densities were 2.1 fish/100 ft for age 0 (13.9 in 2023) and age 1+ (1.6 in 2023) steelhead (Table 4). Age 0 densities at SM-3 were very low in 2021 and 2022 (only one individual each year), but increased substantially in 2023, suggesting that anadromous spawning may only extend this far up the watershed in very wet years and that the Shingle Mill population may be sustained by low levels of resident trout spawning during drought and normal water years (Podlech 2023). The fact that SM-3 was the only sampling site at which densities decreased in 2024 compared to 2023 supports this assumption.

Larval California giant salamanders and California newt were again observed at SM-3 in 2024. Non-native signal crayfish were also present in low numbers.

Browns Creek #1 (BR-1)

Sampling site BR-1 is located on a moderate gradient (2-3%) reach of Browns Creek downstream of the City's diversion facility (Figure 1). The total channel length of the assessment reach in 2023 was 138 ft (Table 3). Based on percent total length, BR-1 consisted of 62% flatwater and 38% pool habitat. Significant sediment deposition in 2023 resulted in the near-complete filling of a previously large bedrock-dominated pool at the downstream end of the survey reach as well as the complete filling of a previously shallow, smaller pool at the upstream end of the reach. As a result, flatwater habitat availability increased by about 75% in 2023 and pool habitat decreased by a similar margin. Conditions remained relatively unchanged in 2024, but we shortened the total sample reach length by about 80 ft to reduce the over-dominance of flatwater habitat within the sample site. As a result, the estimated total wetted area of the reach was reduced from 2,603 ft^2 in 2023 to 1,705 ft^2 in 2024. Two Level II habitat units (one flatwater, one pool) were sampled at BR-1 in 2024. The remaining pool in this reach had a mean depth of 1.0 ft, a maximum depth of 2.5 ft, and a residual depth of 2.3 ft, indicative of continued sediment deposition. The tail-out at the pool consisted of small cobbles with 25-50% embeddedness, providing fair adult steelhead spawning conditions. The shelter rating for the pool was 10, representative of exceedingly low shelter within this habitat unit. The limited shelter was dominated by boulders and bedrock ledges. Canopy cover was estimated at 65%, composed almost entirely (85%) of hardwood species.

The overall juvenile steelhead population estimate for BR-1 was 17, and the total juvenile steelhead density was 12.3 fish/100 ft (Table 4), a 56% increase from the total density of 7.9 fish/100 ft in 2023. Juvenile densities have fluctuated widely at BR-1 since 2016 (Figure 5). Of the juvenile steelhead captured at BR-1 in 2024, 56.3% were age 0 fish (64.7% in 2023) and 43.8% were age 1+ fish (35.3% in 2023) (Figure 3), representative of an age class structure that is comparable to 2023. Estimated age class densities in 2024 were 6.9 fish/100 ft for age 0 steelhead (5.1 in 2023) and 5.4 fish/100 ft for age 1+ steelhead (2.8 in 2023) (Table 4). Steelhead densities at BR-1 declined substantially from 2019 through 2022, but the 2024 estimate represents a second consecutive increase (Figure 5), suggesting a continuing recovery in the Browns Creek steelhead population after low abundances during drought years.

Sculpins were moderately abundant, and some non-native signal crayfish were present at BR-1. One California newt was also observed.

Browns Creek #2 (BR-2)

Sampling site BR-2 is located on a moderate gradient (2-3%) reach of Browns Creek upstream of the City's diversion facility (Figure 1). The total channel length of the assessment reach in 2024 was 226 ft (Table 3), comparable to 2023. Based on percent total length, BR-2 consisted of 53% flatwater and 47% pool habitat, which is largely unchanged from 2023. The total wetted area of the reach at the time of the 2024 assessment was estimated at 2,804 ft^2, approximately 20% higher than the 2023 estimate of 2,327 ft^2, which is primarily due to an approximately 2.5-ft increase in the average wetted width of the

flatwater habitat unit from 2023 to 2024. Three Level II habitat units (one flatwater, two pools) were sampled at BR-2. The pools in this reach had a combined mean depth of 1.3 ft, a maximum depth of 2.5 ft, and a residual depth of 2.1 ft. The tail-outs at both pools consisted of very large cobbles and boulders that are not suitable for spawning by adult steelhead. The mean shelter rating for the pools was 40, representative of low shelter abundance. The limited shelter was dominated by boulders in one pool and by a complex root mass in the other. Canopy cover was estimated at 80%, composed of 75% hardwood and 25% conifer species.

The overall juvenile steelhead population estimate for BR-2 was 30, and the total juvenile steelhead density was 13.3 fish/100 ft (Table 4), a 183% increase from the total density of 4.7 fish/100 ft in 2023. Of the juvenile steelhead captured at BR-2, 39.3% were age 0 fish (30.0% in 2023) and 60.7% of captured fish were classified as age 1+ (70.0% in 2023) (Figure 3). Estimated age class densities were 5.2 fish/100 ft for age 0 steelhead (1.4 in 2023) and 8.1 fish/100 ft for age 1+ steelhead (3.3 in 2023) (Table 4), suggestive of improved spawning success upstream of the City's diversion in 2023 after the City completed emergency repairs to its Browns Creek diversion structure and fish ladder in fall 2023.

Sculpins were moderately abundant and some non-native signal crayfish were present at BR-2. One California newt was also observed.

Casserly Creek #3 (CA-3)[1]

Sampling site CA-3 is located within a moderate-gradient (3%) reach of Casserly Creek approximately 250 ft downstream of Mt. Madonna Road bridge and 2.5 miles upstream of College Lake (Figure 2). The total channel length of the assessment reach in 2024 was 170 ft (Table 3), approximately 25 ft shorter than in 2023. Based on percent total length, CA-3 consisted of 64% flatwater, 31% shallow pool, and 5% riffle. CA-3 exhibits a relatively dynamic channel morphology with frequent shifts in habitat types and structure (e.g., Podlech 2023). Based on the total length and mean widths of the habitat units, the total wetted area of the reach at the time of the 2024 assessment was estimated at 761 ft^2, a 32% decrease from the 2023 estimate of 1,005 ft^2. Five distinct Level II habitat units (two flatwater, two pool, one riffle) were sampled at CA-3. The pools in the reach had a mean depth of 0.4 ft, a maximum depth of 0.8 ft, and a residual depth of 0.7 ft. These depths are reduced by approximately 0.2 ft compared to 2023. Dominant pool tail-out substrates in 2024 consisted of large cobbles with a high embeddedness rating of 50-75% and 75-100%. The shelter rating for the pools was 35, reflective of decreased cover availability compared to pre-2022 years. Silt is the dominant substrate type in the two pools. Canopy cover was estimated at 40%, consisting of approximately 90% hardwood and 10% conifer species.

The overall juvenile steelhead population estimate for CA-3 was 41, and the total juvenile steelhead density was 24.1 fish/100 ft, an over 1,000% increase over the 2023 density of 2.1 fish/100 ft and the and the highest density observed at this site in eight years of sampling (Figure 5). Notably, this follows the lowest density observed at this site in 2023. Almost all of the juvenile steelhead captured at CA-3 (94.6%) were age 0 fish (25% in 2023) and only two (5.4%) were age 1+ fish (75% in 2023) (Figure 3).

---

[1] Note that the *2019 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watershed* report (Podlech 2019) misidentified this sampling site as "Casserly Creek #1 (CA-1)" due to inconsistencies in site-naming in Alley (2017). However, the location of the Casserly Creek sampling site has remained consistent during all survey years.

Estimated age class densities were 22.8 fish/100 ft for age 0 steelhead (0.5 in 2023) and 1.3 fish/100 ft for age 1+ steelhead (1.5 in 2023) (Table 4). In 2019, the high proportion and density of age 0 steelhead suggested successful spawning in Casserly Creek, and therefore successful adult migration through College Lake (Podlech 2019). However, in 2020 through 2022, the relative abundances of age 0 fish were greatly reduced, a trend that was consistent with observations in Shingle Mill Creek during that period and indicative of limited adult migration opportunities during drought years (Podlech 2022). In 2023, however, the population decline at CA-3 was in stark contracts to the substantial increase at SM-3 and may have been the result of channel bed scour/deposition in Casserly Creek and/or challenging fish passage conditions at Paulson Road on the north side of College Lake (Podlech 2023). The significant increase in total and age 0 densities in 2024 suggest successful migratory and spawning conditions in Casserly Creek.

No other fish, amphibian, or crustacean species were observed at CA-3 in 2024.

Discussion

Many factors influence intra- and interannual fish population fluctuations. These include among others the magnitude and timing of streamflows, water quality conditions, the ability of adult steelhead to pass natural barriers, spawning success, food production (i.e., benthic macroinvertebrate abundance), and sedimentation. Direct cause-and-effect relationships are difficult to establish since fish populations, even in an undisturbed area, can fluctuate due to natural variations in the biotic and abiotic components of the environment. For anadromous salmonids such as steelhead, ocean conditions also play an important factor in maturation and recruitment of adults.

Droughts create low-flow conditions that are positively correlated with overall population declines, especially in age 0 juvenile salmonids. Low flows impede upstream migration of adult steelhead, limit streambed substrate for spawning, and tend to result in higher water temperatures that may adversely affect summer survival. Low juvenile steelhead densities in the Corralitos Creek watershed were reported by Alley (2018) in 2014 and 2016. After experiencing near-record precipitation and stream discharges during water year 2017, and a concomitant improvement in juvenile steelhead densities in the Corralitos Creek watershed (Alley 2018), water year 2018 saw a return to below-average rainfall in coastal central California and juvenile steelhead densities decreased at all sampling sites in the Corralitos Creek watershed[2] except CO-1, where a high density of age 0 juveniles accounted for the highest total juvenile density (Figure 5).

For salmonids, the timing of runoff events is more important than the total or mean annual discharge. In water year 2018, only one minor runoff event occurred in early January 2018, then streamflows in Corralitos Creek remained below the long-term average through the end of March, significantly limiting adult steelhead access to the watershed during the typical peak of the spawning migration season, before several additional moderate runoff events occurred in March in early April toward the tail end of the adult migration and spawning season. The fact that only the lower watershed sites of CO-0 and CO-1 supported high proportions of age 0 steelhead in 2018, while age 1+ fish were far more abundant than age 0 fish in the upper watershed sites of CO-9, BR-1, and BR-2, supported the hypothesis that the late

---

[2] Casserly Creek (CA-3) was not sampled in 2018.

arrival of adult migration opportunities largely limited adult access to the lower watershed (Podlech 2018).

Water year 2019 resulted in Corralitos Creek streamflows consistently remaining above the long-term average through the entire adult steelhead migration and spawning season and smolt outmigration season. Hydrologically, 2019 was an almost ideal water year for steelhead as streamflows remained elevated but did not reach levels that would be expected to result in redd (egg nest) scour and/or significant flushing of age 0 fish. It appears that higher flows in water year 2019 provided adult steelhead access higher up in the watershed, as reflected by substantial increases in age 0 juvenile densities at CO-9, SM-3, BR-1, and BR-2 compared to 2018 (Figure 5). Conversely, age 1+ densities decreased moderately at most sites and substantially in Shingle Mill Gulch (SM-3). The favorable 2019 smolt outmigration conditions (i.e., sustained, moderate spring flows), combined with the relatively low age 0 densities (<10 fish/100 ft) in 2018 likely resulted in the weaker age 1+ densities at these sites in 2019 (Podlech 2019).

Water years 2020 through 2022 were characterized by drought conditions throughout the central California coast region and steelhead trout densities the Corralitos and Casserly creeks drainages generally declined (Figure 5). The importance of the timing of the limited precipitation events was even more evident during drought years. Water year 2021 had only one meaningful precipitation event in late January during the peak steelhead migration and spawning season. This relatively brief event enabled adult steelhead to enter the Corralitos Creek basin and spawn in the lower reaches of the watershed (CO-0, CO-1, CO-3) where age 0 steelhead densities were substantially higher in 2021 compared to the other drought years of 2020 and 2022 (Figure 6) (Podlech 2023).

It is important to note that the City of Watsonville did not operate its filter plant in 2020, 2021, or 2022. Lower creek flows combined with a lack of late rain events and a lack of overall total rain accumulation, rendered extended diversion periods infeasible. As such, 2020 through 2022 amount to control years from the perspective of a fisheries effects analysis. As described above, the three non-diversion years were drought years, yet juvenile steelhead population trends differed based on differences in the timing of runoff events and the location of sampling sites.

Water year 2023 was characterized by substantial and extended precipitation. Multiple atmospheric rivers maintained streamflows along the central California coast well above long-term averages during much of December 2022 through spring and summer 2023 (Figure 7). These elevated flows likely provided numerous and prolonged migration and spawning opportunities for adult steelhead throughout much of the Corralitos-Casserly Creek subbasin. However, several peak flow events in Corralitos Creek in late December and mid-January approached or exceeded 2,000 cubic feet per second (cfs) (Figure 7), resulting in major sediment transport events as evidenced by substantial geomorphic changes at some sampling sites. Significant sediment transport events have the potential to scour or burry active spawning redds, resulting in loss of incubating eggs and/or alevins. In March 2023, a time when newly emerged fry are present in the streams, streamflows remained above 100 cfs for much of the month and again peaked at approximately 2,000 cfs (Figure 7). In addition to potentially flushing fry, turbidity and suspended sediment levels were qualitatively very high throughout this time. High and prolonged turbidity concentrations can lower dissolved oxygen in the water column, reduce respiratory function, disrupt normal feeding behavior and efficiency, reduce growth rates, lower disease tolerance,

and cause fish mortality. These effects are more pronounced in smaller fish such as steelhead fry. The lower portion of a watershed typically experiences higher flow rates and turbidity/suspended sediment levels, and age 0 steelhead densities at sites CO-0, CO-1, and CO-3 in 2023 were among the lowest recorded during nine years of population surveys (Figure 6). Casserly Creek (CA-3) underwent substantial geomorphic changes, including the loss of feeding (riffle) and rearing (pool) habitat. Densities of total and age 0 juveniles remained as low as during recent drought years. Conversely, upper watershed sites such as CO-9 and SM-3 saw some the highest total juvenile densities recorded at these sites (Figure 5), driven largely by substantial increases in age 0 densities (Figure 6). In Browns Creek, the lower site (BR-1) had the highest density of age 0 steelhead in the past four years while the upper site (BR-2) had the second lowest density in the past eight years even though total densities remained largely unchanged. Damage to a weir at the Browns Valley diversion site may have adversely affected adult fish passage opportunities through the fish ladder in water year 2023 (Podlech 2023).

Precipitation patterns in water year 2024 were similar to water year 2019 described above. Although 2024 was "only" an average water year in terms of total precipitation, Corralitos Creek streamflows consistently remained above the long-term average through the entire adult steelhead migration, spawning, and emergence periods. Like 2019, 2024 was an almost ideal water year for steelhead as streamflows remained elevated but did not reach levels that would be expected to result in significant redd (egg nest) scour and/or significant flushing of age 0 fish. Total juvenile densities increased at seven of eight sampling sites from the prior year, with some of the increases being multiple-fold (Figure 5). Lower Corralitos Creek (CO-0, CO-1, CO-3) and Casserly Creek (CA-3), in particular, were seeded with some of the highest densities of age 0 steelhead since 2019 (Figure 6). Shingle Mill Creek (SM-3), the only outlier to increasing juvenile densities, is the upstream-most sampling site in the Corralitos Creek watershed and is located above relatively steep channel gradient sections. As noted previously (e.g., Podlech 2023), anadromous spawning may only extend this far upstream in the watershed in very wet years, and the Shingle Mill population may be sustained by low levels of resident trout spawning during drought and normal water years.

TABLE 2

WATER QUALITY RESULTS AT EIGHT SAMPLING SITES IN THE CORRALITOS CREEK AND CASSERLY CREEK WATERSHEDS, SEPTEMBER/OCTOBER 2024

Parameter	CO-0	CO-1	CO-3	CO-9	SM-3	BR-1	BR-2	CA-3
Date	10/10	9/27	10/11	9/23	9/23	9/24	9/24	9/25
Time	1000	930	1305	1155	945	1245	955	1145
Weather	clear	clear	clear	clear	clear	clear	clear	clear
Air Temp (°C)	18.7	15.1	15.5	17.3	15.6	17.9	14.8	17.1
Water Temp (°C)	14.8	14.1	14.4	14.3	13.6	14.9	14.4	15.2
Conductivity (µmhos/cm)	404	416	417	447	408	525	499	1122
DO Conc. (mg/l)	9.4	9.5	9.4	9.0	8.9	9.0	8.2	8.7
DO Sat. (%)	104	93	93	88	86	90	81	89

TABLE 3

SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS AT EIGHT SAMPLING SITES IN THE CORRALITOS CREEK AND CASSERLY CREEK WATERSHEDS, SEPTEMEBR/OCTOBER 2024

Site ID	Habitat Unit Type	# of Units	Total Length (ft.)	% of Reach Length	Mean Width (ft.)	Mean Depth (ft.)	Max. Depth (ft.)	Residual Pool Depth (ft.)	Estimated Total Area (sq. ft.)	Dominant Substrate Types	Dominant Pool Tail Substrate	Mean Tail Embedded-ness	Mean Shelter Value
CO-0	P	2	86	50	15.2	0.8	1.4	1.0	1,307	LC	LC/BO	2.0	13
	F	1	42	24	10.6	0.6	0.9	---	445	LC	---	---	---
	R	1	44	26	17.1	0.3	0.7	---	752	LC	---	---	---
	TOTAL		**172**						**2,504**				
CO-1	P	1	110	83	21.1	1.8	3.4	3.0	2,321	SA	BO	NA	20
	R	1	22	17	18.7	0.4	0.8	---	411	LC	---	---	---
	TOTAL		**132**						**2,732**				
CO-3	P	2	174	75	15.4	1.4	3.2	2.7	2,680	SA	LC/BO	2.0	15
	R	2	57	25	9.7	0.3	0.8	---	553	LC/BO	---	---	---
	TOTAL		**231**						**3,233**				
CO-9	P	1	56	45	11.4	1.5	1.8	1.6	638	BO	BO	NA	60
	F	1	69	55	9.7	0.5	1.2	---	669	BO	---	---	---
	TOTAL		**125**						**1,307**				
SM-3	P	2	94	67	7.5	0.8	2.2	2.1	705	SC/SI	SC/SC	1.5	65
	R	2	46	33	5.0	0.2	0.3	---	230	GR/SC	---	---	---
	TOTAL		**140**						**935**				
BR-1	P	1	52	38	9.3	1.0	2.5	2.3	484	LC	SC	2.0	10
	F	1	86	62	14.2	0.4	0.9	---	2,221	LC	---	---	---
	TOTAL		**138**						**1,705**				
BR-2	P	2	106	47	12.3	1.3	2.5	2.1	1,304	BO	BO/BO	NA	40
	F	1	120	53	12.5	0.7	1.0	---	1,500	BO	---	---	---
	TOTAL		**226**						**2,804**				
CA-3	P	2	53	31	4.2	0.4	0.8	0.7	223	SI/SI	SC/SC	3.5	35
	F	2	109	64	4.7	0.2	0.4	---	512	SI/SA	---	---	---
	R	1	8	5	3.3	0.1	0.2	---	26	SC	---	---	---
	TOTAL		**170**						**761**				

NOTE: Habitat type codes: R = riffle; F = flatwater; P = pool.
Substrate type codes: SI =silt; SA = sand; GR = gravel; SC = small cobble; LC = large cobble; BO = boulder; BR = bedrock.
NA = not applicable

TABLE 4

JUVENILE STEELHEAD DENSITIES (# FISH/100 FT) AT EIGHT SAMPLING SITES IN THE CORRALITOS CREEK AND CASSERLY CREEK WATERSHEDS, SEPTEMBER/OCTOBER 2024

Metric	CO-0	CO-1	CO-3	CO-9	SM-3	BR-1	BR-2	CA-3
Total Density	31.4	29.5	22.5	48.0	4.3	12.3	13.3	24.1
Age 0 Density	22.5	6.8	13.0	29.5	2.1	6.9	5.2	22.8
Age 1+ Density	8.9	22.8	9.5	18.5	2.1	5.4	8.1	1.3
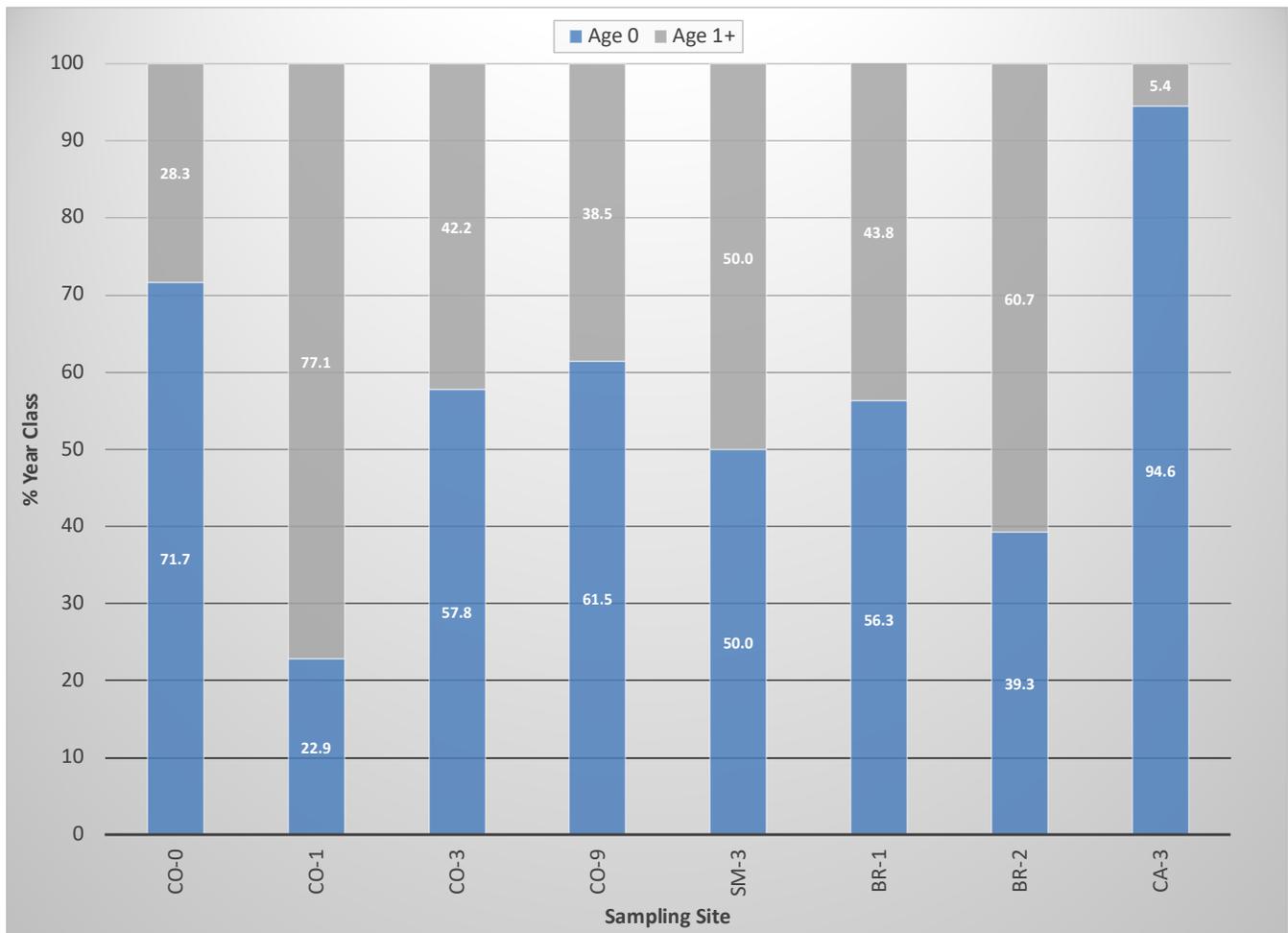
Figure 3. Relative Proportion (%) of Juvenile Steelhead Age Classes at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, September/October 2024
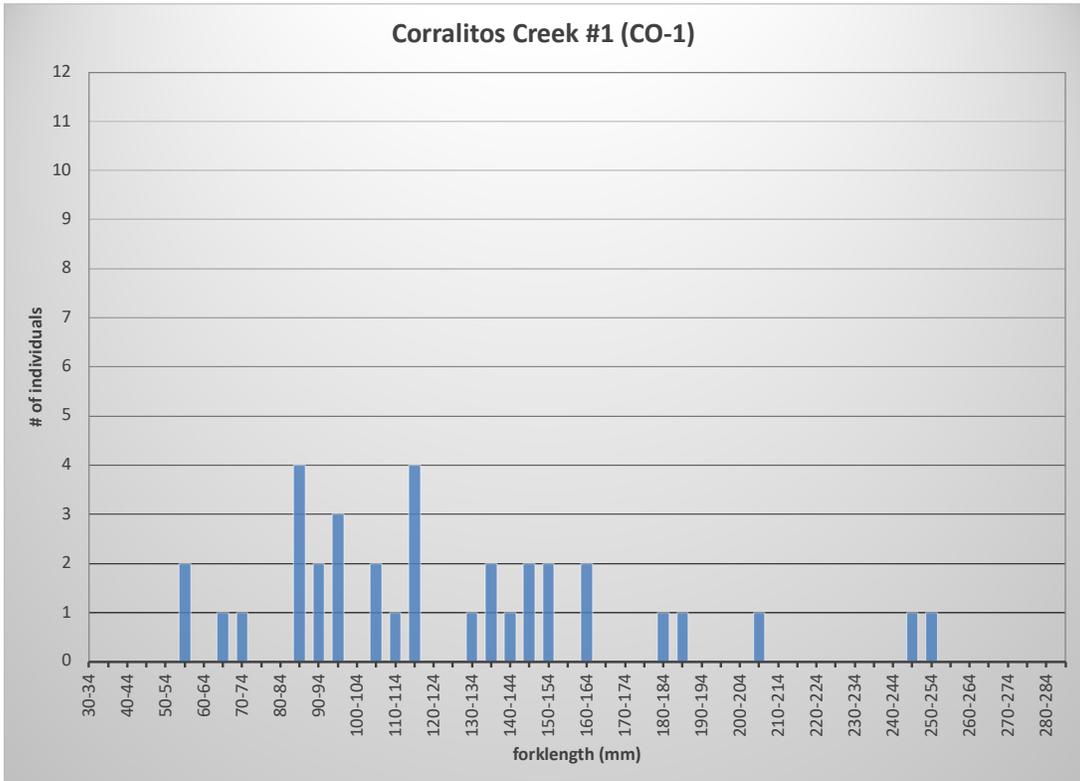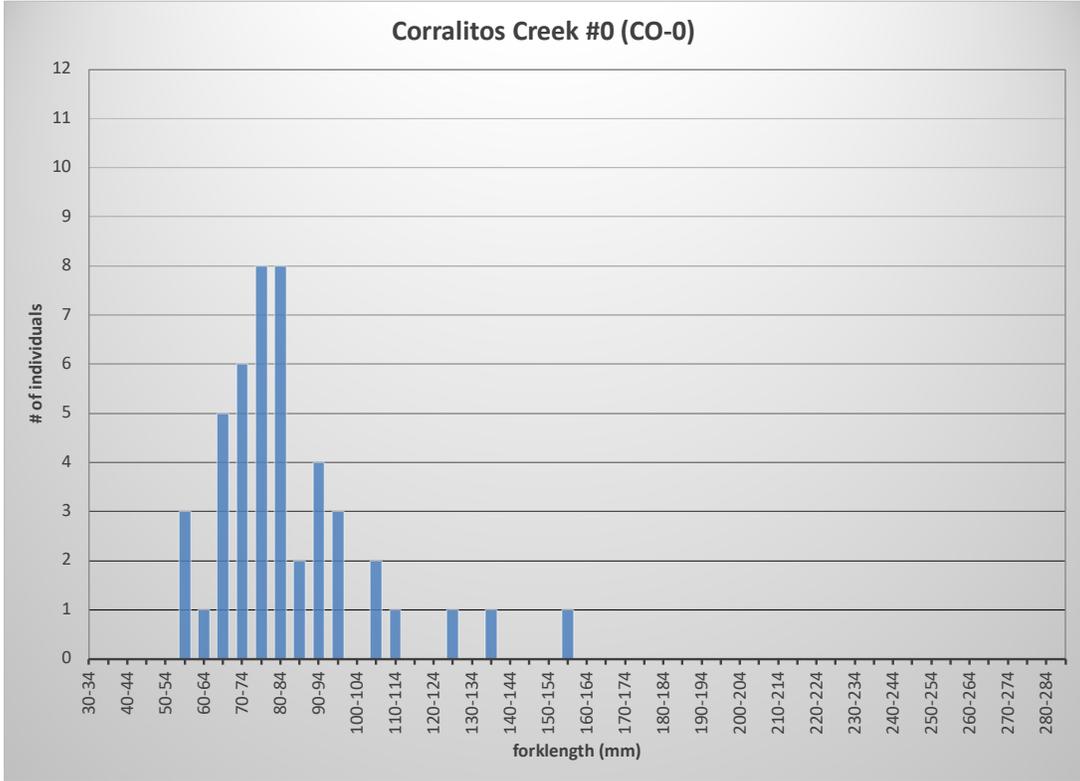
Figure 4. Forklength Distributions of Juvenile Steelhead at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, September/October 2024
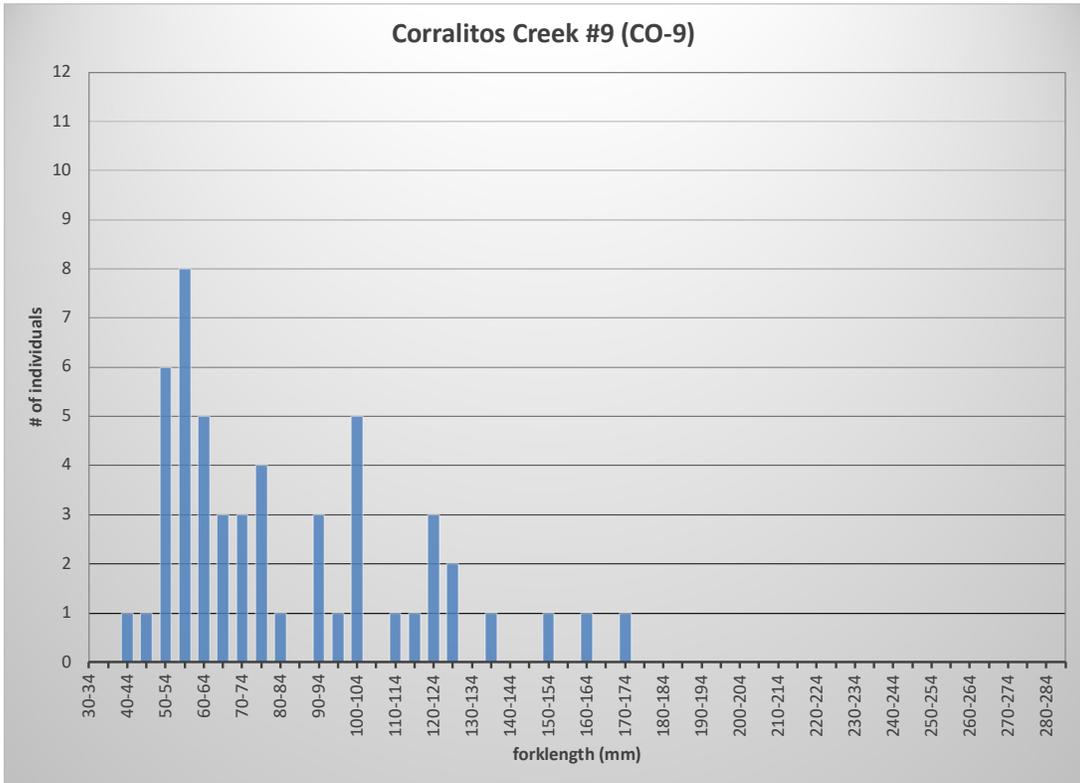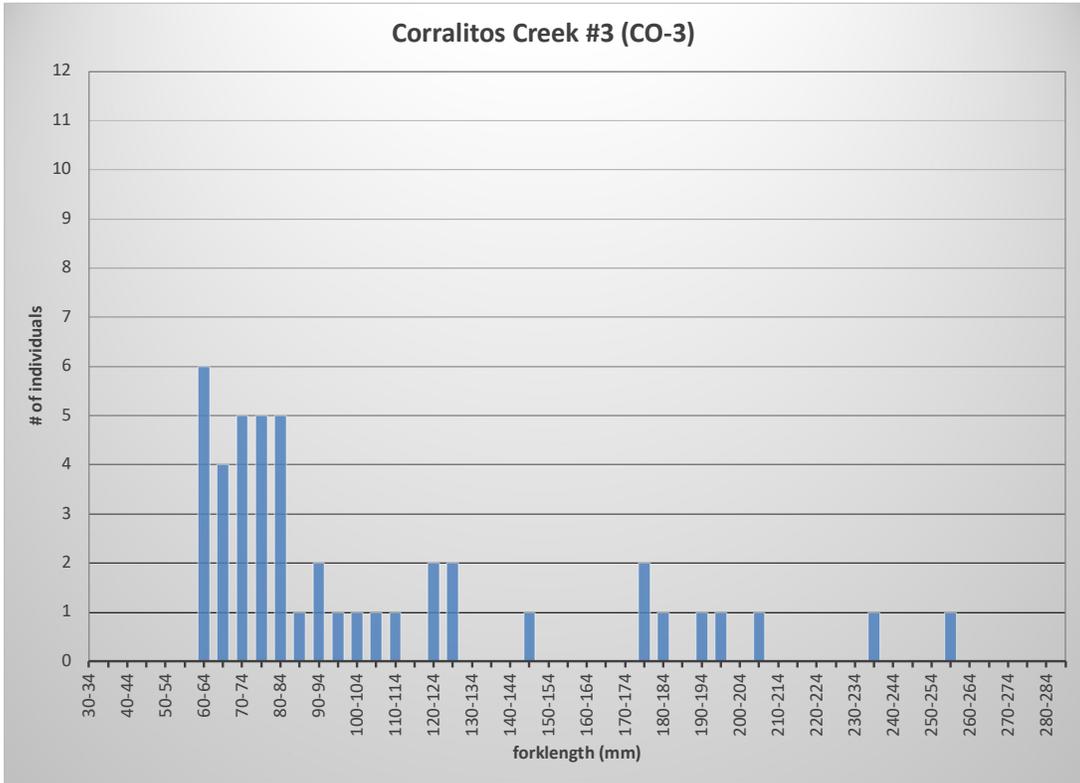
Figure 4 (cont.). Forklength Distributions of Juvenile Steelhead at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, September/October 2024
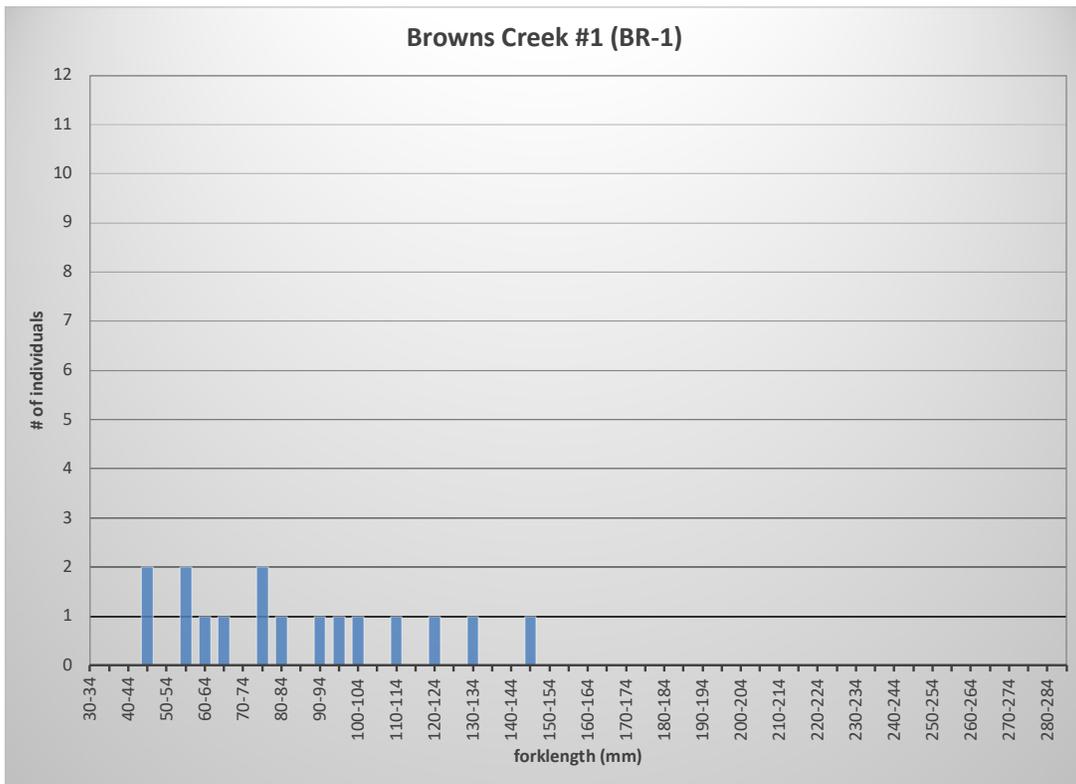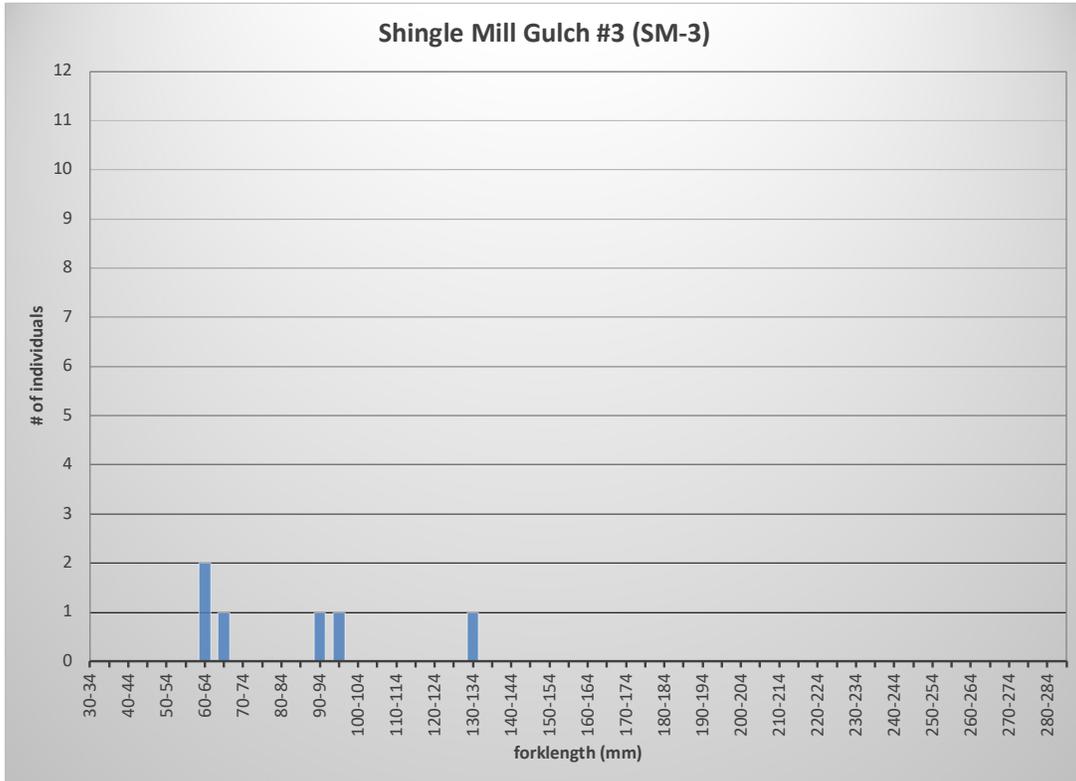
Figure 4 (cont.). Forklength Distributions of Juvenile Steelhead at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, September/October 2023
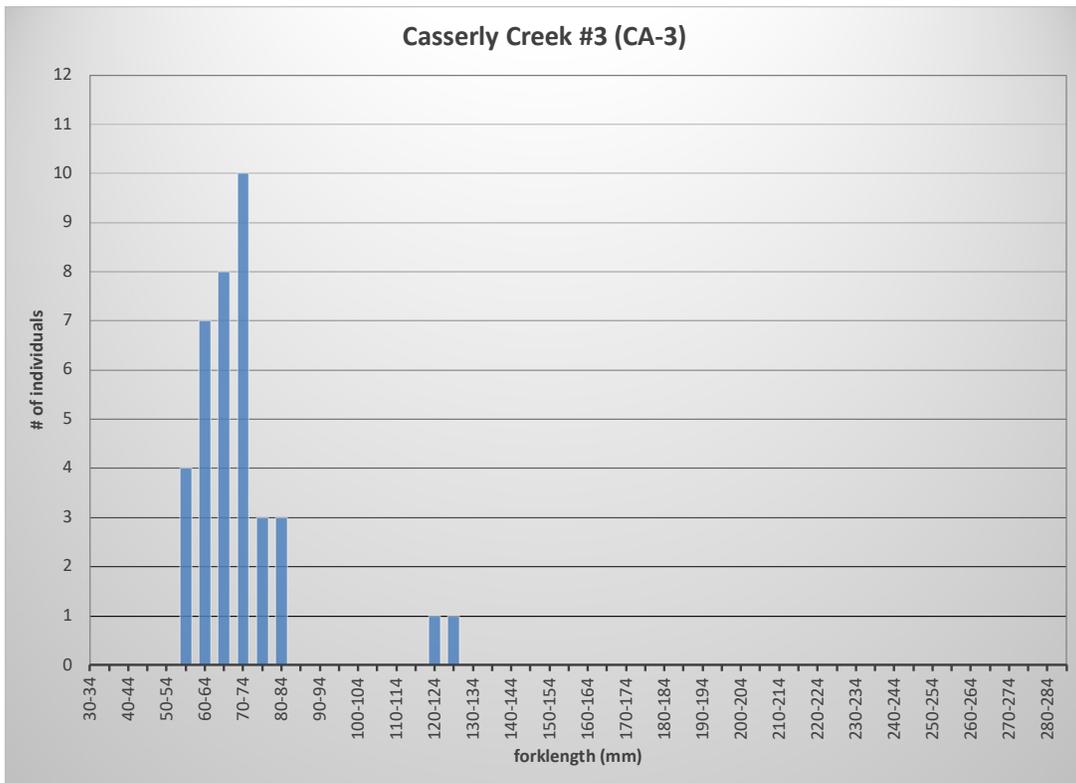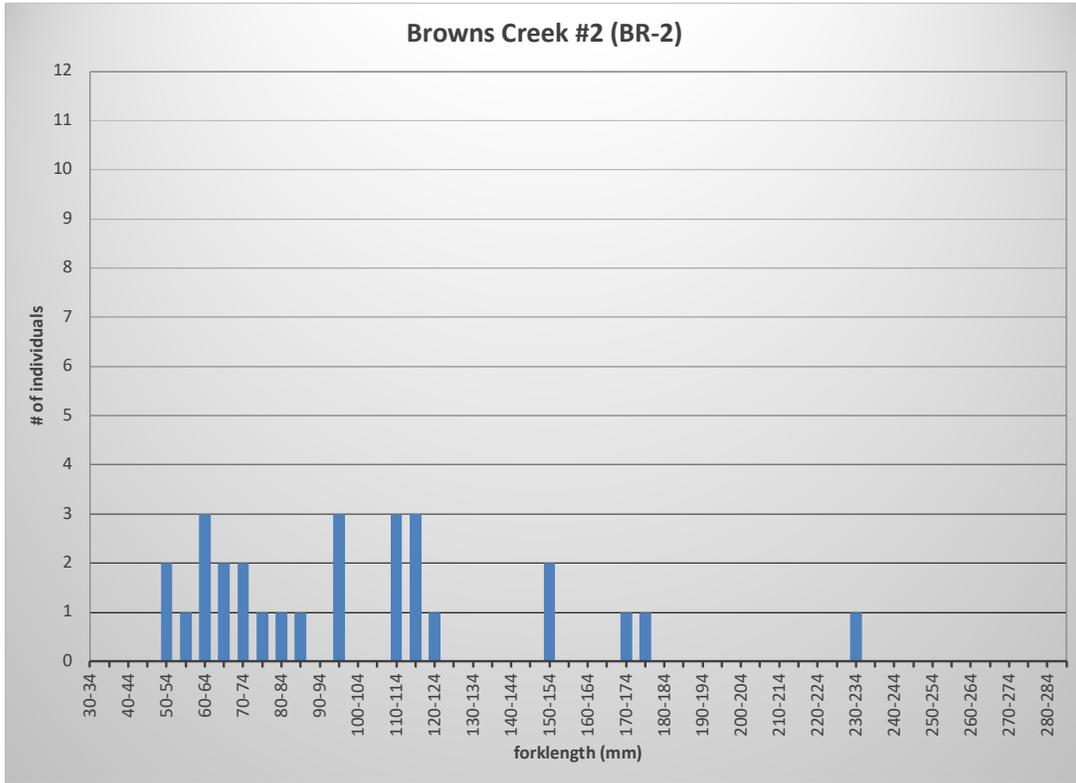
Figure 4 (cont.). Forklength Distributions of Juvenile Steelhead at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, September/October 2024

Total Juvenile Steelhead Densities, 2016-2024

	CO-0	CO-1	CO-3	CO-9	SM-3	BR-1	BR-2	CA-3
2016	6.0	3.7	8.2	25.1		11.7	6.7	24.7
2017	43.6	24.8	30.6	42.4	24.3	30.0	22.5	32.1
2018	17.6	39.9	32.3	28.3	10.3	10.9	14.8	
2019	39.7	26.6	29.4	44.2	16.4	39.7	24.9	41.2
2020	12.9	10.7	15.4	28.0	4.8	14.3	13.1	15.0
2021	14.8	16.4	24.8	38.6	3.6	8.3	2.2	6.4
2022	11.1	7.7	12.3	14.0	3.6	4.7	5.2	5.3
2023	3.3	9.9	5.6	40.5	21.0	7.9	4.7	2.1
2024	31.4	29.5	22.5	48.0	4.3	12.3	13.3	24.1
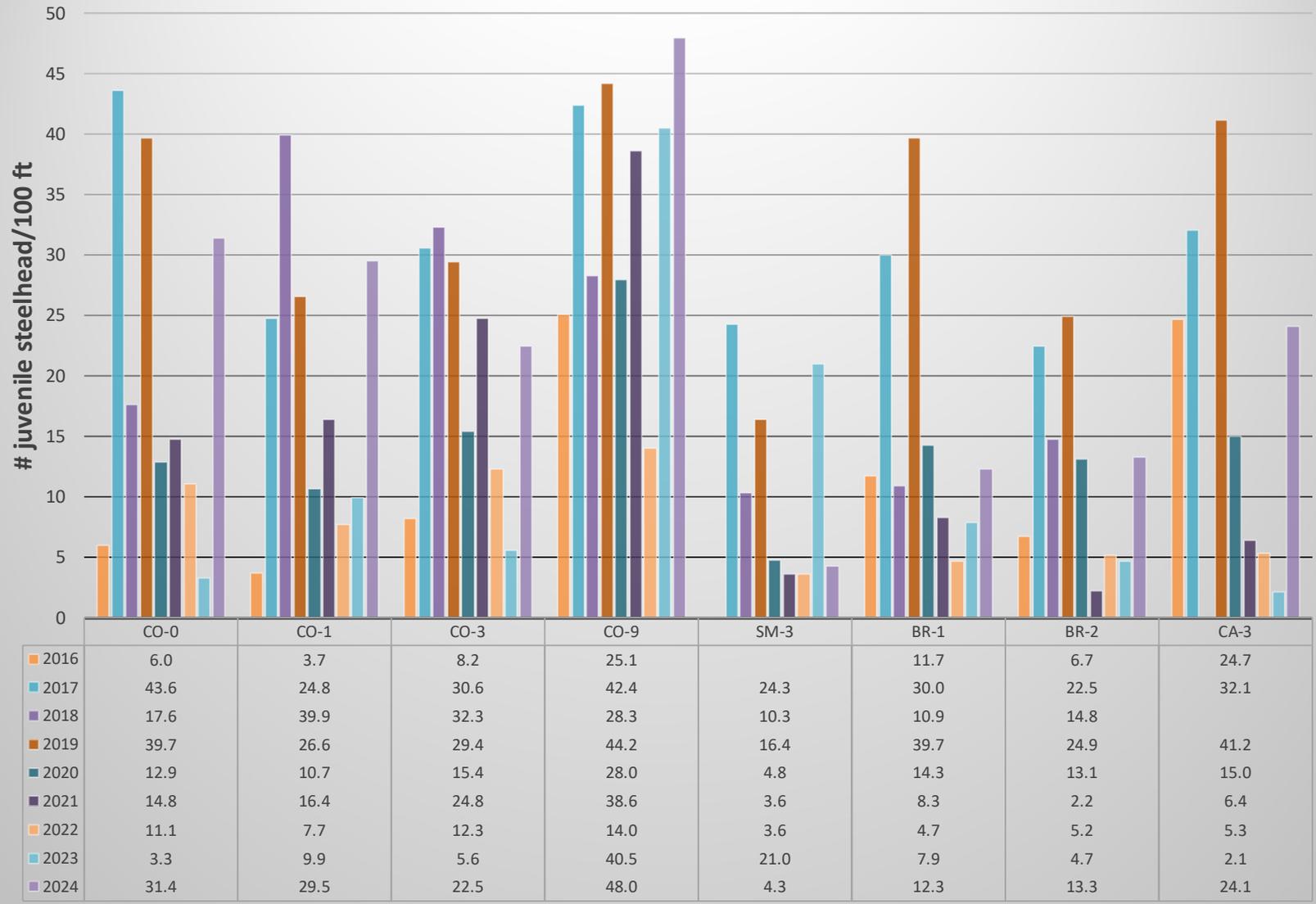
Figure 5. Total Juvenile Steelhead Densities at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, 2016-2024 (data for 2016-2017 adapted from Alley [2017, 2018])

Age 0 Steelhead Densities, 2016-2024

	CO-0	CO-1	CO-3	CO-9	SM-3	BR-1	BR-2	CA-3
2016	0.8	0.0	0.9	18.0		2.3	1.9	22.1
2017	39.1	22.0	28.9	29.0	20.3	23.0	20.6	26.4
2018	13.5	28.0	17.5	9.7	10.3	3.2	5.8	
2019	33.3	14.5	23.0	23.0	15.4	31.3	19.0	34.3
2020	7.3	2.8	7.5	10.8	3.2	4.6	7.8	5.5
2021	12.0	14.3	17.7	21.8	0.7	3.3	0.0	4.3
2022	5.0	1.3	3.0	0.9	0.7	1.7	4.7	0.6
2023	1.1	0.0	0.7	31.3	13.9	5.1	1.4	0.5
2024	22.5	6.8	13.0	29.5	2.1	6.9	5.2	22.8
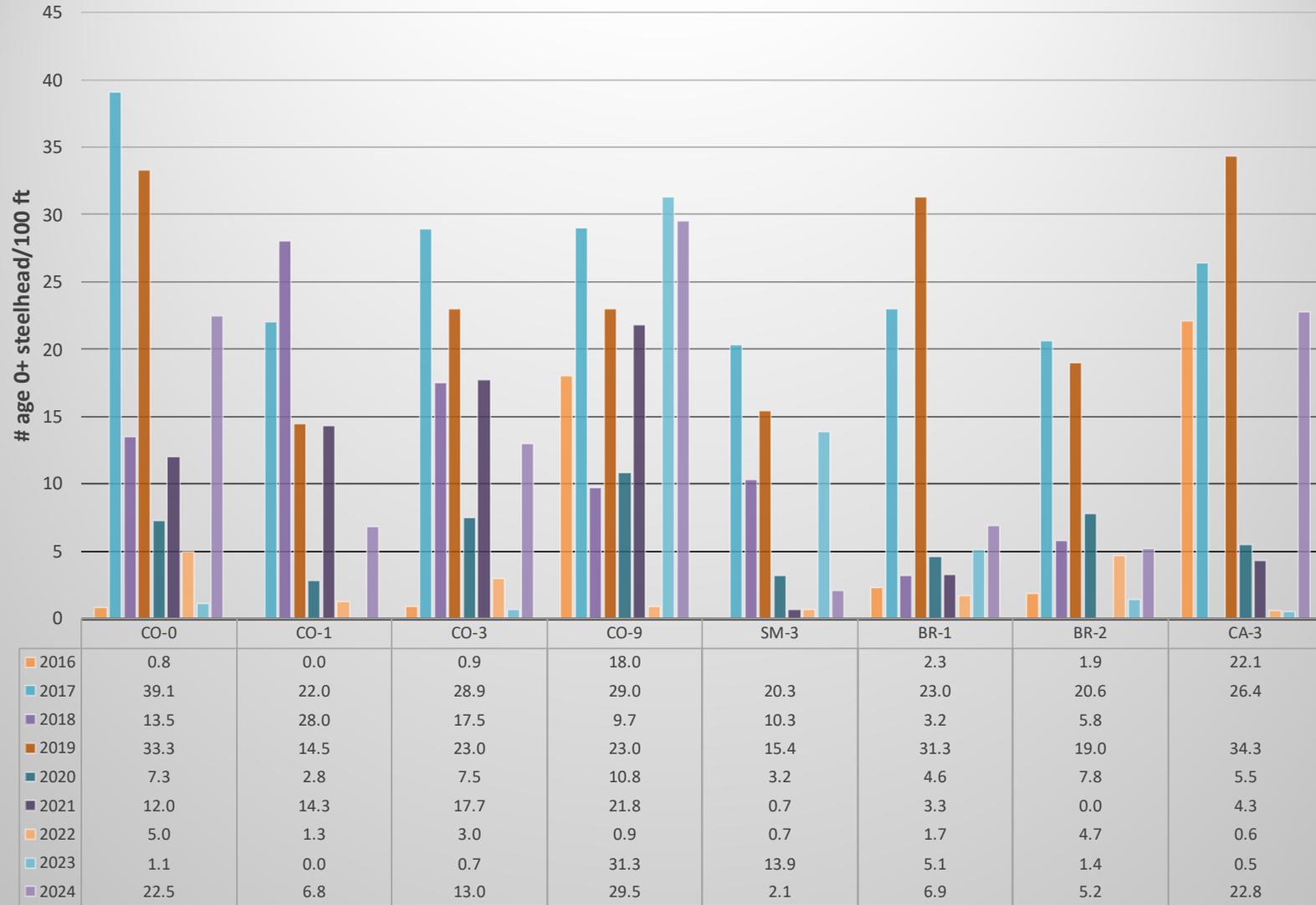
Figure 6. Age 0 Steelhead Densities at Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds, 2016-2024 (data for 2016-2017 adapted from Alley [2017, 2018])
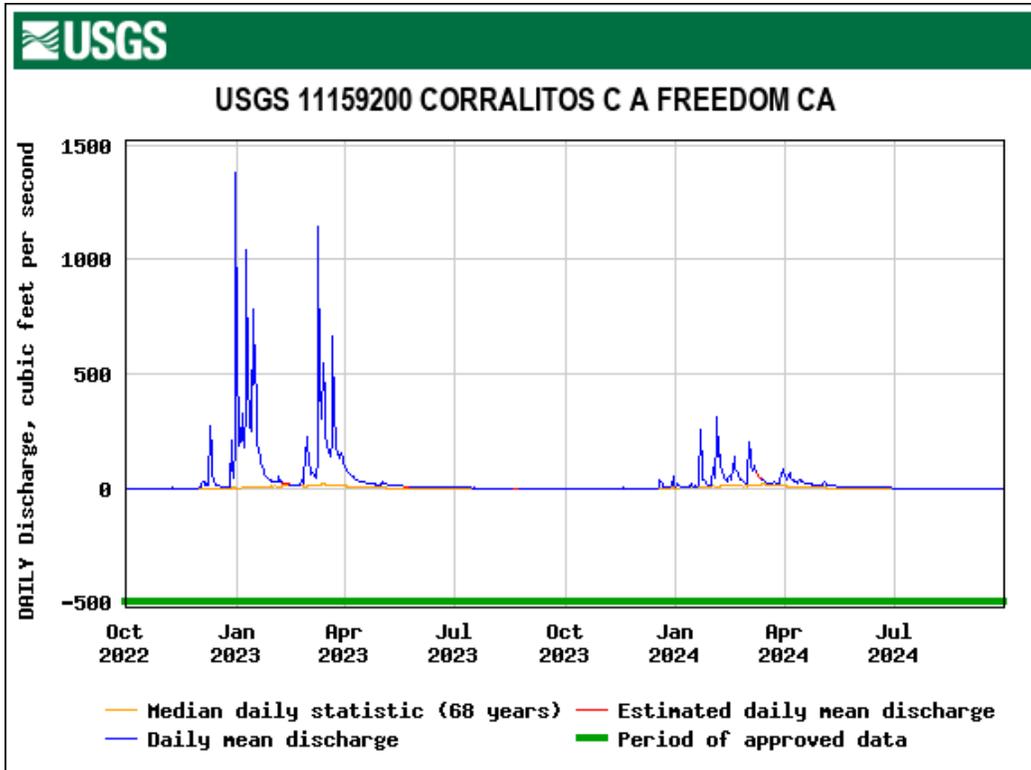
SOURCE: U.S. Geological Survey, 2024

Figure 7. Mean Daily Discharge in Corralitos Creek at Freedom, USGS 11159200, Water Years 2023-2024
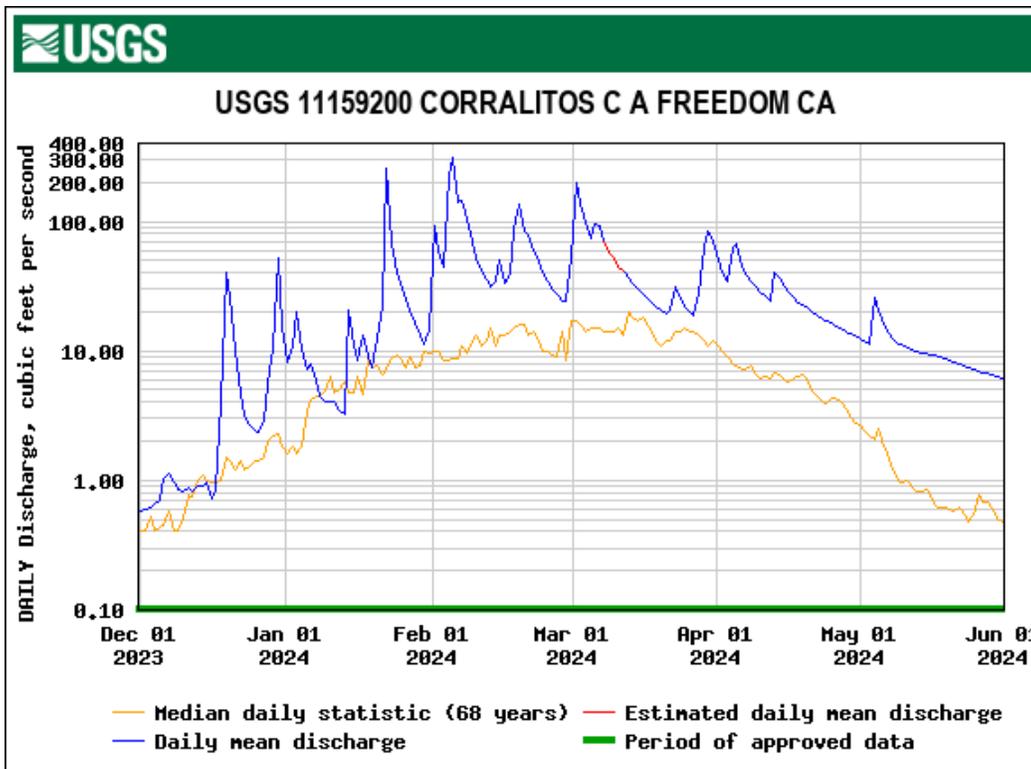
SOURCE: U.S. Geological Survey, 2024

Figure 8. Mean Daily Discharge in Corralitos Creek at Freedom, USGS 11159200, December 2023-May 2024

References

Alley, D.W. 2018. 2017 Summary Report – Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds, Santa Cruz County, CA. Prepared for Santa Cruz County.

Alley, D.W. 2017. 2016 Summary Report – Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Pajaro Watersheds, Santa Cruz County, CA. Prepared for Santa Cruz County.

Bond, M.H., S.A. Hayes, C.V. Hanson, and R.B. MacFarlane. 2008. Marine survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Canadian Journal of Fisheries and Aquatic Sciences, 65(10): 2242-2252.

California Data Exchange Center (CDEC). 2024. Watsonville Water (WTW). Available at https://cdec.water.ca.gov/dynamicapp/QueryMonthly?s=WTW&end=2025-09&span=24months.

Casagrande, J. 2010. Distribution, abundance, growth and habitat use of steelhead in Uvas Creek, California. M.S. Thesis, San Jose State University, San Jose, CA. 160 pp.

Cochran, S. 2024. Corralitos Creek (Santa Cruz County, CA) August 8, 2024 Steelhead Rescue Summary. Department memorandum prepared August 8.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 2010. California Salmonid Stream Habitat Restoration Manual. 4th edition, California Department of Fish and Game, Inland Fisheries Division. Sacramento, CA.

National Marine Fisheries Service (NMFS). 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act, June.

Pajaro Valley Water Management Agency (PV Water). 2022. Pajaro Valley Subbasin Water Year 2021 Annual Report. Available at: https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/SGMA-WY/PVWater_AR_SGMA3-002.01WY2021.pdf

Podlech, M. 2011. College Lake Smolt Outmigrant Study – Spring 201 1. Prepared for the Resource Conservation District of Santa Cruz County, Capitola, CA.

Podlech, M. 2018. 2018 Juvenile Steelhead Densities in the Corralitos Creek Watershed. Prepared for the City of Watsonville, Watsonville, CA.

Podlech, M. 2019. 2019 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds. Prepared for the City of Watsonville and Pajaro Valley Water Management Agency, Watsonville, CA.

Podlech, M. 2020. 2020 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds. Prepared for the City of Watsonville and Pajaro Valley Water Management Agency, Watsonville, CA.

Podlech, M. 2021. 2021 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds. Prepared for the City of Watsonville and Pajaro Valley Water Management Agency, Watsonville, CA.

Podlech, M. 2022. 2022 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds. Prepared for the City of Watsonville and Pajaro Valley Water Management Agency, Watsonville, CA.

Podlech, M. 2023. 2023 Juvenile Steelhead Densities in the Corralitos Creek and Casserly Creek Watersheds. Prepared for the City of Watsonville and Pajaro Valley Water Management Agency, Watsonville, CA.

Sogard, S.M., T.H. Williams, and H. Fish. 2009. Seasonal Patterns of Abundance, Growth, and Site Fidelity of Juvenile Steelhead in a Small Coastal California Stream, Transactions of the American Fisheries Society, 138:3, 549-563.

Temple, G. M. and T. N. Pearsons. 2007. Electrofishing: Backpack and drift boat. Pages 95–132 in D. H. Johnson, B. M. Shrier, J. S. O'Neal, J. A. Knutzen, X. Augerot, T. A. O'Neil, and T. N. Pearsons, editors. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

US Geological Survey (USGS). 2024. National Water Information System website. Current and historical discharge data for the Corralitos Creek at Freedom USGS gage 11159200; https://waterdata.usgs.gov/ca/nwis/dv?cb_00060=on&format=gif_stats&site_no=11159200&legacy=&referred_module=sw&period=&begin_date=2022-10-01&end_date=2024-09-30.

Van Deventer, S. J. and W. S. Platts. 1989. Microcomputer software system for generating population statistics in Electrofishing data user's guide for MicroFish 3.0. Gen Tech Rep INT-254. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 29 p.

Appendix A

Photographs of Eight Sampling Sites in the Corralitos Creek and Casserly Creek Watersheds
September/October 2024
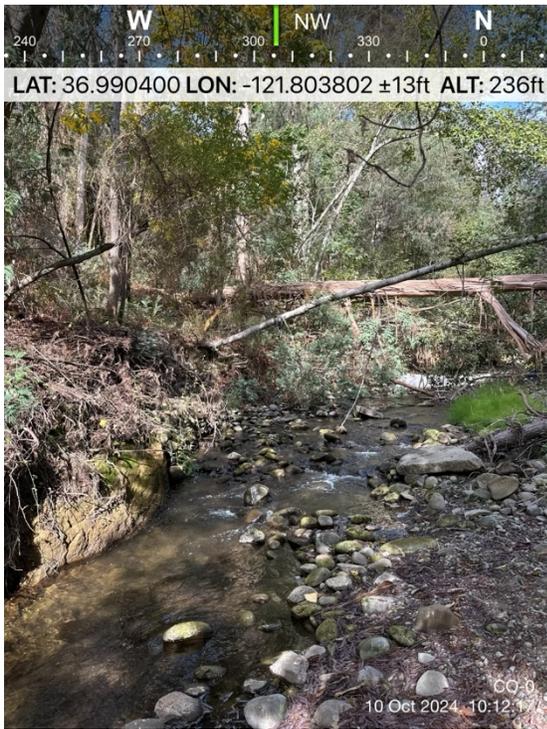
Photo 1. CO-0 flatwater-riffle transition, Oct. 10, 2024
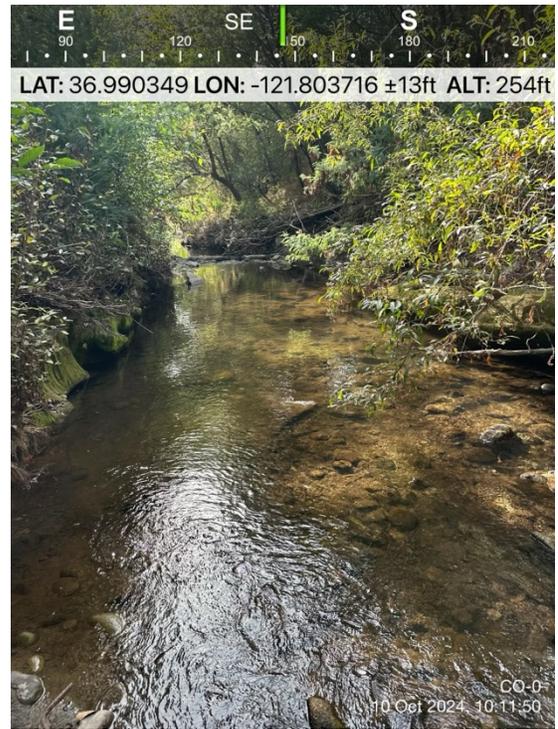
Photo 2. CO-0 pool/flatwater, Oct. 10, 2024
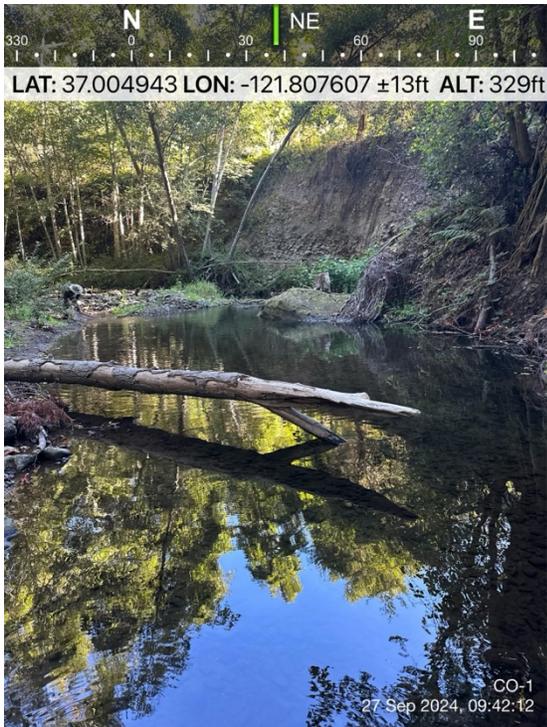
Photo 3. Large pool at CO-1, Sep. 27, 2024
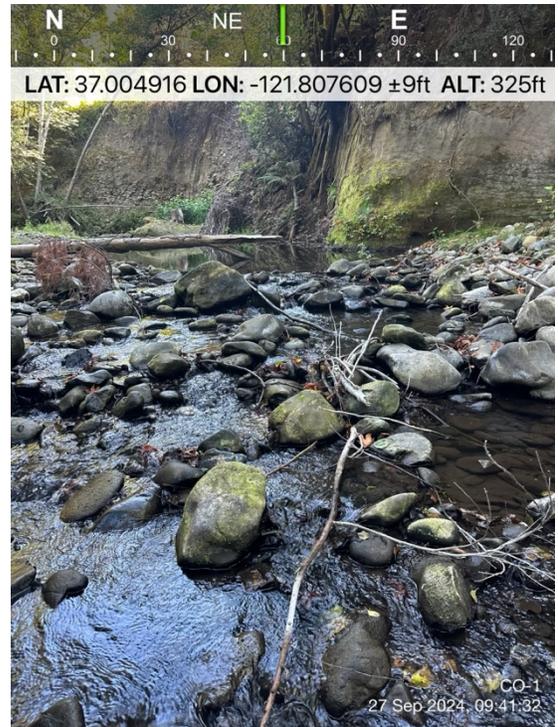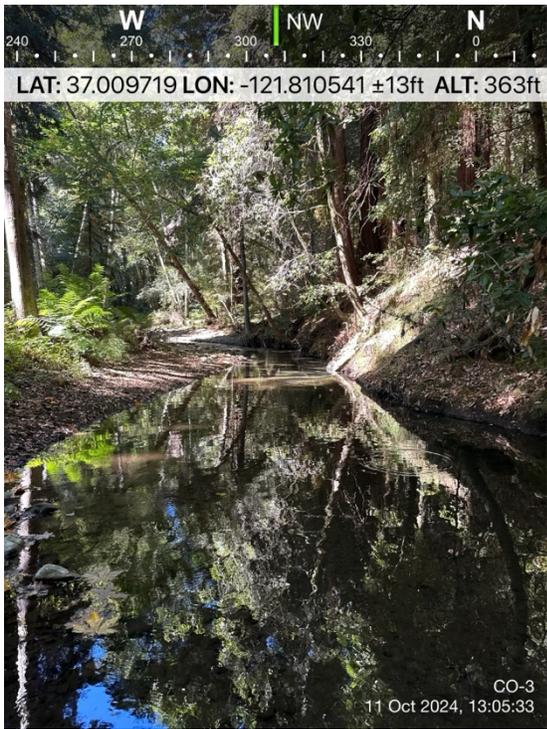

Photo 4. CO-1 riffle, Sep. 27, 2024

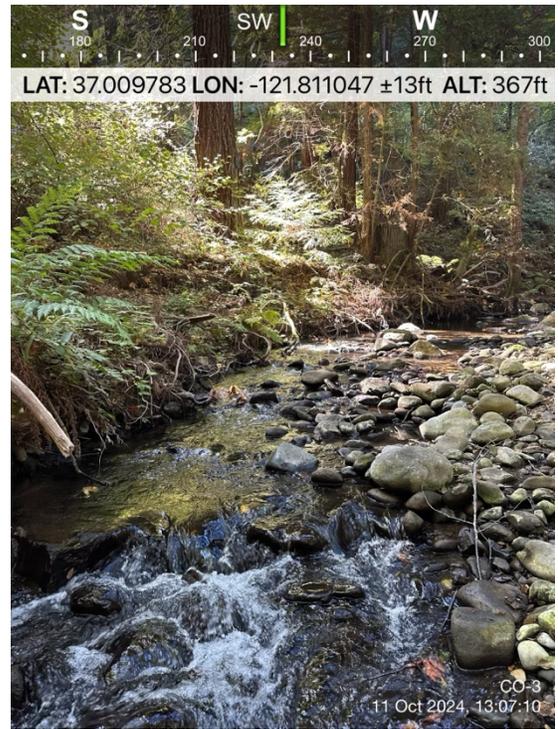**Photo 5**. CO-3 pool, Oct. 11, 2024
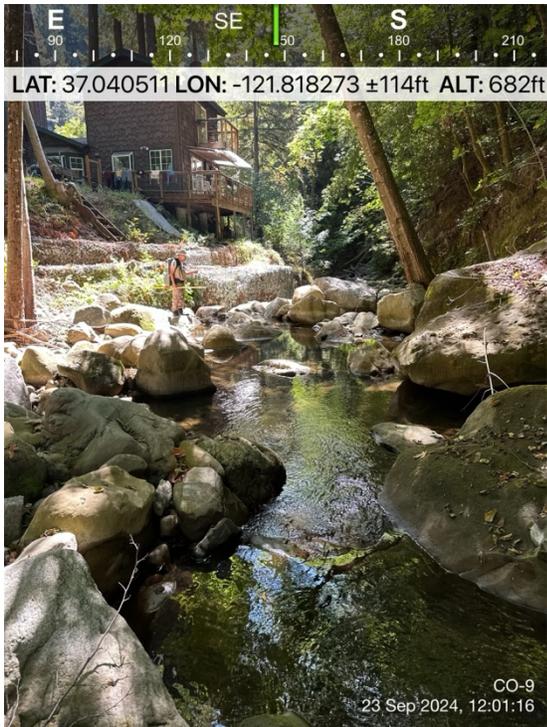

Photo 6. CO-3 riffle, Oct. 11, 2024

Photo 7. CO-9 pool, Sep. 23, 2024
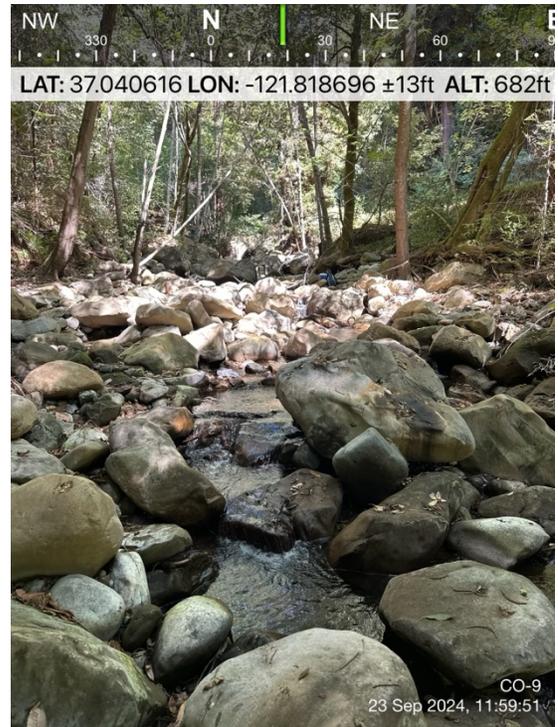
Photo 8. CO-9 flatwater, Sep. 23, 2024
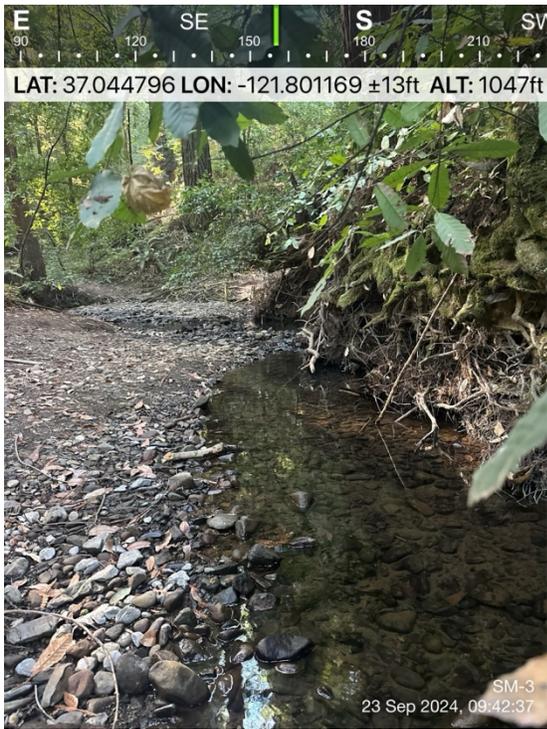
Photo 9. SM-3 pool, Sep. 23, 2024

Photo 10. SM-3 riffle-pool transition, Sep. 23, 2024
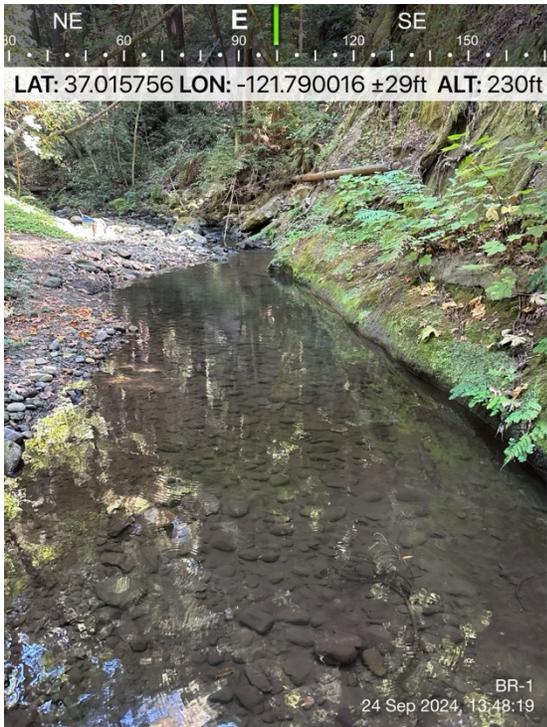
Photo 11. BR-1 pool, Sep. 24, 2024
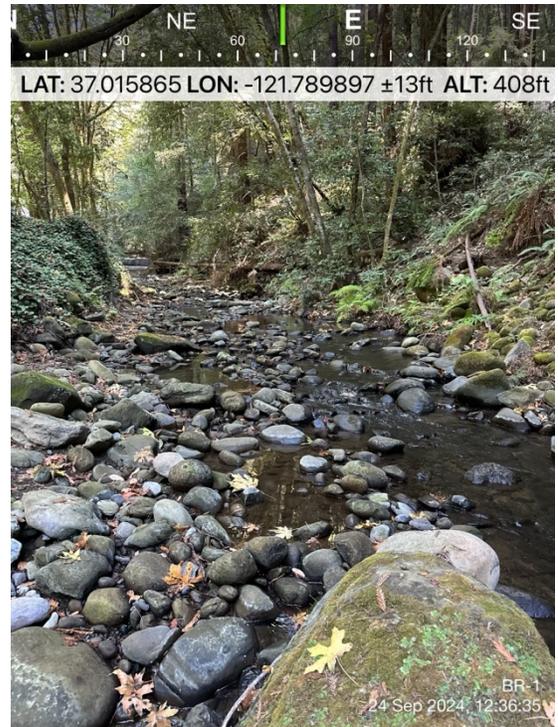
Photo 12. BR-1 flatwater, Sep. 24, 2024
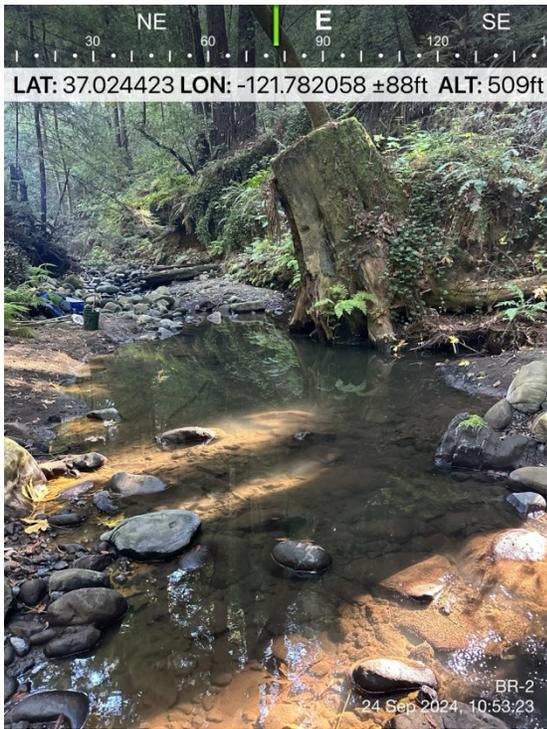
Photo 13. BR-2 pool, Sep. 24, 2024
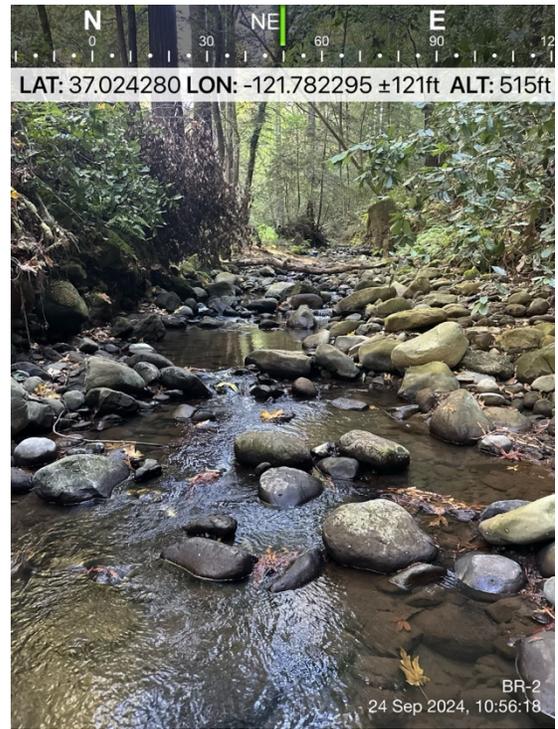
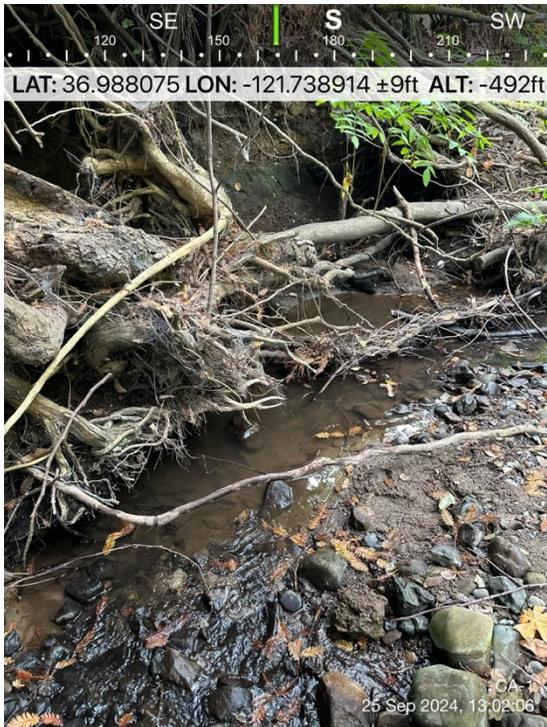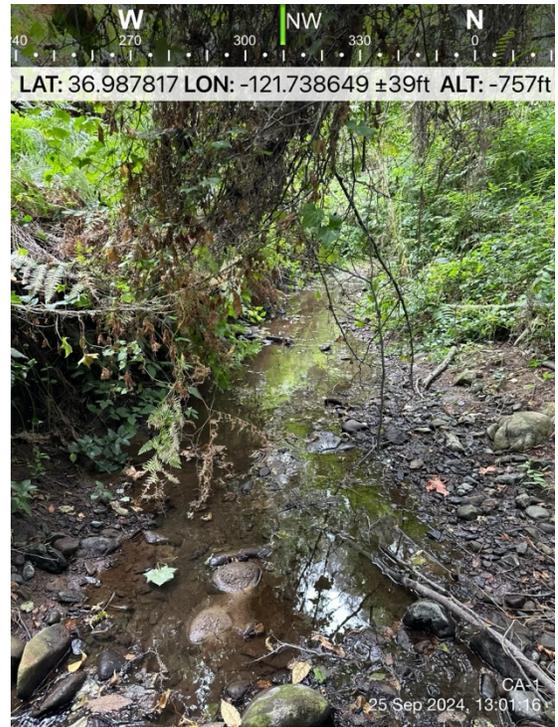**Photo 14**. BR-2 flatwater, Sep. 24, 2024

Photo 15. CA-3 pool, Sep. 25, 2024

Photo 16. CA-3 flatwater, Sep. 25, 2024