

Monitoring and Evaluation of Salmonid Habitat Restoration

2023 Annual Validation Monitoring Report for the South Coast

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INTRODUCTION

The Monitoring and Evaluation of Salmonid Habitat Restoration (MESHR) team conducts effectiveness, validation, and Before-After-Control-Impact (BACI) monitoring on restoration projects funded through the California Department of Fish and Wildlife (CDFW) Fisheries Restoration Grant Program (FRGP). Each grant cycle, MESHR selects 10% minimum of funded projects to receive effectiveness monitoring to comply with the United States Army Corps of Engineers (USACE) permitting requirements of the regional general permits (RGP-12 for the north coast of California and RGP-78 for the south coast). Projects are selected using a stratified random sampling design stratified by USACE geographic area and FRGP project type. Projects are randomly selected until the 10% minimum is achieved. Final sampling rates are above 10% as additional projects are selected until one to three projects from each area/project type stratum is represented. Due to the low numbers of FRGP projects implemented annually within the region covered by RGP-78, 100% of projects are commonly selected for monitoring.

Three project types receiving effectiveness monitoring also receive validation monitoring: instream habitat improvement (HI), fish passage at stream crossings (FP), and instream barrier modification for fish passage (HB). An upslope watershed restoration (HU) project can also include validation monitoring if it has an instream component. A subset of HI projects with validation monitoring also receive BACI monitoring to monitor habitat metrics, fish response, and overall effectiveness of large wood (LW) treatments. Due to the limited number of HI projects implemented in Southern California, none have been selected for BACI monitoring in the South Coast region as of 2023.

Validation monitoring assesses salmonid response to instream treatments or fish barrier remediation. Snorkel surveys are used to estimate salmonid distribution, relative abundance, and stream habitat availability. Spawning surveys are used to estimate salmonid spatial structure. If conducted as a complete census of available spawning habitat, spawning surveys can be used to provide an index of effective population size. This report summarizes validation monitoring completed by MESHR staff in Southern California within the RGP-78 district (San Luis Obispo County through San Diego County) from January 1, 2023, to December 31, 2023.

The only anadromous salmonid species present within the RGP-78 region is steelhead trout (*Oncorhynchus mykiss*). Steelhead located within the region belong to two Distinct Population Segments (DPSs): the South-Central California Steelhead DPS and the Southern California Steelhead DPS. The South-Central California Steelhead DPS, occurs from the Pajaro River watershed in Monterey County to (but not including) the

Santa Maria River watershed in Santa Barbara County. It is currently listed as threatened under the federal Endangered Species Act (ESA). The Southern California Steelhead DPS, occurs from the Santa Maria River watershed in Santa Barbara County through the Tijuana River at the U.S.-Mexico border. It is currently listed as endangered under the ESA (NOAA 1997).

METHODS

Validation monitoring consists of summer juvenile snorkel surveys and winter adult spawning ground surveys. All three project types that receive validation monitoring receive snorkel surveys, while adult spawning surveys are limited to fish passage projects (FP and HB). Monitoring of HI projects is typically conducted three years after implementation to allow LW features to scour over three winter flow periods. However, FB and HB projects can be monitored one to three years after implementation for fish or redd presence above former barriers. If recolonization by salmonids is not documented upstream of a former barrier within the first three years of post-treatment monitoring, additional monitoring can be done.

Snorkel Surveys

MESHR biologists follow snorkeling protocols adapted from Duffy (2005) and O'Neal (2007) to conduct snorkel validation surveys to determine the presence or absence and density of juvenile salmonids in stream reaches directly associated with instream features or barrier removal locations. For HB and FP projects, one to five pool units upstream and downstream of the project barrier location are snorkeled. For HI projects, up to five randomly selected pool and/or run habitat units adjacent to instream structure locations are selected for snorkeling. South Coast MESHR staff snorkel additional units, up to the length of CDFW's previously established California Coastal Monitoring Program (CMP) reaches. This is to collect data that can be used by both projects and be comparable with past data collected by CMP. This will also help determine the most effective snorkel survey methods for MESHR validation data collection in Southern California streams. Additionally, the stream habitat within and near project sites often dries during the summer snorkel season, making it unlikely that fish will be observed in pools surrounding project sites. So, all upstream available habitat should be snorkeled to effectively determine whether steelhead have repopulated these streams following fish passage barrier removals.

Snorkel surveys are conducted in teams of two or more, which include at least one data recorder and one snorkeler. During surveys, the wetted stream channel is delineated into discrete, natural units of similar habitat (Hankin 1984). Units are classified as either riffles, pools, or flatwaters according to certain defining characteristics. These habitat types are adopted from definitions outlined in Flosi et al. (2010).

For these surveys, all units with a maximum depth of 0.7 feet (ft) or greater are deemed snorkelable and are snorkeled in one pass. The snorkeler enters the water at the downstream end of each habitat unit while being careful to minimize disturbance to the

water and sediment. Once in the water, the snorkeler moves in a zig-zag pattern towards the upstream end of the unit making sure to visually search the entire area of the unit. The snorkeler searches the margins of the unit, boulder crevices, and other areas of potential fish cover using a waterproof flashlight. Cover is defined as any natural or artificial stream feature capable of hiding a 3-inch trout from the surface. To avoid duplicate counts, fish are counted as the snorkeler moves past them.

For each salmonid observed, the associated cover and estimated length are recorded. Fish sizes are estimated by 2-inch size bins (0-1.99 inches, 2-3.99 inches, 4-5.99 inches, etc.). The snorkeler assesses the total trout cover available in each unit by estimating the percent of surface area containing trout cover and surface area containing no cover. The snorkeler also estimates the percentage of total cover each cover type in the unit comprised.

All habitat units are measured for length, mean width, mean depth, maximum depth, and maximum residual depth. Length is measured along the thalweg (line of lowest elevation within a valley or watercourse) and mean unit width is measured perpendicular to the length (thalweg) line. The percentage of surface area that contained exposed substrate (usually comprised of gravel, boulders, or bedrock) is estimated for each unit. Exposed substrate included areas of dry exposed substrate not accounted for in measurements of unit length or mean width. This allows for a more accurate surface area calculation of the available wetted habitat.

Water visibility is recorded on a scale of zero to three. A value of zero indicates the snorkeler is unable to perform the survey due to a lack of visibility, one is poor visibility, two is adequate visibility, and three is clear visibility. Water and air temperatures are measured with a thermometer at the beginning of each survey day and subsequently after every tenth unit surveyed. Stream flow is measured using OTT MF Pro flow meter or recorded from a nearby USGS gauge.

Spawning Surveys

Adult spawning surveys record counts of total redds, live fish, and carcasses in reaches immediately upstream and downstream of a barrier removal location. Spawner surveys are conducted based on the methods outlined in *California Department of Fish & Game's Salmonid Spawning Survey Personal Digital Assistant Data Entry Protocol* (2011) and the *National Marine Fisheries Service's Southern California Steelhead DPS Redd Survey Protocols* (2012 and 2015). The minimum standard survey reach length is approximately 20 bankfull channel widths, though survey lengths further upstream of the standard 20 bankfull channel widths can be established if a surveyed reach does not contain suitable spawning habitat. In addition to MESHHR minimum standard survey reach length, the Southern California MESHHR team generally surveys the full length of previously established CMP redd survey reaches when restoration projects occur in streams with CMP survey reaches. This allows for more accurate comparison of data collected by MESHHR with historical data collected by CMP. Surveys are conducted during the spawning season from January through May. Survey reaches are planned to

be surveyed again every two weeks after the initial survey date if weather and time permit. Approximately two weeks is the accepted minimum amount of time redds remain detectable in Southern California stream systems. Some creeks may only be surveyed once depending on time available, stream flows and/or weather conditions.

At the start of the survey, air temperature, water temperature, and velocity/flow measurements are recorded. A GPS unit is used to determine survey start and endpoints and coordinates of all recorded observations.

Teams of at least two surveyors walk the reaches in an upstream direction and record observations. Fish observations are identified to species. For each salmonid observation, a total length estimate, location, condition, and life history stage (when possible) are recorded. When redds are observed, measurements of pot and tailspill dimensions are taken. Pot length, width, and depth relative to the adjacent streambed are measured. For tailspill dimensions, the tailspill length and two width measurements (taken at 1/3 and 2/3 the distance along the tailspill from the pot) are recorded. Dominant substrate size is also recorded for both the pot and tailspill. Redds are marked with a flag denoting the redd record number, distance and bearing of redd from the flag location, date of initial recording, and redd age. Redd ages and significant changes to redd measurements are updated and recorded during subsequent observations. Redds are re-measured when pot and tailspill dimensions have noticeably changed following their initial observation.

Data Analysis

All validation monitoring data is collected using either paper datasheets or a tablet with custom Pendragon forms and subforms. Data is then entered into Excel workbooks and later undergoes quality control methods to correct any potential errors.

Snorkel survey data are analyzed to calculate salmonid size distributions and densities, and total and mean habitat measurements. To examine trout relative abundances, trout density is calculated as the mean number of trout per square foot. To evaluate trout life stage diversity, the total number of trout per size class are calculated. To examine wetted habitat the total length surveyed, mean unit length, total unit area, mean unit area, mean unit depth, mean unit maximum depth, total unit volume, and mean unit volume are calculated. For each mean the standard error (\pm SE) is calculated. All analyses are completed using R (version 4.1.1, R Core Team 2021) and R Studio (version 1.4.1717, RStudio, Inc 2021).

Spawning survey data are analyzed to determine salmonid distribution and redd area. Total redd length is calculated as the sum of the pot and tailspill lengths and redd area is calculated as the sum of pot and tailspill areas per Gallagher et al. (2007). These measurements are used to compare the relative sizes of all redds observed in order to evaluate whether a redd was produced by anadromous or resident *O. mykiss*. We examine *O. mykiss* distribution by calculating total *O. mykiss* observation counts by reach. All analyses are completed using R software.

RESULTS

Validation Monitoring Project Selection

From the 2023 effectiveness monitoring selection, MESHR designated one project to receive pre-treatment validation monitoring in the South Coast region (Table 1). This project received pre-treatment spawner validation.

Table 1. 2023 restoration projects selected for pre-treatment validation monitoring.

Grant #	Project Type	Project Title	Grantee	Status
Q2250406	FP	Maria Ygnacio Creek Fish Passage Project Implementation – Patterson Ave Bridge	Earth Island Institute	Pre-treatment spawner surveys conducted by MESHR.

Additionally, seven projects were surveyed for post-treatment monitoring. One project had snorkel surveys and all seven had spawner surveys conducted to confirm successful fish passage. These post-treatment projects are included in 2023 validation efforts (Table 2).

Table 2. Restoration projects from previous years that received post-treatment validation monitoring in 2023.

Grant #	Project Type	Project Title	Grantee	Status
D1450006	FP	Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal	California Department of Parks and Recreation	Post-treatment snorkel and spawner surveys conducted by MESHR
P1450010	FP	Circle G Ranch Fish Passage Restoration	Earth Island Institute/South Coast Habitat Restoration	Post-treatment spawner surveys conducted by MESHR
P1050003	FP	Quiota Creek Fish Passage Improvement, Crossing 7	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR

Grant #	Project Type	Project Title	Grantee	Status
P1050005	FP	Fish Passage Improvement at Crossing 2, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1250007	FP	Fish Passage Improvement at Crossing 1, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1450011	FP	Fish Passage Improvement at Crossing 3, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1450014	FP	Fish Passage Improvement at Crossing 0A, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1550010	FP	Fish Passage Improvement at Crossing 4, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1650902	FP	Fish Passage Improvement at Crossing 5, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1750902	FP	Fish Passage Improvement at Crossing 9, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR
P1850902	FP	Fish Passage Improvement at Crossing 8, Quiota Creek	Cachuma Operation and Maintenance Board	Post-treatment spawner survey conducted by MESHR

This report covers validation monitoring for 2023 and includes data collected from January 1, 2023, to December 31, 2023.

Post-Treatment Snorkel Survey Observations

The following projects received post-treatment snorkel validation monitoring in 2023:

- D1450006 - Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal

Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal (FP)

This project removed two concrete Arizona crossings which were determined to be total or severe temporal barriers to upstream steelhead passage. From 2015 through early 2017, both crossings were removed and replaced with free spanning bridges, restoring access to 4.5 miles of historic spawning and rearing habitat. At both sites, the channel was recontoured to match the natural stream gradient and then reconstructed with native boulders and cobble.

In 2023, 2.3 miles of Arroyo Sequit, from the estuary up to a boundary with private property, were surveyed during post-treatment validation snorkel surveys. A total of 53 habitat units met the requirements to be considered snorkelable, all of which were upstream of both project sites. A total area of 1,7101.7 ft² of stream habitat was snorkeled. Snorkeled habitat units had an average area of 322.7 ± 37.1 ft² (mean ± SE) and an average maximum residual depth of 1.5 ± 0.11 ft. No trout were observed during the survey (Table 3).

Table 3. Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal, post-treatment snorkel validation survey data. 2022 and 2023 post-treatment data was collected by MESHR and CDFW staff; all previous data was collected by CDFW.

Survey	Date(s)	No. of Units Surveyed	Avg Unit Area (ft ²)	SE (ft ²)	Avg Max Depth (ft)	SE (ft)	Avg Max Residual Depth (ft)	SE (ft)	<i>O. mykiss</i> observations	Density fish/ft ²
Post-Treatment	6/8/2020	20	58.1	7.2	1.2	0.1	NA	NA	0	0
Post-Treatment	5/5/2021-5/6/2021	23	52	5.5	1.1	0.1	NA	NA	0	0
Post-Treatment	8/17/2022-8/18/2022	3	68.5	34.7	1.1	0.1	1	0.1	0	0
Post-Treatment	9/12/2023-10/11/2023	53	322.7	37.09	1.8	0.1	1.5	0.1	0	0

This survey reach was selected because much of the lower portion of Arroyo Sequit, including the area surrounding both project sites, seasonally dries each year, with summer refugia remaining in the upper watershed. This is also the survey reach used by the CMP, which allows for 2023 and 2022 validation data collected by MESHR to be

easily compared with data collected by CDFW in previous years. Snorkel surveys have been conducted annually in Arroyo Sequit by the Resource Conservation District of the Santa Monica Mountains (RCDSMM) from 2005-2019 and by CDFW in 2020 and 2021. Surveys conducted by RCDSMM used different methods, so habitat data from these surveys could not be directly compared with data collected by CDFW or MESHHR.

Adult Spawning Survey Observations

The following projects received spawning survey validation monitoring in 2023:

- D1450006 - Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal
- P1450010 - Circle G Ranch Fish Passage Restoration
- P1050003 - Quiota Creek Fish Passage Improvement, Crossing 7
- P1050005 - Fish Passage Improvement at Crossing 2, Quiota Creek
- P1250007 - Fish Passage Improvement at Crossing 1, Quiota Creek
- P1450011 - Fish Passage Improvement at Crossing 3, Quiota Creek
- P1450014 - Fish Passage Improvement at Crossing 0A, Quiota Creek
- P1550010 - Fish Passage Improvement at Crossing 4, Quiota Creek
- P1650902 - Fish Passage Improvement at Crossing 5, Quiota Creek
- P1750902 - Fish Passage Improvement at Crossing 9, Quiota Creek
- P1850902 - Fish Passage Improvement at Crossing 8, Quiota Creek
- Q2250406 - Maria Ygnacio Creek Fish Passage Project Implementation – Patterson Ave Bridge

Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal (FP)

This project removed two stream crossing barriers to upstream fish passage along Arroyo Sequit, the first located approximately 0.1 miles upstream of the mouth of the estuary and the second located approximately 0.65 miles upstream of the first barrier. The barriers were removed, and fish passage restored by late 2015, while overall project construction was completed in early 2017. Arroyo Sequit was surveyed for 2.3 miles, from the estuary to a private property boundary. Six spawning surveys were conducted by MESHHR and CDFW staff during the 2023 spawning season. No steelhead or redds were observed during any of these surveys (Table 4).

Table 4. Leo Carrillo State Park, Arroyo Sequit Steelhead Trout Barrier Removal: observations from adult spawning surveys conducted after barrier removal.

Reach Length (mi.)	Date Surveyed	Live Fish	Carcasses	Redds
2.31	1/24/2023	0	0	0
2.31	2/7/2023	0	0	0
2.31	2/27/2023	0	0	0
2.31	3/20/2023	0	0	0
2.31	4/13/2023	0	0	0
2.31	4/26/2023	0	0	0

Annual spawning surveys have been conducted in Arroyo Sequit since 2010. The RCDSMM conducted monthly surveys during spawning seasons from 2010 through 2019. Over the course of all of these surveys, only two steelhead were recorded and no redds or spawning activity were observed (Dagit et al. 2019). CDFW conducted bi-weekly spawning surveys during the 2020 and 2021 spawning seasons and observed no steelhead or redds during any survey. MESHR staff have conducted spawner surveys in partnership with the CMP since 2022, and again no steelhead or redds have been observed.

Circle G Ranch Fish Passage Restoration (FP)

This project, completed in 2016, removed a barrier along Carpinteria Creek, located approximately 2.9 miles upstream of the mouth of the estuary. The barrier, consisting of approximately 100 feet of concrete lined channel and banks and an undersized bridge, was removed. It was replaced with a larger free spanning bridge and regraded and reconstructed channel and banks consisting of engineered streambed materials. Carpinteria Creek was surveyed for 4.2 miles, the entire part of the stream from the estuary to a natural barrier to fish passage that is accessible to anadromous fish. During the 2023 spawning season, six spawning surveys were conducted by MESHR and CDFW staff. No steelhead or redds were observed during these surveys (Table 5).

Table 5. Circle G Ranch Fish Passage Restoration: observations from adult spawning surveys conducted after barrier removal.

Reach Length (mi.)	Date Surveyed	Live Fish	Carcasses	Redds
4.21	1/24/2023	0	0	0
4.21	2/15/2023	0	0	0
4.21	3/9/2023	0	0	0
4.21	4/4/2023	0	0	0
4.21	4/19/2023	0	0	0
4.21	5/2/2023	0	0	0

Bi-weekly spawning surveys have been conducted by CDFW and previous Pacific States Marine Fisheries Commission (PSMFC) project staff along this same survey reach annually from 2016 through 2021 and by CDFW and MESHR staff from 2022 through 2023. No steelhead or redds have been observed during these surveys.

Fish Passage Improvement at Crossings 0A, 1, 2, 3, 4, 5, 7, 8, and 9, Quiota Creek (FP)

Between 2011 and 2019, nine separate FP projects were completed at stream crossings along Quiota Creek, a tributary to the Santa Ynez River. Each of these projects removed a partial barrier to fish passage along Quiota Creek. All of the projects involved the removal of a concrete Arizona crossing and replacement with a bottomless arch culvert, with the exception of Crossing 8, which removed an undersized and damaged bridge and replaced it with a bottomless arch culvert. Additionally, Crossing 6 was removed and replaced with a bottomless arch culvert in 2008, but was not funded through FRGP. The first crossing, 0A, is located 0.07 miles upstream of the confluence with the Santa Ynez River, while the last crossing, 9, is located 3.3 miles upstream of the confluence. One barrier to fish passage still remains on Quiota Creek, Crossing 0B, though efforts are underway to remove this concrete crossing and replace it with a bottomless arch culvert. Quiota Creek was surveyed for 0.78 miles, from Crossing 3 through Crossing 9, as this was the reach of creek for which landowner access could be obtained. The remaining barrier to fish passage, Crossing 0B, is located downstream of this survey reach. This reach was surveyed once by MESHR staff during the 2023 spawning season. Four additional spawner surveys were conducted by the Cachuma Operation and Maintenance Board (COMB) throughout the 2023 spawning season. No steelhead or redds were observed during any of these surveys (Table 6).

Table 6. Fish Passage Improvement at Crossings, Quiota Creek: observations from adult spawning surveys conducted after barrier removal.

Reach Length (mi.)	Date Surveyed	Live Fish	Carcasses	Redds
0.75	4/4/2023	0	0	0

Regular spawning surveys have been conducted by COMB staff along this same survey reach annually since 2012. No steelhead have been observed during these surveys. Redds and trout were observed on Quiota Creek during spawner surveys conducted in 2012, and were likely resident trout based on size.

Maria Ygnacio Creek Fish Passage Project Implementation – Patterson Ave Bridge (FP)

This project proposes to modify the existing Patterson Ave Bridge fish passage barrier to allow for fish passage at the site for juvenile and adult southern steelhead. The barrier is located within the Goleta Slough Complex, at the confluence of Atascadero and Maria Ygnacio creeks, approximately 1.5 miles upstream of the mouth of the estuary. Removal of the barrier restoring access to 0.77 miles of upstream migratory habitat, to the next impassible barrier. Other upstream barriers within Maria Ygnacio Creek have had designs for removal completed, so this project is the first step in a larger effort to

remove all barriers within the watershed. No previous regular spawning surveys have been conducted in the upper watershed by CDFW or other organizations. In 2023, several survey reaches were established along Maria Ygnacio Creek by the CMP. The first survey reach begins at the Patterson Ave. Bridge barrier and the rest are further upstream. These reaches were surveyed on an approximately bi-weekly basis by MESHR and/or CDFW staff. Nine pre-treatment spawning surveys were conducted during the 2023 spawning season. No trout or redds were observed during any of these surveys (Table 7).

Table 7. Maria Ygnacio Creek Fish Passage Project Implementation – Patterson Ave Bridge: observations from adult spawning surveys conducted in 2023 prior to barrier removal. Maria Ygnacio Creek (MYG) was delineated into 4 CMP survey reaches, the downstream-most three of which were surveyed during the 2023 spawning season.

Reach Length (mi.)	Date Surveyed	Live Fish	Carcasses	Redds
2.1 (MYG 1+2)	2/8/2023	0	0	0
1.4 (MYG 3)	3/13/2023	0	0	0
2.1 (MYG 1+2)	3/20/2023	0	0	0
1.4 (MYG 3)	4/3/2023	0	0	0
2.1 (MYG 1+2)	4/5/2023	0	0	0
1.4 (MYG 3)	4/18/2023	0	0	0
2.1 (MYG 1+2)	5/1/2023	0	0	0
1.4 (MYG 3)	5/16/2023	0	0	0
2.1 (MYG 1+2)	5/30/2023	0	0	0

DISCUSSION

Juvenile Snorkel Validation Surveys

Pre-treatment validation monitoring is essential to document baseline biological productivity prior to restoration to compare to post-treatment data. However, small changes in fish density based on individual surveys can be due to daily, seasonal, or annual variability in fish abundance in a particular stream or stream reach. Larger sample sizes over a longer period are necessary for statistical analyses to determine if variability in fish densities is significant. Using available resources MESHR conducts pre- and post-treatment surveys under similar conditions (e.g., flow, temperature, visibility, or seasonal re-distribution of salmonids) to reduce variability in fish densities, but additional factors may affect salmonid distribution.

No projects received pre-treatment snorkel validation monitoring during 2023. Post-treatment snorkel validation monitoring was completed on one project in 2023 located in Arroyo Sequit following the re-establishment of a Southern California MESHR project in late 2021. No validation monitoring was conducted during pre-treatment

monitoring under the previous central and south coast MESHR grant which ran from 2013-2017. Ongoing annual monitoring has been conducted in both creeks by CDFW and other organizations and this data was used to compare with MESHR data collected in 2023.

Arroyo Sequit was surveyed by MESHR staff in the summer of 2022 for 2.31 miles, from the estuary to a private property boundary. Along this survey reach, approximately 38.5% of the instream habitat surveyed was wetted at the time. Fifty-three habitat units met the depth requirements to snorkel, and no steelhead were observed. Arroyo Sequit surveys conducted in 2022 and 2023 by MESHR and CDFW staff used methods comparable with those used by CDFW in the summers of 2020 and 2021. All previous surveys also resulted in zero steelhead observations. Average habitat unit area and average maximum depths increased compared to previous years in surveys conducted by CDFW and MESHR following project implementation. The increase in these values, along with the increase in snorkelable units, in 2023 compared to previous years could be attributed to the higher-than-average amounts of rainfall and significant storm flows that the watershed received, which scoured out much of the sediment deposited within the channel following the 2018 Woolsey Fire. Snorkel surveys had also been conducted on an almost monthly basis by RCDSMM from 2005 through 2019, but different methods were used. RCDSMM focused snorkel efforts on several pools and did not regularly record habitat unit dimensions, so no comparisons between pre- and post-treatment habitat parameters can be made using this data. Between 2005 and 2019, no juvenile *O. mykiss* were observed during surveys conducted during the summer months. Prior to the removal of the barriers to fish passage, an adult resident *O. mykiss* was observed during a 2014 winter snorkel survey. In 2017, after the construction of both bridges had been completed, two adult *O. mykiss* were observed upstream of both former barriers during a winter snorkel survey conducted in January. The results of this survey indicate that adult steelhead were capable of passage upstream of the former barriers immediately following project implementation. Despite this, there is no evidence of successful recolonization as no juvenile steelhead have been observed during summer snorkel surveys within the survey reaches. Post-treatment snorkel surveys may continue in upcoming years until steelhead recolonization within Arroyo Sequit is observed, if time and staff availability permit.

Adult Spawning Validation Surveys

Documenting fish response to barrier removal or modification using spawner surveys is more critical for complete barrier removals than for partial or temporal barrier modifications or large wood (LW) addition projects. No evidence of fish above a barrier at pre-treatment followed by observed fish upstream after barrier removal suggests new habitat was opened by the project. However, confidence in re-occupation above the barrier increases with more surveys conducted during both pre- and post-treatment monitoring.

Arroyo Sequit was surveyed along a 2.3-mile survey reach six times during the 2023 spawning season. No steelhead or redds were observed during these surveys. Spawning

surveys were conducted bi-weekly during spawning seasons from 2020 through 2023 by CDFW and/or MESHR and monthly during spawning seasons from 2010 through 2019 by RCDSMM. Following project implementation, two adult *O. mykiss* were observed by RCDSMM staff upstream of the former barriers to fish passage during spawner surveys conducted in 2017. No redds or spawning activity were observed during spawning surveys conducted that year. No other steelhead or redds have been observed. Observations of anadromous steelhead upstream of the former barriers indicate that fish passage has been restored at the project locations. Despite the observations of adults, the lack of spawning activity or young-of-year steelhead observations indicate that successful recolonization has not yet occurred in Arroyo Sequit. Surveys will continue during future spawning seasons to document successful spawning upstream of the former barrier.

Carpinteria Creek was surveyed six times during the 2023 spawning season along the entire 4.2 miles of anadromous habitat. No steelhead or redds were observed during these surveys. Spawning surveys were conducted bi-weekly during spawning seasons from 2016 through 2023 by CDFW, previous PSMFC project, and/or MESHR staff. This effort provided multiple years of comparable post-treatment spawning survey data. No adult steelhead or spawning activity was observed during any of these previous surveys. Surveys will continue in the future to document successful spawning upstream of the former barrier.

Nine pre-treatment spawning surveys were conducted by MESHR and CDFW staff in the Maria Ygnacio Creek in 2023. These pre-treatment surveys were done in order to scout out suitable spawning and rearing habitat and determine presence or distribution of anadromous steelhead or resident trout. Also, no spawning surveys had been previously conducted by CDFW or other organizations in the upper watershed. A 2.1-mile reach along Maria Ygnacio Creek, which begins at the confluence of Maria Ygnacio and Atascadero creeks and is the location of the current barrier to fish passage, was surveyed five times. An additional 1.4 miles of Maria Ygnacio Creek upstream of the previous reach was surveyed four times. The remaining 1.3 miles of upstream habitat up to a natural barrier to anadromy was unable to be surveyed due to an inability to gain landowner access. No steelhead or redds were observed during these surveys. Some habitat observed in the surveys conducted along the upper portions of Maria Ygnacio appeared suitable for steelhead spawning. Post-treatment spawning surveys will be conducted to determine if fish passage is restored or improved following project implementation.

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