TASK 1. PRESENCE/ABSENCE SURVEYS, WATER TEMPERATURE, STREAM FLOW AND LAGOON MONITORING OF SANTA MONICA MOUNTAINS CREEKS

SANTA MONICA BAY ANADROMOUS ADULT AND JUVENILE STEELHEAD MONITORING 2013-2018



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Prepared by:

RCD of the Santa Monica Mountains 540 S. Topanga Canyon Blvd. Topanga, CA 90290

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EXECUTIVE SUMMARY

Documenting the spatial distribution, abundance, and density of all life stages of *O. mykiss* throughout its historical predicted habitat in the creeks of the Santa Monica Mountains region was accomplished by visual surveys of Big Sycamore, Las Flores, Solstice, Topanga, Trancas, and Zuma Creeks upstream to the limit of anadromy. Arroyo Sequit and Malibu Creeks were also surveyed but the results of that effort are reported in Dagit et al. (2017a). Due to the lack of surface flow in most of these watersheds, neither flow monitoring nor snorkel surveys were possible during the study except for in Topanga Creek. Because all stream reaches below the limit of anadromy were surveyed, the GRTS algorithm was not applicable to this study. This research specifically provides information requested by the Southern California Steelhead DPS Recovery Action Tables (NMFS 2012).

Presence/Absence

No anadromous adult or juvenile steelhead were observed in these small coastal streams from 2013-2018, except for two observed in Topanga Creek in 2017. Two more anbadromous adults were observed in 2017 in Arroyo Sequit, and one in Malibu Creek, but neither of these systems were part of this study.

Creek Monitoring

Yearly stream surveys were conducted in October or November to record the presence/absence of surface water from the ocean/creek interface through the limit of anadromy in each creek within the study area. Throughout the study period, the creeks remained very dry and disconnected both from the ocean and between pool habitats when wetted pool habitat was actually present. Despite a substantial rain year in 2017 that temporarily broke drought conditions seen from 2012-2016, the creeks dried down almost completely again by November 2017. Topanga Creek was the exception, though a large stretch in the lower reach – 200m to 1800m did dry down in the early summer of 2017 and many low flow barriers restricted in stream movement by resident trout (Dagit et al. 2017b).

Lagoon Monitoring

Lagoon/ocean interface monitoring took place at Big Sycamore, Las Flores, Solstice, Topanga, Trancas, and Zuma Creeks with funding from this grant. Monitoring of Arroyo Sequit and Malibu Creeks was funded by a different source, but took place simultaneously, providing a complete look at presence/absences of *O. mykiss* throughout all the major coastal creeks in the Santa Monica Bay, however specific data for these two creeks is not included in this analysis.

Throughout the study period, the creeks were isolated from the ocean for most of the time, and in fact, many of the lagoons dried up completely. When surface water was present, measurements of area and volume were taken in order to provide analysis of volumetric capacity on a temporal scale for each lagoon in the study area. Breach frequency, duration, relationship to rainfall amounts and potential for fish passage were also recorded and analyzed. Comparisons of these conditions for each system are detailed in Appendix D.

Flow

The only stream gauge is located in Topanga Creek and maintained by Los Angeles County Department of Public Works. Due to low flows and movement of the thalweg, there is little to no flow data available for 2013-2017.

Temperature monitoring

Continuously recording thermometers (Onset HOBO Tidbit v2 water temperature data logger) were installed in Las Flores, Trancas, and in upper Topanga lagoon from April through October according to the Summer Water Temperature Protocol. Sites were selected to reflect the dominant canopy cover, substrate, habitat type and depth conditions of the lagoons (Table 2). Both air and water temperatures were recorded when possible. We attempted to deploy two sets of tidbits in each creek (Big Sycamore, Las Flores, Solstice, Trancas, and Zuma), one located near the ocean and the other further upstream near the upper limit of anadromy, or as needed to adequately characterize temperature impacts in the creek. However, surface water was so limited during the study period that we were unable to collect much data in the upper watersheds, and even some of the lagoons dried up. In 2017, tidbits were not deployed in Las Flores, Solstice, or Zuma. Though Las Flores and Solstice were wetted, the amount of surface water present was not enough to fully submerge data logger continuously. In the case of Zuma Lagoon, a location where a tidbit could be secured to avoid both theft and being washed away could not be identified as 2017 was the first year in the study where surface water was present.

A potential limiting factor for steelhead is summer temperatures that exceed 23 °C, which is considered to be the critical thermal limit of tolerance for southern steelhead trout (Farrell et al. 2015, McEwan and Jackson 1996, Richter and Kolmes 2006, Spina 2007). The water temperatures associated with the current lagoon conditions and drought were extremely challenging for steelhead. Consideration of ways to moderate summer temperatures should be considered during restoration planning.

Lagoon	2013	2014	2015	2016	2017
Big Sycamore	ND	DRY	DRY	DRY	8
Las Flores	ND	0	6	4	ND
Solstice (upstream refugia pool)	ND	0	DRY	DRY	ND
Topanga	9	43	81	41	29
Trancas	ND	0	65	25	69
Zuma	ND	DRY	DRY	DRY	ND

 Table 1.1. Frequency of days with temperatures exceeding 23 °C in Santa Monica Bay Lagoons

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OBJECTIVES

We documented the spatial distribution, relative abundance and density of all life stages of *O. mykiss* throughout its historical predicted habitat in the creeks of the Santa Monica Mountains region. Due to the relatively small stream lengths and the lack of surface water caused by the drought 2013-2016, it was not possible to implement snorkel surveys. Instead, walking surveys examined all possible habitats, from the ocean to the natural limit of anadromy, or the anthropogenic limit of anadromy, whichever was furthest upstream on each creek. Because entire anadromous stream reaches were surveyed, the GRTS algorithm was not applicable to this study (Adams et al. 2011). This research specifically provides information requested by the Southern California Steelhead Distinct Population Segment Recovery Action Tables for Big Sycamore Creek (Table 11-4), Las Flores Creek (Table 11-7), and Topanga Creek (Table 11-8) (NMFS 2012).

STUDY AREA

Based on the priority watersheds identified in the Southern California Steelhead Recovery Plan (NMFS 2012), the following areas within the Santa Monica Bay were the focus of this study: Big Sycamore Canyon, Las Flores Canyon, Solstice Canyon, Topanga Canyon, Trancas Canyon, and Zuma Canyon. Malibu Creek is the second largest watershed draining into the Santa Monica Bay and is monitored in a complementary study effort that is not reported here. Figures 1.1 and 1.2 illustrate the regional context and provide a sense of public land ownership protecting these watersheds within the Santa Monica Mountains National Recreation Area. Individual watershed maps are included in the sections for each creek.



Figure 1.1. Overview of the Santa Monica Bay watersheds in the anadromous adults and juvenile steelhead monitoring study area. (Map prepared by Melanie Beck and Luis Aguilar, Santa Monica Mts. National Recreation Area, NPS)



Figure 1.2. Public land ownership protecting the watersheds within the Santa Monica Mountains National Recreation Area

METHODS

Ground and snorkel surveys

Summer-fall ground surveys were conducted to examine habitat conditions and search for refugia pools, but due to the drought conditions, surface flow was limited or non-existent in most watersheds. Therefore, the focus for habitat documentation was on any remaining refugia pools. Snorkel surveys were only possible in Trancas Creek in February 2017, and 2013-2018 in Topanga Creek.

Genetic analysis

Any carcasses observed were to be collected either in entirety (if fresh enough) or tissue and scale samples according to standard procedures. All samples were to be sent to the NMFS Genetic Tissue Repository, Santa Cruz, CA.

Monitoring of the lagoon/ocean interface

Storm-event related monitoring of the lagoon/ocean interface was conducted in order to document passage opportunities and constraints. Seining in lagoons was proposed but only possible on a few occasions. The physical condition of the lagoons was photographed and condition noted following each storm event. Records of other native or non-native aquatic species were collected when possible.

Temperature monitoring

Continuously recording thermometers (Onset HOBO Tidbit v2 temperature data loggers) were installed in pools used by *O. mykiss* in Topanga Creek from June to October 2013-2017. Both air and water temperatures were recorded. We intended to deploy two sets of tidbits in each creek (Big Sycamore, Las Flores, Solstice, Trancas, and Zuma), one located near the ocean and the other further upstream near the upper limit of anadromy, or as needed to adequately characterize temperature impacts in the creek. However, surface water was so limited during the study period that we were unable to collect much data in the upper watersheds, and even some of the lagoons dried up. Hobos could only be deployed opportunistically in Big Sycamore (2017), Solstice (2014), and Las Flores (2014-2016) and never in Zuma. Tidbits were deployed consistently in Topanga and Trancas (2013-2017).

Flow

Summer and fall flow was non-existent in all but Topanga Creek. In Topanga Creek, we described and mapped the distance and locations of disconnected flow reaches during monthly snorkel surveys (Dagit et al. 2017b). The only stream gage available for any of these creeks is located in Topanga Creek at the mile marker 2.02 bridge on Topanga Canyon Blvd. This gage (F54C-R) is maintained by Los Angeles County Department of Public Works. There was no surface flow in Big Sycamore, Las Flores, Solstice, Trancas, or Zuma Creeks to measure from 2013-2016. Starting with the rains in January 2017, intermittent flows were documented in all creeks until late spring, but no measured data was obtained.

RESULTS

Ground and snorkel surveys

For the majority of the study area no data was collected as there was no surface flow except for in Topanga Creek until 2017. In Topanga Creek monthly snorkel surveys were conducted, and any locations of sub-surface flow, duration of interruptions, and both relative abundance and distribution of *O. mykiss* between the ocean and upper limit of anadromy at 5.3 river kilometers (rkm) were recorded. Data on relative abundance and distribution of *O. mykiss* in Topanga Creek is summarized in the section for that watershed and previously reported data found in Dagit et al. (2018).

Genetic analysis

Due to the dry conditions, no carcasses were collected from any of these creeks, thus no genetic analysis was possible.

Monitoring of the lagoon/ocean interface

It is generally recognized that a lagoon can provide habitat that allows steelhead smolts to make the transition from freshwater to marine environments at a larger size (Bond et al. 2008). Stormevent related monitoring of the lagoon/ocean interface was therefore conducted in order to document passage opportunities and constraints, as well as overall condition. Seining in lagoons was conducted during closed conditions 2013-2016 when there was little water and no *O. mykiss* were observed. Storm event and weekly monitoring of all lagoons took place between January– September 2017, and following storm events through March 2018. The physical condition of the lagoons was photographed and condition noted following each storm event. Records of other native or non-native aquatic species were collected when possible. The observations are provided within each watershed summary.

A summary of storm events and possible fish passage opportunities is provided in Table 1.1. During the study period, the creeks were connected to the ocean for less than ten days associated with storm events occurring 28 February - 2 March 2014, 12-15 December 2014, 12 January 2015, and 3 March 2015. Additional results are presented for each watershed in alphabetical order.

Lagoon	Water Year*	Rainfall Total** (inches)	Dates Entrance Open	Number of Days Breached	Estimated Number of Days Passable	O. mykiss present in study reach
Big Sycamore	2013-2014	5.87	none	0	0	No
	2014-2015	17.5	03 Mar 2015 (trickle)	0	0	No
	2015-2016	9.09	none	0	0	No
	2016-2017	29.06	23 – 27 Jan 2017 3 Feb – 8 Mar 2017	39	30	No
	2017-2018	10.94	none	0	0	No

Table 1.2. Summary of rainfall and fish passage opportunities of monitored lagoons in the Santa Monica Mountains

Las Flores	2013-2014	5.16	26 Feb - 02 Mar 2014	4	4	No
	2014-2015	17.12	12 Dec 2014 - 3 Mar 2015	64	<10	No
	2015-2016	7.36	6 – 12 Mar 2016	7	1	No
	2016-2017	22.13	24 Dec 2016 – 21 Apr 2017	119	44	No
	2017-2018	7.17	10 Jan 2018 3 Mar – 13 Apr 2018	42	<5	No
Solstice	2013-2014	6.31	none	0	0	No
	2014-2015	16.06	12 - 16 Dec 2014	71	<10	No
	2015-2016	9.84	5 – 15 Mar 2016	11	0	No
	2016-2017	24.8	23 Dec 2016 – 3 Jul 2017	193	5	No
	2017-2018	10.63	3 Mar – 1 May 2018	60	0	No
Topanga	2013-2014	6.85	27 Feb - 07 Mar 2014	15	4	Yes
2014-2 2015-2 2016-2	2014-2015	13.76	03 Dec 2014 10 - 19 Jan 2015	14	<10	Yes
	2015-2016	8.31	6 March – 12 April 2016	38	5	Yes
	2016-2017	26.39	21 – 26 Dec 2016 11 Jan – 16 May 2017	132	36	Yes
	2017-2018	9.96	10-17 Jan 2018 3-25 Mar 2018	28	5	Yes
Trancas	2013-2014	5.87	none	0	0	No
	2014-2015	17.5	03 Dec 2014 (overwash)	5	<5	No
	2015-2016	9.09	6 Mar 2016	1	0	No
	2016-2017	29.06	24 Dec 2016 – 12 Jan 2017 19 Jan – 18 Apr 2017	110	61	No
	2017-2018	10.94	22-26 Mar 2018	5	1	No
Zuma	2013-2014	5.87	none	0	0	No
	2014-2015	17.5	none	0	0	No
	2015-2016	9.09	none	0	0	No
	2016-2017	29.06	20 Jan – 1 Mar 2017	41	39	No
	2017-2018	10.94	none	0	0	No

Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018

*Water year, as used by the USGS: October 1 through September 30 of the following year.

**Rainfall data from gage stations managed by Los Angeles County Department of Public Works

Temperature monitoring

Continuously recording thermometers were installed in pools used by *O. mykiss* in Topanga Creek and when possible in Big Sycamore, Las Flores, Solstice, Trancas, and Zuma lagoons. Sites were selected to reflect canopy cover, substrate, habitat type and depth (Table 1.2). Both air and water temperatures were recorded when possible. While the goal was to deploy two sets of tidbits in each creek, one located near the ocean and the other further upstream near the upper limit of anadromy, surface water was so limited during the study period that we were unable to collect data in the upper watersheds, and even in some of the lagoons.

Lagoon	2013	2014	2015	2016	2017
Big Sycamore		DRY	DRY	DRY	15 April – 9 Nov
Las Flores (Water)		12 May-13 Nov	24 Apr-29 Oct	04 April-20 July (dried)	Not Deployed*
Las Flores (Air)		12 May-13 Nov	24 Apr-29 Oct	04 April-20 July (dried)	Not Deployed*
Solstice (Water)		12 May-18 Nov	DRY	DRY	Not Deployed*
Solstice (Air)		12 May-18 Nov	DRY	DRY	Not Deployed*
Topanga (Water)	12 Jul – 31 Dec	01 Jan-14 Nov	10 Apr-2 Nov	06 April-09 Nov	15 April – 14 Aug
Trancas (Water)		12 May-13 Nov	24 Apr- 29 Oct	04 April-01 Nov	15 April - 9 Nov
Trancas (Air)		12 May-13 Nov	ND	04 April-01 Nov	15 April - 9 Nov
Zuma		DRY	DRY	DRY	Not Deployed*

 Table 1.3.
 Summary of temperature monitored locations and dates in lagoons, 2013-2017

*Lagoons were not dry but HOBO tidbits were not deployed due to insufficient surface water or inability to deploy tidbit in a secure location

Summer temperatures that exceed 23°C, considered to be the critical thermal limit of tolerance for southern steelhead trout (Farrell et al. 2015, McEwan and Jackson 1996, Richter and Kolmes 2006, Spina 2007) were a real concern. Table 1.3 below shows the number of days in which water temperatures exceeded this limit in each creek between 2013 and 2017.

Lagoon	2013	2014	2015	2016	2017
Big Sycamore	ND	DRY	DRY	DRY	8
Las Flores	ND	0	6	4	ND
Solstice (upstream refugia pool)	ND	0	DRY	DRY	ND
Topanga	9	43	81	41	29
Trancas	ND	0	65	25	69
Zuma	ND	DRY	DRY	DRY	ND

Table 1.4. Frequency of days with temperatures exceeding 23 °C

Watershed Summaries

Big Sycamore

Big Sycamore Creek Watershed covers 21 square miles of minimally developed area within Point Mugu State Park, which connects to NPS holdings in the upper part of the watershed (Figure 1.3). Approximately 15% of the watershed and 12 miles of creek are accessible before reaching a natural limit of anadromy at a waterfall. Ownership is 79% state park, 5% federal parkland, 15% privately owned, and 1% local parkland. The Springs wildfire of 2013 burned 12% of the Santa Monica Mountains National Recreation Area (SMMNRA) in the most undeveloped section of the park. This included approximately 85% of the Big Sycamore Creek Watershed (NPS unpublished data). The creek is accessible on the south end from Pacific Coast Highway, where parking is available at the Point Mugu State Park trailhead, and also from Rancho Sierra Vista/Satwiwa, which is located off Potrero Road, across from Via Goleta in Thousand Oaks, CA.



Figure 1.3. Big Sycamore watershed, USGS 7.5-minute QUAD Pt Mugu. Ocean/creek mouth: 34.0709°, -119.0149° / Upper limit of anadromy: 34.1419°, -118.9395°

O. mykiss population assessment

Steelhead were historically present in Big Sycamore, as reported by Swift et al. (1993). Big Sycamore Creek is listed as a potential site for recovery by NMFS (2012). A compilation of all recorded historical information is found in Dagit et al. (2005).

O. mykiss relative abundance, spatial distribution, and density

There were no *O. mykiss* individuals of any size class observed during any of the surveys in this watershed. This creek was dry during most of the study period, and drought conditions following the Springs Fire of 2013 resulted in little to no surface flow in the creek.

O. mykiss migration information

There were no opportunities for fish to migrate into or out of Big Sycamore between September 2013 and December 2016. The lagoon was connected to the ocean for 39 days between 23 January, 2017 and 8 March, 2017. There was no connection at all in 2018.

O. mykiss spawning and rearing information

No spawning or redds were observed in Big Sycamore Creek. Spawning gravel was not mapped due to the lack of water. It was not possible to accurately examine embeddedness but overall fine sediment deposition associated with the Springs Fire was observed throughout the creek.

O. mykiss genetics within the Santa Monica Bay region

No genetic information was collected in Big Sycamore Creek because *O. mykiss* were not present.

Lagoon utilization/condition and accessibility

A small remnant lagoon was observed in the fall of 2013 isolated under the old pedestrian bridge approximately 90 meters upstream of the ocean, with a sand bar blocking ocean connection. It supported a small population of tidewater gobies, tadpoles and aquatic invertebrates. By May 2014 the water was gone, along with all of the fauna. Some overwash in September 2014 created a small, saline puddle under the bridge. Rain events in March and October 2015 created a small trickle of outflow. Site visits were interrupted in April 2015 due to a landslide that forced closure of the access road. Upon return in September 2015, a small puddle containing water boatmen and algae and evidence of overwash was again observed. The lagoon remained completely dry through the end of 2016. Large rain events that occurred in late December 2016 and January 2017 were sufficient enough to fill the lagoon and cause a breach from 23-27 of January. Another breach occurred 3 February to 8 March 2017. The lagoon remained wetted through the rest of the year. Although a small pool formed following the rains in March 2018, no connection occurred. A summary of site conditions is found in Table 1.4. Photographs illustrating physical conditions are found in Appendix 1A.

Date	Lagoon	Notes			
18 Sep 2013	disconnected	Initial site visit for photos and mapping. No NZMS			
		First seine pull - 5 tidewater gobies, 1 juvenile Hyla regilla			
		Second seine pull - 4 tidewater gobies, 1 adult toebiter			
06 Nov 2012	disconnected	Tidewater gobies - 40-50mm total length (TL)			
00 100 2013	uisconnecteu	Second pool under bridge			
		First seine pull - 17 tidewater gobies 25-50mm TL, 1 juv toebiter, 1 juv Hyre,			
		tadpoles, 1 Hyre metamorph			
02 Mar 2014	disconnected	Potentially connected at high tide			
12 May 2014	disconnected	No H20 - totally dry. All gobies gone.			
02 Sep 2014	disconnected	Salinity 17, Puddle at the lagoon <2in			
03 Dec 2014	disconnected	not accessible due to mudslide			
12 Dec 2014	disconnected	not accessible due to mudslide			
12 Jan 2015	disconnected	not accessible due to mudslide			
02 Mar 2015	(.1.11)	not flowing, but some pools along creek near bridge; lots of woody debris upstream			
03 Mar 2015	trickle	of bridge; not connected to ocean aside from a minor trickle on south bank of creek			
24 Apr 2015	disconnected	No water; full of driftwood in lagoon; totally dry except some moist sand			
14 May 2015	ND	not checked due to road closure preventing access			
17 Jun 2015	ND	not checked due to road closure preventing access			
07 July 2015	ND	not checked due to road closure preventing access			
13 Aug 2015	ND	not checked due to road closure preventing access			
15 Sep 2015	disconnected	some water and large woody debris under bridge			
20.0 + 2015	*	Overwash evident but not actively passable. Salinity 4ppm. Seine pull found only			
29 Oct 2015	*connected	corixidae and Macrocystis			
05 Jan 2016	Disconnected	Channel dry, flushed out post rain event			
07 March 2016	Discourse to d	Lagoon not breached after rain event, but full of muddy water. Berm is built up quite			
07 March 2010	Disconnected	high. Looks like some overwash but no evidence of flowing channel wet or dry			
31 Oct 2016	Disconnected	Channel choked with mulefat, no seining and mapping because lagoon not wetted			
16 Day 2016	Discomposted	Evidence of some wetting under the pedestrian bridge with some flow towards the			
10 Dec 2010	Disconnected	ocean but no surface flow remained			
24 Dec 2016	Disconnected	Lots of silt deposited under pedestrian bridge. No surface pooling – not connected			
11 Jan – Oct	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for detailed			
2017	variable	accounts			
27 Jan 2017	Connected	Lagoon measured and seined			
2 Mar 2017	Connected	Lagoon seined.			
22 Jun 2017	Disconnected	Overwash evident but not connected and not passable. Lagoon seined, measured and			
25 Juli 2017	Disconnected	mapped			
		7 seines pulled. Small carp caught, never seen before, must be a recent dump. Heavy			
5 Oct 2017	Disconnected	algae mats cover the main lagoon and continue under bridge and up towards			
		campground. Not connected, no overwash			
11 Nov 2017 -	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for detailed			
Mar 2018	Disconnected	accounts.			
Mar- May	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for detailed			
2018	Disconnected	accounts.			

 Table 1.5. Summary of lagoon conditions and accessibility for Big Sycamore Creek

Water temperature

Continuously recording thermometers were not deployed in the lagoon or at any upstream site between 2013-2016 due to lack of water. A HOBO was deployed from 14 April–9 November 2017 just upstream of the pedestrian bridge. Further details on the data are found in Appendix 1C.





Figure 1.4. Big Sycamore Lagoon water temperatures for the monitoring period from April through November of 2017

Description of summer-fall flow characteristics

Due to lack of flow, there was no summer or fall surface flow observed within the entire stream reach from 2013-2016. The creek was connected during short periods associated with storms during winter 2017, but by early summer flows went sub-surface and only remnant pools remained. An October 2017 survey found 2449m² of surface water above the PCH bridge and extending up past the pedestrian bridge for roughly 200m. No flow was present at this time and the water was disconnected from the ocean and the upstream section went dry. Data from these surveys is included in Appendix 1A. A summary of precipitation events for the Lechuza rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

The only invasive aquatic species detected in Big Sycamore were small carp were that were removed during lagoon seining in October 2017. Following the Springs Fire (May 2013) some invasive plants were observed but failed to become established in the creek channel due to drought conditions, although *Euphorbia terracina* has spread in the uplands (NPS unpublished data).

Presence of other aquatic native species

Native species recorded during the seining event in November 2013 included tidewater gobies (*Eucyclogobius newberryii*), Pacific tree frogs (*Pseudacris regilla*), and toebiters (*Abedus indentatus*). Unfortunately, in May 2014, the lagoon completely dried up, and no gobies have been seen since then. Multiple seining events during 2017 documented primarily water boatman (Corixidae sp.). *O. mykiss* were not present at any life stage in the lagoon or creek. Other native

aquatic species observed in the upper watershed and reported by NPS include CA newts (*Taricha torosa*), Western toads (*Anaxyrus borealis*) and both Pacific tree frogs and CA tree frogs (*Pseudacris cadaverina*). Seining in 2018 captured several juvenile carp (*Cyprinus carpio*).

Potential restoration actions to address identified limiting factors

The Southern California Steelhead Recovery Plan (NMFS 2012) identifies the following threats for Big Sycamore Creek: Roads, Recreational Facilities, Culverts and Road Crossings (Very High Threats); Wildfires (High Threat).

CalTrout (2006) identified the culvert road crossing with a severity rating of gray as the Keystone barrier. This barrier could be addressed by replacing the existing large boulders below the dirt road crossing with smaller stone that achieves the same erosion control benefit without impeding fish passage. Barriers that currently exist should be physically modified or removed to allow migration upstream for spawning and rearing and downstream for smolt passage to the ocean.

Both CDPR and NPS participated in the development of a wildfire management plan (Santa Monica Mountains Community Wildlife Protection Plan 2013), which identifies balancing wildfire mitigation strategies with long-term sustainability of natural resources (Goal 4), but it could be amended to specifically address monitoring, remediation and adaptive management for *O. mykiss*. Practices such as these aimed at reducing potentially catastrophic effects to *O. mykiss* and their habitat and preserving natural ecosystem processes should be incorporated into the overall watershed and state/national park planning process.

Other barriers caused by recreational facilities, roads, culverts, and road crossings can be addressed when the Point Mugu State Park General Plan (1977) is updated by including provisions for restoring the physical configuration, size, and diversity of steelhead habitat within the park.

CDPR is currently working with Caltrans to develop a strategy for replacing the aging bridge under Pacific Coast Highway at the mouth of Big Sycamore Creek. This could provide an opportunity for restoring a larger and more functional lagoon.

Las Flores

Las Flores Creek Watershed is approximately 4.5 square miles and only the lower two miles (approximately 5%) is accessible for anadromous fish (Figure 1.4). Ownership is 36% state park, 5.5% federal parkland, 58% private and 0.5% local parks. It is accessible in numerous locations along Las Flores Road, which directly connects to Pacific Coast Highway in Malibu, CA. The Las Flores Creek Watershed has been developed as per the development guidelines found in the City of Malibu General Plan (1995) and Local Coastal Plan (2002). Development is interspersed with parklands in the upper watershed. It is anticipated that future development will consist of the continued incremental construction of single-family homes on existing undeveloped lots.



Figure 1.5. Las Flores Creek watershed, USGS 7.5-minute QUAD Las Pulgas Canyon Ocean/creek mouth: 34.0364°, 118.6364° / Upper limit of anadromy: 34.0703°, -118.6382° Approximate location of two Keystone barriers (red star) identified by CalTrout at 2355m and 2479m

O. mykiss Population Assessment

Although no documentation of historical steelhead presence was found, both NMFS (2012) and Dagit et al. (2005) identified this watershed as having potential for steelhead presence and use.

O. mykiss relative abundance, spatial distribution, and density

There were no *O. mykiss* individuals of any size class observed from 2013-2018. This creek was dry during most of the study period.

O. mykiss migration information

There were approximately four days (26 February - 2 March 2014) when the creek was connected to the ocean with opportunities for fish to migrate into or out of Las Flores especially on the high tide. During 2017 the creek was connected to the ocean for 119 days, from 24 December 2016 through 21 April 2017, with 44 days of passability. Connection to the ocean also occurred from March 3 – April 13, 2018, but passability was extremely limited to less than 5 days at the lagoon/ocean interface.

O. mykiss spawning and rearing information

No spawning or redds were observed in Las Flores Creek. Spawning gravel was not mapped due to the lack of water. It was also not possible to accurately examine embeddedness.

O. mykiss genetics within the Santa Monica Bay region

No genetic information was collected in Las Flores Creek because O. mykiss were not present.

Lagoon utilization/condition and accessibility

The small remnant lagoon at the mouth of Las Flores Creek is constrained by development on both the east and west banks. The west bank consists of a pile wall extending from just above the high tide line upstream to the Pacific Coast Highway Bridge. The thalweg tends to form along the west bank and there was little vegetation downstream of the bridge. Upstream the west bank forms a steep slope (almost vertical in places) flanking Las Flores Road but merges with a limited band of willow and sycamore dominated riparian overstory. The east bank was also the wall of a building (Duke's Restaurant) and has drainage pipes flowing directly into the lagoon. A few willows have managed to become established amid a thicket of cattails. Upstream of Pacific Coast Highway (PCH), the east bank was almost vertical, and collected runoff from the adjacent plant nursery.

The two bay culvert style PCH Bridge is approximately 14.3 meters wide. The lagoon itself varied between 0-180 cm deep, with dense cattails on the east side. Water was mostly stagnant and often smelled like urine. In fall 2017, all vegetation was removed from the main portion of the channel under the PCH bridge, leaving only a small stand of *Arundo donax* and a Myoporum tree. Additionally, a concrete wall was poured on the west side of the lagoon channel extending from the wooden wall already in place. It is not clear who authorized that creek modification. A summary of site conditions is found in Table 1.5. Photos illustrating physical conditions are found in Appendix 1B.

Date	Lagoon	Notes
18 Sept 2013	disconnected	Initial site visit - No NZMS
06 Nov 2013	disconnected	30+ Hyla regilla juveniles
		Low flow barrier at 34°02.250 N, 118°38.213 W
02 Mar 2014	*connected	Between 26 Feb to 2 Mar, nearby LA County DPW WRD stations, Big Rock,
		Topanga Canyon and Monte Nido recorded 4.92", 5.43", and 5.12" rain,
		respectively. Lagoon was connected to the upper creek and flowing out to the
		ocean (trickle; depth at outflow ~3-5cm). Upstream of PCH Bridge, creek was
		about 10-15cm max depth; depth below PCH Bridge ~60+cm
12 May 2014	disconnected	Lagoon disconnected, creek dry
07 Jul 2014	disconnected	Lagoon disconnected, creek dry
24 Oct 2014	disconnected	Lots of trash, Bad smell
13 Nov 2014	disconnected	No connection to ocean, water pooled under bridge
03 Dec 2014	disconnected	Lagoon disconnected, but had been connected
12 Dec 2014	connected	Lagoon open, thalweg W side wall, foam at ocean edge
15 Dec 2014	*connected	Lagoon open, but not passable
12 Jan 2015	*connected	Connected, ~1m @ mouth, 1-2 in. deep
03 Mar 2015	*connected	Connected, low flow
08 Apr 2015	disconnected	ponded lagoon to end of wood pilings
24 Apr 2015	disconnected	water by HOBO smells awful, blue color, bottom- black
14 May 2015	disconnected	not connected. 3 male mallards. Water is opaque gray. Stormwater from rain
		coming out of teal pipe by W. Wall. Offensive sulfur/ anaerobic odor.
17 Jun 2015	disconnected	Chlorine/other (?) smell, algae/scum and trash in lagoon. Water level has dropped.
07 July 2015	disconnected	Yuck! Lagoon max 1m, avg 70 cm. 80% ulva floating cover live, cattails have
		overgrown path. Muck 20-30 cm deep. Lagoon disconnected. No overwash
12 Aug 2015	disconnected	A lot of dead ulva intestinalis, lagoon filled with cattails. no evidence of
10 Sam 2015	discomposted	Overwash. Duckweed floating covers about 75-80%. Smells like feees.
10 Sep 2015	disconnected	filled with cottails with block much on the substrate (20 cm doon). No evidence
		of overwash Duckweed floating covers about 20% of surface Smells like poop
		with a lot of mosquito larvae (photos taken) and trash present. Max denth \sim 70cm
		and Average depth ~ 40 cm.
15 Sep 2015	disconnected	Post-rain event. Some overwash.
29 Oct 2015	disconnected	Cattails have been cut back upstream of the bridge. Sign of overwash but not
		connected.
7 Mar 2016	Connected	Trickle flow and very turbid
4 Apr 2016	Disconnected	Shallow and ponded with small isolated puddles upstream of bridge. 1 pacific tree
_		frog under bridge. Black sulfur smell, floating dead algae
26 May 2016	Disconnected	Ponded, sulfur smell and lots of mosquito larvae
22 June 2016	Disconnected	Lagoon mostly dry and still smells of sulfur
20 July 2016	Disconnected	Lagoon mostly dry, HOBO devices removed due to lack of water
15 Sept 2016	Disconnected	Totally dry and no overwash
16 Dec 2016	Connected	1m thalweg on west side of lagoon, less than 5cm deep
11 Jan – Oct	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for
2017		detailed accounts
2 Mar 2017	Connected*	Lagoon connected but not passable, Seined
23 Jun 2017	Disconnected	Bankful but not connected lots of emergent vegetation. Lagoon seined, measured
		and mapped
Oct 2017	Disconnected	
		Surface water had almost disappeared until the lagoon was buildozed sometime
1		12 - 20 Sept. 10cm of water stagnant in buildozed area, was totally dry

 Table 1.6.
 Summary of lagoon conditions and accessibility for Las Flores Creek

Task 1. Presence/Absence -	SMB	Steelhead	Monitoring	2013-2018
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		before bulldoze occurred. All instream vegetation gone except arundo on S side.
9 Nov 2017 –	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for
Jan 2018		detailed accounts
10 Jan 2018	Connected*	
		3 in storm event. Berm completely eroded on N side of lagoon. About an inch of standing water. No wildlife, no gobies. Lots of leaf and seaweed debris in thalweg. Thalweg in same west side. Left over berm is about 7ft tall. Overwash and connected with tide but not passable.
Jan – April	Connected*	Monthly lagoon condition documentation conducted. See Appendix 1B for
2018		detailed accounts
April – May	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for
2018		detailed accounts

*connected but not passable

Water temperature

Continuously recording thermometers were deployed in the lagoon (water and air) from May through November 2014, April to October 2015, and April to July 2016. HOBO tidbits were pulled out early in 2016 because the lagoon dried down. Tidbits were not deployed in 2017 because the majority of the lagoon was dry; a small amount of water was present but not enough to get a consistent measurement of water temperature. The tidbits were tied to the branches of the willow located on the east bank just downstream of the PCH bridge.

Water temperatures ranged from a minimum of 7.65 °C in May 2015 to a maximum of 24.70 °C in August 2015 (Table 1.6). Average air temperatures ranged between 16.01 °C in May 2015 to 22.08 °C in September 2015.

Sita Month			2014			2015			2017 [!]		
Site	wionun	Min Average Max		Min	Average	Max	Min Average		Max	ND	
Las Flores- Water	*April	ND	ND	ND	15.70	16.93	18.13	13.50	16.81	23.04	ND
	May	19.20	20.39	21.32	7.65	17.87	19.25	14.75	17.72	22.32	ND
	June	18.39	19.95	21.22	17.18	18.96	21.27	16.89	19.34	23.67	ND
	July	19.34	21.06	22.80	18.32	20.28	22.11	18.96	20.15	22.85	ND
	Aug	18.30	20.34	22.47	18.60	20.93	24.70	ND	ND	ND	ND
	Sep	17.11	20.16	22.01	18.77	21.34	23.62	ND	ND	ND	ND
	Oct	15.37	18.35	21.03	16.99	20.15	22.73	ND	ND	ND	ND
	*Nov	14.53	16.21	17.99	ND	ND	ND	ND	ND	ND	ND
Las Flores- Air	*April	ND	ND	ND	12.65	17.24	24.85	10.96	15.51	20.53	ND
	May	14.10	19.64	31.74	10.10	16.01	21.60	12.00	16.82	22.42	ND
	June	14.36	18.95	26.89	14.05	18.48	28.97	14.72	18.94	31.54	ND
	July	17.37	21.02	28.37	16.18	20.44	27.33	16.53	20.35	28.47	ND
	Aug	15.84	20.75	28.35	16.84	21.46	28.27	ND	ND	ND	ND
	Sep	16.06	21.30	33.31	17.65	22.08	29.24	ND	ND	ND	ND
	Oct	15.22	19.67	28.25	15.46	21.34	30.70	ND	ND	ND	ND
	*Nov	13.06	17.90	24.97	ND	ND	ND	ND	ND	ND	ND

 Table 1.7. Summary of Absolute Maximum, Absolute Minimum, and Average temperatures for each monitoring month for 2014 - 2017.

*April 2015 data incomplete: only includes from 24-04-15.

**November 2014 data: logger pulled on 11-13-14.

¹ HOBO data logger not deployed in 2017 due to insufficient surface water

Figures 1.5-1.9 illustrate the continuous temperature patterns in 2014 and 2015. Overall water temperatures were slightly higher in 2015 and the water level in the lagoon slightly lower. Figure 1.10 illustrates the proportion of time at each temperature. In 2014, temperatures were often between 18.5-21 °C, but in 2015 there was a shift to more time at temperatures above 21 °C. As shown in Figure 1.10 temperatures exceeded 23 °C for several hours in August 2015. This is considered to be the threshold for temperatures supporting *O. mykiss*.



Figure 1.6. Las Flores Lagoon water temperatures for the monitoring period from April through November of 2014 - 2016



Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018

Figure 1.7. Las Flores Lagoon air temperatures from April through November of 2014- 2016.



Figure 1.8. Las Flores Lagoon summer water temperatures for 2014 - 2016.



Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018

Figure 1.9. Las Flores Lagoon summer air temperatures for 2014 -2016.



Figure 1.10. Las Flores Lagoon frequency distribution of temperatures recorded every 30 minutes from May 12-October 29, for 2014 -2016. (The period selected is based on data availability for all years)



Figure 1.11. Occurrence of high temperatures and the number of hours greater than 23°C and 25°C recorded during the monitoring period for each year in Las Flores Lagoon.

Description of summer-fall flow characteristics

There was no summer or fall surface flow observed within the entire stream reach during the study period. Fall surveys in 2016 and 2017 documented several refugia pools that retained some water, but none were suitable for supporting *O. mykiss*. Data from these surveys is included in Appendix 1A. A summary of precipitation events for the Big Rock Mesa rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

To date, no invasive aquatic fauna has been detected in Las Flores Creek. The New Zealand mud snail (NZMS) has not been observed but is potentially present, therefore precautions were taken to avoid moving NZMS from this system to any others. Invasive *Arundo donax* and *Myoporum sp.* are found in the lagoon area and some upstream reaches.

Presence of other aquatic native species

The only native aquatic fauna observed in Las Flores Creek were Pacific tree frogs (*Psuedacris regilla*). The lagoon supports native willows and cattails and sycamores are found further upstream. *Ulva intestinalis* along with *Ruppia sp.* were observed in the lagoon.

Potential restoration actions to address identified limiting factors

The Southern California Steelhead Recovery Plan (NMFS 2012) identifies the following threats for Las Flores Creek: Roads (High Threat) and Wildfires (Medium Threat).

Las Flores Creek runs adjacent to Las Flores Road and numerous developments, resulting in steep banks with high potential for erosion and sedimentation. Management of the road shoulders by Los Angeles County should avoid stockpiling loose road spoils that could spill into the

channel. The City of Malibu participated in the development of the Santa Monica Mountains Community Wildfire Protection Plan (2013) which although primarily focused on risk reduction and protection of human communities, acknowledges the potential impacts to natural resources, especially creeks. Building upon this existing program to include monitoring, remediation and adaptive management focused on reducing potentially catastrophic effects to *O. mykiss* and their habitat and preserve natural ecosystem processes should be considered.

Restoration of the banks within a short reach of the creek within Las Flores Canyon Creek Park were completed in 2008, and a pedestrian bridge to cross the creek there was completed in 2015. This restoration included installation of native riparian species and was intended to improve habitat for steelhead.

CalTrout (2006) identified the Keystone barrier in Las Flores Creek as a complex of two abandoned sediment filled concrete dams (barrier no. 2 and barrier no. 3) located in the center section of the watershed. Barrier no. 2 is a reinforced concrete dam, while barrier no. 3, which is located 124 meters upstream, is a dam made of natural substrate cemented together. Jump heights for each exceed 1.6 meters in elevation, with pool depths of 0.4 meters and 1.2 meters, respectively. For these reasons the barrier severity rating for both these keystone barriers was considered red (no passage under any flow conditions). CalTrout (2006) recommended removal of the two concrete dams.

At present there are no known restoration plans for Las Flores lagoon, which is severely constrained by development on both banks as well as the PCH culvert bridge.

Solstice

Solstice Creek Watershed covers approximately 4.3 square miles. The natural limit of anadromy is at the upper end of the lower two-mile reach managed by NPS. Ownership is 6% state park, 44% federal parkland, 48% privately owned, and 2% local parks. Management of most of the parkland is covered by the Santa Monica Mountains National Recreation Area General Management Plan (2002). The City of Malibu General Plan (1995) and Local Coastal Plan (2002) oversee single-family home development upstream of that parkland. The creek is accessible from Pacific Coast Highway, as well as by turning into the NPS parking area located at the intersection of Solstice Canyon and Corral Canyon Roads in Malibu, CA. NPS has extensively restored fish passage in the lower two miles of Solstice Creek, including removal of the low flow barriers on their property. A pending Caltrans project is proposed to remove the keystone barrier culvert under PCH.



Figure 1.12. Solstice Creek watershed USGS 7.5-minute QUAD Malibu Beach Ocean/creek mouth: 34.0328°, 118.7422° / Upper limit of anadromy: 34.0421°, -118.7426°

O. mykiss Population Assessment

Dagit et al. (2005) documents records of steelhead caught in Solstice Creek from the 1920's through the 1960's. No trout have been observed since the 1980's, but NMFS (2012) identifies this creek as having recovery potential.

O. mykiss relative abundance, spatial distribution, and density

There were no *O. mykiss* individuals of any size class observed during any of the surveys. This creek was intermittently dry below the limit of anadromy at the waterfall located approximately 3.2 rkm upstream of the ocean during the study period.

O. mykiss migration information

From 2013-2016, there were fewer than ten days each year when the creek flowed to the ocean and the keystone passage barrier at the mouth of the creek was not passable at any time observed. In 2017, the creek flowed to the ocean for 119 days but due to the nature of the Pacific Coast Highway culvert, there were only five days where that connection was passable into the culvert, but not further upstream. While there was outflow from the culvert for 60 days in 2018, fish passage remained impossible.

O. mykiss spawning and rearing information

No spawning or redds were observed in Solstice Creek. Spawning gravel has not been mapped. Embeddedness was not determined.

O. mykiss genetics within the Santa Monica Bay region

No genetic information was collected in Solstice Creek because *O. mykiss* was not observed to be present.

Lagoon utilization/condition and accessibility

Solstice "lagoon" consists of an erratically formed thalweg from the outflow of the culvert under PCH across the beach to the ocean. Historically, the lagoon was never very large, but formed seasonally at the creek mouth providing passage opportunities during rain events. It was inaccessible to anadromous fish for most of the study period, but connected for a short time during a significant rain event (5.12") in March 2014. Depth was as high as 1-3 cm in some places within the culvert. Accessibility for anadromous adults under these conditions is questionable if not impossible. The lagoon was disconnected throughout the rest of spring, summer, and fall 2014 with some overwash. In December 2014 the creek and outflow ranged in depth from 4-10 cm. By January 2015, outflow was reduced to < 4 cm and not passable. After this brief window of connection, the creek was disconnected from April - December 2015. The lagoon connected to the ocean briefly in early March 2016 then closed for the remainder of the year. Heavy rains in the winter of 2016/2017 breached the lagoon in late December 2016 and the lagoon remained connected to the ocean through the beginning of July 2017. Despite this long period of outflow, passability was again extremely limited – an estimated five days due to the limitations of the culvert under PCH. Limited rainfall in 2018 was unable to breach the lagoon until March 3, 2018. The breach was impassable due to sheet flow throughout the PCH culvert and ultimately closed in early May. A summary of site conditions is found in Table 1.7. Photos illustrating physical conditions are found in Appendix 1B.

Date	Lagoon	Notes
18 Sept 2013	disconnected	Not connected. Initial site visit to establish photo points
07 Nov 2013	disconnected	
02 Mar 2014	*connected	Between 26 Feb to 2 Mar, nearby LA County DPW WRD station Monte Nido
		recorded 5.12" rain. Lagoon was connected to the upper creek and flowing out
		through the culvert to the ocean as a trickle (depth at outflow about 2-3cm). Depth
		was 1-3cm through the culvert and downstream of the culvert, 5-10 cm above
		culvert. Sewage smell.
12 May 2014	disconnected	Creek has shallow flow, connected upstream. H2O limit of anadromy: 34.02.980,
		118.45.191
07 Jul 2014	disconnected	Hike to Black Widow Pool up Sostoma Trail takes 15-20 min. Pool above
		waterfall - air and water hobos ok. Red leg frog tadpoles fantastic! 1 small one got
		away. 1 big previous escapee observed. Avg depth 45cm, 3x4m. Flow - trickle,
		attached algae ~50%, lots of dragon/damselfly nymphs. Photos of mouth - kelp
		almost to culvert.
29 Aug 2014	disconnected	Hurricane Marie brought high waves along much of the southern California coast
_		between 27-29 August. High tides ranged from 4.9 to 5.0 during that time. No
		breach. Waves reached into the culvert under PCH but did not cause much
		erosion of pooling on the beach below.
03 Dec 2014	disconnected	No connection, some overwash. Lots of trash. Two dead juv. western Grebes.
12 Dec 2014	*connected	Connected, flowing out. 6" max depth. 2-3" at high tide line in cobble.
16 Dec 2014	*connected	Connected, flowing out. 2" deep max
12 Jan 2015	*connected	Trickle to beach, connected, not passable. 1in. deep 1ft. wide
03 Mar 2015	*connected	Solstice - Creek running about 12 inches across, 1 inch deep, connected to ocean
08 Apr 2015	disconnected	trickle ponded; disconnected
24 Apr 2015	disconnected	small flow from culvert 10m out. not connected
14 May 2015	disconnected	not connected, some water puddle in culvert
17 Jun 2015	disconnected	Not connected. Very small puddle in culvert
07 July 2015	disconnected	Lagoon disconnected. No overwash. No parking
13 Aug 2015	disconnected	Only trickle of water under culvert. Mostly dry.
10 Sep 2015	disconnected	Not connected with no overwash. Mud under the culvert cracking
15 Sep 2015	disconnected	Post-rain event. No connection or flow.
29 Oct 2015	disconnected	Evidence of overwash but no connection or flow.
5 Jan 2016	disconnected	Post rain monitoring, no connection
7 Mar 2016	Connected	Narrow channel with shallow flow out to the ocean
18 Oct 2016	Disconnected	Water puddle at bottom of culvert
16 Dec 2016	Disconnected	No surface flow but purposeful anthropogenic manipulation. Trench dug and
		stake fence erected
24 Dec 2016	Connected	Connected along east side where ditch was last observed
11 Jan –	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for
October 2017		detailed accounts
27 Jan 2017	Connected	Seined and mapped
23 Jun 2017	*Connected	
		Connected but not passable, further manipulation to the thalweg apparent.
		Lagoon seined, measured and mapped.
5 Oct 2017	Disconnected	
		Too small to seine. Light trickle coming out of culvert, sand deposition high, no
		drop off between water level and culvert
9 Nov 2017 –	Disconnected	Monthly lagoon condition documentation conducted See Appendix 1B for
Mar 2018		detailed accounts

 Table 1.8. Summary of lagoon conditions and accessibility for Solstice Creek

Mar – May	Connected	Outflow only. Monthly lagoon condition documentation conducted. See Appendix					
2018		1B for detailed accounts					
May 2018	Disconnected	Disconnected. Trickle outflow from culvert.					
"*************************************							

"*connected" = connected but not passable

Water temperature

Continuously recording thermometers were deployed in the Black Widow pool upstream of the limit of anadromy during 2014 in order to obtain some information on refugia pool conditions and to assist NPS with their monitoring of the re-introduced red legged frogs. Although there is no possibility of *O. mykiss* using this pool, we hoped to get a sense of an upper watershed refugia pool temperature range. This small (3 m x 4 m) pool had an average depth of 45 cm but the location where the tidbit was installed went dry mid-summer. We did not deploy it again from 2015 through 2017 as flows and depth in the lagoon were even lower. Figures 1.12 through 1.14 and Table 1.8 show air and water temperatures collected during the 2014 monitoring period.

 Table 1.9. Summary of Absolute Maximum, Absolute Minimum, and Average Temperatures for each monitoring month for 2014 for Solstice Creek.

Site	Month	2014					
Site	IVIOIIII	Min	Average	Max			
Black Widow Pool - Water	*May	15.51	17.25	19.32			
	June	15.51	17.18	18.70			
	July	17.30	18.32	19.98			
Black Widow Pool - Air	May	12.65	19.23	31.61			
	June	13.04	17.7	23.45			
	*July	15.89	19.99	26.30			

*2014: May data includes 20 days; July data includes 10 days. Hobo was pulled due to lack of water encountered during the monthly visit on 08/07/14.

Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018



Figure 1.13. Solstice Creek - Black Widow Pool water temperatures for the monitoring period from April through November of 2014.



Figure 1.14. Solstice Creek - Black Widow Pool air temperatures for the monitoring period from April through November of 2015.

Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018



Figure 1.15. Solstice Creek - Black Widow Pool frequency distribution of temperatures recorded every 30 minutes from May 12-July 22 2014.

Description of summer-fall flow characteristics

Summer and fall flow was interrupted and disconnected with a few shallow pools intermittently distributed between the PCH bridge culvert upstream two miles to the waterfall pool. No pool was deeper than 15 cm and most were choked with watercress, mint and other emergent vegetation. No flow was observed even at the waterfall until 2017. Data from these surveys is included in Appendix 1A. A summary of precipitation events for the Monte Nido rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

New Zealand Mud Snails have been present throughout Solstice Creek since at least 2009. Red eared sliders (*Trachemys scripta elegans*) have been removed periodically by NPS staff. No crayfish, bullfrogs, or non-native fish have been observed to date (K. Delany, NPS pers. communication).

Presence of other aquatic native species

Native species recorded by NPS in the lower reach of Solstice include Pacific tree frogs (*Pseudacris regilla*), California tree frogs (*Pseudacris cadaverina*), California newts (*Taricha torosa*). The sycamore, oak, willow, alder riparian corridor provides a natural canopy with primarily native understory plants.

Potential restoration actions to address identified limiting factors

The effort to remove fish passage barriers in Solstice Creek began in 2001. The RCDSMM and NPS worked with Caltrans and the City of Malibu to develop plans to replace identified barriers (1947 culvert under PCH and Corral Canyon Road culvert) as recommended by CalTrout (2006).

The PCH culvert is approximately 25 meters upstream from the ocean and approximately 150 meters downstream from the Corral Canyon Road barrier. The plan is to remove the existing concrete bottom of the culvert and recreate a soft bottom natural channel. This plan has been under development for many years and received a coastal development permit in November 2011, but has been stalled by funding and design constraints. The City of Malibu completed replacement of the Corral Canyon Road culvert with a bridge in 2008.

The eight instream road crossing and small instream barriers located upstream of Corral Canyon Road within Solstice Creek Park were removed in 2006, restoring fish passage from PCH upstream approximately two miles to the waterfall, which forms the natural limit of anadromy.

The last remaining fish passage obstruction is the PCH culvert. A coalition of local landowners and agencies continues to work with Caltrans to implement the restoration of passage here. There are no plans to enhance or create a lagoon at the mouth of Solstice Creek.

Topanga Creek

Topanga Creek Watershed is the third largest in the Santa Monica Bay at 18 square miles. The natural limit of anadromy is located approximately four miles upstream from the ocean so 10% of the watershed was included in our study area. Ownership in the Topanga Creek Watershed is approximately 70% state park, 2% federal parkland, 26% privately owned, and 2% local parks. Existing development includes two residential sub-divisions, a mobile home park, three commercial areas (under 20 acres each), and residential development located in historic small lot sub-divisions or on private lots. Most parcels in Topanga are less than 40 acres and regulated by Hillside Management Criteria, the Santa Monica Mountains North Area Plan, and the Santa Monica Mountains Local Coastal Plan, all of which restrict development density. The creek is accessible from numerous locations along the road shoulder of Topanga Canyon Blvd. The DIDSON site is accessed from the old Rodeo Grounds Road, which is approximately 500 meters north of Pacific Coast Highway on Topanga Canyon Blvd. in Malibu, CA.



Figure 1.16. USGS 7.5-minute QUAD Topanga showing upper limit of anadromy

Ocean/creek mouth: 34.0403°, 118.5806° / Upper limit of anadromy: 34.075420°, 118.589652° <u>O. mykiss Population Assessment</u>

Dagit et al. (2005) provide extensive historic documentation of steelhead in Topanga Creek between 1911 and 1980. Between 1980 and 1998, no steelhead were observed but some seasonal stocking of hatchery fish in the upper watershed took place. The re-colonization by steelhead was documented in 1998 and monitoring has continued since 2001.

O. mykiss relative abundance, spatial distribution, and density

Monthly snorkel surveys documented the abundance and distribution of *O. mykiss* between the ocean and the upper limit of anadromy located at approximately 5.3 river kilometers from the ocean (Dagit et al. 2018). Figure 1.17 shows the total number of *O. mykiss* observed. The relative abundance follows a fairly normal seasonal trend reflecting young of the year appearing in the spring, and recruiting into larger size classes over the summer and fall. Winter counts are often low due to cold temperatures,, even though the fish have not been able to move out of the system.



Figure 1.4. Abundance of O. mykiss in Topanga Creek 2013- March 2018

Figure 1.18 shows the number of discrete habitat unit locations where *O. mykiss* were observed. During most of the year, the fish are found in identifiable refugia pools, but distribution expands in spring when young of the year are found in shallower habitat units, and contract in the winter when fewer fish are observed overall.



Figure 1.5. Distribution of O. mykiss in Topanga Creek 2013-March 2018

O. mykiss migration information

From 2013 through 2016, opportunities to migrate into or out of Topanga Creek were severely limited with fewer than ten days each year having sufficient connectivity to the ocean and depth in the creek to sustain movement. Deployment of an instream antenna detected a total of two individuals smolts moving downstream to the ocean in March 2014. Heavy rains fell during the winter of 2016/2017, providing 36 days of passable connection from Topanga Creek to the ocean. Deployment of an instream antenna in 2017 was not possible due to equipment failures. DIDSON camera deployment confirmed two smolts outmigrating from the creek to the ocean and an additional two anadromous adults returned to the creek from the ocean. While the anadromous adults were not detected with the DIDSON camera, they were observed in pools in the middle reach of Topanga Creek during the April 2017 snorkel survey. Connection in 2018 was limited to 28 days in January and March and no fish were detected moving in or out by snorkel surveys. A single smolt was observed moving downstream 300 meters above the lagoon in March. Both the instream antenna and DIDSON cameras were not deployable during that short window of rain connectivity due to low flow conditions.

O. mykiss spawning and rearing information -

A total of 27 redds were observed in Topanga Creek during 2013 (10), 2014 (9), 2015 (1), 2016 (0), 2017 (4) and 2018 (4). Spawning gravel was mapped and determined to be present throughout 0.26% (2013), 14% (2015), and 3.6% (2017) of the reaches available for *O. mykiss*. Embeddedness ranged from 25-50%, depending on season and has increased overall since 2013. The distribution of spawning gravel shifted as sediments were entrained and moved downstream.

O. mykiss genetics within the Santa Monica Bay region

Tissue samples were collected during electrofishing events in November of 2013-2017. A total of 1010 fin clips have been submitted to the NMFS Genetic Tissue Repository and analysis is in reported in Dagit et al. (2018). The population seems to have grown from a few founder fish, is a

unique wild steelhead population most closely related to fish from Santa Ynez, and expresses only limited hatchery ingression.

Lagoon utilization/condition and accessibility

Topanga Lagoon is constrained by fill material on the east and west banks, as well as by the culvert bridge under PCH. The approximately one acre remnant lagoon is supported by subsurface flows year round, augmented by some overwash during extreme tides. The lagoon experiences fairly high water temperatures and has been listed for bacteria level exceedances. Nutrients have not been problematic. Besides short windows of connectivity to the ocean on a few occassions, Topanga Lagoon remained inaccessible to anadromous fish for most of the 2013-2016 water years. Overwash was intermittent and high numbers of tidewater gobies were often observed in the lagoon, along with a seasonal variety of gulls and shorebirds. Average water depth varied from 20 cm to 115 cm and water was most often stagnant. Algae was sometimes observed and was highest in August 2014 when it covered 85% of surface water. The lagoon is regularly disconnected from Topanga Creek upstream of the Elbow Pool (0.3 rkm upstream of the ocean) impeding anadromy as well as smolt migration or residency. Water condition was also poor on some survey dates when high turbidity, oil slicks, grey, green, or white coloration, and sulfur or sewage odors were observed. A summary of lagoon observations is included in Table 1.9. Photos illustrating physical conditions are found in Appendix 1B.

Date	Lagoon	Notes
13 Sept 2013	disconnected	Thousands of tidewater gobies in lagoon; (creek dry from elbow pool to cattail pool at 1825m).
18 Oct 2013	disconnected	murky brown water, thousands of tidewater gobies present through lagoon to elbow pool (up to 300 per square meter. creek dry from elbow pool to about 1725m
15 Nov 2013	disconnected	50% microphytobenthos, 100% diatoms, max depth=150 cm, average depth=75cm, thousands of tidewater gobies present throughout lagoon to elbow pool. Creek dry from elbow pool to about 1680m
13 Dec 2013	disconnected	Lagoon CLOSED, hundreds of gobies observed when hobo uploaded
10 Jan 2014	disconnected	Lagoon CLOSED, water slightly turbid, no fish observed
14 Feb 2014	disconnected	Lagoon CLOSED, hasn't been connected since about January 2012, no opportunities for trout to move into or out of lagoon since then. No gobies observed from edge of lagoon near beach; oily slick on surface of water above pch bridge, water depth above pch bridge low ~20cm average, 20cm max.
07 Mar 2014	connected	Lagoon OPEN, flowing out. Connected since high rainfall (~3") on Feb 27- 28. There is a sediment bank on the east side of the lagoon near the concrete wall, and it looks like a tractor pushed a large clump of kelp wrack towards the lagoon (photos). Max depth ~100cm; lagoon is brown and murky throughout up to elbow pool, upper lagoon ~20cm. Seems to be more sediment in the lagoon since storm event. No gobies or any other fish were observed in the lagoon.
4 April 2014	disconnected	Lagoon is cloudy, murky, grey, milky at the top end of PCH-Bacteria or spill? Upper lagoon connected on E side. Elbow pool is stagnant, isolated, mosquito larvae but no gobies. Pool above elbow has lots of Cladophora, no gobies. Pool above snake pit has lots of Arundo, dying Cladophora, maybe 1 goby, a few chub, 10-20cm of water.

Table 1.10. Summary of lagoon conditions and accessibility for Topanga Creek

Task 1. Presence/Absence ·	- SMB Steelhead	Monitoring 2013-2018
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_			
	01 May 2014	disconnected	Swollen but not connected. 100 + gulls, 2 egret, 10 pelicans, 2+ mallards, max 160/75 av, silt/sand, kelp wrack, no/lo attached algae, cloudy vis., construction N end tractor moving 10 ft piles of dirt in parking lot. Hobo uploaded ok. Upper lagoon stagnant, brown depth 65/40 cm, fence lizard, broom in bloom. No gobies observed.
	06 Jun 2014	disconnected	Lagoon closed with some overwash evident. Visibility ok. No gobies
			observed. Difficult to walk in the wetted area. Hobo uploaded ok.
			Connection between lagoon and Elbow Pool moist and flowing at a trickle,
			but not dry. About 1 m wide, 2" deep to the East of the dry channel bed.
			Rattlesnake on rocky patch.
	11 July 2014	disconnected	Lagoon closed, receded since last survey. Visibility ok. Gobies (10+, 1")
			were observed during the WQ sampling event (July 15, 2014) in the interior
			section of lagoon tail. No fish observed. Lagoon has a lot of surface scum at
			head of lagoon. Connected to Elbow pool, but only via a narrow, shallow
	00.4	1 1	channel along E side of dry bed. Avg=60. Depth at hobo, 40 cm.
	08 August	disconnected	Lagoon closed. Blue heron at the northern end of the lagoon. Lagoon only 20
	2014		cm deep at the hobo. A lot of algae (>85%) cover making it impossible to
			estimate max or average depth. No visibility. Has receded however (~20 cm
			based on depth of hobo). Sulfur smell, Not connected to Elbow pool
			anymore, not even by the small trickle at Eastern edge under the vegetation.
_	20 August	discomposted	No fish observed, but heroin was present.
	29 August 2014	disconnected	coast between 27.29 August. High tides ranged from 4.9 to 5.0 during that
	2014		time
			Site visits were conducted between 1/00-1700 on a falling tide
			Weather was clear and suppy, slight breeze
			No breach Overwash added a substantial amount of water to the lagoon
			expanding it back to the end of the west bank. Some keln washed in and
			visibility too poor to see fish. A seine is planned for Friday 5 September.
			······································
	05 September	disconnected	Lagoon closed. Blue heron at northern (upstream) end of the lagoon. Algae
	2014		cover (95%) makes it impossible to see in the water to estimate depth or
			observe fish. Hobo is still in the water. Smells like sewage. Only 20 cm deep
			at hobo. Not connected to Elbow still. Elbow is stagnant with mosquito
			larvae. Still has water in it although not connected (perhaps not evaporating
			quickly because very shaded?).
	17 Oct 2014	disconnected	Lagoon closed. Kingfisher at upstream end of lagoon. Crows (5) and 10-20
			gulls in lagoon area. Algae cover <5% at lower end. Max depth ~50cm.
			About 25-30 cm deep at hobo (rose a little). Not connected to Elbow. No bad
			odors. Water turbid, no fish or gobies observed.
	11 Nov 2014	disconnected	Lagoon closed. Hobo removed. 7" deep at hobo, only 1 foot average. First
			fime in many months since we could see through patches of skum to the
			bottom, at the upper end. Surface skum/algae=90% at upper end. Not
	10 5 2014		bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end.
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30-
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30- 60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30- 60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30- 60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies observed in Elbow Pool (200m) with max/avg 50/35cm through 240m in challow pools of 5.20cm with achieved substrate. About 20 cohieve in
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30- 60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies observed in Elbow Pool (200m) with max/avg 50/35cm through 240m in shallow pools of 5-20cm with cobble/gravel substrate. About 30 gobies in total sub adults from 4 5cm throughout
	19 Dec 2014	disconnected	bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30- 60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies observed in Elbow Pool (200m) with max/avg 50/35cm through 240m in shallow pools of 5-20cm with cobble/gravel substrate. About 30 gobies in total, sub-adults, from 4-5cm throughout.
	19 Dec 2014 19 Jan 2015	disconnected	 bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30-60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies observed in Elbow Pool (200m) with max/avg 50/35cm through 240m in shallow pools of 5-20cm with cobble/gravel substrate. About 30 gobies in total, sub-adults, from 4-5cm throughout. Topanga Lagoon - 12:30PM, Lagoon was still connected after rain event from the weekend of Lanuary 10th (via a parrow channel) to the occar. Some
	19 Dec 2014 19 Jan 2015	disconnected	 bottom, at the upper end. Surface skum/algae=90% at upper end. Not connected to Elbow. No fish or birds seen. Algae cover <5% bottom end. Lagoon – closed. Sand bar ~8m wide after recent storm. No gobies at bottom end of lagoon, shuffled 20ft inward, no fish seen at all. Depth varies from 30-60 cm. Algae cover 0% at bottom end. Algae/skum cover upper end = ~ 50%. Lagoon and Elbow connected by narrow trickle of water. Gobies observed in Elbow Pool (200m) with max/avg 50/35cm through 240m in shallow pools of 5-20cm with cobble/gravel substrate. About 30 gobies in total, sub-adults, from 4-5cm throughout. Topanga Lagoon - 12:30PM, Lagoon was still connected after rain event from the weekend of January 10th (via a narrow channel) to the ocean. Some waterfowl were using the lagoon and no fish were observed from the bridge

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		(bottom was visible from the underpass). Depth in the lagoon was fairly low (water level evident in photos). Some surface algae (<10%) was visible north of the bridge on surface of water, and none in the lagoon itself. Gobies were found in Elbow pool (7), as well as 20 m upstream from Elbow pool (11 gobies). Pools shallow and patchy.
13 February 2015	disconnected	Topanga Lagoon - closed (?). Algae cover 0% (photo). Lower reach patchy, isolated pools. Elbow pool, 10 Tidewater gobies, 2 crayfish, 0 chub (75cm max, 50cm avg), algae=0%, gravel substrate). 10m upstream of Elbow pool, 3 Tidewater gobies, 3 crayfish, 41 chub (Max 50/Avg 30cm, gravel substrate).
*03 Mar 2015	*connected	Topanga Lagoon - open, although with very little flow, ~3 inches MAX and AVG flow. Algae cover 0% (photo). Seined by A. Sanchez and S. Williams, pulled seine twice: 1st pull ~200 gobies, 4-5cm, near east wing wall; 2nd pull ~10 gobies 4-5cm, near north-west lagoon bank. before entering lagoon, coot and merganser present
10 Apr 2015	disconnected	Tidbit deployed in Topanga lagoon. No gobies observed in lagoon. Upper lagoon (above 50m) not checked. Muck covered 75% of bottom of lagoon
14 May 2015	disconnected	Raining. Max/Avg (near HOBO) 90/60Algae: >5%Blue/Green tint to water. Disconnected from lagoon to the West. Elbow poolpartly connected to Lagoon by east channel. 10+ gobies in Elbow Pool, 10+crayfish. Water extends 15ft above Elbow Pool, then dry around(westchannel) 1st Arundo clump. East Channel connected all the way. Upstreamof Elbow Pool: Channel is very silty and Arundo clogging channel ~ 70ftabove Elbow Pool.
11 Jun 2015	disconnected	Topanga Lagoon closed, backed up to Elbow pool. Low visibility. 200+ gobies seen from above.
07 July 2015	disconnected	Can't see bottom. Small - downstream edge by wall. Connectivity: dry from run above elbow to 1700, and above 1700 to 1780. Visibility/Clarity: murky, poor visibility Max/Avg Depth (cm): Max 100cm? hard to see. Algae cover (%): <5% Species: 50-100 gobies, mostly on west side of lagoon Observations: Jenny J's team sampling dog bacteria in lagoon.
13 Aug 2015	disconnected	Green but visibility to bottom. not connected, may have been some overwash. 3+ gobies seen, around 1". Didn't see until 20 cm deep (not in groups either). Gulls around 20. 4 Wood ducks. Lagoon receded to U/S edge of Arundo along West bank. Average depth lagoon: 30 south of bridge, max depth 80? Hard to see in deeper areas (under bridge). Algae 5 % South of bridge, >50 North of bridge. No gobies seen upstream (Elbow Pool). Elbow not connected to lagoon, or upstream
10 Sep 2015	disconnected	Light shade of green but visibility to bottom. Not connected, no clear evidence of overwash. No gobies seen this survey, but light rain that started affected visibility. Gulls around 5. Lagoon receded to U/S edge of Arundo along West bank. Average depth lagoon: 40cm south of bridge, max depth ~100 cm. Algae <5 % South of bridge (dried, floating near banks. No gobies seen upstream (Elbow Pool). Elbow not connected to lagoon, or upstream. Scum/pollen? on the surface of (elbow pool) covering ~80% of surface. Baby crayfish present, no algae. Max depth ~40 cm, Average depth 20 cm. Stagnant.
15 Sep 2015	disconnected	Rain event = 0.96" in Topanga. Water level increased, but lagoon did not breach.
08 Oct 2015	disconnected	Warm, (85), sunny. Low tide 2-4' swell. Lagoon closed. Lagoon not connected to Elbow pool or rest of creek. Visibility poor, Max/Avg Depth: 100/50cm, little to no algae cover. Some black anoxic sediments at center

		edge area.
29 Oct 2015	disconnected	Signs of overwash but no connection. Lots of seagulls.
02 Nov 2015	disconnected	Seining event, 100's of gobies. No connection.
03 Dec 2015	disconnected	Sunny/hazy, 70's, Disconnected, no evidence of overwash recently, though
		ponded water under bridge appears to have retreated (hence moist sand
		around it) downstream.
5 Jan 2016	Disconnected	Post rain monitoring. Almost connected - will probably connect with high
		tide or next storm. Topanga rainfall = 2.52"
5 Feb 2016	Disconnected	Some recent overwash visible. Lagoon seined
7 Mar 2016	Connected	2m wide channel, shallow connection due to low tide. Turbid water. Not
		actually flowing now, but will be better connected at high tide
6 April 2016	Disconnected	Low tide. Narrow channel (1.5m) connecting, but not passable. Not
1		connected upstream.
26 May 2016	Disconnected	Lots of trash, many birds
23 June 2016	Disconnected	SW swell picking up and a high tide which looked like it ovewashed leaving
		marine algae bundles in the lagoon. Berm still wet. No fish seen but 25 gulls.
20 Jul 2016	Disconnected	Elbow pool is full, but creek 100% disconnected from lagoon, no more flow
		to East as before. Lagoon disconnected from ocean, no overwash
16 Dec 2016	Disconnected	1.77-2.5 inches of rainfall, no connection or overwash
24 Dec 2016	Connected	Connected and flowing out. Thalweg center eastward 2-3 m wide. 5-20 cm
		deep. Berm 2-4'.
4 Jan – Oct	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for
2017		detailed accounts
27 Jan 2017	Connected	Connected and passable, lagoon seined, measured and mapped
23 Jun 2017	Disconnected	Lagoon seined measured and mapped
5 Oct 2017	Disconnected	Lagoon seined, measured, and mapped. Lagoon closed with no tidal
		influence. About 1500+ gobies caught near the beach on the W side.
9 Nov 2017-10	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for
Jan 2018		detailed accounts
10 Jan 2018	Connected	Breached! Not passable at the moment but could be at high tide. Lagoon
		drained, lots of seaweed, lots of gulls around the thaleweg. Tidewater gobies
		pulled in the seine. Water is very murky and brown Max depth 95cm,
		average about 45cm. Thalweg is a consistent 10cm deep with steady flow to
		the ocean. 6ft bank of sand on N side of water. Sand grading shows flow was
		much stronger/wider at one point, ~15cm at max, 2-3m currently
17 Jan-Mar	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for
2018		detailed accounts
N. 2010		Several storms connected the lagoon throughout the month. Storm related
Mar 2018	Connected	monitoring can be found in Appendix 1B.
April – May	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for
2018		detailed accounts

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"*connected" = connected but not passable

Water temperature

Continuously recording thermometers were deployed in the upstream end of Topanga Lagoon from July 2013 through November 2014, April through November in 2015, April through November 2016, and April through August in 2017. Table 1.10 compares the monthly minimum, average and maximum temperatures. Figure 1.18 summarizes continuous water and air temperatures during the study period. Figure 1.19 shows how the proportion of time at each temperature has shifted towards the higher temperatures since 2013 and this is reinforced by Figure 1.20 which documents the amount of time when water temperatures exceeded the critical thermal limit for steelhead.

Manth	2013			2014		2015			2016			2017			
Month	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
*Apr	ND	ND	ND	13.88	18.09	21.75	15.49	17.87	21.65	15.53	18.52	21.77	14.65	17.59	20.98
May	ND	ND	ND	15.34	20.23	24.53	15.56	18.47	21.60	15.25	20.14	24.63	18.65	20.81	22.87
June	ND	ND	ND	16.08	20.16	24.44	16.25	19.90	25.26	17.49	20.02	22.97	16.20	19.75	23.57
*July	*17.7 5	20.84	24.05	17.99	20.52	23.79	18.82	22.15	28.00	19.25	22.92	26.06	17.34	21.39	25.70
Aug	16.75	19.43	22.90	17.39	20.32	23.52	**19.1 0	21.76	26.13	18.22	21.30	23.81	21.15	23.57	23.57
Sep	15.32	19.51	23.35	16.63	22.01	26.01	18.89	22.86	26.13	16.89	20.33	22.82	ND	ND	ND
Oct	14.00	16.93	20.41	15.51	18.71	21.84	16.63	20.88	25.09	15.63	18.29	21.92	ND	ND	ND
*Nov	13.31	15.61	18.79	14.12	16.34	18.06	15.89	17.18	18.70	14.86	16.91	19.44	ND	ND	ND

 Table 1.11. Summary of Absolute Maximum, Absolute Minimum, and Average Water Temperatures for each monitoring month for 2013 through 2017 for Topanga Lagoon

*2013: July data includes 20 days; November data includes 30 days (full month). / *2014: April data includes 30 days (full month); November data includes 14 days. / *2015: April data includes 20 days; November data includes 2 days. **2015: Topanga Lagoon hobo out of water or near surface from 7/23-7/30/15 and 8/6/-8/14/2015.



Figure 1.6. Topanga Lagoon water temperatures for monitoring period April - November of 2013 to 2017



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Figure 1.20. Topanga Lagoon frequency distribution of temperatures recorded every 30 minutes from Jul 12-November 02, for 2013 through 2017. (The period selected is based on data availability for all years)



Figure 1.21. Occurrence of high temperatures and the number of hours greater than 23°C and 25°C recorded during the monitoring period for each year in Topanga Lagoon.

Description of summer-fall flow characteristics -

Reaches of Topanga Creek between 0.3-1.7 rkm remained dry throughout most of the study period. Between 2013 and 2016, additional creek segments either dried down or had such low flow that emergent vegetation was able to become established, further reducing depth and flow, altering runs into riffles, and riffles into merely damp areas (Dagit et al. 2017b). 2017 brought slightly above average rainfall that connected the entire reach during the wet season, but the reach between 0.2-1.7 rkm dried down again during the summer. Low flow persisted throughout the remainder of the year and into 2018, when minimal rain fell in the region. There is no flow data available for the storm events but the low flow observed throughout the creek only increased for short times associated with rain events. Data from these surveys is included in Appendix 1A. A summary of precipitation events for the Topanga rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

To date New Zealand mud snails (NZMS) were documented in a 200 meter reach (1.825-2.15 rkm) in Topanga Creek for several months in fall 2016, but have not been observed following the flushing flows of winter 2017. Red swamp crayfish (*Procambarius clarkii*), fathead minnows (*Pinnephales promelas*), and goldfish (*Carasseus avratus*) have been observed. Occasionally, red eared sliders (*Trachemys scripta elegans*) have also been removed.

Presence of other aquatic native species

In addition to *O. mykiss*, Topanga Creek supports two other native fishes: tidewater gobies (*Eucyclogobius newberryii*) and Arroyo chub (*Gila orcutti*) as well as over 20 species of native reptiles and amphibians. The riparian corridor that frames the channel consists of a mixture of sycamore, alder, willow, and coast live oak canopy as well as numerous understory native plants.

Potential restoration actions to address identified limiting factors

The Southern California Steelhead Recovery Plan (NMFS 2012) identifies the following threats for Topanga Creek: Roads, Urban Development (High Threat); Wildfires, Non-native species (Medium Threats). Additionally, the Topanga Lagoon and Creek Restoration Feasibility Study (Dagit and Webb 2002) and the Topanga Creek Watershed Management Plan (Dagit 2002) identify three main barriers within Topanga Creek: a) lagoon and Rodeo Grounds Berm; 2) Narrows, and, 3) landslides.

As in other parts of the Santa Monica Mountains, wildfire is a major concern. The Topanga Creek watershed is included in the Santa Monica Mountains Community Wildfire Protection Plan (2013), which although primarily focuses on risk reduction and protection of human communities, acknowledges the potential impacts to natural resources, especially creeks. Building upon this existing program to include monitoring, remediation and adaptive management focused on reducing potentially catastrophic effects to *O. mykiss* and their habitat and preserve natural ecosystem processes should be considered.

Non-native species introductions and spread occurred during the study period, highlighting the concern with this threat. Removal efforts targeting red swamp crayfish were initiated in 2012, and are on-going. The recent establishment of fathead minnows and gold fish is being addressed during annual electrofishing events, as well as with targeted removal when funding is available.

A more coordinated effort to control these invasive competitors has been developed and ready to implement pending funding availability.

CalTrout (2006) identified a two-part Keystone barrier, which was composed of the culvert bridge under PCH, coupled with the Rodeo Grounds Berm. The berm was removed in 2008, restoring connectivity to 1,000 meters of creek upstream of the lagoon. The plan for restoring Topanga Lagoon was initially stalled waiting for the certification of the Topanga Creek State Park General Plan (CDPR 2012). Since that time, the RCDSMM has been working with CDPR to identify and solicit funding to accomplish the next steps needed to move towards implementation of the PSR/PDS document prepared and approved by Caltrans in 2004. The proposed restoration calls for a wider span bridge and excavation of the fill materials from the area within the footprint of the historic lagoon, restoring as much of the lagoon footprint as possible.

The reach of creek known locally as the "Narrows" provides another major opportunity for improving both road safety and habitat for steelhead. Located on Topanga Canyon Blvd. between mile marker 2.02 and 2.5, this stretch of road has consistently collapsed during high flow events, requiring repeated repairs. It has been listed as a line item for funding under Measure R but next steps to get funding allocated have not yet occurred. Caltrans would like to build on the designs evaluated in the PSR/PDS document (2004) to develop the final project design and complete environmental documents. Grouted riprap on the west bank has severely constrained the channel in this location, further increasing flood hazard. At present, it has been undermined and portions of the riprap are hanging over two meters above the creek bed. This restoration could result in over 2,000 meters of habitat improvement, including improved spawning and rearing habitat areas and extending migration opportunities by restoring above surface flow.

The final potential restoration action identified for the anadromous reach of Topanga Creek includes stabilization of three large landslides that have occurred at bends on the west bank of Topanga Creek downstream of the bridge at mile marker 2.02 due to hardening of the bank with riprap to protect Topanga Canyon Blvd. It would be possible to restore the east banks using bioengineered stabilization methods, which would decrease excess sedimentation, restore channel capacity, and stabilize the landslides allowing for riparian vegetation restoration as well.

Trancas

Trancas Creek Watershed (10.2 square miles) is 49.4% parkland managed by NPS, 2.8% state parks, 0.9% local parks, and 49.6% scattered single-family residences and suburban development, with the Malibu Institute golf course (600 acres) at the headwaters. Trancas Creek extends approximately 6.5 miles from the ocean to a natural waterfall that is the limit of anadromy. The Trancas Market complex is located on the west bank of the lagoon north of PCH. A pocket sewage treatment plant located just north of the Trancas lagoon property, built in 1962, is operated by LA County and serves 237 homes. On the southwest side of PCH are the Broad Beach single-family residences. The southeast side of PCH is Zuma Beach operated by LA County Department of Beaches and Harbors. The keystone barriers in this creek include two concrete trapezoidal flood control channels located just upstream of the lagoon. A recently completed feasibility study (Dagit et al. 2015b) developed plans to restore passage through those culverts as well as to restore the lagoon. Given this current limitation, only 10% of the watershed is included in the project. The creek is accessible by parking on the Pacific Coast Highway at Zuma Beach on the south, and from several Backbone Trail parking areas along Encinal Canyon Road, Malibu, CA. NPS also provides access through their locked gate off Trancas Canyon Road.





O. mykiss population assessment

Although only anecdotal records are available, it appears that steelhead were caught in Trancas Creek between 1930-1980 (Dagit et al. 2005).

O. mykiss relative abundance, spatial distribution, and density

There were no *O. mykiss* individuals of any size class observed during any of the surveys. This creek was dry during most of the study period with few refugia pools in the upper watershed and a small lagoon remaining under the PCH bridge.

O. mykiss migration information

There were fewer than five days between 2013-2015 when the creek was connected to the ocean and had continuous flow; however, passage opportunities were primarily restricted to a few hours during high tides when flow depth across the beach berm was sufficient for fish to use. In 2016, the creek was connected to the ocean for a single day with no passage opportunity. In the 2017 water year, the creek was connected almost continuously from the end of December 2016 through mid April 2017 for a total of 110 days of connection to the ocean and 61 days with a passable connection. In 2018, several small stormed filled the lagoon to capacity until it finally breached on 22 March, 2018. A passable connection was maintained for only a short period of time (estimated <5 days) and a return visit on 2 April revealed the lagoon had decreased in volume significantly and the thalweg had dried.

O. mykiss spawning and rearing information

No spawning or redds were observed in Trancas Creek. Spawning gravel has not been mapped.

O. mykiss genetics within the Santa Monica Bay region

No genetic information was collected in Trancas Creek because *O. mykiss* was not observed to be present.

Lagoon utilization/condition and accessibility

Between September 2013 and November 2016 Trancas Lagoon was only connected to the ocean after a >3" rain event in December 2014 and again for a single day after a rain event in March 2016. However, even on these occasions passage was limited to high tide conditions as the outflow channel was generally shallow. Between December 2016 and October 2017, heavy rains filled the lagoon to capacity and a sustained breach occurred from 24 Dec-12 Jan 2017 and 19 Jan-18 Apr 2017. Passability was again influenced by high tide but it was not as dependent on high tide as the previous years. Overwash was intermittent and salinity ranged from 0-25 ppm. Wetted area was generally confined to the western section of the three bay pier culvert bridge under PCH where depth ranges from 40-100 cm in the scour pools by the bridge piers. The lagoon was regularly disconnected from the upper sections of the creek which dried down 100-200m upstream of the PCH bridge. A 3+ inch storm breached the lagoon in late March 2018 for 4 days. The rainy season ended after that leaving the lagoon closed for the remainder of the year. Table 1.11 summarizes all observations. Photos illustrating physical conditions are found in Appendix 1B.

Date	Lagoon	Notes			
18 Sept 2013	disconnected	Initial site visit to establish photo points			
07 Nov 2013	disconnected	took lagoon measurements. First seine pull:			
		50-100 Gambusia and muck			
		Second seine (under bridge):			
		50-100 Gambusia, 1 mussel, 1 snail			
		Third seine (top of bridge):			
		50-100 Gambusia, 1 mussel			
02 Mar 2014	*connected	Between 26 Feb to 2 Mar, nearby Lechuza Patrol station (LA County DPW WRD)			
		recorded 5.12" rain. Lagoon was connected at least at high tide and received wave			
		overwash.			
12 May 2014	disconnected	Hiked across the very dry channel downstream to the upper end of the lagoon			
		located at 34.00.883, 118.49.131. Wetted width about 1 meter and depth between			
		5-15 cm. Lots of gambusia jumping. Snowy egret perched eying them. Kildeer			
		nest nearby. Lagoon length = $94.7m$. Wetted width under the bridge = $\sim 20m$ filled			
		west bay only. Max depth = 80 cm average depth = 40 cm . Water quality at the			
		upstream end of the PCH bridge: Salinity: 25 ppt, DO: meter died, pH: 8.39,			
		conductivity: 2540 µS/cm, water temp:24oC, air temp: 36 oC			
08 Jul 2014	disconnected	No flow, closed. Avg depth ~40cm. Muck ~10cm, 50% algae. Air and water hobo			
		uploaded ok. Photos taken.			
20.4.2014	1 1				
29 Aug 2014	disconnected	Hurricane Marie brought high waves along much of the southern California coast			
		between 27-29 August. No breach			
		It was difficult to tell if overwash had occurred or not as the lagoon footprint			
		remained small and close to the PCH bridge and there was no evidence of a			
		that we gremanning. The sand berm at the mouth of the creek is elevated about 2-5			
		feet above the fagoon level and the beach scarp is fairly steep. The fagoon was full			
24 Oct 2014	discomposted	1 Snoury Egent Late of microfich			
12 Nov 2014	disconnected	I Showy Eglet, Lots of Inicionsh			
13 NOV 2014	disconnected	Evidence of groundwater incursion. Lagoon disconnected, water in standing pool			
02 Dec 2014	2	Overweeth fills ell three bridge sections although shallow to E			
12 Dec 2014	/ disconnected	Flooded us & ds bridge. Close to top of berm, but no overwesh			
12 Dec 2014	disconnected	Product us & ds offdge. Close to top of berni, but no overwash.			
10 Dec 2014	diagonnostad	Net composted, no mouth			
12 Jan 2015	disconnected	Not connected, no mouth			
05 Mar 2015	disconnected	20 meters from the bridge some culls present			
08 Apr 2015	discomposted	So meters from the orage, some guns present			
08 Apr 2015	disconnected	Last side of PCH: upstream appears to be snanow ponding; west side of PCH:			
24 Apr 2015	disconnected				
24 Apr 2015	disconnected	Water brown color only PMI obcoming califyingh not connected			
14 Iviay 2015	disconnected	water brown color, only Divir observed, salibush, not connected			
17 Jun 2015	disconnected	I male mailard, I female, 4 ducklings, I snowy egret. water extends 10m			
07 Jule 2015	dissorres etc. 1	downsureani of orige. Dudleya in bloom near Trancas parking lot.			
07 July 2015	disconnected	15 below bridge, 50 above. Scum on surface. Water tidbit uploaded UK. Added			
		whe to get closer to bottom. Need Air nobo. 50% ulva, gambusta. mom mallard			
12 4 2015		with 2 chicks. I showy egret.			
15 Aug 2015	disconnected	I rancas not connected, water under building only on Westermost section, middle			
		and east sections dry. Avg deput of citi, max depth / 5cm. no overwash. No algae.			
10 Sec 2015	dissorres etc. 1	Upioaded water fidbil ok.			
10 Sep 2015	disconnected	rancas not connected, water pooled bridge mostly on westermost section ~20			
1	1	T INCLETS DEVOLUTE THE INCLUE AND EAST SECTIONS TEMAIN UTV. AVY DEDITIOU CM.			

Table 1.12. Summary of lagoon conditions and accessibility for Trancas Creek

Task 1. Presence/Absence -	- SMB Steelhead	Monitoring 2013-2018
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		may depth 75cm. No evidence of overwash ~5% algae (bottom) water fairly		
		alger with block much on substrate Unleaded water bobs of removed old tidhit		
		wire to avoid confusion. May depth ~ 90 cm, average depth ~ 40 cm. Male mallard		
		whe to avoid confusion. Max deput ~90 cm, average deput ~40 cm. Male manard		
15.0 2015	1 1	seen, no outer spp. seen.		
15 Sep 2015	disconnected	Post-rain event closed, no overwash, no connection.		
29 Oct 2015	disconnected	Depths: max 100 cm avg 50cm. Seine performed. floating dead intestinalis,		
		mosquito fish, tube worms. Sandy substrate. Salinity 0 ppm		
03 Dec 2015	Disconnected	No evidence of overwash recently, although the ponded water under bridge		
		appears to have retreated (hence moist sand around it) downstream		
5 Jan 2016	Disconnected	Trancas lagoon is ponded 2/3 of the way to the mean high tide. Looks like some overwash.		
7 Mar 2016	Disconnected	Lagoon full, but ponded. Muddy. Not connected but may have breached/been		
		flowing earlier from the way the lagoon outlet is scoured		
4 Apr 2016	Disconnected	Lagoon not connected. Water pooled under bridge, not flowing. Quite turbid.		
1		Substrate soft with black muck under bridge		
26 May 2016	Disconnected	Lagoon Closed. Water pooled, shallow. Max/Avg depth 40/25cm		
22 Jun 2016	Disconnected	Lagoon dried out. 80 max/ 50 avg under bridge/ <5% zostera, sand bottom		
20 Jul 2016	Disconnected	Lagoon is closed, water does not extend d.s. bridge. No evidence of overwash.		
9 Sept 2016	Disconnected	Lagoon closed, no overwash. Only W side of bridge is wetted. About 5 5" fish		
1		(flatfish?) decomposing on bottom. Look like halibut, but too decomposed to		
		remove. Strange purple color at lagoon edge but fish (MQ) seen swimming.		
16 Dec 2016	Disconnected	wet bank to bank under bridge, berm still intact. No overwash. Not breached.		
24 Dec 2016	Connected	Breached and flowing out. Very shallow, <10cm max. Lagoon still pretty full.		
11 Jan – Oct	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for detailed		
2017		accounts		
27 Jan 2017	Connected	Measured lagoon, Seined, Lagoon; open (connected and passable)		
23 Jun 2017	Disconnected	Lagoon not connected but obvious signs of overwash with high tide About 80-		
20 0 000 2017	2100011100100	100cm deep Chunks of kelp on edges of lagoon Lagoon measured seined and		
		manned		
5 Oct 2017	Disconnected	Lagoon not connected Measured seined and manned Tons of mosquito fish		
9 Nov 2017 -	Disconnected	Monthly lagoon condition documentation conducted. See Annendix 1B for		
Mar 2018	Disconnected	detailed accounts		
22-26 March	Connected	Connected and passable! S side of berm is where the breach occurred. Thalweg is		
22-20 Wateri 2018	Connected	$3-5m$ wide and $20-23$ cm deen. Water is flowing fast and steady ~ 5 gulls at the		
2010		connection point feeding. Channel US of PCH is full within the established		
		channel not much overflow into adjacent wetland area		
April Mey	Disconnected	Monthly lagoon condition documentation conducted See Annendiy 1D for		
2018	Disconnected	detailed accounts		
2018	1			

*connected but not passable

Water temperature

Continuously recording thermometers were deployed in the lagoon, where they were tied to the center pier that was next to the deepest area on the downstream side of the bridge (water) and in the branches of a tree on the west bank (air) from May through August in 2014 (when both were stolen), and again tied to the bridge pier in April through November 2015 (no air temperatures measured due to high potential for theft). In 2016 and 2017, both the air and water temperature recorders were mounted to the bridge pier from April to November. The 2017 water logger was stolen in mid July, so there is a data gap until 22 August when another water logger was deployed. The maximum, minimum, and average monthly temperatures are summarized in Table 1.12. Lagoon water temperatures were highest in 2017 overall.

5 :40	Manah	2014			2015			2016			2017		
Site	Month	Min	Ave	Max									
Trancas - Water	*Apr	ND	ND	ND	14.34	17.08	21.58	14.03	15.59	17.15	12.68	18.78	24.41
	*May	16.73	18.95	20.72	13.81	18.07	22.78	14.58	16.73	18.75	16.46	20.80	24.34
	June	16.63	19.03	20.70	16.13	19.47	25.55	16.15	18.74	23.93	17.37	21.81	26.72
	July	19.79	20.48	21.22	17.80	20.74	25.40	19.41	21.22	24.34	20.10	24.72	29.72
	Aug	18.60	20.07	21.20	18.84	21.71	25.79	17.11	20.58	24.17	21.68	23.62	26.52
	Sep	**ND	ND	ND	18.82	22.17	25.28	15.72	19.42	24.15	18.30	22.42	27.58
	*Oct	ND	ND	ND	17.42	20.86	24.34	13.14	17.47	22.63	17.42	19.56	22.44
	Nov	ND											
Trancas - Air	*Apr	ND	ND	ND	ND	ND	ND	10.83	15.38	30.75	11.57	15.91	23.93
	*May	12.29	18.97	31.31	ND	ND	ND	11.39	16.62	27.58	11.71	16.03	20.75
	June	11.76	18.46	26.04	ND	ND	ND	13.69	18.35	23.71	14.19	18.34	21.89
	July	15.51	20.87	27.14	ND	ND	ND	15.80	20.25	24.46	15.37	20.56	25.55
	Aug	13.55	20.62	29.99	ND	ND	ND	13.38	19.75	25.74	17.49	21.00	25.87
	Sep	13.45	21.05	28.32	ND	ND	ND	14.29	20.06	32.18	14.79	20.48	28.15
	*Oct	13.59	20.00	30.98	ND	ND	ND	13.52	18.28	37.15	13.43	20.27	45.28
	Nov	ND	14.39	18.41	37.04								

 Table 1.13. Summary of Absolute Maximum, Absolute Minimum, and Average Temperatures for each monitoring month for 2014 -2017 for Trancas Lagoon

*2014: May data includes 20 days; August water data includes 7 days; November air data includes 13 days.

*2015: April water data includes 7 days; October water data includes 29 days (almost full month). No air data was collected for 2015.

**The Trancas tidbits were removed in 2014 due to dryness starting 8/7/14.

Figures 1.22 through 1.25 illustrate the changes in water temperature over time. As was observed in Las Flores and Topanga Creeks, the proportion of time when water temperatures were higher increased during 2015, as did the number of times water temperature exceeded 23 °C, the critical thermal limit for steelhead.





Figure 1.23. Trancas Lagoon water temperatures for the monitoring period from April through November of 2014-2017. Data for 2014 ends August 2014 due to dry up.



Figure 1.24. Trancas Lagoon air temperatures from April through November, 2014-2017. No air data was collected for 2015.





Figure 1.7. Trancas Lagoon frequency distribution of temperatures recorded every 30 minutes from May 12-August 07, for 2014-2017. (The period selected is based on data availability for all years)



Figure 1.26. Occurrence of high temperatures and the number of hours greater than 23°C and 25°C recorded during the monitoring period for each year in Trancas Lagoon.

Description of summer-fall flow characteristics

There was no summer-fall flow observed during the course of the study. The lagoon area was disconnected from the creek and filled by subsurface flow except during winter storm events. The creek was fully connected in February 2017, and a snorkel survey was completed from the ocean upstream to the limit of anadromy. A follow up survey conducted in October 2017 found that the creek had completely dried down from the lagoon to 4830m where the survey was concluded. Data from these surveys is included in Appendix 1B. A summary of precipitation events for the Lechuza rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

The only non-native aquatic species observed in the lagoon were mosquitofish (*Gambusia affinis*). Crayfish and New Zealand Mud Snails have been documented throughout the watershed (Kats et al. 2013). There are also scattered records of bullfrogs (*Rana catesbeiana*). A source population of these invasives, as well as largemouth bass, blue gill and other fishes found in a pond at the headwaters of the watershed located within the Malibu Institute Golf Course, is slated for removal in 2016 (L. Kats, pers. communication).

Presence of other aquatic native species

A single staghorn sculpin (*Leptocottus armatus*) was collected in a seine in 2003 (RCDSMM unpublished data) and another three staghorn sculpins (under 3cm) were collected in January and March, 2017. A few aquatic insects including water boatman (*Coxina punctata*) and water striders (*Gerridae sp.*) have also been observed. Other native aquatic species observed in the upper watershed (as reported by L. Kats) include CA newts (*Taricha torosa*), Western toad (*Anaxyrus borealis*), western pond turtles (*Actinemys marmorata*), and both Pacific tree frogs and CA tree frogs (*Pseudacris cadaverina*).

Potential restoration actions to address identified limiting factors

The most important potential restoration actions for Trancas Creek include restoring fish passage in the flood control channels identified as the Keystone barrier (CalTrout 2006), restoration of the lagoon, and removal of invasive species from the headwaters. Finally, the potential loss of habitat associated with wildfires is a major concern.

The keystone barrier is really composed of the lowermost two flood control channels separated by a section of natural creek that have a passage severity rating as red (CalTrout 2006). Recent hydrologic and hydraulic analysis (Dagit et al. 2015b) indicates that it would be possible to maintain flood capacity and restore a soft bottom natural channel if the channel walls were made vertical and slightly higher. Los Angeles County Department of Public Works has been working with the RCDSMM to develop a plan to further evaluate these possibilities and identify an implementation plan to restore passage.

Lagoon restoration is presently on hold until such time as a conservation easement for the property is conveyed to a public entity. NPS has been in negotiations with the landowner but no action has been accomplished to date. Caltrans will be replacing the bridge under PCH in the near future, and the plan is to extend the span of the bridge up to 250 feet to facilitate future lagoon restoration and incorporate mitigation for fish.

Zuma

Zuma Creek watershed (ten square miles) is 49.6% federal parkland, 0.6% state and 1.2% local parklands interspersed with 45.1% scattered single family residences, suburban development, orchid nurseries, and a commercial complex located north of PCH. The southeast side of PCH is Zuma Beach operated by LA County Department of Beaches and Harbors. Zuma Creek is adjacent to the road in the lower section but extends a total of 5.5 miles to the waterfall that is the natural limit of anadromy. Zuma Creek is accessible by parking either on Westward Beach Road near the lagoon, or in the Los Angeles County Beaches and Harbors Parking lot off Pacific Coast Highway. The north end of the creek is accessible via the NPS trailhead parking lot at Newton Canyon, located on Kanan-Dume Road approximately five miles north of Pacific Coast Highway, Malibu, CA.



Figure 1.27. Zuma Creek Watershed. USGS 7.5 minute QUAD Pt. Dume ocean/creek mouth: 34.0141°, -118.8213° / limit of anadromy: 34.0792°, -118.8223°

O. mykiss population assessment

Anecdotal records of steelhead presence in Zuma Creek up until the 1980's have been compiled in Dagit et al. (2005).

O. mykiss relative abundance, spatial distribution, and density

There were no *O. mykiss* individuals of any size class observed during any of the surveys. This creek was dry during most of the study period.

O. mykiss migration information

There were no migration opportunities between 2013-2016 as the creek was not connected to the ocean at any point in time during these years. In 2017, the lagoon was connected to the ocean for 41 days, from 20 January - 1 March 2017. The wide beach berm at the mouth of Zuma Creek presents a significant barrier for connection. During the breach in 2017, there were 39 days of passable connection aided by high tide. No breach occurred in 2018. Another passage barrier presents itself at the upstream end of the lagoon, where an Arizona crossing cuts through the creek and created an approximately 5m wide area of sheet flow throughout the entire breach period. Upstream connectivity is further disrupted due to numerous instream concrete crossings and culverts.

O. mykiss spawning and rearing information

No spawning or redds were observed in Zuma Creek. Spawning gravel has not been mapped.

O. mykiss genetics within the Santa Monica Bay region

No genetic information was collected in Zuma Creek because O. mykiss was not observed.

Lagoon utilization/condition and accessibility

Zuma Lagoon has fish passage constrictions on the beach side due to the approximately 200meter-wide beach berm separating the ocean from the lagoon, and upstream with a series of 17 instream road crossings (Kelley et al. 2013). From 2013-2016, the lagoon was shallow (less than 30 cm) and bordered on both east and west sides by dense tule beds. The lagoon filled to capacity during the rainy season of 2017, breaching and flushing out sediment that had built up in the lagoon basin. Depth increased to average over 115cm. Dense tule beds remained intact on the side borders of the lagoon. A summary of lagoon conditions is found in Table 1.13. Photos illustrating physical conditions are found in Appendix 1B.

Date	Lagoon	Notes				
18 Sept 2013	disconnected	Initial site visit to establish photo points. Has NZMS!				
07 Nov 2013	disconnected	Seine 1: Sandy bottom, 0 fish, 20+ water boatman				
		Seine 2: Cobble/sand, 100-500+ gambusia, 100+ water boatman				
		Seine 3: 50 gambusia, 100+ water boatman				
02 Mar 2014	disconnected	Between 26 Feb to 2 Mar, nearby Lechuza Patrol station (LA County DPW WRD)				
		recorded 5.12" rain. No water downstream of photopoint Arizona crossing,				
		upstream area is damp, but no pool. Lagoon connected at some point with wave				
		overwash or flow from salinity measurements. There was evidence of breach on the				
		east side of the lagoon				
12 May 2014	disconnected	No H2O, lagoon shrunk! Tules brown and dead.				
08 Jul 2014	disconnected	Still shrinking.				
24 Oct 2014	disconnected	8 mallards, 9 coots, 9 gulls, lots of microfish				

Table 1.14. Summary of lagoon conditions and accessibility for Zuma Creek

03 Dec 2014	disconnected	No overwash, berm is very wide to ocean			
12 Dec 2014	disconnected	Disconnected, no flow or overwash. No change.			
16 Dec 2014	disconnected	Disconnected. No flow in creek at AZ crossing.			
12 Jan 2015	disconnected	Disconnected with wide berm, no overwash, no flow. No water at AZ crossing.			
03 Mar 2015	disconnected	lagoon has some water, pool about 10-12 meters wide, some mallards present, P.			
		regilla calling in vegetation, lots of vegetation in lagoon			
08 Apr 2015	disconnected	tamarisk & pampas @ NW edge; small 10x15 ponded water @ lagoon edge			
24 Apr 2015	disconnected	very little water- tidbit not deployed. many fence lizards. not connected			
14 May 2015	disconnected	Not connected, lagoon pool ~ 15 ft wide, lots of gulls and 2 mallards			
17 Jun 2015	disconnected	Not connected, lagoon very shallow. ~20 gulls and 4 crows.			
07 July 2015	disconnected	Not connected, DRY. no photos, could not park!			
13 Aug 2015	disconnected	Water present: surface algae present near banks. No sign of fish or tadpoles. Water			
		not connected.			
10 Sep 2015	disconnected	Dry U/S and D/S. Zuma lagoon, not connected. Water present: dead surface algae			
		present near banks (~10%). Fish (~100 individuals) seen between 1-2" long. Fish			
		were transparent, with single black patch (round) along sides (some appeared to			
		have black horizontal lateral line). Abundance of bird tracks seen.			
15 Sep 2015	disconnected	closed but water ponded. Lots of dead tules. No evidence of flow over AZ crossing.			
		No surface flow in creek up or downstream.			
29 Oct 2015	disconnected	No connectivity to lagoon. Overwash close. Seagulls bathing in the water. About			
5.1. 2016		5% dead floating algae			
5 Jan 2016	Disconnected	Arizona crossing creek channel dry - did not connect to lagoon. Lagoon is not			
		connected.			
7 Mar 2016	Disconnected	Totally disconnected. AZ crossing dry. Lagoon a small shallow pond			
5 Aug 2016	Disconnected	Road Crossing Dry. Barely any lagoon remaining			
18 Oct 2016	Disconnected	Some water but not much at beach end. Wave surge almost over crest.			
16 Dec 2016	Disconnected	Instream crossing creek dry. No overwash, lagoon continues to shrink			
24 Dec 2016	Disconnected	Dry at crossing and Lagoon. No breach			
11 Jan – Oct	Variable	Weekly lagoon condition documentation conducted. See Appendix 1B for detailed			
2017		accounts			
27 Jan 2017	Connected	Connected and passable, lagoon measured, mapped and seined			
23 Jun 2017	Disconnected	Potential overwash. Lagoon measured, mapped and seined			
5 Oct 2017	Disconnected				
		Lagoon disconnected. Measured, seined, and mapped. Track marked cut into			
		eastern edge by vector control. Center of lagoon too deep to seine but edges were			
		seined. Lots of gambusia, no water boatman.			
9 Nov 2017-	Disconnected	Monthly lagoon condition documentation conducted. See Appendix 1B for detailed			

Task 1. Presence/Absence - SMB Steelhead Monitoring 2013-2018

Water temperature

It was not possible to deploy continuously recording thermometers in the lagoon due to lack of water depth from 2013 to 2016. While there was adequate depth in 2017, we were not able to identify a location to secure a tidbit that would protect it from theft or being washed away.

Description of summer-fall flow characteristics

During our study period, there was no surface flow in Zuma Creek and even the upper watershed refugia pools dried down substantially. Data from these surveys is included in Appendix 1A. A summary of precipitation events for the Lechuza rain station managed by Los Angeles County Department of Public Works is found in Appendix 1C.

Presence and extent of non-native aquatic species

To date, several invasive aquatic species have been detected by NPS in Zuma Creek including bullfrogs (*Rana catesbeiana*) and New Zealand Mud Snail. A variety of non-native plant species are also found throughout the watershed.

Presence of other aquatic native species

No native aquatic species were observed in the lagoon during the study period, but Zuma Creek is known to support a variety of native amphibians and reptiles, including a small relic population of western pond turtles (Dagit et al. 2009). Other native aquatic species observed by NPS in the upper watershed include CA newts (*Taricha torosa*), Western toad (*Anaxyrus borealis*) and both Pacific tree frogs (*Pseudacris regilla*) and CA tree frogs (*Pseudacris cadaverina*). A restoration of lagoon and wetland habitat occurred in 2002 resulting in a dense growth of tules (*Schoenoplectus acutus*) which dominates the area (Tizler and Sagar 2010).

Potential restoration actions to address identified limiting factors

The challenges to removing fish passage barriers in Zuma Creek is substantial, but the lagoon itself could potentially support both fish passage and limited rearing time based on its size and recently restored native wetlands. However, during the study period, lagoon function had been compromised by the extreme drought. Zuma Beach is managed by the Los Angeles County Department of Beaches and Harbors, who also jointly manage the lagoon with NPS. The county grooms the beach to maintain vehicle access. The lagoon is approximately 200 meters from the mean high tide line, requiring significant storm events to develop a connection to the ocean.

Historically, Zuma lagoon extended upstream as far as the current PCH bridge, was substantially larger than it is today, and as recently as the 1990's had a narrower beach berm separating the lagoon from the ocean. Restoration initiated by NPS in 1999 has restored much of the transitional and upland habitat on the eastern bank of the lagoon, but due to development constraints it was not possible to expand the footprint of the lagoon itself.

Analysis of the barriers in Zuma was initiated by CalTrout (2006) and followed up with a more detailed study done by Northwest Hydrological Consultants (2013), which evaluated possible removal of an instream road crossing at the upstream end of the lagoon and replacement with a bridge.

CalTrout (2006) also identified the keystone barrier as the combination of the instream road crossing and the upstream channel confinement under the three span culvert style PCH bridge. The site is aggrading with sediment associated with maintenance of the beach access road under the bridge. Prior to 2005, when sediment accumulated on the road surface during creek flows, it was shoved to the closest location in the adjacent channel under the middle bridge span creating a small levee. This practice was discontinued subsequently. The simplest approach could be to excavate out the accumulated sediment and place it on the sand on the nearby beach where it would have been deposited anyway by natural streamflow. Annual or less frequent dredging or excavation of the channel, while usually not the environmentally superior option, could remedy the sediment accumulation and allow the creek to reclaim the original channel under the middle and left span of the bridge.

Additional upstream barrier assessment done by Kelley et al. (2013) found 17 anthropogenic barriers, 16 of which were located within the lower 1.1 miles of the creek. The barriers are mostly privately owned low water crossings, and many of the property owners were not interested in making any changes unless required to do so by the City of Malibu or other entity. The creek channel is impacted by development along both banks and overall stream habitat is poor in this reach. In addition to removal of the barriers and replacement with bridges, extensive riparian and channel restoration were also identified as necessary. The majority of the central and upper watershed area is located within NPS management, with one obsolete dam located on public lands at the upper end of the watershed.

SUMMARY

Between 2013 and May 2018, status monitoring designed to document annual anadromous run size in each creek including presence/absence monitoring, stream conditions, storm event monitoring, and fish passage opportunities were conducted at Big Sycamore, Las Flores, Solstice, Topanga, Trancas, and Zuma Creeks, within the Santa Monica Mountains Distinct Population Segment region to attempt to characterize the status of the entire population.

No steelhead were observed in any of the lagoons. Two anadromous adults were found along with resident *O. mykiss* upstream in Topanga Creek in 2017.

During the study, extreme drought conditions eliminated continuous surface flows, and significantly reduced the number and condition of refugia pools. Big Sycamore Creek was additionally impacted by sedimentation from the Springs Fire in May 2013. Small, isolated refugia pools were noted in the upper reaches of Solstice, Trancas, and Zuma Creeks, but no refugia pools survived in either Big Sycamore or Las Flores Creek. Topanga Creek refugia pools were reduced in volume, and portions of the creek were rendered impassable for fish due to encroachment of emergent vegetation. Overall, creek habitat was extremely limited throughout the study region.

Water temperatures were monitored at least some years in all lagoons except for Zuma. Water temperatures increased between 2013 and 2017, achieving levels associated with summer thermal stress for steelhead (>23 °C). The potential for steelhead to use any of these remaining lagoons for summer smolt rearing was limited, and would be quite challenging. Even after a slightly above average water year in 2017, lagoons quickly became disconnected from upstream habitat preventing any movement.

Storm event and fish passage monitoring found extremely limited migration opportunities (<10 days per creek) between 2013 and 2016. Surface flows throughout the creeks were too low to create a connection to the ocean. Fish passage opportunities in 2017 were slightly improved with a range of passable days between 5-35 days across the creeks in this study. Passage at the ocean was restricted due to high tide at times and as the 2017 storms ended, upstream creek passage was restricted due to dry down despite the lagoons retaining water through the rest of the year. Little rain in 2018 provided few passage opportunities and little upstream connectivity.

Due to these conditions, it was not possible to determine what kind of dispersal of *O. mykiss* might be possible should precipitation and surface flows become more favorable.

Finally, as has been observed elsewhere, the impacts of post-wildfire sedimentation on steelhead habitat can be quite severe. None of the refugia pools in Big Sycamore Creek had water due to the combination of drought and sediment accumulation, even after the 2017 water year.

This five-year window documenting conditions within the Santa Monica Bay illustrates the extreme variability of the habitat availability for steelhead in the southern California coastal zone. Good planning requires the most complete information possible. At minimum, a long-term (i.e.

15-20 year), data set will be needed to provide reliable information upon which to base recovery and management decisions throughout southern California.

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