Comprehensive Lifecycle Monitoring of *Oncorhynchus mykiss* in Topanga Creek, California

FINAL REPORT 2008-2018

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EXECUTIVE SUMMARY

In this report, we provide cumulative results from over 10 years of intensive study of both anadromous and resident life history forms of *Oncorhynchus mykiss* in Topanga Creek. In addition, we provide a refined conceptual model for Topanga Creek *O. mykiss* that describes a species adapted to conditions at the southern extent of their range. To address critical uncertainties about the life history of Southern California steelhead in Topanga Creek we augmented our previous habitat characteristic mapping, snorkel surveys, temperature monitoring and migration trapping efforts by initiating a program to capture, tag and monitor growth of individual *O. mykiss* beginning in fall 2008. This report represents the summary of all data directed through a series of Fisheries Restoration Grants to the RCD of the Santa Monica Mountains between 2008 and 2018.

To address the needs identified by the Coastal Monitoring Program (CMP: Adams et al. 2011), we summarize all lifecycle monitoring efforts, as well as assessments of population abundance, distribution, habitat characteristics, temperature constraints, and passage opportunities for the duration of the study period (Dagit and Reagan 2006, Dagit et al. 2007, Dagit et al. 2009, Stillwater Sciences et al. 2010, Bell et al. 2011, Dagit and Krug 2011, Krug et al. 2014, Dagit et al. 2015a, 2015b, Dagit et al. 2016).

The goal of the CMP is to provide a statistically robust framework to characterize the abundance, productivity, diversity, and spatial distribution of salmon and steelhead. These parameters are used to help assess the viability of a population. The CMP recommends identification of a geographic sample framework and generation of a rotating panel of randomly selected study reaches that are systematically sampled over time. However, with only three reaches totaling 6.0 river kilometers (RKM), it is feasible and in fact desirable, to census the entire study area each year, which is how we have approached this effort to date.

Since 2012 and for the duration of this specific grant study period (2014 - 2016), the creek has suffered from extreme drought, reducing connectivity within the creek and to the ocean to fewer than five days per year, with ocean connectivity further restricted primarily to hours of high tide conditions. Even with a DIDSON camera deployed to improve detections since 2012, rain events have been so few that there has been extremely limited opportunity to deploy the camera and no opportunities to deploy the weir traps. This resulted in limited opportunity for *O. mykiss* in Topanga to express any life history pattern other than resident.

Electrofishing events in fall 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 and 2017 and spring 2011, 2012, and 2013 resulted in the capture of 1,687 *O. mykiss*. All fish were measured, scale samples were collected to determine age, tissue samples were collected for genetic analysis, and fish were tagged with either a full duplex tag (n=61, 110-125 mm fork length [FL], 2008-2010), a small half duplex tag (n=248, 110-125 mm FL, 2010-2017) or a large half duplex tag (n=618, >125 mm FL, 2008-2017) for mark-recapture studies. Antennas capable of detecting half duplex tags were constructed in lower Topanga Creek in each fall 2008-2018 to monitor outmigration and possible return of tagged individuals and to augment migrant trapping efforts.

Observations of adult anadromous *O. mykiss* were few, despite increasing effort to detect escapement using a DIDSON camera. Based on analysis of PIT tag mark and recapture data using Program MARK, the total population of juvenile and resident *O. mykiss* in Topanga Creek ranged from a low of approximately 41 (95% CI 34 to 82) in November 2016, to a high of 574 (95% CI 365 to 944) in March 2011. Abundance estimates from snorkel surveys range from 20% above to 733% below electrofishing captures (average of 229% below), indicating that estimates of relative abundance from snorkel surveys are far fewer than true abundance. Despite this, snorkel surveys provide a relatively inexpensive, non-invasive method of tracking population trends over time. Snorkel surveys show seasonal fluctuations in

size classes and annual fluctuations due to variable spawning success and immigration of anadromous adults, and observations are summarized in Dagit et al. (2015b). This variability reflects the wide range of young-of-the-year observed, with only 11 observed in the extremely wet year of 2005, and a peak of 590 observed in 2008, when anadromous adult spawning was suspected, down to 92 in 2013, 33 in 2014, 112 in 2015, 17 in 2016 during an extended drought, then 132 in 2017 after anadromous adults entered the system and successfully spawned.

Viable Salmonid Population Metrics

Abundance:

The number of anadromous adults observed passing into Topanga Creek was one in March 2011 and two more in 2017.

The number of smolts outmigrating was limited by low flow conditions associated with the drought, but between 2008 and 2018 a total of 50 individuals were caught moving downstream to the ocean in the weir trap, three were detected by the DIDSON camera and 52 were detected by the instream antenna.

None of the 940 tagged individuals were detected by the array or camera upon their return from the ocean as an anadromous adult, so it is not possible to evaluate marine survival. Based on recaptures within the creek, individuals are able to survive for at least four years.

With few redds observed and small numbers of young of the year, we based our population estimate on analysis of PIT tag, amount of stream habitat available which varied due to drought, and recapture data using Program MARK. The total population of resident *O. mykiss* in Topanga Creek ranged from a low of approximately 41 (95% CI 34 to 82) in November 2016, to a high of 574 (95% CI 365 to 944) in March 2011. Relative abundance estimates from snorkel surveys was consistently below electrofishing population estimates, indicating that estimates of abundance from snorkel surveys are well below the actual abundance.

Productivity:

All size classes (70 - >300mm fork length) of *O. mykiss* were observed in Topanga Creek but young of the year numbers are low. Survival estimates are lower during summer than winter, especially for adult *O. mykiss*. It appears that for the total population, November to March (winter) survival is relatively high, at over 60%. Lower abundances during this period could be a result of emigration of smolts, and/or actual mortality, depending on the flow conditions. Survival from March to November (summer) at nearly 30% is much lower than for the winter period.

Diversity:

Due to environmental constraints, life history strategies appear to be limited to freshwater residency at this time. Technical difficulties associated with deploying detection equipment during high flows appeared to miss entry of two anadromous adults in the winter of 2017. An updated comprehensive genetic analysis of samples collected in Topanga, Malibu and Arroyo Sequit Creeks from 2002 through 2018, suggested low genetic similarity to nearby hatchery strains. Samples were also found to be distinct from other recently identified southern California strains (Abadia-Cardoso et al. 2016). Levels of genetic diversity, or heterozygosity, in Topanga Creek were comparable to those found amongst all native southern California populations, and was even more elevated within Malibu Creek (the sample size of Arroyo Sequit Creek was too small to perform this analysis reliably). Additionally, despite limited immigration and emigration opportunities due to low water conditions since 2012, the anadromous alleles at both migration-associated Omy5 loci remain fairly frequent within the Topanga Creek population (> 50%).

The apparently distinct genetic identity of Topanga Creek could be explained by a combination of small population size, for which genetic drift can be a powerful force for differentiation, as well as mating with other populations, including hatchery strains, ultimately leading to introgression. However, these results do not exclude the possibility that the Topanga population is derived from some un-sampled population or hatchery strain. Nonetheless, the small effective population size of Topanga Creek and the potential role of this population in maintaining genetic variation and diversity throughout the Southern California region, emphasizes the need to preserve *O. mykiss* within Topanga Creek.

Spatial Distribution:

Current occupancy extends throughout the entire wetted reach from the ocean to the natural upper limit of anadromy at 5.3 RKM. Adult *O. mykiss* and density are positively associated with both average and maximum pool depths, and thus are more abundant in the higher gradient, stable step pools found throughout the upper reach (3.6-5.3 RKM). Juvenile *O. mykiss* are negatively associated with both average and maximum pool depths.

Spawning habitat, summer habitat and winter habitat are all decreasing due to the drought and may become limiting factors (Dagit et al. 2017). Drift net and benthic macroinvertebrate sampling indicate a change in BMI abundance and composition, moving from Baetid dominant to Chironomid dominant (Montgomery et al. 2015). Red swamp crayfish, fathead minnows, and an unidentified “gold” chub are the only aquatic invasive species currently found in Topanga Creek.

Additional hypotheses include:

- Topanga Creek supports a resident population of *O. mykiss*, which is genetically distinct from both other southern steelhead populations and from local hatchery trout strains.
- Topanga Creek steelhead are periodically influenced by anadromous spawners, but generally limited by few resident spawners, resulting in a diverse genetic ancestry combined with small population size.
- The ability of the *O. mykiss* population to express an anadromous life history is strongly related to instream flows and migration opportunities.
- Production from resident *O. mykiss* allows the population to persist in Topanga Creek during years when no anadromous spawning occurs.
- Spawning gravel quantity and quality are becoming limiting factors affecting *O. mykiss* abundance as continued drought supports increased in-channel vegetation growth.
- Summer habitat was not initially a limiting factor, but since onset of the drought in 2012 capacity appears to be a limitation for *O. mykiss* production from Topanga Creek.
- Winter habitat may also be limiting *O. mykiss* production from Topanga Creek, as drought conditions have severely limited connectivity with the ocean and potential for anadromous adults to access the creek.
- Topanga Lagoon conditions are poor and do not support potentially advantageous growth and rearing opportunities for *O. mykiss*.
- Invasive red swamp crayfish (*Procambarus clarkii*) appear to have direct (predation) and indirect (food availability) effects on *O. mykiss* in Topanga Creek.
- It appears that for the total population, November to March survival is relatively high, at over 60%. Mortality during this period could include emigration of smolts, or actual mortality. Survival from March to November (summer) is much lower than for the winter period at nearly 30%, which could reflect mortality during the summer high water temperature period.

Management Recommendations

The above hypotheses and resiliency characteristics lead to the following management recommendations:

- Protect both anadromous (when present) and resident life histories of *O. mykiss* in Topanga Creek.
- Restore Topanga Lagoon to improve passage opportunities and support smolt growth.
- Protect and enhance instream habitat complexity.
- Protect Topanga Creek from anthropogenic sources of sediment.
- Protect Topanga Creek from invasion of non-native species, and continue removal of red swamp crayfish.
- Protect the relatively undisturbed riparian zone and flow regime in Topanga Creek.
- Develop a contingency plan for supporting and maintaining remaining resident fish should drought conditions result in loss of refugia habitat.
- Develop a genetic banking conservation plan to preserve genetic diversity for the future.

Recovery plan implications

The information obtained for this lifecycle study directly contributes to two important research questions outlined in the *Southern California Steelhead Recovery Plan* (NMFS 2012): 1) which ecological conditions favor particular life-history forms?; and 2) which ecological conditions promote and prompt plasticity in life-history trajectories, and to what extent does such plasticity stabilize the anadromous DPS?

Our data suggest that limited ocean connectivity, perennial instream flows, and intact riparian habitat are ecological conditions that favor the long-term persistence of resident life-history; however this is subject to reduced quality due to the drought. Impacts to *O. mykiss* from chronically warm water temperatures in southern California can be ameliorated by high food availability, which is related to both instream flows and allochthonous input from a healthy riparian ecosystem. Our data suggest that critical ecological conditions to support the anadromous life history form of adult and smolt fish migration opportunities is missing due to restricted sandbar breaching and drought reduced instream flows. In addition, freshwater habitat conditions that ameliorate high water temperatures and that are also critical for anadromous juveniles to grow to sufficient sizes to smolt and survive the marine environment may be affected by the drought.

During multiple years that anadromous *O. mykiss* do not have access to Topanga Creek the overall population persists because of resident production. However, given the proper passage conditions, our data indicates that there is outmigration of smolts, such as was observed in March 2011. Observations indicate that the more accessible Malibu Creek and lagoon is where a few anadromous adults are more consistently found at this time. After *O. mykiss* were extirpated from Topanga Creek in the 1980s, it was the eventual migration of adult anadromous steelhead, mingling with escaped hatchery trout that provided for recolonization (Bell et al. 2011, Krug et al. 2014). We believe the overall implication for recovery of the DPS is protecting and enhancing both resident and anadromous life histories, and removing obstacles to upstream and downstream migration opportunities. The restoration of Topanga Lagoon is critical to this effort.

The Biological Recovery Criteria presented in the Recovery Plan identifies passage restraints, urban development, wildfires, roads and groundwater extraction as primary limitations for *O. mykiss* recovery. Topanga Creek is fortunate in that many of these identified threats are of limited impact. There is no groundwater extraction, and most importantly, only 8% impervious surface throughout the watershed, contributing to a mostly natural hydrologic regime. Urban development is concentrated in the upper watershed and private ownership is less than 1/3 of the entire watershed, the rest of which is public open space. Wildfires, however, are a constant potential threat, and roads and bridges contribute to habitat limitations.

The most critical factor that sets Topanga Creek apart from others in the Santa Monica Bay is that water quality (nutrient levels, turbidity, pH, conductivity and temperature) remains suitable to support *O. mykiss* along with many other sensitive aquatic species (Dagit et al. 2014). Sediment movements are entrained as slugs that move through Topanga Creek during rain events, however that process has been altered with the lack of flushing flows during the drought. Maintaining suitable water quality and quantity are critical to the continued survival of the population in Topanga Creek.

Barriers remaining in Topanga include the poor quality of habitat in Topanga Lagoon, the hydrologic restrictions of the Pacific Coast Highway Bridge that constrains the lagoon, and a few upstream natural low flow barriers. A restoration plan for Topanga Lagoon has been included within the Topanga State Park General Plan (CDPR 2012). Although several natural boulder barriers were deemed unpassable when evaluated by the CDFG Fish Passage program (CalTrout 2006), we had sufficient stream recharge and high flows associated with several storms in winter 2010 that allowed at least two adults to migrate upstream of these. However, since 2012, low flows have constrained movement and resulted in loss of riffle habitat, which is important to support both spawning and rearing. Continued monitoring efforts, as well as implementation of identified restoration actions, are needed.

Recommendations for future study

To continue to address critical uncertainties in the population dynamics of the Topanga Creek *O. mykiss* population we recommend the following studies:

- Continue monitoring Viable Salmonid Population metrics in Topanga Creek.
- Develop a study design for focused drought monitoring to examine response variables between drought and non-drought years.
- Further assess the impacts of red swamp crayfish and other invasive species on *O. mykiss*.
- Monitor the seasonal and annual variation in food availability compared to crayfish abundance and rainfall.
- Further investigate potential causes of seasonal and annual growth patterns (e.g., food availability, rainfall, density).
- Regular and intensive sampling of the lagoon to determine residency and growth prior to smolting.
- Installation of an instream antenna array in Malibu Creek to check for tagged immigrating anadromous adults from Topanga Creek.

Original Study Objectives

Of the original objectives outlined for this study starting in 2008, some have been directly addressed, and others still require continued study. A summary of the status of our knowledge relative to our original objectives for this study, which were stated as questions, is as follows:

1) Do smolts from Topanga Creek return to their natal creek to spawn or return to other regional watersheds?

Not certain at this time. A total of 1,687 *O. mykiss* were captured and 940 were PIT tagged since 2008. Returning adults have not yet been detected by the instream antenna, DIDSON camera or in migration traps in Topanga Creek. Passage opportunities have been extremely limited since 2012 (with fewer than five days per year in 2014-2016). A single anadromous adult was observed in Topanga in 2011 with two more observed in 2017. An additional anadromous adult was relocated from Arroyo Sequit to Topanga Creek in November 2017 due to drought conditions. It has not been possible to identify if tagged Topanga fish are immigrating elsewhere, such as other nearby watersheds (e.g., Malibu Creek).

2) What is the length of ocean residency?
Not certain at this time. See objective #1.

3) What is the carrying capacity of critical habitat (e.g., summer thermal refugia pools) for different steelhead age classes in Topanga Creek?
Despite continued drought conditions reducing available habitat and becoming generally stressful, Topanga Creek continues to support an *O. mykiss* population. Summer conditions appear most limiting to all life stages of the population. Drought has reduced the available habitat as the creek flows subsurface during the spring and summer months, contracting from 1.7 RKM to 2.0 RKM. This situation needs continued monitoring.

4) Can juveniles be recruited into the population within these pools, or must they move to find other habitat within the creek that is perhaps less suitable?
Juveniles can be recruited into the population within pools. Based on fish distribution analysis (Section 3.4), it appears that large (> 250 mm) *O. mykiss* are positively correlated with deep pool habitat, while juvenile (<250 mm) *O. mykiss* are negatively correlated with deep pool habitat. In addition, the presence of large *O. mykiss* is correlated with fewer juvenile *O. mykiss*. Overall, it appears that resident large *O. mykiss* are using the larger pools, and juveniles may be displaced to other, more shallow, areas of the stream in the presence of these adults. In general, habitat for juveniles remains abundant, due to low abundance of adult, and abundant shallow pool habitat.

5) What is the relative proportion of residency compared to anadromy in the population?
Both resident and anadromous life histories occur in Topanga Creek and help support the long-term viability of the population. Genetic analysis (Appendix F) has determined that genetic diversity in Topanga Creek appears to be distinct, based on 822 tissue samples. Of these, only 38 were classified as primarily hatchery ancestry, an additional 23 had minor hatchery strains, and the other 761 were of wild steelhead ancestry. Based on phylogeographic clustering, the population in Topanga Creek is genetically distinct. This appears to be a result of a very limited number of founders contributing to the ancestry of the Topanga Creek population, suggesting that the population only occasionally receives new genes from straying by anadromous adults. Thus, resident *O. mykiss* are key to maintaining this population.

6) What are the size and/or age of smolts leaving Topanga Creek?
Smolts captured in outmigrant traps or detected moving downstream by the antenna/DIDSON camera between 2008 -2013 were between age 0+ and 3+, most of which were 1+ or 2+, and in general smolts were larger than 170 mm fork length (FL). Smolts detected in early January were relatively larger (150-325 mm FL), whereas smolts outmigrating in late January were relatively small (100-150 mm FL), and those detected from February through April were generally larger than 170 mm FL. No smolts were detected in 2014-2017.

7) How many smolts outmigrate and under what flow conditions?
Overall, relatively few smolts have been observed leaving Topanga since 2008 (n=50 traps, n=52 antenna), and none were observed in 2014-2018. Between 2008and 2018, a total of 50 smolts were captured in either the downstream fyke net or the downstream weir, and 31 smolts were detected moving downstream by the instream antenna. A total of 41 fish were detected by the antenna in March 2011, however only one antenna was functional at that time because of a storm event. Since that time, it has not

been possible to set the weir traps, and no fish have been detected outmigrating by the antenna or by the DIDSON camera.

8) How are the fish, both juveniles and adults using the available habitat in Topanga Creek?
Fish are using the majority of available habitats within Topanga Creek. In general, adult *O. mykiss* are positively correlated with maximum pool depth and juveniles are negatively correlated with maximum pool depth. Both age classes are similarly correlated with average depth, instream cover, and canopy cover. Adults are more abundant in the higher gradient upstream reach having more stable large pools.

9) What are the seasonal and age specific growth patterns?
Growth appears highest for age 0+ and age 1+ fish, averaging 26 mm between November and January, and appears to decline for fish after age 2+. Mean growth rate 2014-2018 has not changed significantly as compared to 2009-2013. Overall, fish are rarely observed greater than 300 mm. In general, it appears that growth is occurring year-round, with potentially higher growth rates in in winter (November – March) than during spring – summer (March – November).

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1 INTRODUCTION

1.1 Background

Steelhead (*Oncorhynchus mykiss)* residing in Topanga Creek were identified as endangered and included in the southern range expansion of the Southern California Steelhead Distinct Population Segment (DPS) in July 2002. Preservation of both life history forms (anadromous steelhead and resident rainbow trout) is considered a high priority in the Southern Steelhead Recovery Plan (NMFS 2012). Both anadromous and resident *O. mykiss* have been found within the Topanga Creek watershed, although there has been limited opportunity for immigration or emigration from the creek since the onset of drought in 2012. Because it is difficult to detect the difference much of the time, we use the term *O. mykiss* in this report. In general, *O. mykiss* stocks throughout California have declined substantially, and the current population estimate for the anadromous portion of the DPS is approximately 500 adults (NMFS 2012).

Though anadromous *O. mykiss* stocks throughout the Pacific Northwest have been the object of much study, south-central and southern *O. mykiss* populations have only recently been the subject of focused study (Hayes et al. 2008, Bond et al. 2008, Boughton et al. 2007, Spina 2007, Tobias 2006, Stoecker and Kelley 2005, Yedor 2003). Data collected since 2001 on migration patterns, diet, age and growth, genetics, population dynamics, and habitat preferences of *O. mykiss* in Topanga Creek have provided baseline information on the life history of southern *O. mykiss* (Dagit and Reagan 2006, Dagit et al. 2007. Dagit et al. 2009, Stillwater Sciences et al. 2010, Bell et al. 2011, Krug et al. 2012, Krug et al. 2014, Dagit et al. 2016).

The role of colonization and intermittent access of anadromous adults is important relative to moderating alteration of spatial structure and mitigating the related risk of regional extinctions (Boughton et al. 2006), but is rarely documented. Challenges to colonization of new or historical habitat in southern California by *O. mykiss* include highly variable flow regimes, high water temperatures, and frequent isolation from the Pacific Ocean by sandbars that develop at the mouths of most coastal streams. Few aquatic species are adapted to surviving in such conditions. *O. mykiss*, however, is a highly plastic species in terms of phenotypic and life-history variability, capable of exploiting habitats that would not sustain populations of other salmonids.

Despite the contraction of southern California steelhead from their historical range, we believe that a sub-population in Topanga Creek, California re-established (i.e., re-colonized) within the last 20 years following previous extirpation. Until 1980, a population of *O. mykiss* of unknown census size was present in Topanga Creek (Moyle et al. 1989, Swift et al. 1993, Bell. 2012). It is not clear if this was primarily a resident population or if it included anadromous individuals, though it is likely that anadromy was present when conditions were suitable. Occasional surveys by California Department of Fish and Wildlife (formerly CDFG) between 1980 and 1997 failed to find *O. mykiss*. In July 1998, a single 10 cm *O. mykiss* was found approximately 3.2 river kilometers upstream of the ocean. Distance (km) upstream from the ocean within Topanga Creek will hereafter be referred to as “River Kilometers; RKM.” More focused fish surveys were undertaken and three adult *O. mykiss* were observed in April 2000 (Bell et al. 2011).

In order to monitor the relative abundance and size class distribution of *O. mykiss* in Topanga Creek, snorkel surveys have been conducted monthly, when possible, since June 2001. The numbers of juvenile (<100mm), intermediate (110-250mm), and adult (>250mm) *O. mykiss* tend to vary seasonally and annually. The variations in abundance seem to be related to a variety of factors, most of which correlate with rainfall. Of course, there are seasonal variations in the abundance of juveniles based on spawning season as well, but the annual variations in the abundance of juveniles appears to be related to rainfall amount and patterns that provide migration opportunities for both anadromous steelhead and juvenile outmigrants. The patterns are somewhat complicated, and even though we have an 18 year dataset, additional data is necessary for a more clear understanding of their population dynamics. Redd/spawner surveys have also been conducted since 2010, and a total of 45 redds have been observed to date, all located in the second (1.7-3.6 RKM) and third (3.6-6.0 RKM) reaches. The detailed results of monthly snorkel surveys and habitat mapping events are summarized in previous reports (see Dagit and Krug 2011, Dagit et al. 2016).

Habitat types and suitability were measured and mapped in June 2001, October 2002, September 2003, September 2004, June 2005, October 2005, September 2006 and October 2017. Habitat quality and availability (in terms of pool volume) was also recorded during each snorkel survey for all pools containing *O. mykiss*. Using the Habitat Suitability Index matrix developed previously (Dagit et al. 2004, Dagit and Reagan 2006, Allen 2015) it appears that there were major changes in the availability of suitable habitat following the onset of drought in 2012. The majority of changes in habitat unit suitability occurred after storm events and extreme flows or were associated with drought. Most significantly, the length of stream used by *O. mykiss* increased following the 2005 high flow year with *O. mykiss* of all size classes found upstream an additional 900 m to the first natural boulder barrier, located at 5.3 RKM. In February 2010, high flows from a significant storm event allowed *O. mykiss* to migrate further upstream past all three natural boulder barriers previously identified as impassible, with individuals observed at 6.0 RKM. Although the upstream limit to fish presence expanded and then contracted back to 5.3 RKM, the number of locations utilized appears to coincide closely with the total number of fish observed (note that this could be a factor of snorkel survey methods). Many of these fish were young-of-the-year and it is likely that at a small size, many fish can occupy the same unit, however once they start to grow; they need to move because of competition or lack of available habitat in that unit.

Habitat conditions are less favorable upstream of 6.0 RKM, where the creek flows through private property. In fall 2013, approximately 30 hatchery fish were released by an unknown source into a few small disconnected pools just above 6.5 RKM. These fish were captured and removed prior to the rains reconnecting the pools to the main stem of the creek and did not have contact with native wild *O. mykiss*. The upper branches of the main stem and major sub-drainage in Old Topanga Canyon have segments of suitable habitat constrained by impacts from the roads, utilities and bank armoring. Water quality in the upper watershed is somewhat degraded, with impacts from graywater and septic systems increasing nutrient loading in some areas. Downstream of the town of Topanga, within Topanga State Park (6.0 RKM) where *O. mykiss* reside, the influence of pollutants are diminished and water quality is consistently of high quality (Dagit et al. 2014).

The purpose of this final report is to summarize all existing data from Topanga Creek to provide a better picture of *O. mykiss* life history characteristics in a representative coastal southern California creek. This information will be used to enhance ongoing restoration planning efforts, with a focus on the larger landscape-scale projects needed to fully optimize *O. mykiss* recovery in Topanga Creek.

1.2 Objectives

Establishing a structured long-term program to monitor *O. mykiss* abundance, distribution, and migration patterns is essential to developing a well-documented and prioritized planning effort for *O. mykiss* recovery in the Santa Monica Bay region. This lifecycle monitoring study attempts to expand upon the information provided by the snorkel surveys and outmigration monitoring that have taken place since 2001 (funded by grants from the Fisheries Restoration Grant Program) by integrating mark-recapture efforts using passive integrated transponder (PIT) tagging, migration trapping, instream PIT antenna, DIDSON camera, genetic analysis, and scale analysis.

These study elements were added to provide a more detailed understanding of whether production of smolts and retention of adults is sufficient to sustain the *O. mykiss* population in Topanga Creek, and also to provide insight into the metapopulation complexities. Goals of the monitoring program include answering the following questions: (1) does population persistence in a representative small southern California coastal stream, such as Topanga Creek, rely solely on local recruitment; and, (2) what is the role of anadromous individuals in maintaining long-term population sustainability?

Of the original objectives outlined for this study based on Contract No. 1350010 (2008), some have been directly addressed, and others require further study.

- What are the size and/or age of *O. mykiss* smolts leaving Topanga Creek?
- How many smolts outmigrate and under what flow conditions?
- How are *O. mykiss*, both juveniles and adults, using available habitat?
- What are the seasonal and age specific growth patterns?
- What is the relative proportion of residency compared to anadromy in the population?
- Can juveniles be recruited into the population within critical habitat (e.g., pools that provide summer thermal refuge), or must they move to find other habitat within the creek that is perhaps less suitable?

Our research program on a small population of fish in a watershed with an inherently flashy flow regime (and relatively dry climate) has proved challenging and some of our original study objectives have not yet been met. Questions we have not yet been able to answer include the following:

- Do smolts from Topanga Creek return to their natal creek to spawn or return to other regional watersheds?
- What is the length of ocean residency?
- What is the carrying capacity of critical habitat (e.g., pools that provide summer thermal refuge) for different *O. mykiss* age classes in Topanga Creek?

Although our study is concluding, we hope that continued monitoring of the population will address these objectives and expand our study design to continue a focused comparison of drought vs. non-drought years in the future.

2 METHODS

2.1 Lifecycle Monitoring Study elements

To address critical uncertainties regarding the life history of *O. mykiss* in Topanga Creek, as well as address the needs of the CMP and NMFS Recovery Plan, we implemented a Lifecycle Monitoring Station including a program to capture, tag, and monitor *O. mykiss*, conduct redd surveys, deploy an instream antenna system capable of detecting half-duplex tags, DIDSON camera station and storm event weir trapping in lower Topanga Creek to monitor outmigration and return of tagged anadromous adults. The methods are described in detail in the sections below.

The results of the 10 year Lifecycle Monitoring study were considered in conjunction with the results of previous efforts in Topanga Creek, including assessments of *O. mykiss* abundance, distribution, habitat characteristics, temperature constraints, and passage opportunities (Dagit and Reagan 2006, Dagit et al. 2007, Dagit et al. 2009, Stillwater et al. 2010, Dagit and Krug 2011, Krug et al. 2014, Dagit et al. 2015b, Dagit et al. 2016).

Starting in 2001, snorkel surveys were conducted monthly between the ocean and the previously assumed natural upper limit of anadromy (5.3 RKM), which was extended to 6 RKM following the 2010 storm but contracted back to 5.3 RKM during the drought of 2012 to present. The number and size of all *O. mykiss* individuals observed was recorded. Habitat characteristics (habitat type, maximum and average depth, substrate, canopy cover, algal cover, shelter value and percent instream cover) were recorded at each location where *O. mykiss* were observed. Any unusual health conditions, smoltification, and anadromy were also noted. Additional notes were collected on presence/absence of invasive species (crayfish, fathead minnows, etc.), as well as other aquatic species of interest including Arroyo chub (*Gila orcutti)* and tidewater gobies (*Eucyclogobius newberryi*). During spawning season (January to June), observations of spawning activity, number, size and location of redds, and locations and area of potential spawning gravel were also recorded. Photo points were captured at data pools at specified location to document potential changes over time

A summary of DIDSON camera results are found in Dagit et al. (2018) and are not presented here.

Fish passage opportunities were monitored year round, but especially from the start of each rainy season (typically November, but delayed until later during these drought years) until spring when flows diminish and the beach berm closed ocean access due to low flow conditions. Due to low flows, it was not possible to deploy the in-stream migration traps from 2014-2018, although they were staged and ready. In addition to the passage barrier posed by the beach berm conditions, a reach between 0.5 RKM and 1.3 RKM typically flowed sub-surface each year between spring and fall. The 2008 restoration of the area between 0.5-1.5 RKM was carefully monitored. The methods used for snorkel surveys, habitat mapping and habitat characteristic analysis are described in previous reports (Dagit and Reagan 2006, Dagit et al. 2007, Dagit et al. 2009, Stillwater Sciences et al. 2010, Bell et al. 2011, Dagit and Krug 2011, Krug et al. 2014, Dagit et al. 2015a, 2015b, Dagit et al. 2016) and are not repeated here, however, relevant results will be reviewed.

2.1.1 Study Area

Topanga Creek drains a 50 km^2 watershed located entirely within Los Angeles County, adjacent to the city of Los Angeles. Distances upstream from the ocean within Topanga Creek are referred to as River Kilometers (RKM). The study area (Figure 2-1) extends from the ocean at Topanga Beach (0 RKM) upstream to the southern limit of development of the town of Topanga (6.5 RKM). This reach of the creek represents both the current and documented range of southern steelhead (*Oncorhynchus mykiss*) from initial records in the 1930's to present, and is within Topanga State Park. The extent of snorkel surveys varied depending on time of year and distribution of wetted channel. Before 2005, the majority of monthly surveys started at 1.68 RKM and extended upstream to 4.4 RKM. Since 2005, the surveys have extended to 5.3 RKM, and following a large storm in February 2010 extended further to 6.5 RKM when conditions were suitable. The lower section of the creek, between 0 and 1.68 RMK, was usually dry with a few isolated pools during summer and fall and were included in the snorkel surveys whenever it was wetted in winter and spring. There are no tributaries that can support fish.

Upstream of the parkland, the ownership along the creek is a mosaic of primarily private lands, interspersed with some public land. Of the approximately 50 km^2 in the Topanga Watershed, 37 km^2 are dedicated public open space, and the remaining is privately held. Existing development includes two residential subdivisions and a mobile home park at the northern end of the watershed, three small commercial areas (less than 0.08 km^2 each) along Topanga Canyon Boulevard, and individual residential development located in areas of small lot subdivisions or on private lots throughout the canyon. It is anticipated that future development will be the continued incremental construction of single family homes on existing undeveloped lots. Most parcels in Topanga are under 0.1 km^2 and regulated by the Santa Monica Mountains Local Coastal Plan (LA County 2014), all of which restrict development density, especially in relation to septic system limitations.

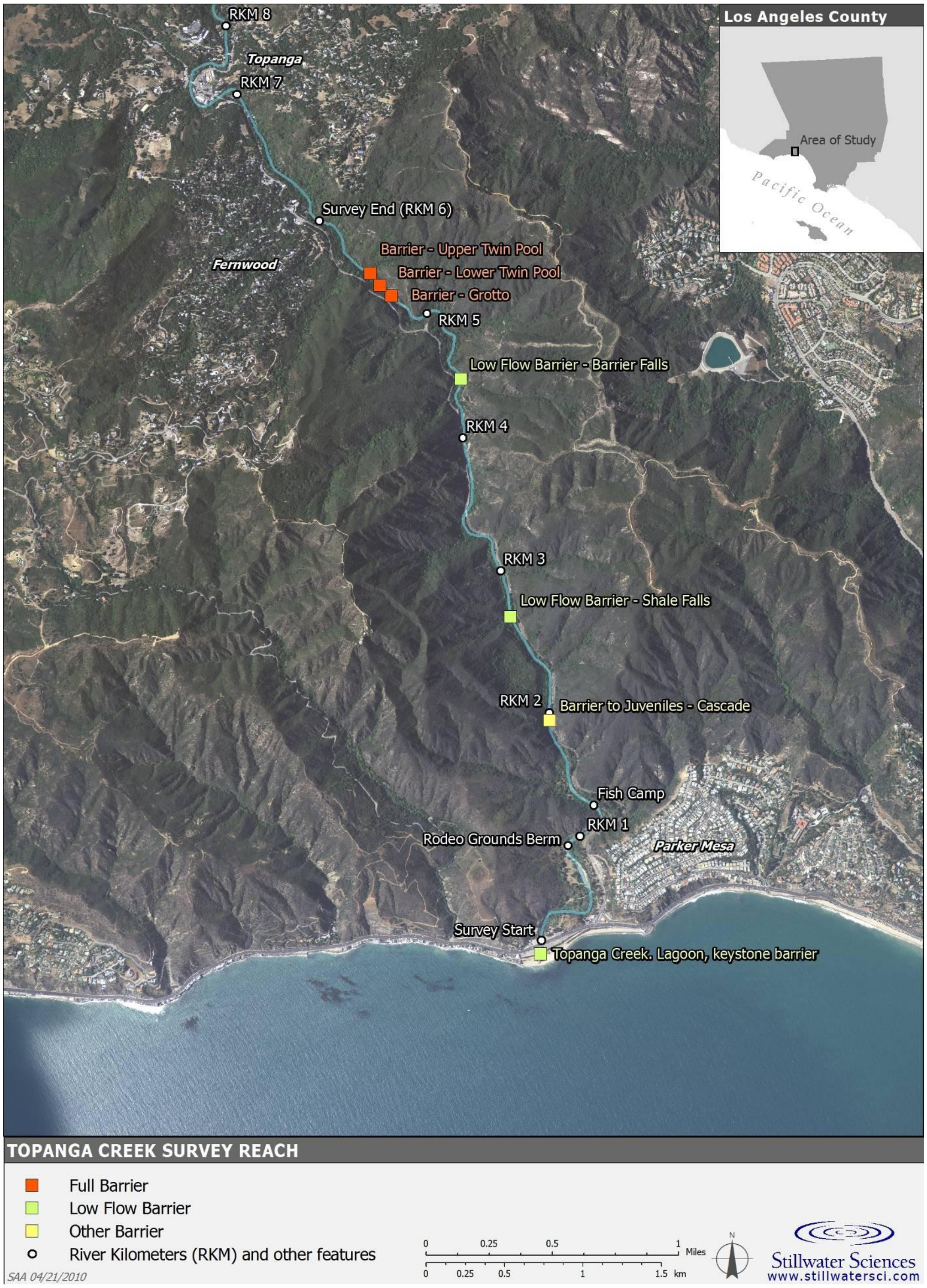

Figure 2- 1. Study Area, Topanga Creek, Los Angeles County.

2.1.2 Training for fish capture and processing

During a subset of years, we used either hatchery or store bought fish, *O. mykiss* ranging in size from 100 to 350 mm fork length (FL) to demonstrate each part of the sampling process. Experienced RCDSMM biologists demonstrated PIT tagging and tissue collection procedures step-by-step. Following the training, only a few experienced staff with demonstrated skill actually processed the fish in the field. Everyone else helped with netting fish or carrying buckets of fish back and forth from the electrofishing team to the processing team.

All participating staff and volunteers in this study were required to attend training sessions held at the start of each field day for each mark-recapture event. The training then moved to the start of the survey in Topanga Creek, to practice electrofishing, netting, transport and processing captured fish *in situ*. Training included methods for proper net handling, labeling of buckets, movement of fish from capture site to the processing station and returning them safely, collecting stream habitat data at capture locations and coordinating all aspects of the field work so that the crew could work synchronously with minimal stress to fish.

To increase consistency between sampling events over the years, the same core crews were used to handle the backpack electrofishers, tag fish, and record data. Volunteers and additional assistants helped with moving the fish and ensuring complete recovery upon release. See Appendix A (Topanga Creek Lifecycle Monitoring Quality Assurance/Quality Control Plan) for details on training activities and personnel.

2.2 Fish Capture Techniques

2.2.1 Electrofishing

Electrofishing is an efficient tool commonly used to capture freshwater fishes (Snyder, 2003). We used electrofishing to capture fish between 1.7 RKM and 6.5 RKM during 13 sampling events between November 2008 and November 2017. The extent of sampling distance varied among events depending on environmental conditions, electrofisher battery life, and snorkel observations. Water quality data including water temperature, pH, conductivity, salinity, and dissolved oxygen was recorded prior to the start of each electrofishing day. Water temperatures remained under the 17ºC threshold as specified in our sampling permit and flow was less than 1 cfs at all events. During the drought, we also incorporated repeated dissolved oxygen measurements at each pool to ensure that levels were over 5 mg/l to avoid stressing the fish.

Two backpack electrofishers and a team of two to four net handlers and another two to three bucket carriers moved slowly upstream electrofishing in each habitat unit. Due to the endangered status of this population and low flow conditions during the mark-recapture events, electrofishing effort was restricted to a single pass. Typically, fish were netted immediately after being shocked and fish escapement was not an issue.

Backpack electrofishers were initially set at 120 volts and 45 Hz, which worked well in small pools, but was not sufficient to capture fish in deeper pools. A higher voltage setting was considered, but there was a strong desire to avoid injury to fish, and thus the settings were kept under 160 volts. Pulse rate (32-45 HZ) and pulse width (4.5 mS) were adjusted as needed to prevent any branding. Stunned fish were captured in D-frame nets and placed in labeled buckets full of cold creek water. Up to ten fish smaller than 120 mm or one to two fish of larger size were placed in each bucket. Buckets were immediately carried to the tagging station where aerators were added if needed, along with thermometers. Each bucket was labeled with flagging tape indicating the capture location. Water in the buckets was changed as needed to maintain cool temperatures at all times.

Electrofishing efforts typically started at 1.7 RKM (or furthest downstream start of surface flow in November) and continued upstream as far as fish were observed in the pre-event snorkel survey, typically up to at least 5.0 RKM, depending on conditions. It took three to four full days to cover the entire study reach.

2.2.2 Hoop-net traps

In November 2008-2010, custom made collapsible hoop-net traps (Figure 2-2) were deployed in conjunction with electrofishing events in deep pools located at 1.825 RKM, 1.9 RKM, 2.0 RKM, and 4.0 RKM, and other locations between 1.825 and 4.4 RKM where it was not effective to sample with the electrofisher. Traps were sunk and baited with punctured cans of sardines in oil. Traps were set in late afternoon and checked the following morning. The traps appeared to work best when set overnight, and no fish were captured when traps were set during the day. In November 2008, eight traps were deployed for a period of 48 hours. In November 2009, six traps were deployed for 24 hours. In November 2010, three traps were set for 16 hours. It was determined that hoop-net traps were not an efficient way of capturing fish and were not used again after November 2010.

Figure 2-2. Custom made collapsible hoop-net trap.

2.2.3 Migrant trapping

Migrant trapping was conducted at 1.3 RKM ("Fish Camp") during storm events from 2008 to 2012. Due to low flows it was not possible to set the traps between 2012 and 2018. A weir trap was used to capture upstream migrants. The trapping location was selected in June 2001 and approved by California Department of Fish and Wildlife (CDFW) Region 5 personnel, as well as National Marine Fisheries Service (NMFS) biologists and ecologists from California State Parks. As described in Dagit et al. (2009), the criteria for selecting the trapping location included accessibility, appropriate flow characteristics and sandy substrate to facilitate net installation. Permission to set up the traps was obtained from the landowner, the California Department of Parks and Recreation. Figures 2-3 to 2-6 illustrate the instream setup of the traps.

Traps were set on the falling limb of storm-related runoff events when the water depth was sufficient (>10 cm). Observers kept close watch on the water level, tidal stage, and connectivity between the trap location and the ocean. Traps were typically installed in mid-afternoon, monitored continuously until removed around 0700 the following morning or when flows were too low to require trapping. Flow, water temperature, dissolved oxygen, and depths were recorded during each trapping event. A team of at least two observers checked the traps hourly throughout deployment. Captured fish were carefully removed from the trap using a dip net, placed into a bucket with water, and treated according to the capture-tag-release protocol (see Section 2.3). If a previously tagged fish was captured, the condition and length were recorded and a scale sample was collected. Fish were released either upstream or downstream of the traps in their original direction of travel.

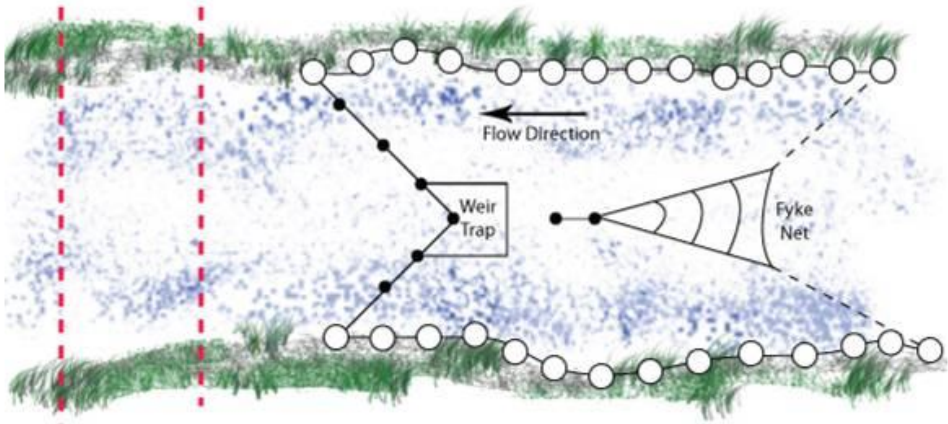

Figure 2-3. Illustration of upstream and downstream migrant traps, and instream antenna (red dashed lines) in Topanga Creek, 2008 to spring 2010.

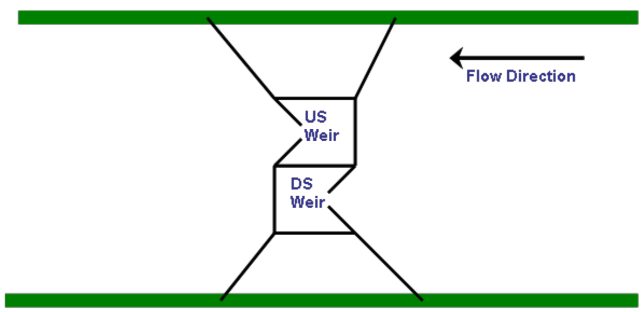

Figure 2- 4. Simplified diagram of downstream and upstream migrant weir traps used in Topanga Creek at ~1.3 RKM from fall 2010 to present when flows were high enough to set traps. The trapping location is at approximately 1.3 RKM upstream of the lagoon.

Figure 2-5. (A) Upstream migrant weir trap at 1.3 RKM, and (B) Downstream migrant fyke trap (used from 2008-spring 2010).

Figure 2- 6. Downstream and Upstream migrant weir traps at 1.3 RKM (A) with and (B) without cover (used from fall 2010-present).

2.2.4 Instream Antenna

Each November, we constructed a half-duplex PIT tag instream antenna system (Multi-Antenna Low-Frequency Half-Duplex Reader, Oregon RFID) in order to monitor fish passage (Figure 2-7). Construction of a half-duplex antenna system was relatively less expensive than commercially available full-duplex systems, which only work in very small stable streams, however standard protocols for constructing an instream antenna system had not yet been developed as of 2008. Furthermore, a standardized protocol might be difficult to follow as implementation of an instream antenna system is site-specific and may require many adjustments.

Two antennas were installed to detect the direction of fish movement. Each antenna consisted of a single loop of copper wire. For each antenna, a 12-gauge copper extension cord wire ran from a RI-Acc-008B antenna tuner box, 10 meters to the other side of the stream where it was connected to a heavy, rubber-coated, 1/0 gauge welding cable running back to the tuner unit (to create a loop). The antenna was secured to mature trees on each bank and the tuner boxes were placed on the same side as the computer system in a tree at a higher elevation than that typical of flood flows. A length of coaxial cable connected each tuner box to the Oregon RFID PIT tag computer system, which includes a RI-RFM-008 Reader board, multiplexor and data logger. Power was supplied by six 6-volt deep cycle batteries arranged in series to supply a nominal 12 volts. When a half-duplex PIT-tagged fish passed within the antennas read range, the unique tag number, the antenna ID, and the date and time of passage were recorded on the data logger.

Three types of Passive Integrated Transponder (PIT) tags were used in this study. Between 2008 and 2010, a 12.5 x 2.07 mm full-duplex PIT tag (134.2 kHz, BioMark, Inc) was used for fish 110-125 mm fork length (FL). This was replaced with a 12 x 2.12 mm half-duplex tag (134.2 kHz, Oregon RFID) in 2010 as the full-duplex tag was undetectable by the instream antenna. For all years, a 23 x 3.65 mm half-duplex tag (134.2 kHz, Oregon RFID), which is also detectable by the instream antenna, was used for fish >125 mm FL. Both full and half duplex tags can also be detected using hand-held PIT tag readers, requiring the capture and handling of fish. The half-duplex tags have a stronger signal, which can be detected by antennas without capturing fish.

In 2008 and 2009, the reader and data logger were housed at 1.3 RKM in the same steel security box as the batteries, approximately 70 m from the creek and tuning boxes. Even though both antennas worked well with an approximately 30 cm read range, there were difficulties getting both antennas to work simultaneously through the multiplexor. During the migration season the system was set to function as a single reader with one antenna. The second antenna was left in place as a backup in case the first one was damaged. Prior to the winter 2009–2010 sampling season, the system was modified by moving the reader, multiplexor and data logger closer to the tuners in an additional steel security box. This reduced the length of the coaxial cable connecting the tuners to the multiplexor to about 20 m which allowed both antenna loops to function well with the multiplexor.

From October 2008 to February 2010, each antenna was set up as a vertical loop (Fig. 2-7A). After a storm event destroyed both antennas in February 2010, the antennas were reconstructed one day later with the downstream-most antenna configured in a horizontal loop along the bottom (Figure 2-7B). This modification reduced the risk that debris would catch on the antennas, and was feasible at the downstream antenna location since the water depth was relatively shallow (<10 cm) even during moderate to high flows. The upstream-most antenna was reconstructed in a vertical loop to increase the probability that at least one antenna could detect fish swimming near the top of the water column during high flows when water depth is greatest. This set up was used through March 2011, when a high flow event (6.16in / 15.64cm rainfall) buried the downstream antenna and destroyed the upstream antenna. Once the flow subsided, we were able to replace the downstream antenna and for the remainder of that season, a single antenna was functional.

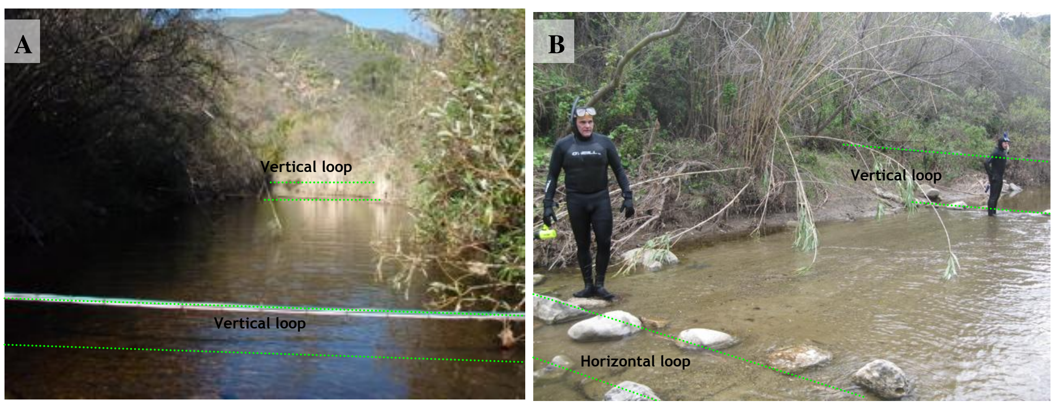

Figure 2-7. PIT tag antenna setup at Fish Camp (1.3 RKM), (A) October 2008 through February 2010, and (B) February 2010 through May 2011.

Beginning in fall 2011, the antenna was installed close to the ocean at approximately 0.5 RKM. The proximity to the ocean allowed for better assessment of outmigration, rather than just within-stream movement. The location is also just downstream (approx. 30 m) of the DIDSON camera site, allowing for comparison of video images with PIT tag detections of known migrating anadromous fish or known outmigrants.

Figure 2- 8. Antenna set up at ~0.5 RKM (fall 2011-present). Dotted yellow line represents approximate upstream and downstream antenna location.

2.2.5 Lagoon seining

Topanga lagoon was sampled at least once each spring to document presence/absence of *O. mykiss* using a combination of blocking nets and seine nets. Seine nets of varying sizes and mesh sizes were pulled across a blocked area, mainly in the lagoon area downstream of the Pacific Coast Highway Bridge, with the weighted bottom of the net kept firmly along the substrate. At the end of each pull, the net was raised and all fish were counted, sized, and released. Distances for each seine pull varied depending on the locations. The entire blocked area was sampled in each set. Tidewater gobies (*Eucyclogobius newberyii*) were typically captured in seine nets, and no *O. mykiss* were ever captured during lagoon seining.

2.3 Fish Processing

Mark-recapture events were held in November 2008-2017, and March 2011-2013 for a total of 13 events. The PIT-tagging station and team were located near the fish capture site and moved upstream along with the electrofishing team. Bucket carriers would bring captured fish in a bucket flagged with capture location to the tagging team. The captured *O. mykiss* were then transferred to a bucket containing the anesthetic MS-222 (500 ml of distilled water to 5 g of MS-222). Once fully anesthetized, fork length (FL) was measured to the nearest millimeter with a wetted fish measuring board. Scales and fin clips were also collected from most individuals to assess age composition and genetics. Before measuring, all fish were scanned with a hand-held PIT tag reader. If an individual was recaptured, a fin sample was not taken. Table 2-1 summarizes data collected during all mark-recapture events.

Table 2- 1. Summary of data collected during electrofishing events in Topanga Creek, 2008-2017.

Event Date	Total *O. mykiss* captured*	Total PIT tagged	Recaptures	Scale samples	Fin clip samples	Lavage samples	Stable Isotope samples	Total Branded
Nov 2008	214	76	0	101	101	0	26	1*
Nov 2009	176	71	1	94	93	0	0	2
Nov 2010	255	198	15	170	166	70	0	0
Mar 2011	84	84	18	83	64	14	0	18
Nov 2011	136	99	36	134	97	24	0	16
Mar 2012	50	25	25	32	25	21	21	9
Nov 2012	210	118	22	144	122	10	0	3

Event Date	Total *O. mykiss* captured*	Total PIT tagged	Recaptures	Scale samples	Fin clip samples	Lavage samples	Stable Isotope samples	Total Branded
Mar 2013	174	116	48	166	116	20	22	14
Nov 2013	50	14	22	40	28	0	0	0
Nov 2014	58	41	13	46	33	0	0	2
Nov 2015	104	29	21	53	28	0	0	3
Nov 2016	36	32	14	34	18	0	0	2
Nov 2017	129	38	4	84	119	0	0	0
TOTALS	**1676**	**940**	**239**	**1181**	**1010**	**159**	**47**	**70**

Mortality = 5 juvenile *O. mykiss*
*An additional fish was bent from the electroshocker during this event but not branded.

2.3.1 PIT tag insertion

O. mykiss between 110 mm and 125 mm FL were implanted with a 12 x 2.12 mm half-duplex tag (134.2 kHz, Oregon RFID) from 2010 to present. Prior to that, a full duplex PIT tag (134.2 kHz, BioMark, Inc) was used for fish 110-125 mm fork length (FL). Fish greater than 125 mm FL were implanted with a 23 x 3.65 mm half-duplex tag (134.2 kHz, Oregon RFID) for the entire study period. Half-duplex tags could be subsequently detected at the instream antenna, and either tag could be detected in subsequent fish capture events (e.g., electrofishing, outmigrant traps) using a hand-held PIT tag reader. During the 13 mark-recapture events a total of 940 individuals were tagged (see Table 2-1). Additionally, eight individuals were tagged during a January 2010 trapping event, three during a February 2011 trapping event, and seven during a March 2011 trapping event.

Tag insertions were made with a three to eight millimeter incision (dependent upon tag size) into the body cavity anterior to the pelvic fin, or in the dorsal sinus (generally on fish greater than 250 mm FL) using a clean, sharp scalpel. Just before insertion, tags were scanned with a hand-held PIT tag reader to make sure they were functioning properly. The tag was then pushed gently into the body cavity and the incision was sealed with a drop of VetBond tissue adhesive. The fish was then placed into the recovery bucket and monitored until it resumed normal swimming behavior. All fish were returned to the habitat unit where they were captured upon recovery.

2.3.2 Scale collection (Age and growth)

Scale samples were collected according to procedures outlined in Drummond (1966). Scales were removed from the region located between the posterior end of the dorsal fin and the lateral line on the left side, roughly two scale rows above the lateral line. Scales were collected from the same location on the right side for recaptured fish to avoid getting all regenerated scales. If a fish was captured more than twice, scales were collected from a different location. Scales were removed from anesthetized fish by scraping a dull knife from the posterior to the anterior of the sample area. A minimum of ten scales per fish were removed from the sample location.

All collected scales were placed on a square of “Rite in the Rain” paper and immediately inserted into an envelope. Envelopes were clearly labeled with fish species, site location, date, capture method, fish length, fish weight (if measured), fish condition, PIT tag number, and any other applicable information. Envelopes were pressed flat to reduce curling and increase analytical accuracy. Knives used for scale sample collection were thoroughly cleaned between samples to prevent cross-contamination of scale samples. A total of 1,181 scale samples were taken during the study period (Table 2-1).

2.3.3 Opportunistic otolith sampling (Age)

If any carcasses were found, otoliths were extracted, and cleaned. Otoliths were archived at the RCDSMM office and then provided to NMFS Long Beach office for further analysis.

2.3.4 Gastric lavage sampling (Diet)

To assess the diet of *O. mykiss*, stomach contents were collected during fall (November) and spring (March) sampling events from November 2010 to March 2013 using the gastric lavage methods described in Giles (1980), which have been shown to have an efficiency of 99.1%. Stomach samples were stored in whirlpak bags and frozen until analysis. No samples were collected after March 2013 due to drought conditions and the concern of over stressing individuals. A total of 159 samples were taken to assess the diet composition and relationship between growth and diet of *O. mykiss* in Topanga Creek (Table 2-1).

2.3.5 Mucus collection (Stable isoptopes)

To identify food web structure using the stable isotopes $\delta^{13}C$ and $\delta^{15}N$, an experimental method of collecting and analyzing fish mucus from *O. mykiss* was attempted, following the approach of Robbins-Church et al. (2009). It has been previously demonstrated that stable isotope analysis of mucus material can be used to determine the diet of *O. mykiss* in laboratory trials, including shifts from invertebrates to fish prey (Heady and Moore 2013). The traditional technique of analyzing stable isotope concentrations from fish muscle tissue requires either euthanizing fish or obtaining a sufficiently large tissue sample that would jeopardize the survival for the size of fish encountered in Topanga Creek.

The challenge of applying this novel approach in the field is collecting enough mucus material (e.g., >1 mg dry weight) to support analysis without subjecting fish to undue stress. Mucus samples were collected from 21 *O. mykiss* in March 2012 according to the protocol developed by Robbins-Church et al. (2009). Fish were anesthetized and transferred by net to a re-sealable plastic bag. The fish were gently moved back and forth inside the bag for 20 to 30 seconds, which resulted in the transfer of mucus from the epidermal surface of the fish to the inside surface of the bag. The fish were then transferred to a bucket with cool water for observation during recovery from the anesthetic and then processed according to tagging protocol. The plastic bags containing mucus samples were labeled and stored on ice in the field until they could be frozen. To determine the isotopic signature of primary and secondary consumers within the food web supporting *O. mykiss*, samples were also collected from Arroyo chub, benthic macroinvertebrates and algae.

Due to analysis costs and uncertainties in the approach, only a subset of the mucus samples was initially analyzed to determine if the technique would yield reliable results. Samples of invertebrates, chub, and algae have not yet been analyzed. During summer 2013, mucus samples from 22 fish ranging in size from 139 – 307 mm were submitted to Northern Arizona University's Colorado Plateau Stable Isotope Laboratory. To prepare mucus samples for isotope analysis, mucus material was transferred from the plastic bags into labeled scintillation vials. Each of these samples were transferred to a 60 ml glass vial by rinsing the bag with deionized, distilled (reverse osmosis; RO) water. Vials were pre-rinsed and drained with RO water. Mucus samples were thawed for approximately five minutes after removal from the freezer. Bags were inspected for any large debris such as pebbles or leaves and debris was removed with a clean forceps if necessary. Forceps were cleaned with a kimwipe and ethanol and rinsed with deionized, distilled water between samples to prevent cross-contamination. 20 ml of RO water was added to the sample bag and the bag was massaged to mix the mucus material with the water. A 30 ml syringe was inserted into the container to withdraw all of the liquid mixture into the syringe. The mixture was transferred to a 60 ml vial and labeled. Each vial was transferred to a freezer that maintained a temperature near -15 C to – 20 C prior to sending to laboratory. Samples were shipped on dry ice to the

Northern Arizona University's Colorado Plateau stable isotopes lab. All samples were weighed by the laboratory, and analyzed for $\delta^{13}C$, $\delta^{15}N$, %C, %N, and C/N.

Unfortunately, this sampling method failed to collect sufficient material and due to increasing stress from drought conditions we elected to stop further attempts to use this method.

2.3.6 Tissue samples (Genetics)

Fin clip samples were collected from the lower lobe of the caudal fin. A one to three millimeter clip was made with sharp scissors and placed on a square of "Rite in the Rain" paper and immediately inserted into an envelope with the tool used for removal. Envelopes were clearly labeled with fish species, site location, date, capture method, fish length, fish weight, fish condition, PIT tag number, and any other applicable information. Envelopes were pressed flat to reduce curling and increase analytical accuracy. Scissors were thoroughly cleaned between samples to prevent cross-contamination of fin clip samples. A total of 1,010 fin clip samples were collected to date during electrofishing, along with an additional 130 samples collected opportunistically from carcasses throughout the Santa Monica Bay, and sent the NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division for analysis.

2.3.7 2013 upper Topanga Creek hatchery trout

In October 2013, we became aware of a group of large trout in a pool above the upstream limit of our snorkel surveys. The pool was located above Owl Falls Drive at about 6.5 RKM just below several houses. The trout appeared to be hatchery rainbow trout as they were larger than most wild trout in Topanga Creek, many had injured fins. There were many individuals residing in a relatively small pool exhibiting behavior that was different from typical wild Topanga trout behavior. However, we were not permitted by NMFS to remove them from the pool until we were certain that they were hatchery trout (based on results of genetic analysis), so we processed them in the manner of mark-recapture events. We used electrofishers and seine nets to capture 27 trout from the pool on 24 October. The scales had uniform circuli suggesting supplemental feeding (i.e., fish pellets). Fin clips were sent to Dr. Garza for genetic analysis, which confirmed that these fish were indeed triploid hatchery fish from the Filmore strain. On 7 November 2013, we removed 30 individuals from the pool using electrofishers and seine nets, 27 recaptures and three fish that were not previously tagged. Captured fish were scanned with the hand-held PIT tag reader and immediately placed on ice. After at least two hours on ice, fish were taken back to the Topanga Ranch Motel for processing. PIT tags were removed and later cleaned and sanitized in ethanol. Otoliths, gonads and stomachs were removed for analysis.

2.3.8 Invasive species monitoring

Monitoring for invasive species is a part of every field effort, including snorkel surveys, redd surveys and trapping events. New Zealand Mud Snails were observed in August 2016 in a 200 m reach of creek from 1.825 – 2.0 RKM. This infestation altered our snorkel survey patterns to avoid contamination but since the flash flood events in January - February 2017, no evidence of the snails has been found. Since this invasive exotic was established in Malibu Creek in 2006, the RCDSMM has implemented decontamination procedures in order to prevent spread from Malibu into Topanga. In addition to using different wetsuits, shoes, and backpacks, any gear used in Malibu Creek is cleaned well and decontaminated by freezing for at least 72 hours.

Red swamp crayfish (*Procambarus clarkii*) were initially observed in the main stem of upper Topanga Creek above the limit of anadromy in 2001. At that point, a volunteer removal program was initiated with the assistance of local 4th graders. This effort was partly successful, and the heavy rain and stream flow in

2005 helped wash them out of the creek. Unfortunately, those flows also distributed survivors throughout the lower main stem of Topanga Creek where they have subsequently become established.

Beginning in 2012, the RCDSMM Stream Team initiated a targeted hand removal effort focused on a 200 m reach between 3.5-3.7 RKM. In fall 2013, the RCDSMM Watershed Steward Members increased this effort by engaging several local school groups in regular weekly removal, and initiated a study to examine the effects of crayfish on water quality and community assemblage of benthic macro invertebrates (BMI). Negative effects on BMI and water quality could negatively affect *O. mykiss* in the creek. Water quality data (temperature, salinity, dissolved oxygen, conductivity and turbidity) were collected in the removal area and just up and downstream prior to each removal event. Numbers, sizes and sex of captured crayfish were recorded. Numbers of crayfish in the removal reach and an adjacent, upstream 200 m non-removal reach were recorded during monthly snorkel surveys; along with numbers and sizes of *O. mykiss* in those reaches. Data was also collected during the November 2013 mark-recapture event on number, size and condition of captured fish in the same reach. Additional fish and crayfish count data continues to be collected during monthly snorkel surveys. Slightly above average rain conditions in 2017 flushed out a majority of the crayfish population that boomed in Topanga during the 2012-2016 drought. Despite the dramatic reduction in numbers due to the high flows, crayfish are still found throughout Topanga Creek, but reduced density has halted targeted removal efforts at this time due to difficulty of access for groups to reach pools that are more affected by crayfish. The low flows of 2012-2016 resulted in a population explosion of crayfish throughout the reaches co-occupied with *O. mykiss*. Heavy rain in 2017 helped to wash out much of the crayfish population, but individuals that did not get washed away are repopulating the creek and many young crayfish were observed in spring 2018.

2.4 Analysis

2.4.1 Effects of electrofishing and processing

Electrofishing is a tool widely used to study fish populations, despite its potential behavioral and physical effects on individuals (Snyder 2003). We examined rates of external hemorrhaging (i.e., branding) and its effect on growth rates of recaptured individuals, as well as investigated potential causes of high rates of electrofishing-induced injury. Following the recommendations of Dagit and Krug (2016), we continued to investigate the effects of branding on growth rates of individuals. Daily growth rate (mm/day) was calculated for branded individuals that had been captured multiple times using the change in fork length between captures, divided by the number of days between captures. Daily growth rates of recaptured branded individuals were compared to the average daily growth rate of similar sized fish captured and recaptured in the same time period as the branded individual. The percentage above or below the non-branded average was determined for each individual and then averaged among each set of conditions for which it could be established. Statistical analyses were not applied to the data due to the opportunistic sampling design. Detailed results of this effort are found in Dagit and Krug (2016).

As stated previously, water quality measurements were taken at the beginning of each sampling day. Conductivity and water temperature readings were used to determine electrofisher settings, which were modified as needed in order to achieve sufficient immobilization of fish. Water conditions and electrofisher settings were examined to determine if any variations in these conditions could have attributed to higher rates of branding.

Physical characteristics including habitat type, maximum and average depth, percent canopy cover, dominant substrate, percent algae cover, shelter value and percent instream cover were noted at each habitat unit where fish were captured, following the protocol of McEwan and Jackson (1996). It is possible that electrofishing units were operated differently or varied in their efficacy among habitat units, related to variations in habitat type, maximum or average depths or dominant substrate. Habitat type and maximum and average depths were examined to determine if there was any relationship among habitat types, depth and the occurrence of branding.

2.4.2 Scale analysis (Age)

Scales were prepared for analysis by Resource Conservation District of the Santa Monica Mountains (RCDSMM) staff according to procedures outlined in Drummond (1966). Using the blunt end of a paper clip, scales were transferred from the Rite in the Rain paper in the envelopes on to a flat glass microscope slide. All scales were lined up and oriented in the same way to make it easy to efficiently scan the slide for readable scales. Another glass slide was placed on top and they were taped together by placing a piece of scotch tape around the top and one piece around the bottom of the slide. The slide was then labeled with the sample identification number on top and PIT tag number or “No Tag” on the bottom. Each scale sample was examined using a compound microscope using between 40x and 400x power, depending on the size of the scales and the details necessary to discern age.

Scales were independently analyzed by trained RCDSMM biologists and interns. Results were recorded in an Excel spreadsheet. If there was a difference of opinion or other difficulty reading the scale, all examining staff convened to review the scales and determine the age. Scale samples and images were archived at the RCDSMM until transferred to CDFW in 2018.

The age of a fish based on scale analysis was determined by following the methods of DeVries and Frie (1996). Where *y* = age in years, the age of a fish was noted as *y*+ or *y*, when the annuli was at the edge of the scale. A fish aged *y* was considered *y*+ for cohort analysis. Evidence of regeneration and spawning scars were noted. Evidence of anadromy was noted if it was apparent on any scale sample. Fish ≤120 mm were assumed to be young-of-year and were considered age-0+ for analysis, unless suggested otherwise by representative scale samples from the same time period. Fish that were age 0+ in March were considered to be that year minus one to determine cohort. When possible, we also took liberties in estimating the ages of recaptured fish, where either no scale sample was taken upon recapture or all scales were regenerated upon recapture, based on the known age of the fish from other captures, and/or sizes and ages of other fish captured in the same time period.

2.4.3 Growth analysis

Growth was quantitatively analyzed for fish captured during electrofishing events from November 2008 to November 2017 based on measured individual growth rates of recaptured individuals and observations of PIT tagged fish. In addition, growth was qualitatively analyzed for spring to fall, fall to winter, and winter to spring based on the size of a small number (<50) of fish observed during snorkel surveys in each season.

Growth rate was calculated for all fish that were PIT tagged and subsequently recaptured between 2008 and 2017 for the following periods:

- November to November (annual growth) 2008-2017
- November to March (winter growth) 2011-2013, and
- March to November (summer growth) 2011-2013.

Growth analysis of individually PIT tagged fish was based on “intrinsic growth rate”, expressed as grams-per-gram-per-day (g/g/d). Intrinsic growth rate (often referred to as “g” in the literature) is calculated here as:

$$\frac{1}{3}\frac{\ln \square_2 - \ln \square_1}{\square_2 - \square_1}$$

Where $\square_1$and $\square_2$ are the starting and ending lengths and $\square_2 - \square_1$ is the time in days between measurements.

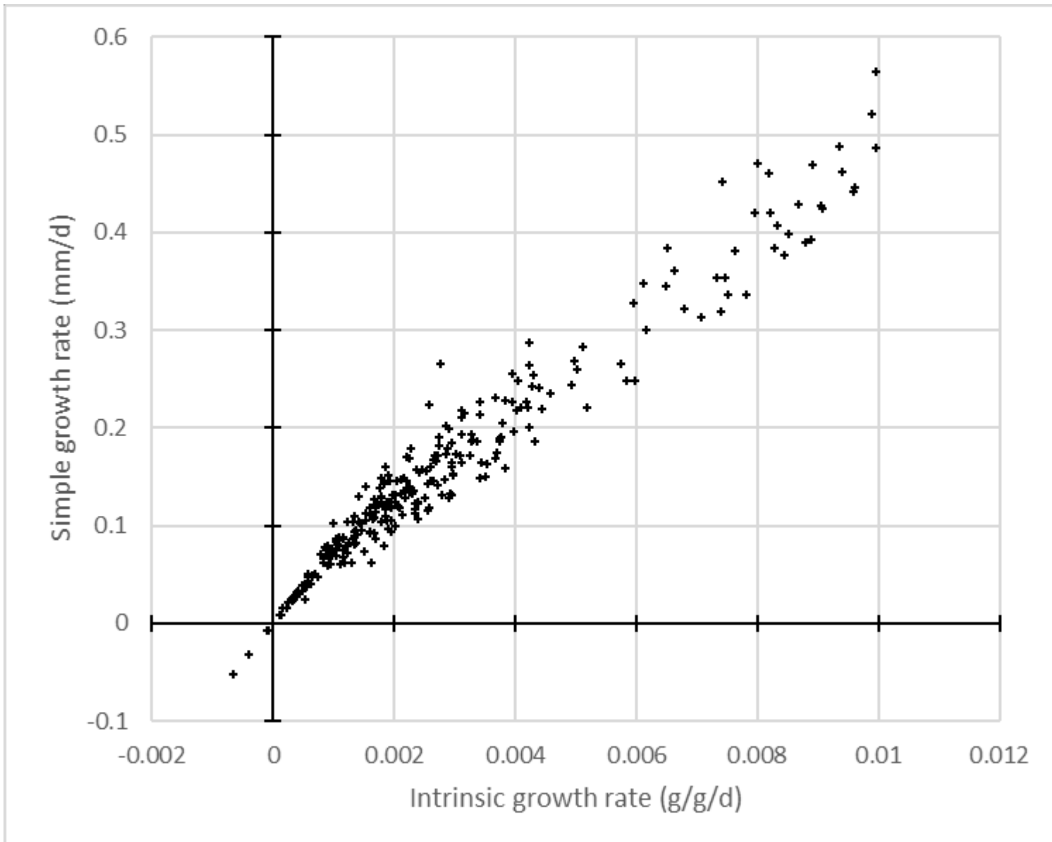

Figure 2- 9. Comparison of simple daily growth rate (mm/d) with intrinsic growth rate (g/g/d), for 239 tagged and recaptured *O. mykiss* in Topanga Creek.

Intrinsic growth rates were compared with initial sizes of fish, season, location (distance upstream) within study area, and movement (distanced migrated) within study area. Density of fish within habitat units was also compared with growth. Density was defined by both the relative abundance (number of *O. mykiss* observed), as well density (number of *O. mykiss* observed per habitat unit area). Because intial results suggested that growth is a power function of initial length, for density analysis residual growth was estimated as a linear function of the log of initial length.

All *O. mykiss* were also classified into cohorts based on the year that individuals emerged as fry. Cohort classification was based on the fork length when fish were observed, and was aided by size at age data from scales, otoliths, and from size-age data from recaptures. Average daily growth (mm/day) was calculated for each age class of each cohort by dividing the change in mean fork length from one year class to the next by the mean number of days between sampling periods (November to November). In addition, average growth rates of cohorts were qualitatively compared with food availability and rainfall.

2.4.4 Diet and lavage

Stomach samples (n=159) collected between 2010 and 2013 were thawed and emptied into a strainer for processing. All samples were processed in entirety. Items from the sample were placed into a petri dish and a dissecting microscope was used to sort, identify, and count all prey items. The presence of algae, seeds and other organic debris was recorded. Whole prey items were identified to the lowest taxonomic level possible. Heads and other body parts were recorded as such and were not included in analyses. Weights (g) of each taxa per stomach sample was obtained using a Mettler analytical balance.

The percent frequency occurrence (%FO) was calculated for each prey item in order to determine which prey items were being consumed by most *O. mykiss* in fall and spring. Percent FO characterizes the food habits of a population (Cailliet 1977), ranges from zero to 100, and was calculated as the number of stomach samples containing prey item *x* divided by the total number of stomach samples containing food. The %FO of the various prey items was compared qualitatively between fall and spring samples. We also assessed differences in the types of prey being consumed by *O. mykiss* in fall and spring by calculating the mean percent of each prey type in a sample, which was calculated as the number of individuals from category *x* in sample *n* divided by the total number of prey items in sample *n* and averaged for each season. Prey items were placed into one of three categories: 1) aquatic insects; 2) terrestrial insects; and 3) fish, crayfish, or snails. Annual and seasonal differences among stomach contents in the number and types of prey items and types of prey observed were assessed and compared qualitatively.

Fish can regenerate scales and fins, and therefore removing a small amount of scales and a small caudal fin clip sample likely had little to no effect on the growth, survival or behavior of processed individuals. Gastric lavage, however, could have an effect as it removes up to 99.1% of the individual's stomach contents (Giles 1980). We examined the effects of gastric lavage on growth rates of *O. mykiss* by comparing growth rates of lavaged and then recaptured individuals with average growth rates of similar sized individuals captured and recaptured in the same time period.

2.4.5 Food availability

Each year since 2000, the RCDSMM Stream Team has collected samples according to Ode (2007) as part of the amphibian surveys conducted each spring at four locations within the watershed: Lower Topanga at 3.2 RKM, Upper Topanga at 4.5 RKM, Backbone Trail in the Old Topanga Creek drainage, and mainstem at Greenleaf Road. The first two of these sites are located in areas where *O. mykiss* are typically observed. Analysis of the archived samples from these two sites provided additional insight helping to characterize long-term spatial and temporal variability of food availability.

Between May 2013 and June 2014, benthic macroinvertebrate samples were collected in May, July, and September using the SWAMP Bioassessment Procedure (Fetscher et al. 2009) at an additional four sites, 1.7 RKM, 3.6 RKM, 4.8 RKM and 6.5 RKM to allow for assessment of seasonal and annual variability in the benthic macro invertebrate assemblages. *O. mykiss* have been observed at three of four of these sites (not at 6.5 RKM) and analysis of these samples provided further insight into the spatial and temporal variability of food availability. This data is detailed in Dagit et al. (2014).

In November 2012 and March 2013, drift nets (30cm x 50cm with 363 micron nylon mesh) were deployed just downstream of Topanga Bridge at 3.58 and 3.6 RKM, to capture drifting benthic macro invertebrates entering the pool-riffle complex. Nets were set side-by-side to cover the entire wetted channel width. Depth, flow and water quality parameters were measured when the nets were installed. Drift nets were deployed for 24 hours each time, with a collection at 1800, 0000, 0600, and 1200 to examine diurnal variations in food availability. Each of these sampling events was done just prior to the mark-recapture event for that season so that we could compare food availability to the diet of lavaged individuals. Drift net deployment continued through 2017 even though the March mark-recapture and gastric lavage sampling event were halted due to drought conditions.

All benthic macro invertebrate samples were preserved in 70% ethanol. For processing, each sample was strained and samples were analyzed in entirety, or up to 600 individual invertebrates were randomly selected for identification. Using a 50x dissecting microscope, most organisms were sorted and identified to the lowest practical taxon-family, sub-family or species level when possible. Voucher samples were archived, and Dr. Raphael Mazor (SCCWRP) and/or Dr. Jim Harrington (CDFW) reviewed specimens needing extra identification.

2.4.6 Abundance trends analysis

Relative abundance trends in Topanga Creek were assessed based on 1) snorkel observations and 2) PIT tag mark and recapture analysis, both as described below.

2.4.6.1 Snorkel observation relative abundance trends

Relative abundance of *O. mykiss* was estimated based on the total number of individuals of both juveniles (<100 mm FL), intermediate (100-250 mm FL), and adults (>250 mm FL) observed during snorkel surveys (Appendix D). Annual relative abundance was compared by plotting total counts during each survey from 2001 to 2017 for a 3.6 RKM stretch of Topanga Creek common to all surveys (1.7-5.3 RKM). However, within each survey the distance of Topanga Creek observed varied, based on environmental or safety conditions (e.g., dry or excessively turbid reaches were not surveyed). Therefore, the estimated counts were scaled for each survey based on reaches that were included so that counts could be compared between surveys and between years. Relative abundance for each survey was estimated as,

$$X=Y(A-B)/(B-A)$$

Where X is the scaled estimate of relative abundance for Topanga Creek for the surveyed reach, Y is the count within sub-reach observed between two locations within the creek, denoted as A (upstream RKM of survey) and B (downstream RKM of the survey).

2.4.6.2 PIT tag mark-recapture analysis

Abundance of *O. mykiss* in Topanga Creek was also estimated based on mark-recapture analysis of all fish PIT tagged between November 2008 and November 2017 (Appendix B). A standard computer program (Program MARK) was used to estimate relative abundance and survival based on the available history of detections for each individual fish PIT tagged and resighted during capture and detection efforts (White and Burnham 1999). PIT tag capture/recapture data was assigned to thirteen survey periods: Fall 2008, Fall 2009, Fall 2010, Spring 2011, Fall 2011, Spring 2012, Fall 2012, Spring 2013, Fall 2013, Fall 2014, Fall 2015, Fall 2016, and Fall 2017. The capture history (i.e, resighted or not) of each PIT tag with respect to these surveys was determined. An artificial "Spring" survey (with capture probability 0) was added for any missing years, so that the data made up a sequence of alternating Fall and Spring surveys.

Survival and abundance was estimated for all *O. mykiss* combined, regardless of size to increase the sample size and robustness of the estimates. However, we were concerned that potential emigration (i.e., smoltification) of *O. mykiss* smaller than 200 mm FL would bias estimates, particularly for survival during potential outmigration (late winter and spring). Therefore, abundance and survival are also estimated for "adults," considered less likely to smolt, and defined as greater than 200 mm FL for this analysis. Although we generally consider adults to be greater than 250mm FL, the sample size was too small for robust analysis and we thus used the smaller threshold in order to have sufficient data to conduct an assessment.

2.4.6.3 Recovered PIT Tag Analysis

During summer of 2016, CDFW staff led an effort to recover PIT tags from Topanga Creek that were no longer in fish (sometimes referred to as "ghost tags"). This effort recovered 76 tags from the estuary to 5.3 RKM. Analysis is presented in a separate report (McLaughlin and Dagit 2018).

2.4.7 Distribution analysis

2.4.7.1 Habitat characteristics

During snorkel surveys, habitat characteristic data were recorded at each habitat type where *O. mykiss* were observed according to the methods of Flosi and Reynolds (updated 2010). Data included habitat type, maximum and average depth, percent canopy cover, dominant substrate, percent algae cover, shelter value and percent instream cover.

A total of 30 pools were evaluated based on habitat characteristic data collected between 2002 and 2017. *O. mykiss* were observed in these pools at least once each year. The Habitat Suitability Criteria Ranking Matrix (Dagit and Reagan 2006) was applied to each pool based on averaged conditions in individual pools over the study period. Habitat suitability criteria were initially evaluated in Dagit et al. (2007) during their evaluation of habitat mapping data collected between 2001 and 2006. Habitat suitability was defined according to criteria for optimal conditions for each life stage of *O. mykiss* using five variables: depth, canopy cover, substrate, shelter value, and habitat type. The Habitat Suitability Criteria Ranking Matrix was revised based on data reported in Stillwater et al. (2010) and review of pertinent literature (Allen 2015, Bovee 1978, Carpanzano 1996, McEwan and Jackson 1996, Moyle 2002, Reiser and Bjornn 1979, Stoecker and Kelley 2005, Yedor 2003). This matrix represents the current understanding of preferences for each life stage, but has not yet been robustly tested for completion, a task beyond the scope of this study. These metrics were used to examine the interaction between each different factor and documented use by fish.

Table 2- 2. Habitat suitability criteria matrix.

Substrate		gravel	boulder	cobble	sand	silt/clay
Depth (cm)	Adults	>80	60–79	40–59	20–39	0–19
	Intermediates	>60	40–59	30–39	20–29	0–19
	Juveniles	>30	20–29	10–19	5–9	0–4
Shelter value		2.5–3.0	2.0–2.5	1.5–2.0	1.0–1.5	0–1.0
Canopy cover (%)		80–100	60–79	40–59	20–39	<20
Habitat type	Adults (>25 cm)	mid-channel pools	Runs/glides, step runs	Scour pools	Backwate r pools	Low to high gradient riffles
	Intermediates (11–25 cm)	Runs/glides, step runs	mid–channel pools	Low to high gradient riffles	Scour pools	Backwater pools
	Juveniles (<10 cm)	Low to high gradient riffles	Runs/glides, step runs	mid-channel pools	Scour pools	Backwater pools

Note: Most pools in Topanga Creek are considered mid-channel and step pools. Few scour or backwater pools are found.

Data for specific pools where *O. mykiss* are routinely observed were pooled for spatial and temporal analysis. Data were also analyzed to examine *O. mykiss* distribution in Topanga Creek in relation to the following habitat characteristics:

- Pool area (m^2)
- Pool volume (m^3)
- Pool depth (cm)
- Distance to groundwater input (m)
- Reach gradient (%)
- Area of spawning habitat (m^2)
- % Canopy cover

2.4.7.2 Statistical analysis of habitat used by *O. mykiss*

The habitat characteristics listed above were compared with *O. mykiss* observations from snorkel surveys to determine if there were statistically significant correlations. Analysis was conducted using generalized linear modeling, based on a Poisson model with the canonical (log) link (McCullagh and Nelder 1989). All the analyses treat the fish counts as Poisson deviates, where the log of the Poisson parameter is a linear combination of explanatory variables. The Poisson model is preferred for this analysis because counts are often too small to be safely treated as Gaussian deviates. The log link is the natural one for Poisson models. In a conventional linear regression, one would simply replace abundance with density as the response variable. For the generalized linear modeling performed here, it is important that the response variable is an integer count; however, one can achieve the same effect by adding an offset term to the model. In particular, adding an offset term of log (area) or log (volume) to a model with log link (as here) forces the model to make abundance proportional to area or volume, respectively.

Regressions with different habitat characteristics were also compared using "Akaike's Information Criterion" (AIC) (Burnham and Anderson 2002). All the analyses were carried out in “Program R,” version 2.10.1 (Venables et al. 2009), using the functions glm and AIC. The majority of regressions were considered significant ($p<0.05$). Moreover, when relationships were significant, they tended to be highly significant (that is, p-values were very much smaller than 0.01). For this reason, more attention was given to rankings of models by the AIC criterion than to p-values. AIC values are used somewhat like adjusted R-squared values in linear regression, in that they measure how much of the variability in the data is explained by the model. Note, however, that *smaller* values of AIC within a group of models correspond to *better* models.

2.4.7.3 Movement

The location (distance upstream in meters) of all PIT tagged fish was recorded during all capture and recapture efforts. Analysis of location data included determining the distanced moved of all recaptured fish, and comparing movement with size, growth, location within the study area, and season.

2.4.8 Drift Net Monitoring and Food Availability

Drift nets were deployed on 3/25/14, 7/01/14, 11/24/14, 3/30/15, 7/13/15, 11/04/15, 3/22/16, 7/6/16, 11/18/16, 3/16/17, 7/10/17, and 11/1/17 at a pool habitat unit located approximately 3.58 RKM upstream of the ocean and just downstream of Topanga Creek Bridge (Figure 2-10). Three drift nets (30 cm x 50 cm) with 363-micron nylon mesh were set at the upstream (3.6 RKM) and downstream extent (3.58 RKM) of the pool to filter any flow entering or exiting the habitat unit. The pool measured approximately 20 meters in length, four meters in width, and experienced flows between 0.0 and 0.72 cfs during the study period. Specimens were collected at six-hour intervals hours (1800, 0000, 0600, and 1200) in a 24-hour period.

Figure 2- 10. Topanga Creek drift net stations.

Physical and chemical habitat conditions (pool depth, air and water temperature (^oC), salinity (ppm), dissolved oxygen (mg/l), pH, conductivity (mS/cm), dominate substrate, percent instream cover, percent canopy cover, dominate canopy type, and percent algae) were measured at net deployment (1200 hr) downstream of the 3.6 RKM nets. At six-hour specimen collection intervals, water depth at the nets was measured with a meter stick, and velocity was measured with a Marsh-McBirney 2000 flow meter set at the center of each net. Total volume of flow per six-hour collection period was calculated by water depth (ft) * length of nets (ft) * flow (cfs) * 21600 seconds.

Net contents were collected by removing the receptacle end of the nets and emptied directly into labeled sample bags. Contents were preserved in 70% ethanol solution until processed. Invertebrates were separated from other organic material, identified by life stage and to genus when possible, or lowest feasible taxonomic level as per organism condition and size. Invertebrates were sorted between aquatic and terrestrial origin to assess food availability by source. Invertebrate density was calculated by total number organisms divided by total volume of flow (ft^3).

All benthic macroinvertebrate samples were preserved in 70% ethanol. For processing, each sample was strained and samples were analyzed in entirety or up to 600 individual invertebrates were randomly selected for identification. Using a 50x dissecting microscope, most organisms were sorted and identified to the lowest practical taxon: family, sub-family or species level when possible. Voucher samples were archived, and Dr. Raphael Mazor (SCCWRP) and/or Dr. Jim Harrington (CDFW) reviewed specimens needing extra identification.

2.4.9 Invasive species monitoring

Monitoring for invasive species was part of every field effort, including mark-recapture events, snorkel surveys, redd surveys, and trapping events. The number of individuals, size, reproductive status and location are noted.

Since the New Zealand mud snail was established in Malibu Creek in 2006, the RCDSMM has implemented decontamination procedures in order to prevent spread from Malibu into Topanga. In addition to using different wetsuits, shoes, and backpacks, any gear used in Malibu Creek was cleaned well and decontaminated by freezing for at least 72 hours. A small reach of Topanga Creek was infested with NZMS in 2016, but they appeared to be washed out in the flows of 2017 and have not been observed since.

In addition to NZMS, note was taken of any other invasive aquatic species observed including over the course of the study red swamp crayfish (*Procambarus clarkii*), fathead minnow (*Pimephales promelas*), and a "gold" chub type minnow that has not been conclusively identified. Red eared sliders (*Trachemys scripta elegans*) occasionally were observed and removed from the creek. No bullfrogs (*Rana catesbeiana*) or mosquitofish (*Gambusia affinis*) have been observed to date, although they are commonly found in other creeks throughout the Santa Monica Bay.

2.4.10 Water Temperature Monitoring

Recording temperature data loggers (HOBO Stowaway Tidbit loggers) were installed seasonally in seven pools from 2005–2017 (Table 2-3). Loggers were deployed in pools known to be refugia for *O. mykiss* and which represented a diversity of canopy cover conditions, depth conditions and proximity to known seeps or springs (Table 2-4). Tidbits originally placed in the uppermost pools were subject to being destroyed or swept away during rain events, so in 2015 Red Rock Pool (5.25 RKM) was established as the representative uppermost temperature monitoring pool. Grotto pool (5.3 RKM) was re-established in 2017 as the uppermost monitoring pool since a location was identified that would protect the tidbit from being swept away. The loggers were set to record data at 30 minute intervals. Data were downloaded monthly during snorkel surveys using Boxcar Pro or HOBOware software and compiled and analyzed using Microsoft Excel.

Water and air temperatures were graphed over time for all years and frequency graphs were made to show the proportion of time a pool was at a given temperature (Appendix E). We focused the proportion graphs on years that have overlapping data from the hottest time of year (July-October in most cases) since we are most interested in the amount of time *O. mykiss* are exposed to warm or extreme temperatures. If a pools' temperature exceeded 25°C for any amount of time, the total amount of time (hours) above 25°C was calculated as well (Appendix E). Annual mean, maximum and minimum temperatures were assessed and compared in preparation for later analysis.

Table 2- 3. Summary of temperature monitored locations and dates in Topanga Creek, 2005-2017. Tidbits placed in the uppermost pools (**) were subject to being destroyed or swept away during rain events, so in 2015 Red Rock Pool (5.025 RKM) was established as the uppermost temperature monitoring pool. Grotto Pool was re-established as a monitoring pool in 2017.

Pool	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Topanga Lagoon (0 RKM)	ND	ND	ND	ND	ND	ND	ND	ND	12 Jul – 31 Dec	01 Jan- 14 Nov	10 Apr-06 Nov	6 Apr-10 Nov	15 Apr-6 Nov
Ski Pole (water) (2.0 RKM)	17 Jun – 19 Oct	21 Jul – 27 Feb 07	11 May – 18 Dec	LM*	31 Jul – 23 Oct	12 Mar – 21 Nov	15 Apr – 8 Nov	15 Mar – 20 Nov	19 Apr – 15 Nov	04 Apr- 14 Nov	10 Apr- continuous	Continuous- 7 Nov	15 Apr-6 Nov
Ski Pole (air) (2.0 RKM)	ND	ND	ND	ND	ND	ND	ND	17 Feb- 31 Dec	01 Jan – 15 Nov	04 Apr- 14 Nov	10 Apr- continuous	Continuous- 7 Nov	15 Apr- continuous
Ken[2] (2.6 RKM)	17 Jun – 19 Oct	30 May – 20 Sept	11 May – 18 Dec	17 Jul – 12 Sept	31 Jul – 23 Oct	22 May – 21 Nov	15 Apr – 8 Nov	15 Mar – 20 Nov	19 Apr – 15 Nov	04 Apr- 14 Nov	10 Apr-06 Nov	28 Mar-7 Nov	15 Apr-6 Nov
Ken[2] (air) (2.6 RKM)	ND	ND	ND	ND	ND	19 Mar- 24 May	ND	ND	ND	ND	ND	ND	ND
Engine (3.5 RKM)	ND*	19 May – 18 Aug	11 May – 18 Dec	20 Jun – 25 Jul	31 Jul – 23 Oct	22 May – 21 Nov	15 Apr – 8 Nov	ND	2 May – 13 Sept	04 Apr- 14 Nov	*10 Apr-06 Nov	19 Mar-7 Nov	15 Apr-6 Nov
Sycamore Tree (3.94 RKM)	ND	21 Jul – 15 Sept	7 Sept – 19 Oct	20 Jun – 25 Jul	31 Jul – 23 Oct	22 May – 15 Nov	15 Apr – 8 Nov	16 Mar – 20 Nov	19 Apr – 13 Sept	04 Apr- 14 Nov	10 Apr-06 Nov	28 Mar-7 Nov	15 Apr-6 Nov
Noel (4.0 RKM)	ND	19 May – 18 Oct	11 May – 22 Jun	LM	31 Jul – 23 Oct	22 May – 21 Nov	15 Apr – 9 Nov	16 Mar – 20 Nov	19 Apr – 14 Sept	04 Apr- 14 Nov	10 Apr-06 Nov	28 Mar-7 Nov	15 Apr-6 Nov
Josh (4.36 RKM)	ND	19 May – 18 Oct	11 May – 19 Oct	20 Jun – 18 Jul	31 Jul – 23 Oct	ND	15 Apr – 9 Nov	15 Mar – 20 Nov	19 Apr – 15 Nov	04 Apr- 14 Nov	10 Apr-06 Nov	28 Mar-7 Nov	15 Apr-6 Nov
Red Rock (5.025 RKM)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10 Apr-06 Nov	28 Mar-7 Nov	15 Apr-6 Nov
Grotto** (5.275 RKM)	ND	ND	ND	ND	31 Jul – 23 Oct	ND	ND	ND	ND	ND	ND	ND	15 Apr-6 Nov
Lower Twin** (5.3 RKM)	ND	ND	ND	ND	ND	ND	15 Apr – 9 Nov	15 Mar – 20 Nov	ND	ND	ND	ND	ND

*** ND = logger was not deployed in this location for this year, LM = logger malfunctioned.**

Table 2- 4. Habitat characteristics of temperature monitored pools from 2008 through 2017 snorkel survey data. **(Data poor years (n < 5 records) for each pool are noted under Site Name information)**

Site Name (RKM)	Habitat Type	Variable average value	2008-2012	2013	2014	2015	2016	2017
Topanga Lagoon (0.0)	lagoon	Max depth (cm)		132.1	63.3	111.7	118	110.9
data 2014 (2)		Avg depth (cm)		80.7	40.0	70.0	59	48.2
		% canopy		7.1	10.0	6.7	3.75	6.2
		shelter value		1.3	1.0	1.8	1.33	1.3
		% instream cover		3.0	1.0	10.0	5.8	4.2
		Dominant Substrate		sand	sand	sand	sand	sand
Ski Pole Pool (2.0)	mid-channel	Max depth (cm)	100	91.7	93.2	92.2	88.75	64.5
	pool	Avg depth (cm)		48.9	50.0	51.1	49.4	35.9
		% canopy	10	33.3	37.7	33.3	38.5	39.5
		shelter value	3	2.1	1.9	1.8	1.86	1.5
		% instream cover		15.0	15.0	20.0	10	7.6
		Substrate	Sand	sand	gravel	gravel	gravel	gravel
Ken^2 Pool (2.6)[1]	pocket pool	Max depth (cm)	65	105.0	110.0	140.8	91.2	90.8
		Avg depth (cm)		39.2	50.0	67.5	38.3	45
		% canopy	75	45.0	27.5	41.7	37.5	44.8
		shelter value	2	1.8	2.0	2.3	0.5	1.75
		% instream cover		16.7	16.3	33.0	32.5	12
		Dominant Substrate	Sand	gravel	sand	sand/gravel	sand	Sand
Engine Pool (3.5)	step pool	Max depth (cm)	70	67.9	60.0	71.7	65.8	57.9
		Avg depth (cm)		39.3	34.6	45.0	40	29.6
		% canopy	75	62.9	56.3	44.2	42	23.4
		shelter value	2	1.9	1.8	2.0	1.5	1.2
		% instream cover		17.9	22.1	22.5	13	6.25
		Dominant Substrate	boulder	boulder	boulder	boulder	boulder	gravel
Sycamore Tree (3.94)*	mid-channel	Max depth (cm)	50	58.3	70.0	45.5	58	69.5
data 2013 (3), 2014 (1)	pool	Avg depth (cm)		36.7	35.0	25.0	37	42.5
		% canopy	75	68.3	60.0	63.0	79	59
		shelter value	3	1.8	2.0	1.8	1.6	1.35
		% instream cover		23.3	20.0	16.5	29	6.4
		Dominant Substrate	boulder	boulder	boulder	boulder	boulder	boulder
Noel Pool (4.0)*	mid-channel	Max depth (cm)	170	170.0	161.8	170.0	161.6	218.2
	pool	Avg depth (cm)		93.3	86.0	90.5	101.6	98.2
		% canopy	0	31.7	28.9	42.5	47.2	22.5
		shelter value	3	2.5	2.3	2.3	2.3	2.2
		% instream cover		23.3	22.2	21.0	16.6	12.7
		Dominant Substrate	boulder	sand	sand	sand/boulder	Sand	Sand
Josh Pool (4.36)	deep scour	Max depth (cm)	250	293.3	275.0	246.4	208.3	217.3
data 2013 (3), 2014 (4)	pool	Avg depth (cm)		146.7	135.0	124.3	96	120
		% canopy	50	46.7	50.0	51.4	45	40.4
		shelter value	3	2.7	2.4	2.4	2.7	2.5
		% instream cover		23.3	23.8	22.1	16	15.9
		Dominant Substrate	boulder	sand	sand	sand	sand	Gravel
Red Rock Pool (5.025)	deep scour	Max depth (cm)		237.0	205.0	196.0	190	192.5
2013 (3)	pool	Avg depth (cm)		140.0	100.0	104.0	105	96
2014 (5)		% canopy		37.0	43.0	39.0	25	32.5
		shelter value		2.5	2.3	2.3	2.4	2.2
		% instream cover		22.0	22.5	23.0	13.75	12
		Dominant Substrate		sand	sand	sand	Sand	Sand
Grotto Pool (5.275)	deep scour	Max depth (cm)	250	250.0	313.3	238.3	250	271
data 2013 (3)	pool	Avg depth (cm)		116.7	127.5	133.3	150	171.5
		% canopy	50	33.3	30.0	30.0	15	16
		shelter value	2.5	2.3	2.4	2.2	2	2.7
		% instream cover		23.3	24.0	22.5	20	15
		Dominant Substrate	Sand	sand	sand	sand	sand	sand
Lower Twin Pool (5.3)	deep scour	Max depth (cm)		350.0	240.0	275.0	ND	ND
data: 2013 (1), 2014 (1),	pool	Avg depth (in)	150.0	150.0	125.0		ND	
2015 (2)		% canopy		40.0	nd	25.0	ND	ND
		shelter value		2.0	nd	2.0	ND	ND
		% instream cover		20.0	nd	20.0	ND	ND
		Dominant Substrate		sand	sand	sand	ND	ND

* Ken^2 Pool and Sycamore Tree pool have a documented seep/spring nearby.

** Uppermost pools from previous years represented by Red Rock Pool (deep scour pool) during 2015 onward.

2.4.11 Genetic analysis

Method Evolution

In previous genetic analyses of *O. mykiss* collected in Topanga Creek, CA, individuals were analyzed in distinct batches according to sample collection year. In this report however, we discuss the results of a more comprehensive analysis, in which all samples collected from 2002 through 2018 were analyzed.

In order to actualize such an analysis, we first had to standardize individual genetic data across all sample years. Initial genetic analyses of *O. mykiss* in Topanga Creek, CA utilized microsatellite markers to genotype individuals (Stillwater et al. 2010, Krug et al. 2014, Dagit et al. 2016). Microsatellites have been the favored genetic marker for population genetic analyses for many years, predominately due to their highly polymorphic, and therefore informative, nature (Selkoe & Toonen 2006, Pearse and Crandall 2004). In recent years, however, there has been a transition towards using Single Nucleotide Polymorphism (SNP) markers to understand ecological processes within wild populations. This transition largely arose out of convenience: SNP markers are abundant and therefore readily discoverable, and the genotyping process can be automated at a moderate cost and standardized across laboratories (Schlötterer 2004). However, SNPs are biallelic markers, meaning there are only two possible alleles at each locus per individual, and therefore provide less resolving power per locus than multiallelic microsatellites. Nonetheless, it has been demonstrated that as few as 60 SNPs provide enough power to perform various analyses, including relationship estimation amongst thousands of individuals (Anderson and Garza 2006).

Genotyping methods in the NOAA NMFS Tissue Lab, Santa Cruz have followed this progression, with older samples having been genotyped with a standard microsatellite panel and more recent samples having been genotyped with our SNP panel (see section *SNP loci and genotyping*). Therefore, in 2018 all tissue samples associated with Topanga Creek were re-genotyped, as necessary, with the most updated version of our SNP panel to allow for this holistic analysis.

Tissue collection and DNA extraction

A total of 1,112 tissue samples (1,010 from electrofishing events), collected from fish sampled in Topanga, Malibu and Arroyo Sequit Creeks from 2002 to 2018, were genotyped for this analysis. Tissue samples were digested in Proteinase K lysis buffer, and then extracted on a QIAGEN BioRobot 3000, following the DNeasy 96 Tissue Kit protocol (QIAGEN Inc., Hilden, Germany).

SNP loci and genotyping

All individuals were genotyped using a panel of 95 Single Nucleotide Polymorphism (SNP) loci (Abadía-Cardoso et al. 2011, Campbell et al.2009, Aguilar & Garza 2008) (Appendix F). The 95 SNP markers selected for genotyping here demonstrated consistent levels of polymorphism, including higher mean minor allele frequencies, amongst *O. mykiss* populations throughout Southern California, which is conducive to performing phylogenetic, genetic stock identification and parentage-based analyses in the species (Abadía-Cardoso et al. 2011). One additional locus was used to infer genetic sex and was removed before performing any population, assignment or parentage analyses.

After genotyping, and prior to performing any downstream analyses, we used the Microsatellite Toolkit (Park 1999) to compare all individuals against each other to identify duplicate samples across years. Individuals that were compared at least for 85 of 95 loci, and which differed at a maximum of two alleles were accepted as duplicates. We recovered 69 occurrences of duplicate sampling across all years, with the majority of these occurrences being individuals that were re-sampled, typically two to three times after the initial tagging event. One individual, however, was re-sampled five times from 2009 through 2013.

Only one individual from these matching clusters was then retained as a representative and considered in all ensuing analyses. However, nineteen of the 69 matching clusters included individuals whose metadata suggested potential errors in tissue or genetic data collection. For example, two individuals collected on the same day were found to be genetic duplicates, but had significantly different recorded fork lengths. As a result, all individuals implicated in this sort of duplicate clusters were dropped.

Estimates of allele frequencies and heterozygosity can obviously be skewed by the inclusion of these duplicate individuals, as well as the presence of full-siblings (FullSib). Therefore, we also identified FullSib families amongst individuals from the same estimated cohort in COLONY2 (version 2.0.6.4; Jones and Wang 2009). Only one individual from all FullSib groups larger than two, and with Inclusive Probability (P(Inc.)) ε 0.90, was then included in the population genetic analyses (see *Parentage and Sibship Analysis* section for full description of FullSib estimation).

We ultimately used genotype data from 90 of the 95 loci to perform population genetic and assignment analyses. Two of the five dropped loci map to a genomic region (Omy5) found to be closely associated with the anadromous or resident phenotype in *O. mykiss* (Hecht et al. 2012, Pearse et al. 2014) (Appendix F). This explicit link between genotype and phenotype implies these two markers are subject to selection and were therefore not included in any population-level assessments of allele frequencies or heterozygosity. We do, however, separately report the allele frequencies at these loci to determine the potential for anadromy within Topanga Creek and nearby watersheds. Two additional loci were commonly identified as Mendelian incompatible loci across family groups during initial parentage analyses, which means the offspring and identified parent alleles at that locus do not follow the principles of Mendelian inheritance. This suggests these loci may be vulnerable to high genotyping error rates, and were therefore dropped. Lastly, one locus was removed as it was not present in the Southern California *O. mykiss* SNP baseline simply due to the evolution of our SNP genotyping panel, and therefore should not be considered when estimating genetic diversity and relatedness of the Topanga, Malibu and Arroyo Sequit Creeks populations with respect to the Southern California populations and hatchery strains.

We used genotype data from 92 of the 95 loci to perform parentage and sibling relationship (sibship) estimation. The two loci vulnerable to high genotyping error rates and one Omy5 locus were dropped. Only one of the two Omy5 loci was removed prior to parentage-based inference given that these loci can still provide unbiased information relevant to inheritance; however, linkage between these loci suggests using both loci would be redundant. Additionally, since this analysis does not require we pull information from the Southern California baseline, we could include the single locus at which all Topanga Creek samples were genotyped, but which was not present in the baseline.

Finally, any individual missing data at more than 10 of the included loci was dropped from all ensuing analyses.

Population genetics
We utilized the Microsatellite Toolkit to estimate heterozygosity and allele frequencies at the 90 loci and two Omy5 loci separately. These assessments were conditioned upon the sampling collection of the individuals, such that allele frequencies and heterozygosity were calculated for all individuals collected from Topanga Creek, Malibu Creek and Arroyo Sequit Creek separately.

Genetic assignment
To assess influence and relatedness to nearby *O. mykiss* populations on individuals residing in Topanga, Malibu and Arroyo Sequit creeks, all individuals were initially assigned to a baseline of hatchery strains and native Southern California populations (Clemento et al. 2009, Abadía-Cardoso et al. 2016) using a mixture analysis implemented in rubias (Anderson and Moran 2018). We also performed a self-assignment analysis, where all Topanga, Malibu and Arroyo Sequit Creek samples were included in the

reference, and individuals were assigned back to populations in the reference using a leave-one-out approach. A leave-one-out approach simply means the individual being assigned is not included in the respective source population during assignment. Assignments from the mixture and self-assignment analysis were filtered by posterior probability ε 0.95.

We also utilized the program STRUCTURE (Pritchard et al. 2009) to assess population structure and assign individuals to populations. STRUCTURE uses a clustering method, where the user specifies the number of populations (k), each of which is defined by locus-specific allele frequencies. Individuals are then probabilistically assigned to whichever cluster most closely aligns with their genotype. However, individuals can be assigned to several clusters if their genotypes suggest admixture between two or more identified clusters. We performed four separate runs, each constrained by a different number of clusters (i.e. k = 2, k = 3, k = 4, and k = 5), and each run was repeated five times. We visualized our results in DISTRUCT (Rosenberg 2003).

Sibship Analysis
Prior to performing any relationship estimation, all individuals were assigned a cohort, or birth year, according to their estimated age and collection date. Full sibling (FullSib) relationships were estimated in COLONY 2.0.6.4 amongst individuals within the same estimated cohort (Jones and Wang 2009). The input parameters for each run in COLONY2 were as follows: both sexes polygamous and dioecious; no sibship size prior or full sibship scaling; full likelihood estimation with medium run length and high precision; and no updating of allele frequencies. The allelic dropout rate and genotyping error rate were estimated at 0.0025 each. All FullSib families were filtered by Inclusive Probability (P(Inc.)) ≥ 0.90. The inclusive probability indicates how likely it is that a given family can be split into two or more additional families, such that a low P(Inc.) value would suggest the family has inaccurately grouped individuals into a FullSib family. Additionally, we did not consider FullSib families with less than three members (previous analyses have shown sibships of size two to be unreliable).

Parentage Analysis
Potential parent and offspring pools were constructed, such that all individuals born in the six years previous to the offspring pool cohort were considered potential parents. For example, if individuals born in 2018 were being analyzed as offspring, all individuals born in 2017, 2016, 2015, 2014, 2013, 2012 and 2011 would be considered potential parents (see Table 3.37 for full description). Constructing offspring and parent pools in this manner considers known reproductive and life history patterns for *O. mykiss* in Southern California, while also accommodating for potential errors in age estimates.

Parent-offspring trios were assigned using SNPPIT (Anderson 2010), assuming a genotyping error rate of 0.005. Each offspring cohort was analyzed separately and potential parent pairs were only required to be of the opposite sex. Resulting trios were filtered by a False Discovery Rate (FDR) ≤ 0.05. The False Discovery Rate is an analytical parameter, which effectively conveys statistical confidence in any assignment by defining a rate at which one may anticipate recovering false assignments given the data (Anderson 2012). For example, a filtration criterion of FDR ≤ 0.05, suggests one may expect 5 in every 100 assignments passing filter to be inaccurate. The resulting parent-offspring trios were analyzed to assess age at spawning amongst the identified parents.

2.5 Data Management

Field data were collected in the field using bound “Rite in the Rain” field notebooks and printed data sheets applicable for the type of data to be collected. At the end of each field day, all pages were reviewed for completeness and then photocopied and filed. Data were entered promptly into the appropriate Excel spreadsheet with two levels of review to ensure accuracy. First, when entering the initial data, the supervisor compared the entries to the field data sheet to confirm completeness and accuracy. The second level of review was performed by supervising RCDSMM staff and Stillwater Sciences staff when preparing the data for input into various models. The collection, processing, and entry of all data were performed in accordance with the Topanga Lifecycle Monitoring Quality Assurance/Quality Control Plan guidelines described in Appendix A.

2.5.1 Quality Assurance/Quality Control Plan

The design, collection, processing, and entry of all data were performed in accordance with the Topanga Lifecycle Monitoring Quality Assurance/Quality Control Plan guidelines described in Appendix A.

2.5.2 CDFW Coastal Monitoring Program

All data collected since 2008 was reorganized to fit the data templates provided by the CDFW Coastal Monitoring Program ACCESS database. This included individual tag data, count (condition, location, size), summary of samples collected, and redd data. This information has been submitted to CDFW for incorporation into the statewide monitoring ACCESS database by CDFW staff.

2.5.3 BIOS Metadata

In compliance with CDFW requirements, an updated metadata summary has been provided using the BIOS format. This information (abstract, purpose, date, point of contact, data type, field definitions, access constraint, use constraints, data distribution, progress, and update frequency) is provided in Appendix G.

3 RESULTS

3.1 Fish Capture and Detection Summary

PIT tag data analyzed in this report was collected from October 2008 through November 2017. A total of 1,687 *O. mykiss* were captured during all sampling efforts to date. The majority of fish were captured with electrofishing, although the electrofisher had a poor ability to capture fish in deep (>125 cm), complex, pools, where large (>200 mm) *O. mykiss* are observed in snorkel surveys. Appendixes B summarizes all fish capture and recapture data.

Overall, 66 captured *O. mykiss* were tagged with full duplex PIT tags, 262 were tagged with small half duplex tags, and 618 were tagged with large half duplex PIT tags (Table 3-1). To date, a total of 239 individuals have been recaptured at least once. In addition to *O. mykiss*, Arroyo chub (*Gila orcutti*), invasive fathead minnow (*Pimephales promelas*), Pacific tree frogs (*Pseudacris regilla*), and invasive red swamp crayfish (*Procambarus clarkii*) were also captured.

PIT (Passive Integrated Transponder) tags are commonly used for studying life history and population dynamics in fisheries. We were not able to assess whether PIT tags had any effect on the growth, long-term survival or behavior *O. mykiss* in Topanga Creek as we did not have any way of measuring growth of untagged individuals for comparison. We did, however, note any deaths due to the PIT tagging process (n=5).

We were also interested in potential PIT tag loss rates. Acolas et al. (2007) found a PIT tag (11.5 mm) rejection rate of up to 20% for juvenile brown trout ≥57 mm FL, while Gries and Letcher (2002) found a tag loss rate of only 0.2% in age-0 Atlantic salmon. These two studies were done in a controlled laboratory setting, while Ombredane et al. (1998) found a tag loss rate of 3.38% after seven months in a field experiment on age-0+ brown trout in a small brook. We did not set up an experimental design to look at PIT tag loss rates, and therefore could not determine rates of retention. However, genetic analysis revealed that 40 individuals were re-tagged in subsequent surveys as their previous tags had either been shed or were not functional. Furthermore, most recaptures did not have any evidence of tagging (i.e., no scarring at tag implantation site). Some recaptured and new individuals had a mark at the tagging site, it could not be assumed that it was from tagging. A sex bias was evident with 75% (30) of the re-tagged individuals assigning to “female” based on genetic sex determination.

Table 3- 1. Summary of *O. mykiss* captured, tagged, resighted, and recaptured in 2008–2018 monitoring.

Type of capture		Nov 2008	Nov 2009	Nov 2010	Mar 2011	Nov 2011	Mar 2012	Nov 2012	Mar 2013	Nov 2013	Nov 2014	Nov 2015	Nov 2016	Nov 2017	Total
Electrofishing Events	**TOTAL CAPTURES**	220	179	259	84	136	50	210	174	50	58	104	36	129	1687
	Total captured electrofishing	214	176	255	84	136	50	210	174	50	58	104	36	129	1676
	Total captured angling	--	--	3	--	--	--	--	--	--	--	--	--	--	3
	Total captured dip net (night)	2	0	--	--	--	--	--	--	--	--	--	--	--	2
	Total captured dip net (day)	0	2	--	--	--	--	--	--	--	--	--	--	--	2
	Total captured hoop-net traps	4	1	1	--	--	--	--	--	--	--	--	--	--	6
	Full duplex or small half duplex tags deployed	50	7	41	35	2	0	81	33	4	23	6	14	26	322
	Large Half duplex tags deployed	26	64	157	48	97	25	37	83	10	18	23	18	12	618
	PIT tag recaptures	--	1	15	18	36	25	22	48	22	13	21	14	4	239
	PIT Tags recovered that were deployed initially in this year			6	4	15	6	10	24	1	8	7	NA	NA	81
	Scale samples collected	101	94	170	83	134	32	144	166	40	46	53	34	84	1181
	Fin clips collected	101	93	166	64	97	25	122	116	28	33	28	18	119	1010
	Branded	1	2	0	18	16	9	3	14	0	2	3	2	0	70
	Mortality	0	2	0	0	0	0	1	0	0	0	0	0	0	3
Trapping Events		**2002-2003**	**2005-2006**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018***	**Total**
	TOTAL CAPTURES	15	10	1	1	11	12	0	0	0	0	0	0	0	50

	Total captured DS fyke net (2002-2010)	14	9	1	1	10	--	--	--	--	--	0	--	--	35
	Total captured DS weir trap (2010-2014)	--	--	--	--	--	10	_	_	_	_	_	--	--	10
	Total captured US weir trap	1	1	0	0	1	2	_	_	_	_	_	–	–	5
Antenna Detections					**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018***	**Total**
	TOTAL DETECTIONS				1	6	41	2	0	2	0	0	0	0	52
	Outmigrating US – DS				1	6	20	2	0	2	0	0	0	0	31
	Immigrating DS – US				0	0	2	0	0	0	0	0	0	0	2
	Unknown direction				0	0	19	0	0	0	0	0	0	0	19
DIDSON Camera								**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018***	**Total**
	Deployment Dates							April 12-14 2012	Jan 25-27 2013	Feb 28-Mar 2 2014	Dec 08-16, 2014	March 06-07, 2016	Jan 19-20, Feb 6-7,10-11,19-20		
	Number of hours deployed							39	39	49	0**	21	96.5	0	244.5
	Number of *O. mykiss* observed moving downstream							1 (initially recorded as 2)	0	ND	0	2	0	0	3
	Number of *O. mykiss* observed moving upstream							0	0	ND	0	0	0	0	0

* As of May 10, 2018.
**only deployed for training purposes.
ND=No data, because files were corrupted and recovery failed. Fish passage did occur during this event however, based on Antenna data.

3.2 Effects of electrofishing and processing

Because of the endangered status of this population, great care is taken whenever handling fish. It is possible though that fish can be injured during capture (electrofishing, trapping, hand nets, angling) and/or processing (anesthetization, insertion of PIT tag, scale and tissue sampling, and gastric lavage sampling). There has been little direct mortality from study activities (3 deaths out of 1,687 captures) however we have observed possible non-lethal injuries from branding. Recaptured fish rates and observations post-tagging events suggest that handling and PIT tagging does not affect survival.

3.2.1 Electrofishing Injury (Branding)

Dagit and Krug (2016) looked at rates of branding (i.e., external hemorrhaging), which were very low (i.e., 0 to 1%) during the November 2008, 2009, and 2010 events, but were generally higher in March 2011, November 2011 and March 2012 (Table 3-2). March 2011 was the first spring sampling event and the first time utilizing a new backpack electrofisher unit with a pulse width set at 6.3 mS rather than 4.5 mS. This new unit was used as one of two units in each subsequent fishing event, however great efforts were subsequently made to avoid branding and rates reduced again to a low 1% in November 2012, 8% in March 2013, and 0% in November 2013. Branding rates remained low from November 2014 -2017 with rates of 5%, 2%, 3% and 0%, respectively. Overall, fewer than 5% of total captured individuals exhibited branding.

Growth rates of individuals recaptured after branding were, on average, 31% lower than average growth rates for individuals in the same size class captured and recaptured in the same time period (Dagit and Krug 2016). The population-level effects associated with branding remain unknown. Although important information has been obtained through the use of electrofishing, the cumulative effects of electrofishing-induced injuries to this endangered species need to be considered.

Table 3-2. Summary of locations fished, water conditions, electrofisher settings, number of *Oncorhynchus mykiss* captured, recaptured, tagged and branded during each electrofishing sampling event in Topanga Creek from November 2008 to November 2017.

Electrofishing Event Date:	**Nov 2008**	**Nov 2009**	**Nov 2010**	**Mar 2011**	**Nov 2011**	**Mar 2012**	**Nov 2012**	**Mar 2013**	**Nov 2013**	**Nov 2014**	**Nov 2015**	**Nov 2016**	**Nov 2017**	
Locations fished	2050-2700, 3200-4400	1690-4200	1850-5100	1700-2520, 3225-3700	1780-5025	1780-4530	1690-4700	1680-4125	3200-4050, 5810	2100-4875	1700-5025	3450-4800	3560-4875, 2385-2925	
Water Temperature (^{o}C)	12.4-15	13-14	11.9-15	12	16	9.3-10	13-14	12-13	12.9	13.4	11.4	13.5	13.1	
Conductivity (mS)	1.2-1.5	ND	1.3-1.5	1.5	1.6-1.9	1.9	1.3-1.4	1.5	1.6	1.6	1.6	1.3	1.3	
Voltage (V)	120-150	120-150	130	100-130	130	145-160	145	145	130	100-130	120-130	130	130	
Pulse Rate (Hz) straight DC	45	45	32	32	32	32	32	40	32	32	32	30	30	
Pulse Width (mS)	4.5	4.5	4.5	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	
Flow (cfs)	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	<1 cfs	***Total***
Total new *O. mykiss* captured	220	179	259	84	136	50	210	174	50	58	104	36	129	1,687

Electrofishing Event Date:	Nov 2008	Nov 2009	Nov 2010	Mar 2011	Nov 2011	Mar 2012	Nov 2012	Mar 2013	Nov 2013	Nov 2014	Nov 2015	Nov 2016	Nov 2017	
Total PIT tagged	76	71	198	83	99	25	118	116	14	41	29	32	38	940
Total Recaptured	0	1	15	18	36	25	22	48	22	13	21	14	4	239
Total Branded	2*	2	0	18	16	9	3	14	0	2	3	2	0	70
% Branded	**1**	**1**	**0**	**2**	**12**	**18**	**1**	**8**	**0**	**3**	**3**	**5**	**0**	**4**
Mortalities related to electro fishing**	0	2	0	0	0	0	1	0	0	0	0	0	0	3

* During the November 2008 event, one individual was bent from the electrofisher, but not branded and so is not included in the total branded for this event.
** Mortalities included 2 individuals killed by improper placement of the PIT tag incision, and 1 individual killed when stepped on in turbid water during electrofishing.

3.2.1.1 Effects of branding on growth

Of the 1,676 individuals captured or recaptured by electrofishing between November 2008 and November 2017, 70 individuals were branded once, two individuals were branded twice for a total of 72 occurrences of branding, slightly over 4%. Of the 72 branded (or re-branded) individuals, 14 were recaptured post-branding, providing important data on growth and recovery. Only a single individual was observed upon recapture to have sustained spinal deformation (Figure 3-1C). The other 13 had no visible signs of branding injury, indicating some level of recovery. Individuals that were branded ranged in size from 112-301 mm FL, though approximately 79% were between 150 and 250 mm. Scale-aging techniques indicated that they were aged 0+ to 3+ years, which is in the range of the majority of fish captured throughout the study.

Figure 3-1. Photos of Branded *O. mykiss* in Topanga Creek: A) slightly branded - a single bruise on one side of the fish; B) branded - multiple bruises observed on head, dorsal and one or both lateral areas; and C) bent - obvious spinal deformity. (Dagit and Krug 2016)

Outlined below are the results of assessment of the four conditions related to branding:

a) Branded on initial capture and not recaptured

A total of 55 individuals ranging in size from 112-345 mm FL (average 192±44 mm FL) were branded on initial capture between November 2008 and November 2017. For the majority of these fish, the branding extent was recorded as “slight branding” or “branded”, with one or two marks observed along the dorsal column (Figure 3-1A and B). The effects of branding on growth rates of these individuals could not be evaluated since they have not been recaptured post-branding.

b) Branded upon recapture

Between March 2011 and November 2016, a total of 18 individuals were branded upon recapture. These fish ranged from 112-345 mm FL on initial capture and from 144–333 mm FL upon recapture when branding occurred. Fifteen of the 18 were recaptured within 50 m of the initial capture location, many in the same pool as initial capture. Average daily growth rate for these individuals was fairly consistent, and actually slightly higher (approximately 5%), than the average daily growth rate of non-branded individuals captured between the same time periods and in the same size classes. No difference is expected in growth rates of individuals in this group and non-branded individuals in the same size class captured and recaptured in the same time periods as branding would not have influenced the growth rate unless branding influenced length measurements at time of branding.

c) Recaptured after branding

Between November 2010 and November 2017, fourteen individuals ranging in size from 139-256 mm FL were recaptured post-branding (Table 3-2). Upon recapture, none of these recaptured fish showed any signs of scarring or malformation related to the previous branding. Of the fourteen individuals, three were captured a total of three times, and another a total of four times. All four were branded on their second capture. Of the three individuals captured multiple times, one exhibited below average growth between the first and second capture and above average growth between the second (when branding occurred) and third capture. Another one exhibited above average growth between the first and second capture followed by no growth post-branding, and the third showed above average growth initially and below average growth post-branding. The one individual captured four times exhibited a daily growth rate that was slightly above average between the first and second capture, and below average daily growth rates on the third and fourth captures post-branding (33% and 75%, respectively). This could be a reflection of the cumulative and long term effects of branding on an individual, increased exposure to electrofishing, and/or potentially reflect additional internal injuries that were not observed. In general, fish that were branded and then recaptured exhibited growth rates that were approximately 29% below average growth rates of non-branded individuals.

Table 3-3. Comparison of Daily growth rates of individuals recaptured after branding and individuals branded on both captures with average daily growth rates of individuals in the same size class captured and recaptured in the same time period*.

Recaptured after branding; n=12										
PIT TAG #	**Date**	**Dist (m)**	**Annular Rings**	**Fork L (mm)**	**New/ Recap**	**Branded date**	**Daily Growth Rate (mm)**	**Difference in growth***	**Above or Below Average?**	**% of average**
168779167	11/16/2010	2155	0+	143	N					
168779167	3/15/2011	2155	1+	186	R	3/11	0.361	-0.014	Below	-4
168779167	11/14/2011	2000	1+	206	R		0.082	-0.033	Below	-29
168779167	3/20/2012	2180	ND	208	R		0.016	-0.061	Below	-79
174147928	11/18/2010	2770	1+	194	N					
174147928	11/16/2011	3405	2+	238	R	11/11	0.121	-0.022	Below	-15
174147928	3/20/2012	3400	ND	249	R		0.088	0.011	Above	14
176795602	11/14/2011	2315	1+	201	N	11/11				

176795602	3/20/2012	2315	ND	215	R		0.11	0.033	Above	43
176795624	11/15/2011	4530	2+	212	N	11/11	0.078	0.001	Above	1.3
176795624	3/21/2012	4530	ND	222	R					
174147912	3/15/2011	2250	1+	191	N	3/11				
174147912	11/14/2011	2255	2+	208	R		0.069	-0.046	Below	-40
176795567	11/14/2011	2015	2+	207	N	11/11				
176795567	11/26/2012	2015	3+	222	R		0.040	-0.027	Below	-40
178695826	11/16/2011	4395	1+	209	N	11/11				
178695826	11/28/2012	4395	2+	236	R		0.071	0.005	Above	8
178695916	3/20/2012	2835	1+	219	N	3/12				
178695916	11/26/2012	2500	2+	221	R		0.008	-0.047	Below	-85
174147921	11/18/2010	2490	1+	139	N					
174147921	3/15/2011	1950	1+	205	R	3/11	0.564	0.189	Above	50
174147921	11/26/2012	1780	2+	255	R		0.080	0.000	Equal	0.0
176795569	3/16/2011	3475	1+	143	N					
176795569	3/21/2012	4000	2+	241	R	3/12	0.264	0.071	Above	37
176795569	11/27/2012	4050	3+	228	R		-0.052	-0.106	Below	-195
176795556	3/16/2011	3685	1+	170	N	3/11				
176795556	11/16/2011	4000	2+	190	R		0.082	-0.033	Below	-29
178696034	3/20/13	4100	1+	154	N	3/13				
178696034	11/19/14	4220	2+	195	R		0.067	-0.073	Below	-52
							Average		**Below**	**-23**

Branded on both captures; n=2

PIT TAG #	Date	Dist (m)	Annular Rings	Fork L (mm)	New / Recap	Branded date	Daily Growth Rate (mm/d)	Difference in growth *	Above or Below Average	% of average
176795575	11/14/2011	1780	1+	230	N	11/11				
176795575	3/20/2012	1780	1+	226	R	3/12	0	-0.077	Below	-100
							-0.031			
0379091200513599	11/26/2012	2130	0+	129	N	11/12				
0379091200513599	3/19/2013	2130	1+	144	R	3/13	0.133	-0.166	Below	-56
							Average		**Below**	**-78**

* Difference in growth is the difference in the daily growth rate of the branded individual and the mean daily growth rates of individuals in the same size class that were captured and recaptured in the same time period (see Table 3-7 for average daily growth rates by size class and capture-recapture period).

d) Branded on multiple captures

One individual was branded at first capture in November 2011 at a size of 230 mm FL and branded again upon recapture in March 2012 in the same pool at a size of 226 mm FL. This difference may illustrate a limitation of measurement precision, rather than actual loss of length, although slight spinal deformity is a possibility. Another individual was first captured and branded in November 2012 at a size of 129 mm FL and was recaptured and branded again in the same pool in March 2013 at a size of 144 mm FL. This fish exhibited an average daily growth rate of 0.13 mm/day, which is about 56% below the 0.30 mm/day average growth rate exhibited by non-branded fish captured and recaptured in the same time period and in a similar size class. Branding could have influenced reduction in daily growth rate observed in these individuals. Cumulative effects of multiple brandings can be observed if these individuals are captured again.

Potential causes of branding

a) Water conditions and electrofisher settings

Water temperature (ºC) and conductivity (mS), conditions that would affect the efficiency of the electrofisher units, did not vary much among events (see Table 3-2). Electrofisher settings ranged from a voltage of 100 to 160 V and a pulse rate of 32 to 45 Hz. Pulse width was set to 4.5 mS for the first three events in both units and to 6.3 mS in one unit (the other unit still at 4.5 mS) starting with the March 2011 event.

b) Habitat characteristics

There were 50 discrete locations where branding occurred among the thirteen events (Table 3-4). Twelve locations, primarily pools, had two or more occurrences of branding throughout the study. Branding occurred in three habitat types, with the majority of branding occurring in pools that ranged from 55 to 185 cm maximum depth. Pools with boulder or sand substrates and step pools with boulder substrate made up 76% of habitat units where branding occurred. Fifty-five percent of fish branding occurred in pool habitats with boulder or sand bottoms that had a mean, maximum depth of 109 cm and 103 cm, respectively.

Table 3-4. Summary of habitat types, dominant substrate, and maximum and average depths of habitat units in Topanga Creek where fish were branding occurred during electrofishing events, 2008-2017.

Habitat Type	Dominant Substrate	# Units	% of Total Units	# Units w/ Multiple Brandings	Maximum Depth (cm) Range / Mean	Average Depth (cm) Range / Mean	# of Brandings	% of Total Brandings
	Boulder	13	26	5	65 – 185 / 109	40 – 80 / 63	20	29
	Cobble	3	6	0	60 – 165 / 102	30 – 80 / 57	3	4
Pool	Gravel	6	12	1	60 – 125 / 80	35 – 75 / 46	7	10
	Sand	11	22	4	55 – 160 / 103	40 – 80 / 58	18	26
	TOTAL	**33**	**66**	**10**	**55 – 185 / 101**	**35 – 80 / 58**	**48**	**69**
Step	Boulder	14	28	2	40 – 110 / 66	25 – 65 / 41	17	25
Pool	Sand	1	2	0	70 / 70	30 / 45	1	1
	TOTAL	**15**	**30**	**2**	**40 – 110 / 66**	**20 – 65 / 42**	**18**	**26**
Step	Boulder	1	2	0	40 / 40	25 / 25	1	1
Run	Cobble	1	2	0	70 / 70	30 / 30	1	1
	TOTAL	**2**	**4**	**0**	**40 – 70 / 55**	**25 – 30/27**	**2**	**2**

3.2.2 Effects of Gastric Lavage on Growth

Of the 159 individuals lavaged from 2010 - 2013, 102 individuals were never recaptured. Twenty-five individuals were lavaged upon second capture, and three individuals' recapture status is unclear because of misrecorded data. The effects of lavage on these individuals could not be examined. Twenty-nine individuals were recaptured post-lavage, allowing for analysis of the potential effects of lavage on growth (Table 3-5). One individual was captured three times and lavaged on both the first and second capture. Eight of these were captured on three occasions, and another individual was captured four times. Twenty-two were lavaged on first capture and subsequently recaptured. Five were lavaged on first recapture and recaptured a second time. Five lavaged individuals were branded on subsequent recapture, and one individual had been branded on first capture, lavaged, and branded again on recapture. We compared growth rates of lavaged individuals (between lavage and next capture if captured-recaptured more than once) with growth rates of similar sized individuals captured and recaptured in the same time period.

Overall, gastric lavage appears to have only a slight negative effect on growth. When branded individuals were included in the analysis, growth was about 5% lower for lavaged individuals than on average. If branded individuals were removed from analysis, to avoid compounding potential impacts on growth, there was no difference between average growth rates and average growth of lavaged individuals, suggesting very little to no long-term effects of lavage, especially relative to impacts from branding (see Section 3.2).

Table 3-5. Comparison of daily growth rates of recaptured, lavaged individuals with average growth rates of individuals in the same size class captured and recapture in the same time period*.

PIT TAG #	Date	Dist (m)	Annular Rings	Fork L (mm)	New/ Recap	Lavage ?	Branded?	Growth rate (mm/day)	Difference in growth*	Above or Below	% Difference
166458497	11/16/2010	1900	1+	200	N	11/10					
	11/14/2011	1980	1+	227	R			0.07	-0.07	Below	-48
166458541	11/16/2010	1940	0+	135	N	11/10					
	3/15/2011	1940	1+	185	R		3/11	0.42	0.05	Above	12
168779140	11/17/2010	4710	0+	134	N	11/10					
	11/28/2012	4230		223	R			0.12	0.00	-	0
168779149	11/17/2010	4900	2+	250	N	11/10					
	11/15/2011	4920	3+	297	R		11/11	0.13	0.03	Above	36
168779159	11/17/2010	4410	1+	203	N	11/10					
	11/16/2011	4370	2+	241	R			0.10	0.01	Above	10
	3/21/2012	4330	ND	245	R			0.03	-0.02	Below	-40
168779167	11/16/2010	2155	0+	143	N	11/10					
	3/15/2011	2155	1+	186	R		3/11	0.36	-0.01	Below	-4
	11/14/2011	2000	1+	206	R			0.08	-0.03	Below	-29
	3/20/2012	2180	ND	208	R			0.02	-0.04	Below	-70
168779172	11/16/2010	1940	0+	143	N	11/10					
	11/14/2011	2130	1+	233	R			0.25	0.08	Above	45
	3/20/2012	2130	ND	238	R			0.04	-0.01	Below	-26
174147920	11/18/2010	2490	3+	204	N	11/10					
	11/14/2011	2435	4+	222	R			0.05	-0.05	Below	-48
174147928	11/18/2010	2770	1+	194	N	11/10					
	11/16/2011	3405	2+	238	R		11/11	0.12	-0.02	Below	-15
	3/20/2012	3400	ND	249	R			0.09	0.04	Above	66
176795559	3/16/2011	3500	1+	196	N	3/11					
	11/16/2011	3500	2+	221	R			0.10	-0.01	Below	-11
176795565	11/14/2011	1990	1+	180	N	11/11					
	11/26/2012	2095		210	R			0.08	-0.02	Below	-22
176795570	3/16/2011	3255	1+	172	N	3/11					
	11/15/2011	3320	2+	205	R			0.14	0.02	Above	18
176795575	11/14/2011	1780	1+	230	N	11/11	11/11				
	3/20/2012	1780	1+	226	R		3/12	-0.03	-0.08	Below	-159
176795591	11/15/2011	4400	2+	293	N	11/11					
	3/21/2012	4360	ND	295	R			0.02	0.00	Below	-2
176795619	11/14/2011	2130	3+	320	N	11/11					
	3/20/2012	2130	ND	319	R			-0.01	0.00	-	0
176795642	3/16/2011	3470	1+	178	N	3/11					
	11/16/2011	3940	2+	210	R			0.13	0.02	Above	14
178695832	3/21/2012	4000	1+	210	N	3/12					
	11/27/2012	4000		217	R			0.03	-0.03	Below	-49
178695842	3/21/2012	4270	1+	186	N	3/12					
	11/28/2012	4270		205	R			0.08	-0.01	Below	-10
178695845	11/16/2011	3525	1+	201	N	11/11					
	11/27/2012	3560		226	R			0.07	0.00	Above	0

PIT TAG #	Date	Dist (m)	Annular Rings	Fork L (mm)	New/ Recap	Lavage ?	Branded?	Growth rate (mm/day)	Difference in growth*	Above or Below	% Difference
178695877	3/20/2012	2250	1+	192	N	3/12					
	11/26/2012	2270		194	R			0.01	-0.08	Below	-91
178695903	3/20/2012	2960	1+	218	N	3/12					
	11/27/2012	3065		224	R			0.02	-0.03	Below	-57
178695910	3/20/2012	2975	ND	216	N	3/12					
	11/27/2012	2990		228	R		11/12	0.05	-0.01	Below	-13
166458537	11/5/2009	4020	0+	125	N						
	11/16/2010	2300	1+	207	R	11/10		0.22	0.03	Above	19
	11/14/2011	2315	2+	253	R			0.13	0.03	Above	33
178695836	11/16/2011	4300	Regen	227	N						
	3/21/2012	4200	ND	240	R	3/12		0.10	0.05	Above	95
	11/28/2012	4300		252	R			0.05	-0.01	Below	-13
0379091200547887	11/16/2010	2280	0+	120	N						
	11/14/2011	2220	1+	189	R	11/11		0.19	0.02	Above	11
	3/20/2012	2240	ND	195	R			0.05	-0.06	Below	-56
0379091200548908	3/15/2011	2070	1+	195	N						
	3/20/2012	1780	2+	233	R	3/12		0.10	0.00	Below	-2
	11/26/2012	1825		289	R			0.22	0.17	Above	306
4516726D06	11/20/2008	3400	0	110	N						
	3/16/2011	3470	2+	194	R	3/11		0.10	0.00	-	0
	11/16/2011	3445	ND	204	R			0.04	-0.07	Below	-65
168779189	11/16/2010	1975	0+	134	N	11/10					
	3/15/2011	2080	0+	163	R			0.24	-0.13	Below	-35
168779172	11/16/2010	1940	0+	143	N	11/10					
	11/14/2011	2130	1+	233	R	11/11		0.25	0.08	Above	45
	3/20/2012	2130	ND	238	R			0.04	-0.01	Below	-25
0379091166857756	11/27/12	3500	0+	127	N	3/12					
	03/20/13	3475	0+	139	R			0.11	0.00		
	11/19/13	3500	1+	181	R			0.17	0.06	Above	60
	11/18/14	3500	2+	203	R			0.06	-0.11	Below	-68
	11/10/15	3500	3+	255	R			0.14	0.08	Above	50

* Difference in growth is the difference in the daily growth rate of the lavaged individual and the mean daily growth rates of individuals in the same size class that were captured and recaptured in the same time period (see Table 3-7 for average daily growth rates by size class and capture-recapture period).

3.3 Age

Scales were collected from 1181 individual captures, including 184 individuals (Table 3-6), who were marked and recaptured at least once over 239 recaptures allowing for clear determination of scale-aging patterns. Scales collected from anadromous adult carcasses were also included.

3.3.1 Age assignments

For fish captured during November of any year, age 0+ refers to a fish that emerged January to July of that year and has reared in freshwater for one summer and fall and no winters. Age 1+ refers to a fish that emerged in the previous year and has reared in freshwater for two summers and one winter, age 2+ refers to a fish that emerged in spring two years prior and has reared in freshwater for three summers and two winters, and so on. Table 3-6 summarizes the age classes and sizes of *O. mykiss* in Topanga Creek during each electrofishing event, and one trapping event (January 2010).

Table 3- 6. Summary of age classes and size ranges of *O. mykiss* captured in Topanga Creek based on scale analysis, 2008-2017.

November 2008						
Age class	Cohort	n	Size range	Median	Mean	SD
0+	2008	174	55–125	98	97	14
1+	2007	24	113–226	129	149	34
2+	2006	6	187–291	219	229	42
3+	2005	4	278–309	293	293	13
4+	2004	2	310-322	316	316	8
November 2009						
0+	2009	114	60–125	90	89	13
1+	2008	49	130–215	165	164	19
2+	2007	11	170–235	205	201	21
3+	2006	2	240-255	248	248	11
January 2010						
0+/1+	2009	10	85-145	117	121	17
November 2010						
0+	2010	113	58-149	113	112	18
1+	2009	51	122-207	165	166	23
2+	2008	46	185-279	219	224	23
3+	2007	9	227-349	274	284	42
4+	2006	2	260-368	314	314	76
March 2011						
0+	2010	7	108-174	158	153	23
1+	2009	77	115-235	170	170	25
2+	2008	9	184-327	239	249	53
3+	2007	1	324	324	324	-
November 2011						
0+	2011	1	111	111	111	.
1+	2010	15	129-182	170	165	15
2+	2009	95	150-257	214	213	20
3+	2008	22	206-297	245	246	26
4+	2007	3	293-324	320	312	17
March 2012						

1+	2010	6	146-210	167	176	25
2+	2009	32	186-278	217	216	20
3+	2008	9	240-295	255	260	19
4+	2007	3	297-355	319	324	29
November 2012						
0+	2012	158	69-158	112	112	16
1+	2011	24	116-256	167	176	47
2+	2010	21	194-289	226	230	22
3+	2009	2	252-269	261	261	12
4+	2008	2	301-303	302	302	1
March 2013						
0+/1+	2012	152	95-209	141	142	22
2+	2011	8	177-246	199	206	26
3+	2010	9	221-290	240	249	22
4+	2009	1	278	278	278	.
November 2013						
0+	2013	5	92-136	105	107	18
1+	2012	15	133-254	164	170	30
2+	2011	11	158-249	189	195	34
3+	2010	3	218-264	264	243	23
4+	2009	1	374	374	374	.
November 2014						
0+	2014	9	105-147	116	123	15
1+	2013	22	119-266	159	171	46
2+	2012	14	126-278	213	218	54
3+	2011	9	203-345	257	268	69
November 2015						
0+	2015	9	48-111	84	84	21
1+	2014	17	123-245	155	169	43
2+	2013	23	201-317	246	250	31
3+	2012	9	255-308	298	287	19
4+	2011	1	339	339	339	--
5+	2010	2	273-386	330	330	80
November 2016						
0+	2016	4	65-155	80	95	41
1+	2015	17	107-187	141	144	22
2+	2014	5	197-246	206	211	20
3+	2013	4	314-333	323	323	8
4+	2012	4	260-317	315	302	28
5+	2011	1	359	359	359	--
6+	2010	1	284	284	284	--
November 2017						
0+	2017	95	65-144	88	92	23
1+	2016	23	96-249	126	146	45
2+	2015	7	192-305	211	226	40
3+	2014	3	225-246	234	235	11

Figure 3-2 illustrates the growth-related features of an otolith: a focus is visible in the center, followed by a translucent section (first summer of growth), an opaque section (first winter growth), a second translucent section (second summer of growth), and lastly by the very beginning of a second opaque section. Figure 3-3 shows scales from an *O. mykiss* first captured in November 2010 (124mm FL), and recaptured twice in March 2011 (175mm FL), and March 2012 (215mm FL). The age 1+ determination in March 2011 indicates that the individual hatched early in the sesason between January and early March of 2010. Although the scale from March 2012 is slightly regenerated, it is still possible to see 2 annuli, which is confirmed by the previous scales.

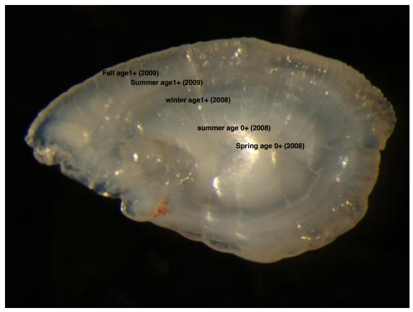

Figure 3-2. Interpretation of an otolith from an age 1+ *O. mykiss* captured in Topanga Creek in November 2009.

Figure 3-3. Scales from an *O. mykiss* captured three times in Topanga Creek between 2010 and 2011.

3.3.2 Age-length relationships

Age-length relationships were determined using two methods, cohort analysis and recapture analysis. Individuals were placed into cohorts and age-length relationships were graphed in order to visually compare size-at-age relationships of the various cohorts (Figure 3-4).

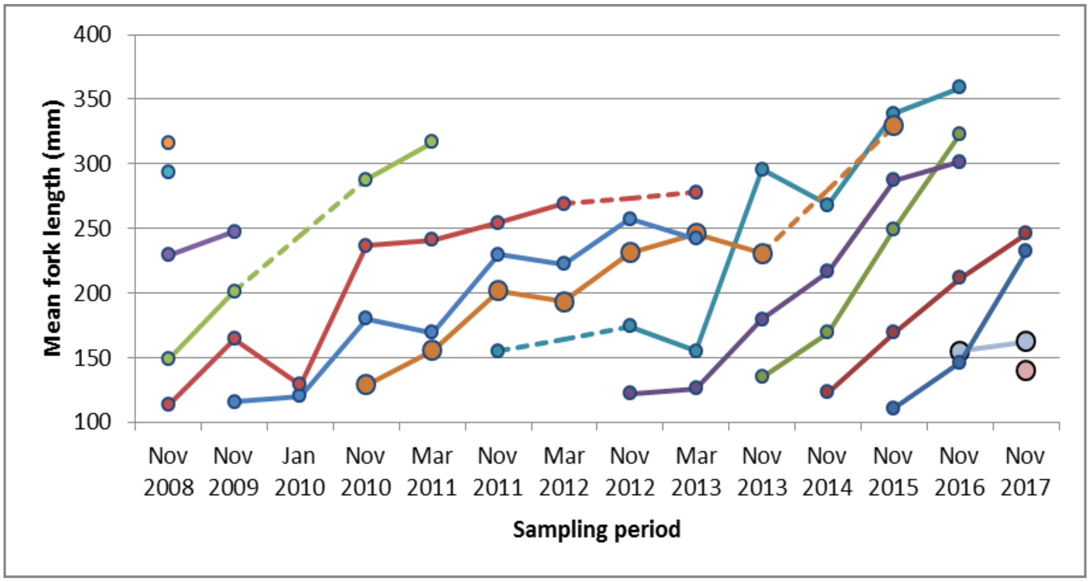

Figure 3- 4. Average lengths (mm; fork length ± SD) of *O. mykiss* cohorts observed in Topanga Creek during electrofishing events 2008-2017, and one trapping event in January 2010, (see Table 3-2 for sample sizes). Ages based on scale analysis. The dashed lines bridge "gaps" where no value was available (because no fish from that cohort was captured in that survey event).

3.4 Growth

During the November and March surveys the older age classes were larger on average than younger ones. The size-distributions for the different age classes of the November data sets (2008-2017) are unambiguously different (Figure -3-5). The size-distributions for the March data sets (2011-2013) are also all significantly different, but this significance is marginal in the 2+ vs. 3+ cases because the sample sizes are smaller than for other comparisons. No additional spring data is available.

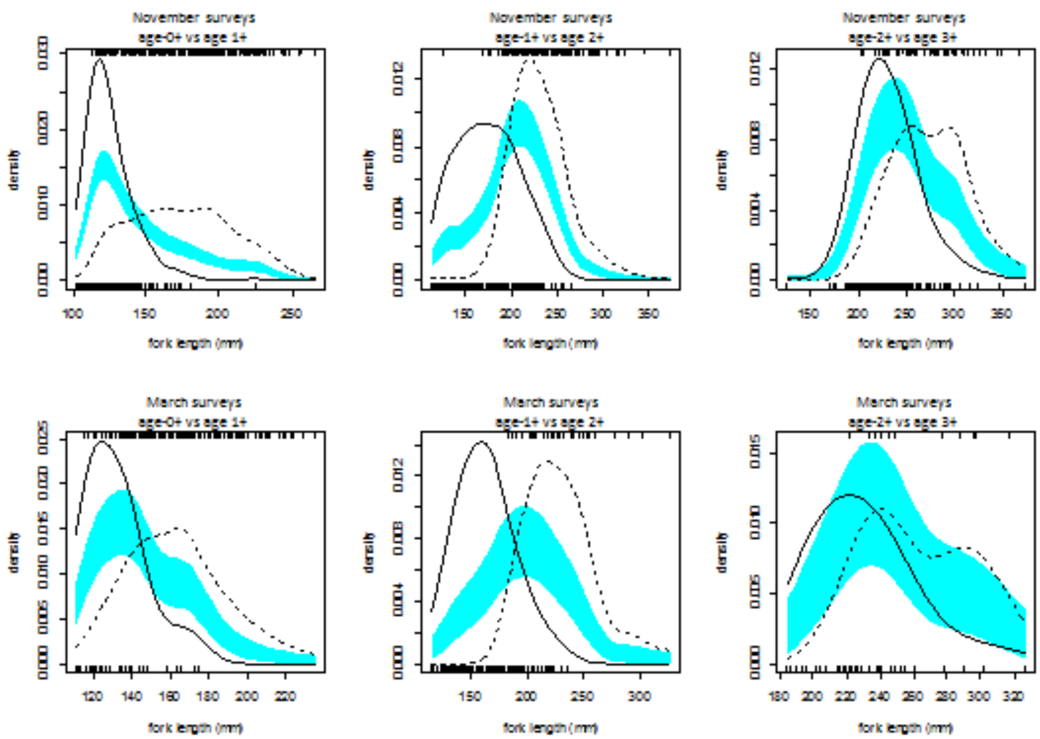

Figure 3- 5. Size distribution of PIT-tagged *O. mykiss* from 2008-2017. For each pair of age classes, the sizes of individual fish of the first age class are plotted as a rug at the bottom and a non-parametric estimate of their size distribution is plotted as a solid line; the sizes of fish of the second age class are plotted as a rug at the top and a dashed line. The grey band encodes a non-parametric test for equality of distributions. If the two data sets were drawn from the same distribution, the fitted lines would both lie within band with about a 95% confidence.

By examining the trajectory of the fork length of all observed fish in Figure 3-6, general patterns are evident. The slope of each line is an indicator of growth in this figure, such that high growth appears as a steep line connecting individual fish observations between periods. It is evident in this figure that growth is occurring during all seasons, and throughout the life of each fish. It is also clear that small fish grow at faster rates than larger fish, and that fish of the same initial size grow at similar rates between years, with exception. For example, change in size of small fish from November 2010 to March 2011, and from November 2012 to March 2013, appears to be substantially higher than during other periods. However, it is also evident that this may partially be due to fewer small fish present during November 2011 and November 2014-17. Larger adult fish (greater than 250 cm) showed greater increases in fork length in 2016 than 2011, but they also had a whole year to grow compared to just 4 months. These patterns are further explored in more detailed analysis of individual growth rates below.

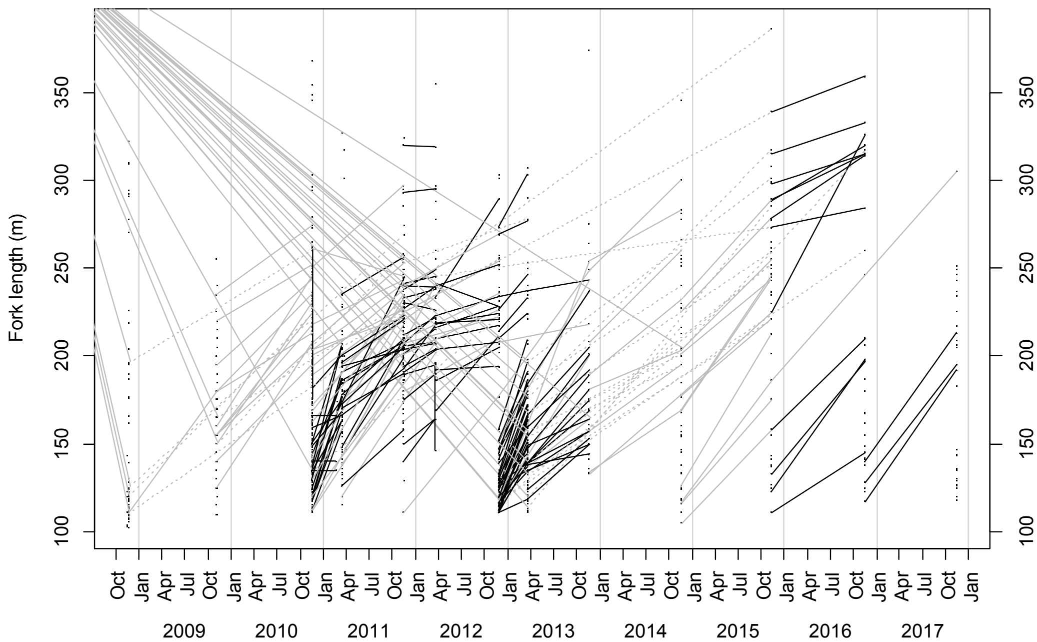

Figure 3- 6. Fork length of all observed *O. mykiss* from 2008-2017. Every measurement of a tagged fish is indicated with a dot. Successive captures of the same individual fish are connected with lines: solid black lines join points from consecutive seasons, solid grey lines join points from consecutive years, dotted grey lines join points separated by more than one year.

Intrinsic growth rate was calculated for all recaptured fish and summarized to assess annual growth (November to November), winter growth (November to March), and summer growth (March to November). Growth rate was observed to be strongly dependent on initial size, as is true with most fishes (Busaker et al. 1990), and so all analyses consider initial size. Based on Figure 3-7, annual growth rates appeared to be similar among years, although growth for the November 2011 to November 2012 year was lower on average for all fish sizes. This may correspond to particularly low rainfall in Water Year 2012 (October 2011 through September 2012) (see Appendix C), although Water Year 2013 was even drier, and growth rates were not correspondingly lower (see Section 3.4.5 for diet analysis). The largest individual fish captured and re-captured supporting individual growth measurements were in 2016. This is likely due to very low water conditions that concentrated larger fish into small habitat units allowing higher capture efficiency than was typically observed.

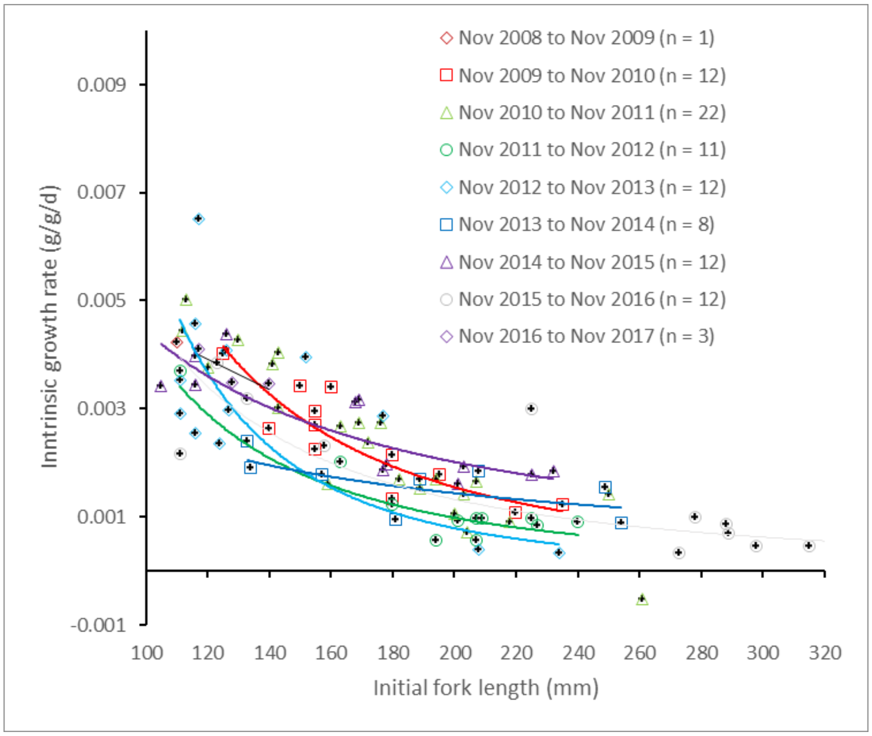

Figure 3- 7. Annual (November to November) intrinsic growth rate (g/g/d) based on successive captures of 93 individually PIT tagged *O. mykiss* in relation to initial fork length.

Based on growth rate analysis it appears that growth is occurring year-round during all years assessed, with substantially higher growth rates during the winter period of November to March for fish of most sizes (Figure 3-8). Based on the timing of capture events, it is not known if growth during "winter" is constant during the period, or occurring predominantly in late fall/early winter (November to December), or late winter/early spring (January through early March).

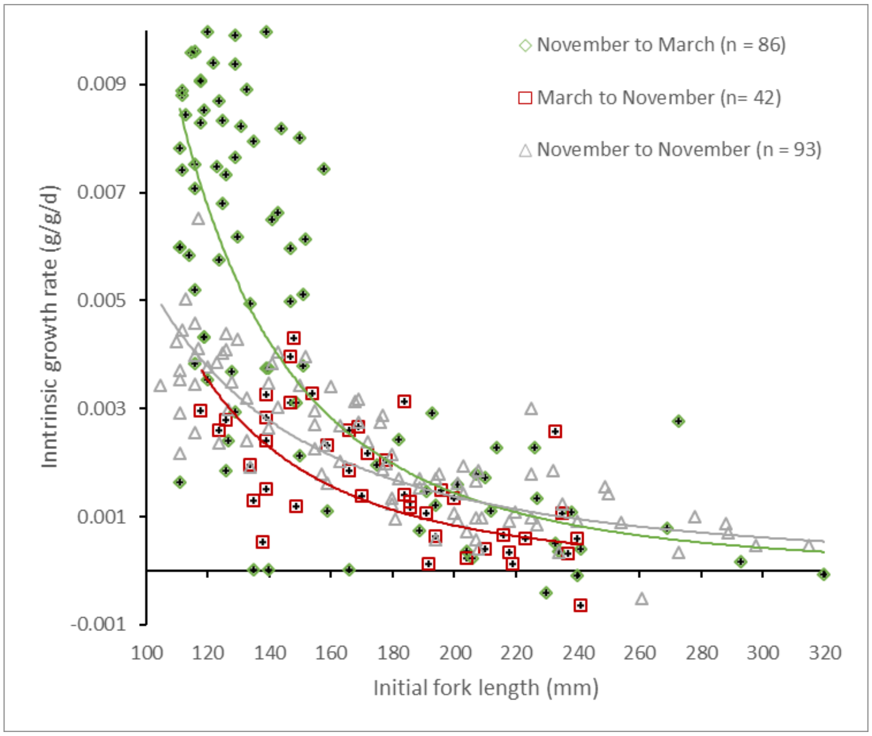

Figure 3- 8. Seasonal patterns in intrinsic growth rate (g/g/d) based on successive captures of 221 individually PIT tagged *O. mykiss*.

Based on examining the high growth period of November to March, we looked at annual variations in growth during this period. Growth appeared to be higher during November 2010 to March 2011 and substantially lower during the period from November 2011 to March 2012 for fish of all ages (Figure 3-9). Growth during the period of November 2012 to March 2013 also appeared substantially higher than during other time periods. However, this apparent pattern may be due in part to fewer small fish being observed in November 2011, as discussed above.

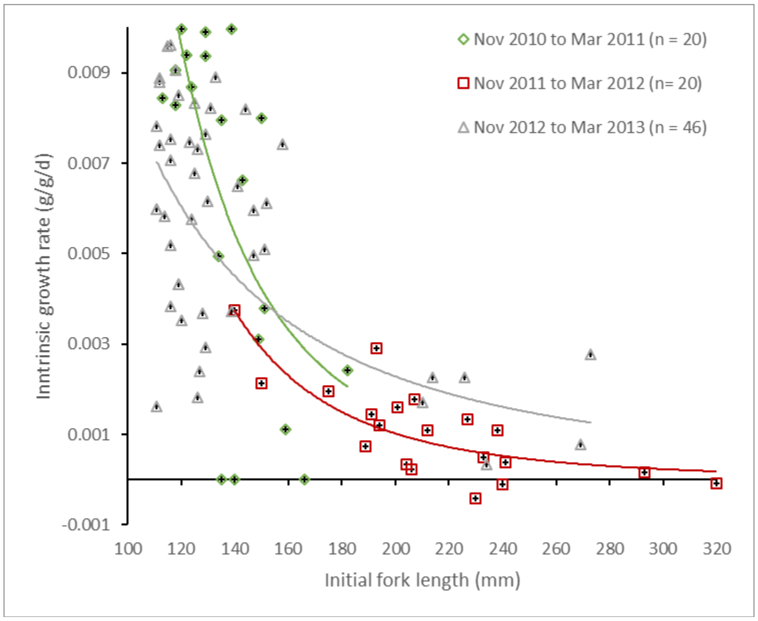

Figure 3- 9. Winter (November to March) patterns in intrinsic growth rate (g/g/d) based on successive captures of 86 individually PIT tagged *O. mykiss*.

During the lower growth period of March to November, growth appeared to be higher during 2011 and lower during 2012 (Figure 3-10). This pattern is likely related to fewer small fish observed during 2012, and fewer large fish (>200mm) observed during the other years.

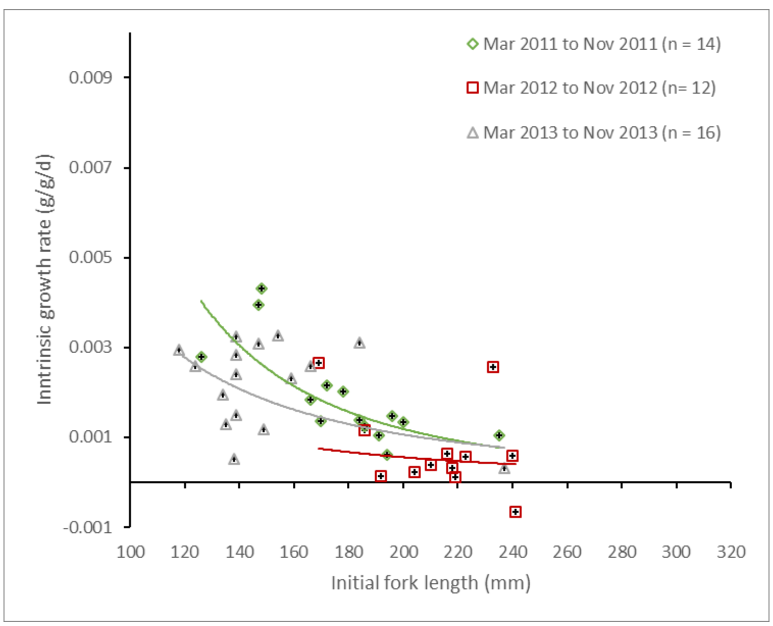

Figure 3- 10. Spring and summer (March to November) patterns in intrinsic growth rate (g/g/d) based on successive captures of 42 individually PIT tagged *O. mykiss*.

3.4.1 Growth patterns based on scale analysis

Based on examination of scales, it appears that the annulus (also known as a "growth check" resulting from reduced growth) begins to form during fall, likely due to decreasing water temperatures, decreased photoperiod, and reduced food availability. However, the annulus area on most of the scales is quite wide, which suggests that the fish continue to feed and grow at a reduced rate into late fall-early winter. Scales from March recaptures typically had an annulus followed by a period of fast growth, further indicating increased growth rates between late-November and March.

3.4.2 Growth rates based on cohorts

Table 3-7 summarizes the average growth rates by age group for the 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 and 2017 cohorts. See Section 3.2.1 and 3.3.2 for information on age determination and cohort analysis. Growth rate was based on median cohort size.

Table 3- 7. Summary of average growth rates of cohorts by starting age (based on age estimates from scale samples).

	Mean growth rate (mm/d)				
Growth period	**0+**	**1+**	**2+**	**3+**	**Overall**
Year					
11/08-11/09	0.20	-	-	-	0.20
11/09-11/10	0.22	0.16	0.09	-	0.15
11/10-11/11	0.22	0.13	0.05	-	0.15
11/11-11/12	0.13	0.06	0.06	-	0.08
11/12-11/13	0.20	0.20	0.03	-	0.17
11/13-11/14	0.10	0.10	0.14	-	0.11
11/14-11/15	0.17	0.17	0.16	0.15	0.17
11/15-11/16	0.09	0.17	0.13	0.06	0.11
11/16-11/17	-	0.20	-	-	0.20
Winter					
11/10-3/11	0.34	0.26	-	-	0.31
11/11-3/12	0.19	0.10	0.04	-0.01	0.07
11/12-3/13	0.30	0.22	0.10	0.07	0.28
Spring-Fall					
3/11-11/11	0.25	0.13	0.07	-	0.13
3/12-11/12	-	0.05	0.05	0.05	0.05
3/13-11/13	0.13	0.13	-	0.02	0.12

3.4.3 Growth rates used for branding and lavage analysis

Table 3-8 summarizes average growth rates of recaptured fish by size class. These growth rates were used to compare growth rates of branded and lavaged individuals in order to assess potential effects on *O. mykiss*.

Table 3-8. Average growth rates (mm/day) of various size classes of recaptured *O. mykiss* in Topanga Creek from 2008-2017. Sample sizes are in parentheses.

Time period	<120	120-160	161-200	201-250	251-300	>300	Overall	n
11/09-11/10	.	0.18 (7)	0.14 (3)	0.09 (2)	.	.	0.14 (12)	12
11/10-11/11	0.24 (2)	0.20 (5)	0.18 (4)	0.08 (5)	.	.	0.18 (16)	16
11/11-11/12	0.17 (1)	.	0.10 (3)	0.07 (4)	.	.	0.12 (8)	8
11/12-11/13	0.31 (2)	0.18 (2)	0.20 (1)	0.03 (1)	.	.	0.20 (6)	6

Time period	<120	120-160	161-200	201-250	251-300	>300	Overall	n
11/13-11/14	.	0.1 (2)	.	0.14 (1)	.	.	0.11 (3)	3
11/14-11/15	.	0.17 (3)	0.16 (3)	0.17 (6)	.	.	0.17 (12)	12
11/15-11/16	.	0.1 (1)	0.17 (3)	.	0.11 (5)	0.05 (3)	0.11 (12)	12
11/16-11/17	.	.	0.2 (2)	.	0.18 (1)	.	0.197 (3)	3
11/10-3/11	0.41 (2)	0.33 (9)	.	.	.	.	0.37 (11)	11
11/11-3/12		0.12 (2)	0.11 (4)	0.06 (2)	0.02 (1)	-0.01 (1)	0.06 (10	10
11/12-3/13	0.30 (18)	0.30 (17)	.	0.16 (3)	0.17 (2)	.	0.23 (40)	40
3/11-11/11	.	0.16 (3)	0.12 (8)	.	.	.	0.14 (11)	11
3/12-11/12	.	.	0.08 (3)	0.05 (6)	.	.	0.07 (9)	9
3/13-11/13	0.13 (1)	0.11 (12)	0.19 (2)	0.02 (1)	.	.	0.12 (16)	16
11/08-11/10	.	0.14 (1)	0.07 (2)	.	.	.	0.10 (3)	3
11/09-11/11	.	0.15 (3)	0.09 (1)	.	.	.	0.12 (4)	4
11/10-11/12	.	0.12 (1)	.	.	.	.	0.12 (1)	1
11/08-11/11	0.09 (1)	0.13 (1)	.	.	.	.	0.11 (2)	2
11/08-3/11	0.10 (1)	.	.	.	.	.	0.10 (1)	1
11/11-3/13	.	.	0.09 (1)	0.08 (1)	.	.	0.08 (2)	2
3/11-11/12	.	.	0.15 (1)	.	.	.	0.15 (1)	1
3/11-3/12	.	0.20 (2)	0.10 (1)	.	.	.	0.15 (3)	3

3.4.4 Growth and movement

One hundred and eighty four individuals were recaptured at least once and were used to assess movement of individuals within Topanga Creek. A total 239 recaptures occurred between 2008 and 2017.

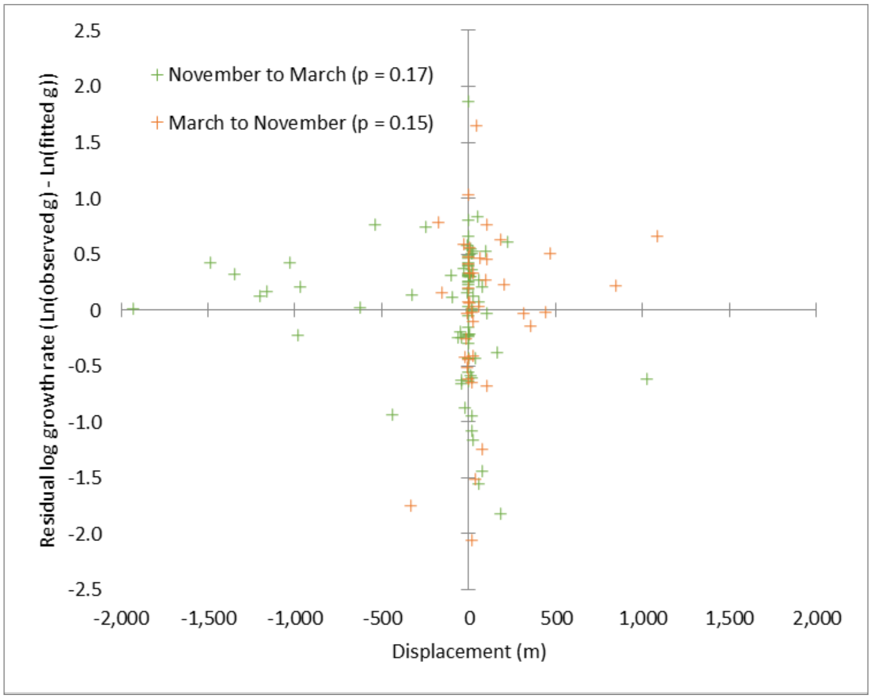

Figure 3- 11. Residual log growth rate compared with movement (m) within the Topanga Creek study area.

The relationship between location of fish within the study area (distance; m) and growth was also assessed. When capture distance (m) of fish was included in the analysis by comparing distance with residual log growth rate, there was no apparent relationship between growth and distance within the study area (Figure 3-11), and no significant relationship was found for either time period (November to March p=0.17, March to November p=0.15) (Figure 3-12).

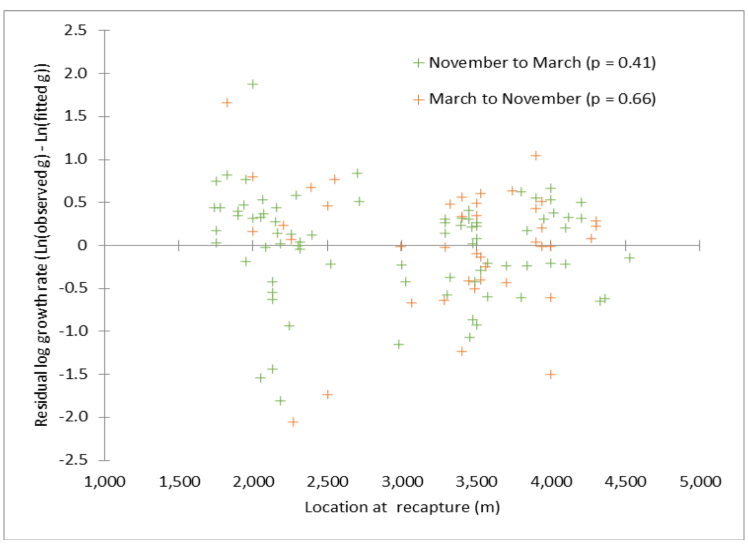

Figure 3-12. Residual log growth rate compared with distance (meters upstream) within the Topanga Creek study area.

In general, movement during November to March 2013 was initiated by smaller individuals, and was mostly in the downstream direction (Figure 3-13). During the summer (March to November) movement was less clearly related to size; although a substantial number of fish between 150 and 200 mm migrated upstream during this period.

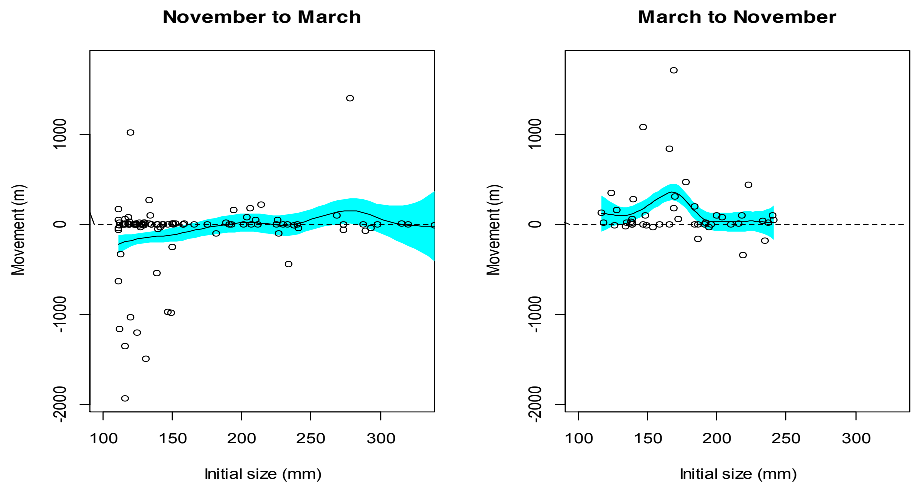

Figure 3- 13. Initial size (mm) and movement direction (m) within the Topanga Creek study area. The sample sizes are 98 and 46 for Nov-Mar and Mar-Nov, respectively. The shaded area is an approximate 95% "variability band."

Growth rates were also compared with density of fish within habitat units, and no relationship was detected (Figure 3-14). However, the movement of fish described in Section 3.3 may be related to density, as fish migrate to maximize growth, resulting in near uniform densities and no large differences in growth among habitats.

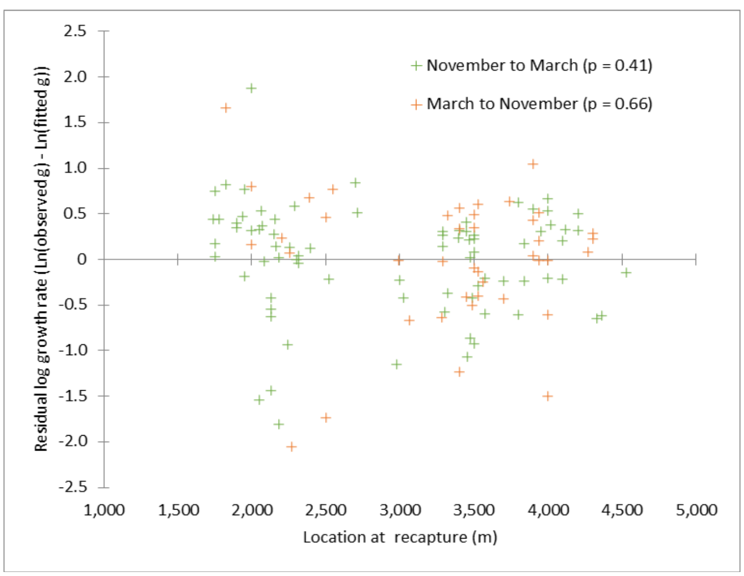

Figure 3- 14. Growth rates compared with location at recapture of *O. mykiss* in Topanga Creek.

3.4.5 Growth and diet

Stomach contents from four *O. mykiss* that died during the study, two in November 2009, one in January 2010 (carcass recovered) and one in November 2012 were removed and identified for each of these fish. Of the two November mortalities, one (180 mm FL) had nothing in its stomach, and the other (190 mm FL) had a low volume of stomach contents, consisting of an unidentifiable adult stage macro invertebrate and the remains of a small crayfish. The 118 mm (FL) fish dissected in January 2010 had a full stomach containing mosquito larvae, dragonfly larvae, a western sycamore beetle grub, unidentified insect larvae and the remains of at least one small (<50 mm) crayfish. However, only results from analysis of gastric lavage samples from living *O. mykiss* were used for the analyses of growth and diet below.

One hundred and fifty-nine gastric lavage samples were taken, and of those 130 were analyzed and used to determine diet composition of *O. mykiss* in Topanga Creek during three fall and three spring sampling events, November 2010 to March 2013 (Table 3-9). Twenty-four samples taken were not used as they had sardines in their stomachs from our baited hoop-net traps. The average number of prey items per stomach sample as well as the composition of prey types varied among years and seasons (Figure. 3-15 and 3-16, respectively). In general, *O. mykiss* in Topanga Creek appear to feed opportunistically and switch prey depending on what is available (e.g., more aquatic insects are available in the winter and less in the summer).

In fall (November) 2010, stomach samples had a equal amount of aquatic and terrestrial prey types (40% of each) and 20% composed of crayfish, fish (Arroyo chub) or snails, whereas in spring (March) 2011 the diet of *O. mykiss* consisted of primarily aquatic insects, few terrestrial insects and no fish, crayfish or snails. In fall 2011 and spring 2012, diet again was composed of primarily aquatic insects with fewer terrestrial insects and some crayfish, fish or snails. Then in fall 2012 fish, crayfish and snails composed the largest portion of the diet of *O. mykiss* in Topanga Creek, with fewer aquatic and terrestrial insects, and in spring 2013, although aquatic insects were the main item found in stomach samples, fish, crayfish and snails made up a large portion again.

Water year (October-May) total rainfall amounts decreased over the three years that stomach samples were taken (see water year totals in Figure 3-15 &16 listed above the spring events). Rainfall amounts prior to the November sampling event of each year (listed above the fall events) are also shown. The average number of prey items appears to coincide with highest rainfall amounts (Figure 3-15), and as rainfall decreased, the proportion of different prey types in the diet of Topanga Creek *O. mykiss* evened out (Figure 3-16), which may help explain the relatively high mean growth in Spring 2013 relative to rainfall (Table 3-9).

It seems logical that growth would be related to rainfall as rainfall, should be related to stream health and food availability in terms of benthic macro invertebrates. However, we did not see a clear relationship between rainfall, aquatic insect abundance, and growth. This further documents the opportunistic feeding habits of Topanga Creek *O.mykiss*. Not only did they switch prey among seasons, but among years as well, depending on condition and food availability. Snorkel survey data showed an increase in the invasive red swamp crayfish population since 2010, and interestingly, the percent frequency occurrence as well as the relative proportion of crayfish, fish, and snails as a prey type, also increased over time. Furthermore, despite "Below Average" rainfall status for 2012 and "Dry" status for 2013, growth in spring 2013 was second only to spring 2011 (an Above Normal rainfall year).

The increase in crayfish is likely due to the lack of high flow events over the low rainfall years which typically wash out crayfish in Topanga Creek. It is unclear whether the low rainfall or the increase in crayfish is effecting the benthic macro invertebrate assemblage, and, if so, to what relative extent. Garcia et al. (2015) suggest that both are negatively influencing the benthic macro invertebrate assemblage; however which is more important remains unclear. See Section 3.4.5.2 for additional results and discussion on food availability.

Table 3-9. Percent frequency occurrence (%FO*) of prey items in stomach content samples from *O. mykiss* in Topanga Creek, 2010-2013.

Prey Item	Fall 2010	Spring 2011	Fall 2011	Spring 2012	Fall 2012	Spring 2013
Rainfall (inches)	3.35	31.4	4.14	16.22	1.00	9.99
*Mean growth rates** (n)*	0.14 (12)	0.37 (11)	0.14(11)	0.06(10)	0.07(9)	0.23(40)
# of samples analyzed	43	13	24	20	10	20
Aquatic						
Diptera						
Larvae	14	92.3	45.8	85	20	35
Pupae	7	7.7	0	0	10	10
Trichoptera						
Larvae	48.8	69.2	62.5	75	40	30
Pupae	2.3	30.8	0	10	0	15
Ephemeroptera						
Baetidae: subimago	9.3	61.5	16.7	10	0	10
Baetidae: nymphs	11.6	69.2	29.2	5	20	30
Other	18.6	30.8	20.8	65	0	0
Odonata						
Nymphs	11.6	15.4	0	40	0	15
Plecoptera	0	15.4	4.2	35	0	5
Coleoptera	34.9	61.5	41.7	55	20	5
Hemiptera	25.6	53.8	20.8	15	0	20
Terrestrial						
Diptera						
Adult	53.5	53.8	4.2	10	0	10
Hymenoptera	34.9	69.2	25	30	0	5
Lepidoptera	14	38.5	4.2	0	0	0
Araneae	23.3	23.1	8.3	15	0	5
Amphipoda	23.3	15.4	45.8	45	10	0
Other						
Fish: Arroyo chub	4.7	0	0	0	10	5
Crayfish	9.3	0	12.5	50	40	75
Snails	34.9	23.1	50	15	40	5

*%FO = # lavage samples containing prey item / total # samples

**Mean growth rates (mm/day) based on analysis of recaptures from previous sampling season: Fall 2010=Nov 2009-Nov 2010, Spring 2011=Nov 2010-Mar 2011, Fall 2011=Mar 2011-Nov 2011, Spring 2012=Nov 2011-Mar 2012, Fall 2012=Mar 2012-Nov 2012, Spring 2013=Nov 2012-Mar 2013.

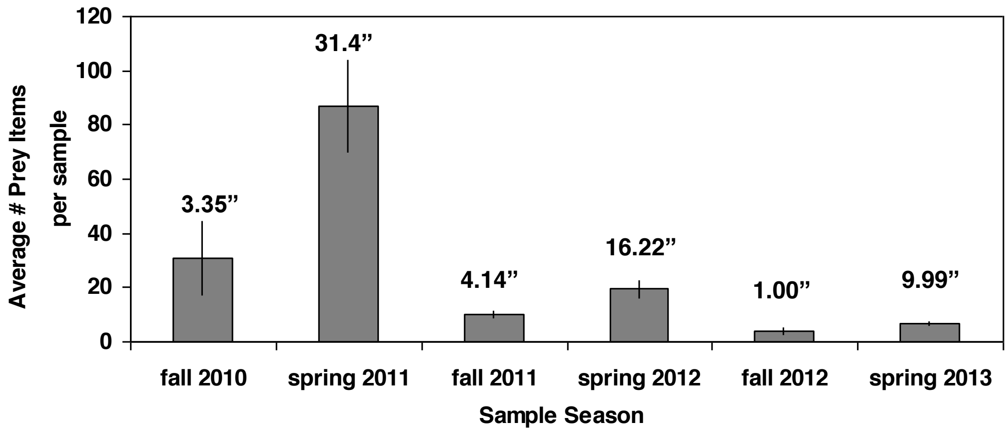

Figure 3-15. Average number of prey items in *O. mykiss* stomach samples from Topanga Creek, fall 2010-spring 2013.

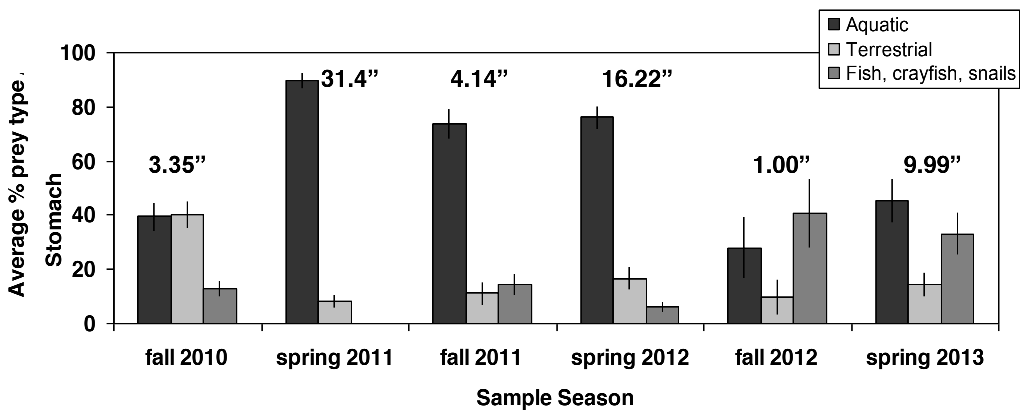

Figure 3-16. Percent of different prey types in *O. mykiss* stomach samples from Topanga Creek, fall 2010-spring 2013.

3.4.5.1 Food web dynamics (stable isotopes)

Of the 21 fish mucus samples shipped to the Northern Arizona University's Colorado Plateau Stable Isotopes Laboratory in March 2013, four were destroyed during shipping and could not be analyzed. The remaining 18 samples were weighed by the laboratory, and analyzed for $\delta^{13}C$, $\delta^{15}N$, %C, %N, and C/N (Table 3-10). Typically 1 mg of organic material is needed to reliably measure C and N isotopes. Very few mucus samples yielded enough material for isotope analysis. Based on these initial results no additional fish mucus samples were submitted. Clearly additional experimentation is required to find an approach to gather more mucus tissue, while maintaining the health of each fish.

The three fish, which yielded results for $\delta^{13}C$ and $\delta^{15}N$ isotopes, happened to be the three smallest fish sampled, so there is potential for fish as small as 150 mm to be effectively processed. An alternative method may be to massage the fish in the bag with epure water, filter the sample through 24 mm diameter glass-fiber syringe filters, and keep filtering until no more water can be passed through the sample (Melanie Caron, NAU Colorado Plateau Stable Isotopes Laboratory, *personal communication*). The next step would be to submit the filter for analysis without the drying/scraping/weighing process. This approach may yield more organic material from the fish mucus sample. We recommend trials potentially using hatchery fish in a controlled setting to develop a more reliable protocol prior to conducting additional field collection of fish mucus.

Table 3-10. Stable isotope analysis results.

FL (mm)	Vial Broken	Mass (mg)	$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)	%C	%N	C/N	Comments
307	Y	0.167	-27.62	8.03	22.86	3.88	5.89	C and N peaks too small
303	N	0.361	-29.41	5.52	13.03	1.43	9.15	C and N peaks too small
290	N	0.298	-27.01	5.74	15.28	2.22	6.89	C and N peaks too small
253	N	0.190	-31.94	2.83	40.75	2.35	17.35	C and N peaks too small
246	N	0.403	-28.44	5.07	17.32	2.68	6.46	C peak too small
240	N	0.674	-29.72	7.57	11.96	2.46	4.86	C peak too small
240	N	0.462	-27.77	5.83	17.28	2.62	6.60	C peak too small
207	N	0.562	-25.36	7.16	11.06	1.87	5.90	C peak too small
196	N	0.430	-26.74	9.18	15.39	2.43	6.34	C peak too small
190	Y	1.031	-24.54	5.68	9.57	1.31	7.30	C peak too small
184	Y	0.172						No Peaks
184	N	0.131						No Peaks
164	N	0.196						No Peaks
164	Y	0.112						No Peaks
160	Y	0.234						No Peaks
156	N	1.040	-28.98	5.93	13.30	2.34	5.69	
156	Y	0.771	-28.68	6.37	14.95	2.13	7.00	
152	N	0.660	-25.54	3.92	21.70	1.47	14.76	

The three samples for which enough organic material was collected were analyzed for $\delta^{13}C$ and $\delta^{15}N$ isotopes. Figure 3-17 shows an isotope biplot showing the C and N values for the consumers (fish) and the expected mean prey signatures. In general, consumers have N levels ~ 3 units higher and C levels ~1 unit higher than their prey. Isotopic signatures of other food web components were not analyzed, but primary producers tend to have N levels between ~ 0 – 1 and a wide range of C values between -34 – -24. Two fish had similar isotopic signatures, suggesting similar diets. With an N signature of ~6, the isotopes suggest that they were feeding on secondary consumers, such as macro invertebrates. The C value of these two fish is very different from that of the third fish, suggesting a different organic matter source at the base of their food chain. The third fish had an isotopic signature characteristic of an herbivore (e.g., N~4), which is unlikely for *O. mykiss*, suggesting that the isotopic values for this fish may not be reliable.

If this approach had been more successful with the *O. mykiss* processed, the food web would have been analyzed using the isotopic signatures of the prey items (e.g., algae, invertebrates, crayfish, chub) and the consumer (i.e., *O. mykiss*). Available isotope mixing models (e.g., Ward et al. 2011) would then be used to estimate the contribution of each prey source to the *O. mykiss* diet. We recommend development of a more effective method for obtaining organic matter from fish mucus, and then processing additional items of the food web.

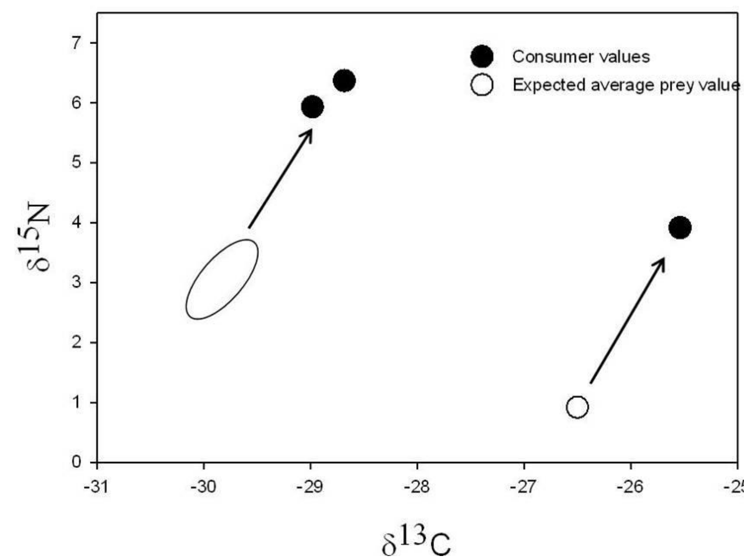

Figure 3-17. Stable isotopes biplot. Label dots with fish ID.

3.4.5.2 Food availability

Many potential *O. mykiss* prey items were observed in Topanga Creek, including Arroyo chub ranging in size from 3 mm to 150 mm FL, young-of-year *O. mykiss* smaller than 50 mm FL, crayfish smaller than 50 mm in length, as well as terrestrial and aquatic macro invertebrates. Of these potential prey types, aquatic macro invertebrates were typically the most common prey item for *O. mykiss*. Analysis of benthic macro invertebrate samples can be found in Dagit et al. (2018).

Results of this analysis indicate that diversity and density of macro invertebrates in Topanga Creek are sufficient to support a wide variety of predators, including *O. mykiss*. The assemblage is dominated by moderately tolerant species that are able to survive the high disturbance regime associated with the intermittent and variable rainfall patterns common in southern California (Table 3-11). The nutrient levels, temperatures and dissolved oxygen levels in Topanga Creek are generally suitable for aquatic invertebrates, although infiltration of fine sediment appears to limit production in some locations (Dagit and Webb 2002, Dagit et al. 2014, Dagit et al. 2018). The most dominant taxa observed were damselflies, chironomids, mayflies, caddisflies and true flies, all of which are documented food sources for *O. mykiss*. Observations during snorkel surveys indicate that Dobsonflies (Megaloptera: Corydalidae) and numerous species of dragonflies (Odonata) are abundant and regularly observed as well.

Table 3-11. Major groups of aquatic macro-invertebrates found in Topanga Creek, 2001-2017.

Common name	Class or Order	Family	Functional feeding group	Tolerance level*
amphipod	Amphipoda (*o.*)	--	collector gatherer	4
spider	Arachnida (*o.*)	Acari (*taxon*)	parasite	5
beetle	Coleoptera (*o.*)	Dytiscidae	predator	5
		Elmidae	collector gatherer/scraper	4

		Haliplidae	macrophyte herbivore	5
true fly	Diptera (*o.*)	Ceratopogonidae	predator	6
		Chironomidae	collector gatherer	6
		Culicidae	collector gatherer	8
		Simuliidae	filterer collector	6
		Stratiomyidae	collector gatherer	8
		Tipulidae	shredder/predator/shredder/collector gatherer/omnivore	2-6
mayfly	Ephemeroptera (*o.*)	Baetidae	collector gatherer	4-5
		Caenidae	collector gatherer	7
		Leptohyphidae	collector gatherer	4
		Leptophlebiidae	collector gatherer	4
ribbon worm	Enopla (*c.*)	Prostoma	predator	8
snail	Gastropoda (*c.*)	Physidae	scraper	8
true bug	Hemiptera (*o.*)	Hebridae	predator	6
aquatic moths	Lepidoptera (*o.*)	Pyralidae	shredder	5
dragon/damsel fly	Odonata (*o.*)	Aeshnidae	predator	5
		Coenagrionidae	predator	7
		Lestidae	predator	9
aquatic worm	Oligochaeta (*c.*)	--	collector gatherer	5
ostracod	Ostracoda (*c.*)	--	collector gatherer	8
caddisfly	Trichoptera (*o.*)	Hydroptila	piercer herbivore	6
flatworm	Turbellaria (*c.*)	--	predator	4

* Tolerance level: 0 = extremely sensitive to pollution, 10 = extremely tolerant of pollution (Bode et al. 1996)

3.4.5.3 Drift Net and Kick Net Abundance and Species Composition

Benthic macro invertebrates were sampled in drift nets from 2014-2017 during the months of March, July, and November (n= 94 total samples). Nets were set at 12:00 at 3.58 RKM and 3.6 RKM, and then sampled at 1800, 0000, 0600, and 1200 for six hour sampling periods. Invertebrates were also sampled with kick nets each spring from 2014-17 during April or May, in 150-meter reached of creek in both the lower (3.2-3.7 RKM) and upper (4.5-5.0 RKM). Eleven samples were collected in rifles using a standard D net, which is a 30-cm diameter, D-shaped rim fitted with a heavy canvas bag with a 500-micron mesh bottom. These eleven samples were then combined into a composite sample, with lower and upper sample for each year and a total of eight kick net samples according to the SWAMP Protocol (Fetscher et al. 2009).

There were some slight differences between the species composition of the upper and lower kick net samples, but with no significant difference in total invertebrate abundance and a small sample size (n=8), the lower and upper sites were combined when compared to all drift net samples (n=94). In total, 13,333 invertebrates of both aquatic and terrestrial origin were sampled by drift nets, and 6,389 invertebrates were sampled by kick nets.

One major difference that stood out when comparing the kick net to the drift net samples was that there were four more taxa representing over 1% abundance in drift net samples than in the kick net samples, showing a slightly more diverse species assemblage (Table 3.12). Odonata was rare in the kick net samples, while they were the most dominant invertebrate family in the drift net samples. Chironomids were dominant in both sampling methods, comprising 57.9% of the kick net invertebrate abundance and 14.2% of the drift net relative abundance. Drift net samples had nine taxa groups over 3% relative abundance, compared to only three groups over 3% abundance in all kick net samples. More details on the analysis of these samples is provided in Dagit et al. (2018).

Table 3.12. Percentage of each taxa representing over 1% of all kick net samples (n=8) and drift net samples (n=94) from 2014-2017.

Order	Family	Percentage of all kick individuals	Number of all kick individuals	Percentage of all drift individuals	Number of all drift individuals
Odonata	Coenagrionidae	-	-	15.3%	1,935
Odonata	Coenagrionidae (Argia sp.)	2.2%	139	-	-
Diptera	Chironomidae (larvae)	57.9%	3,700	14.2%	1,895
Diptera	Chironomidae (pupae)	-	-	2.1%	284
Diptera	Chironomidae (adult)	-	-	1.5%	195
Diptera	Simuliidae (Simulium sp. Larvae)	2.9%	186	1.1%	141
Diptera	Simuliidae	1.7%	108	-	-
Diptera	Ceratopogonidae (larvae)	-	-	3.3%	443
Diptera	Ceratopogonidae (pupae)	-	-	3.2%	422
Diptera	Unidentified Adult	1.1%	68	3.0%	398
Copepoda	Copepoda	1.7%	107	11.8%	1,583
Ephemeroptera	Baetidae	5.9%	378	10.4%	1,381
Ephemeroptera	Baetidae (Baetis sp.)	2.0%	126		
Amphipoda	Hyalellidae (Hyalella sp.)	8.0%	512	5.9%	790
Decapoda	Cambaridae	2.0%	125		
Turbellaria	Turbellaria	1.8%	117		
Trichoptera	Polycentropodidae	1.5%	96		
Trichoptera	Philopotamidae	1.2%	76		
Order	**Family**	**Percentage of all kick individuals**	**Number of all kick individuals**	**Percentage of all drift individuals**	**Number of all drift individuals**
Other (79 taxa groups)		10.2%	651		
Thysanoptera	Thysanoptera	-	-	5.7%	756
	Hemiptera			1.2%	164
	Aphidoidea (adult)			1.9%	251
	Corixidae (adult)			1.2%	157
	Formiscidae			1.5%	197
	Ostracoda			1.2%	154

Other (133 taxa groups)				16.4%	2,187

3.5 Size at outmigration

No outmigration in the traps was documented between 2014-2017. Previous data is reported in Dagit et al. (2016) and summarized here. Downstream-migrating *O. mykiss* (presumably smolts) have been captured during opportunistic migrant trapping efforts since 2002. Fifty fish were captured in downstream migrant traps (fyke until 2010, then weir) between 2002 and 2013. Figure 3-18 shows the sizes (mm; fork length) of all fish captured in outmigrant traps between 2002 and 2013. No fish were captured in downstream traps since 2012 as flows were too low to be able to set traps and have them function properly.

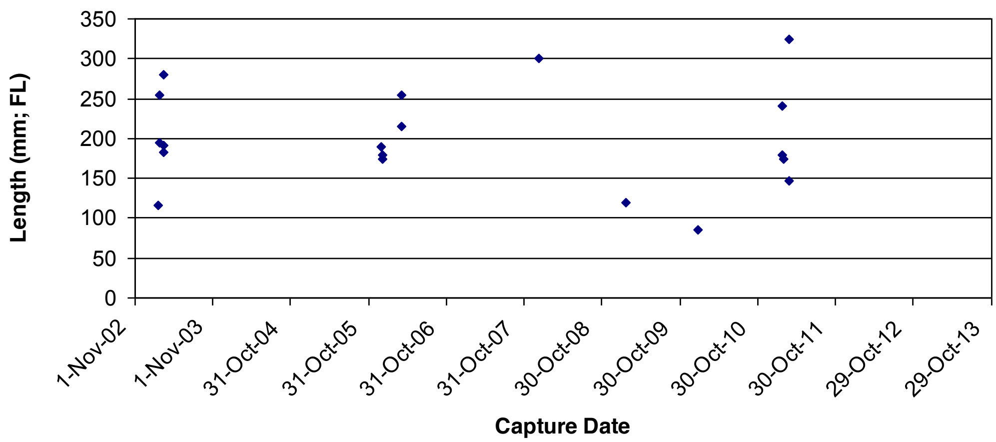

Figure 3-18. Sizes (mm; FL) of all outmigrant *O. mykiss* captured in downstream traps in Topanga Creek from 2002 to 2017 (n=50).

Two individuals were detected on March 1, 2014 on the antenna array set up at 610 river meters upstream of the ocean/creek interface. Previous capture and scale assessment of both individuals indicated that they were both 2+ years old when they migrated out of Topanga creek. No antenna detections were recorded from April 2014 through 2018.

Downstream migration appears to occur from early January to early April (Figure 3-19, Table 3-13), and is a function of instream flows and rain events, since the lower reach of Topanga Creek (0.5–1.5 RKM) is often dry from May through November. In general *O. mykiss* migrating downstream were larger than 100 mm FL and smaller than 250 mm FL, with a few exceptions (Figure 3-18). Fish migrating downstream in early January were generally larger than 150 mm FL, where as fish migrating a few weeks later in the end of January tended to be smaller than 150 mm FL (Figure 3-19). Many of the downstream migrants were observed moving downstream and then back upstream repeatedly at the PIT tag antenna before finally migrating downstream, suggesting a protracted migration. It is possible that these fish were continuing to grow and would enter the ocean at a larger size than documented at the outmigrant trap (1.3 RKM), however the size and condition of the lagoon is such that it likely does not promote rapid growth, and based on the low number of fish ever observed in the lagoon, it's likely that fish do not spend too much time in the lagoon, but rather move through it quickly into the ocean.

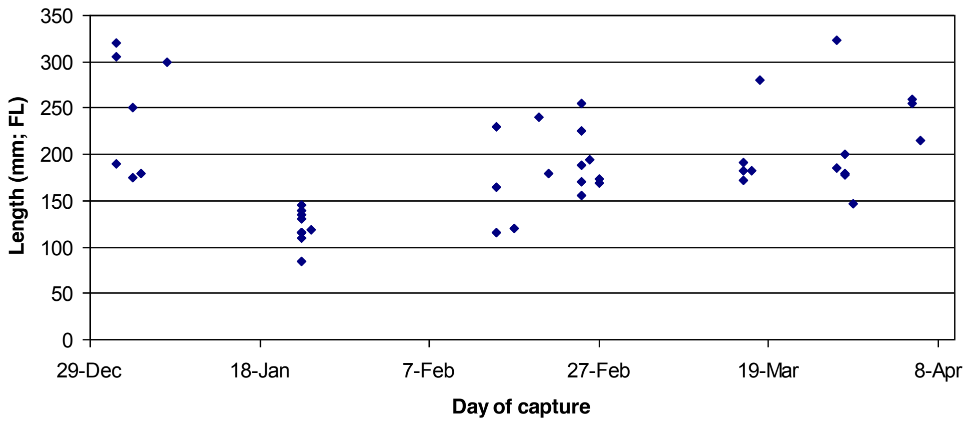

Figure 3-19. Day of year of outmigrant capture compared to size (n=50).

Table 3-13. Summary of all *O. mykiss* captured in traps at 1.3 RKM, 2003-2017*.
*No fish were caught in traps 2012-2017 (no trapping possibilities as flows were very low).

Date of capture	Time of capture	Fork length (mm)	Age based on scale analysis	DS Trap type (Fyke/Weir)
15 Feb 2003	1215	116	--	Fyke
	0415	230	--	Fyke
	0515	164	--	Fyke
25 Feb 2003	1815	255	--	Fyke
	1815	225	--	Fyke
	1815	188	--	Fyke
	2015	170	--	Fyke
	2015	155	--	Fyke
26 Feb 2003	0615	195	--	Fyke
16 Mar 2003	0220	192	--	Fyke
	0200	172	--	Fyke
	0515	182	--	Fyke
17 Mar 2003	0915	183	--	Fyke
18 Mar 2003	0200	280	--	Fyke
1 Jan 2006	1800	190	--	Fyke
	1800	305	--	Fyke
	1800	320	--	Fyke
3 Jan 2006	2000	175	--	Fyke
	2200	250	--	Fyke
4 Jan 2006	0100	180	--	Fyke
5 Apr 2006	1900	255	--	Fyke
	2000	260	--	Fyke
6 Apr 2006	0000	215	--	Fyke
7 Jan 2008	0500	300	--	Fyke
17 Feb 2009	0600	120	--	Fyke
23 Jan 2010	1900	85	1+	Fyke
	1900	145	1+	Fyke
	1900	135	1+	Fyke
	1900	140	1+	Fyke
	1900	115	1+	Fyke
	1900	110	1+	Fyke

Date of capture	Time of capture	Fork length (mm)	Age based on scale analysis	DS Trap type (Fyke/Weir)
	1900	115	1+	Fyke
	1900	115	1+	Fyke
	2200	130	1+	Fyke
24 Jan 2010	0700	155	1+	US Weir
	0700	118 - died	1+	Fyke
20 Feb 2011	1900	240	2	Weir
21 Feb 2011	0600	180	1+	Weir
27 Feb 2011	0400	174	0+	Weir
	0600	169	1+	Weir
27 Mar 2011	2100	324	2+	Weir
	2100	186	1+	Weir
28 Mar 2011	0000	301	2+	US Weir
	0100	200	1+	Weir
	0700	180	1+	Weir
	0900	317	3+	US Weir
	1200	178	1+	Weir
29 Mar 2011	0000	147	0+	Weir

3.6 Abundance trends

Abundance estimates for *O. mykiss* in Topanga Creek rely on three data sources: (1) monthly snorkel surveys conducted from June 2001 through December 2017, (2) redd surveys conducted from 2010 through 2018, and (3) focused PIT tag and recapture efforts in fall (November 2008 - 2017) and spring (March 2011-2013). Results of each of these are described in detail below.

3.6.1 Snorkel surveys

Snorkel surveys have been conducted monthly between the ocean and the previously assumed natural upper limit of anadromy (5.3 RKM) since June 2001. These surveys are funded by a separate CDFW grant and methods are detailed in previous reports (Dagit and Krug 2011, Dagit et al. 2015b, Dagit et al. 2016).

Based on plotting the scaled relative abundance of juvenile (<100 mm FL; also referred to as young-of-the-year), intermediate (100 - 250 mm FL), and adult (> 250 mm FL) *O. mykiss*, it appears that the relative abundance for all age classes fluctuates substantially among years (Figures 3-20 through 3-23). The pattern of *O. mykiss* relative abundance varied seasonally, though the number of *O. mykiss* counted during surveys may be affected by water clarity limitations (especially following storm events) and algal cover. Not surprisingly, surveys in spring and early summer (April–June) generally documented juveniles, except in 2005, when stream flow was high and very few small fish were observed (Table 3-14). The highest number of juveniles was observed in June 2008, when 590 small *O. mykiss* were counted. As the summer progressed, the numbers of fish in this size class decreased and the numbers in the intermediate size class increased (indicating growth from juvenile to intermediate), although the total population numbers decreased overall. Adults, presumably residents, have consistently been observed each year (Table 3-15), although their overall abundance has apparently been declining since 2006. Drought conditions lasting from 2012 through 2016 contributed to low numbers in all size classes, but normal rainfall in 2017 resulted in a bump in juvenile numbers and passage opportunities for anadromous fish. *O. mykiss* numbers remain low overall at the end of 2017 when comparing all previous years.

Rain events between 28 March and 5 April 2011 resulted in 6.16" precipitation. The snorkel survey conducted on 11 March documented a total of 303 *O. mykiss*, including 15 under 10 cm, 246 between 110-250 mm and 42 fish over 250 mm. The snorkel survey conducted on 15 April (with good visibility) found only 129 *O. mykiss* remaining, with 4 fish under 100 mm, 113 between 110-250 mm, and 12 over 250 mm. This suggests that a high proportion of fish from the March survey either outmigrated or died during that rain event. Extremely dry conditions have restricted movement between pools and to the ocean since 2012. Fish are confined to short connected stream reaches. However, when 26.34 inches of rain fell over the 2017 water year connection throughout Topanga Creek was restored, allowing for both movement throughout the creek and potentially migration between the creek and ocean. Only two anadromous adults were confirmed to enter Topanga Creek in 2017, but adult numbers increased as the year progressed suggesting that resident individuals may have moved during this time and were then confined when water levels and flow decreased during the summer to places where they were more easily spotted. The increased number of juveniles appears related a spawning event by one anadromous adult at 2.7 RKM who immigrated during the winter and died in the late summer of 2017.

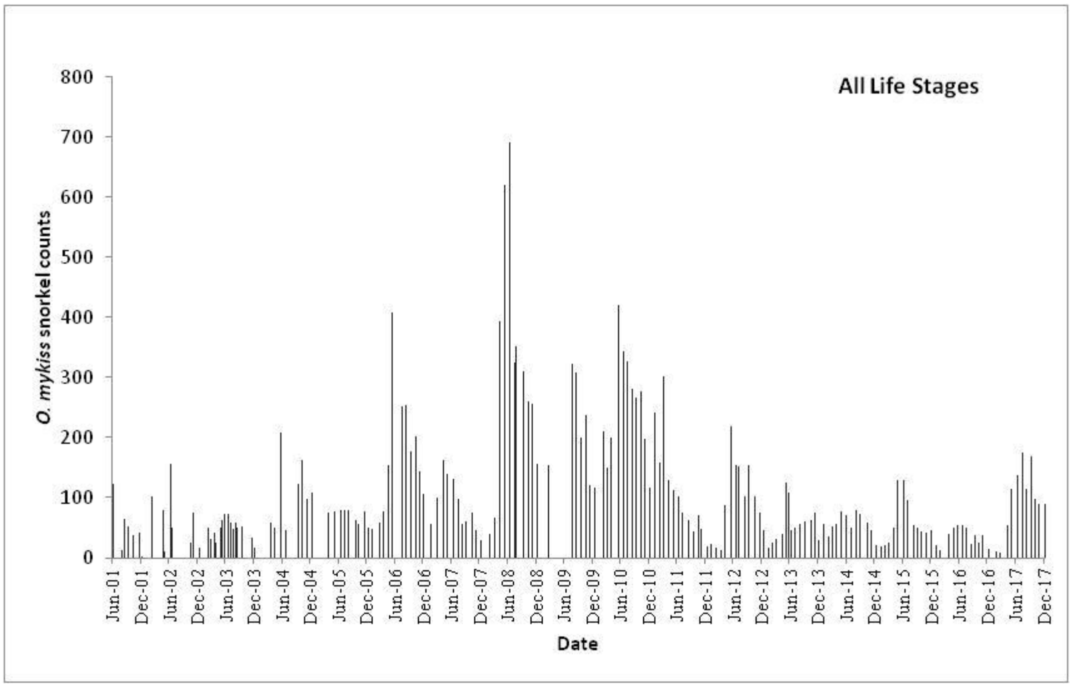

Figure 3- 20. Number of *O. mykiss* of all size classes observed in monthly snorkel surveys in Topanga Creek, June 2001– December 2017.

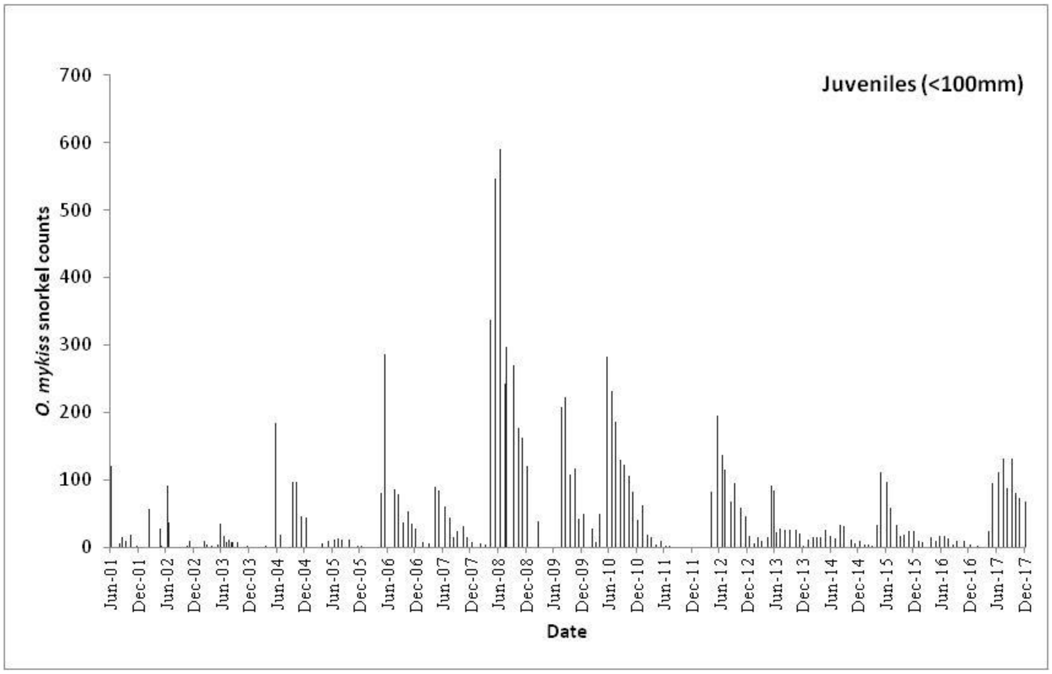

Figure 3- 21. Number of juvenile *O. mykiss* observed in monthly snorkel surveys in Topanga Creek, June 2001– December 2017.

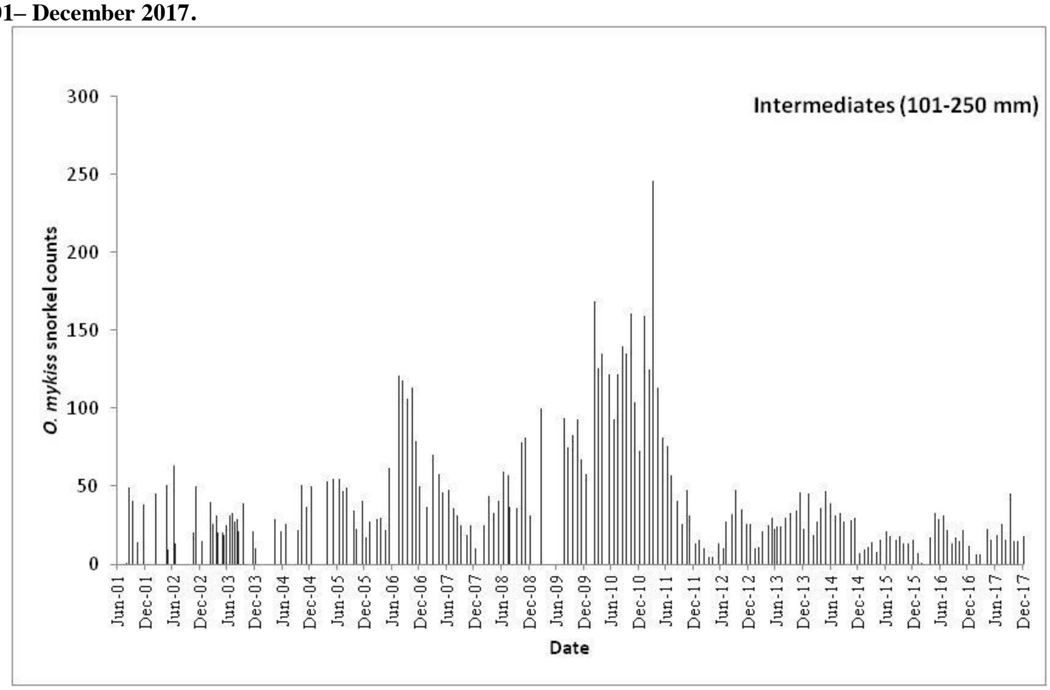

Figure 3- 22. Number of intermediate life-stage *O. mykiss* observed in monthly snorkel surveys in Topanga Creek, June 2001– December 2017.

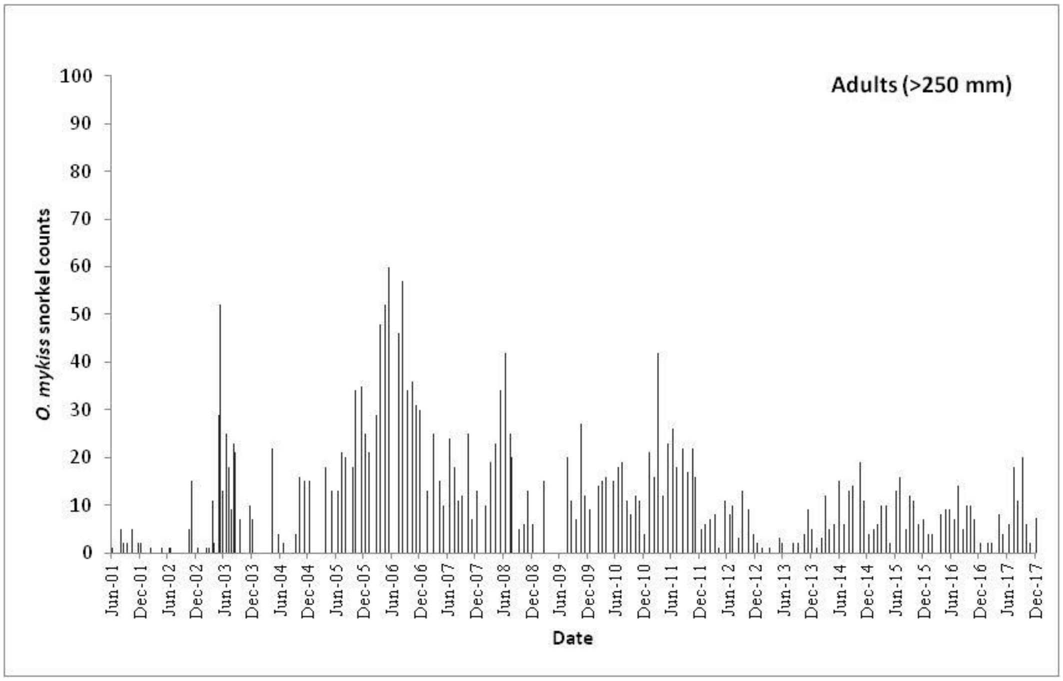

Figure 3- 23. Number of adult *O. mykiss* observed in monthly snorkel surveys in Topanga Creek, June 2001–December 2017.

Table 3- 14. Annual monthly maximum number of juvenile *O. mykiss* observed in Topanga Creek, 2001–2017.

Year	Total Rainfall (WY, inches)	Number of juveniles (<100 mm FL)	Month of maximum abundance
2001	27.8	118	June
2002	7.24	133	June
2003	17.92	20	June
2004	13.16	189	May
2005	61.58	11[a]	June
2006	21.98	287	May
2007	4.62	89	April
2008	23.08	590[b]	June
2009	16.16	223	August
2010	24.4	283	May
2011	31.44	62	January
2012	16.22	195	May
2013	9.99	92	May
2014	6.85	33	August
2015	13.76	112	May
2016	10.54	17	May
2017	26.34	132	July

[a]High rainfall during this period.
[b]Anadromous *O. mykiss* were observed in Topanga Creek, no rain during this period.

Table 3- 15. Average number of each size class based on combined monthly Topanga Creek snorkel survey observations 2001–2017.

Year of observation	Juvenile (<100 mm)	Intermediate (100–250 mm)	Adult (>250 mm)	Total
2001	25	25	3	53
2002	34	56	6	95
2003	6	34	19	59
2004	46	50	12	103
2005	6	46	20	71
2006	62	68	40	170
2007	35	36	16	86
2008	250	47	18	316
2009	112	81	14	209
2010	115	125	13	253
2011	9	85	20	114
2012	68	21	7	95
2013	28	26	2	56
2014	16	31	9	57
2015	35	14	9	59
2016	9	18	7	34
2017	73	18	8	96

3.6.2 Redd Surveys

Beginning in 2010, surveys for redds were conducted during snorkel surveys, as well as during additional focused spawner surveys conducted one or more days (if young of the year observed) monthly between December and May. Data was collected according to the southern steelhead Spawning Ground Survey protocols (NMFS 2017).

Most of the redds observed were fairly small, suggesting that predominantly resident *O. mykiss* were reproducing (McEwan and Jackson 1996), which is consistent with observations of fish between 130-230 mm FL either milling around redds, or having eggs or milt when captured. Because of the low flow conditions between 2005 and 2016, no anadromous adults were observed. Following the high flows in January – March 2017, two anadromous adults were observed, but no redds from those adults were found.

Between 1 and 9 redds have been observed per year in Topanga Creek (Table 3-16). However redds in Topanga Creek are difficult to observe, as they are typically relatively small and tend to deteriorate quickly. Several redds observed one week were difficult to find just one week later as they were covered with sediment and diatoms. A large cohort of juveniles was observed in a pool where one anadromous adult was restricted in the summer 2017, indicating that spawning had occurred there but no red was found.

Table 3- 16. Redds observed in Topanga Creek 2010-2018.

Date	Number Redds	Stream reach (RKM)	Location (meters)
4/9/10	4	2.4-3.5	2430-3490
2010 Total	**4**		
1/5/11	1	2.6	2600

1/14/11	1	2.3	2380
1/28/11	4	2.3-4.3	2385- 4270
3/16/11	1	3.4	3320
2011 Total	**7**		
2/3/12	1	3.6	3600
2/17/12	1	2.6	2600
2012 Total	**2**		
2/1/13	1	2.6	2650
3/1/13	2	3.6-4.4	3600, 4400
3/20/13	6	3.0-3.5	3030-4160
2013 Total	**9**		
2/21/14	4	1.7-6	2000-4160
3/4/14	4	1.7-6	2385-4100
3/7/14	1	3.6-6	4100
2014 Total	**9**		
3/6/15	1	3.6-6	4920
2015 Total	**1**		
2016 Total	**0**		
1/31/17	1	3.5	3490
3/10/17	1	4	4020
3/23/17	1	2.9	2910
2017 Total	**3**		
3/8/18	1	2.9	2940
4/5/18	3	2	2000
2018 Total	**4**		

Analysis of temporal pattern of observed redds (Table 3-17) suggests that the peak of spawning occurs in March in Topanga Creek, and the subsequent observations of young of the year occurs approximately two months later (Table 3-18), although young of the year are observed throughout the entire year (Figure 3-24) and are distributed throughout the entire survey reach.

Table 3- 17. Temporal distribution of redd observations 2010 -2018 in Topanga Creek.

	Rainfall (inches)	Jan	Feb	Mar	Apr	May	**Total**
2010	24.34	0	0	0	4	0	**4**
2011	31.44	6	0	1	0	6	**13**
2012	16.22	0	1	1	0	0	**2**
2013	9.99	0	1	8	0	0	**9**
2014	6.85	0	4	5	0	0	**9**
2015	13.76	0	0	1	0	0	**1**
2016	10.54	0	0	0	0	0	**0**
2017	26.34	1	0	2	0	0	**3**
2018	9.96	0	0	1	3	0	**4**
Total # of redds		**7**	**6**	**19**	**7**	**6**	**45**

Table 3- 18. Peak observations of Young of the Year in Topanga Creek by year, 2010-2017.

Year	Month	#YoY	Rainfall (inches)
2010	May	283	24.34
2011	Jan	62	31.44
2012	May	195	16.22
2013	May	92	9.99
2014	Aug	32	6.85
2015	May	112	13.76
2016	May	17	10.54
2017	July	132	26.34

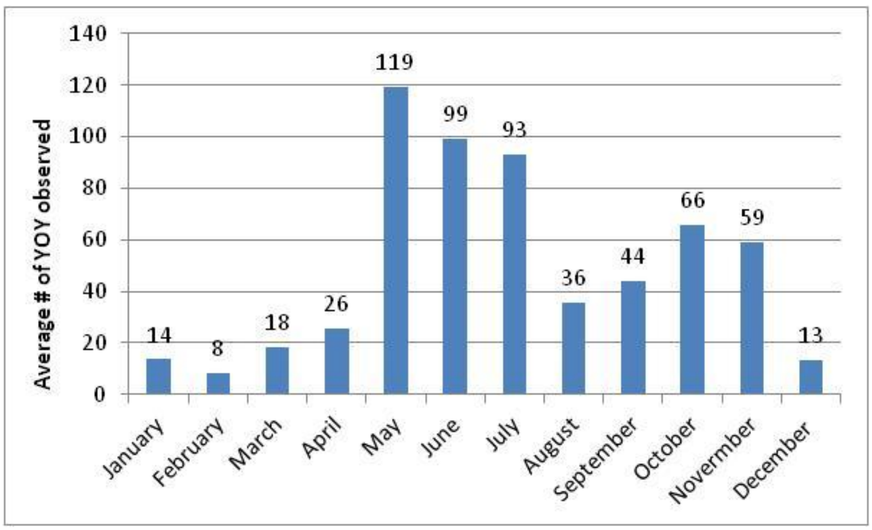

Figure 3-24. Average Young of the Year observed in Topanga Creek by month, 2010-2017.

3.6.3 PIT tag mark-recapture

Several models were fitted to the data using Program MARK, including: a "full model" with the maximum number of estimable parameters (20), and simplified models with fewer degrees of freedom. Of these, the most reasonable model (based on Akaike Information Criterion, AIC) was the most parsimonious of those considered. This model (the "Parsimonious model") has 12 parameters: probabilities of capture at each survey after the first ($\square_2, \ldots, \square_{10}$), a common survival from Fall to Spring for all years ($\square_{\square\square}$), and a common survival from Spring to Fall for all years ($\square_{\square\square}$) (Table 3-19). The parameter $\square_2$, was held fixed at 0, so there are 11 degrees of freedom (Table 3-19).

Table 3- 19. Summary of model results for total abundance.

			95% Confidence Interval	
Parameter	Estimate	Std. Err	Lower 95%	Upper 95%
$\square_2$ (fixed)	0.000			
$\square_3$	0.062	0.062	0.008	0.345
$\square_4$	0.000	0.000		
$\square_5$	0.595	0.126	0.345	0.804

$\square_{6}$	0.136	0.036	0.080	0.223
$\square_{7}$	0.587	0.091	0.405	0.747
$\square_{8}$	0.266	0.062	0.162	0.403
$\square_{9}$	0.757	0.150	0.386	0.939
$\square_{10}$	0.514	0.089	0.345	0.680
$\square_{11}$	0.356	0.087	0.208	0.538
$\square_{\square\square}$	0.594	0.074	0.442	0.725
$\square_{\square\square}$	0.441	0.057	0.335	0.553

The performance of this model demonstrated that the capture probabilities vary significantly from year to year, but the data are consistent with a common fall-to-spring survival (November to March)and a common spring-to-fall (March to November) survival. It appears that for the total population, November to March survival is relatively high, at nearly 60%. Mortality during this period could include emigration of smolts or actual mortality. Survival from March to November is lower than for the winter period at nearly 30%, which could include some emigration of smolts in the late spring, as well as mortality during the summer high water temperature period.

For all surveys, the number of PIT tags observed were expanded using the estimated capture probability to obtain estimates of the total population, as summarized in Table 3-20 and plotted in Figure 3-25. Expanded estimates for November 2008 and November 2009 were not usable, due to small number of recaptured tagged fish from those periods.

Table 3- 20. Total population estimates based on PIT tag mark and recapture.

			95% Confidence Interval	
Survey	**Observed**	**Expanded**	**Lower 95%**	**Upper 95%**
November 2010	204	393	278	686
March 2011	94	574	365	944
November 2011	133	312	233	452
March 2012	49	205	136	327
November 2012	139	323	226	528
March 2013	162	360	273	515
November 2013	36	171	114	268
November 2014	54	154	101	265
November 2015	53	65	56	99
November 2016	32	41	34	82
November 2017	38	95	50	316

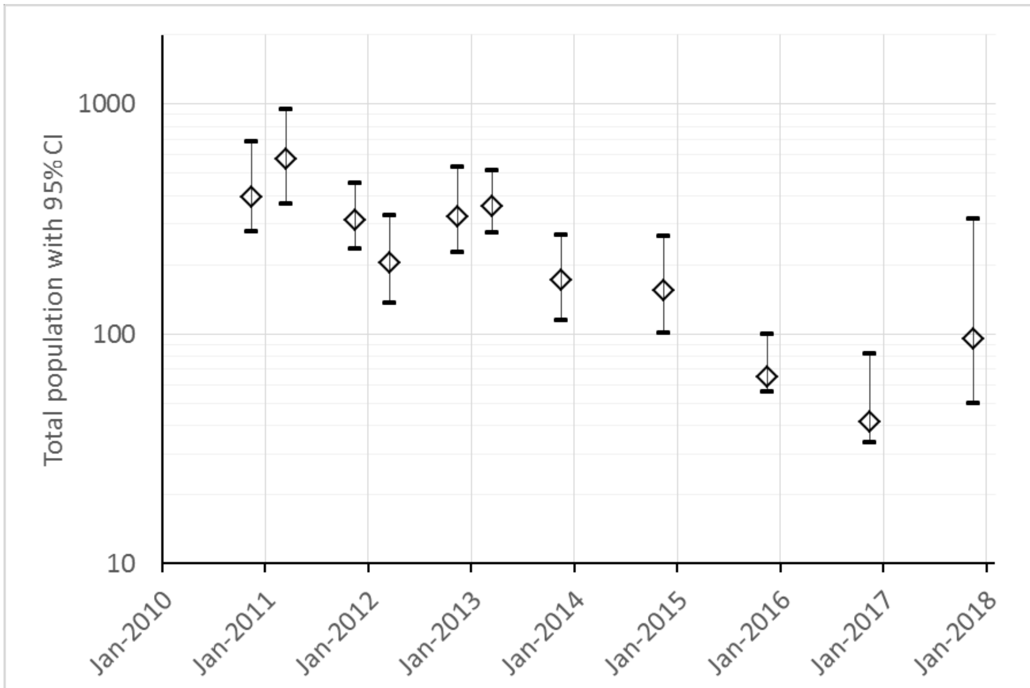

Figure 3-25. Total population estimates based on PIT tag mark and recapture, November 2010 through November 2017.

The percent estimated ranges from 25 to 86% of observed, and there are no clear seasonal or annual patterns in the percent estimated relative to observed. Ideally, these population estimates would be calibrated by conducting a four-pass depletion sampling to get an actual abundance in the creek that could be compared to the model estimate. Due to the endangered status of this population, only single pass samples were completed, and so these estimates should be considered carefully. Total abundance estimated from PIT tag mark recapture reflects a general trend in declining abundance, with a substantial and notable "low" population in November 2016. After several years of drought, the total *O. mykiss* population appeared to have nearly collapsed before showing some recovery by November of 2017 (following precipitation events in early 2017). Overall, the total estimated abundance is much higher than *O. mykiss* numbers observed during snorkel surveys. This suggests that the population in Topanga Creek is more robust than would be assumed based solely on snorkel surveys, and that, detection probability during snorkel surveys is not 100%.

In addition to estimating total abundance, the abundance of "adults," considered less likely to smolt (>200 mm FL) was also assessed. As with total abundance, the most reasonable model (based on Akaiki Information Criterion, AIC) was also the most parsimonious of those considered. This model (the "Parsimonious model") has 12 parameters: probabilities of capture at each survey after the first, a common survival from fall to spring for all years, and a common survival from spring to fall for all years (Table 3-21). Based on this analysis, the fall to spring survival for adults was estimated to be nearly 60% (SE 8%) and the spring to fall survival was estimated to be 28% (SE 5%), suggesting that conditions during summer for adults may result in more mortality than winter conditions as was observed for the total population

Table 3- 21. Summary of model results for adult (> 200 mm FL) abundance.

			95% Confidence Interval	
Parameter	**Estimate**	**Std. Err**	**Lower 95%**	**Upper 95%**
$\square_{2}$ (fixed)	0.000			
$\square_{3}$	0.000	0.000		
$\square_{4}$	0.000	0.000		
$\square_{5}$	1.000	0.000		
$\square_{6}$	0.000	0.000		
$\square_{7}$	0.529	0.212	0.175	0.856
$\square_{8}$	0.281	0.103	0.126	0.516
$\square_{9}$	0.725	0.194	0.281	0.947
$\square_{10}$	0.333	0.149	0.119	0.649
$\square_{11}$	0.218	0.164	0.040	0.648
$\square_{\square\square}$	0.596	0.084	0.426	0.745
$\square_{\square\square}$	0.279	0.045	0.199	0.375

The performance of this model demonstrated that the capture probabilities vary significantly from year to year, but the data are consistent with a common fall-to-spring survival and a common spring-to-fall survival. It appears that for the adult population, survival from November to March is lower than for the total population. This may be the result of mortality of larger, older individuals. Survival from March to November was similar for adults and the total population. As was observed for the total population, it appears that after several years of drought the adult population of *O. mykiss* nearly collapsed by November of 2016. Based on available data, it is not known if the adult population has recovered at this time.

Due to smaller sample size of larger fish, the estimated probability of capture for many periods was not usable. For the remaining surveys, the numbers of PIT tags seen were expanded using the estimated capture probability to obtain estimates of the total population, as summarized in Table 3-22 and plotted in Figure 3-26. Figure 3-27 shows the average number of adult *O. mykiss* observed during snorkel surveys each year from 2001 to 2017 as well as their distribution (number of locations observed during each). During the past few years, both numbers and locations maintain their declining trend.

Table 3- 22. Adult (>200 mm FL) population estimates based on PIT tag mark and recapture.

			95% Confidence Interval	
Survey	Observed	Expanded	Lower 95%	Upper 95%
Nov-2010	59	91	60	1664
Mar-2011	16	Estimator undefined		
Nov-2011	95	239	137	596
Mar-2012	39	175	94	376
Nov-2012	38	99	61	197
Mar-2013	18	90	43	226
Nov-2013	13	141	39	639
Nov-2014	26	89	39	328
Nov-2015	39	47	39	1313
Nov-2016	13	16	12	116
Nov-2017	13	Estimator undefined		

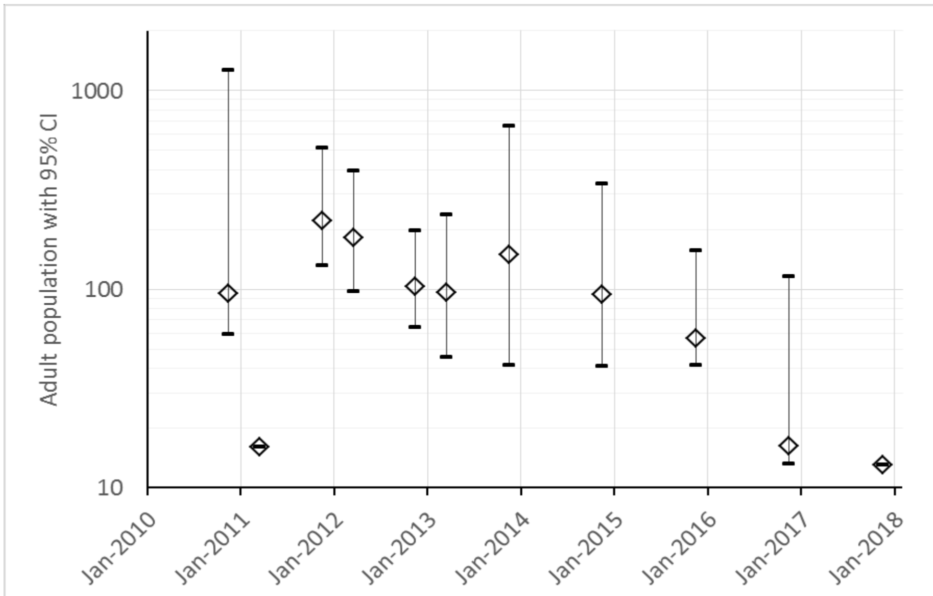

Figure 3- 26. Adult (>200 mm FL) population estimates based on PIT tag mark and recapture, November 2011 through November 2017.

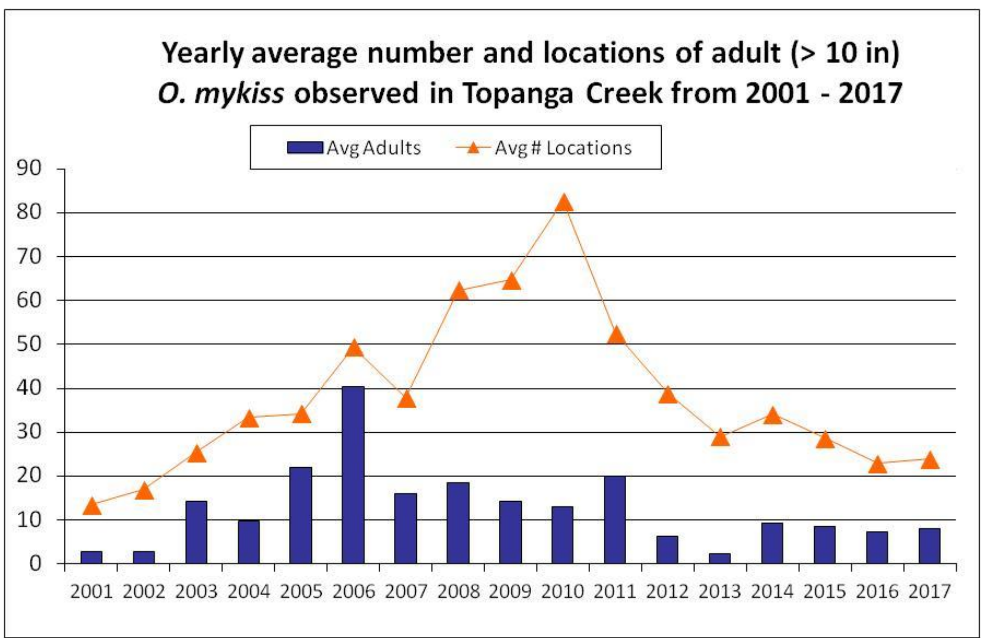

Figure 3-27. Observations of adult (>200 mm FL) *O. mykiss* from snorkel surveys in Topanga Creek, 2001-2017.

Despite the fact that population numbers have come down from what they once were, there continues to be *O. mykiss* of all life stages in Topanga Creek. Although this is also reflected in the snorkel surveys, the PIT tag mark recapture analysis suggests that many of the larger fish are not observed during snorkel surveys.

3.6.3.1 Comparison of snorkel and efishing methods

A total of 1,676 *O. mykiss* were captured by electrofishing during the study. However, because an intensive four-pass depletion methodology was not used in this study, the total abundance in the sampled habitat units could not be reliably estimated. It is likely that poor capture efficiency in deep, complex pools also biased the abundance estimates, density estimates, and habitat use information. Snorkel counts maybe more effective at counting *O. mykiss* in deep pools. Relative effectiveness between electrofishing and snorkeling in complex pools is not possible to ascertain given the data on hand (since observation probabilities while snorkeling likely decreases in complex habitat structures) (Table 3-23). On average, the total number of fish captured during electrofishing events was 229% higher than that observed during snorkel surveys (110% for November surveys, 468% for March surveys). The higher total capture with electrofishing is likely due to the efficiency of the electrofisher in shallower habitat units (i.e., electrofishing can essentially sample more habitat than snorkeling within the same reach). However, in habitat units deep enough for divers to enter and efficiently observe fish, more fish are likely observed with snorkeling than are captured by electrofishing.

Table 3- 23 Comparison of total number of and density (#/m) of *O. mykiss* observed during snorkel surveys and captured during subsequent electrofishing events, November 2008 – November 2017.

Event	Meter limits	Total Distance (m)	Total Observed Snorkel	Snorkel Density (#/m)	Total Observed E-fishing	E-fishing Density (#/m)	Difference (snorkel - efishing)	Higher density observed*
Nov 2008	2050-4400 (not inc. 2700-3200)	1850	224	0.121	218	0.116	0.005	Snorkel
Nov 2009	1690-4200	2510	78	0.031	179	0.071	-0.040	E-fish
Nov 2010	1850-5100	3250	190	0.058	259	0.080	-0.022	E-fish
Mar 2011	1700-2520, 3225-3700	1295	104	0.080	84	0.064	0.016	Snorkel
Nov 2011	1780-5025	3245	44	0.014	136	0.042	-0.028	E-fish
Mar 2012	1780-4530	2750	6	0.002	50	0.018	-0.016	E-fish
Nov 2012	1690-4700	3010	71	0.024	210	0.070	-0.046	E-fish
Mar 2013	1680-4125	2445	22	0.009	174	0.071	-0.062	E-fish
Nov 2013	3200-4050 (plus 5810)	880	26	0.030	50	0.057	-0.027	E-fish
Nov 2014	2130-4875	2745	37	0.013	58	0.021	-0.008	E-fish
Nov 2015	1750-5025	3275	42	0.013	104	0.032	-0.019	E-fish
Nov 2016	3450-4800	1350	21	0.016	36	0.027	-0.011	E-fish
Nov 2017	2300-4875 (not incl.2925-3525)	1975	79	0.04	129	0.065	-0.025	E-fish

3.7 Downstream migration

Downstream migration in Topanga Creek was assessed based on PIT tag detections at two antennas, an outmigrant trap, and snorkel surveys in the lower creek. Results from each of these methods are discussed below.

3.7.1 Antenna detections

Each November, two PIT tag antennas capable of detecting half-duplex tags were installed at 0.6 RKM in lower Topanga Creek. These antennas were designed to operate synchronously, so that each migrating PIT-tagged fish would be detected twice and the direction of movement could be determined. The instream antenna system was only activated when flows in Topanga Creek were high enough that continuous surface water was flowing past the antenna, which happened episodically from December through May. Table 3-24 lists all dates the antenna was operational between 2009 and May 2018. No detections were recorded from April 2014 through April 2018. During the March 2016 rain event, two individuals were detected by the DIDSON camera, but not by the antenna. A summary of all antenna detection data is found in Table 3-25.

Table 3- 24. Antenna operations summary.

Deployment Dates	One antenna operational	Two antennas operational
24? Nov 2008 – 28 Apr 2009	108 days	--
1 Nov 2009 – May 2010	--	>200 days
15 Nov 2010 – 3 Jun 2011	75 days*	125 days
17 Nov 2011 – 1 May 2012	--	166 days
6 Nov 2012 – 13 May 2013	--	188 days
14 Nov 2013 – 04 April 2014	120+ days**	--
17 Nov 2014 - 14 May 2015	50	50
02 Nov 2015 – 03 May 2016	25	25
14 Nov 2016- 24 Apr 2017***	3	3
2017-2018****	0	0

*Upstream antenna destroyed in March 2011 storm.

**Installed as of 15 Mar, but only had to turn on for a few days 26 Feb to 3 Mar 2014, and upstream antenna was not working properly.

*** Antenna was completely blown out during first storm, removed for repair. After cords were repaired and reinstalled, a circuit in the reader box shorted. Returned to manufacturer for repair. Antenna out for the rest of the season

**** Unable to tune antenna to read PIT pit tags. Multiple configurations would not work. Borrowed new tuner boxes and reader from PSMFC in Santa Barbara but still unable to tune.

Table 3-25. Detections of PIT-tagged *O. mykiss* in Topanga Creek 2008-April 2018.

Last antenna detection date	PIT number	Direction of movement	Length and age at last capture		Age when detected	Last capture date	Initial capture site (RKM)
			FL (mm)	Age			
6 Feb 2009	166458594	Downstream	143	1+	1+	18 Nov 2008	2.25
23 Jan 2010	166458527	Downstream	145	1+	1+	23 Jan 2010	1.3
23 Jan 2010	166458542	Downstream	140	1+	1+	23 Jan 2010	1.3
23 Jan 2010	166458530	Downstream	130	0	0	23 Jan 2010	1.3
27 Jan 2010	166458504	Downstream	155	1+	1+	5 Nov 2009	4.07
5 Feb 2010	166458546	Downstream	135	1+	1+	23 Jan 2010	1.3

20 Feb 2010	166458556	Downstream	165	1+	1+	4 Nov 2009	1.95
27 Feb 2010	132415458	Downstream	165	1+	1+	4 Nov 2009	2.3
27 Feb 2010	166458513	Downstream	130	1+	1+	4 Nov 2009	2.7
17 Mar 2010	166458507	Upstream	150	1+	1+/2+	5 Nov 2009	3.2
5 Apr 2010	166458499	Downstream	135	1+	1+/2+	4 Nov 2009	2.5
5 Apr 2010	166458561	Downstream	145	1+	1+/2+	4 Nov 2009	2.0
6 Apr 2010	166458511	Downstream	165	1+	1+/2+	5 Nov 2009	3.29
19 Feb 2011	168779142	Downstream	140	0+	0+	17 Nov 2010	4.735
20 Feb 2011	174147909	Downstream	166	--	--	18 Nov 2010	3.05
23 Feb 2011	168779163	Downstream	135	0+	0+	17 Nov 2010	4.495
2 Mar 2011	132145476	US-DS-US	195	2+	2+	16 Nov 2010	2.015
14 Mar 2011	174147951	Downstream	159	--	--	19 Nov 2010	3.85
16 Mar 2011	174147897	Downstream	133	--	--	19 Nov 2010	3.39
18 Mar 2011	168779184	Downstream	128	0+	0+/1+	16 Nov 2010	2.23
19 Mar 2011	0379091200509998	Unknown	165	1+	1+	15 Mar 2011	2.24
20 Mar 2011	168779170	Downstream	138	0+	0+/1+	17 Nov 2010	4.53
20 Mar 2011	174147937	Unknown	129	0+	0+/1+	18 Nov 2010	2.85
20 Mar 2011	176795640	Downstream	170	1+	1+	16 Mar 2011	3.46
20 Mar 2011	174147890	Downstream	180	1+	1+	20 Feb 2011	1.3
24 Mar 2011	0379091200541745	Unknown*	166	1+	1+	16 Mar 2011	3.225
26 Mar 2011	176795558	Unknown	327	2+	2+	16 Mar 2011	3.32
26 Mar 2011	168779181	Unknown	132	0+	0+/1+	16 Nov 2010	2.075
28 Mar 2011	0379091200542234**	Unknown	184	2+	2+	15 Mar 2011	2.0
28 Mar 2011	176795583	Unknown	301	2+	2+	28 Mar 2011	1.3
29 Mar 2011	176795555**	Unknown	147	1+	1+	29 Mar 2011	1.3
30 Mar 2011	166458528	Unknown	153	0+	0+/1+	16 Nov 2010	2.31
30 Mar 2011	166458595	Unknown	207	1+	1+	15 Mar 2011	1.935
30 Mar 2011	0379091200546347	Unknown	119	0+	0+/1+	18 Nov 2010	2.49
1 Apr 2011	168779147	Unknown	147	1+	1+	17 Nov 2010	4.875
2 Apr 2011	174147904	Unknown	132	--	--	19 Nov 2010	4.23
2 Apr 2011	176795647	Unknown	181	1+	1+	15 Mar 2011	2.385
5 Apr 2011	0379091200538649	Unknown	171	1+	1+	15 Mar 2011	2.02
6 Apr 2011	176795561	Unknown	317	3+	3+	27 Mar 2011	1.3
16 Apr 2011	174147924	Unknown	162	--	--	18 Nov 2010	2.495
18 Apr 2011	174174875**	Unknown	169	1+	1+	27 Feb 2011	1.3
11 Apr 2012	178695891	Downstream	355	3+	3+	21 Mar 2012	3.8
12 Apr 2012	178695858	Downstream	164	1+	1+	20 Mar 2012	1.95
1 Mar 2014	178695900	Downstream	177	1+	2+	20 Mar 2013	3.5
1 Mar 2014	0380180914265177	Downstream	111	0+	2+	27 Nov 2012	2.915

*Downstream antenna destroyed and pulled after 20 Mar 2011 storm, direction unknown.
**Captured again in Nov 2011 above 2200m.
No detections from April 2014 through 2018 season.

3.7.2 Trap captures

Both the fyke trap and weir trap were operated opportunistically from 2003 to 2012 when flows in Topanga Creek were safe for trapping. Due to low flow conditions, it was not possible to set traps since 2013. Overall, the traps were operated for 39 days, and 45 *O. mykiss* were captured, with a minimum of 0 captures in some years, and a maximum of 15 in 2003 (Table 3-26). More *O. mykiss* were trapped moving downstream (n=45) than upstream (n=5).

Trap operation in Topanga Creek presents several challenges (e.g., flow fluctuations, persistent vandalism), which means the trap rarely samples more than a small fraction of the time that flow is continuous in the lower creek reach. Therefore it is not possible to estimate the total outmigrant abundance using trap data. Based on the small fraction of sampling that occurs, we assume the number of outmigrants is much larger than the numbers of *O. mykiss* captured. For example, the large rain event in March 2011 appeared to allow extensive outmigration, based on the reduced numbers of fish observed in subsequent snorkel surveys, but due to the flashy nature of the event, trapping was not possible and the instream antenna was severely damaged.

Table 3-26. Number of *O. mykiss* captured by upstream migrant traps and downstream outmigrant traps in Topanga Creek, 2003–2018.

Trapping period	Days of operation	Number of hours trapping	Upstream captures	Downstream captures
13–17 February 2003	5	72	1	3
25–28 February 2003	4	72	0	6
14–18 March 2003	5	40	0	5
Total 2003	**14**	**184**	**1**	**14**
26–27 February 2004	2	18	0	0
30–31 December 2004	2	8	0	0
Total 2004	**4**	**26**	**0**	**0**
1–2 January 2006	2	12	0	3
3–4 January 2006	2	16	1	3
4–5 March 2006	2	17	0	0
5–6 April 2006	2	15.5	0	3
Total 2006	**8**	**60.5**	**1**	**9**
5–8 Jan 2008	1	28	0	1
Total 2008	**1**	**28**	**0**	**1**
16–17 February 2009	2	15	0	1
Total 2009	**2**	**15**	**0**	**1**
23–24 January 2010	2	15	1	10
Total 2010	**2**	**15**	**1**	**10**
20-21 February 2011	1	13	0	2
26-28 February 2011	2	38	0	2
27-29 March 2011	3	38	2	6
Total 2011	**6**	**89**	**2**	**10**
26-27 March 2012	1	14	0	0
Total 2012	**1**	**14**	**0**	**0**
None	0	0	0	0
Total 2013	**0**	**0**	**0**	**0**
None	0	0	0	0
Total 2014	**0**	**0**	**0**	**0**
None	0	0	0	0
Total 2015	**0**	**0**	**0**	**0**
None	0	0	0	0
Total 2016	**0**	**0**	**0**	**0**
None	0	0	0	0
Total 2017	**0**	**0**	**0**	**0**
None	0	0	0	0
Total 2018	**0**	**0**	**0**	**0**
TOTAL ALL YEARS	**39**	**431.5**	**5**	**45**

3.7.3 DIDSON camera

In collaboration with CDFW, a DIDSON camera was deployed in Topanga Creek at approximately 0.5 RKM on five occasions from 2012- 2015/2016 and then an additional four times in 2017. DIDSON deployment in Topanga Creek 2013-2018 was funded by another FRGP grant and detailed data from that effort is provided in Dagit et al. (2018).

3.7.4 Snorkel observations (smolts)

Observations of *O. mykiss* with visible smolt characteristics (e.g., shiny silver coloration, lack of parr marks, black outline on caudal fin: McEwan and Jackson 1996) in Topanga Creek has been episodic. No smolts were observed in 2001, 2002, 2004, 2005, 2007, 2011, 2012, 2013, 2014, 2015, 2016, or 2017. Nine smolts were observed in February 2003 and five in March 2003. Six smolts were observed in January 2006 and three in April 2006. A single smolt was observed in February 2008 and 2009. In February 2010, seven smolts were observed just downstream of 1.7 RKM and in March and April between 25-28 smolts (most were about 250 mm total length) were observed in Topanga lagoon. These fish are thought to have outmigrated during a brief period in April when the lagoon was connected to the ocean. This is the only time *O. mykiss* have been observed in Topanga Lagoon. Finally, one 152 mm FL smolt was observed around 350 meters upstream of the lagoon in March 2018. The majority of *O. mykiss* in this size range captured or observed in Topanga Creek retain the rainbow coloration pattern. Subsequently, one to two smolts were captured during the electrofishing surveys in March 2012 and 2013, but not observed during snorkel surveys. Electrofishing surveys in 2014- 2018 also did not find any smolts.

3.7.5 Downstream migration behavior

During rain events flow in Topanga Creek was occasionally high enough to operate the outmigrant trap on the falling limb of the hydrograph. During these efforts the trap was monitored continuously for as long as stream flows were sufficient. Most downstream migration occurs between January and April, and on the falling limb of the hydrograph (which is partially a function of opportunities to operate the trap). Most downstream migration was observed at dawn and dusk; however there was also migration during the daylight hours.

Data from the DIDSON camera confirms that most *O. mykiss* movement observed in Topanga Creek from 2012-2017 was outmigration. During April 2012, the DIDSON detected one *O. mykiss* milling at the camera between 1940-2120 on April 12th, which was also detected by the antenna at 1940 (355 mm). Peak flow occurred at 1430 the next day and the camera did not provide adequate footage between 1430 an 2000 so it is not known whether fish moved through during that time. From 2020 to about midnight (0000) outmigration was detected followed by a short lull between 0200-0720, and another tagged fish 164 mm moved downstream but was only captured by the antenna, not by the DIDSON. During the March 2016 rain event, no antenna detections were made despite both the upstream and downstream antenna working, however, the DIDSON camera detected two outmigrating *O. mykiss* (230 mm and 220 mm) after the second storm pulse at around 0830 and 0930 respectively, on March 07, 2016. No outmigration was recorded during the four DIDSON deployments in 2017.

No *O. mykiss* have been detected moving upstream with either the antenna or DIDSON camera to date. It is apparent from known directional data from the DIDSON, trapping, and instream antenna that *O. mykiss* were almost exclusively leaving the system, which is not surprising considering the limited passage opportunities in this system and number of years those individuals remain as residents of the creek. Two anadromous adults, 711mm and 610 mm, were sighted multiple times beginning April 2017 through the summer, indicating that the DIDSON camera missed their migration into Topanga Creek when deployed during the winter months prior to their detection during snorkel surveys. The importance of applying several different counting and movement methodologies should also be emphasized for a comprehensive understanding of migration and the effectiveness of different detection techniques.

3.8 Distribution and Habitat Use

Distribution and habitat use of *O. mykiss* in Topanga Creek was assessed by examining impediments to migration, snorkel surveys, and analysis of habitat use. Results of each of these are discussed below.

3.8.1 Impediments to migration

Distribution of *O. mykiss* in Topanga Creek was affected by barriers and impediments to migration, many of which are a function of flow. We have observed that during high flows, fish appear to migrate much farther upstream in the creek. Many of the passage impediments were passable by fish moving downstream even under low flow conditions, however as the drought continued, flows decreased and pools contracted making movement difficult except during rain events.

In 2006, fish passage barriers and impediments in Topanga Creek were identified using DFG FishXing V2 software, which rates barrier severity by color. A total of 10 low flow barriers ("gray" or "green") and three complete barriers ("red") were identified (CalTrout 2006) and discussed in Krug et al. (2014).

Table 3-27. Fish passage barriers and impediments in Topanga Creek (from CalTrout 2006).

Location	RKM	Barrier type	Barrier material	Passage severity rating	Adult habitat quality rating
Bridge at PCH, Topanga Lagoon	0–0.2	Box culvert bridge	Concrete	Gray	Poor
Rodeo Ground Berm (restored in 2008; not yet re-evaluated)	0.5–1.0	fill berm, instream crossing	Lead contaminated fill covered with gunnite	Gray	Good
Brookside Drive instream crossing (naturally restored; not yet re-evaluated)	1.7	Instream road crossing	Concrete	Green	Good
Cattail Pool cascade	1.85	Natural boulder cascade	Boulders	Gray	Very good
Transient Pool	1.9	Natural boulder cascade	Boulders	Gray	Very good
Ski Pole Pool	2.0	Natural boulder cascade	Boulders	Gray	Very good
Landslide debris	2.4–2.6	Landslides	Boulders, sand, gravel	Gray	Good
Shale Falls	2.7	Natural bedrock cascade	Shale bedrock	Gray	Good
Barrier Falls	4.4	Natural cascade	Shale bedrock	Gray	Very good
Cascade pool	4.5	Natural cascade	Boulders	Gray	Good

Location	RKM	Barrier type	Barrier material	Passage severity rating	Adult habitat quality rating
Grotto waterfall	5.3	Natural cascade	Boulders	Red	Good
Lower Twin Pool	5.4	Natural cascade	Boulders	Red	Good
Upper Twin Pool	5.5	Natural cascade	Boulders	Red	Good

Green= passable at most flows over 5 cubic feet per second (cfs):
Gray= passable only at moderate (>50 cfs) to high (>100 cfs) flows;
Red = not passable.

The Rodeo Grounds Road berm, which restricted floodplain and channel configuration, caused sediment accumulation, and created sub-surface flow for approximately 1,000 m of stream channel was removed in October 2008. The channel at this location had longer periods of surface flow in 2009-2012, and habitat conditions continue to improve, however flows returned to sub-surface conditions during the ensuing drought.

Figure 3-28 is a visual representation of the extent and distribution of the sub-surface flow conditions in Topanga Creek from 0.2 to 3.6 RKM described in the field notes from 2008 through 2017. The lower gradient section of the creek experienced seasonal dryness, but the drought affected the length (both spatially and temporally) of low flow or sub-surface flow conditions. The upper creek (upstream of 3.6 RKM) did not have dry sections but did experience lower pool volume and flow conditions which created low flow barriers that restricted *O. mykiss* movement. U.S. Drought Monitor (2018) listed 2012 through 2016 as moving from abnormally dry to extreme drought. In 2013 the lower part of the reach dried as early as April, and rainfall during the following wet season was not sufficient for recharging the system. It was not until a full year and a half later (November 2014) that surface flow connected again. From 2013 to present, the frequency and length of dry reaches has increased, and by April 2016 the lower reach (0.45 -1.7 RKM) had already dried up. The higher rainfall in 2017 helped but was not sufficient to alleviate the above normal drought conditions which are continuing into 2018 (U.S. Drought Monitor 2018).

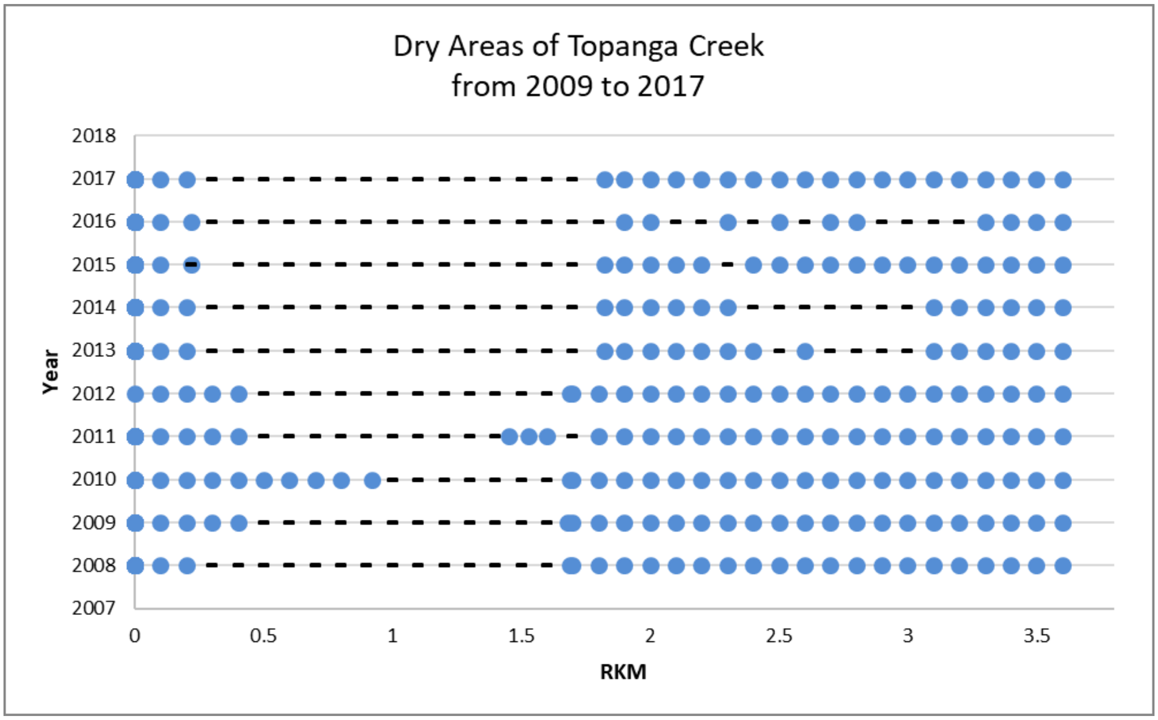

Figure 3-28. The extent (from 0.2 to 3.6 RKM) of dry sections in lower Topanga Creek for each year from 2008 through 2017. Wetted sections are indicated by blue markers, and dry sections are indicated by dashed lines.

A preliminary examination of the relationship between precipitation, and the extent (in time and space) of dry sections of the lower reach (0.4-1650 RKM) showed that, not surprisingly low rainfall years were strongly correlated with both longer time periods of being dry (n =8, r= -0.86), and longer dry sections (n=8, r=-0.871). Rainfall was a very good predictor of how long the seasonally dry sections would remain dry (R^2=0.749, p=0.0055) as well as how much (as a distance) of the lower reach would have dry patches (R^2=0.758, p=0.0059) as shown in Figure 3-29. Wetted areas that remained are sustained by groundwater input from a variety of seeps and springs located throughout that reach (Tobias 2006).

Another factor contributing to the dry down is the increased spread of emergent vegetation into the channel. Watercress, bergamot mint, cattails and arundo have all expanded into the channel causing increased low flow barriers throughout the lower study reach.

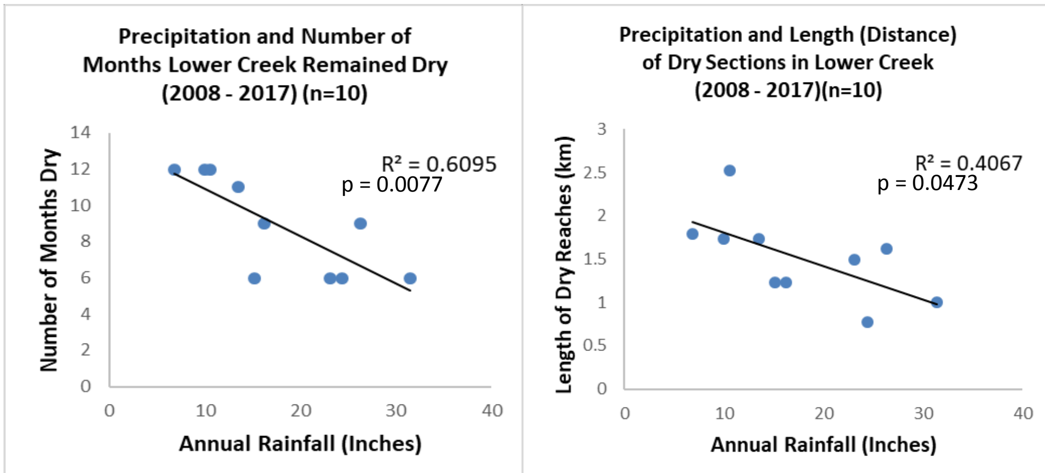

Figure 3-29. Lower rainfall years affect the lower reach of Topanga Creek at a temporal and spatial scale, resulting in longer periods that the lower creek remains seasonally dry (a) and longer stretches of dried patches from 0.2-3.6 RKM. (This data was derived from field notes, and as such is a preliminary examination only).

3.8.1.1 Migration conditions in lower Topanga Creek and the lagoon

For smolts to migrate out of Topanga Creek or for adult anadromous *O. mykiss* to migrate into and upstream in Topanga Creek, two key variables have to be aligned. First, the lagoon entrance needs to be open and passable to the ocean. Second, the base stream flow level needs to be high enough to ensure surface flow connectivity in areas with minimal depth and to provide sufficient depth for fish to pass natural low flow barriers and impediments.

Fish migration conditions have been monitored in Topanga Creek since 2001 (Table 3-28). Rainfall patterns were variable, with storm events scattered throughout the rainy season between December and March. This resulted in a wide annual variation in the timing and duration of potential anadromous adult or smolt migration opportunities. Periods of rainfall and annual accumulation totals are presented in Appendix C. Dry years in 2001–2004, 2012-2016 provided few times when passage was possible. The high flow year of 2005 represented the other end of the extreme, with the ocean-creek connection providing suitable passage conditions for most of the year. A slightly above average rain year in 2017 also provided multiple windows of opportunity for migration into or out of the creek with adequate connection throughout the reach and at the ocean. However, low rainfall in 2018 provided few opportunities for passage.

Table 3-28. Average annual snorkel observations of *O. mykiss* in Topanga Creek and passage opportunities for migration (based on open and passable conditions at lagoon berm and connected lower reach).

Year	Average monthly *O. mykiss* observations (all size classes)	Range of monthly totals of *O. mykiss* observed	Potential migration opportunity (days)	Annual total Rainfall (inches)
2001	53	2–122	10	28.16
2002	95	8–156	1–2	9.9
2003	59	6–72	~20	18.71
2004	103	46–209	20-30	13.16
2005	71	49–80	>200	61.58
2006	75	48–409	45	21.98

Year	Average monthly *O. mykiss* observations (all size classes)	Range of monthly totals of *O. mykiss* observed	Potential migration opportunity (days)	Annual total Rainfall (inches)
2007	86	30–166	<5	7.17
2008	316	40–691	ND	23.08
2009	209	117–323	<5	15.16
2010	253	117-420	~20	24.34
2011	114	18-303	<5	31.44
2012	95	13-219	<5	16.22
2013	56	17-125	<5	9.99
2014	57	21-80	<5	6.85
2015	59	18-130	<5	13.76
2016	35	13-55	<5	10.54
2017	97	8-176	36	26.34
2018	60	48-71	1	9.96*

* January to May 2018

3.8.2 Fish distribution

The entire length of Topanga Creek, from the ocean to all headwaters and small upper ephemeral drainages, has been examined to determine limitations to the distribution of *O. mykiss*, as well as other native fishes, amphibians and reptiles. Surveys have consistently documented five fish species in Topanga Creek upstream of the lagoon: *O. mykiss*, tidewater goby (*Eucyclogobius newberryi*) as far as 0.03 RKM, Arroyo chub (*Gila orcutti*), fathead minnow (*Pimephales promelas*) and an as yet unidentified "gold" chub type fish. Despite targeted surveys, no mosquitofish (*Gambusia affinis*) have been found in any part of the creek, including the headwaters. A summary of all snorkel survey data is provided in Appendix D.

3.8.2.1 Snorkel surveys

The watershed-wide snorkel survey data demonstrate that *O. mykiss* in Topanga Creek expanded their distribution steadily since 2006, inhabiting pools as far upstream as the previously assumed barrier located at Grotto Pool (5.3 RKM). Until 2010 this location was considered the upstream limit for anadromous fish in Topanga Creek. A major storm event in February 2010 increased flows and allowed at least two adult *O. mykiss* (320 mm and 400 mm FL) to migrate upstream past all three "impassable" barriers. The majority of *O. mykiss* remained downstream between 1.7 RKM and 5.3 RKM during this high flow period. However, since 2012, the distribution has contracted as the drought continued to expand reaches of sub-surface flow.

Distribution of *O. mykiss* of all size classes varied seasonally and was closely associated with the overall numbers of fish (Figure 3-30). *O. mykiss* were more widely dispersed in the spring, with more limited distribution in fall and winter. On average, fish were observed in about 38 locations in any given month. The number of locations with fish observations peaked at an average of 80 in summer 2010, but since the onset of the drought in 2012 that number has dropped to between 29-34 locations, suggesting that habitat is likely becoming a limiting factor affecting population distribution of Topanga Creek *O. mykiss*. The smaller *O. mykiss* tended to be more scattered throughout the system, but even with flow events providing opportunities for upstream migration, the larger *O. mykiss* remained in segments of the creek with more stable refugia pools. Low flow passage barriers precluded much movement either up or downstream for parts of the study period, and it appeared that we observed the same fish in the same pools for many months. In 2017, surface flow reconnected the entire creek during the wet season but as the summer progressed, low flow barriers re-emerged and lower reaches of the creek dried down restricting movement of YOY and juveniles that were born in the beginning of the year.

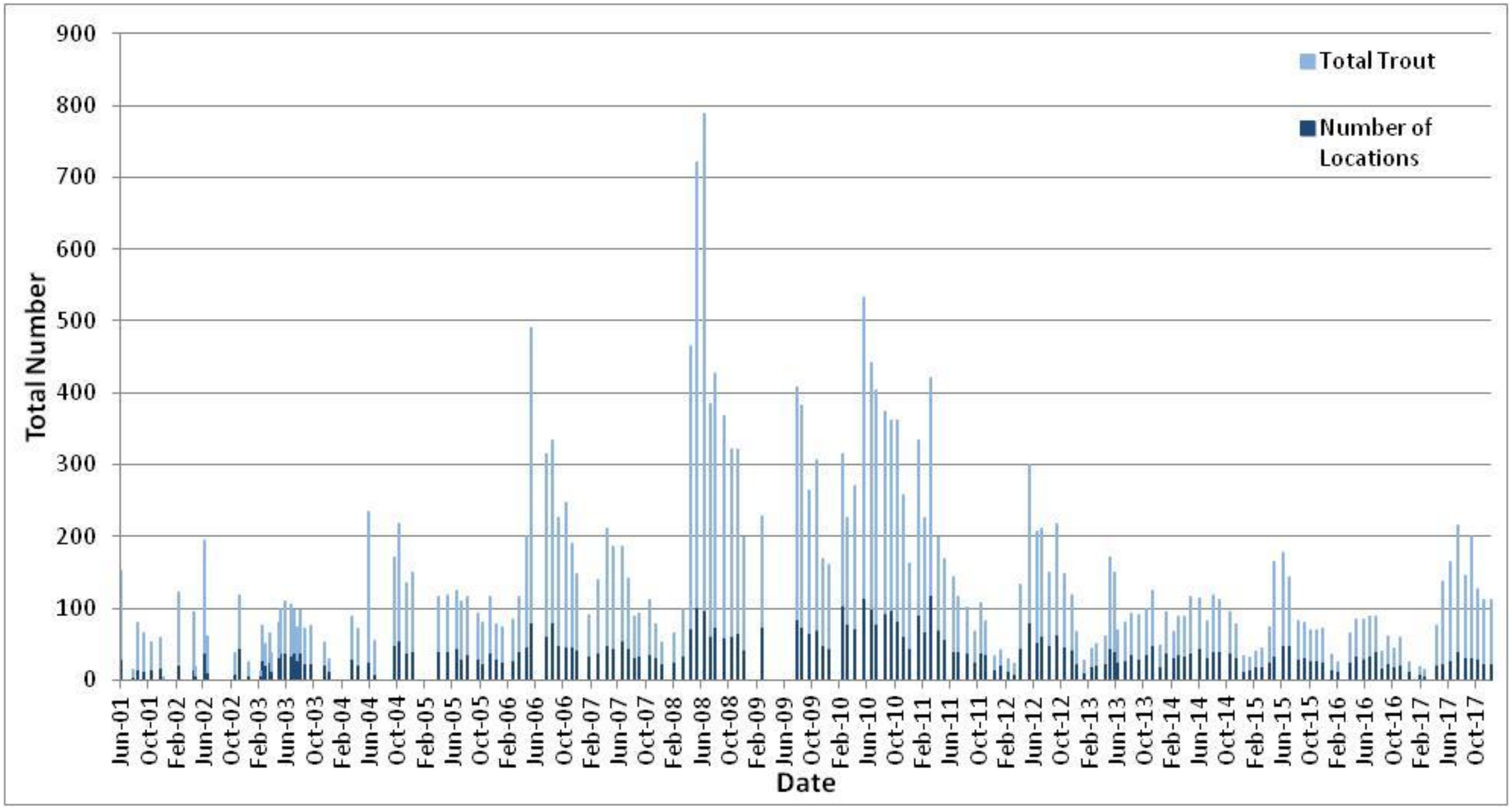

Figure 3-30. Number of observations and locations in Topanga Creek used by O. mykiss by month, 2001-2017.

3.8.2.2 Migration

Of 940 fish tagged and included in the analysis, 239 were re-sighted at least once (19.5% recapture rate). Figure 3-31 shows the location within Topanga Creek of all PIT tagged *O. mykiss*, with a line connecting the location of all re-sighted fish (i.e., each line represents one fish and shows the distance at each capture). It is evident that most PIT tagged fish were re-sighted near their previous locations (indicated by straight lines connecting distance from one capture to the next), especially during the relatively low water years of 2014 and 2015. When migration did occur, there was a general tendency of smaller (>150 mm) fish to move downstream between November and March. Downstream migration of smaller fish during this time coincides with potential smolt outmigration, or could be the result of displacement of smaller fish from suitable habitat by larger individuals. There was also a general tendency for upstream migration between March and November, without a strong size bias. These fish may have been migrating to suitable upstream habitat as instream flows reduced, or may have been resident adults seeking spawning partners.

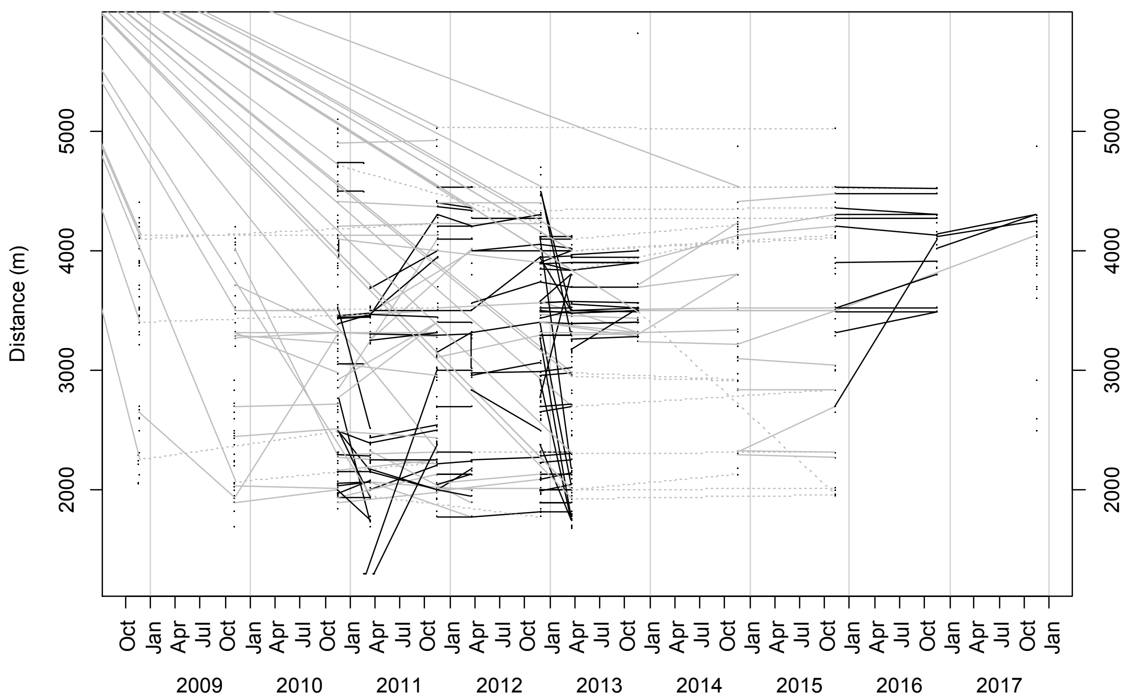

Figure 3-31. Migration of 940 *O. mykiss* PIT taged and monitored in Topanga Creek. Every observation of a tagged fish is indicated with a dot. Successive captures of the same individual fish are connected with lines: solid black lines join points from consecutive seasons, solid grey lines join points from consecutive years, dotted grey lines join points separated by more than one year.

One hundred and eighty four individuals were recaptured at least once (total recapture instances = 239) and were used to assess movement of individuals within Topanga Creek. A quarter of all recaptured individuals were recaptured in the same location as previously captures, and almost half of recaptured individuals (42%) moved less than 25 meters from previous capture location (Table 3-29). The greatest distance moved by an individual was 1930 m in the downstream direction by a fish sized 116 mm FL (age 0+) at previous capture, and the greatest movement upstream was 1715 m by a fish sized 169 mm FL (age 1+) at previous capture. The largest fish sized at 320 mm FL at previous capture was recaptured in the same pool. Forty-five percent of all recaptured individuals that migrated were between 120-200 mm FL. See Section 3.3.3 for results and discussion on movement in relation to fish size and growth.

Table 3-29. Summary of distance moved by recaptured individuals, within specific sampling periods 2008-2017.

	Number of fish				Fraction of fish		
Movement (m)	Nov to Mar	Mar to Nov	Nov to Nov	All pairs	Nov to Mar	Mar to Nov	Nov to Nov
0	37	7	17	74	38%	15%	22%
1–25	22	13	11	65	22%	28%	14%
26–100	18	8	26	73	18%	17%	33%
101–500	9	15	17	73	9%	33%	22%
501–1000	4	1	45	19	4%	2%	6%
> 1000	8	2	3	18	8%	4%	4%
total	*98*	*46*	*79*	*322*	*100%*	*100%*	*100%*

3.8.3 Habitat characteristics and fish distribution

O. mykiss were captured throughout the entire surveyed length, between 1.5-3.6 RKM during electrofishing sampling. All locations where *O. mykiss* were captured or observed were described for habitat type, dimensions, substrate, and other habitat characterizations that are also recorded during snorkel surveys.

Snorkel survey data also showed that *O. mykiss* were consistently distributed throughout 1.5-5.3 RKM. Typically, larger fish were observed in the upper reach (3.6 to 5.3 RKM), which has a steeper gradient (3-6%) than the lower reach (1.5 to 3.6 RKM; 1-3% gradient), and is characterized by larger, deeper bedrock and boulder pools whereas smaller step-pool-run habitat characterizes the lower reach. Furthermore, pools with an upstream cascade, which provided a bubble curtain and turbulence (oxygenated water) on the upstream end of the pool, were preferred refugia.

In general, older age classes were most commonly captured in deep, complex pools, whereas younger age classes were more frequently found in shallower step-pools which often had very high amounts of cover in the form of interstitial spaces among cobbles and boulders. Small fish (<150 mm FL) were rarely observed in deep pool habitat and were common in low gradient habitat and step-pools, while larger fish (> 150 mm FL) were rarely observed in low gradient habitat. Although it appears that young *O. mykiss* preferred step-pool habitat, this may be a function of both poor capture efficiencies in pool habitat and the greater amount of step-pool habitat overall. Snorkel surveys also observed more fish in step-pool habitat than in pools.

In this study we built on previously reported data (Krug et al. 2014, Dagit et al. 2016) and conducted additional analysis of these data using generalized linear modeling, and compared covariates using AIC. The results that stand out most clearly are:

- Adult *O. mykiss* abundance and areal density are *positively* associated with average and maximum pool depth;

- Juvenile *O. mykiss* abundance (by all metrics) is *negatively* associated with average and maximum pool depth;
- Adults *O. mykiss* are more abundant (by all metrics) upstream (above 3.6 RKM) than downstream (below 3.6 RKM); and
- Juveniles are more abundant (by all metrics) downstream than upstream.

Almost all of the *O. mykiss*/covariate relationships are highly significant ($p<0.05$), and hold whether considering numerical abundance (fish per pool), areal density (fish per unit area), or volumetric density (fish per unit volume). The exceptions are:

- Adult *O. mykiss* volumetric density was not significantly related to distance, canopy, or maximum pool depth;
- Juvenile *O. mykiss* abundance was not significantly related to area or shelter;
- Juvenile *O. mykiss* areal density was not significantly related to cover; and
- Juvenile *O. mykiss* volumetric density was not significantly related to cover.

Most of the relationships were quite highly significant ($p<0.0001$). Many other relationships are formally significant, but difficult to interpret because of the many correlations among the covariates. For example, groundwater was a surprisingly weak explanatory variable, but since groundwater influence was positively correlated with distance upstream, the moderately strong positive relationship between adult *O. mykiss* and distance upstream might reflect a real relationship with groundwater, which is difficult to disentangle from other geographic trends.

3.8.3.1 Correlation of habitat characteristics

As one would expect, pool area and pool volume are strongly correlated, and average and maximum water depths are strongly correlated, as is pool volume and water depth (Table 3-30). Many habitat characteristics are also correlated with longitudinal distance (distance in table) within Topanga Creek. For example, gradient increases in an upstream direction from around 1% at RKM 1.7 to 6% at RKM 4.4-5.3, which is correlated with decreasing pool volume, and increasing groundwater inputs.

Table 3-30. Habitat Correlation coefficients for pools.

	avgdepth	**maxdepth**	**area**	**volume**	**distance**	**year**	**canopy**	**algae**	**shelter**	**instream**
avgdepth	1	0.82	0.12	0.66	0.24	-0.03	-0.22	0.03	0.24	0.19
maxdepth	0.82	1	0.09	0.53	0.24	0.02	-0.21	0.06	0.28	0.18
area	0.12	0.09	1	0.78	0.00	-0.18	0.09	0.07	-0.01	0.02
volume	0.66	0.53	0.78	1	0.18	-0.12	-0.06	0.05	0.09	0.10
distance	0.24	0.24	0.00	0.18	1	-0.02	0.13	0.02	-0.04	-0.06
year	-0.03	0.02	-0.18	-0.12	-0.02	1	0.13	-0.46	-0.10	-0.42
canopy	-0.22	-0.21	0.09	-0.06	0.13	0.13	1	-0.13	-0.08	-0.10
algae	0.03	0.06	0.07	0.05	0.02	-0.46	-0.13	1	0.08	0.28
shelter	1	0.82	0.12	0.66	0.24	-0.03	-0.22	0.03	0.24	0.19
Instream cover	0.82	1	0.09	0.53	0.24	0.02	-0.21	0.06	0.28	0.18

3.8.3.2 Generalized linear modeling

All the analyses treat the fish counts as Poisson deviates, where the log of the Poisson parameter is a linear combination of explanatory variables. The Poisson model is preferred here because counts are often too small to be safely treated as Gaussian deviates. The log link is the natural one for Poisson models. All analyses were done in R.

The majority of regressions considered were formally significant ($p<0.05$). Moreover, when relationships were significant, they tended to be highly significant (that is very much smaller than 0.01). For this reason, more attention was given to rankings of models by the AIC criterion than to p-values.

3.8.3.3 Two-covariate models for abundance

For adult and juvenile *O. mykiss*, the habitat variable most strongly correlated with abundance (in the sense of yielding the model with the lowest AIC) was "year". The data further suggest that this is more about strong variability from year to year than an overall linear trend in abundance; that is, it is not necessarily the case that abundance is increasing or decreasing, but rather highly variable. In particular, the model in which year is taken as a categorical variable yields a lower AIC than the model with year as a linear variable (ΔAIC=90), despite having many more degrees of freedom (12 versus 2). Subsequent analyses included year (as a categorical variable), together with each habitat variable. All of these regressions were highly significant ($p<<0.01$).

The best single variable for predicting abundance (in the AIC sense) in combination with year, for both *O. mykiss* adults and juveniles, was maximum pool depth. The depth coefficient was positive for adults and negative for juveniles; that is, adults tended to be more abundant in deeper pools, and juveniles in shallower pools. Similarly, *O. mykiss* adult abundance was positively correlated with pool volume, and juvenile abundance negatively correlated with pool volume. Canopy was a fair predictor for *O. mykiss* juvenile abundance, but one of the worst for adult abundance. These relationships were highly significant ($p<<0.01$).

3.8.3.4 Two-covariate models for fish density

Initially we expected to see more fish in larger habitat units and fewer fish in smaller units. Notwithstanding the poor performance of pool area and pool volume as predictors of abundance by the AIC criterion, some analyses were conducted with areal or volumetric densities instead of numerical abundance. As before, "year" was included as a categorical variable in all models.

For both *O. mykiss* adults and juveniles, pool volumetric density was negatively correlated with pool area, and areal density was negatively correlated with pool volume. Overall, adult *O. mykiss* densities tend to be higher in deeper pools, and juvenile *O. mykiss* densities tend to be higher in shallower pools. The YEAR effect is strong and significant for both areal and volumetric densities. That is, adult densities tend to decrease, and juvenile densities tend to increase, over the study period.

3.8.4 Lagoon conditions and fish presence

Between 2001 and 2017 the lagoon entrance remained closed to the ocean for most of the year, opening only when rainfall was sufficient to breach the berm (sandbar) at the lagoon-ocean interface. These brief openings created a limited time window for *O. mykiss* to enter or leave Topanga Creek, except in 2005, when the large amounts of rainfall and high flows kept the connection open for over 200 days. Sediment deposited into the lagoon following most rain events, restricted passage further by reducing depth at the mouth to just a few centimeters during both high and low tides for much of the period when the lagoon berm was open. A narrow channel formed through the sediment deposits for brief periods of time, but was typically quite shallow (< 1 m) and quickly refilled with sediments. Movement by *O. mykiss* into and out of the lagoon itself was limited by water depth and occurred mostly during high tide conditions, even during and immediately following storm events when creek flow was more constant.

Depths in Topanga Lagoon are extremely variable depending on rainfall and sedimentation and the lagoon provides little cover for *O. mykiss*. When not connected to the ocean, the lagoon conditions were characteristic of a fresh water pond. Water quality in Topanga Lagoon has been monitored primarily using grab samples. Salinity in the lagoon is generally low (i.e., fresh water). Brackish conditions were noted rarely (Dagit and Reagan 2006, Dagit et al. 2014, Dagit et al. 2016).

The entire lagoon was seined in spring each year. The only fishes captured during these seining surveys were tidewater gobies (*Eucyclogobius newberryi*) and grunion (*Leuresthes tenuis*).

No *O. mykiss* were captured or observed in the lagoon during seining efforts.

3.8.5 Spawning Gravel

The amount and condition of suitable spawning gravel is a major component of habitat for *O. mykiss*. From 2001-2006, the percent of available spawning gravel was calculated as the distance of gravel (m) divided by the distance surveyed (m), whereas from 2010-2018, the percent available spawning gravel was calculated as area gravel (m^2) divided by the distance surveyed (Figure 3-32). The majority of suitable spawning gravel in Topanga Creek is located downstream of 4.4 RKM. The low flow conditions in 2012-17 resulted in growth of instream vegetation and increased gravel embeddedness, which has reduced the amount of gravel available for spawning.

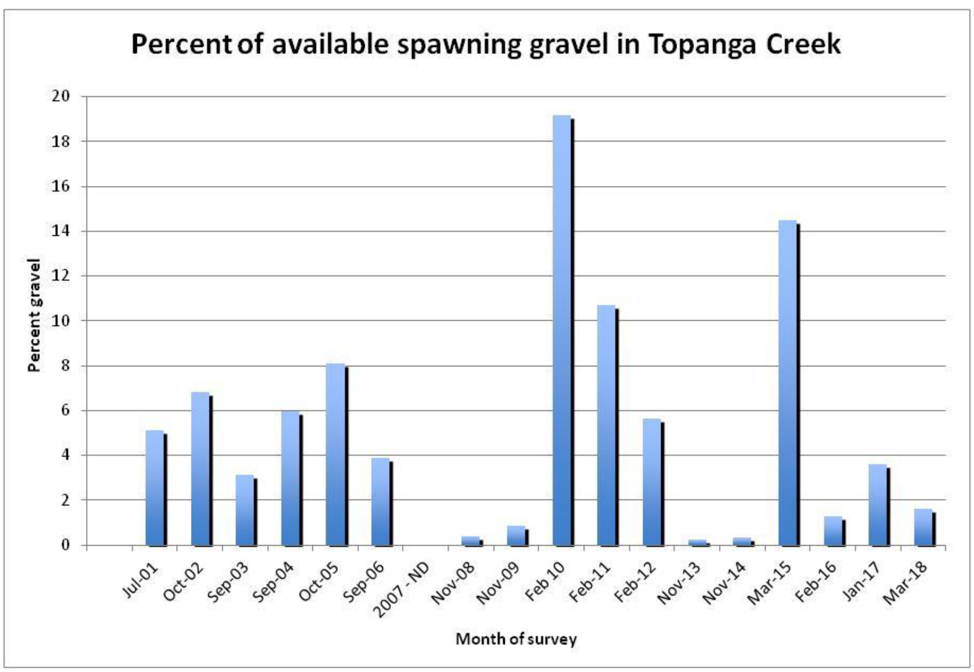

Figure 3-32. Percentage of Topanga Creek (0–6.0 RKM) with gravel suitable for *O. mykiss* spawning, 2001-2018. 2001-2006 = distance gravel (m)/distance surveyed (m), 2008-2018 = area gravel (m^2)/distance surveyed (m). 2007 data not available.

Embeddedness was measured each spring according to the physical habitat characterization SWAMP protocol (Fetscher et al. 2009) in two reaches of the creek (Table 3-31). The lower gradient reach beginning at 3.2 RKM had higher levels of embeddedness than the higher gradient upper reach starting at 4.5 RKM. This pattern is consistent with the observations of dry downs and encroachment of emergent vegetation.

Table 3-31. Percent Embeddedness.

	2013	2014	2015	2016	2017	Average %
Lower	49	49	34	53.7	38.6	44.9
Upper	26	44	35.4	35.4	31.6	34.5

3.9 Drift net monitoring and food availability

Many potential *O. mykiss* prey items were observed in Topanga Creek, including terrestrial and aquatic macro invertebrates as well as Arroyo chub ranging in size from 3 mm to 150 mm, young-of-year *O. mykiss* smaller than 50 mm, and crayfish smaller than 50 mm in length. Of these potential prey types, aquatic macro invertebrates were typically the most common prey item for *O. mykiss* based on previous gastric lavage analysis (Krug et al. 2014).

A total of 13,333 invertebrates representing 150 distinct taxa and life cycles were collected and identified from 94 samples throughout the study period from March 2014 - November 2017. Invertebrate abundance varied highly per six-hour sample, from 0 to 816 individuals. The relative abundance of over 50% of all aquatic individuals during the study were Coenagrionidae (*Argia sp*./*Enallagma sp*., 15.3%), Chironomidae larvae (14.2%), Copepoda (11.8%), Baetidae (*Baetis sp*. larvae (10.4%), and Amphipoda (*Hyalella sp*., 5.9%). The most abundant taxa of terrestrial origin were Thysanoptera (thrips, 5.7%), Diptera adults (3%), Aphidoidea (1.9%), Chironomidae adults (1.5%), and Formiscidae adults (1.5%).

Although *Argia sp*. of Odonata has the highest relative abundance by family, Diptera represents a larger order with four times the number of taxa groups than Odonata. Diptera and Plankton were the most numerically dominant invertebrate groups of all samples from 2014-17, with mean abundances of 44.32% (+/- 8.38) and 27.80% (+/- 4.08 standard error) respectively from all samples. Plankton includes copepods, *Hyalella sp*. amphipods, and ostracods. They were followed by Odonata (*Argia sp*./*Enallagma sp*.) and EPT groups. Hemipiterans and thrips showed the lowest mean abundances of 9.91% +/- 1.5 and 8.04% +/- 3.87 respectively (+/- standard error). Overall, aquatic invertebrates were significantly more abundant than terrestrial organisms, comprising 83.5% of the mean sample abundance. Also 72.3% of the taxa observed were aquatic compared to 27.7% terrestrial taxa.

Invertebrate density was calculated by total number of organisms / total volume of flow (m^3). Density of invertebrates was not significantly different between upper and lower drift net sites ($F_{1,86} = 0.4081$, p = 0.5246) or sampling time of day ($F_{3,84} = 1.327$, p = 0.2712). There was a significant difference however between the three sampling months however, with higher density in July ($F_{2,85} = 4.328$, p = 0.01622), even though flows were higher in March on average. The numbers of individuals per sample were low overall, with samples with more than 500 individuals reached only in July 2014 and March 2015.

More macro invertebrates were collected in the lower nets for every group except plankton (Figure 3-33). The lower net was sampling only the 20 meters of the pool upstream to the nets at the top of the pool, as compared to the upstream nets, which sampled a much greater area of the upstream habitat. However, the flow was higher at the lower net, while the upstream net had slow and stagnant flow that was potentially limited by a large arundo patch upstream.

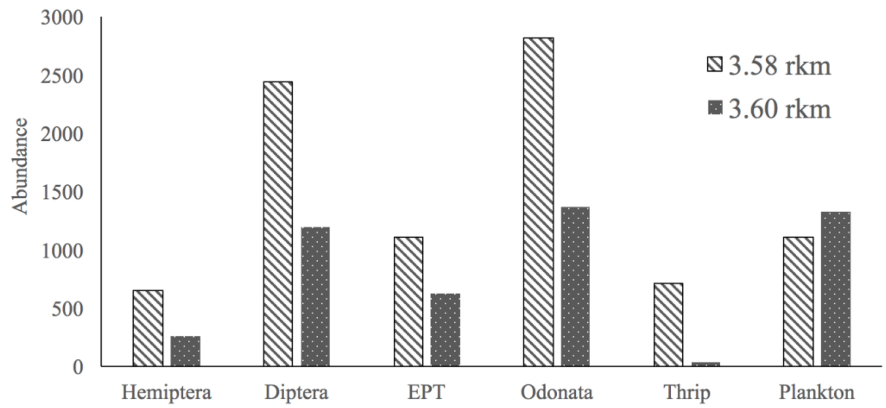

Figure 3-33. Total abundance of invertebrate groups from all drift net samples (n=94) in both upper vs. lower traps from 2014-17.

Diptera abundance increased greatly in 2017, quadrupling their total abundance as compared to previous drought years (Figure 3-34). Hemipterans had consistently low abundance in all four sampling years, while EPT only gradually increased slightly over the study period. Odonata and plankton showed similar trends of increasing steadily from 2014-16, then dropping in 2017. March samples consistently had the greatest abundance of invertebrates, with sharp declines in July. The sampling period of lowest abundance was November for all six invertebrate groups except Hemipterans (Figure 3-24).

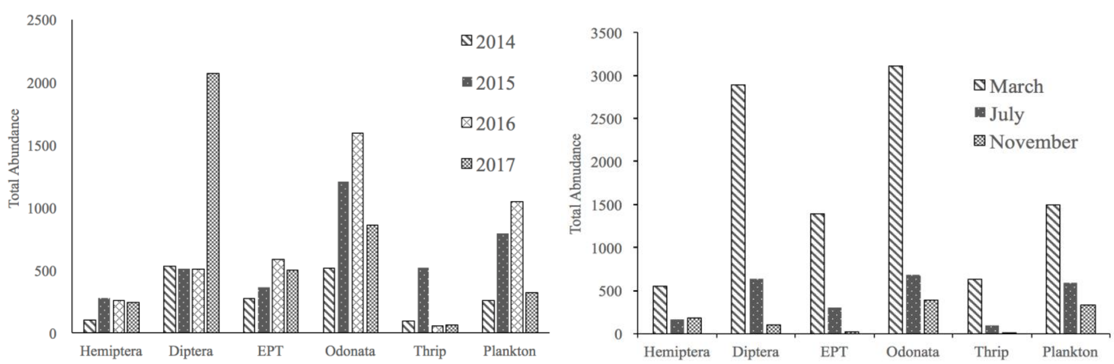

Figure 3-34. Total abundance of invertebrate groups from all samples 2014-2017 (n=94) by year and season.

Sample abundance patterns illustrated a trend with the 1800 samples all having the lowest numbers for all groups, and then a steady increase in abundance overnight from 0000 to 0600 (Figure 3-35). The pattern between 0600 and 1200 was variable with all taxa except Diptera and plankton decreasing by the noon sampling. The increase in abundance overnight may be related to cooler night temperatures and the slight increase in flow (Figure 3-35).

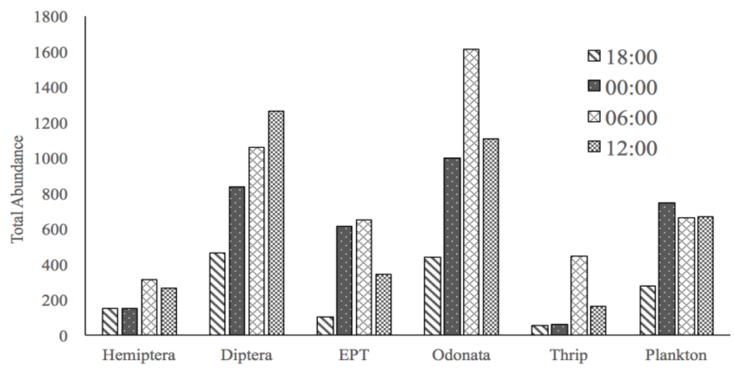

Figure 3-35. Total abundance of invertebrate groups from all drift net samples (n=94) by sampling time of day.

3.10 Kick net monitoring and food availability

Over 16,000 BMI were collected each spring via kick net sampling between 2003 and 2015, with abundance ranging from 11.4 to 390.7 organisms per square foot. The most abundant taxa 2014 to 2015 were Chironomidae, Amphipoda, Ostracoda, Coenagrionidae, and Planaria. This was a shift from the major groups present from 2003 to 2011, which were Baetidae, Chironomidae, Simulidae, Elmidae, and Planaria (Montgomery et al. 2015). The number of organisms collected in 2014 and 2015 was within normal range of previous collections, suggesting that drought conditions had not yet affected total BMI abundance, which was overall fairly low, except for in the wet year 2005 and 2007 (Figure 3-36).

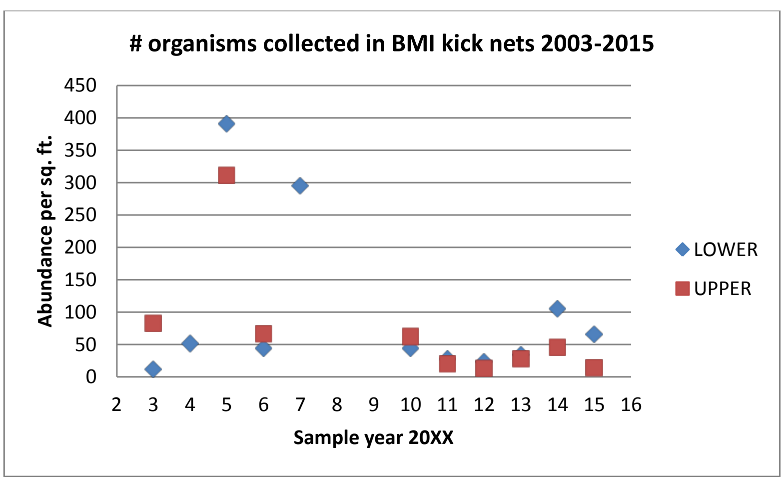

Figure 3-36. Abundance of benthic macro-invertebrates per square foot by year at two locations in Topanga Creek (3.2 RKM Lower, 4.5 RKM upper).

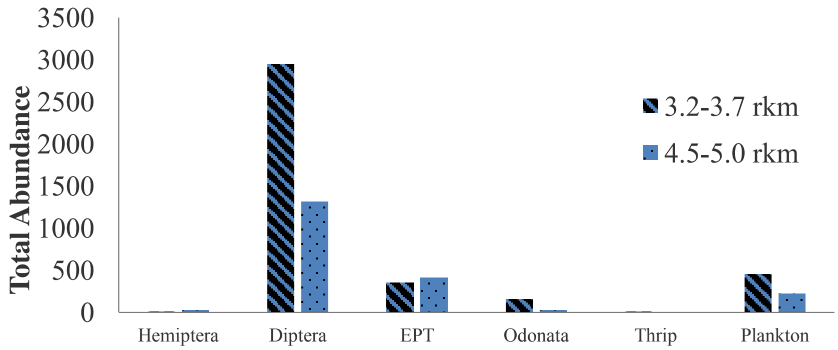

Figure 3-37. Total invertebrates by group in the lower kick net sampling section (3.2-3.7RKM) versus the upper kick net sampling section (4.5-5.0 RKM).

From 2014-2017, a total of 6,389 invertebrates were collected in kick nets in lower (3.2-3.7 RKM) and upper (4.5-5.0 RKM) sampling reaches combined. In the lower kick nets, a total of 4,161 invertebrates representing 70 distinct taxa and life cycles were collected and identified throughout the study period April/May 2014 - 2017. The most abundant aquatic taxa observed throughout the study were Chironimidae larvae (63.3%), Amphipoda (*Hyalella sp*., 8.1%), Baetidae larvae (5.9%), Simuliidae larvae (*Simulium sp*., 4.1%), Copepoda (1.9%) Coenagrionidae larvae (*Argia* sp., 2.8%), Cambaridae (2.7%), Copepoda (1.6%), Ostracoda (1.2%) and Baetidae (*Baetis sp*. larvae (1.1%). Baetidae were separated by those identifiable to species, versus individuals that were only identifiable to family.

The upper kick nets had a total count of 2,228 individuals from 64 different taxa and life cycles. Chironimidae larvae (47.8%), Baetidae larvae (9.3 %), Amphipoda (*Hyalella sp*., 7.8 %), Turbellaria (5.3%), Simuliidae larvae (*Simulium sp*., 4.5%), Baetidae (*Baetis sp*. larvae 3.6%), Polycentropodidae (3.0%), Diptera adults (2.8%), Copepoda (1.9%), Philopotamidae (1.7%) and Ostracoda (1.2%) and Coenagrionidae (Argia sp., 1.0%).

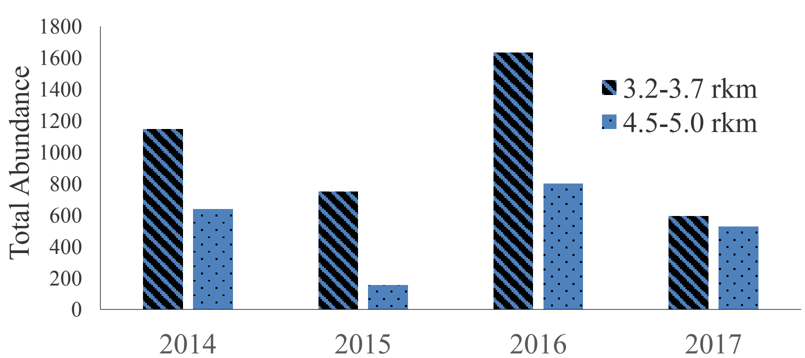

Figure 3-38. Total **abundance of invertebrates sampled in kick nets, by sampling site from 2014-17.**

Both lower and upper sites showed similar trends across the four years, with cycles between high and then low abundance occurring each separate two-year cycle. In 2014 there was moderate abundance of about 1,700 individuals in total, then dropping to about half of that total in 2015 (Figure 3-38). The highest abundance was recorded in 2016, followed by a large drop in abundance again in 2017.

Preliminary results of this analysis indicate that diversity and density of macro invertebrates in Topanga Creek were sufficient to support a wide variety of predators, including *O. mykiss*. The assemblage was dominated by moderately tolerant species that are able to survive the high disturbance regime associated with the intermittent and variable rainfall patterns common in southern California (Table 3-32). The nutrient levels, temperatures and dissolved oxygen levels in Topanga Creek were generally suitable for aquatic invertebrates, although infiltration of fine sediment appears to limit production in some locations.

Table 3-32. Major groups of aquatic macro-invertebrates found in Topanga Creek, 2001-2017.

Common name	Class or Order	Family	Functional feeding group	Tolerance level[a]
amphipod	Amphipoda (*o.*)	Hyalellidae	collector gatherer	8
spider	Arachnida (*o.*)	Acari (*taxon*)	parasite	5
beetle	Coleoptera (*o.*)	Dytiscidae	predator	5-8
		Elmidae	collector gatherer/scraper	4
		Haliplidae	macrophyte herbivore	5
true fly	Diptera (*o.*)	Ceratopogonidae	predator	6
		Chironomidae	collector gatherer	6
		Culicidae	collector gatherer	8
		Dixidae	collector gatherer	2
		Simuliidae	filterer collector	6
		Stratiomyidae	collector gatherer	8
		Tipulidae	shredder/predator/shredder/collector gatherer/omnivore	2-6
mayfly	Ephemeroptera (*o.*)	Baetidae	collector gatherer	4-5
		Caenidae	collector gatherer	7
		Leptohyphidae	collector gatherer	4
		Leptophlebiidae	collector gatherer	4
ribbon Worm	Enopla (*c.*)	Prostoma	predator	8
snail	Gastropoda (*c.*)	Hydrobiidae	scraper	8
		Physidae	scraper	8
Common name	**Class or Order**	**Family**	**Functional feeding group**	**Tolerance level[a]**
true bug	Hemiptera (*o.*)	Hebridae	predator	6
		Corixidae	predator	8
aquatic moths	Lepidoptera (*o.*)	Pyralidae	shredder	5
dragon/damsel fly	Odonata (*o.*)	Aeshnidae	predator	5
		Coenagrionidae	predator	7
		Lestidae	predator	9
aquatic worm	Oligochaeta (*c.*)	--	collector gatherer	5
ostracod	Ostracoda (*c.*)	--	collector gatherer	8
stonefly	Plecoptera (*o.*)	Nemouridae	shredder	2
caddisfly	Trichoptera (*o.*)	Hydroptila	piercer herbivore	6
		Hydropsychidae	collector filterer	4
		Polycentropodidae	predator	6
flatworm	Turbellaria (*c.*)	Planaria	predator	4

[a] Tolerance level: 0 = extremely sensitive to pollution, 10 = extremely tolerant of pollution (Bode et al. 1996)

3.11 Invasive Species Monitoring

During each sampling event and snorkel survey, the presence of any invasive species was noted. New Zealand mud snails were found in Topanga Creek, observed in August 2016 in a reach between 1.825 and 2.0 RKM. However, following the rains in winter 2017, they have not been observed. Since 2001, a single adult bullfrog (*Rana catsbeia*) was observed and removed, along with several adult red-eared slider turtles (*Trachemys scripta elegans*).

The most abundant invasive aquatic fauna observed is the red swamp crayfish (*Procambarus clarkii*). They were introduced into the mainstem of the creek upstream of the town in 2001 by an individual who wanted a more reliable source for bait. The abundance of crayfish remained fairly low, with a few individuals observed in pools between 1.8 and 5.0 RKM, between 2008 and 2011. Big rain events in February 2010 and March 2011 were thought to have helped control spread. Starting in June 2011, the numbers of crayfish began to rise, and they were observed in more pools. Figure 3-39 below provides a snapshot of the population pattern, illustrating the average number of crayfish that were observed in a specific pool by year. Because we do not have absolute counts throughout the survey reaches, this serves as a proxy to illustrate the increase in crayfish presence during the low flow conditions of 2012 to 2017. From the figure, it appears that the presence of crayfish increased dramatically at the start of the drought in 2012 in the lower reaches (below 3.6 RKM) more so than in the upper reaches, however, it should be noted that it is also possible that the recording of presence is not as consistent in the upper reach as in the lower reach. Sufficient flows in 2017 flushed out a majority of the crayfish population in Topanga Creek, but as you can see in Figure 3-39, counts in the upper reach were not as affected. As 2018 progresses, very young crayfish have been observed in the upper reaches, likely offspring of large adults who were able to anchor themselves during storm surges in 2017.

A focused crayfish removal effort was initiated in September 2013 with volunteers supervised by RCDSMM biologists and Watershed Steward Program members. Removal efforts were focused in the reach between 3.4-3.55 RKM, where water quality and benthic macro invertebrate assemblage data was also collected (Garcia et al. 2015). Community volunteer removal events continued in 2014 -2016 supervised by RCDSMM biologists. This effort is still in progress with a focus on reducing crayfish density in and around observed redds and areas with young of the year.

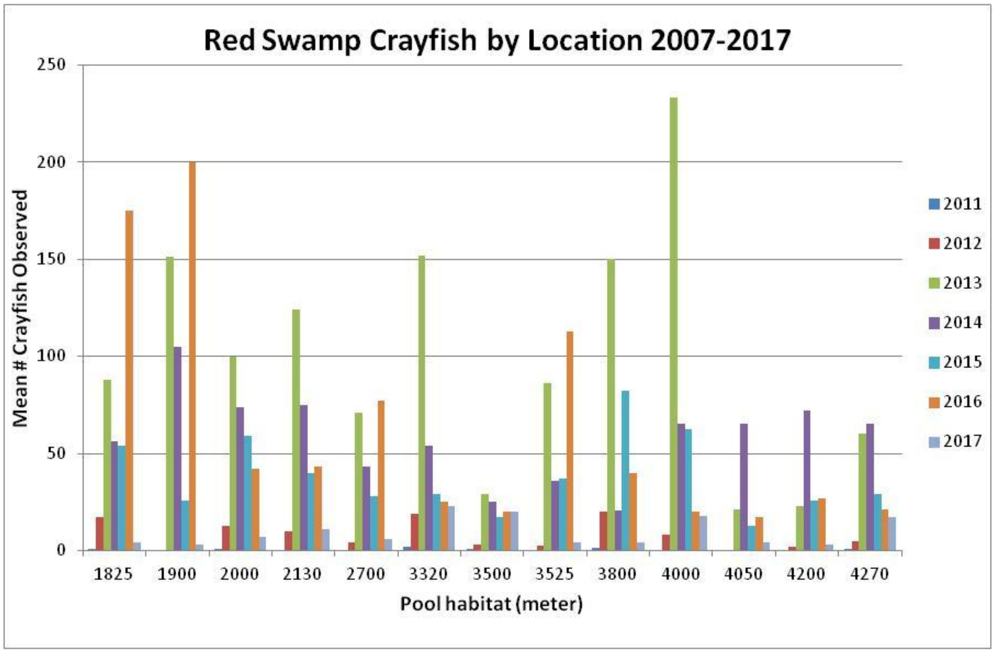

Figure 3- 39. Average number of crayfish observed in selected representative pools in Topanga Creek.

Between March 2013 and July 2015, 1,934 crayfish were removed at 31 volunteer events. At each event, crayfish were counted, sexed, and measured and catch per unit effort was calculated to provide demographic data. Water quality parameters (dissolved oxygen, salinity, pH, conductivity, and water temperature) were measured at each event. While current community volunteer based efforts might reduce pressure at targeted locations, it is likely removal efforts will need to be scaled up in order to significantly reduce the crayfish population throughout Topanga Creek mainstem, which appears to be increasing overall.

Non-native fish: Fat-head minnow

Fat-head minnow (*Pimephales promelas*) were observed at a number of locations in Topanga Creek beginning in July 2014 and as recently as March 2016. Despite their distribution throughout the entire perennial snorkel survey reach (1.8-5.3 RKM), counts remained low (0-32 total per survey). Male fatheads are easier to distinguish during the spring and summer, as they become more colorful with enhanced turbercules on their heads in the breeding season. Female fatheads are more difficult to distinguish from Arroyo chub. Monitoring of fathead minnows in Topanga Creek will continue on a monthly basis to determine establishment and inform management decisions (funded by other grants until 2019).

Non-native fish: gold chub

Swimming among schools of native Arroyo chub, snorkelers often observe small orange minnows. It is uncertain when they originated in Topanga Creek. They are distributed along the length of the creek with 1-30 individuals observed per pool at any given time. They appear similar to rosy red minnows, which are a hybrid of fathead minnows. Specimens were brought to Dr. Rick Feeney at the Los Angeles Natural History Museum who was unable to identify the fish. Theories as to whether they are an endemic hybrid of native Arroyo chub and/or fathead minnow or non-native rosy red minnows remain invalidated.

Non-native fish: other
Goldfish and koi are occasionally dumped into Topanga Creek and removed when found.

3.12 Water Temperature Monitoring

Water temperature has been monitored at several pools in Topanga Creek since 2004. The temperature in Topanga Creek (downstream of 5.3 RKM) varied seasonally and spatially according to canopy cover, proximity to seeps and springs, and water depth. The daily range of temperature followed a pattern of late afternoon peak temperatures followed by slow cooling overnight with the lowest temperatures recorded just before dawn.

Average water temperatures between April and October in the lower reach remained below 20ºC and in the upper were generally less than 22ºC, but usually exceeded 23ºC for nearly a week each summer in late July and early August, and in some cases exceeded 25ºC (Figure 3-40). Figure 3-41 shows the average maximum monthly water temperatures in Topanga Creek between April and October, 2005-2017, while Figure 3-42 shows the minimum water temperature during this same period. The three monitoring locations near groundwater sources (Ken2 at 2.6 RKM, Sycamore at 3.8 RKM, and Noel at 4.0 RKM) did not appear to have significantly different temperatures from the three monitoring locations (Ski Pole 2.0 RKM, Engine 3.5 RKM, Josh 4.36 RKM) that do not get groundwater input. Presumably shading from the canyon walls and the riparian canopy are other factors influencing water temperature in Topanga Creek. Average temperatures illustrated a fairly consistent pattern, with the exception of the hot spell in summer 2006.

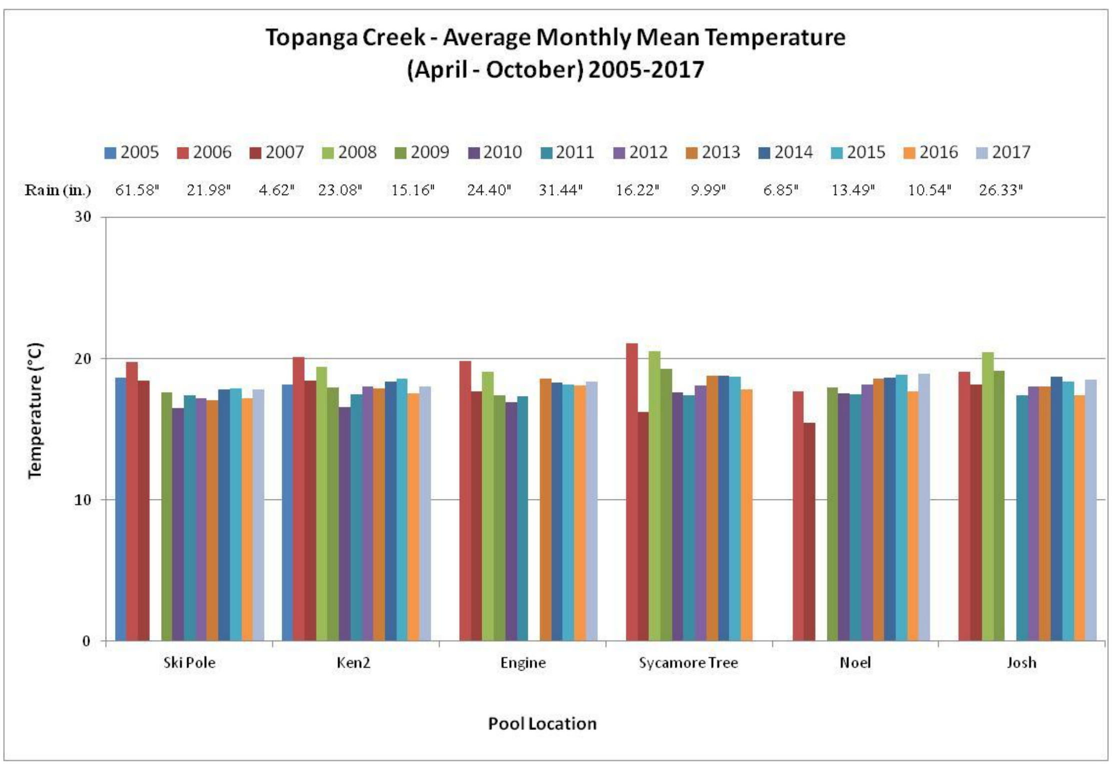

Figure 3-40. Average monthly water temperatures in Topanga Creek between April and October, 2005-2017. No data available for white blank rows within each site.

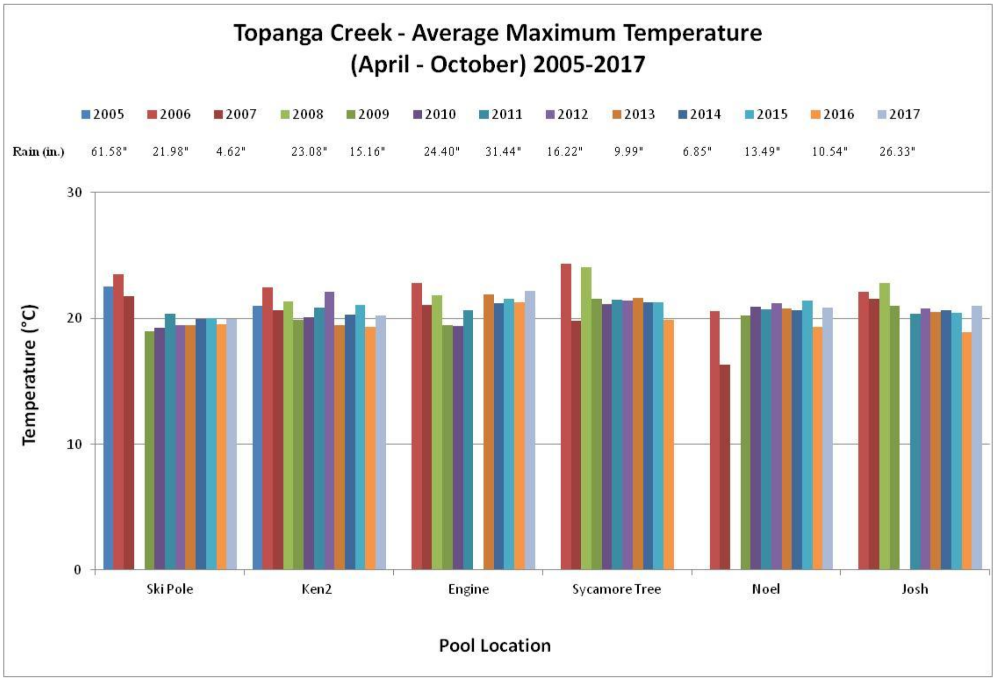

Figure 3-41. Average monthly maximum water temperatures in Topanga Creek between April and October, 2005-2017. . No data available for white blank rows within each site.

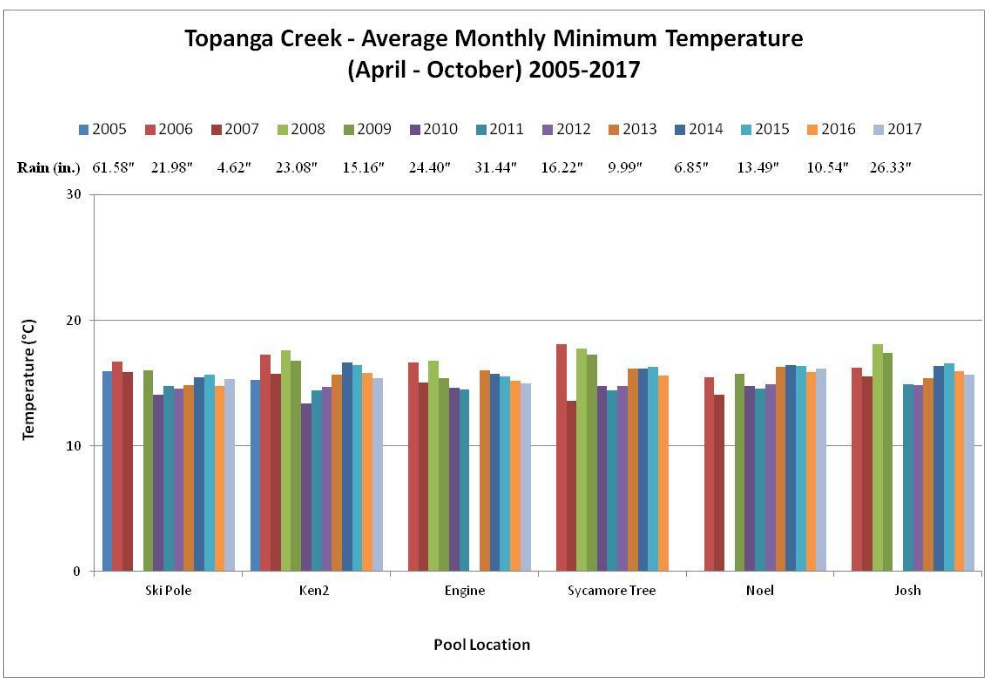

Figure 3-42. Average monthly minimum water temperatures in Topanga Creek between April and October, 2005-2017. No data available for white blank rows within each site.

3.13 *O. mykiss* Genetics

Population genetics

After removing all but one representative individual for all duplicate clusters and FullSib family groups, as well as seven individuals missing data at more than 10 loci, 15 individuals from Malibu Creek, 428 individuals from Topanga Creek, and only one individual from Arroyo Sequit Creek remained. Consequently, the heterozygosity of Arroyo Sequit is not reported given the sample size. The observed heterozygosity amongst the Malibu Creek individuals is 0.4083, and 0.3347 amongst the Topanga Creek individuals (Table 3-33). The observed mean heterozygosity amongst the native southern California populations and hatchery strains in the existing baseline is 0.336 and 0.3086, respectively (Table 3-33).

Table 3-33. Observed heterozygosity (Obs Hz) and expected heterozygosity (Exp Hz) amongst individuals collected in Topanga and Malibu Creeks.

Population	n	Exp Hz	Obs Hz	Mean Exp Hz across populations	Mean Obs Hz across populations
Malibu Creek	15	0.3836	0.4083	---	---
Topanga Creek	428	0.3421	0.3347	---	---
Native Southern CA populations	1470	---	---	0.3361	0.336
Fillmore Hatchery strains	238	---	---	0.3149	0.3086

Additionally, after removing individuals implicated in duplicate sampling or FullSib families, as well as individuals missing data at both of the Omy5 loci, two individuals from Arroyo Sequit Creek, 18 individuals from Malibu Creek and 435 individuals from Topanga Creek remained. The frequency of the anadromous allele for the Arroyo Sequit samples is reported, but should be interpreted with caution given the small sample size. The frequency of the anadromous allele at the OmyR04944 locus amongst individuals sampled in Arroyo Sequit Creek, Malibu Creek and Topanga Creek is 0.00%, 85.29% and 67.17%, respectively (Table 3-34). The frequency of the anadromous allele at the SH114448-87 locus amongst individuals sampled in Arroyo Sequit Creek, Malibu Creek and Topanga Creek is 0.00%, 81.25% and 66.78%, respectively (Table 3-34). We do not have genotype data for the Filmore Hatchery strains and native Southern CA populations at OmyR04944 or the native populations at SH114448-87 simply due to developments during the data collection process.

Table 3-34. Frequency of the anadromous allele at the two loci associated with the Omy5 region amongst all individuals according to sampling location. Includes individuals collected in Arroyo Sequit, Malibu and Topanga Creek, as well as individuals from all Filmore Hatchery strains.

Population	n	Frequency of anadromous allele at OmyR04944	Frequency of anadromous allele at SH114448-87	Mean freqeuency of anadromous alleles at SH114448-87
Arroyo Sequit Creek	2	0	0	---
Malibu Creek	18	85.29%	81.25%	---
Topanga Creek	435	67.17%	66.78%	---
Fillmore Hatchery Strains	190	---	---	41.28%

Genetic Assignment

We report the results of the mixture assignment by listing the top five populations to which each individual was assigned, along with corresponding proportional assignment to that population. A table with these details is provided in Appendix F. When the study populations were not included in the assignment baseline, the top population to which individuals were assigned was Santa Ynez River - Hilton Creek (n=394) followed by Santa Ynez River - Main stem (n=302).

Only 26 individuals of 988 had the largest proportional assignment to a strain from Fillmore Hatchery. When we examined the maximum-a-posteriori assignments for each individual, rather than proportional assignment, and filtered by Posterior Prob. ≥ 0.95, the Santa Ynez River remained the population to which the majority of individuals sampled in Topanga Creek and Malibu Creek assigned. Further, after applying these filtration criteria, fewer individuals assigned to a Fillmore Hatchery strain (n = 14) (Table 3-35).

Table 3-35. Maximum-a-posteriori population assignments. Presents the number of individuals from each sampling location assigned to each respective source population. The most common inferred population for each sampling location is bolded. Results derived from mixture analysis implemented in rubias, and filtered by Posterior Prob >= 0.95.

Sampling Location	Inferred Population	n	Mean Posterior Probability
Malibu Creek	**SYnzMain**	**8**	0.9923743
Malibu Creek	ArGrMain	2	0.9996096
Topanga Creek	**SYnzHilt**	**110**	0.979241
Topanga Creek	SYnzMain	69	0.9804813
Topanga Creek	SaMaRey	26	0.9850259
Topanga Creek	SaGaWFork	42	0.9868019
Topanga Creek	FilHaCole	14	0.9788209
Topanga Creek	SalTjera	15	0.9780428
Topanga Creek	SanSim	5	0.9792152
Topanga Creek	ArGrMain	3	0.9679961
Topanga Creek	SYnzSals	1	0.9890839

When the individuals from Topanga, Malibu and Arroyo Sequit Creeks were included in the baseline and then assigned to a population using self-assignment, only 17 of 906 individuals passing filtration criteria (Posterior Prob. ≥ 0.95) did not assign back to the location at which they were sampled (Table 6). Six of these assignments actually included individuals sampled in Topanga Creek, but which assigned to Malibu Creek. Amongst these 17 assignments, the majority of individuals assigned to Santa Maria Basin – Reyes Creek (n = 7) (Table 3-36). Lastly, only one individual assigned to a Fillmore Hatchery strain (Table 3-36).

Table 3-36. Non-matching results from self-assignment implemented in rubias after filtering all assignments by Posterior Prob >= 0.95.

Individual	Individual RCDSMM ID	Collection Location	Inferred Location	Posterior Prob	Date Captured	Location	Gender	Size (mm)	Age
M103799	MC14-1	MalCrk	ArGrMain	0.995816563	3/11/2014	2901	Female	670	nd
M097904	**T16-1D**	**TopCrk**	**FilHaCole**	**0.999991108**	2/4/2016	4450	Male	320	2+
M031440	T08-86	TopCrk	MalCrk	0.993053036	11/19/2008	2500	Female	85	0+
M031368	T08-13	TopCrk	MalCrk	0.99164781	11/19/2008	2650	Male	123	1+
M038215	T09-148	TopCrk	MalCrk	0.987946935	11/4/2009	2700	Male	160	1+
M065219	T11-230	TopCrk	MalCrk	0.967840508	11/16/2011	4300	Male	227	2+
M053038	T10-117	TopCrk	MalCrk	0.965032766	11/18/2010	2315	Female	145	0+
M065165	T11-11	TopCrk	MalCrk	0.957326294	3/15/2011	1935	Female	207	1+
M011640	nd	TopCrk	SaGaWFork	0.966228361	2/15/2003	1300	Male	116	0+
M103710	T17-131	TopCrk	SaMaRey	0.996089957	9/8/2017	2700	nd	635	4+
M102169	T17-88	TopCrk	SaMaRey	0.994768369	11/15/2017	2520	Female	92	0+
M031371	T08-16	TopCrk	SaMaRey	0.982447032	11/19/2008	2650	Male	110	0+
M102188	T17-107	TopCrk	SaMaRey	0.979674843	11/15/2017	2650	Female	88	0+
M102203	T17-122	TopCrk	SaMaRey	0.979465424	11/15/2017	2700	Female	66	0+
M102176	T17-95	TopCrk	SaMaRey	0.96884438	11/15/2017	2590	Female	87	0+
M102174	T17-93	TopCrk	SaMaRey	0.96784838	11/15/2017	2590	Male	77	0+
M038202	T09-135	TopCrk	SYnzHilt	0.953249573	11/4/2009	2450	Male	170	1+

The STRUCTURE clustering constraint that appears to most cleanly describe population structuring amongst the Southern California populations, including Topanga Creek and Malibu Creek, and Fillmore Hatchery strains is k = 3 (Figure 3-43). At k=3, the individuals from Topanga Creek are consistently placed into a group distinct from the native populations and hatchery strains (represented by orange color). The hatchery strains likewise represent another distinct group (represented by yellow color), but there is evidence of admixture with hatchery strains in several native groups (i.e. groups 14, 15, and 25), as well as some Topanga Creek individuals. However, the Malibu Creek individuals (group 8) appear to be more genetically similar to the native populations (represented by blue color).

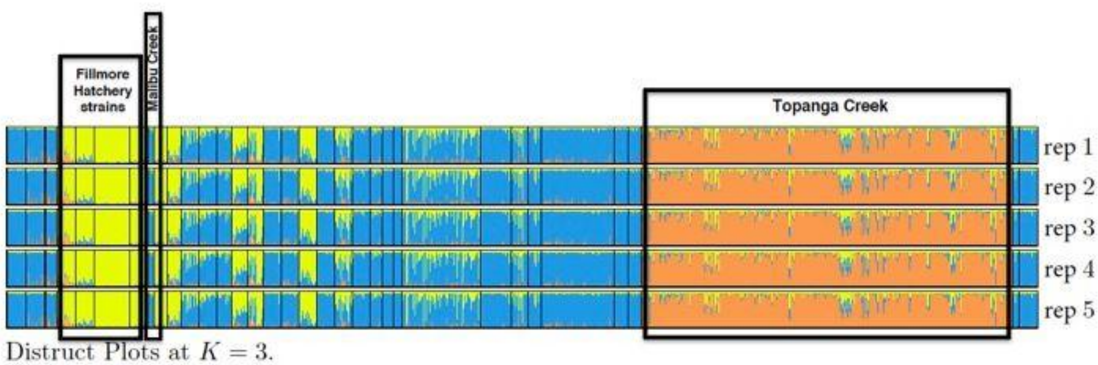

Figure 3-43. STRUCTURE plot at k=3. Sections are boxed according to their labels. Yellow= Filmore Hatchery strains; Blue=native southern California populations; Orange= Topanga Creek population.

In addition to a STRUCTURE analysis, we assessed regional population structure using phylogenetic inference. We constructed a neighbor-joining tree in POPTREEW, with 1000 bootstrap replications (Figure 3-44). For ease of description, the resulting phylogenetic tree can be roughly divided into two sections: 1) Filmore Hatchery strains at the top right and 2) native Southern California populations at the bottom left. However, there are a few native populations that appear to be more closely related to the Filmore Hatchery strains, such as the North Fork of San Jacinta – Santa Ana River (SaAnNFSaJa) and

San Antonio – Santa Ana River (SaAnSaAnt). Individuals from Topanga Creek fall essentially between these two clusters, whereas individuals from Malibu Creek group more closely with the cluster of native Southern California populations. This pattern, of the Topanga Creek branch falling between the larger hatchery cluster and the cluster of native populations, was also produced in previous phylogenetic analyses of Topanga Creek (Dagit et al. 2016).

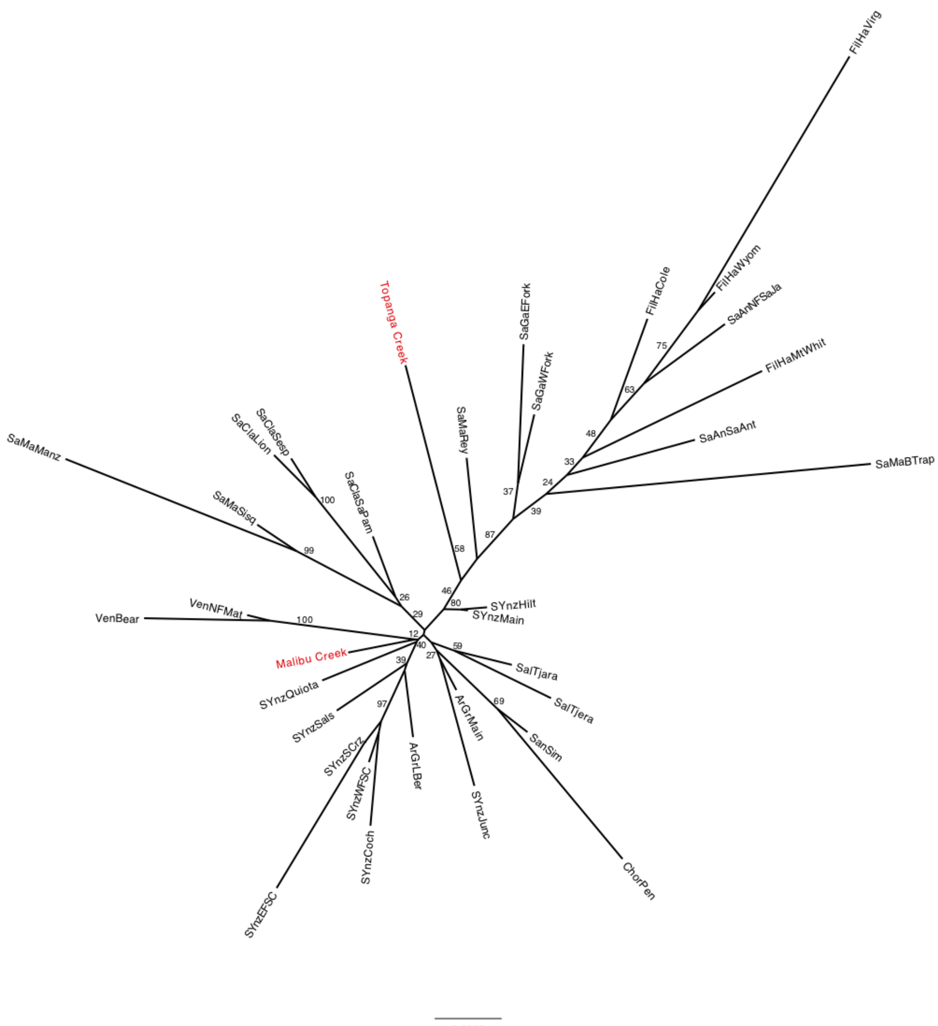

Figure 3-44. – Neighbor-Joining phylogenetic tree including Topanga and Malibu Creeks, native Southern California populations, and Filmore Hatchery strains. See Table "pop codes" for population codes.

Sibship Analysis

We performed FullSib family estimation for cohorts 2007 through 2017. After dropping FullSib families of size two and filtering by P(Inc.) ≥ 0.90, we recovered a total of 73 FullSib families across all cohorts (Table 3-37). The maximum family sizes ranged from size three (2014 cohort) to size 30 (2017 cohort).

No inferred FullSib families passed filter within the 2015 cohort, which is not to say reproduction did not occur in 2015, but we simply did not have enough information to confidently identify full-sibling families (Table 3-37).

Table 3-37. Full Sibling (FullSib) Family results.

Cohort	No. FullSib families	Max Family Size	Mean Family Size
2007	2	7	5
2008	14	21	7.14
2009	17	19	7
2010	11	22	9.91
2011	9	19	8.33
2012	10	26	10.7
2013	2	4	4
2014	1	3	NA
2015	0	NA	NA
2016	1	4	NA
2017	6	30	13.83

Parentage Analysis

After filtering all individuals for duplicate sampling and missing data, the potential offspring and parent pools were constructed as described in Table 3-38. The earliest cohort for which we recovered trios that passed our established filtration criteria was 2009, and we recovered a total of 152 parent-offspring trios across all cohorts. Across these 152 trios, we identified 50 unique parent pairs, indicating several parent pairs produced multiple offspring. The maximum number of offspring attributed to one parent pair was 27.

Table 3-38. Recovered Parent-Offspring Trios. The potential parent pool represents which cohorts were drawn from to create the possible parent pool. The number of individuals assigned parents by cohort only includes those trios which passed the described confidence threshold (FDR <= 0.05).

Offspring Cohort	n	Potential Parent Pool	No. individuals assigned parents
2017	94	2011 - 2016 (n= 340)	20
2016	19	2010 - 2015 (n= 473)	7
2015	21	2009 - 2014 (n= 610)	16
2014	27	2008 - 2013 (n= 729)	17
2013	38	2007 - 2012 (n= 735)	25
2012	136	2006 - 2011 (n= 611)	9
2011	99	2005 - 2010 (n= 520)	13
2010	152	2004 - 2009 (n= 374)	31
2009	158	2003 - 2008 (n= 219)	14
		total:	152

We utilized the parent-offspring results to assess the accuracy with which all individuals were aged, and adjusted metadata accordingly. First, we examined the cohort of all offspring attributed to the same unique parent pair. While it is possible to capture reproduction by a single adult in multiple years (i.e. iteroparity), monogamous matings across years is much less likely. Therefore, any offspring attributed to the same parent pair, but for which the cohort years were not identical, were flagged for a reassessment of age. We then considered date of collection, length at collection, and size of the putative siblings to re-estimate cohort, such that all individuals assigned to the same parent pair were ultimately grouped into the same cohort. We ultimately adjusted the cohort for 34 of the 152 individuals assigned as offspring, with presumed cohort of only one individual being adjusted by more than one year.

We then were able to assess the occurrence of iteroparity and estimate age at spawning amongst the identified parents individually. From the 50 parent pairs, we identified 88 unique adults, indicating some polyagomous matings. We identified 11 iteroparous spawners, of which four were male and seven were female (Table 3-39). Overall, the age at which the 88 recovered parents spawned ranged from age-1 to age-6 (Table 3-40), based on their cohort assignments. More males than females were found to have spawned at the minimum and maximum ends of the age range; however the most common age-at-spawning amongst males was age-2 and age-3 (Table 3-40). The most common age-at-spawning amongst females was age-3 (Table 3-40).

Table 3-39. Occurrences of Iteroparity recovered from our parent-offspring trio analysis.

Individual NMFS Id	Individual RCDSMM Id	Sex	Collection Locality	No. times spawned	Years spawned	Size at First Spawn	Age at First Spawn
M065228	T11-196	M	3525	3	2011, 2012, 2014	201mm(In Nov 11)	2+
M038246	T09-179	F	3500	2	2012, 2013		4+
M031359	T08-4	M	2250	2	2013, 2014		5+
M065204	T11-212	F	4100	2	2013, 2014		3+
M065212	T11-185	F	3320	2	2013, 2014		3+
M065237	T11-206	M	4000	2	2013, 2014		4+
M067377	T13-338	M	3720	2	2013, 2014	208mm(In Nov 13)	1+
M062953	T13-137	F	3525	2	2014, 2015		2+
M062915	T13-83	F	2950	2	2014, 2017		3+
M062971	T13-171	F	4100	2	2015, 2016		4+
M065313	T12-209	F	3740	2	2016, 2017		4+

Table 3-40. **Age at spawning amongst recovered parents.**

Age at spawning	n	No. Males	No. Females
1	11	8	3
2	15	11	4
3	27	11	16
4	21	8	13
5	10	5	5
6	4	3	1

4 DISCUSSION

The *O. mykiss* population in Topanga Creek appears to be persisting, although high summer mortality and substantial annual variation in abundance are very likely related to stressful conditions resulting from low precipitation during the on-going drought. The years 2013-2016 have been characterized by extreme drought conditions in Topanga Creek, as well as throughout California (US Drought Monitor 2018). The analysis presented in this report is not focused on assessing the impacts specific to the drought; that analysis is found in Dagit et al. 2017, included in Appendix H. Normal to slightly above average rain in 2017 ended the drought in California, but conditions quickly reverted to dry disconnected creek reaches as extreme summer heat continued in Southern California. As we move into 2018, which is already quite dry again, it remains to be seen if additional drought responses continue or worsen. The substantial annual variability in the population that we documented continues to reinforce the need for long-term monitoring to more realistically characterize the status of this population, potential disturbances and identify recovery processes.

The focus of this report was to continue assessment of the Viable Salmonid Population metrics defined by the Coastal Monitoring Program (Adams et al. 2011). Additionally, we posed a number of study objective questions based on information requested by the Southern California Steelhead Recovery Plan (NMFS 2012).

4.1 Viable Salmonid Population Metrics

4.1.1 Abundance

Abundance of anadromous adults in Topanga Creek is extremely low and varies in part due to passage opportunities. As a result of low rainfall and limited connectivity to the ocean, as well as constriction of instream freshwater habitat, the overall population of *O. mykiss* in Topanga Creek continues to decline. After several years of drought, the population appeared to nearly collapse by the fall of 2017 (see Section 3.6.3). An observed small pulse of recruitment in spring 2015 and spring 2017 increased the average population observed to levels that were seen at the start of the drought in 2012 (Table 4-1). Until 2016, all young of the year are offspring of a small estimated number of resident spawners. At the beginning of 2017, an anadromous female entered Topanga Creek and successfully spawned with a resident male, remaining in the pool upstream of her offspring until she died in September 2017. These observations reiterate the importance of life history diversity, and support the need for continued monitoring.

Table 4-1. Observations of *O. mykiss* in Topanga Creek 2001-2017.

Year	Avg Juvenile <100mm (≤ 4")	Avg Intermediate 100-250mm (5-10")	Avg Adult >250mm (>10")	Average Total (n=surveys/ months)	Range Mm FL	Redds	Smolts Observed	#Anadromous Adults Observed	Rainfall* (inches)
2001	25	25	3	53 (n=7)	2-122	nd	0	1	28.16
2002	34	56	6	95 (n=10)	8–156	nd	0	2	9.9
2003	6	34	19	59 (n=16)	6–72	nd	14	1	18.71
2004	46	50	12	103 (n=8)	46–209	nd	0	0	13.16
2005	6	46	20	71 (n=9)	49–80	nd	0	0	61.58
2006	62	68	40	170 (n=11)	48–409	nd	9	1	21.98
2007	35	37	16	87 (n=11)	30–166	nd	0	2	7.17
2008	250	48	18	316 (n=11)	40–691	nd	1	1	23.08
2009	112	82	15	209 (n=7)	117–323	nd	1	0	15.16
2010	115	128	13	256 (n=11)	117-420	4	7 (+23 in lagoon)	1	24.34
2011	9	85	20	114 (n=12)	18-303	13	0	0	31.50
2012	68	21	7	95 (n=12)	13-219	2	0	1	16.22
2013	28	26	2	56 (n=13)	17-125	9	0	0	9.99
2014	16	31	9	57 (n=12)	21-84	9	0	0	6.85
2015	35	14	9	59 (n=12)	25-508	1	0	1	13.76
2016	10	19	8	35 (n=12)	25-508	0	0	0	10.54
2017	73	19	8	97 (n=11)	25-711	3	0	2	26.34
2018 **	31	24	5	(n=5)	25-406	4	1	0	9.96

*Rainfall is calculated according to water year dates. Example: 2001 water year = 1 October, 2000 – 30 September, 2001

** 2018 Data is from January through early May only.

4.1.2 Productivity

Relative abundance has been monitored in Topanga Creek since 2008, providing an evaluation of productivity. During this monitoring period, declines in relative abundance have been observed for young-of-year, juveniles, and anadromous adults, whereas resident adult abundance remained relatively stable until declining recently (2016 and 2017). Under current conditions, small numbers of resident *O. mykiss* continue to spawn and maintain a subpopulation despite the limited production from anadromous individuals.

Snorkel surveys documented very low abundances of age 0+ *O. mykiss* in Topanga Creek during most years, indicating that several factors may be playing a role in their survival. Embryo survival may be low;

fry mortality may be high; or individual spawner fecundity or spawner occurrence may be low. Given the decreasing availability of suitable spawning locations and the low number of redds observed, as well as the relatively low ratio of age 0+ to age 1+ juveniles, it would appear that reproductive success is potentially limiting production and is not sufficient to seed the available rearing habitat.

However, even if only one or two *O. mykiss* redds were successful, the abundance of young-of-the-year should be much greater than observed. Based on spawning habitat quantity and quality, we believe that the observed low abundance of young-of-the-year is more likely a function of other factors, such as infrequent spawning of anadromous adults, and relatively low fecundity of resident adults, rather than solely spawning habitat. It is possible that snorkel surveys are not effective at observing young-of-the-year *O. mykiss*, and therefore the true abundance may be much higher than would appear. It is also possible that mortality of young-of-year is very high from predation, as discussed in more detail in Section 3.5.2.

Overall, survival estimates for the total *O. mykiss* population based on PIT tag mark and recapture indicated lower survival during summer (~44%) than during winter (~60). For the adult population (> 200 mm FL) the pattern is even more pronounced, with winter survival nearly 60%, but summer survival around 28%, suggesting stressful summer conditions are limiting the adult population. This trend was observed during the drought as well, although the population declined to such low levels that limited recapture data complicated obtaining accurate estimates of seasonal survival (Dagit et al. 2017). The abundance of *O. mykiss* within habitat units does not appear high, which may be a function of food availability, or just the relatively low number of fish observed or present compared to potential habitat. Overall, it appears that a combination of density-dependant (use of all available habitats, food availability) and density-independent (high water temperature, predation, disease, etc.) processes limit the capacity of summer habitat. It is possible that during summers with higher flows, capacity for *O. mykiss* increases, and additional analysis will be conducted to assess the effect of varying instream flow conditions.

4.1.3 Diversity

Population Genetics Analysis

The highest level of expected heterozygosity, or genetic diversity, amongst the study and baseline populations was associated with Malibu Creek, which also had the highest level of observed heterozygosity (Table 3-34). The expected and observed heterozygosity of the Topanga Creek population was not significantly different from the mean expected and observed heterozygosity amongst all of the native Southern California populations. The lowest levels of expected and observed heterozygosity, and thereby genetic diversity, were associated with the Fillmore Hatchery strains. This suggests Malibu Creek, especially, and Topanga Creek display levels of genetic diversity more comparable to native *O. mykiss* populations throughout Southern California. Therefore, any potential interactions with Fillmore Hatchery fish have not been significant enough to actually suppress population-level genetic diversity within Topanga or Malibu Creeks.

The anadromous allele was actually more frequent than the resident allele at both Omy5 loci for both the Malibu Creek and Topanga Creek populations. This suggests that despite being limited to a primarily resident life history, due to limited passage opportunities as a result of drought being limited to a primarily resident life history, due to limited passage opportunities as a result of drought since 2012, the Topanga Creek population may still have the capacity to express the anadromous phenotype should migration opportunities arise.

Genetic Assignment

The low incidence of assignment to Fillmore Hatchery strains by mixture assignment suggests individuals from Topanga, Malibu and Arroyo Sequit Creeks are actually more genetically similar to native Southern California populations, particularly the Santa Ynez River. However, the results of the self-assignment analysis, with 889 of 906 individuals assigning back to their respective source populations, suggests Topanga Creek is actually fairly distinct from the included native Southern California populations and hatchery strains. This result is further confirmed by the STRUCTURE analysis. All individuals from the native Southern California populations were grouped together into one cluster (represented in blue), while the hatchery strains and Topanga Creek individuals were placed into separate, unique clusters (yellow and orange clusters, respectively; (Figure 3-43). It is important to note, however, that there does appear to be some admixture, and thereby influence, by both native populations and hatchery strains within Topanga Creek. Interestingly, when constrained by only three groups, the STRUCTURE analysis actually places individuals from Malibu Creek as more closely related to native populations than the Topanga Creek group (Figure 3-43).

Sibship and Parentage

The full-sibling family analysis of all samples separated by cohort identified a total of 73 FullSib families, with as few as zero and as many as 17 families per cohort. The number of FullSib families can also be used as a proxy to estimate the number of effective breeders. For example, in the 2017 cohort we recovered six FullSib families, which suggest a maximum of 12 adults successfully produced offspring assuming no polygamous matings. Twelve adults from a potential parent pool of 340 suggest the proportion of adults effectively contributing to production in 2017 is fairly low at 3.53%. This calculation can be performed for all cohort years for which we have a fairly complete sampling of the potential parent pool, with the proportion of effective breeders being below 5% for the majority of the study years. However, it is important to note that we may not have tissue samples for all potential offspring and we may therefore underestimate the effective population size each year. The results of the parentage analysis also suggest a few adults disproportionately contribute to production, given the current juvenile and adult sampling regime. For example, we only recovered 76 distinct parents across all cohort years. However, we also only assigned 152 of 744 individuals as offspring, suggesting there must be more potential parents that were unsampled.

We also used the parentage results to estimate iteroparity rates amongst the adults identified as parents across all years. Seven of 35 females identified as mothers were involved in iteroparous matings, all of which reproduced twice and the majority of which reproduced in consecutive years. However, one female apparently reproduced in 2014, and again in 2017. Hence, the iteroparity rate amongst females, which were identified as parents by our analysis, was 20.0% (7 of 35). Four of the 41 males identified as fathers were involved in iteroparous matings. Three of the four males reproduced twice and in consecutive years. One male apparently reproduced three times in 2011, 2012 and 2014. Therefore, the iteroparity rate amongst males, which were identified as parents by our analysis, was 9.76% (4 of 41).

Iteroparity appears to occur more frequently amongst resident, rather than anadromous, *O. mykiss* (Kendall et al. 2014); however, the rate of iteroparity in any given population can be highly variable. For example, as many as 80% of resident females have been observed spawning twice in populations in Oregon (Schroeder & Smith 1989, Kuzishchin et al. 2007), while the rate of iteroparity amongst resident females sampled in Waddell Creek, CA was much lower, at 41% (Shapovalov and Taft 1954). Hence, it is difficult to define an expected iteroparity rate for any given population of *O. mykiss*. Although 20% (for females) and 9.76% (for males) does appear quite low, iteroparous individuals here are individuals that not only spawned multiple times, but successfully produced offspring that were sampled and identified by our analysis. Hence, if we were simply assessing iteroparity rate by number of spawning attempts, it is possible our estimates would be higher.

Finally, we use our parentage results to describe age at spawning amongst the recovered parents. Females were most frequently observed spawning at age 3, whereas males appeared to spawn at age 2 or age 3 most frequently (Figure 4.1). This aligns with previous understandings of age at spawning amongst steelhead in the Central and Southern California region (Busby et al. 1996).

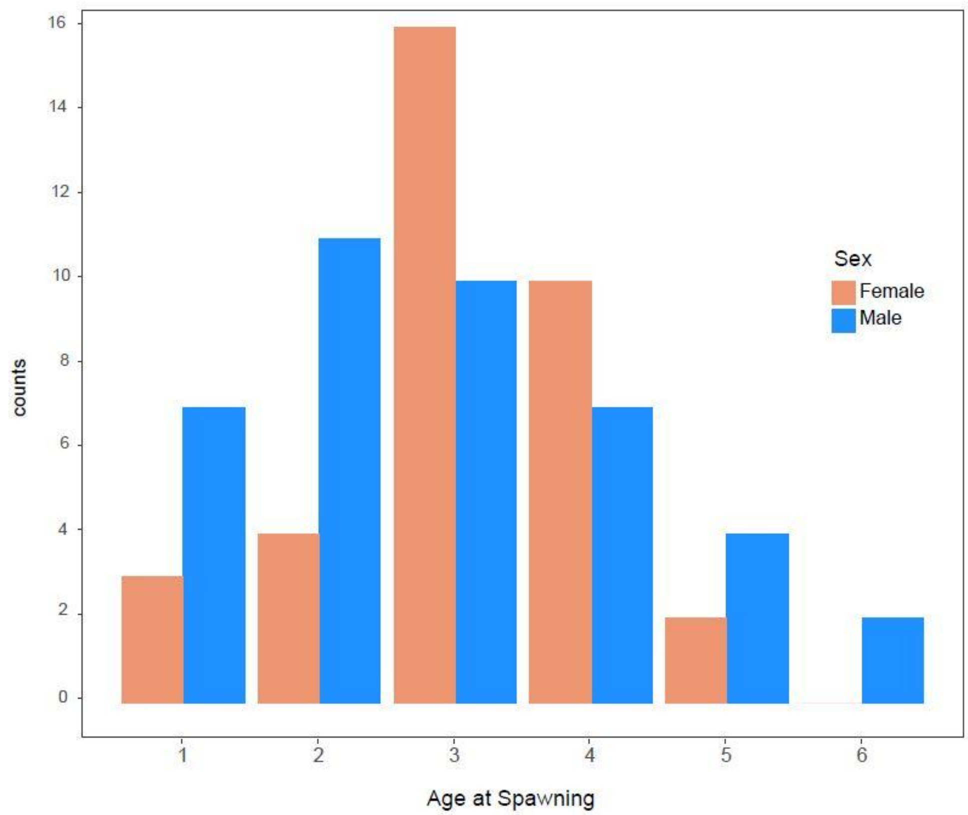

Figure 4-1. Age at spawning for Topanga Creek 2008-2017.

Role of Topanga O. mykiss in the regional meta-population

Both the STRUCTURE and phylogenetic analyses appear to distinguish Topanga Creek as distinct from both Filmore Hatchery strains and native southern California populations, while Malibu Creek appears to be more genetically similar to native southern California populations. Phylogenetic inference of meta-population structure within southern California essentially places Topanga Creek equidistant to the native population cluster and the hatchery cluster. Hence the distinct genetic identity of Topanga Creek, which is especially evident in the STRUCTURE analysis, may be due a mixed genetic ancestry via admixture with hatchery strains. However, it is also important to acknowledge the increased role genetic drift may play in a population as small as Topanga Creek, such that the supposed distinct genetic identity may be attributable to chance differentiation.

Management recommendations for sustaining diversity

The retention of the anadromous allele, as well as the higher levels of genetic diversity associated with the Malibu Creek and Topanga Creek populations suggest these populations have some genetic capacity to adapt to sub-optimal conditions. However, this resiliency is not limitless, and these populations are unfortunately still quite vulnerable to the excessive habitat modifications that have come to characterize the region. Furthermore, our sibship and parentage analyses suggest that effective population size is much lower than the already low census size. Genetic drift has more pronounced effects on populations with low effective population size, which may create differentiation by chance (Frankham 1996). Therefore, it is difficult to determine whether the distinct clustering of the Topanga Creek individuals via the STRUCTURE analysis and by genetic assignment is reflection of genetic drift or local adaptation.

Nonetheless, whether the distinct genetic identity of Topanga Creek is a product of small population size or mixed genetic ancestry and adaptation, the population still expresses levels of genetic diversity comparable to nearby native populations, suggesting it has the potential to act as a source of diversity and variation. Therefore, Topanga Creek should be prioritized for management and mitigation to facilitate increases in effective population size.

4.1.4 Spatial Distribution

The number of locations throughout Topanga Creek that are occupied by *O. mykiss* varies seasonally, but in general, fish are found throughout the entire study reach up to the natural limit of anadromy, wherever flows persist. As shown in Figure 3-28, as the drought has continued, the length of stream in the lower gradient reach downstream of 3.6 RKM that dries down has increased both spatially and temporally. This loss of connectivity has repercussions on availability of suitable spawning and rearing habitat, movement between pools, and density of *O. mykiss* in remaining refugia pools. Additional impacts to habitat quality include encroachment of emergent vegetation into formerly wetted channel segments, and the loss of riparian trees.

Habitat characteristics and fish distribution were analyzed and consistent with results reported previously. Adult *O. mykiss* and density are positively associated with both average and maximum pool depths, and thus are more abundant in the higher gradient, stable step pools found throughout the upper reach (3.6-5.3 RKM). Juvenile *O. mykiss* are negatively associated with both average and maximum pool depths, and are more widely distributed throughout the lower gradient reach downstream of 3.6 RKM.

4.1.4.1 Spawning habitat quantity and quality

Since 2010, the amount of available wetted spawning gravel area has been steadily declining. This appears related to the low rainfall and lack of high flows necessary to flush out the system and loosen gravel and small cobbles making it available for use in creating redds. Analysis of spawning gravel characteristics (i.e., cobble embeddedness) was conducted using the SWAMP protocols (Ode 2007, Fetscher et al. 2009) in 2013-2017. Gravels appear well sorted and embeddedness varied throughout the creek, but was mostly between 25 and 60%, with higher levels observed in the lower gradient reach. Continued monitoring of embeddedness is needed, as it is likely that the percent embeddedness will increase in the case of continued drought. However, for most *O. mykiss* populations, population data indicates that spawning gravel quality is not a limiting factor for *O. mykiss* production (Stillwater Sciences 2004, 2006, 2007a). Further research into the causes of inter-annual variability in resident spawning is warranted, as for the majority of study years, the population was sustained by only resident spawning.

4.1.4.2 Migratory access to spawning habitat

Low flow conditions and the sandbar at the mouth of Topanga Creek prevented migratory access of anadromous *O. mykiss* to spawning habitat, and with few storm events, outmigration was also severely limited for smolts as well. Overall, passage opportunities into Topanga Creek were fewer than 5 days in 2009, approximately 20 days in 2010, five days per year in the 2011-2016 seasons, about 36 days in 2017, and only 1 day in March 2018. Although there are no significant water diversions within Topanga Creek, naturally low instream flows restrict migration at some locations throughout the entire creek and during increasingly longer time periods due to drought. In particular, there is a low gradient reach between 0.5 and 1.5 RKM that is only wetted with continuous flow when there is enough rainfall to support base flow, typically during the winter season. This stretch quickly goes dry once rains cease, usually within days to weeks. Additionally, natural low flow barriers are further restricting movement between pools in the upper reaches 2.7-5.3 RKM for longer periods of the year.

4.1.4.3 Summer habitat

Until 2014, we hypothesized that Topanga Creek appeared to have good summer rearing habitat, with frequent pools, abundant food, and habitat complexity from interstitial spaces among cobble and boulder substrate (Bell et al. 2011). However, as the availability of summer habitat has declined, it appears that the limiting factors identified in other coastal California streams, such as a lack of habitat complexity, low pool volume, low food availability, and excessive water temperatures (Spina 2007, Harvey et al. 2006, and Stillwater Sciences 2007b) are apparent in Topanga during periods of drought. In particular the number of young of the year that persist into the winter months suggests that predation and mortality (potentially associated with the increased population of red swamp crayfish, see section 3.11) reduce the number of age 1+ and age 0+ *O. mykiss* that a given reach of stream is able to support.

The pattern of distribution observed with older age classes in deep, complex pools, and younger age classes in shallower step-pools and riffles suggests that the decline of this habitat type during summer months is taking a toll in both habitat types (Dagit et al. 2017). We have also observed that most PIT tagged fish were re-sighted near their previous locations, with very little migration. This could reflect either that the low flow passage barriers precluded movement, or that sufficient habitat was available, and few fish were displaced. The observed pattern of higher relative abundances of all age classes in spring, declining into fall supports the hypothesis that *O. mykiss* relative abundance is being limited by summer rearing conditions exacerbated by the drought.

4.1.4.4 Winter habitat

Overall, winter habitat conditions appear suitable in Topanga Creek, and winter survival for all life stages of *O.mykiss* is higher than during other seasons, although habitat constriction in the lower gradient reach downstream of 3.5 RKM during the drought may be a problem. Despite a slightly above average water year in 2017, this lower gradient reach did not stay wetted for very long after any storm in the 2018 winter season (only 9.97 inches total as of 15 May 2018). This indicates that maintaining connectivity will be an issue in this system even during the more typically wet winter season. Similar to other watersheds supporting *O. mykiss* populations, Topanga Creek is generally high gradient (i.e., >3%), with its channel tightly confined between valley walls and few or no off-channel water bodies such as sloughs and backwaters. In most high gradient confined channels, winter rearing habitat comprised of unembedded cobbles and boulders may occur within discrete portions of the channel network according to reach-scale sediment supply and transport capacity, channel confinement, and local hillslope processes. Using the conceptual framework of Montgomery and Buffington (1997), cobble-boulder rearing habitats are most likely to occur in step-pool channels. As would be expected, cobble-boulder rearing habitat occurs between 1.7 and 6.0 RKM in Topanga Creek, and is generally associated with 3–6% gradients.

Sediment supply to Topanga Creek is currently limited to infrequent natural events, and the transport capacity of the channel appears adequate to move that sediment through the system. As a result of the recent prolonged low flows, embeddedness has been increasing and sediment movement may not be as great as needed to sustain quality winter rearing habitat.

4.1.4.5 Habitat limitations for adult resident *O. mykiss*

Resident *O. mykiss* are well adapted to small watersheds with extreme temperatures and variable flows by being very aggressive (Moyle 2002), growing at relatively fast rates (Hayes et al. 2008), reaching maturity as young as age 1 and as small as 130 mm (Moyle 2002), and by spawning multiple times, which has been documented with our genetic analysis. As discussed above, it is this resident adult component of the population that allows *O. mykiss* to persist in Topanga Creek during years when no anadromous spawning occurs. Based on age and size, we assume that *O. mykiss* in Topanga Creek larger than 250 mm FL are resident adults, although, in the past few years (when connection to the ocean has been very limited), fish as small as 130 mm have been observed spawning (RCDSMM, *unpublished data*), which corroborates Moyle's (2002) findings. Whether these small, reproductively active individuals are still able to outmigrate if the opportunity presents itself is unclear, and further monitoring is necessary to answer this important life history question.

For salmonids, adult habitat is typically saturated if recruitment is sufficient to maintain the population (Elliot and Hurley 1998, Morita and Yokota 2002). When food availability is adequate, space limitations for adult *O. mykiss* are manifested by agonistic behavior, resulting in these types of mortality or emigration of subadults. Territorialism, piscivory, and cannibalism may result in mortality of fry and juveniles; however, this high mortality is likely to have a low impact on the overall resident population because adult habitat (food and space) presumably limits the size of the population (Morita and Yokota 2002). We hypothesize that the adult resident population of *O. mykiss* in Topanga Creek is habitat limited due to low water associated with the on-going drought.

The most effective test of a hypothesized adult habitat limitation is to increase the amount of available habitat and observe the population response, which is often challenging and infeasible. In Topanga Creek in 2005, high flow events effectively eliminated the low flow migration barriers and adult trout were observed as far upstream as 5.3 RKM for the first time, essentially increasing the amount of potential *O. mykiss* habitat by 900 m. During that year and in the years that followed it appeared that the adult population increased, suggesting a previous adult habitat limitation. As Figure 3-28 illustrates, the recent declines in wetted habitat in Topanga Creek may be related to the simultaneous decline in the adult abundance (Dagit et al. 2017). However, the overall high apparent variability in adult abundance in Topanga Creek may indicate that recruitment at an earlier life stage is limiting, and that habitat availability shifts as flows fluctuate among seasons and years.

4.1.5 Food Availability

Although we were not able to continue gastric lavage sampling past March 2013 due to potential stress to resident drought affected fish, continued monitoring of both benthic and drift macro invertebrates indicated that a wide variety of potential prey were available to *O. mykiss* in Topanga Creek. Total abundance and diversity were highest in spring, decreasing as the summer progressed into fall. Total number of Diptera, EPT (Ephemeroptera, Plecoptera, and Trichoptera), and thrips were significantly more abundant in spring, with Odonata significantly more abundant in July and November. The drift assemblage was dominated by moderately tolerant species that are able to survive the high disturbance regime associated with the intermittent and variable rainfall patterns common in southern California (Table 3-11). The nutrient levels, temperatures and dissolved oxygen levels in Topanga Creek were generally suitable for aquatic invertebrates, although infiltration of fine sediment appears to limit production in some locations.

As the drought continues, further focused sampling to characterize any changes in abundance and community diversity would provide important information on how *O. mykiss* responds to shifts in species. Montgomery et al. (2015) found that between 2003 and 2015 a shift in dominant species from Baetid sp.

to Chironomid sp. correlated to lower rainfall. Both are in the same functional feeding group, considered to be collector gathers, but have very different reproductive, foraging and habitat use patterns that could result in lower availability of Chironomids to foraging *O. mykiss*. Continued chironomid dominance has been observed to date, corresponding to an overall decline in abundance of all size classes. The synergistic effects of drought, low flows, limited spawning and changes to food available could all be contributing to this decline.

4.1.6 Invasive species interactions

Since 2011, the population of invasive red swamp crayfish, *Procambarus clarkii,* has become increasingly more abundant and widespread throughout Topanga (Dagit et al. 2015b). Crayfish are generalist omnivores, and in addition to competing with native wildlife for critical resources, such as food and shelter, in Topanga Creek, crayfish have been observed to be preying upon *O. mykiss* young-of-the-year, and potentially could also be preying upon eggs (RCDSMM *unpublished data*). Beginning in 2013, we targeted removal of crayfish in a specific reach of Topanga Creek, and compared abundance of young-of-the-year *O. mykiss*, water quality and benthic macro invertebrate community assemblages in this reach with an adjacent, upstream non-removal area (Garcia et al. 2015, Montgomery et al. 2015).

Results suggest that crayfish may be contributing to lower benthic macro invertebrate abundance and diversity. This could be negatively impacting *O. mykiss,* as they generally rely on a good source of benthic macro invertebrates for food. *O. mykiss* appear to be taking advantage of the increase in the crayfish population by consuming them (Krug et al. 2014). Crayfish, however, have a lower caloric value (cal/g) than many benthic macro invertebrates. *O. mykiss* appear to be functionally responding to the increase in crayfish abundance by eating more.

In an effort to better understand the dynamic relationship between crayfish abundance and impacts on *O.mykiss*, Cox and Davis (2017) developed a mathematical model. Although still a work in progress, preliminary modeling results addressing the questions of how often and at what intensity crayfish removal are needed in order to provide both direct predation reduction and indirect food competition with *O. mykiss* is telling. Consistent and long-term removal of crayfish could potentially increase the abundance of *O.mykiss* and that without any crayfish control, predation on *O. mykiss* eggs and young of the year could lead to extirpation.

The introduction and establishment of fathead minnow and the as yet unidentified "gold" chub are also of concern as it is not yet clear how they are competing for food resources, if at all. Snorkel surveys have not detected a substantial fathead minnow population. Single fathead individuals have been seen in various locations, but schools have not been able to establish as of March 2018. Similarly, individual "gold" chub have been seen in a similar fashion, single individuals sporadically, but their presence is not consistent and seems to have disappeared going into 2018. A potential New Zealand Mudsnail infestation was discovered in the lower reach of Topanga Creek in August 2016, but subsequent dry down of the affected area found that all signs of mudsnails had disappeared by January 2017. Continued monitoring did not detect New Zealand mudsnails as of spring 2018.

Additional studies are needed to investigate the impact of crayfish, fathead minnow, and the "gold" chub on *O. mykiss* in Topanga Creek, both directly by feeding on them and influencing behavior, and indirectly by impacting water quality and food availability.

4.1.7 Water Temperature

Water temperatures in Topanga Creek appear to be within the tolerance limits of southern *O. mykiss*, remaining mostly below 23^{o}C. Analysis of six pools from 2005-2017 illustrates the variability of temperature patterns, with both average maximum and average temperatures remaining relatively constant, but average minimum temperatures appear to be slowly rising as the drought continues. There was no significant difference between pools that receive documented groundwater influx compared to those that do not, however other factors such as shading by canyon walls and riparian vegetation may be other contributing factors in addition to the effect of groundwater cooling. Additional analysis and discussion of water temperature is found in Dagit et al. (2015a).

A subsequent analysis of drought impacts on water temperature through 2016 confirmed that average maximum, and overall average water temperatures are not increasing significantly in Topanga Creek, but average minimum temperatures are (RCDSMM unpublished data). On a daily diurnal scale, temperature range contracted as well at the expense of cooler temperatures. If drought conditions continue and minimum temperatures continue to rise, further study into the physiological effects on *O.mykiss* fitness will need to be examined.

4.2 Original Study Objectives

Of the original objectives outlined for this study, some have been directly addressed, and others still require continued study. A summary of the status of our knowledge relative to our original objectives for this study, which were stated as questions, is as follows:

1) Do smolts from Topanga Creek return to their natal creek to spawn or return to other regional watersheds?
Not certain at this time. A total of 1,687 *O. mykiss* were captured and 940 were PIT tagged since 2008. Returning adults have not yet been detected by the instream antenna, DIDSON camera or in migration traps in Topanga Creek. Passage opportunities have been extremely limited overall and especially since 2012 (with fewer than five days per year in 2014-2016). Only 13 anadromous adults have been documented entering Topanga creek since 2001, with the most recent observations in 2015 (1 individual) and 2017 (2 individuals). It has not been possible to identify if tagged Topanga fish are immigrating elsewhere, such as other nearby watersheds (e.g., Malibu Creek).

2) What is the length of ocean residency?
Not certain at this time. See objective #1.

3) What is the carrying capacity of critical habitat (e.g., summer thermal refugia pools) for different steelhead age classes in Topanga Creek?
Despite continued drought conditions reducing available habitat and becoming generally stressful, Topanga Creek continues to support an *O. mykiss* population. Summer conditions appear most limiting to all life stages of the population. Drought has reduced the available habitat as the creek flows subsurface during the spring and summer months, contracting from 1.7 RKM to 2.0 RKM. We will continue to examine this question with further monitoring.

4) Can juveniles be recruited into the population within these pools, or must they move to find other habitat within the creek that is perhaps less suitable?
Juveniles can be recruited into the population within pools. Based on fish distribution analysis (Section 3.7.2), it appears that large (> 250 mm) *O. mykiss* are positively correlated with deep pool habitat, while juvenile (<250 mm) *O. mykiss* are negatively correlated with deep pool habitat. In addition, the presence of large *O. mykiss* is correlated with fewer juvenile *O. mykiss*. Overall, it appears that resident large *O. mykiss* are using the larger pools, and juveniles may be displaced to other, more shallow, areas of the stream in the presence of these adults. As low rainfall and high summer temperatures persist in southern California, shallow habitat utilized by juveniles is becoming scarcer. Additionally, lack of adequate flow

has inhibited movement in some instances forcing juveniles to remain in pools with larger adults. The affects of this on juveniles survival appears to result in fewer individuals recruiting to larger size classes.

5) What is the relative proportion of residency compared to anadromy in the population?
At present, resident fish are the primary spawners as connectivity to the ocean has largely precluded anadromous access, however both resident and anadromous life histories occur in Topanga Creek and help support the long-term viability of the population. An analysis of loci located on Omy5 – a genomic region associated with migration behavior amongst individuals collected in Topanga Creek found the anadromous allele occurred at a frequency of 67.17% and 66.78% at each locus (section 3.12). In comparison, the frequency of the anadromous allele at one of the Omy5 loci amongst a sampling of the Southern California populations included in the baseline ranged from 15.96% in Santa Maria – Manzana Creek to 79.03% in San Simeon. The mean frequency of the anadromous allele at the same locus amongst all Filmore Hatchery strains was 41.28%. Thus, while resident fish are currently sustaining the Topanga Creek population, the relatively high frequency of the anadromous alleles suggests *O. mykiss* still has the genetic capacity to express the anadromous phenotype.

6) What are the size and/or age of smolts leaving Topanga Creek?
Smolts captured in outmigrant traps or detected moving downstream by the antenna/DIDSON camera between 2008 -2013 were between age 0+ and 3+, most of which were 1+ or 2+. In general smolts were larger than 170 mm fork length (FL). Smolts detected in early January were relatively larger (150-325 mm FL), whereas smolts outmigrating in late January were relatively small (100-150 mm FL), and those detected from February through April were generally larger than 170 mm FL. No smolts were detected from 2014-2017. A single 152 mm smolt was unexpectedly captured in a benthic macro invertebrate survey net heading downstream in March 2018.

7) How many smolts outmigrate and under what flow conditions?
Overall, relatively few smolts have been observed leaving Topanga since 2008 (n=45 traps, n=42 antenna, plus one smolt captured in a net during a benthic macro invertebrate survey 2018), and none were observed in 2014-2017. Between 2001and 2013, a total of 45 smolts were captured in either the downstream fyke net or the downstream weir, and 52 smolts were detected moving downstream by the instream antenna. A single smolt was detected by a survey crew in March 2018. A total of 41 fish were detected by the antenna in March 2011, however only one antenna was functional at that time because of a storm event. Since that time, it has not been possible to set the weir traps, and no fish have been detected outmigrating by the antenna or by the DIDSON camera.

8) How are the fish, both juveniles and adults using the available habitat in Topanga Creek?
Fish are using the majority of available habitats within Topanga Creek. In general, adult *O. mykiss* are positively correlated with maximum pool depth and juveniles are negatively correlated with maximum pool depth. Both age classes are similarly correlated with average depth, instream cover, and canopy cover. Adults are more abundant in the higher gradient upstream reach having more stable large pools. As consistent low flows continue, decreased ability of individuals to move between reaches for longer stretches of the year may become an important factor to analyze.

9) What are the seasonal and age specific growth patterns?
Growth appears highest for age 0+ and age 1+ fish, averaging 26 mm between November and January, and appears to decline for fish after age 2+. Mean growth rate has not changed significantly from 2009 - 2017. Overall, fish are rarely observed greater than 300 mm. In general, it appears that growth is occurring year-round, with potentially higher growth rates in winter (November – March) than during spring – summer (March – November).

4.2.1 Recovery plan implications

The information obtained for this lifecycle study directly contributes to two important research questions outlined in the *Southern California Steelhead Recovery Plan* (NMFS 2012); 1) which ecological conditions favor particular life-history forms?; and 2) which ecological conditions promote and prompt plasticity in life-history trajectories, and to what extent does such plasticity stabilize the anadromous DPS?

Our data suggest that limited ocean connectivity, perennial instream flows, and intact riparian habitat are ecological conditions that favor the long-term persistence of resident life-history, however this is subject to reduced quality due to the drought. Impacts to *O. mykiss* from chronically warm water temperatures in southern California can be ameliorated by high food availability, which is related to both instream flows and allochthonous input from a healthy riparian ecosystem. Both water temperature changes and benthic macro invertebrate community shifts have occurred during the drought, resulting in lower abundances of *O. mykiss*. It is not possible with our data to further pull apart the synergistic effects of these multiple factors.

Our data suggest that critical ecological conditions to support the anadromous life history form of adult and smolt fish migration opportunities is missing due to restricted sandbar breaching and drought reduced instream flows. In addition, freshwater habitat conditions that ameliorate high water temperatures and that are also critical for anadromous juveniles to grow to sufficient sizes to smolt and survive the marine environment may be affected by the drought.

During multiple years that anadromous *O. mykiss* do not have access to Topanga Creek the overall population persists because of resident production. Based on the genetic analysis provided in this report, the potential for anadromy is present in these residents. Given the proper passage conditions, our data indicates that there is outmigration of smolts, such as was observed in March 2011. Observations indicate that the more accessible Malibu Creek and lagoon is where a few anadromous adults are more consistently observed. After *O. mykiss* were extirpated from Topanga Creek in the 1980s, it was the eventual migration of adult anadromous steelhead that provided for recolonization (Bell et al. 2011). Given the extremely low numbers of anadromous adults observed throughout the southern California DPS (RCDSMM unpublished data), the loss of this small remnant population could be devastating, with few anadromous adults to repopulate. We believe the overall implication for recovery of the DPS is protecting and enhancing both resident and anadromous life histories, and removing obstacles to upstream and downstream migration opportunities. The restoration of Topanga Lagoon is critical to this effort.

The Biological Recovery Criteria presented in the Recovery Plan identifies passage restraints, urban development, wildfires, roads and groundwater extraction as primary limitations for *O. mykiss* recovery. Topanga Creek is fortunate in that many of these identified threats are of limited impact. There is no groundwater extraction, and most importantly, only 8% impervious surface throughout the watershed, contributing to a mostly natural hydrologic regime. Urban development is concentrated in the upper watershed and private ownership is less than 1/3 of the entire watershed, the rest of which is public open space. Wildfires, however, are a constant potential threat, and roads and bridges contribute to habitat limitations.

The most critical factor that sets Topanga Creek apart from others in the Santa Monica Bay is that water quality (nutrient levels, turbidity, pH, conductivity and temperature) remains suitable to support *O. mykiss* along with many other sensitive aquatic species (Dagit et al. 2014). Sediment movements are entrained as slugs that move through Topanga Creek during rain events, however that process has been altered with the lack of flushing flows during the drought. Maintaining suitable water quality and quantity are critical to the continued survival of the population in Topanga Creek.

Barriers remaining in Topanga include the poor quality of habitat in Topanga Lagoon, the hydrologic restrictions of the Pacific Coast Highway Bridge that constrains the lagoon, and a few upstream natural low flow barriers. A restoration plan for Topanga Lagoon has been included within the Topanga State Park General Plan (CDPR 2012). Although several natural boulder barriers were deemed impassable when evaluated by the CDFG Fish Passage program (CalTrout 2006), we had sufficient stream recharge and high flows associated with several storms in winter 2010 that allowed at least two adults to migrate upstream of these. However, since 2012, low flows have constrained movement and resulted in loss of riffle habitat, which is important to support both spawning and rearing. Continued monitoring efforts, as well as implementation of identified restoration actions are needed.

4.2.2 Recommendations for future study

To continue to address critical uncertainties in the population dynamics of the Topanga Creek *O. mykiss* population we recommend the following studies:

- Continue monitoring Viable Salmonid Population metrics in Topanga Creek
- Develop a rapid response genetic banking plan for preserving genetic diversity of this population.
- Further assess the impacts of red swamp crayfish and other invasive species on *O. mykiss*.
- Monitor the seasonal and annual variation in food availability compared to crayfish abundance and rainfall.
- Further investigate potential causes of seasonal and annual growth patterns (e.g., food availability, rainfall, density).
- Conduct regular sampling of the lagoon to determine residency and growth prior to smolting.
- Install an instream antenna array in Malibu Creek to check for tagged immigrating anadromous adults from Topanga Creek.
- Continue a coordinated lifecycle monitoring program in Topanga Creek.
- Conduct age analysis of recovered adults in Topanga Creek and nearby watersheds to assess impacts of limited migratory opportunities on anadromous adult life history.
- Continue genetic analysis to develop and implement a conservation banking management plan.

4.2.3 Management Recommendations

The above hypotheses and resiliency characteristics lead to the following management recommendations:

- Protect both anadromous (when present) and resident life histories of *O. mykiss* in Topanga Creek.
- Restore Topanga Lagoon to improve passage opportunities and support smolt growth.
- Develop a contingency plan for supporting and maintaining remaining resident fish should drought conditions result in loss of refugia habitat.
- Develop a genetic conservation banking plan to conserve biodiversity and protect against extinction.
- Protect and enhance instream habitat complexity.
- Protect Topanga Creek from anthropogenic sources of sediment.
- Protect Topanga Creek from invasion of non-native species, and continue removal of red swamp crayfish.
- Protect the relatively undisturbed riparian zone and flow regime in Topanga Creek.

5 SUMMARY

For 17 years we have monitored the population of *O. mykiss* in Topanga Creek by monthly snorkel surveys augmented by a lifecycle monitoring station since 2008. The Topanga Creek subpopulation of the southern California DPS has been postulated to be a "satellite" population based on a relatively small abundance of smolts observed and limited ability to outmigrate. Although satellite populations are more prone to extinction (as demonstrated by the temporary extirpation in the 1980s), they provide important buffers for the metapopulation from disturbance events, can serve to increase metapopulation viability, and may become a source population in the future (Boughton et al. 2006).

In general, the subpopulation seems to be persisting with limited anadromous adult influx despite high summer water temperatures, poor habitat conditions in the lagoon, and a multi-year period of low rainfall and reduced flows. However, as the drought conditions persist, continued monitoring focusing on the response variables responsible for supporting persistence of the subpopulation need to be carefully studied. This is a rare opportunity to compare identified limiting factors such as pool volume/area, habitat connectivity and quality, fish movement, density, growth and size distribution between drought and non-drought years.

In addition, other watersheds within the Southern California Steelhead Distinct Population Segment that do not currently support *O. mykiss* should be recognized for their potential contribution to the metapopulation. As was demonstrated in Topanga Creek, if habitat within watersheds, such as Arroyo Sequit, Ballona, Big Sycamore, Las Flores, Solstice, Trancas, and Zuma Creeks, is restored it is possible that these creeks could also once again support subpopulations of *O. mykiss* and increase the overall viability of the metapopulation.

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Appendix A

Topanga Lifecycle Monitoring Quality Assurance/Quality Control Plan

I. TITLE AND APPROVAL PAGE

Topanga Creek Steelhead Lifecycle Monitoring
Project Name

Resource Conservation District of the Santa Monica Mountains
Responsible Agency

1 June 2017
Date

***Project Manager* Signature:** ________________________________

Print Name & Date: ________________________________

QA/QC Development and Implementation

The goal of this living document is to develop strategies designed to ensure that standards of data collection reliability and correct use of monitoring protocols takes place. These strategies will utilize the existing CDFW acceptable protocols from the *Salmonid Stream Habitat Restoration Manual* and the *Interim Protocol for Effectiveness and Validation Monitoring of Salmonid Habitat Restoration Projects*, as well as other applicable monitoring protocols, and incorporate new standards and methodologies as they become available from CDFW ***CA Coastal Salmonid Monitoring Program.***

II. TABLE OF CONTENTS

III. DISTRIBUTION LIST

Names and telephone numbers of those receiving copies of this QAPP.

1. Mary Larson, CDFW Region 5, 562.342.7186
2. Dana McCanne, CDFW Region 5, 805.892.2352
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IV. PROJECT ORGANIZATION

Program Manager:
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Rosi Dagit, Senior Conservation Biologist, RCDSMM

Project Manager:
Rosi Dagit

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Rosi Dagit
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Ben Chubak
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Danielle Alvarez
Ethan Bell, Stillwater Sciences
Dr. Carlos Garza, NOAA NMFS

V. PROBLEM DEFINITION AND BACKGROUND

In a narrative, briefly state the problem your monitoring project is designed to address. Include any background information such as previous studies that indicate why this project is needed. Identify how your data will be used and who will use it.

The purpose of this study is to build upon existing data to provide a better picture of *O. mykiss* life history characteristics in southern California. This information will be used to enhance ongoing restoration planning efforts, provide updated information for the statewide Coastal Monitoring Program and Viable Salmonid Population estimation, with a focus on the larger landscape-scale projects needed to fully optimize *O. mykiss* recovery in Topanga Creek.

Steelhead (*Oncorhynchus mykiss)* residing in Topanga Creek were included in the southern range expansion of the Southern California Steelhead Evolutionarily Significant Unit (ESU; now Distinct Population Segment, DPS) in July 2002. Steelhead belonging to this DPS are listed as endangered under the federal Endangered Species Act. Steelhead is the common name used for the anadromous life history form of *O. mykiss*, and rainbow trout is the common name for the resident life history form. Preservation of both life history forms is considered a high priority in the Southern Steelhead Recovery Plan (NMFS 2012). Both anadromous and resident *O. mykiss* are found within the Topanga Creek watershed, although detailed information on the relative proportion of each life history type is not available. Because it is difficult to detect the difference much of the time, we use the term *O. mykiss* in this report. In general, *O. mykiss* stocks throughout California have declined substantially, and the current population estimate for the anadromous portion of the DPS is approximately 500 adults (NMFS 2012).

Until 1980, a population of *O. mykiss* of unknown census size was present in Topanga Creek (Moyle, et al. 1989, Swift, et al. 1993, Dagit, et al. 2015). It is not clear if this was primarily a resident population or if it was mixed, with anadromy present when conditions were suitable. Occasional surveys by CDFW between 1980 and 1997 failed to find *O. mykiss*. In July 1998, a single 10 cm *O. mykiss* was found approximately 4,000 m upstream of the ocean during a stream walk. Distances upstream from the ocean within Topanga Creek will hereafter be referred to as "River Kilometers" (RKM). More focused fish surveys were undertaken the following spring and summer, and three adult *O. mykiss* were observed in April 2000. Snorkel surveys conducted monthly since June 2001 have found that, although variable, the population of *O. mykiss* in Topanga Creek has remained fairly stable (see Dagit and Krug 2011, Krug et al. 2014, Dagit et al. 2015).

Though anadromous *O. mykiss* stocks throughout the Pacific Northwest have been the objects of much study, central and southern *O. mykiss* populations have only recently been the subject of focused study (Hayes et al. 2008, Bond and Hayes 2008, Boughton et al. 2007, Spina 2007, Tobias 2006, Stoecker and Kelley 2005, Yedor 2003). Since 2001, data collected on migration, diet, age and growth, genetics, population dynamics, and habitat preferences of *O. mykiss* in Topanga Creek has provided baseline information useful in understanding more about the life history of southern *O. mykiss*. This project builds on the information summarized in reports from 2004-2014, as well as peer reviewed publications.

VI. PROJECT/TASK DESCRIPTION

In general terms, describe the work that will be performed and where it will take place. Identify what kinds of samples will be taken, what kinds of conditions they will measure, which are critical, and which are of secondary importance. Indicate how you will evaluate your results--that is, how you will be making sense out of what you find. For example, you may be comparing your water quality readings to State or EPA standards, or comparing your macroinvertebrate evaluations to State-established reference conditions or historical information.

Establishing a structured long-term program to monitor *O. mykiss* abundance, distribution, and migration patterns is essential to developing a well documented and prioritized planning effort for *O. mykiss* recovery in the Santa Monica Bay region. This lifecycle monitoring project, which will take place solely in Topanga Creek, Los Angeles County, California (34.038022N, -118.582990 W) attempts to expand upon the information provided by the snorkel surveys and outmigration monitoring that have taken place since 2001 (funded by grants from the Fisheries Restoration Grant Program). These study elements were added to provide a more detailed understanding of whether production of smolts and retention of adults is sufficient to sustain the *O. mykiss* population in Topanga Creek, and also to provide insight into the metapopulation complexities. Goals of the monitoring program include answering the following questions: (1) does population persistence in a representative small coastal stream such as Topanga Creek rely solely on local recruitment? and (2) what is the role of anadromous individuals in maintaining long term population sustainability? A more comprehensive, regional program including more coastal watersheds that could further our understanding of the population sources and sinks for the southern DPS is envisioned as an outgrowth of this project.

In order to address the goals of the project, annual electrofishing events are held in November and March (when feasible). During each event, *O. mykiss* are collected from throughout Topanga Creek using single pass electrofishing techniques. When a fish is captured, it is transferred into a bucket containing MS222, a commonly used anesthetic. The individual is then scanned (to assess capture status) and measured (millimeters, fork length), and scale, fin, stomach, and/or stable isotope samples are taken, when applicable. If appropriate size (i.e., >110mm, FL), the individual is then given a passive integrated transponder (PIT) tag. Scale samples are used to determine the age of the individual, and, along with length measurements, age-length relationships are established for each sampling event. Ages are also used to determine cohort abundance and distribution as well as survival. Lengths are also used to calculate growth rates of recaptured individuals. Fin samples are sent to Dr. Carlos Garza at the NOAA Genetic Tissue Repository for genetic analysis. Stomach samples are taken using gastric lavage techniques and are used to assess seasonal and annual patterns of diet. Stable isotope samples are taken by collecting slime from an individual. Samples are sent away to appropriate labs for analysis, and provide information on food webs within the creek. Results are compared among sampling events, as well as with results found in comparable studies completed in similar locations.

In addition to the annual electrofishing events, an instream antenna system and DIDSON camera are installed during the wet season (November through May), and opportunistic weir trapping events occur when flows are high enough. The instream antenna system is composed of an upstream and a downstream antenna and detects and records movement as well as direction of movement of tagged individuals. When trapping events occur, captured fish are treated in the same manner as when captured during an electrofishing event. The position of the trap in which the individual was captured is also recorded. The trap consists of an upstream and a downstream weir. The DIDSON camera allows for detection of migratory fish when flows are too high to allow for trapping and can corroborate data collected by the instream antenna.

Table 1 outlines the various project tasks and timelines in which they will be completed. Data collected during each task is checked for completeness as it is collected and is entered into a database (EXCEL or ACCESS) as collected. Final reports are completed at the end of each grant cycle and include details regarding data collection, management and analysis.

Include an overall project timetable that outlines beginning and ending dates for the entire project as well as for specific activities within the project. The timetable should include information about sampling frequency, lab schedules, and reporting cycles.

Table 1. Project activities and timetable.

Activity	Projected Start Date	Anticipated Date of Completion	Frequency
Instream Antenna	October/November	May/June	Annually (2008-2018)
Antenna installation	Early-Mid November		
Antenna removal	Early-Mid May*		
Data entry			As needed
DIDSON Camera	October/November*	May/June	Annually, and as needed during storm events (2013-2018)
DIDSON deployment			
DIDSON removal			
Data entry			As needed
Weir Trapping	October/November*	May/June	Annually, and as needed during storm events (2008-2018)
Weir trap deployment			
Weir trap removal			
Data entry			As needed
Electrofishing Events	March/November	March/November	Annually; when possible (2008-2018)
Age analysis (scales)	Intermittently		
Diet analysis (lavage)	Intermittently		
Genetics analysis (fin clips)	Intermittently		
Stable isotope analysis			
Data entry			As needed
Final Report	na	na	End of grant cycle

* Rain dependent.

VII. DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Data Quality Objectives (DQOs) are the quantitative and qualitative terms you use to describe how good your data need to be to meet your project's objectives. DQOs for measurement data (referred to here as data quality indicators) are precision, accuracy, representativeness, completeness, comparability, and measurement range. Provide information on these indicators, in quantitative terms if possible. See Chapter 3 for a further discussion of these terms.

In this type of monitoring, the data quality indicators cannot be expressed quantitatively (such as reporting the accuracy and precision of water quality test probes), however, it can be expressed in narrative form as representativeness, comparability, and completeness.

Representativeness

The electrofishing events typically sample the entire creek area that is known to contain *O.*

mykiss. Scale samples are collected from all fish >110mm, FL and fin samples are collected from any new individuals. For stomach lavage sampling, approximately half of the samples are collected from below 3.6 rkm (gradient 1-3%) and the other half are collected from above 3.6 rkm (gradient 3-6%). Within each reach, sampling is conducted among various habitat units, rather than all within one unit.

Benthic macroinvertebrates (BMI) are collected in several ways, each method attempts to collect the most representative data possible: 1) 2001 to 2011, BMI samples were collected annually using D-frame kick nets from the same three consecutive riffles in up to four reaches also surveyed for amphibians; 2) 2013 to 2014, BMI samples were collected from three riffles at up to five sites also tested for water quality, three D-frame kick net samples are collected from the west, mid and east parts (sampling transect is perpendicular to stream flow) of each riffle, and all kick net samples are combined for each site; 3) 2013-2018 BMI samples have been collected following the SWAMP protocol (Ode 2007); and 4) 2013-2018 24-hour drift nets have been set over night at a location mid-way from the ocean to the town of Topanga (Topanga Bridge, 3.6 RKM), cod ends are emptied and collected every six hours to look at food availability for *O. mykiss*.

Comparability
In order to ensure comparability, we follow protocols established by NOAA NMFS and CDFW for electrofishing, tagging and collection of samples and analysis. Standardized taxonomic keys are used to identify macroinvertebrates found in stomach samples as well as in benthic macroinvertebrates samples to the lowest taxonomic level necessary for analyses. Analytical methods and units of reporting are such that results can be comparable with the majority of other similar studies. BMI samples are processed to the best of our abilities following protocols from Southern California Coastal Water Research Project (SCCWRP) for the California Stream Condition Index (CSCI).

Completeness
We do not anticipate any legal or compliance uses for data collected during this study. Samples are expected to be collected in the most complete way possible. Exceptions include weather or stream conditions that prevent complete sampling.

VIII. SPECIAL TRAINING REQUIREMENTS

Identify any specialized training or certification requirements your volunteers will need to successfully complete their tasks. Discuss how you will provide such training, who will be conducting the training, and how you will evaluate volunteer performance.

A. Training Logistical Arrangements

Table 2 outlines the types and frequency of training that occur to ensure quality data is consistently being collected for the lifecycle monitoring project.

Table 2. Details of training activities and frequency.

Type of Training	Trainees	Frequency of Training/Certification
Pit tagging, scale, fin clip procedure	RCDSMM or Stillwater Science Biologists	Each event
Electrofishing	Stillwater Sciences, CDFW Biologists	Each event
Lavage sampling	Stillwater Sciences or	Each event

	RCDSMM Biologist	
DIDSON camera monitoring	CDFW (initial) or RCDSMM Biologists	Annually, and as needed
Safety training	RCDSMM Biologists	Semi-annually, and refresher at start of each field day
CPR/First Aid/AED	RCDSMM Biologists, Stream team leaders	Bi-annually

B. Description of Training and Trainer Qualifications

Training for Field Crew

For electrofishing events, all electrofishers are trained from a professional, experienced CDFW Biologist, and netters and bucket carriers assisting electrofishers are trained by CDFW or Stillwater Sciences Biologists as well. The PIT tagging team are trained using either hatchery trout or supermarket trout samples. The lavage sampler is trained by an either an experienced Stillwater Sciences or RCDSMM Biologist.

Experienced CDFW Biologists and Environmental Scientists initially led the training on the deployment and use of the DIDSON camera. Training includes DIDSON set up, breakdown, and software use and video analysis. Once RCDSMM Biologists become experienced with the use and analysis of the DIDSON, they will lead further training of volunteers and assistants.

Annual safety training is completed for all RCDSMM Biologists, stream team members and volunteers. RCDSMM lead biologists are certified in CPR/First Aid/AED on a biannual basis by American Red Cross, American Heart Association or similar organization (e.g., Joffe Emergency Services).

Trainer Qualifications

RESOURCE CONSERVATION DISTRICT OF THE SMM:

Rosi Dagit, Senior Conservation Biologist

Since 1988, Rosi Dagit has coordinated current research within the Topanga Creek Watershed, as well as other areas of the Santa Monica Mountains. As Principle Investigator for the steelhead monitoring project, she has conducted training of staff, coordinated all fieldwork, conducted QA/QC for all data, and managed the grants supporting all fieldwork. In addition to monitoring steelhead trout, she has a variety of projects in process including: monitoring tidewater gobies in Santa Monica Bay creeks; developing long-term vegetation management strategies for increased fire safety that incorporate ecological parameters for preserving upslope integrity and reducing sedimentation and stormwater run-off; coordinating volunteer water quality monitoring throughout the watershed; conducting surveys of vegetation and sensitive terrestrial and aquatic species; mark recapture study of southwestern pond turtles in Topanga Creek; developing design alternatives suitable for Caltrans restoration planning; annual monitoring of amphibian population density and diversity; and numerous projects related to the physiology of Coast Live Oaks and their role in streambank stabilization, ecosystem integrity, and watershed management. Ms. Dagit has a B. S. in Marine Science from Kutztown University. She holds scientific collecting permits for monitoring southern steelhead trout (*Oncoryhnchus mykiss*) in the Santa Monica Bay (CDFG SC-000604 and NMFS Section 10 Permit # 15390), as well as for capture, tag and release of southwestern pond turtles (*Clemmys marmorata*). USFWS Permit # TE811188-1 covers the research on tidewater gobies (within the Santa Monica Bay). Ms. Dagit also maintains a current Wilderness First Responder certification from Wilderness Medical Associates.

Jennifer Mongolo, Field Biologist 1
Jennifer L. Mongolo is a bilingual environmental consultant and conservation biologist with extensive experience in integrated resource management, including conservation and restoration planning, environmental analysis, and geographic information systems (GIS). Ms. Mongolo's professional and academic interests have long centered on watershed management and stream ecology. In graduate school her research primarily focused on the four dimensions of stream connectivity and the impacts of common barriers, such as dams and culverts, on the natural function and structure of riverine ecosystems. Throughout her graduate studies, and later as an independent consultant in New Hampshire and Peace Corps volunteer in Mexico, Ms. Mongolo designed and conducted an assortment of ecological assessments related to stream habitat, streambank stability, channel geomorphology, riparian and aquatic invasive plant control, stream buffers, benthic macroinvertebrate populations, and non-point source pollution. Since beginning her work with the RCDSMM in July of 2015, Ms. Mongolo has routinely assisted with lifecycle monitoring of southern steelhead trout, including monthly snorkel surveys, redd monitoring, benthic macroinvertebrate studies, and lagoon monitoring. She is currently working with DIDSON camera and instream antenna monitoring, as well as helping to maintain the data sondes and temperature loggers. She has a Master of Science degree in Resource Management and Conservation from Antioch University New England and Bachelor of Science in Natural Resources Planning and Interpretation from Humboldt State University.

Krista Adamek, Field Biologist 2
Krista Adamek has many years of experience in conducting wildlife and vegetation surveys in a variety of habitats throughout the world, and most recently in southern California. As a Biologist for the RCDSMM, she has conducted monitoring of southern steelhead trout, water quality sampling, collection and identification of macroinvertebrates, maintenance and calibration of field equipment, and installation of data sondes, DIDSON camera, instream antennae, and data loggers. Ms. Adamek has also been responsible for data entry and management, assisted with report writing, and attended public meetings and events. She participated in invasive plant removal, amphibian monitoring, and southwestern pond turtle monitoring. Prior to her work with RCDSMM, she spent several years analyzing long-term data from field work with the World Wildlife Fund in the Peruvian Amazon, which focused on space use and movements of area-sensitive species. She also spent a year on an upland aquaculture farm on the desert coast of the Red Sea, where she monitored water quality, surveyed aquatic and avian species in the channels and created wetlands, and initiated a woman's cooperative to protect and manage wetland plant communities for the Carbon Credit program. She has worked with Parks Canada, where she surveyed, mapped, and made recommendations for their newest National Park, and collaborated with the Nature Conservancy and Missouri Department of Conservation while studying the dispersal of grassland birds. She holds a B. Sc. in Biology from the University of British Columbia (1998) and a M. Sc. in Wildlife and Fisheries Sciences from Texas A& M University (2011).

Elizabeth Montgomery, Field Biologist 3
Elizabeth Montgomery has worked to support anadromous fish conservation and recovery in Southern California from 2012 to 2016. Within riverine ecosystems of the Santa Monica Mountains she has assisted with lifecycle monitoring of southern steelhead trout populations by snorkel survey, mark-recapture, pit-tagging and antenna operation, DIDSON image analysis, and water temperature monitoring. She has carried out SWAMP habitat assessments, vegetation mapping, water quality and nutrient testing, fish seining and wildlife surveys for southwestern pond turtles, California and Pacific tree frogs, California newt, and aquatic invertebrates. Her most recent work involves the effects of crayfish removal on water quality and the relationship between drought and the Baetid mayfly population in Topanga Creek. Additionally, Ms.

Montgomery has lead citizen science efforts to characterize angler's catch on the Los Angeles River, and community volunteer events to reforest riparian corridor. Ms. Montgomery graduated from Grinnell College, Iowa, in 2011 with a B.S. in Political Science and Environmental Studies, and is currently a Master of Science candidate at Montana State University Extension in the Land Resources and Environmental Science degree program.

Russell Dauksis, Field Biologist 2
Russell Dauksis has been working for the RCDSMM since January of 2017 assisting in steelhead monitoring as well as oak tree surveys and beetle trapping. Lab identification of benthic macro invertebrates caught in drift nets and comparing this information to collections of past years was a focus of his work as well. Russell graduated from the University of Rhode Island with a B.S. in Marine Biology. His undergraduate research consisted of three summers in Puerto Rico and the British Virgin Islands restoring endangered elkhorn and staghorn corals. Mr. Dauksis is currently a M.S. candidate in biology soon to graduate from California State University, Northridge studying fish and eelgrass trophic ecology.

Danielle Alvarez, Field Biologist 2
Danielle Alvarez has been working at the RCDSMM since February of 2017 assisting with steelhead lifecycle monitoring in the creeks of the Santa Monica Mountains through snorkel surveys, mark DIDSON video analysis, oak tree monitoring, habitat mapping and water temperature monitoring. Major responsibilities include data analysis for in stream water temperature probes, overall data QA/QC, and leading an effort examining lagoon hydrology and longitudinal profile for historically anadromous creeks in the Santa Monica Bay. Ms. Alvarez graduated from UCLA with a B.S in Environmental Science concentrating in Atmospheric and Oceanic Sciences in 2016. As an undergraduate, Ms. Alvarez worked in a conservation genomics lab with California Tiger Salamanders examining genetic differences in the response to heat stress. Additionally, she worked on a senior capstone project with The Nature Conservancy, National Park Service, and The Natural History Museum of LA County to develop a set of biodiversity and ecosystem health indicators for urban Los Angeles, using ArcGIS and iNaturalist data to map current biodiversity conditions. Prior to working at the RCDSMM, Ms. Alvarez was employed with the California Conservation Corps in Camarillo, CA working on restoration projects to improve habitat suitability in historically utilized steelhead trout habitat in Ventura and Santa Barbara counties.

Field Assistants 1-3
The members of the RCDSMM Stream Team are from a variety of backgrounds, but share a common love of the Santa Monica Mountains and enthusiasm for all kinds of field work. Many of them have participated in numerous trainings, and are experienced in the following field activities:

- snorkel surveys
- electrofishing
- seine and trapping of endangered fishes and southwestern pond turtles
- maintaining the instream antenna and assisting with weir monitoring
- assisting with DIDSON camera deployment
- water quality sampling
- monitoring surveys for amphibians, reptiles and bats

CA DEPT. OF FISH AND WILDLIFE:
Dana McCanne, Environmental Scientist
Dana McCanne is an Environmental Scientist for the California Department of Fish and Game Steelhead Assessment Program in Santa Barbara. Working as a Senior Research Analyst,

Biologist, and project Principle Investigator at the Forest Science Project, Institute for Watershed Management and the Institute for River Ecosystems at Humboldt State University, he has over a decade of experience designing and implementing region wide salmonid surveys. He is a member of the California Coastal Salmonid Monitoring Plan Technical Team tasked with developing the statewide salmonid monitoring program.

STILLWATER SCIENCES:

Ethan Bell, Senior Fisheries Biologist

Ethan Bell is the lead biologist of the Morro Bay office in Central California. He currently works in various capacities on several large-scale hydroelectric projects in the Pacific Northwest, and watershed assessment projects throughout California. His current work includes technical studies focused on assessing the impacts of alterations to instream flows, water temperature, and urbanization on native fish in freshwater and estuary environments. When he is not chasing fish with a mask and snorkel, Ethan can be found running in the chaparral or surfing remote reefs. He has been assisting with the lifecycle monitoring project in Topanga Creek since its inception in 2008.

Peter Baker (Mathematician)

Dr. Peter Baker is a mathematical biologist with over 20 year's experience in applications of mathematics and statistics to fisheries biology. He has developed or assisted in the development of numerous models for populations of various species of salmonid fishes throughout California and the Pacific Northwest. He has experience working with numerous existing population models, including the Salmon Lifecycle Analysis Modules (SLAM). He is co-developer of Stillwater's BasinTemp model for predicting cumulative effects of watershed management actions on water temperature throughout a stream network, and of Stillwater's RIPPLE model for linking landscape-scale physical habitat to salmonid population responses.

IX. DOCUMENTATION AND RECORDS

Description of what happens to data after collection

Field data sheets are completed in the field at the time of sampling. The date, location, and names of all team members are recorded at the start of each sampling event. At the end of each sampling day, data sheets are checked for completeness and accuracy. Complete and accurate data is entered into an EXCEL and/or ACCESS (CDFW Coastal Monitoring Program) database at the end of each electrofishing event/season. After entry, entered data is checked against data sheets. Each event has its own file containing all data for that event including pit tag data, habitat data, age and growth, and scale, fin, stomach, isotope sample data. All PIT tag data is imported into a master pit tag data file. Original data sheets are archived at the RCD office indefinitely. Data sheets and data files, which are backed up on an external hard drive, are maintained by the RCDSMM. See Appendix A for a copy of the data sheets used during electrofishing events. A Rite-in-the-rain book is used as well to record notes on habitat data for each unit where fish are captured. Data is checked for completeness at the end of each day by the lead biologist, and copies of the habitat data are made at the end of each event, and archived at the RCD office indefinitely.

In-stream antenna data is collected by a lead biologist using a RCDSMM laptop. The antenna data is saved onto the laptop and then transferred onto a desktop computer at the RCD office, which is backed up daily. A Rite-in-the-rain book is used to record antenna installation and removal dates, personnel, rain events, and other notes. Trapping data is treated in a similar manner to both the antenna and electrofishing data. The date and time of each trapping event, as well as personnel is recorded in a Rite-in-the-rain book. Data is checked for completeness at the end of each event by a lead biologist, and copies of the trapping, antenna and fish capture data are made at the end of each event, and archived at the RCD office indefinitely. This data is also entered into the appropriate electronic database.

When the DIDSON camera is deployed, data is recorded throughout the deployment on the data log, and includes dates, times, personnel, and conditions, among other notes. Video is monitored while recording throughout the event. Anytime something of note appears on the screen, it is recorded in the log along with a timestamp so that it can be reviewed later. Previously collected video is analyzed on a second computer by a trained biologist, while the assistant monitors the current video imagery. Data is checked regularly for completeness and accuracy. Data is entered into a database at the end of each event. After entry, entered data is checked against data sheets. See Appendix A for a copy of the data log used during DIDSON deployments.

X. SAMPLING PROCESS DESIGN

Outline the experimental design of the project including information on types of samples required, sampling frequency, sampling period (e.g., season), and how you will select sample sites and identify them over time. Indicate whether any constraints such as weather, seasonal variations, stream flow or site access might affect scheduled activities, and how you will handle those constraints. Include site safety plans.

Project location and design overview

Topanga Creek drains a 50 km^2 watershed located entirely within Los Angeles County, adjacent to the city of Los Angeles. Distances upstream from the ocean within Topanga Creek are referred to as River Kilometers (RKM). The study area (Figure 1) extends from the ocean at Topanga Beach (0 RKM) upstream to the northern boundary of Topanga State Park (6.0 RKM). This reach of the creek represents both the current and documented range of southern steelhead (*Oncorhynchus mykiss*) from initial records in the 1930's to present. Preservation of both anadromous and resident life history forms of *O. mykiss* is identified as a high priority in the Southern Steelhead Recovery Plan (NMFS 2012). The extent of surveys varies depending on time of year (spring or fall) and distribution of wetted channel and flow conditions as well as on the potential for migratory opportunities. Generally, sampling is not rescheduled if it is limited by any reason. However, if weather is an issue and the minimum sampling does not get done in the initially designated time, sampling will be rescheduled. The lower section of the creek, between 0 and 1.68 RMK, is usually dry with a few isolated pools during summer and fall and is included in the snorkel surveys whenever it is wetted in winter and spring. There are no tributaries that can support fish. These surveys represent a full census of all reaches potentially accessible to *O. mykiss*, rather than using a GRTS based sample frame.

Safety is an important part of getting complete and accurate data and is taken very seriously. Each year, safety training is conducted by the senior conservation biologist, and at the beginning of each field sampling day, a safety briefing is conducted by the lead biologist or supervisor for that field effort. See Appendix B – SAFETY PLAN for more information on the RCDSMM safety protocols and emergency information.

Electrofishing events occur twice a year in the fall (November) and spring (March, if feasible). During each electrofishing event, scales, fin clips, fish length measurements, lavage samples, and/or stable isotope samples are taken when applicable. The numbers of samples taken depends on the number of fish captured, and capture status. Stream conditions may also affect the number of samples taken. For instance, if stream flow conditions are very low and fish passage opportunities have been limited, sampling will be adjusted to reduce any potential additional stress on the population.

The instream antenna and DIDSON camera are deployed at the beginning of each wet season (October/November) and kept in until the end of the wet season (May/June). The units are turned on when flows are high enough to allow for fish passage opportunities. Trapping occurs during the wet season on the falling limb of the hydrograph, when flows are high enough to allow for migratory opportunities and trapping efficiency.

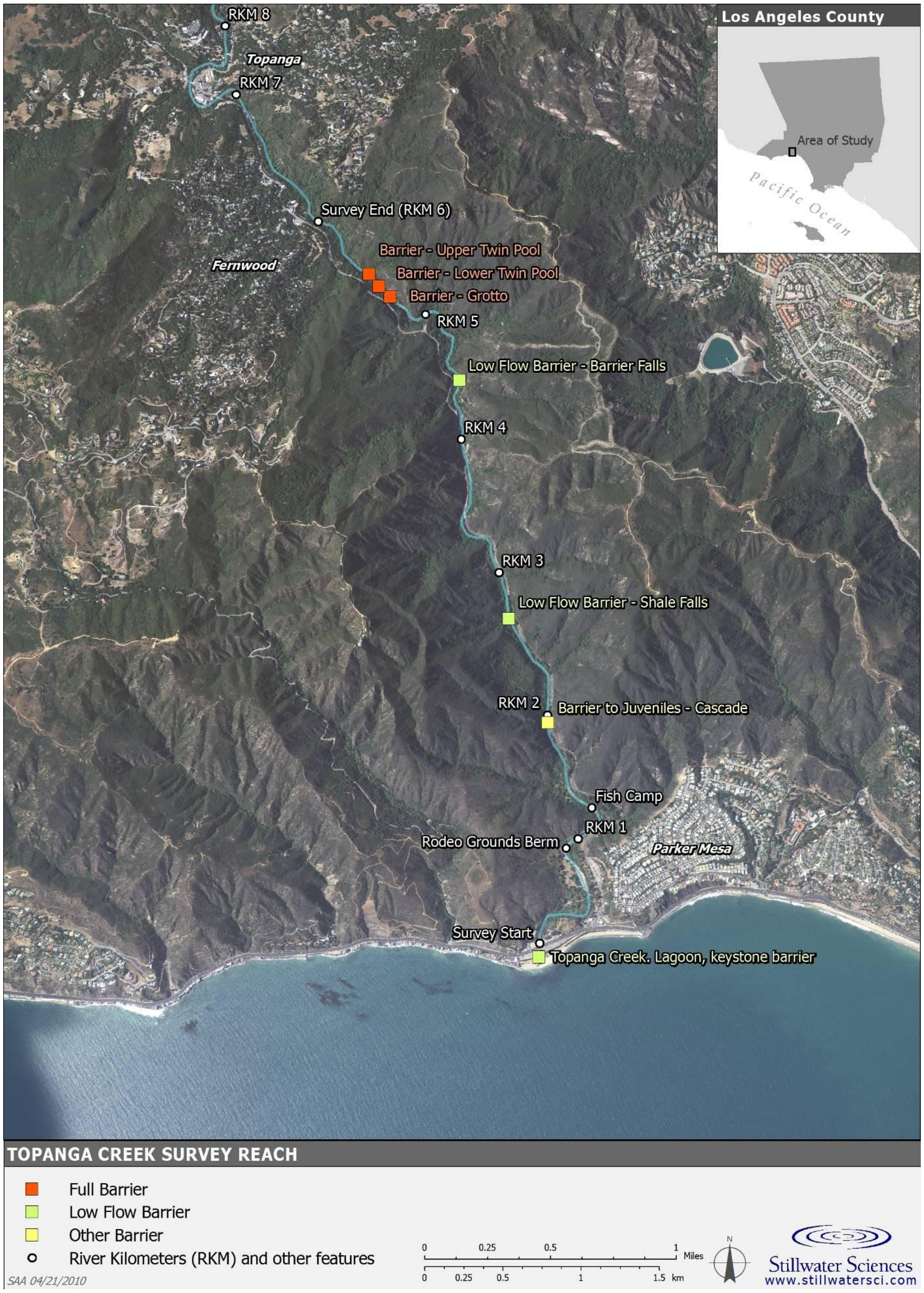


Figure 1. Study Area, Topanga Creek.

XI. SAMPLING METHODS REQUIREMENTS

Describe your sampling methods. Include information on parameters to be sampled, how samples will be taken, equipment and containers used, sample preservation methods used, and holding times (time between taking samples and analyzing them). Describe procedures for decontamination and equipment cleaning.

Electrofishing and Fish Processing

Electrofishing is an efficient tool commonly used to capture freshwater fishes. We use electrofishing to capture fish between 1.5 RKM and 6.5 RKM during spring (March) and fall (November) events. The extent of sampling varies among events depending on season, environmental conditions, electrofisher battery life, snorkel observations, and opportunity for immigration and emigration. Water quality data including water temperature, pH, conductivity, salinity, and dissolved oxygen is recorded prior to the start of each electrofishing day. Two trained backpack electrofishers and a team of 2 or 3 experienced net handlers and another 2 or 3 bucket carriers move slowly upstream electrofishing in each habitat unit. Electrofishing is typically done as a single pass effort, as flows are generally low, the stream channel is fairly narrow, and most pools are discrete under these low flow conditions. Bucket carriers are staged at the upstream and downstream limits of the pool to prevent fish from escaping, however fish are typically netted immediately upon being shocked. It is not possible to use blocking nets to help establish barriers, but boulder barriers serve to block movement as well.

Backpack electrofishers are set at 120-160 volts, depending on water chemistry conditions. Pulse rate (32-45 HZ) and pulse width (4.5–6.3 mS) are adjusted as needed to prevent any branding as well. Water temperature and conductivity are measured each hour and the electrofisher setting modified if needed. Stunned fish are captured in D-frame nets and placed in buckets full of fresh, cold creek water. Buckets are labeled with the capture distance so that they can be returned to their original location. Up to 10 fish smaller than 120 mm, or 1–2 fish of larger size are placed in each bucket. Buckets are immediately carried to the tagging station where aerators are added if needed, along with thermometers. Water in the buckets is changed to maintain cool temperatures at all times. Captured *O. mykiss* are then transferred to a bucket containing the anesthetic MS-222 (500 ml of distilled water to 5g of MS-222). Once fully anesthetized, fish are processed as described in Section VI.

O. mykiss between 110 mm and 125 mm FL are implanted with a 12 x 2.12 mm half-duplex tag (134.2 kHz, Oregon RFID). Fish greater than 125 mm FL are implanted with a 23 x 3.65 mm half-duplex tag (134.2 kHz, Oregon RFID). Half-duplex tags could be subsequently detected at the PIT tag antenna, and either tag could be detected in subsequent fish capture events (e.g., electrofishing, outmigrant traps, etc.) using a hand-held PIT tag reader. Tag insertions are made with a 3 mm to 8 mm incision into the body cavity anterior to the pelvic fin, or in the dorsal sinus (generally on fish greater than 250 mm FL) using a clean, sharp scalpel. Just before insertion, tags are scanned with a hand-held PIT tag reader to make sure they are functioning. The tag is then pushed gently into the incision point and the incision is then closed with a drop of VetBond tissue adhesive. The fish is then gently placed into the recovery bucket and monitored until it resumes activity. All fish are returned to the habitat unit where they were captured as quickly as possible once recovered.

Scale samples are collected according to procedures outlined in Drummond (1966). Scales are removed from the region located between the posterior end of the dorsal fin and the lateral line on the left side, roughly two scale rows above the lateral line. Scales are collected from the same location on the right side for recaptured fish to avoid getting all regenerated scales. If a fish is captured more than twice, scales are collected from a location not previously sampled. Scales are removed from anesthetized fish by scraping a dull knife from the posterior to the anterior of the sample area. A minimum of 10 scales per fish are removed from the sample location to ensure getting at least a few quality scales that can be used for aging. Knives used for scale sample collection are thoroughly cleaned between samples to prevent cross-contamination of scale samples. Scales are typically processed (i.e., mounted onto slides) and analyzed during the winter or summer following collection.

A 1–3 mm fin clip sample is collected with scissors from the lower lobe of the caudal fin from all newly captured individuals. Scissors are thoroughly cleaned between samples to prevent cross-contamination of fin clip samples. Fin clips are sent for analysis immediately following collection event.

To assess the diet of *O. mykiss*, stomach contents are collected during fall (November) and spring (March) events using the gastric lavage methods described in Giles (1980), which have been shown to have an efficiency of 99.1%. Per NMFS permit limitations; a total of 40 stomach samples per year can be taken. Sampling is divided equally between the two seasons, and the two reaches, to have a comparable dataset. Stomach samples are analyzed within one year of collection.

To identify food web structure using the stable isotopes $\delta^{13}C$ and $\delta^{15}N$, fish mucus is collected following the approach of Robbins-Church et al. (2009). If successful, mucus sampling could provide a non-lethal method to analyze food webs supporting *O. mykiss* without using fish muscle tissue. The traditional technique of analyzing stable isotope concentrations from fish muscle tissue requires either euthanizing fish or obtaining a sufficiently large tissue sample that would jeopardize the survival for the size of fish encountered in Topanga Creek. The challenge of applying this novel approach in the field is collecting enough mucus material (e.g., >1 mg dry weight) to support analysis without subjecting fish to undue stress. Mucus samples were collected from 22 *O. mykiss* ranging in size from 139 – 307 mm in March 2012 according to the protocol developed by Robbins-Church et al. (2009). Fish were anesthetized and transferred by net to a re-sealable plastic bag. The fish were allowed to move inside the bag for 20 to 30 seconds, which resulted in the transfer of mucus from the epidermal surface of the fish to the inside surface of the bag. The fish were then transferred to a bucket with cool, aerated water for observation during recovery from the anesthetic and then released. The plastic bags containing mucus samples were labeled and stored on ice in the field until they could be frozen. To determine the isotopic signature of primary and secondary consumers within the food web supporting *O. mykiss*, mucus samples were also collected from arroyo chub, and benthic macroinvertebrates and algae. The pilot study of 22 individuals proved unsuccessful, as not enough mucus material was collected for accurate analysis. This sampling method is on hold until better techniques for collecting sufficient material are identified.

Migrant Weir Trapping

Migrant weir trapping is conducted by setting up an upstream and downstream weir trap system at 1.3 RKM (Fish Camp) during storm events. The trapping location was selected in June 2001 and approved by California Department of Fish and Wildlife (DFW) Region 5 personnel, as well as NMFS biologists and State Parks ecologists. As described in Dagit et al. (2009), the criteria for selecting the trapping location included accessibility, appropriate flow characteristics and sandy substrate to facilitate net installation. Permission to set up the traps was obtained from the landowner, the California Department of Parks and Recreation. Traps are set on the falling end of storm-related runoff events when the water depth was sufficient (>10 cm). Throughout deployment, observers monitor water level, tidal stage and connectivity between the trap location and the ocean. Traps are typically installed in mid-afternoon, monitored continuously until removed around 0700 the following morning, or longer should flows persist. Flow, water temperature, dissolved oxygen and depth, are recorded at the start and end of each trapping event. A team of at least two observers checks the traps hourly. Captured fish are carefully removed from the trap, placed into a bucket with water, and treated according to the capture-tag-release protocol (see fish processing above). If a previously tagged fish was captured, the condition and length are recorded and a scale sample is collected. Fish are released upstream or downstream of the traps in their original direction of travel.

Instream Antenna
An instream channel-spanning half-duplex PIT tag antenna system (Multi-Antenna Low-Frequency Half-Duplex Reader, Oregon RFID) is used to monitor fish passage. The antenna is deployed at the beginning of the wet season around October or November and kept instream until the end of the wet season around May or June, when fish passage opportunities become limited by low flows. The antenna system is installed at approximately 0.6 RKM upstream from the ocean. The proximity to the ocean allows for better assessment of outmigration, rather than within-stream movement. At this site, both the downstream and upstream antennas are positioned flat on the ground to reduce any displacement during storm events. The location is also just downstream (approx. 30 m) of the DIDSON camera site, allowing for comparison of video images with PIT tag detections of known migrating anadromous fish or known outmigrants.

Two antennas are installed so the direction of movement of detected fish could be determined. Each antenna consisted of a single loop of copper wire. For each antenna, a 12-gauge copper extension cord wire runs from a RI-Acc-008B antenna tuner box, 10 meters to the other side of the stream where it is connected to a heavy, rubber-coated, 1/0 gauge welding cable running back to the tuner unit (to create a loop). The antenna is secured to mature trees on each bank and the tuner boxes are placed on the same side as the computer system in a tree at a higher elevation than that typical of flood flows. A length of coaxial cable connected each tuner box to the Oregon RFID PIT tag computer system, which includes a RI-RFM-008 Reader board, multiplexor and data logger. Power is supplied by six 6-volt deep cycle batteries arranged in series to supply a nominal 12 volts. When a half-duplex PIT-tagged fish passes within the antennas read range, the unique tag number, the antenna ID, and the date and time of passage are recorded on the data logger.

DIDSON Camera
The DIDSON camera is deployed during the wet season when flows are high enough to allow for fish passage. The camera is monitored by trained technicians throughout its entire deployment, and adjusted as needed. See Appendix C (DIDSON Deployment Protocol) for details on DIDSON methods.

Equipment decontamination and storage
All equipment is cleaned thoroughly with water and/or sterilized (i.e., ethanol) following use, and stored properly in the RCDSMM storage shed. To date, Topanga Creek does not have New Zealand mud snails or invasive mussels, therefore, any equipment that is used elsewhere is stored in a freezer for at least 72 hours and cleaned thoroughly prior to use in Topanga Creek in order to prevent introduction and further spread of these invasive species.

XII. SAMPLE HANDLING AND CUSTODY PROCEDURES

Sample handling procedures apply to projects that bring samples from the field to the lab for analysis, identification, or storage. These samples should be properly labeled in the field. At a minimum, the sample identification label should include sample location, sample number, date and time of collection, sample type, sampler's name, and method used to preserve sample. Describe the procedures used to keep track of samples that will be delivered or shipped to a laboratory for analysis. Include any chain-of-custody forms and written procedures field crews and lab personnel should follow when collecting, transferring, storing, analyzing, and disposing of samples.

Scale samples

All collected scales are placed on a square of "Rite in the Rain" paper and immediately inserted into an envelope. Envelopes are clearly labeled with fish species, site location, date, capture method, fish length, fish weight (if measured), fish condition, PIT tag number, and any other applicable information. Envelopes are pressed flat to reduce curling and increase analytical accuracy. Scale samples are stored at the RCDSMM office until they are processed (i.e., mounted onto a slide) and analyzed.

Fin clips samples

Fin clip samples are placed on a square of "Rite in the Rain" paper and immediately inserted into an envelope with the tool used for removal. Envelopes are clearly labeled with fish species, site location, date, capture method, fish length, fish weight, fish condition, PIT tag number, and any other applicable information. Envelopes are pressed flat to reduce curling and increase analytical accuracy. Fin clips samples are sent via USPS along with a list of samples to Dr. John Carlos Garza, Genetic Tissue Repository, at the NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division for analysis.

Stomach samples

Stomach samples are stored in whirlpak bags and/or ziplock bags and frozen in the RCDSMM freezer until analysis.

Stable isotope samples

To prepare mucus samples for isotope analysis, mucus material is transferred from the plastic bags into labeled scintillation vials. Each of these samples is transferred to a 60 ml glass vial by rinsing the bag with deionized, distilled (reverse osmosis) water. Vials are pre-rinsed and drained with RO (deionized, distilled) water. Mucus samples are thawed for approximately five minutes after removal from the freezer. Bags are inspected for any large debris such as pebbles or leaves and debris was removed with a clean forceps if necessary. Forceps are cleaned with a kimwipe and ethanol and rinsed with deionized, distilled water between samples to prevent cross-contamination. 20 ml of RO water is added to the sample bag and the bag was massaged to mix the mucus material with the water. A 30 ml syringe is inserted into the container to withdraw all of the liquid mixture into the syringe. The mixture is transferred to a 60 ml vial and labeled. Each vial is transferred to a freezer that maintained a temperature near -15 C to – 20 C prior to sending to laboratory. Samples along with a list of samples are shipped on dry ice to the Northern Arizona University's Colorado Plateau stable isotopes lab. All samples are weighed by the laboratory, and analyzed for $\delta^{13}C$, $\delta^{15}N$, %C, %N, and C/N.

XIII. METHODS REQUIREMENTS

List the analytical methods and equipment needed for the analysis of each parameter, either in the field or the lab. If your program uses standard methods, cite these. If your program's methods differ from the standard or are not readily available in a standard reference, describe the analytical methods.

Scale samples
Scale samples are analyzed based on standard aging techniques where each annuli is considered 1 year of age.

Fin clip samples
Fin clip samples are analyzed by Dr. John Carlos Garza at the NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division for analysis using current protocols. Upon receipt, the tissue samples were stored in a benchtop desiccator to ensure complete desiccation. All samples were then catalogued and transferred to tubes in 96 well microplates for DNA extraction. Total nucleic acids were then extracted from approximately 2 mm^2 of each tissue sample using Qiagen DNeasy Tissue Kits, following the manufacturer's recommended protocol for animal tissues and using a BioRobot 3000 (Qiagen, Inc.) for all liquid handling. Following a final elution in 200µL buffer AE (Qiagen, 2000), extracted DNA was kept frozen at 20°C until it was diluted (10:1 with autoclaved, distilled water) and distributed to 96 well plates for microsatellite amplification via polymerase chain reaction (PCR).

Genotypic data at up to 18 microsatellite loci was collected for all fish. The loci analyzed were initially discovered in several salmonid species; steelhead (*O. mykiss: Omy1011, Omy77* - Morris et al. 1996), sockeye salmon (*O. nerka: One11b, One13b* - Scribner et al. 1996), Chinook salmon (*O. tshawytscha: OtsG243, OtsG401, OtsG253b, OtsG249b, OtsG43, OtsG85, OtsG3, OtsG409 - Williamson et al. 2002; Ots103*- Small et al. 1998; *Ots1b* - Banks et al. 1999), coho salmon (*O. kisutch: Oki23*- Smith et al. 1998) and Atlantic salmon (*Salmo salar: Ssa85* - O'Reilly et al. 1996; *Ssa289* - McConnell et al. 1995). PCR was carried out in 15µL volume containing 4µL purified and diluted template DNA, 6.35µL H_2O, 1.5µL ABI 10X II PCR buffer, 0.9µL $MgCl_2$, 1.2µL dNTPs, 0.05µL DNA polymerase (Amplitaq, Applied Biosystems), and 1µL fluorescent-labeled oligonucleotide primers (Integrated DNA Technologies, Inc.). Variable thermocycling regimes were carried out on MJ Research (PTC 225) thermal cyclers to maximize PCR product. The typical profile consisted of a two minute pre-denaturation at 95°C, then two amplification stages: (a) 10 cycles of denaturation at 95°C for 15s, annealing at 53°C for 15s, and extension at 72°C for 45s; (b) 25 cycles at 89°C for 15s, 55°C for 15s, and 72°C for 45s. The routine concluded with a final extension phase of 72°C for 5 minutes and indefinite hold at 10°C. PCR products were pooled to equalize peak heights and to take advantage of multiple label colors and two non-overlapping ends of the measurable size range (50bp-500bp) within each lane. A mix of formamide, loading dye and internal size standard was added to the pooled PCR product, denatured at 95°C for 3 minutes and immediately transferred to ice. The samples were then electrophoresed on an ABI Prism 377 DNA sequencer. Gel imaging, lane tracking and allele size for determination were performed with GENESCAN version 3.1.2 and GENOTYPER version 2.1 software (Applied Biosystems). At least two people performed all size scoring independently, discrepancies were identified and, if a resolution was not reached, the sample was rerun. If a discrepancy persisted through the second analysis, the fish was not scored at that locus. A representative fraction was re-genotyped as a control for data quality.

Stomach samples
Stomach samples are analyzed following general methods outlined in Merz (2002) and other related diet papers.

Stable isotope samples
Stable isotope samples were shipped on dry ice to the Northern Arizona University's Colorado Plateau stable isotopes lab. All samples were weighed by the laboratory, and analyzed for $\delta^{13}C$, $\delta^{15}N$, %C, %N, and C/N using standard protocols.

XIV. QUALITY CONTROL REQUIREMENTS

QC checks for biological monitoring programs can be described narratively, and, if appropriate, should include discussion of replicate sample collection, cross checks by different field crews, periodic sorting checks of lab samples, and maintenance of voucher and reference collections. Describe what actions you will take if the QC samples reveal a sampling or analytical problem.

Scale samples
Scale samples are analyzed using a compound microscope. Each sample is analyzed by two readers, and a third reader is used to resolve any inconsistencies between the two primary readers. Additionally, images of each scale are taken using a compound microscope and the image analysis software, ImageJ. Age-length relationship data is graphed for each event and any outliers are reassessed.

Fin clip samples
Fin clip samples are analyzed by Dr. John Carlos Garza's laboratory at the NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division and are subject to their QC requirements.

Stomach samples
Once stomach samples are defrosted, a compound microscope and light source are used to sort and identify prey items to the lowest taxonomic level possible and identified as aquatic, terrestrial or crayfish, fish or snail. Each taxon is placed into a small glass vial and a label with sample information including sample date, process date, fish id, and taxa id. is placed into the vial. Processed samples are stored in the RCDSMM freezer. Volunteers or interns assisting with stomach sample processing are instructed to verify their identification with a lead biologist. Crayfish parts, whole crayfish, or Arroyo chub are measured to the nearest mm. Stomach contents are weighed using a Mettler analytical balance with a precision to 0.0001g.

Stable isotope samples
Stable isotope samples were shipped on dry ice to the Northern Arizona University's Colorado Plateau stable isotopes lab. All samples were weighed by the laboratory, and analyzed for $\delta^{13}C$, $\delta^{15}N$, %C, %N, and C/N. are sent to the Northern Arizona University's Colorado Plateau stable isotopes lab and are subject to their QC requirements.

XV. INSTRUMENT AND EQUIPMENT REQUIREMENTS

Describe your plan for routine inspection and preventive maintenance of field and lab equipment and facilities. Identify what equipment will be routinely inspected, and what spare parts and replacement equipment will be on hand to keep field and lab operations running smoothly. Include an equipment maintenance schedule, if appropriate.

The following equipment is necessary for attaining the goals of the lifecycle monitoring program:

Electrofishing Events

Electrofishing backpack units – one unit is typically borrowed from the CA Department of Fish and Wildlife and one unit is on loan to the RCDSMM from CDFW. The unit that is loaned to the RCDSMM is inspected one month before each event to ensure that it will be functioning properly for the event. If it is not functioning properly, there is then time to send it out for maintenance and repair. Batteries for electrofishing units are kept at the RCDSMM shed and are charged, two at a time, continuously for at least one month prior to an event. Spare batteries are taken into the field each day to reduce the possibility of battery operation time limiting sampling. Used batteries are recharged at the end of each day of use. The units are cleaned and checked at the end of each event. If additional maintenance is needed, they are sent back to Smith-Root for service.

Mark-recapture procedure – all equipment necessary for mark-recapture, including the pit tag hand held scanners, scissors for fin clips, knives for scale collection, measuring boards and scalpels for pit tag insertion, are inspected and prepared at least one or two weeks prior to an electrofishing event. New batteries are placed into any equipment requiring batteries, and additional batteries as well as a spare tagging kit are taken into the field each day. PIT tags are scanned prior to insertion to ensure proper functioning. A pressure sprayer used for gastric lavage is checked prior to each event to ensure it is functioning properly.

Water quality measurements – water quality probes and sensors used to collect pre-electrofishing event water quality data are calibrated and inspected one day prior to each event following calibration instructions for each probe. Batteries are replaced as needed and spare batteries are taken into the field if needed.

Flow – flow measurements are sometimes taken during electrofishing events and are taken during all trapping and DIDSON deployment events using a Marsh-McBirney FlowMate 2000. Prior to use, batteries are replaced as needed.

Migrant Weir Trapping

Trap panels, stakes, ties, sandbags, cover and nets used during migrant trapping are stored at the RCDSMM storage shed and are inspected at the beginning of the wet season. Repairs to the traps are made as needed throughout the season. Spare panels, sandbags and stakes are kept in the RCDSMM storage shed in case any panels need replacing.

Instream Antenna

The instream antenna system is stored in roughneck boxes in the RCDSMM storage shed and is inspected each year when it is put away in the spring, and again just prior to fall installation. Once deployed, it is monitored continuously throughout the season. The instream antenna array is cleared of debris as needed, and the antennas are tuned through their respective tuner boxes as needed. A tester pit tag is used to ensure proper functioning of the upstream and downstream antennas. The computer is checked throughout the season as well to make sure it is recording the correct date and time and any detections. Every few years or as needed, the computer system and tuner boxes are sent to Oregon RFID for routine maintenance. Spare tuning parts and tools are kept in the antenna computer box if needed.

DIDSON Camera

The DIDSON camera is stored in the DIDSON shed until needed. The camera is visually inspected at the beginning of the sampling season and prior to each use. It is carefully handled in order to prevent breakage, as there is not a spare camera. Spare tools and other smaller parts are kept in the DIDSON shed throughout the season if needed. All associated cables, connectors, stand, security devices and other equipment needed for safe and secure deployments are kept in the DIDSON shed. At the end of every deployment, all equipment is inspected for any problems and fixed so that the camera is ready to go for the next event.

XVI. DATA ACQUISITION REQUIREMENTS

Identify any types of data your project uses that are not obtained through your monitoring activities. Examples of these types of data include historical information, information from topographical maps or aerial photos, or reports from other monitoring groups. Discuss any limits on the use of this data resulting from uncertainty about its quality.

The only data we are using that is not directly collected by the RCDSMM through various grants and projects is some water quality data for Topanga Lagoon. Flow, water level, dissolved oxygen and water temperature measurements, are being collected through a variety of tools by the Southern California Coastal Watershed Research Program (SCCWRP). They have strict QA/QC protocols and to date we have had no problems with coordinating data efforts.

XVII. DATA MANAGEMENT

Trace the path your data take, from field collection and lab analysis to data storage and use. Discuss how you check for accuracy and completeness of field and lab forms, and how you minimize and correct errors in calculations, data entry to forms and databases, and report writing. Provide examples of forms and checklists. Identify the computer hardware and software you use to manage your data.

Electrofishing Events

Hard copy data sheets (included in Appendix A) are used in the field to record all mark-recapture data associated with individual fish. Data is recorded by one person, who repeats the PIT tag number, fish length, event identification number, location of capture and any notes back to the tagger. Another observer uses a Rite-in-the-rain book to record any notes and all habitat data associated with habitat units where fish are captured. The field book and data sheets are checked at the end of each day by the senior conservation biologist for completeness and accuracy by cross checking that the number of fish per location matches the habitat data information, and that the PIT tag, length, and location data recorded on the scale and fin clip envelopes match. The scale and fin clip envelopes, as well as any lavage or mucus samples are also cross checked with the field data to make sure that no samples were lost or mis-identified. If anything is missing, data recorders are made aware of what is missing and are instructed to make sure to collect all necessary data.

At the end of each electrofishing event, all data is entered into an EXCEL workbook. Two people work together to enter the data, one reads the original data while the other enters it into the workbook. Once finished, the person entering into the workbook reads all data back to the person with original data to check for accuracy and completeness. Copies of the field notebook data are made and stored along with the original data sheets and a printout of the EXCEL data in a binder at the RCDSMM office, where they are stored indefinitely. The list of scale samples is printed out and stored with the scale samples. The list of fin clip samples is printed out and sent along with the fin clip samples to Dr. John Carlos Garza. All PIT tag data is copied and pasted into a MASTER PIT TAG EXCEL workbook. All PIT tag data is also transferred into an EXCEL file that is compatible for transfer into the CDFW CA Coastal Monitoring ACCESS database.

EXCEL or SYSTAT are used for any analyses completed by the RCDSMM. Stillwater Sciences completes analyses as well on the mark-recapture and habitat assessment data. Any discrepancies they come across in the data are sent back to the RCDSMM for review and correction if necessary.

Migrant Trapping
Migrant trapping events use the same fish mark-recapture data sheets used for electrofishing events (see Appendix A). The Rite-in-the-rain field book is also used during migrant trapping events to record flow and water quality measurements, personnel, dates and times, and other notes. All data is checked for completeness and accuracy and entered at the end of each trapping event into an EXCEL workbook by a lead biologist.

Instream Antenna
Instream antenna data is uploaded directly from the antenna array main computer system to an RCDSMM laptop. Any notes or detections are also recorded in a Rite-in-the-rain field book, which is stored in the stronghold box with the antenna computer. Detection data is entered into an EXCEL file upon collection as well. Field notes from each season are copied at the end of the season and stored in a binder at the RCDSMM office.

DIDSON Camera
Data sheets (see Appendix A) are used to record notes along with timestamps during DIDSON deployment. A Rite-in-the-rain field book is also used to record any additional notes and water quality and flow measurements. Video footage, collected by the DIDSON software, is analyzed in six hour segments. Once six hours of video footage has been collected, the external hard drive storing all data, is switched out and while one team member monitors the current video footage, the previous footage is analyzed by a second trained biologist. Data is checked for completeness and accuracy and is entered into an EXCEL file at the end of each field day. Fish sizes of known individuals also detected by the antenna estimated on DIDSON software are compared to sizes at last capture. All original data sheets and copies of field notes are stored in a binder at the RCDSMM office indefinitely.

XVIII. ASSESSMENTS AND RESPONSE ACTIONS

Discuss how you evaluate field, lab, and data management activities, organizations (such as contract labs) and individuals in the course of your project. These can include evaluations of volunteer performance (for example, through field visits by staff or in laboratory refresher sessions); audits of systems such as equipment and analytical procedures; and audits of data quality (e.g., comparing actual data results with project quality objectives). Include information on how your project will correct any problems identified through these assessments. Corrective actions might include calibrating equipment more frequently; increasing the number of regularly scheduled training sessions, or rescheduling field or lab activities.

Training for field staff, especially data observers/recorders is held annually. Reminders of specific focus needs are reviewed at the start of each field day. Field notes are evaluated at the end of each surveying date or event, and discrepancies in data are reviewed with data recorders before the next field event. When notes are consistently subpar, semiannual trainings are held. Data checklists are posted in a visible location and consulted regularly. When possible, observers and data recorders are kept consistent and are, therefore, knowledgeable about the locations within their survey reach. When data is missing, the lead biologist will consult the entire field team to pull together missing data as best as possible. Data QC audits occur at the end of each sampling event and at the end of each year. If problems are noted, then appropriate steps are taken to prevent them from reoccurring.

XIX. REPORTS, PRESENTATIONS AND OTHER DELIVERABLES

Identify the frequency, content, and distribution of reports to data users, sponsors, and partnership organizations that detail project status, results of internal assessments and audits, and how QC problems have been resolved.

Reports (including field notes, participating staff lists, data summary) are prepared at the end of each electrofishing event and distributed to CDFW, NMFS and RCDSMM Biologists.

Monthly reports detailing all work accomplished in that time period, are sent out with monthly invoices to the CDFW grant manager. Final reports are produced at the end of each grant cycle and include a description of methods used, data collected, and all data analyses and interpretation as well as a discussion of how the data collected compares and contributes to the broader field. The final report contains results of QC audits and internal review of methodology and analysis, and is distributed to the granting agency, CDFW, as well as other appropriate and collaborative agencies.

Peer reviewed journal articles are submitted when appropriate throughout the study. Professional presentations in the form of oral talks and posters are given when applicable as well. Typically, at minimum, a poster presenting results from this study is given at the Salmonid Restoration Federation annual conference.

XX. DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

State how you review data and make decisions regarding accepting, rejecting, or qualifying the data. All that is needed here is a brief statement of what will be done, by whom.

All field and laboratory data is reviewed internally by a Conservation Biologist (Project Manager) and/or by the Senior Conservation Biologist (Program Manager, RCD). In addition, Stillwater Sciences Biologists review data as well when preparing results for the final report. Decisions whether data should be accepted, rejected, or qualified are made by the Senior Conservation Biologist.

XXI. VALIDATION AND VERIFICATION METHODS

Describe the procedures you use to validate and verify data. This can include, for example, comparing computer entries to field data sheets; looking for data gaps; analyzing quality control data such as chain of custody information, spikes, and equipment calibrations; checking calculations; examining raw data for outliers or nonsensical readings; and reviewing graphs, tables and charts. Include a description of how errors, if detected, will be corrected, and how results will be conveyed to data users.

Errors in the dataset are checked for in several ways and throughout the data processing. First, when entering the data into a computer file, the data is verified by comparing computer entries with field data sheets and field books. Once entered into the computer file, the person entering the data reads the data back to the person with the data sheets or field book. If there are discrepancies in any dataset, the original datasheets, copies of data, and/or chain of custody forms are checked to try to correct the error. Reviewing data graphs, charts and tables can make checking for outliers and errors in a dataset simpler, and thus is used to validate and verify data. If errors or outliers are found, field notes and original datasheets are checked as well as calculations used to formulate the graphs, charts or tables in order to determine the cause of the error. Depending on the type of data and the situation, outliers may be removed for analysis when appropriate.

XXII. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Once the data results are compiled, describe the process for determining whether the data meet project objectives. This should include calculating and comparing the project's actual data quality indicators (precision, accuracy, completeness, representativeness, and comparability) to those you specified at the start of the project, and describing what will be done if they are not the same. Actions might include discarding data, setting limits on the use of the data, or revising the project's data quality objectives.

The first review is at the conclusion of each event, be it electrofishing, trapping, instream antenna deployment or DIDSON deployment. The intent is to identify any problems immediately so they can be addressed and corrected. This is particularly true for the master PIT tag data, and associated information provided to the CDFW CA Coastal Monitoring ACCESS database. At the midterm of the grant cycle, the data quality objectives set forth are assessed for the entire dataset compiled during that grant period. If any of the objectives are not met at the midterm review, the project and data collection and management plan is reassessed and actions are taken so that the DQO's will be met. At the midpoint, actions might include adjusting the training schedule or data management plan to make sure DQO's are met, or revising the DQO's. At the end of the project, it may be decided that errors in the dataset should be rejected and discarded, or the project's DQO's may be revised. Issues with the data quality objectives and actions taken to reconciliation of those issues will be discussed in the final report.

XXIII. APPENDIX A – SUPPLEMENTARY INFORMATION

APPENDIX A.1 –Field data Sheets
APPENDIX A.2 – RCDSMM Safety Protocol & Emergency Information
APPENDIX A.3 – RCDSMM HACCP Equipment Decontamination Protocol
APPENDIX A.4 – RCDSMM DIDSON Deployment and Analysis Protocol
APPENDIX A.5 – RCDSMM Training Log

APPENDIX A.1
MARK-RECAPTURE Data Sheet

Large tags go in fish > 125 mm, Small tags in fish 110-125 mm

Page ____ of ____

O. mykiss Direct Capture or Recapture

Date: Nov 2010	Crew: See field notes	Weather (code):
Location: Topanga		Site (code):
Start GPS (UTM):		Start Time:
End GPS (UTM):		End Time:

Fish ID number	Habitat Unit number	Fork Length (mm)	Condition (code)	Capture method	Pit Tag Number (write number twice)	New/ Recap (N/R)	Fin-Scale Sample (Y/N)	NOTES (sex, hatchery fish, photos, injuries, etc) Lavage sample?
T10 -					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			
T10					_ _			

Weather: 1=Sunny, 2=Overcast, 3=Partly Cloudy, 4=Rain

Capture method – T= trap, E – efish, A = angling, H=hand capture

Condition: 1=Healthy, 2=Injured, 3=Mortality, 4=Smolting (losing scales), 5=Ripe (eggs or sperm observed)

Be sure to scan each fish to check for tags. Record all data but no fin clip collection.
Fin clips for all new fish. Scales for all fish >150 mm. 25 samples for fish < 150 mm

DIDSON Data Sheet

Viewed by:______________ Date viewed:______________ Page number:___________

DIDSON Analysis Datasheet

Site	Date	File	Species	Direction	Frame in	Frame out	Frame-1	Length-1 (cm)	Range-1 (m)	Frame-2	Length-2 (cm)	Range-2 (m)	Frame-3	Length-3 (cm)	Range-3 (m)	Quality of frames (1-4) 1=best, 4=unusable	Avg. Length	Definite=1 Confident=2 Possible=3	Comments

Viewed by:______________ Date viewed:______________ Page number:___________

MIGRANT TRAPPING Data sheet

SCAN ALL FISH TO CHECK FOR TAGS! **Page _____ of _____**
Collect scales for ALL fish – Fin clips new fish only!
Crew (first initials and last names):

____

Date:_________________ Time:________________ Weather:__________

Notes:____

For individual fish: Large tags go in fish > 125 mm, Small tags in fish 110-125 mm

Trap	Species Code	Fork Length (mm)	Condition Code	PIT-tag # or Other Mark (write number twice)	New/ Recap (N / R)	Fin-Scale Coll. (Y/N)	Notes (injuries, photo #; etc. Use more than one row if necessary)
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			
U D				1 2			

Species Code: Steelhead (SH), Arroyo Chub (AC)
Weather: 1 = clear, 2 = overcast, 3 = partly cloudy, 4 = raining,
Debris: 1 = no debris present, 2 = debris present, 3 = debris jammed in trap
Fish Condition: 1 = healthy, 2 = injured, 3 = dead, 4 = smolting (e.g., losing scales)
PIT-tag or Other Mark: If fish is PIT-tagged, write PIT-tag number twice.

APPENDIX A.2
RCDSMM Safety Protocol & Emergency Information

RCDSMM
FIELD SAFETY MANUAL
May 2018

PROTECT YOURSELF – PAY ATTENTION TO SAFETY!

1. REVIEW ALL POTENTIAL SITE RISKS WITH RCDSMM LEADER.
2. WASH YOUR HANDS WITH SOAP BEFORE EATING.
3. WEAR APPROPRIATE SHOES AT ALL TIMES.
4. REPORT ANY PROBLEMS OR ACCIDENTS PROMPTLY TO THE RCDSMM LEADER.
5. PLEASE KNOW HOW TO GET TO THE FOLLOWING CARE CENTERS

Local Hospitals and Urgent Care Centers
Malibu Urgent Care 310-456-7551
23656 PCH At corner with Webb Way on east side of PCH near shopping center
Urgent Care Calabasas 818-880-2225 9am – 9pm
26777 Agoura Rd. Suite 4 In Summit shopping center between Lost Hills and Las Virgenes Rds.
Santa Monica Hospital
15th and Arizona Emergency Room entrance
Los Robles Hospital
215 W. Janss Rd, Thousand Oaks
Take 101N exit at Lynn Rd Go north to W. Janss and turn right (east)
West Hills Hospital
7300 Medical Center Dr, West Hills Go north on Fallbrook Rd past Sherman Way

TABLE OF CONTENTS

1.0 INTRODUCTION

This document presents the health and safety procedures that are intended to guide all field activities conducted by RCDSMM staff, field assistants and volunteers.

It is important to recognize that although serious hazards are present, fieldwork may be safely conducted if care is taken, intelligence is used, hazards are given respect, and people are observant.

2.0 POLICY STATEMENT

Safety of all its personnel is RCDSMM' highest priority.

It is the policy of RCDSMM to provide a safe work environment for all of its employees. Fieldwork can be dangerous; however, all accidents are preventable, and with proper training and execution field workers can conduct their work free from health and safety incidents. To accomplish this, RCDSMM will 1) maintain a code of safe practices for its work activities, 2) support a positive accident prevention program to reduce the risk of injuries occurring on the job and 3) provide all applicable safety equipment for its employees. This program is to be used in conjunction with applicable federal, state, and local safety codes and regulations, as well as the safety plans of the client and other consultants in the field.

The goals of the Health and Safety Plan are to:

- Conduct all fieldwork free from accidents.
- Prevent accidents from occurring by communicating the importance of safe practices to all RCDSMM staff, field assistants and volunteers.
- Outline and assign the duties and responsibilities of all individuals who will establish and maintain an active safety program

Accident prevention is beneficial to all and is the responsibility of RCDSMM to its personnel on site. The RCDSMM expects the full cooperation of everyone in complying with safety procedures. Compliance with all federal, state, county, and local safety codes and regulations is mandatory.

Safety is a mutual endeavor. Each individual is responsible for their own health and safety and that of their immediate co-workers. Everyone is expected to exercise personal judgment, and have an explicit right to refuse hazardous assignments if they have safety concerns.

Unsafe conditions requiring work suspension or modification may arise from weather, wildfire, presence of dangerous animals or other unforeseen conditions.

The RCDSMM may request anyone whose on-site conduct is judged not to comply with the provisions of this plan and/or endangers the health and/or safety of others to leave the work site immediately.

It is everyone's responsibility to inform all co-workers and their supervisor of any pre-existing conditions that may affect their health and safety in the field and that may require special awareness by other workers (i.e. diabetes, allergies, vision or hearing impairments or other health concerns). Field teams should discuss health and safety issues when beginning a new work task and decide on appropriate responses to potential situations.

Everyone is expected to be familiar with basic first aid before conducting fieldwork and team leaders are required to have current CPR certification.

3.0 POTENTIAL HAZARDS

Fieldwork has inherent hazards especially in remote locations with difficult terrain and variable weather conditions. These hazards may include but are not limited to:

- Poisonous plants
- Dangerous animals
- Inclement weather
- Wild fires
- Flashfloods
- Hiking over rugged terrain
- Criminal activity

RCDSMM field activities fall into two categories with specific safety concerns. All RCDSMM staff, field workers and volunteers are expected to know and implement all safety procedures.

WATER QUALITY TESTING:

- Read all instructions to familiarize yourself with the procedures before you begin. Note any precautions in the instructions.
- Keep all equipment and reagent chemicals out of the reach of young children.
- In the event of an accident or suspected poisoning immediately call 911, the Poison 800-777-6476, or your physician. Be prepared to give the name of the reagent in question. The MSDS are in water quality testing kit.
- Avoid contact between reagent chemicals and skin, eyes, nose, and mouth.
- Wear safety goggles or glasses when handling reagent chemicals.
- Use test tube caps or stoppers, to cover test tubes during shaking or mixing. Use gloves for hand protection when handling reagent chemicals.
- Do not eat or drink at the same time as using the reagents. Wash hands thoroughly after using the chemicals before contact with eyes, food, or mouth.
- When dispensing a reagent from a plastic squeeze bottle, hold the bottle vertically upside down (not at an Angle) and gently squeeze it. If a gentle squeeze does not suffice, the dispensing cap or plug may be clogged.
- Wipe up any reagent chemical spills, liquid or powder, as soon as they occur. Rinse area with wet sponge.
- Thoroughly rinse test tubes before and after each test. Dry your hands and the outside of the tube.
- Tightly close all reagent containers immediately after use. Do not interchange caps from different containers. Put all reagents and equipment back in their proper locations in the test kit to ensure safe transport.
- Avoid prolonged exposure of equipment/reagents to sunlight.

FIELD RESEARCH AND RESTORATION:

- Be careful not to fall. You may be traversing slippery rocks, hillsides, and steep erodible streambanks. Wear tennis shoes or boots that provide good support, and that you don't mind getting wet.
- Be prepared! Dress and Pack for all types of weather, including a hat! If needed bring a

cellular phone, a change of clothes, footwear, a walking stick.

- Bring plenty of water! Heat exhaustion can be a real problem and is easily avoided by remaining well hydrated at all times.
- Use sunscreen at all times. Apply at least 1/2 hour before going into the field and re-apply as needed during the day.
- Never take it upon yourself to conduct monitoring or fieldwork on your own. Inform the program coordinator of any unscheduled monitoring event you wish to conduct and let someone at home know where you plan to go so that your location is known if anything happens. Two heads are better than one, particularly for monitoring. Always work with a partner!
- When crossing or wading through a stream be aware of fast moving current. Use your walking stick for balance and to judge the depth. If possible look for areas shallower than knee depth to wade across.
- Be aware of flood conditions. Do not enter low-lying areas if you have reason to believe flooding is possible. When in doubt consult your Field Team leader.
- Don’t drink the water!
- If you suspect high levels of pollution protect yourself. Wear rubber gloves and avoid exposure.
- Bring a map and compass (that you know how to use!), particularly in areas that do not have established trails.

4.0 POISONOUS PLANTS

4.1 POISON OAK

Be aware of Poison Oak. Avoid direct contact by wearing long sleeved shirts and long pants. Get to know this plant's characteristics. Leaves of three, let it be! It changes through the seasons and the physical characteristics can vary from plant to plant. Contact with this plant, even just the bare twigs in winter can cause severe blistering and itching. Even secondary contact such as petting a dog, handling equipment that has been in contact, or washing someone else's laundry that had direct contact with poison oak can
cause adverse reactions.

PREVENTION

Each field worker should learn to recognize poison oak. Avoid contact with poison oak if possible. Wear protective clothing to prevent exposure to skin.

TREATMENT

Wash affected area thoroughly with cold water (for at least 3-5 minutes) immediately following exposure to try and rinse off the oils. The reaction can take place within 15 minutes, so prompt response is important. This may help avert a reaction. After an hour or so, however, the urushiol has usually penetrated the skin and washing won't necessarily prevent a reaction, but it may help reduce its severity.

If you must wait, then use of soaps like Technu and Fels-naptha can help remove the oils and reduce reaction areas.

If you get a rash, itching and blisters, hot showers followed by soaking in oatmeal or aveeno solutions can help reduce the itching. Topical applications of calamine lotion, benedryl creams or other topical products can also be helpful. Rubbing the area with ice cubes can also provide relief.

Call your supervisor and Company Nurse (877-518-6711) if any of the following occur:

- The reaction is severe or widespread.
- The rash affects sensitive areas of the body, such as eyes, mouth or genitals.
- Blisters are oozing pus.
- A fever greater than 100 F develops.
- The rash doesn't get better within a few weeks

There are numerous over the counter products designed to protect the skin from poison oak. Each product has proponents and some have detractors. Field workers are encouraged to investigate these products to determine whether they are suitable for their use.

After exposure to poison oak workers should remove any exposed clothing before entering project vehicles or cover the seats with covers that can be removed and cleaned to wash away toxic poison oak residue. Exposed clothing and fabrics should be washed as poison oak oils persist on fabrics for lengthy periods.

Often, the rash has a linear appearance because of the way the plant brushes against the skin. But if skin comes into contact with a piece of clothing or pet fur that has urushiol on it, the rash may be more diffuse.

The reaction usually develops a day or two after exposure and can last several weeks, even with treatment. In severe cases, new areas of rash may break out several days or more after initial exposure.

Spreading blister fluid through scratching doesn't spread the rash, but germs under fingernails may cause a secondary infection.

4.2 STINGING NETTLES

Stinging nettles are often encountered in moist areas in chaparral or wetland areas. There are two common species, Stinging Nettle (Urtica doica), which has opposite leaves 2-4 inches long and is a densely hairy perennial herb standing up to 8 feet high; and the Annual Stinging Nettle (Hesperocnide tenella), which is smaller overall and blooms earlier in April- June.

PREVENTION

Each field worker should learn to recognize stinging nettles. To avoid the intense pain associated with brushing your skin against the hairs of this plant, wear long pants and long sleeve shirt.

TREATMENT

If you grab one by mistake, treating the affected area with vinegar can help, as can rinsing the area with cool water.

5.0 DANGEROUS ANIMALS

Wild animals cause injury through bites, kicks, or blunt trauma, or by the use of horns or claws. Wild animals in general tend to avoid human beings, but they can attack if they perceive threat, are protecting their young or territory, or are injured or ill. Although attacks by wild animals can be dramatic, attacks by domestic animals are far more common.

5.1 MOUNTAIN LIONS

Mountain lions are generally shy and nocturnal, but as the urban world encroaches further into the wildlands, some have become more habituated to humans and less fearful. If you see a mountain lion, keep your distance. Most will give you a wide berth and you will have had an outstanding wilderness experience. Mountain lions should always be considered potentially dangerous. Mountain lions are powerful predators capable of seriously injuring and killing humans.

Make noise as you walk. The noise you make will generally scare the lion away and halt any confrontation.

If however they begin to stalk you or refuse to give way, stand tall and make yourself as large as possible. Yell, scream and throw things, as long as you don’t need to bend over to pick them up! Slowly back away, keeping your eye on the lion and making yourself as big and scary as possible. Children and dogs are particularly vulnerable. Keep children between 2 adults when hiking. Dogs should not be off leash.

Never run away from a mountain lion. Running stimulates a mountain lion's natural instinct to chase.

Make yourself look larger, stand up as tall as possible, it intimidates the lion and often makes them turn and run

Never turn your back on a lion.

Do not squat down or bend over.

If you have a jacket on, open it and flap it about, yell, throw stones, make sure you react so that the lion senses you are in control.

If you are attacked, fight back. Never succumb or roll into a ball. Hit as hard as possible especially to the head area. If you can retrieve a stick or large rock, use it as a weapon. If face to face with the cat, go for the eyes by clawing or throwing sand in the face of the cat.

If attacked from behind, try to reposition yourself to meet the lion face to face.

Attempt to drive an attacking lion away in order to prevent further injury and to allow treatment of injury. If serious bleeding occurs attempt to stop bleeding with standard first aid techniques.

Once the injured party is stabilized, seek help. Attempt to call 911 for help with a cell phone, seek a high point to use a cell phone. If no contact can be made, and the injured person is unable to hike out, make the injured person as comfortable as possible, explain to the injured person that you are going to get help, hike or drive to the nearest location to obtain help or call for help. If it is possible to keep a second person with the injured person, do so.

5.2 RATTLESNAKES

Rattlesnakes really don't want to bother you, especially if you don't bother them. Keep a respectable distance from them and they will probably leave you alone. Be careful where you step, wear high hiking boots, and be careful where you put your hands if you are climbing over rocks. Adult rattlesnakes don't like to waste their venom on humans, and the majority of bites are "dry". They are still subject to infection and should be treated by a physician. Baby rattlers are not as much in control, and can inject sufficient venom to cause problems. Be particularly careful with these little guys!
Rattlesnake bites are a potentially serious accident. They can lead to severe pain or other problems, and in the rare instance even death. Rattlesnake bites seldom result in death, but they cause very serious injury, which requires medical attention.

Rattlesnakes inject venom when they bite, usually containing two types of poison: hemolytic toxins that attack the walls of blood vessels; and neurotoxins that attack the nerves. Rattlesnakes have a very efficient venom injection mechanism. They have long hollow fangs and a system to inject venom through those fangs. They can inject large volumes of venom quickly.

PREVENTION
Be very careful in rattlesnake areas about moving rocks, logs, and brush where snakes may hide, or reaching into any potential hiding spot. Be aware of your surroundings and avoid stepping into areas or putting your hands into places that have not first been inspected for rattlesnakes. Wear boots and long pants, which both provide protection if a rattlesnake strikes.

TREATMENT
If bitten, try to remain calm and move away from the snake to avoid more bites.
If possible, photograph the snake to confirm identification.

Do not attempt to cut or suction the wound.
Remove all potentially constricting jewelry, rings, watches, etc. that could be problematic with swelling.

Wash puncture with clean water and soap if available.
Apply a loose bandage to protect the bite.

Keep bitten area below heart level if possible.

Call ahead to the hospital or inform 911 personnel of bite location and species. The most important priority is getting the bitten person to medical help. Do not delay.

5.3 TICKS

Ticks are frequently encountered, usually in grassy or bushy places. They wait (sometimes for up to 15 years) for some warm blooded creature like you to come walking by. They can attach to you, burying their heads under the skin for a nice drink of blood. Ticks occur throughout our study area and can be difficult to avoid. Ticks may carry diseases such as Lyme disease or Rocky Mountain spotted fever.

PREVENTION
Wear light colored clothing where possible and regularly inspect for ticks that could be removed prior to biting. Insect repellants and wrapping pant-leg-bottoms with duct tape or stuffing your pants inside your socks may also help avoid tick bites. When you get back from a field excursion, make sure you check your body carefully for any ticks you may have brought home. They especially like the hairline, under arms and in the crotch.

TREATMENT
Ticks are best removed as soon as possible, because the risk of disease transmission increases significantly after 24 hours of attachment. If you do find a tick, carefully remove the tick with forceps, making sure to remove any buried parts. Lyme Disease is not common, but a definite possibility. It usually is not transmitted unless an infected host tick is embedded in you for more than 18 hours. Pay attention to development of a characteristic “bull’s eye” rash, spreading out from the tick bite. Only 50% of bites get the rash, although localized tenderness and infection is more common.

If you have had a tick for more than 18 hours, then it is best to carefully remove the tick, wrap in moist paper towel, place in a Ziploc baggie and take with you to the doctor for identification. If it is a western black-legged tick, then you may need to start antibiotic treatment. To see if the tick is carrying the disease, send to IgeneX, Inc. 797 San Antonia Rd, Palo Alto, CA 94303. Their web site (www.igenex.com) also has a lot of good information, including the forms and prices for sending in a tick. This testing is not usually covered by workers compensation or regular health insurance.

Blunt, medium-tipped, angled forceps/tweezers offer the best results. It is important to remove the tick completely, including the mouthpart and the cement the tick has secreted to secure attachment. The most commonly recommended and successful tick-removal method is manual extraction of the tick.

Do not use petroleum jelly or a hot match to kill and remove a tick.

Tick removal method:

(1) Grasp the tick's mouthparts against the skin, using forceps.

(2) Pull back slowly and steadily with firm force.

(a) Pull in the reverse of the direction in which the mouthparts are inserted, as removing a splinter.

(b) BE PATIENT – The long, central mouthpart (called the hypostome) is inserted in the skin. It is covered with sharp barbs, sometimes making removal difficult and time-consuming

(c) Most ticks secrete a cement-like substance during feeding. This material helps secure their mouthparts firmly in the flesh, further adding to the difficulty of removal.

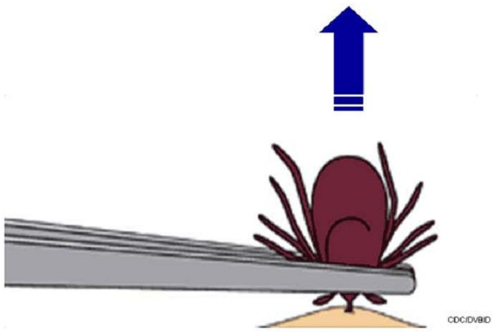
(d) It is important to continue to pull steadily until the tick can be eased out of the skin

(e) DO NOT pull back sharply, as this may tear the mouthparts from the body of the tick, leaving them embedded in the skin. If this happens, do not panic. Embedded mouthparts are comparable to having a splinter in the skin. Mouthparts alone cannot transmit disease because the infective body of the tick is no longer attached.

(f) DO NOT squeeze or crush the body of the tick because this may force infective body fluids through the mouthparts and into the wound site.

(3) Save the tick for future identification should disease symptoms develop later. Preserve it by placing it in a clean, dry jar, vial, small Ziploc plastic bag, or other sealed container and keeping it in the freezer. Identification of the tick will help the physician's diagnosis and treatment, since many tick-borne diseases are transmitted only by certain species.

Figure Tick Removal



From the Center for Disease Control (CDC)

Inspect the bite area carefully for any retained mouthparts. The area should be cleaned with antiseptic solution. Signs of local or systemic illness should be monitored.

5.4 BEES, WASPS AND HORNETS

Bee, hornet and wasp stings inject venom or other substances into the skin that triggers an allergic reaction. The severity of the reaction depends on the individual's sensitivity to the insect venom or substance.

Most reactions to bee stings are mild, causing little more than an annoying itching or stinging sensation and mild swelling that disappear within a day or so. A delayed reaction may cause fever, hives, painful joints and swollen glands. Sometimes both the immediate and the delayed reactions occur from the same sting. Some individuals are highly allergic to bee stings.

Africanized honey bees have made their way into southern California. If you observe a bee hive, leave the area and do not encroach on their territory. If bees attack you, run until they stop chasing you. Agitated bees may pursue for up to a quarter of a mile. Do not hide in a bush or under water. They will just wait until you are exposed.

PREVENTION

If bees, hornets or wasps are encountered, remain calm, be still and move away slowly. Do not wildly flail arms: this is likely to excite them and probably causing them to sting. Avoid wearing any strong-smelling scents in the field (perfumes, after shave, heavily-scented shampoos, etc.).

TREATMENT

If stung repeatedly, seek prompt medical attention at first sign of any symptoms like shortness of breath, rapid heart rate or dizziness. If you have a bee allergy, carry your epi-pen and medical alert information with you at all times. Notify your Team Leader of this allergy and review use of the epi-pen or other medications with the Team Leader before heading into the field.

Mild reaction treatment

Scrape or brush off the stinger with a straight-edged object, such as a credit card or the back of a knife. Wash the affected area with soap and water. Don't try to pull out the stinger. Doing so may release more venom.

Apply a cold pack or cloth filled with ice to reduce pain and swelling. Apply hydrocortisone cream (0.5 percent or 1 percent), calamine lotion or a baking soda paste (with a ratio of 3 teaspoons baking soda to 1 teaspoon water) to the sting several times a day until the symptoms subside. Take an antihistamine containing diphenhydramine or chlorpheniramine maleate.

Severe reaction treatment
Severe reactions may progress rapidly. Dial 911 immediately if any of the following signs or symptoms occur:

- Difficulty breathing
- Swelling of the lips or throat
- Faintness
- Dizziness
- Confusion
- Rapid heartbeat
- Hives
- Nausea, cramps and vomiting

Take these actions immediately while waiting with a severely affected person for medical help:

- Check for special medications that the person might be carrying to treat an allergic attack, such as an auto-injector of epinephrine (for example, EpiPen). Administer the drug as directed, usually by pressing the auto-injector against the person's thigh and holding it in place for several seconds. Massage the injection site for 10 seconds to enhance absorption.

- Have the person take an antihistamine pill if he or she is able to do so without choking, after administering epinephrine.

- Have the person lie still on his or her back with feet higher than the head.

- Loosen tight clothing and cover the person with a blanket. Don't give anything to drink.

- Turn the person on his or her side to prevent choking, if there's vomiting or bleeding from the mouth.

- Begin CPR, if there are no signs of circulation (breathing, coughing or movement).

5.5 Pressure Immobilization Technique FOR STINGS

The pressure immobilization method can be used for various bites and stings. The technique is designed to slow the blood flow to the area of envenomation by applying pressure to the skin over the bite or sting. Use this technique especially if medical attention is not available to the person within at least 2 hours.

- Apply pressure to the bite or sting by placing a 1-inch-thick gauze pad or cloth directly over the wound. The pressure bandage may be held in place with a hand or elastic bandage. When wrapping an elastic bandage around the pad, check for adequate circulation in the fingers or toes. Fingers or toes with adequate circulation have normal color and feeling.

- The pressure should be firm enough to press the pad into the skin but not so tight that blood circulation is stopped. For example, do not wrap tape completely around the limb because this may hamper circulation.
- The pressure pack should be released within 8 hours or as soon as medical care is reached.
- Another technique involves wrapping the arm or leg, not tightly, with an elastic bandage. This slows the absorption of the venom. Then splint the limb so the person is not able to move it. Use a sling if the bite is on the arm or hand.

6.0 HOT WEATHER

Hot weather, typical of the region, poses safety risks from: sunburn, dehydration, heat exhaustion, and heatstroke,

6.1 SUNBURN

Sunburn is a potential health hazard. Sunburn occurs when the sun's energy penetrates deeply into the skin and damages DNA of skin cells. Sunburn increases the risk of certain complications and related skin diseases including: dry, wrinkled skin; liver spots; actinic keratoses; and skin cancer.

PREVENTION

Each field worker should wear protective clothing and use adequate amounts of sunscreen to avoid over exposure to the sun. Wear tightly woven clothing that covers your arms and legs and a broad-brimmed hat.

Apply sunscreen liberally 30 minutes before going outdoors and reapply about every two hours, sooner if it's washed away by perspiration or water. Use it even on cloudy or hazy days.

Wear sunglasses when outdoors. Look for a manufacturer's label that says the sunglasses block 99 percent or 100 percent of all UV light. To be even more effective, choose sunglasses that fit close to your face or have wraparound frames that block sunlight from all angles.

TREATMENT

The following treatments may reduce sunburn pain and discomfort in the hours and days following sunburn:

- Cool the sunburned area with a cold compress such as a towel dampened with cool tap water, or take a cool bath or shower.

- Apply a moisturizing cream, aloe vera lotion or hydrocortisone cream to sunburned skin. A low-dose (0.5 percent to 1 percent) hydrocortisone cream may decrease pain and swelling, and speed up healing.

- If blisters develop, don't break them. Blisters contain natural body fluid (serum) and are a protective layer. Additionally, breaking blisters slows healing and increases infection risk. If needed, blisters should be covered lightly with gauze. If blisters break on their own, apply an antibacterial cream.

- Drink plenty of fluids. Sun exposure and heat can cause fluid loss that needs to be replenished to prevent dehydration.

6.2 DEHYDRATION

Dehydration occurs when more fluid is lost than taken in by the body and the body doesn't have enough water and other fluids to carry out its normal functions. If lost fluid is not replenished, serious consequences may result. Mild dehydration can cause symptoms such as weakness, dizziness and fatigue. Severe dehydration can lead to heat exhaustion, heat stroke or death.

PREVENTION

Drink liquids regularly during work in warm or hot weather. Fieldworkers should carry sufficient liquids, preferably water, and drink regularly to prevent dehydration. It is a misconception that one should only drink when thirsty; in fact, if you're thirsty, it's a sign your body is already low on water. Another misconception is that it is only necessary to drink water in hot weather. It's actually very easy to become dehydrated at any time of the year, even in the winter.

Mild to moderate dehydration is likely to cause:

- Dry, sticky mouth
- Sleepiness or tiredness — children are likely to be less active than usual
- Thirst
- Decreased urine output
- Few or no tears when crying
- Muscle weakness
- Headache
- Dizziness or lightheadedness

TREATMENT

The only effective treatment for dehydration is to replace lost fluids. Drinking cool water and resting in a cool place is recommended. Getting into an air-conditioned building is best, but at the least, one should find a shady area.

6.3 HEAT EXHAUSTION

Heat exhaustion is a heat related syndrome usually caused by exposure to high temperatures, particularly when combined with high humidity and strenuous physical activity. Strenuous exercise or overexertion in hot, humid weather can lead to heat exhaustion. Without prompt treatment, heat exhaustion can progress to heatstroke, a life-threatening condition. Fortunately, heat exhaustion is preventable.

PREVENTION

When working or exercising in hot weather, take breaks, rest frequently in a cool spot and replenish fluids regularly. Wear a lightweight, wide-brimmed hat to protect from the sun, and apply sunscreen to any exposed skin. A sunburn reduces the body's ability to rid itself of heat.

Seek a cooler place such as shade, an air conditioned vehicle or air conditioned building. Drink plenty of fluids. Staying hydrated will help the body sweat and maintain a normal body temperature. Soaking clothes in water can help cool the body.

Pay attention to the frequency and color of urine. You should be drinking enough to urinate several times during a work day, and urine should be clear. If the urine starts to darken and become more yellow, drink more water right away.

TREATMENT

- Rest in a cool place. Getting into an air-conditioned building is best, but at the least, find a shady area. Rest on your back with your legs elevated higher than your heart level.
- Drink cool fluids.
- Apply cool water to the skin. If possible, take a cool shower or soak in a cool bath.
- Don't apply alcohol to the skin.
- Keep clothing loose. Remove any unnecessary clothing and make sure clothes aren't binding.

If no improvement occurs within a half-hour using these treatment measures, seek prompt medical attention.

6.4 HEAT STROKE

Heatstroke is the most severe of the heat-related problems, often resulting from exercise or heavy work in hot environments combined with inadequate fluid intake. Heatstroke is a life-threatening condition that occurs when the body temperature reaches 104ºF (40ºC) or higher.

PREVENTION

Measures to prevent heatstroke are basically the same as those to prevent dehydration and heat exhaustion. When working or exercising in hot weather, take breaks, rest frequently in a cool area and replenish fluids regularly. Wear a lightweight, wide-brimmed hat to protect from the sun, and apply sunscreen to any exposed skin. A sunburn reduces the body's ability to rid itself of heat.

Seek a cooler place such as shade, an air conditioned vehicle or air conditioned building. Drink plenty of fluids. Staying hydrated will help one sweat and maintain a normal body temperature.

The main sign of heatstroke is a markedly elevated body temperature, generally greater than 104ºF (40ºC), with changes in mental status ranging from personality changes to confusion and coma. Skin may be hot and dry, although if heatstroke is caused by exertion, the skin may be moist.

Other signs and symptoms may include:

- Rapid heartbeat
- Rapid and shallow breathing
- Elevated or lowered blood pressure
- Cessation of sweating
- Irritability, confusion or unconsciousness
- Feeling dizzy or lightheaded
- Headache
- Nausea
- Fainting, which may be the first sign in older adults

TREATMENT
If heatstroke is suspected:

- Move the person out of the sun and into a shady or air-conditioned space.
- Dial 911 or call for emergency medical assistance.
- Cool the person by covering him or her with damp sheets or by spraying with cool water. Direct air onto the person with a fan or newspaper.
- Have the person drink cool water, if he or she is able.

7.0 COLD WEATHER

Exposure to low temperatures presents a risk to safety and health both through the direct effect of the low temperature on the body and collateral effects such as slipping, falling and decreased dexterity. The effects of cold exposure include frostbite and hypothermia. Even in southern California, working in the creek during rain events could potentially cause these problems. By paying attention, wearing appropriate protective waders, raincoats, wetsuits, etc. this should not be a problem.

7.1 HYPOTHERMIA

Hypothermia is the rapid, progressive mental and physical collapse accompanying the chilling of the inner core of the human body. Hypothermia is caused by exposure to cold, aggravated by wet, wind, and exhaustion. Hypothermia is defined as a decrease in a person's core temperature below 96°F. The person remains conscious and responsive with normal blood pressure and a core temperature of 93.2°F. As hypothermia advances beyond this point, the person has a glassy stare, slow pulse, slow respiratory rate, and may lose consciousness. Severe hypothermia starts when the core body temperature reaches 91.4°F.

Hypothermia affects the brain, potentially impairing judgment and motivation. Thus hypothermia is particularly dangerous because a person may not know it is occurring and won't be able to properly respond.

PREVENTION
Exercise increased care when working in cold environments to prevent accidents that may result from the cold.

Wear a hat or other protective covering to prevent body heat from escaping from the head, face and neck. Wear gloves or mittens to minimize heat loss from hands. Wear loose fitting, layered, lightweight clothing. Outer clothing made of tightly woven, water-repellent material is best for wind protection. Wool, silk or polypropylene inner layers hold more body heat than cotton does. Stay as dry as possible.

Common signs to look for are shivering, which is the body's attempt to generate heat through muscle activity, and the "-umbles":

- Stumbles
- Mumbles
- Fumbles

- Grumbles

TREATMENT
Preventing additional heat loss is crucial. Get to a warm and dry place as soon as possible. Put on dry closes, especially hat, socks and shoes. If the affected person is alert and is able to swallow, have the person drink a warm, nonalcoholic beverage to help warm the body. Apply warm compresses to the neck, chest wall and groin. Don't attempt to warm the arms and legs. Heat applied to the arms and legs forces cold blood back toward the heart, lungs and brain, causing the core body temperature to drop. This can be fatal.

Treat mild hypothermia by getting into a warm and dry environment. Seek shelter from wind and weather

8.0 WILDFIRES

All of our study sites are located within HIGH FIRE DANGER AREAS.

The RCDSMM has a NO SMOKING POLICY. Smoking is not allowed at any time, or at any RCDSMM work location.

Field work in areas that have difficult access are not permitted on RED FLAG DAYS.

Team Leaders and office staff will check for fire alert or warnings immediately prior to field work, and monitor conditions while the team is in the field. If there is a higher than normal potential for wildfire (fires are possible almost every day in southern California), Team Leaders will review an exit strategy with the office contact person to make sure that they are notified immediately if there is a wildfire start that could affect the team in the field.

If a wildfire is detected or suspected, evacuate immediately. If evacuation is not possible, seek shelter in the lower reaches of canyons, preferably within the wetted creek channel. Soak your clothes or immerse yourself in the water in the center of the largest pool available.

Wildfire can cause immediate death and serious injury. Burns can vary from mild (first degree) to serious (third degree). Additionally smoke from wildfires can hurt the eyes, irritate the respiratory system, and worsen chronic heart and lung diseases.

9.0 BURNS

9.1 First Degree Burns

First-degree burns involve the top layer of skin. Sunburn is a first-degree burn. Signs of first degree burns:

- Red skin
- Painful to touch
- Skin will show mild swelling

First degree burn treatment:

- Apply cool, wet compresses, or immerse in cool, fresh water. Continue until pain subsides.
- Cover the burn with a sterile, non-adhesive bandage or clean cloth.
- Do not apply ointments or butter to burn; these may cause infection.

- Over-the-counter pain medications may be used to help relieve pain and reduce inflammation.
- First degree burns usually heal without further treatment. However, if a first-degree burn covers a large area of the body, seek emergency medical attention.

9.2 Second Degree Burns

Second-degree burns involve the first two layers of skin. Signs of second degree burns:

- Deep reddening of the skin
- Pain
- Blisters
- Glossy appearance from leaking fluid
- Possible loss of some skin

Second degree burn treatment:

- Immerse in fresh, cool water, or apply cool compresses. Continue for 10 to 15 minutes.
- Dry with clean cloth and cover with sterile gauze.
- Do not break blisters.
- Do not apply ointments or butter to burns; these may cause infection
- Elevate burned arms or legs.
- Take steps to prevent shock: lay the victim flat, elevate the feet about 12 inches, and cover the victim with a coat or blanket. Do not place the victim in the shock position if a head, neck, back, or leg injury is suspected, or if it makes the victim uncomfortable.
- Further medical treatment is required.

9.3 Third Degree Burns

A third-degree burn penetrates the entire thickness of the skin and permanently destroys tissue. Signs of third degree burns:

- Loss of skin layers
- Often painless. (Pain may be caused by patches of first- and second-degree burns that often surround third-degree burns).
- Skin is dry and leathery
- Skin may appear charred or have patches which appear white, brown or black

Third degree burn treatment:

- Cover burn lightly with sterile gauze or clean cloth. Do not use material that can leave lint on the burn.
- Do not apply ointments or butter to burns; these may cause infection
- Take steps to prevent shock: lay the victim flat, elevate the feet about 12 inches.
- Have person sit up if face is burned. Watch closely for possible breathing problems.
- Elevate burned area higher than the victim's head when possible. Keep person warm and comfortable, and watch for signs of shock.
- Do not place a pillow under the victim's head if the person is lying down and there is an airway burn. This can close the airway.
- Immediate medical attention is required. Do not attempt to treat serious burns unless you are a trained health professional.

10. FLASH FLOODS

A flash flood is a sudden local flood of great volume and short duration. Flash floods can take only a few minutes to a few hours to develop. Rain events in southern California are very flashy, and the peak flows can be very powerful and can cause serious injury or death.

Being observant when working on the traps, DIDSON camera or any other creek based activity, and knowing possible exits to higher areas are key factors in preventing injury.

During storm event trapping or DIDSON camera deployment, check weather reports or internet weather sites for flash flood warnings or flash flood watches.

- A flash flood WARNING means a flash flood is occurring or will occur very soon.
- A flash flood WATCH means flash flooding is possible in the area.

Some internet weather sites:
NOAA Los Angeles http://www.wrh.noaa.gov/lox/
CNN Weather http://weather.cnn.com/weather/forecast.jsp
Weather Underground http://www.wunderground.com/

If flash flood warning or watch is in effect, field work in canyons and near streams will not be conducted.

If heavy rains are forecast, fieldwork in canyons and along streams will not be conducted until rains have decreased within the watershed where fieldwork will be conducted.

If you are already conducting field work in the creek, listen for rumbling sounds that might indicate an approaching flash flood. Immediately move to higher ground away from the creek channel. Do not attempt to carry heavy items that will slow your movement.

11. HIKING

Fieldwork in the Santa Monica Mountains requires hiking off of established trails, often in rugged terrain. Slips, trips, and falls can easily occur. Field work within stream channels and adjacent areas has the additional risk of falls due to wet, slippery rocks, and algal mats that hide holes. Rigorous hiking can also lead to fatigue and exhaustion. Fatigue is well established as a contributing factor to occupational injury.

All field workers are required to wear proper footwear for field conditions and pay attention to where they are stepping when hiking. Flip-flops, Tevas or any other open sandal is not permitted in stream work.

Team leaders and field staff should always inform the RCDSMM office contact of when and where field work will be conducted. Team leaders are expected to call the RCDSMM office contact at the end of each field day. A charged cellular telephone and GPS unit will be accessible to each field team.

If a field worker becomes lost, they should call for help or simply find a safe place to sit and wait for searchers to arrive.

Rest breaks should be taken so that fatigue does not occur.

When using ropes to assist climbs, always:

- Check to determine that rope is firmly attached to its anchor point by pulling firmly on rope;
- Visually check rope for frayed spots, wear or other deterioration;
- Climb carefully, making sure grip is tight and feet are placed securely;
- Do not allow rope to run over a sharp edge when climbing,

12. CRIMINAL ACTIVITY

Field personnel could be harassed, threatened or attacked by individuals engaged in illegal activities. Field equipment and vehicles may be stolen or vandalized. Several of our field locations are known areas for transient encampments.

Evidence of suspected criminal activity such as marijuana plants or stripped vehicles should be avoided and immediately reported to the state park rangers, police or other authorities. The location of suspected illegal activity should be noted by GPS coordinates if possible.

Stay together as a team. Do not leave any team member alone.
DO NOT linger at locations of suspected illegal activity.
DO NOT confront individuals in the vicinity of suspected illegal activity.

Lock all equipment securely in vehicles, trailer or the RCD shed.

13.0 GENERAL HEALTH AND SAFETY REQUIREMENTS

All fieldwork will be conducted by a minimum of two persons. The buddy system is a basic component of field safety. In the event of injury, the uninjured person will remain with the injured party unless absolutely necessary to leave in order to obtain emergency assistance.

Code For Safe Practices

The following is a list of safety procedures that will be adhered to while working at any field location:

- All OSHA requirements will be observed
- Eye, ear, hand protection devices and weather protective gear must be worn when the type of work being done requires this type of protection.
- Protective clothing will be worn
- Personnel will carry water

Safety is a mutual endeavor. Each individual is responsible for their own health and safety and that of their immediate co-workers. All personnel are to exercise personal judgment and have an explicit right to refuse hazardous assignments if they have safety concerns.

Protective Equipment and Clothing

Equipment required for Field Personnel while working in the field:

- Boots or closed toe shoes for water work
- Waders for electrofishing
- Cell Phone
- Long Pants

Equipment required to be available onsite and/or in field vehicle:

- First–aid kit
- Flashlight with fully charged batteries
- Cell phone car charger

Equipment recommended for Field Personnel while working in the field:

- Hat
- Gloves
- sunscreeen

A vehicle must be kept on site while personnel are working, for the transport of slightly injured personnel to a hospital or emergency medical facility. Severely injured personnel MUST ONLY be transported by paramedics. A copy of hospital and urgent care center addresses must remain in the field backpack.

APPENDIX A.3
RCDSMM HACCP Equipment Decontamination Protocol

RCDSMM Hazard Analysis and Critical Control Points (HACCP) Equipment Decontamination Protocol

ANS-HACCP Plan –
SNORKEL SURVEYS
Resource Conservation District of the Santa Monica Mountains

1) Product Description

Firm Name:	*RCDSMM*
Firm Address:	*540 S. Topanga Canyon Blvd., Topanga CA 90290*
Species of fish:	*Rainbow Trout (Onchorhynchus mykiss)*
Cultured, wild harvested, or both:	*Wild*
Harvest method:	*Not applicable*
Method of distribution and storage:	*Not applicable*
Intended use and consumer:	*Monitoring population abundance and distribution*

2) Flow Diagram

Step 1	*Malibu Creek and other NZMS stream specific gear collected at the RCDSMM research storage shed. Gear includes wetsuits, gloves, hoods, shoes, dive lights, masks and snorkels.*

⇓

Step 2	*Gear transported in NZMS specific tubs to the input site.*

⇓

Step 3	*Sort gear for each diver. Each diver carries their own gear approximately 1/2 –1 mile hike in to the start point for the snorkel surveys. Change into dive gear.*

⇓

Step 4	*One recorder carries a backpack, while all divers snorkel in NZMS creeks counting all steelhead trout observed.*

⇓

Step 5	*Return to start site and change into regular clothes and shoes. Re-pack all dive gear to carry back to the vehicles.*

⇓

Step 6	*All gear that has been in touch with the water is placed into the storage tubs in the vehicles.*

⇓

Step 7	*Return to the decontamination site at the RCDSMM office. Remove gear from tubs and scrub everything with a brush used only for NZMS gear. Rinse in specific NZMS only tubs.*

⇓

Step 8	*All gear other than wetsuits is then frozen for at least 72 hours.*

⇓

Step 9	*Wetsuits are sprayed with a 10% bleach solution, rinsed, and hung out to dry in a specific zone of the drying area. When inside is dry, then the outside is sprayed, rinsed, and dried as well. Shoes are scrubbed clean and put in the NZMS drying zone outside.*

⇓

Step 10	*Tubs are inspected and washed, then sprayed with a 10% bleach solution and allowed to dry completely.*

⇓

Step 11	*When the tubs and gear have completely dried, everything is neatly stored for future use in a separate part of the gear shed away from all other gear.*

3) Potential Hazards (List relevant species)

1. **ANS Fish and Other Vertebrates.**
   Bullfrog eggs or tadpoles, carp, catfish, bluegill, green sunfish, striped bass, mosquitofish and fathead minnow eggs or fry.

2. **ANS Invertebrates.**
   New Zealand Mudsnails, red swamp crayfish

3. **ANS Plants.**
   Terrestrial precautions

4. ***Diseases (Pathogens and Parasites)***
   None known at this time

4) Hazard Analysis Worksheet

(1) Harvest or Aquaculture Step (from flow diagram)	(2) Identify potential ANS hazards introduced or controlled at this step (1)	(3) Are any potential ANS hazards significant? (Yes/No)	(4) Justify your decisions for column 3.	(5) What control measures can be applied to prevent the significant hazards?	(6) Is this step a critical control point? (Yes/No)
1. NZMS specific gear collected at the RCDSMM research storage shed. Gear includes wetsuits, gloves, hoods, shoes, dive lights, masks and snorkels.	Fish/Other Vert.	No	*Gear is put away clean and disinfected.*	*NA*	*No*
	Invertebrate NZMS	No	*Gear is put away clean and disinfected*	*NA*	*No*
	Plant	No	*Gear is put away clean and disinfected*	*NA*	*No*
2. Gear transported in NZMS specific tubs to the input site.	Fish/Other Vert.	No	No chance of infection during transport.	NA	No
	Invertebrate	No	No chance of infection during transport.	NA	No
	Plant	No	No chance of infection during transport.	NA	No
3 Sort gear for each diver. Each diver carries their own gear approximately 1/2 –1 mile hike in to the start point for the snorkel surveys. Change into dive gear.	Fish/Other Vert.	No	No chance of infection during transport.	NA	No
	Invertebrate	No	No chance of infection during transport.	NA	No
	Plant	No	No chance of infection during transport.	NA	No
4. One recorder carries a backpack, while all divers snorkel in Malibu Creek counting all	Fish/Other Vert. exotic fish eggs and larvae	Yes	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes, clothes, and snorkel gear and the backpack.	Yes

steelhead trout observed.					
	Invertebrate NZMS	Yes.	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes clothes, and snorkel gear and the backpack.	Yes
	Plant Invasive Euphorbia	Yes	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes, clothes, and snorkel gear and the backpack.	Yes
5. Return to start site and change into regular clothes and shoes. Re-pack all dive gear to carry back to the vehicles.	Fish/Other Vert. exotic fish eggs and larvae	Yes	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes, clothes, and snorkel gear and the backpack.	Yes
	Invertebrate NZMS	Yes.	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes clothes, and snorkel gear and the backpack.	Yes
	Plant Invasive Euphorbia	Yes	Contact with water and bank vegetation may cause inadvertent transport	Visually inspect shoes, clothes, and snorkel gear and the backpack.	Yes
6. All gear that has been in touch with the water is placed into the storage tubs in the vehicles.	Fish/Other Vert. exotic fish eggs and larvae	NO	All gear is contained to avoid contaminating the vehicle.	Make sure that everything gets put inside the tubs completely.	Yes
	Invertebrate NZMS	NO	All gear is contained to avoid contaminating the vehicle.	Make sure that everything gets put inside the tubs completely.	Yes
	Plant Invasive Euphorbia	NO	All gear is contained to avoid contaminating the vehicle.	Make sure that everything gets put inside the tubs completely.	Yes
7. Return to the decontamination site at RCDSMM office. Remove gear from tubs and scrub everything with a brush used only for NZMS gear. Rinse in specific NZMS only tubs.	Fish/Other Vert. exotic fish eggs and larvae	No	The decontamination site is away from any natural drainage, and any runoff from the site is contained and filtered to remove invasives.	Decontamination is confined to areas with access to water and adequate filtration. Gear is cleaned in one set of marked tubs only. Rinse water is disposed of away from any waterways that could convey invasives.	Yes

	Invertebrate NZMS	No	The decontamination site is away from any natural drainage, and any runoff from the site is contained and filtered to remove invasives.	Decontamination is confined to areas with access to water and adequate filtration. Gear is cleaned in one set of marked tubs only. Rinse water is disposed of away from any waterways that could convey invasives.	Yes
	Plant Invasive Euphorbia	No	The decontamination site is away from any natural drainage, and any runoff from the site is contained and filtered to remove invasives.	Decontamination is confined to areas with access to water and adequate filtration. Gear is cleaned in one set of marked tubs only. Rinse water is disposed of away from any waterways that could convey invasives.	Yes
8. All gear other than wetsuits is then frozen for minimum of 72 hours. Rinse all gear in specific NZMS only tubs.	Fish/Other Vert. exotic fish eggs and larvae	No	Fish eggs and larvae cannot survive freezing.	Using freezing kills all fish eggs and larvae. Rinsing in a contained area ensures that if any eggs survived, they would be prevented from reaching a drainage.	Yes
	Invertebrate NZMS	No	Crayfish eggs and larvae cannot survive feezing. NZMS are also killed by freezing.	Using freezing kills all eggs and larvae. Rinsing in a contained area ensures that if any eggs or snails survived, they would be prevented from reaching a drainage.	Yes
	Plant Invasive Euphorbia	No	Most seeds cannot survive freezing.	Using freezing kills all seeds. Rinsing in a contained area ensures that if any eggs survived, they would be prevented from	Yes

				reaching a drainage.	
9. Wetsuits are sprayed with a 10% bleach solution, rinsed, and hung out to dry. When inside is dry, then the outside is sprayed, rinsed, and dried as well.	Fish/Other Vert. exotic fish eggs and larvae	No	While fish eggs might attach to the wetsuits, they would not survive the bleach treatment and drying.	Spray with a 10% bleach solution and allow to dry completely, inside and out.	Yes
	Invertebrate NZMS	No	While crayfish eggs and NZMS might attach to the wetsuits, they would not survive the bleach treatment and drying.	Spray with a 10% bleach solution and allow to dry completely, inside and out.	Yes
	Plant Invasive Euphorbia	No	While seeds might attach to the wetsuits, they would not survive the bleach treatment and drying.	Spray with a 10% bleach solution and allow to dry completely, inside and out.	Yes
10. Tubs are inspected and washed, then sprayed with a 10% bleach solution and allowed to dry completely.	Fish/Other Vert. exotic fish eggs and larvae	No	Any organisms left in the tubs would be killed by the bleach solution and drying.	Bleach and drying are effective controls.	Yes
	Invertebrate NZMS	No	Any organisms left in the tubs would be killed by the bleach solution and drying.	Bleach and drying are effective controls.	Yes
	Plant Invasive Euphorbia	No	Any organisms left in the tubs would be killed by the bleach solution and drying.	Bleach and drying are effective controls.	Yes
11. When the tubs and gear have completely dried, everything is neatly stored for future use.	Fish/Other Vert. exotic fish eggs and larvae	No	Equipment is stored in a separate location within a metal shipping container that gets pretty hot and is not used for a month.	Drying and heat effectively kill these organisms. Gear is stored for a month before next use.	Yes
	Invertebrate NZMS	No	Equipment is stored in a metal shipping container that gets pretty hot and is not used for a month.	Drying and heat effectively kill these organisms. Gear is stored for a month before next use.	Yes
	Plant Invasive Euphorbia	No	Equipment is stored in a metal shipping container that gets pretty hot and is not	Drying and heat effectively kill these organisms. Gear is stored for a	Yes

		used for a month.	month before next use.	

5) ANS-HACCP Plan Form

1) Critical Control Point – Water contact while snorkeling and when transporting gear.

2) Hazard – Transport of aquatic invasive NZMS or terrestrial seeds to other drainages

3) Limits for each Control Measure - Zero tolerance

4) Monitoring – What? – Visual Inspection, scrubbing and decontamination of gear

5) Monitoring – How? – Decontamination using scrubbing, freezing and drying, as well as keeping all gear from infected watershed separately

6) Monitoring – Frequency? – Before and following each use.

7) Monitoring – Who? – Field Supervisor

8) Corrective Action(s) – Quarantine and clean equipment; nix the program

9) Verification Process – "Certify" decontamination after each use

10) Records to be Kept- Checklist of decontamination steps kept with the storage tubs and initialed following each step at each event.

APPENDIX A.4
RCDSMM DIDSON Deployment Protocol

Appendix 2A

DIDSON Procedure Manuals

TASK 2. ANADROMOUS ADULT AND SMOLT MONITORING WITH DIDSON CAMERA IN TOPANGA CREEK

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

Prepared for
CDFW contract No P1250013

Prepared by:

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

June 2017

RCDSMM
DIDSON Deployment Protocol 2014-2018

The purpose of this protocol is to guide the installation and deployment of a DIDSON camera in Topanga Creek. Some of the steps will vary depending on flow regime and rainfall rates, and can be adjusted accordingly.

Project Contacts and Phone Numbers:

Contact one of the following people if there are questions or concerns:
Rosi Dagit, RCD Project Manager (Cell) – 310-488-6381
Rosi Dagit (Home Office) – 310-455-7528
Sam Bankston, CDFW – 805-423-5477
RCD Office (Topanga) – 818-597-8627 ext. 102 (John Hendra)
Marcel Bourget (electrician) – 310-488-5361
Steve Williams 310.699.1489
Russell Dauksis 401.855.2068
Danielle Alvarez 951.205.2029
Mary Larson 562.537.8624
Dana McCanne 805.962.4841
Kate McLaughlin 805.962.4475 c
Tom van Meeuwen 805.636.0545

STATE PARKS –
Dispatch – 951.443.2969
Suzanne Goode 310.699.1720c 818.880.0364 o
Stephen Bylin 310.562.1669
Jamie King 310.699.3951c 818.880.0674 o

I. Prior to deployment – when to deploy

When a storm is approaching, the current depth and flow of the creek should be noted and the storm should be tracked using NOAA and other weather tracking sites.

Suggested websites for storm tracking:

- NOAA Weather (also see Forecast Discussion for details) - http://forecast.weather.gov/MapClick.php?site=lox&textField1=34.09361&textField2=-118.60056
- The Weather Channel Satellite Video – http://www.weather.com/maps/geography/westus/westcoastussatellite_large.html
- LA County DPW WRD (for approximate rainfall totals) - http://www.ladpw.org/wrd/precip/

When it appears like the storm will produce enough rainfall and flow to allow for proper use of DIDSON and/or traps, preparation for deployment should begin.

Water levels in the creek should be monitored closely as well when expecting a storm – check Topanga Bridge (mm 2.02), Fish Camp, DIDSON site, and Lagoon for connectedness.

Lagoon needs to be connected and passable at high tide.

Water levels need to be at least 20 inches and holding steady by noon before getting everyone organized to deploy.

Start calling and emailing the team the day before you think it might be possible to deploy and get a sense of who is available when.

Have folks on stand by to activate and set camera and traps meeting at the DIDSON office by 2pm in order to have sufficient time to set both camera and traps before dark, earlier if possible, especially for the first seasonal deployment!

II.A. Prior to deployment – notify State Parks and CDFW

Email Suzanne Goode, Jamie King, Stephen Bylin and let them know when you hope to deploy. Email Mary Larson, Dana McCanne and Kate McLaughlin from CDFW to let them know about the plan and coordinate possible help.
Email/ Call Tom Van Meeuwen (CCC) to get help from WSP/ Vets, etc.

II.B Prior to deployment – check equipment

When a storm is approaching, all equipment should be checked for proper functioning and water quality equipment should be calibrated as needed. All necessary equipment should be staged in the DIDSON OFFICE (Mobile Mini Unit) so that it is ready to go when needed.

Power should be connected to make sure it is working properly (see Section III. below for complete instructions on connecting power to the Mobile Mini).

The *rain gauge* should be set up in an area clear to the sky outside of Mobile Mini to be able to track rainfall nearest to the DIDSON.

II.C. Prior to deployment – staging equipment

The following is a list of equipment is staged in the DIDSON OFFICE:

- DIDSON camera
- DIDSON camera housing
- A-frame
- Black cable connecting camera to topside
- 2 laptops – one for recording, one for processing
- Dive lights, Headlamps and extra batteries
- Life vests
- Waders
- Sand bags and zip ties
- Towels
- Rain gear
- Water quality test probes – pH, conductivity, dissolved oxygen, water and air temperature (see notes above re: calibrating)
- Keys to power boxes and locks for camera housing and tether
- Tether cord
- Yellow DIDSON field notebook
- Data sheets for processing and in-situ data collection
- Pencils
- Cameras and chargers
- Shovels, rebar, loppers, other tools

III. Connecting Power to the Mobile Mini Unit (Reverse these steps to SHUT DOWN)
Follow these steps exactly:

1) Unlock and open the Right side grey breaker box on pole (key in mobile mini)
2) Make sure both breakers (125, 50) are OFF
3) Unlock and open grey breaker box on mobile mini (MM) and make sure everything is in the OFF position
4) Plug in extension cord into MM FIRST – roll it like a wheel towards the pole – then plug in to the pole
    a. To insert, line up arrow on bottom and twist
    b. Make sure the cable is laid out flat and there are no coils!
5) Once both ends are connected
    a. FIRST turn ON 125, 50 at POLE
    b. SECOND turn on all breakers at MM
6) Check that Power is on in MM and lock up both breaker boxes

IV. Deployment
Once it has been decided that the DIDSON should be deployed, first step is to connect power to the shed (see Section III. above). The rain gauge should already be set up in anticipation of rain. Then, the following should be completed (can be simultaneous if staffing allows):

Measure wetted width and flow.
Install rebar at water edge to mark changes in stream width over time. Be sure it is flagged!
Collect water quality data
Collect turbidity sample and process.

Coordinate schedules for personnel to monitor!
A minimum of 2 people needed on site at all times that camera is deployed, 3 during the night if possible.
Lead person on site should be either:
Rosi, Jen, Steve, Krista, Lizzy
People should not work more than 12 hour shifts and 8 hours is best if possible.
Call CDFW to get help with staffing.
Volunteer list will be emailed to everyone and posted on the wall in the office.

Camera can stay in water as long as depth sufficient, typically 2-3 days.

Traps need to be installed after the storm has passed and typically does not stay in as long.
Once depth is <6 inches at the trap, it should be pulled out.
If depth stabilizes over 6" and the camera is still deployed, traps need to be checked for fish every 2 hours at night and 4 hours during the day.

Once the lagoon is closed or not passable, end the deployment unless it looks like fish are still trying to move to the lagoon and are able to get there.

A. Setting up the DIDSON

1) CDFW instructions on how to attach the DIDSON camera to the connector cable and install into housing. Be careful **not** to place the viewfinder side of the housing on gravel or rocks to avoid scratching or scraping it. Use the Master lock in the MM allocated for the didson housing to lock the housing.
2) Carefully carry A-frame down to creek.

3) Connect the camera to the silt box lid and cable in the DIDSON OFFICE.
4) One person should carefully carry camera in housing down to creek while the other person carefully unrolls the black cable, making sure to unroll the long side towards the creek and keep the short side near the MM (it is okay if this cable doubles back on itself or coils, but try to keep it straight and neat so to avoid tripping over it at any point).
5) Once down at the creek, connect the camera to the A-frame and wrap the black cord around the A-frame to reduce any tension on the camera connection.
6) Place the A-frame in the creek at an appropriate spot (depending on flow and safety)
7) Before tethering and adding sandbags – check topside connection
8) Topside box should be attached to the recording computer and to the DIDSON (black cable connector) per CDFW instructions.
9) Follow CDFW instructions to check topside connection, basically open DIDSON software (DIDSON should be OFF), turn off DEMO mode and turn the DIDSON ON.
10) It will take a few minutes to establish a connection as the cable is very long. Can take up to ten minutes. Be patient.
11) Once a connection has been established, then secure the DIDSON camera in the creek.
12) Use the tether cord to lock the DIDSON housing (can attach it through the lock) to a tree on the East bank. Use another lock to lock the tether to the tree.
13) Place sand bags filled with sand around the back of the DIDSON in a manner that will encourage fish to swim about a meter in front of the camera (see photo below for an example).

14) Once the camera is secure, set save directory
    a. Set up a folder on one of the external hard drives named with the deployment date and location (e.g., Topanga_28 Feb 2014)
    b. Save (should be set to save as the date and time in HHMMSS). Do not add anything to the Save As file name. Ex.: 2014-02-28_134000_HF.ddf
    c. Make sure Auto Rate, Auto Frequency and HF are all selected and adjust window length as needed (see CDFW instructions for details)
    d. Start Recording!

B. Data collection and note taking

At the start of each deployment, a WORD document for notes and personnel tracking, and an EXCEL spreadsheet for data entry, should be set up on the processing computer.

Lead person from each shift (likely the same person processing videos) should record shift time and personnel and any notes taken during the shift. Review all previous data and notes at the end/start of each shift and update whomever is taking over next shift.

At a minimum, the following notes should be taken during each shift:

- Hourly, and as needed, field checks on DIDSON camera position
- Any time the DIDSON is adjusted or moved and how/where it was adjusted or moved
- Hourly measurements of turbidity, water and air temperatures, total rainfall (rain gauge and LACDPW WRD)
- Flow (cfs) measurements, when possible. Do not take flow if you feel unsafe or if you see many fish swimming by.
- Lagoon monitoring – check tides and go visit the lagoon to check passability as often as needed. More frequent as flows decline.
- Fish trap monitoring – lock the DIDSON Office at night and whole team go in one car to the

C. Video processing

In order to avoid any missing images, at least every six hours all new DIDSON files should be backed up from the recording external hard drive onto the second processing external hard drive. When ejecting the processing hard drive, make sure you are ejecting the correct one! The hard drives are labeled, the USB ports are labeled, and you can see real-time images being saved on the recording drive, so make sure you have the correct drive.

Process data from each six hour time period, recording onto the appropriate data sheets. Once a six hour time period is complete or at the end of your shift, you should enter all processing data into the appropriate EXCEL spreadsheet.

V. SETTING UP THE TRAP

The stakes and weir frames are staged at Fish Camp and locked together to a willow tree. Other equipment will be either in the shed or in the DIDSON OFFICE.

Be sure and take the correct keys to the site!

Equipment needed to set up the traps:

1. Weir panels (at Fish Camp)
2. fence posts (at Fish Camp)
3. post pounder
4. hard hat and ear plugs
5. long zip ties to tie panels together and to the fence posts (14”)
6. short zip ties for tying the sandbags
7. dikes and wire cutters to cut the zip ties
8. tarps to cover the boxes
9. big net to check the boxes
10. 4 buckets
11. waders
12. 2 shovels
13. loppers
14. Fish processing box that contains:
    - pit tag master list on clipboard
    - pit tag reader
    - pit tags prepared in envelops ready to use
    - fish kit containing scale knife, scalpel and blades, alcohol, scissors for fin clips, tweezers to change scalpel blades, Vet Bond

MS-222
FISH MEASURING BOARD
Camera
Dip nets to move fish to and from buckets

Put together the connected upstream weir panels with bottom netting on shore! Tag should be on the upstream side!
Carry to the creek and secure with fence posts.
Be sure to securely fasten the wood part that keeps the panels open for fish access!
Attach the labeled downstream panels and secure to the upstream side.
Install the panels both up and downstream to direct fish into the openings.
Be sure to feel along the bottom and make sure there are no holes under the panels.
Use sandbags to fill in any gaps.
Use a tarp to cover the tops of the up and downstream boxes and lay fence posts on top to hold them in the wind.

V. End of deployment

Once water levels have dropped to the point that the camera is no longer covered it is time to end the deployment.

Call the team and arrange for sufficient help to move all equipment up from the creek to the DIDSON office.

Make sure everything is clean and in working order to be ready for next deployment.

Review all field notes and make sure they are complete.
Review all video files and make sure they are in the correct folders.

Disconnect power to the DIDSON office.

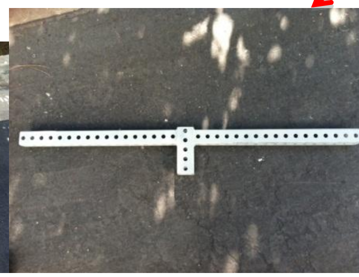
DIDSON Hardware Procedures

Equipment List:

1. Tools
    a. 7/16 wrench
    b. Flat head screw driver
2. DIDSON Pelican Case
    a. DIDSON
    b. Topside box
    c. Topside box power cable
    d. Ethernet cable
    e. Bolts
3. DIDSON Cable
    a. 500ft cable on spool
4. Silt Box and Metal Debris Box
    a. Attached with metal plate
    b. Has attached ball mount
    c. Lock (keeps debris box closed and prevents easy access to the DIDSON)
5. Mount
    a. A frame
    b. 3 locking pins
    c. Ball joint
6. Laptop Computer
    a. Power cord
7. External hard drive
    a. All necessary cords
8. A "can-do" attitude ☺

Assemble A-Frame:

1. The A-frame has 4 main parts, 2 legs with sleds, a cross bar, and a pole for mounting the camera.


2. Attach the cross bar to the two legs, using locking pins
3. Attach the center pole mount to the cross bar using a locking pin

Assemble DIDSON in Silt/Debris Box:

1. Attach silt box lid to the DIDSON

2. Attach one end of the DIDSON cable to the DIDSON
    a. Make sure to align the pin in the cable with the slot on the DIDSON

3. Wrap DIDSON cable around the front of the DIDSON, so that it does not get in the way of the lens.

4. Place DIDSON in the silt/debris box with the lens lined up with the window on the siltbox.
    a. The cable should come out of the notch at the top of the silt/debris box

Set up Computer and topside equipment:

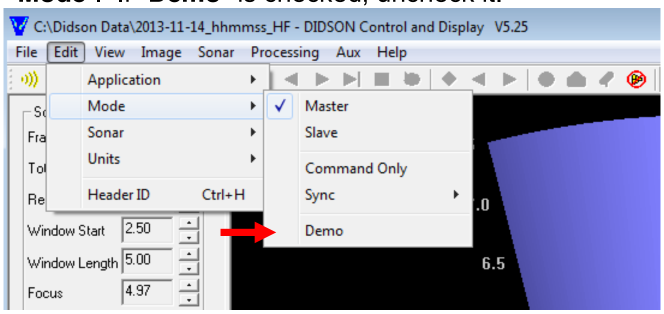
1. Turn on the computer and open the DIDSON software
2. Plug in the hard drive
3. Plug in the DIDSON topside box
    a. Make sure the topside box is off
4. Plug the blue DIDSON Ethernet cable into the topside box (where it says PC) and then into the computer
5. See DIDSON Software procedures for DIDSON software setup and recording

DIDSON Software Procedures

Powering up the DIDSON

- Open the DIDSON topside software with the "**Didson V5.25.35**" shortcut on the desktop.

- Make sure the software is **NOT** operating in "**Demo mode**" by looking under "**Edit**" → "**Mode**". If "**Demo**" is checked, uncheck it.

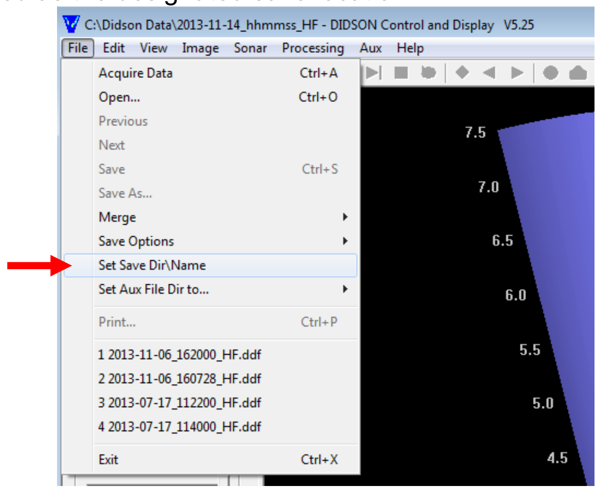


- Turn on the DIDSON topside box

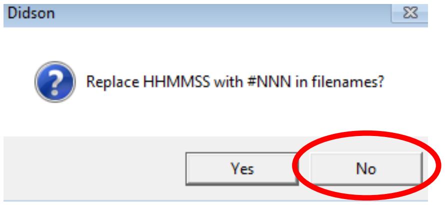
- It takes approximately one minute for the sonar to cycle the lens and focusing motor, at which point the screen will switch to a live feed.

Recording with the DIDSON

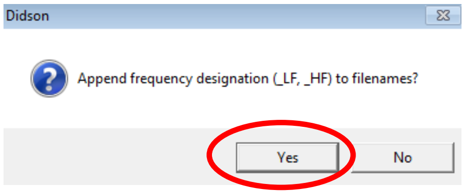
- Prior to hitting the record button, check that files will be saved to the proper directory. Under “**File**” → “**Set Save Dir/Name**”, the external hard drive should be selected as the designated save location.



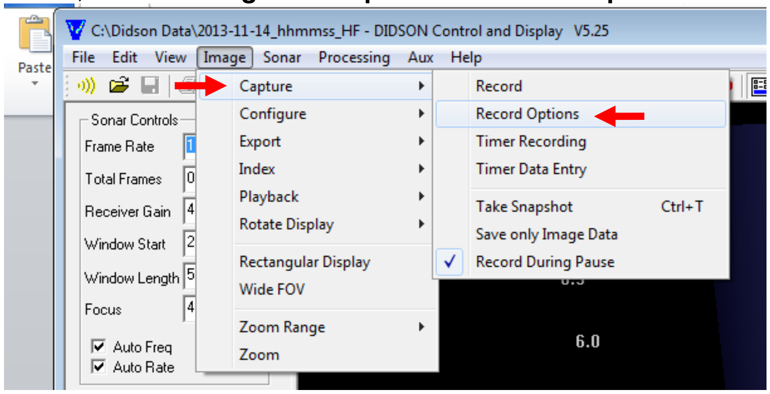
- When prompted to change file name from HHMMSS format to #NNN format, decline.



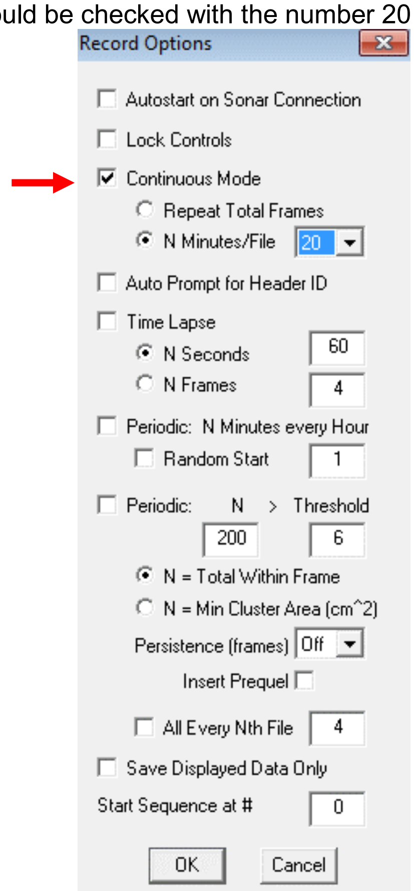
- Accept the “Append frequency designation (_LF, _HF) to file names” message that appears next.



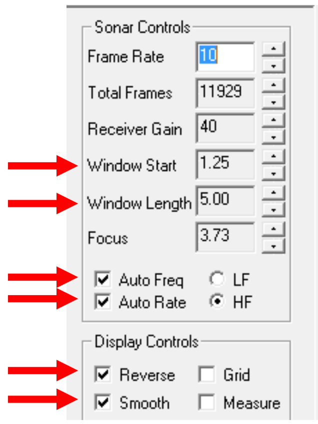
- Files are saved in 20 minute increments. To confirm that files will be recorded in this format, click on "**Image**" → "**Capture**" → "**Record Options**".



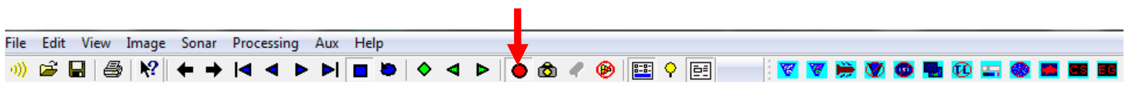
- The square box next to "**Continuous Mode**" should be checked. Below that, "**N Minutes/File**" should be checked with the number 20 displayed in the box.



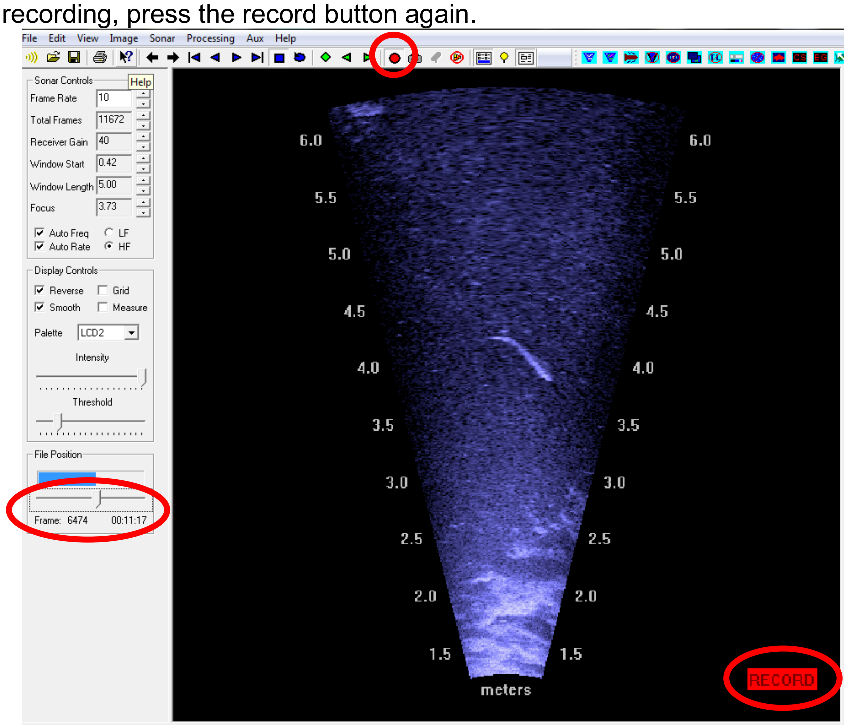
- Set DIDSON Record Options: Window Start, Window Length. Make sure that Auto Freq and Auto Rate are checked, and that Reverse and smooth are checked



- If the above settings are as specified, press the red record button on the taskbar.



- A red box with "Record" will appear in the lower right hand corner of the display. You will see the file numbers going up in the bottom left corner. To stop recording, press the record button again.



Removing the DIDSON

1. Press the **"Record"** icon to stop recording
2. Close the DIDSON software on the laptop- a window will appear that says

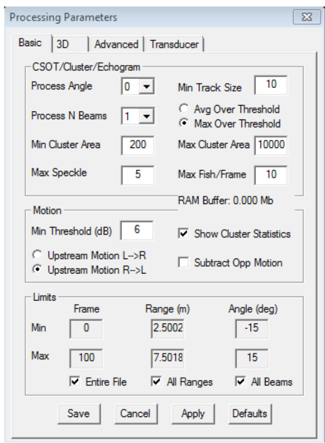
"please wait while the lens is being retracted", a second window will notify you when the retraction is complete

3. Turn off the Top Side Box, you can now remove the DIDSON from the stream
4. Disconnect the Top Side Box by disconnecting the Ethernet cable, sonar cable and power cables
5. Eject the external hard drive, and power down the computer
6. Disassemble the DIDSON, making sure to put all hardware in the appropriate locations

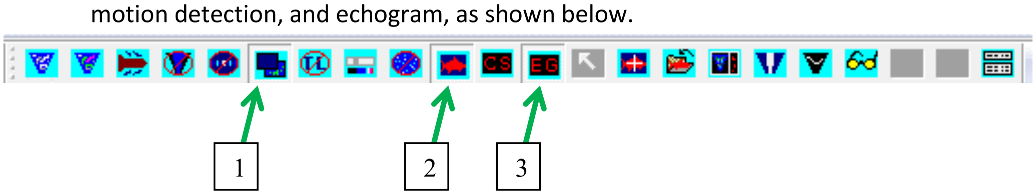
DIDSON Analysis

updated 1.8.18

1. Start by using the Echogram tool with Background subtraction and Motion Detection enabled.
2. Save the "good" parameters and load when starting the program
    a. Check processing parameters, example:



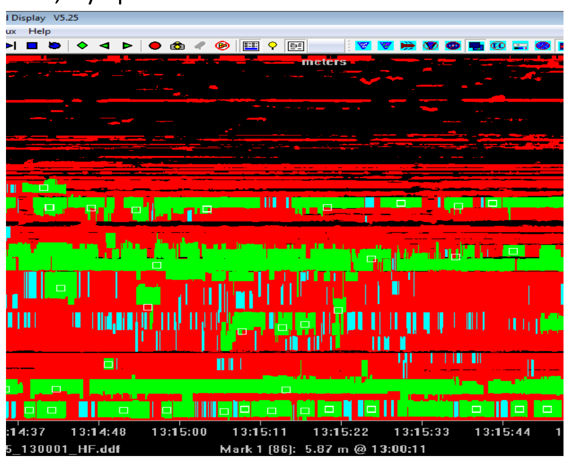
    b. Make sure that "use cluster data" is selected: processing>Echogram> use cluster data
    c. Run the echogram by pressing the following icons: background subtraction, motion detection, and echogram, as shown below.



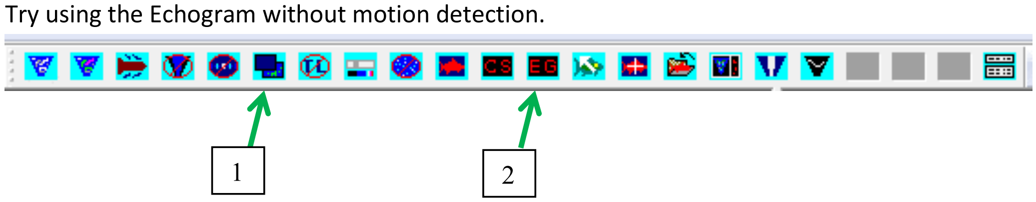
box 1 background subtraction is good
skip (BOX 2) most of the time…..too confusing!

    d. Can you identify fish motion signatures?
        i. If yes, use this tool to find fish in the DIDSON video and measure these fish using the box method. Takes 2-3 minutes to load so be patient!

ii. If no, try option 2.

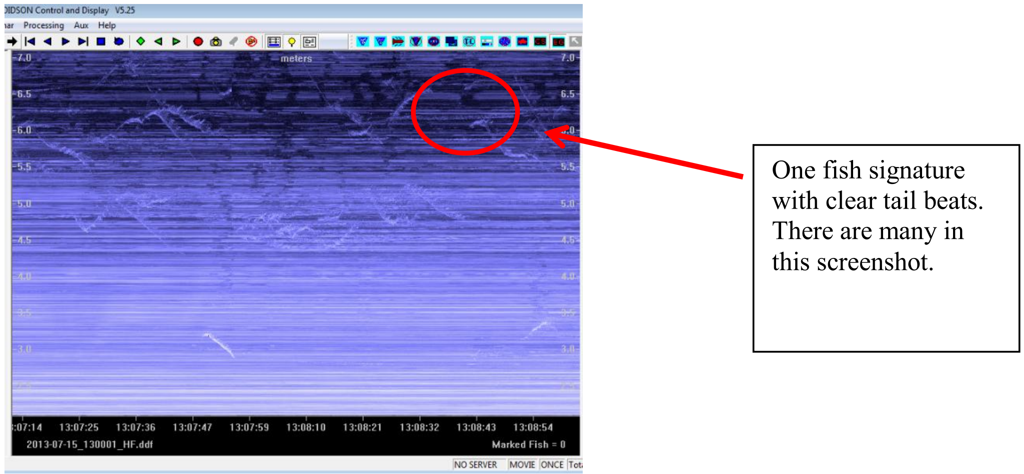


3. Try using the Echogram without motion detection.



a. Can you pick out characteristic fish motion signatures, tail beats etc.?

i. If yes, use this to find fish in the DIDSON video and measure these fish using the box method. Black arrows = ecogram and can be confusing so pay attention to file names!

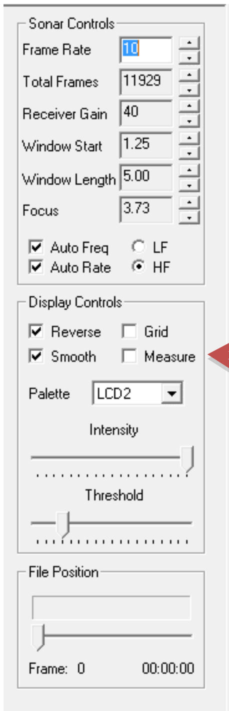


ii. If no, try option 3

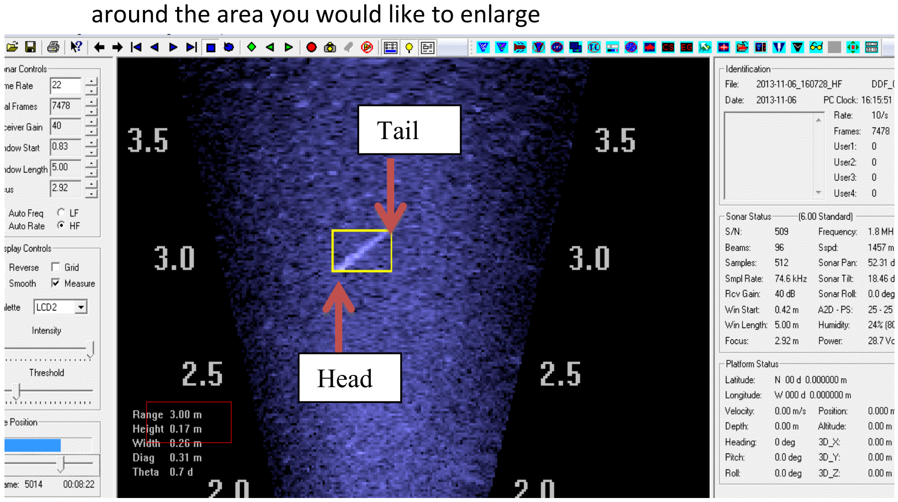
4. Watch the video at increased speed to ID fish.
    a. If it is still difficult to pick out fish use option 4.
5. Watch the video at the recorded speed to ID and measure fish.

6. Box Measurement tool

1. Select “measure” on the left side panel (check the box)



2. When you click and drag on the DIDSON image a yellow box will appear
   a. Left click on the head of the fish and drag the box to the end of the fish to get a measurement (box measures pixels inside only, not on the line)
      i. The box measurements are shown in the bottom left of the screen, in this case you would use the diagonal as the best length estimation, Diag = 0.31m
      ii. You can zoom in on the image by right clicking and dragging a box around the area you would like to enlarge



b. Choose frames (measure at least 3 frames from center of frame of view) where the fish is swimming at a slight angle to the camera, not directly toward the camera or away and not directly perpendicular to the camera
c. Determine where the start and end of the fish are by stopping the video and moving frame by frame and noting which pixels are highlighted

OTHER NOTES FROM HEIDI

Range may be important to note
    Distance from camera and focus can alter pixels

Black arrows can be confusing!

DATA MANAGEMENT

1. set up folder to capture all video from start of deployment – to midnight , then in 24 hour increments
    example 16 Dec 2014 will include from time of deployment to 1159 hours
        17 Dec 2014 will include 0000- end of deployment or 1159 hours

    this will make it easier for us to find files by date and correlate to antenna detections

Follow procedure for switching external hard drives after 8 hours

2. PROCESSING
Viewer 1 – reviews the files on the second computer using the external hard drive
    Set up folder for video reviewed (dates reviewed)– no fish and puts any files with no fish here
    Set up folder for video reviewed (dates reviewed) – FISH present

Viewer 2 – Reviews both folders and if no difference of opinion, then leave as is
    If fish found then move that filed to the fish present folder and make notes!

Please use the datasheets to track the viewing process so next team can pick up where you leave off!

APPENDIX A.5
RCDSMM
QA/QC TRAINING DOCUMENTION
AS OF January 2018

Mark-Recapture Trainings

Includes safety, pit tagging, gastric lavage, scale and fin tissue collection, fish handling, electrofishing, habitat condition data collection, tag, scale, fin clip data collection.

Training took place at the start of each field day.
NOTE: Trainers are highlighted in bold

18 November 2008

Name	Affiliation
Rosi Dagit	**RCDSMM**
Sandra Albers	RCDSMM
Steve Williams	RCDSMM
Jayni Shuman	RCDSMM - ST
Delmar Lathers	RCDSMM - ST
Ken Wheeland	RCDSMM - ST
Karine Tchakerian	RCDSMM - ST
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Mark Wade	**Stillwater Sciences**
Trevor Lucas	**Stillwater Sciences**

19 November 2008

Name	Affiliation
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21 November 2008

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Erin Brown	South Coast Restoration

15 March 2011

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14 November 2011

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Brianna Chandler	WSP
Kristen Gangl	WSP

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20 November 2012

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Noa Rische	CDPR

26 November 2012

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28 November 2012

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19 March 2013

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20 March 2013

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24 October 2013
Removal of Hatchery Trout from the Howell Pool, Topanga Creek

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Sam Bankston	CDFW
Crystal Garcia	WSP
Tom Vander Meeuwen	CDFW
Lizzy Montgomery	WSP
Kayti Christianson	WSP
David Gottesman	WSP

19 November 2013

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Sam Bankston	CDFW
Crystal Garcia	WSP
Tom Van Meeuwen	CDFW
Lizzy Montgomery	WSP
Kayti Christianson	WSP
David Gottesman	WSP

18 November 2014

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Steve Williams	RCDSMM
Andre Sanchez	WSP
Lizzy Montgomery	WSP
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19 November 2014

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Leah Gonzales	WSP
Yi-Jiun Tsai	WSP
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Andre Sanchez	WSP
Kate McLaughlin	CDFW
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5 November 2015
Filmore Fish Hatchery Pit tag training

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Lizzy Montgomery	RCDSMM
Alex Balcerzak	RCDSMM
Ben Chubak	RCDSMM
Kate McLaughlin	CDFW
Ben Lakish	CDFW

9 November 2015
Mark Recapture training

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Lizzy Montgomery	RCDSMM
Alex Balcerzak	RCDSMM
Ben Chubak	RCDSMM
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Ben Lakish	CDFW
Andrea Drunfield	CDFW
Mandy Wegmann	CDFW

Dylan Hofflander	WSP
Shannon Mueller	WSP
Jane Westfall	WSP

10 November 2015

Name	Affiliation
Rosi Dagit	**RCDSMM**
Jen Mongolo	RCDSMM
Krista Adamek	RCDSMM
Steve Williams	RCDSMM
Lizzy Montgomery	RCDSMM
Alex Balcerzak	RCDSMM
Kate McLaughlin	CDFW
Ben Lakish	CDFW
Shea Mia Anderson	CCC
Kelsey Hall	CCC
Dylan Hofflander	WSP
Shannon Mueller	WSP

12 November 2015

Name	Affiliation
Rosi Dagit	**RCDSMM**
Jen Mongolo	RCDSMM
Krista Adamek	RCDSMM
Steve Williams	RCDSMM
Lizzy Montgomery	RCDSMM
Alex Balcerzak	RCDSMM
Ben Chubak	RCDSMM
Kate McLaughlin	CDFW
Ben Lakish	CDFW
Paula Higginson	CDFW
Dylan Hofflander	WSP
Shea Mia Anderson	CCC
Kelsey Hall	CCC

15 November 2016

Name	Affiliation
Rosi Dagit	**RCDSMM**
Jen Mongolo	RCDSMM
Krista Adamek	RCDSMM
Steve Williams	RCDSMM
Alex Balcerzak	RCDSMM
Ben Chubak	RCDSMM
Jayni Shuman	RCDSMM
Kate McLaughlin	**CDFW**
Emma Moffitt	CDFW
Nicole Schager	WSP
Mark Garcia	WSP
Nina Trusso	WSP

16 November 2016

Name	Affiliation
Rosi Dagit	**RCDSMM**
Jen Mongolo	RCDSMM
Krista Adamek	RCDSMM
Steve Williams	RCDSMM
Alex Balcerzak	RCDSMM
Jayni Shuman	RCDSMM
Kate McLaughlin	**CDFW**
Taniel Redman	CDFW
Nina Trusso	WSP
Mani Garcia	Vet Corps
Danielle Alvarez	CCC

14-16 November 2017

Name	Affiliation
Rosi Dagit	**RCDSMM**
Danielle Alvarez	RCDSMM
Russell Dauksis	RCDSMM
Steve Williams	RCDSMM
Andy Spryka	RCDSMM
Ben Chubak	RCDSMM
Jayni Shuman	RCDSMM
Kate McLaughlin	**CDFW**
Ben Lakish	PSMFC
Casey Hogan	PSMFC
Brianna Demerci	WSP
Danielle Fitts	WSP
Lisa Rachel	WSP
Sarah Kates	CCC
Danielle LeFer	CDPR

Appendix B

Pit Tag Master 2008-2017

Pit Tag Master 2008-2017

ND=no data (scales not collected)
Regen=all regenerated scales unreadable
0=0+, 1=1+, 2=2+, 3=3+, 4=4+

Orange= Recapture
Pink=antenna detection
Green=Single fish tagged multiple times

PIT TAG #	RCD ID NO	Date	Dist (m)	Annular Rings	Fork L (mm)	New/ Recap	Sex	Cohort	Lavage ?	Branded ?
132145433	T09-126	11/04/09	2245	2+	175	N	Male	2007		
132145449	T09-115	11/04/09	1900	2+	235	N	Female	2007		
132145449	T10-34	11/16/10	2000	3+	274	R			11/10	
132145451	T09-127	11/04/09	2300	1+	180	N	Male	2008		
132145452	T09-121	11/04/09	2050	1+	165	N	Female	2008		
132145458	T09-128	11/04/09	2300	1+	165	N	Female	2008		
132145474	T09-124	11/04/09	2200	2+	170	N	Male	2007		
132145476	T09-120	11/04/09	2035	1+	140	N	Male	2008		
132145476	T10-43	11/16/10	2015	2+	195	R			11/10	
166458497	T10-22	11/16/10	1900	1+	200	N	NA	2009	11/10	
166458497	T11-104	11/14/11	1980	2+	227	R				
166458498	T09-193	11/05/09	4100	1+	150	N	Female	2008		
166458499	T09-138	11/04/09	2500	1+	135	N	Male	2008		
166458500	T09-178	11/05/09	3500	1+	165	N	Male	2008		
166458500	T11-195	11/16/11	3525	3	230	R				
166458501	T09-189	11/05/09	4050	1+	175	N	Male	2008		
166458502	T09-169	11/05/09	3290	1+	150	N	Male	2008		
166458503	T09-192	11/05/09	4100	1+	215	N	Female	2008		
166458504	T09-191	11/05/09	4070	1+	155	N	Male	2008		
166458505	T09-133	11/04/09	2450	2+	175	N	Male	2007		
166458506	T09-145	11/04/09	2700	0+	125	N	Male	2009		
166458507	T09-160	11/05/09	3200	1+	150	N	Female	2008		
166458508	T09-152	11/04/09	2835	1+	195	N	Female	2008		
166458509	T09-168	11/05/09	3290	1+	140	N	Female	2008		
166458510	T09-172	11/05/09	3320	1+	180	N	Female	2008		
166458510	T10-169	11/18/10	2975	2+	236	R			11/10	
166458511	T09-167	11/05/09	3290	1+	165	N	Female	2008		
166458512	T09-136	11/04/09	2450	1+	160	N	Female	2008		
166458513	T09-146	11/04/09	2700	1+	130	N	Male	2008		
166458514	T09-179	11/05/09	3500	1+	155	N	Female	2008		
166458514	T10-230	11/19/10	3500	2+	225	R				
166458515	T09-134	11/04/09	2450	1+	155	N	Male	2008		
166458516	T09-173	11/05/09	3320	1+	155	N	Male	2008		
166458516	T10-211	11/19/10	3320	2+	218	R				
166458516	T11-175	11/15/11	3280	3+	243	R				
166458517	T09-186	11/05/09	4000	1+	175	N	Female	2008		
166458518	T10-29	11/16/10	1970	1+	165	N	Male	2009	11/10	
166458519	T09-132	11/04/09	2450	1+	150	N	Female	2008		
166458519	T10-135	11/18/10	2515	2+	231	R			11/10	
166458520	T09-143	11/04/09	2650	2+	195	N	Female	2007		
166458521	T09-185	11/05/09	3895	1+	195	N	Male	2008		

166458522	T09-181	11/05/09	3525	1+	140	N	Male	2008		11/09
166458523	T09-174	11/05/09	3400	1+	170	N	Male	2008		
166458524	T09-148	11/04/09	2700	1+	160	N	Male	2008		
166458524	T10-152	11/18/10	2720	2+	246	R			11/10	
166458525	T09-137	11/04/09	2480	1+	170	N	Male			
166458526	T09-176	11/05/09	3475	1+	180	N	Female	2008		
166458527	T10-2	01/23/10	1300	1+	145	N	Female	2009		
166458528	T10-60	11/16/10	2310	0+	153	N	Male	2010		
166458529	T09-171	11/05/09	3320	2+	210	N	Male	2007		
166458530	T10-9	01/23/10	1300	0	130	N				
166458531	T09-166	11/05/09	3290	2+	220	N	Female	2007		
166458531	T10-201	11/18/10	3225	3+	252	R				
166458532	T09-195	11/05/09	4200	1+	165	N	Male	2008		
166458533	T09-131	11/04/09	2430	1+	145	N	Male	2008		
166458534	T09-144	11/04/09	2650	1+	140	N	Male	2008		
166458535	T09-183	11/05/09	3715	1+	190	N	Male	2008		
166458536	T09-135	11/04/09	2450	1+	170	N	Male	2008		
166458537	T09-188	11/05/09	4020	0+	125	N	Male	2009		
166458537	T10-57	11/16/10	2300	1+	207	R			11/10	
166458537	T11-121	11/14/11	2315	2+	253	R				
166458537	T13-58	03/19/13	2315	4	278	R				
166458538	T09-153	11/04/09	2925	1+	200	N	Female	2008		
166458539	T09-139	11/04/09	2500	3+	255	N	Male	2006		
166458540	T09-164	11/05/09	3270	1+	155	N	Male	2008		
166458540	T10-214	11/19/10	3320	2+	206	R				
166458541	T10-23	11/16/10	1940	0+	135	N	Female	2010	11/10	
166458541	T11-12	03/15/11	1940	1+	185	R				3/11
166458542	T10-4	01/23/10	1300	1+	140	N	Female	2009		
166458543	T09-159	11/05/09	3200	1+	185	N	Female	2008		
166458544	T10-32	11/16/10	2000	2+	219	N	Female	2008	11/10	
166458545	T09-114	11/04/09	1825	1+	180	N	Male	2008		
166458546	T10-3	01/23/10	1300	1+	135	N	Female	2008		
166458547	T09-158	11/05/09	3200	1+	180	N	Female	2008		
166458548	T09-184	11/05/09	3715	1+	195	N	Male	2008		
166458548	T10-209	11/19/10	3320	2+	244	R				
166458549	T09-177	11/05/09	3500	3+	240	N	Female	2006		
166458550	T09-122	11/04/09	2065	1+	130	N	Female	2008		
166458551	T09-182	11/05/09	3620	2+	205	N	Male	2007		
166458552	T09-125	11/04/09	2240	1+	170	N				
166458553	T10-50	11/16/10	2155	1+	193	N	Male	2009	11/10	
166458554	T10-77	11/17/10	4550	1+	185	N	Female	2009	11/10	
166458555	T09-130	11/04/09	2375	1+	160	N	Male	2008		
166458556	T09-113	11/03/09	1950	1+	165	N	Male	2008		
166458556	T09-113	11/04/09	1950	1+	165	R				
166458557	T10-31	11/16/10	1995	0+	149	N	Male	2010		
166458558	T10-78	11/17/10	4630	0+	168	N	Female	2010		
166458559	T09-129	11/04/09	2375	2+	225	N	Male	2007		
166458560	T09-105	11/03/09	1690	2+	200	N				
166458561	T09-119	11/04/09	2000	1+	145	N	Male	2008		

166458562	T10-172	11/18/10	2975	1+	200	N	Female	2009	11/10	
166458563	T09-117	11/04/09	1955	1+	155	N	Female	2008		
166458564	T09-180	11/05/09	3525	2+	205	N	Male	2007		11/09
166458565	T10-59	11/16/10	2300	0+	129	N	Female	2010		
166458565	T11-33	03/15/11	2290	1+	191	R				3/11
166458566	T10-24	11/16/10	1940	2	219	N	Male	2008		
166458567	T08-74	11/21/08	4270	1	162	N	Male	2007		
166458568	T08-73	11/21/08	4235	1	125	N	Male	2007		
166458569	T09-123	11/04/09	2065	1+	150	N	Male	2008		
166458569	T11-117	11/14/11	2230	3+	258	R				
166458570	T08-70	11/21/08	4200	2	291	N	Male	2006		
166458571	T08-68	11/21/08	4132	4	310	N	Male	2004		
166458572	T08-72	11/21/08	4235	1	166	N	Female	2007		
166458573	T08-69	11/21/08	4132	1	177	N	Male	2007		
166458574	T08-67	11/21/08	4132	1	195	N	Male	2007		
166458575	T08-66	11/21/08	4125	1+	196	N	Male	2007		
166458575	T10-268	11/19/10	4132	3+	260	R				
166458576	T08-65	11/21/08	4100	0	125	N	Male	2008		
166458577	T08-64	11/21/08	4100	0	125	N	Male	2008		
166458577	T11-224	11/16/11	4230	3+	269	R				
166458578	T08-59	11/20/08	4020	2	187	N	Female	2006		
166458579	T08-34	11/20/08	3450	1	176	N	Male	2007		
166458580	T08-75	11/21/08	4400	3	292	N	Male	2005		
166458581	T08-37	11/20/08	3500	2	219	N	Female	2006		11/08
166458582	T08-26	11/20/08	3215	1	204	N	Male	2007		
166458583	T08-33	11/20/08	3450	1	187	N	Female	2007		
166458584	T08-50	11/20/08	3680	2	190	N	Female	2006		
166458585	T08-27	11/20/08	3320	3	309	N	Female	2005		
166458586	T08-29	11/20/08	3320	1	139	N	Female	2007		
166458587	T08-24	11/20/08	2315	1	226	N	Female	2007		
166458588	T08-23	11/19/08	2130	3	278	N	Female	2005		
166458590	T08-22	11/19/08	2130	2	218	N	Male	2006		
166458591	T08-21	11/19/08	2700	3	294	N	Female	2005		
166458592	T08-14	11/19/08	2650	4	322	N	Male	2004		
166458593	T08-20	11/19/08	2670	2	270	N	Male	2006		
166458594	T08-5	11/18/08	2250	1	143	N	NA	2007		
166458595	T11-11	03/15/11	1935	1+	207	N	Female	2009		
168779140	T10-83	11/17/10	4710	0+	134	N	Male	2010	11/10	
168779140	T12-239	11/28/12	4230	2+	223	R				
168779141	T10-88	11/17/10	4730	3+	349	N	Male	2007	11/10	
168779142	T10-89	11/17/10	4735	0+	140	N	Female	2010	11/10	
168779142	T10-89	39132	4735	0+	140	A				
168779143	T10-79	11/17/10	4630	1+	229	N	Female	2009	11/10	
168779144	T10-90	11/17/10	4875	0+	137	N	Female	2010		
168779145	T10-91	11/17/10	4875	2+	345	N	Male	2008	11/10	
168779146	T10-92	11/17/10	4875	2+	251	N	Male	2008	11/10	
168779147	T10-94	11/17/10	4875	1+	147	N	Male	2009	11/10	
168779148	T10-93	11/17/10	4875	0+	138	N	Female	2010		
168779149	T10-99	11/17/10	4900	2+	250	N	Male	2008	11/10	
168779149	T11-153	11/15/11	4920	3+	297	R				11/11

168779150	T10-103	11/17/10	5010	2+	265	N	Female	2008	11/10	
168779151	T10-110	11/17/10	5100	1+	190	N	Female	2009		
168779152	T10-111	11/17/10	5100	1+	204	N	Male	2009	11/10	
168779153	T10-171	11/18/10	2975	Regen	162	N	Male	2009		
168779154	T10-105	11/17/10	5025	3+	368	N	Female	2007	11/10	
168779155	T10-104	11/17/10	5010	0+	127	N	Female	2010		
168779157	T10-61	11/17/10	4400	2+	279	N	Female	2008	11/10	
168779158	T10-62	11/17/10	4410	1+	137	N	Male	2009		
168779159	T10-63	11/17/10	4410	1+	203	N	Male	2009	11/10	
168779159	T11-231	11/16/11	4370	2+	241	R				
168779159	T12-47	03/21/12	4330	3+	245	R				
168779159	T15-84	11/12/15	4360	5+	273	R				
168779159	T16-32	11/16/16	4300	6+	284	R				
168779160	T10-65	11/17/10	4460	2+	248	N	Female	2008	11/10	
168779161	T10-66	11/17/10	4460	2+	201	N	Female	2008	11/10	
168779162	T10-67	11/17/10	4460	1+	195	N	Male	2009	11/10	
168779163	T10-68	11/17/10	4495	0+	135	N	Female	2010	11/10	
168779163	T10-68	02/20/11	4495		135	A				
168779164	T10-70	11/17/10	4515	2+	273	N	Female	2008	11/10	
168779165	T10-69	11/17/10	4530	3+	294	N	Male	2007	11/10	
168779166	T10-71	11/17/10	4515	1+	191	N	Female	2009	11/10	
168779167	T10-49	11/16/10	2155	0+	143	N	Male	2010	11/10	
168779167	T11-24	03/15/11	2155	1+	186	R				3/11
168779167	T11-109	11/14/11	2000	1+	206	R				
168779167	T12-11	03/20/12	2180	2+	208	R				
168779168	T10-20	11/16/10	2315	ND	166	N	Male	2009	11/10	
168779168	T10-118	11/18/10	2315	1+	165	N				
168779169	T10-26	11/16/10	1940	2+	208	N	Male	2008	11/10	
168779170	T10-75	11/17/10	4530	0+	138	N	Female	2010		
168779171	T10-28	11/16/10	1960	1+	144	N	Male	2009	11/10	
168779172	T10-25	11/16/10	1940	0+	143	N	Male	2010	11/10	
168779172	T11-113	11/14/11	2130	1+	233	R				
168779172	T12-7	03/20/12	2130	2+	238	R				
168779173	T10-53	11/16/10	2230	1+	217	N	Female	2009	11/10	
168779174	T10-21	11/16/10	1850	0+	149	N	Male	2010	11/10	
168779175	T10-39	11/16/10	2000	0+	150	N	Male	2010		
168779175	T11-8	03/15/11	1750	1+	206	R				
168779176	T10-42	11/16/10	2040	0+	129	N	Female	2010		
168779176	T11-18	03/15/11	2065	1+	187	R				
168779177	T10-73	11/17/10	4530	1+	197	N	Male	2009	11/10	
168779179	T10-56	11/16/10	2280	1+	187	N	Female	2009	11/10	
168779180	T10-74	11/17/10	4530	1+	194	N	Female	2009	11/10	
168779180		09/22/16	4380			T				
168779181	T10-46	11/16/10	2075	0+	132	N	NA	2010		
168779182	T10-45	11/16/10	2070	1+	148	N	Female	2009		
168779183	T10-113	11/18/10	2315	2+	250	N	Female	2008	11/10	
168779184	T10-52	11/16/10	2230	0+	128	N	Female	2010		
168779185	T10-48	11/16/10	2130	2+	228	N	Male	2008	11/10	
168779186	T10-51	11/16/10	2170	0+	141	N	Male	2010		
168779186	T11-119	11/14/11	2255	2	224	R				

168779187	T10-37	11/16/10	2000	1+	198	N	Female	2009	11/10	
168779188	T10-27	11/16/10	1950	2+	214	N	Male	2008	11/10	
168779189	T10-30	11/16/10	1975	0+	134	N	Male	2010	11/10	
168779189	T11-23	03/15/11	2080	0+	163	R				
168779190	T10-36	11/16/10	2000	1+	216	N	Female	2009	11/10	
174147862	T10-224	11/19/10	3440	ND	130	N				
174147863	T10-220	11/19/10	3390	ND	179	N				
174147864	T10-267	11/19/10	4125	ND	134	N				
174147865	T10-276	11/19/10	4300	Regen	303	N	Male	2007		
174147866	T10-233	11/19/10	3500	0	149	N				
174147866	T11-44	03/15/11	2520	1+	168	R				
174147867	T11-27	03/15/11	2175	1+	235	N	Female	2009		
174147867	T11-106	11/14/11	2000	2+	256	R			11/11	
174147867		08/19/16	2060			T				
174147868	T10-271	11/19/10	4200	ND	192	N				
174147869	T10-228	11/19/10	3455	ND	160	N				
174147870	T10-190	11/18/10	3100	ND	176	N				
174147871	T10-185	11/18/10	3070	ND	189	N				
174147871		09/06/16	2950			T				
174147872	T10-197	11/18/10	3180	ND	161	N				
174147873	T10-265	11/19/10	4125	ND	204	N				
174147874	T10-238	11/19/10	3525	ND	163	N				
174147875	T11-04	02/27/11	1300	1+	169	N	Male	2009		
174147875	T11-161	11/15/11	3015	2+	244	R				
174147876	T10-266	11/19/10	4125	ND	142	N				
174147877	T10-179	11/18/10	3050	1+	163	N				
174147877	T11-159	11/15/11	2960	2+	225	R				
174147878	T10-199	11/18/10	3225	ND	158	N				
174147879	T10-264	11/19/10	4100	1+	168	N				
174147880	T10-232	11/19/10	3500	ND	162	N				
174147881	T10-229	11/19/10	3460	ND	151	N				
174147881	T11-75	03/16/11	3475	1+	175	R				
174147882	T11-20	03/15/11	2070	2+	214	N	Female	2008		
174147883	T11-28	03/15/11	2230	1+	229	N	Female	2009		3/11
174147884	T11-31	03/15/11	2270	2+	228	N	Female	2008		
174147885	T10-234	11/19/10	3500	ND	172	N				
174147886	T10-249	11/19/10	3870	ND	175	N				
174147887	T10-239	11/19/10	3550	1+	163	N				
174147888	T10-274	11/19/10	4250	ND	173	N				
174147889	T10-254	11/19/10	3900	ND	198	N				
174147890	T11-02	02/21/11	1300	1+	180	N	Male	2009		
174147891	T10-247	11/19/10	3800	ND	155	N				
174147892	T11-39	03/15/11	2385	1+	197	N	Female	2009		3/11
174147893	T11-03	02/27/11	1300	0+	174	N	Female	2010		
174147894	T10-235	11/19/10	3515	ND	132	N				
174147895	T10-186	11/18/10	3070	ND	187	N				
174147897	T10-218	11/19/10	3390	ND	133	N				
174147898	T10-223	11/19/10	3440	1+	159	N				
174147898	T11-68	03/16/11	3455	1+	166	R				
174147898	T11-229	11/16/11	4300	2+	193	R				

174147899	T10-253	11/19/10	3900	ND	143	N				
174147900	T10-250	11/19/10	3870	ND	183	N				
174147901	T10-187	11/18/10	3070	ND	208	N				
174147902	T10-270	11/19/10	4200	1+	189	N				
174147902	T11-221	11/16/11	4230	2+	227	R				11/11
174147903	T10-237	11/19/10	3525	ND	163	N				
174147904	T10-272	11/19/10	4230	ND	132	N				
174147905	T10-269	11/19/10	4132	1+	169	N				
174147905	T11-216	11/16/11	4132	2+	235	R			11/11	
174147906	T10-256	11/19/10	3940	1+	176	N				
174147906	T10-263	11/19/10	4100	2+	261	N				
174147906	T11-203	11/16/11	4000	2+	245	R				
174147907	T10-246	11/19/10	3800	ND	176	N				
174147909	T10-181	11/18/10	3050	ND	166	N				
174147909	T10-181	02/20/11	3050		166	A				
174147910	T10-236	11/19/10	3515	ND	147	N				
174147911	T10-273	11/19/10	4250	2+	234	N				
174147912	T11-30	03/15/11	2250	1+	191	N	Female	2009		3/11
174147912	T11-118	11/14/11	2255	2	208	R				
174147913	T10-114	11/18/10	2315	2+	217	N	Male	2008	11/10	
174147914	T10-115	11/18/10	2315	1+	192	N	Male	2009	11/10	
174147915	T10-116	11/18/10	2315	1+	175	N	Female	2009	11/10	
174147916	T10-117	11/18/10	2315	0+	145	N	Female	2010		
174147917	T10-124	11/18/10	2450	1+	174	N	Male	2009	11/10	
174147918	T10-119	11/18/10	2315	0+	164	N	Male	2010		
174147919	T10-130	11/18/10	2490	1+	182	N	Male	2009	11/10	
174147919	T11-41	03/15/11	2395	1+	200	R				
174147919	T11-130	11/14/11	2500	2+	223	R				
174147920	T10-129	11/18/10	2490	2+	204	N	Male	2008	11/10	
174147920	T11-128	11/14/11	2435	3	222	R				
174147921	T10-131	11/18/10	2490	0+	139	N	Female	2010		
174147921	T11-13	03/15/11	1950	1+	205	R				3/11
174147921	T12-53	11/26/12	1780	2+	255	R				
174147921		09/20/16	1750			T				
174147922	T10-137	11/18/10	2575	Regen	354	N	Female	2006	11/10	
174147923	T10-138	11/18/10	2525	0+	140	N	Female	2010		
174147924	T10-133	11/18/10	2495	ND	162	N	Female	2009		
174147925	T10-143	11/18/10	2650	2+	255	N	Female	2008	11/10	
174147926	T10-144	11/18/10	2650	0+	137	N	Male	2010	11/10	
174147927	T10-145	11/18/10	2650	2+	218	N	Male	2008	11/10	
174147928	T10-156	11/18/10	2770	1+	194	N	Male	2009	11/10	
174147928	T11-188	11/16/11	3405	2+	238	R				11/11
174147928	T12-28	03/20/12	3400	3+	249	R				
174147929	T10-146	11/18/10	2650	0+	153	N	Male	2010	11/10	
174147930	T10-148	11/18/10	2675	1+	173	N	Female	2009	11/10	
174147931	T10-150	11/18/10	2700	0+	128	N	Male	2010		
174147932	T10-153	11/18/10	2720	0+	147	N	Male	2010		
174147933	T10-151	11/18/10	2700	0+	136	N	Male	2010		
174147934	T10-159	11/18/10	2850	1+	191	N	Male	2009	11/10	
174147934		09/01/16	2865			T				

174147935	T10-160	11/18/10	2850	0+	136	N	Male	2010		
174147936	T10-161	11/18/10	2850	0+	130	N	Female	2010		
174147936	T11-213	11/16/11	4100	1+	218	R				
174147936		09/19/16	4160			T				
174147937	T10-162	11/18/10	2850	0+	129	N	Female	2010		
174147938	T10-163	11/18/10	2925	1+	189	N	Male	2009	11/10	
174147939	T10-165	11/18/10	2925	1+	172	N	Male	2009		
174147939	T11-189	11/16/11	3405	2+	229	R			11/11	
174147940	T10-166	11/18/10	2925	0+	127	N	Female	2010		
174147941	T10-170	11/18/10	2975	2+	252	N	Female	2008	11/10	
174147942	T10-173	11/18/10	2975	1+	167	N	Female	2009		
174147942		09/13/16	430			T				
174147943	T10-259	11/19/10	4050	2+	225	N	Male	2008		
174147945	T10-260	11/19/10	4050	2+	244	N	Male	2008		
174147946	T10-261	11/19/10	4100	2+	263	N	Male	2008		
174147947	T10-262	11/19/10	4100	1+	196	N	Female	2009		
174147948	T10-257	11/19/10	4000	1+	222	N	Male	2009		
174147949	T10-258	11/19/10	4000	2+	200	N	Female	2008		
174147950	T10-252	11/19/10	3900	1+	212	N	Male	2009		
174147951	T10-248	11/19/10	3850	ND	159	N				
174147952	T10-251	11/19/10	3900	2+	250	N	Male	2008		
174147953	T10-245	11/19/10	3800	1+	144	N	Male	2009		
174147954	T10-244	11/19/10	3800	Regen	233	N	Male	2008		
174147955	T10-243	11/19/10	3705	1+	156	N	Male	2009		
174147956	T10-242	11/19/10	3705	3+	227	N	Male	2007		
174147957	T10-240	11/19/10	3695	1+	203	N	Male	2009		
174147958	T10-241	11/19/10	3700	1+	152	N	Female	2009		
174147959	T10-219	11/19/10	3390	Regen	230	N	Male	2008		
174147960	T10-215	11/19/10	3320	1+	148	N	Female	2009		
174147961	T10-208	11/19/10	3290	2+	296	N	Female	2008		
174147962	T10-178	11/18/10	3050	1+	176	N	Male	2009		
174147963	T10-177	11/18/10	3050	1+	196	N	Male	2009	11/10	
176795548	T11-177	11/15/11	3290	1+	174	N	Female	2010		
176795549	T11-172	11/15/11	3280	1+	185	N	Female	2010		
176795549		08/11/16	3224			T				
176795550	T11-178	11/15/11	3290	1+	201	N	Male	2010		
176795551	T11-92	03/28/11	1300	1+	180	N	Female	2009		
176795552	T11-142	11/14/11	2775	1+	222	N	Male	2010		
176795553	T11-89	03/27/11	1300	1+	186	N	Female	2009		
176795554	T11-63	03/16/11	3400	1+	150	N	Male	2009	3/11	
176795555	T11-95	03/29/11	1300	1+	147	N	Male	2009		
176795555	T11-124	11/14/11	2385	2	199	R				
176795556	T11-85	03/16/11	3685	1+	170	N	Male	2009		3/11
176795556	T11-207	11/16/11	4000	2+	190	R				
176795557	T11-176	11/15/11	3290	1+	150	N	Female	2010		
176795557	T12-26	03/20/12	3300	1+	164	R				
176795558	T11-61	03/16/11	3320	2+	327	N	Female	2008	3/11	
176795559	T11-77	03/16/11	3500	1+	196	N	Female	2009	3/11	
176795559	T11-194	11/16/11	3500	2+	221	R				
176795560	T11-112	11/14/11	2060	0+	163	N	Female	2011		

176795560	T12-89	11/26/12	2130	1+	210	R				
176795560		08/11/16	1990			T				
176795561	T11-93	03/28/11	1300	3+	317	N	Female	2007		
176795562	T11-103	11/14/11	1935	1+	214	N	Male	2010	11/11	
176795563	T11-164	11/15/11	3100	1+	178	N	Female	2010		
176795564	T11-167	11/15/11	3125	1+	185	N	Male	2010		
176795565	T11-105	11/14/11	1990	0+	180	N	Male	2011	11/11	
176795565	T12-82	11/26/12	2095	1+	210	R				
176795565	T13-48	03/19/13	2150	1+	224	R				
176795566	T11-174	11/15/11	3280	1+	194	N	Male	2010		11/11
176795567	T11-110	11/14/11	2015	2+	207	N	Male	2009		11/11
176795567	T12-79	11/26/12	2015	3+	222	R				
176795568	T11-84	03/16/11	3535	1+	150	N	Male	2009		
176795569	T11-76	03/16/11	3475	1+	143	N	Male	2009		
176795569	T12-39	03/21/12	4000	2+	241	R				3/12
176795569	T12-229	11/27/12	4050	3+	228	R				
176795570	T11-55	03/16/11	3255	1+	172	N	Male	2009	3/11	
176795570	T11-187	11/15/11	3320	2+	205	R				
176795571	T11-87	03/16/11	3700	2+	239	N	Female	2008	3/11	
176795572	T11-94	03/28/11	1300	1+	178	N	Female	2009		
176795573	T11-65	03/16/11	3440	1+	139	N	Female	2009		
176795574	T11-155	11/15/11	5025	Regen	228	N	Male	2009	11/11	
176795575	T11-100	11/14/11	1780	2+	230	N	Female	2009	11/11	11/11
176795575	T12-2	03/20/12	1780	2+	226	R				3/12
176795576	T11-123	11/14/11	2315	0+	174	N	Female	2011		
176795577	T11-107	11/14/11	2000	1+	209	N	Male	2010	11/11	
176795578	T11-163	11/15/11	3025	2+	225	N				
176795579	T11-154	11/15/11	4920	1+	214	N	Female	2010	11/11	
176795580	T11-129	11/14/11	2430	1+	217	N	Male	2010		
176795581	T11-137	11/14/11	2620	1+	180	N	Female	2010		
176795582	T11-126	11/14/11	2395	2+	235	N	Female	2009		
176795583	T11-90	03/28/11	1300	2+	301	N	Male	2008		
176795583		10/07/16	3095			T				
176795584	T11-127	11/14/11	2415	0+	173	N	Female	2011		
176795585	T11-120	11/14/11	2240	1+	221	N	Male	2010		11/11
176795586	T11-151	11/15/11	4875	1+	245	N	Female	2010	11/11	
176795587	T11-152	11/15/11	4875	1+	200	N	Male	2010	11/11	
176795588	T11-168	11/15/11	3150	1+	216	N	Male	2010		
176795589	T11-147	11/15/11	4530	1+	203	N	Male	2010		11/11
176795590	T11-173	11/15/11	3280	2+	249	N				
176795590		07/11/16	3242			T				
176795591	T11-143	11/15/11	4400	3+	293	N	Female	2009	11/11	
176795591	T12-49	03/21/12	4360	3+	295	R				
176795591		09/19/16	4230			T				
176795592	T11-145	11/15/11	4530	3+	246	N	Female	2008	11/11	
176795593	T11-179	11/15/11	3290	1+	182	N	Male	2010		
176795594	T11-111	11/14/11	2050	2+	204	N	Male	2009		
176795594	T12-8	03/20/12	2130	2+	207	R				
176795595	T11-180	11/15/11	3290	2+	198	N	Male	2009		
176795596	T11-144	11/15/11	4420	2+	285	N	Female	2009		

176795597	T11-227	11/16/11	4270	2+	235	N	Female	2009		11/11
176795598	T11-157	11/15/11	2925	1+	186	N	Female	2010		
176795598		10/07/16	2985			T				
176795599	T11-131	11/14/11	2500	2+	227	N	Female	2009		
176795600	T11-158	11/15/11	2940	2+	196	N	Male	2009		
176795601	T11-149	11/15/11	4530	1+	196	N	Male	2010	11/11	
176795602	T11-122	11/14/11	2315	1+	201	N	Male	2010		11/11
176795602	T12-14	03/20/12	2315	2+	215	R				
176795603	T11-146	11/15/11	4530	1+	225	N	Male	2010	11/11	
176795603	T15-88	11/12/15	4530	4+	339	R				
176795603	T16-35	11/16/16	4520	5+	359	R				
176795604	T11-101	11/14/11	1825	1+	154	N	Female	2010		
176795605	T11-135	11/14/11	2600	2+	255	N	Female	2009		11/11
176795605		09/01/16	2630			T				
176795606	T11-199	11/16/11	3695	2+	223	N	Female	2009	11/11	
176795607	T12-48	03/21/12	4330	3+	297	N	Male	2008	3/12	
176795608	T11-125	11/14/11	2385	1+	219	N	Female	2010		
176795609	T11-156	11/15/11	5025	1+	237	N	Male	2010		
176795609	T15-104	11/12/15	5020	5+	386	R				
176795610	T11-150	11/15/11	4630	1+	237	N	Male	2010	11/11	
176795611	T11-136	11/14/11	2600	2+	219	N	Male	2009		
176795612	T11-225	11/16/11	4270	2+	238	N	Male	2009		
176795613	T11-133	11/14/11	2525	1+	198	N	Male	2010		
176795614	T11-141	11/14/11	2700	2+	219	N	NA	2009		
176795615	T11-165	11/15/11	3110	1+	162	N	Female	2010		
176795616	T11-140	11/14/11	2700	2+	240	N	Male	2009		
176795616	T12-15	03/20/12	2700	2+	239	R				3/12
176795617	T11-139	11/14/11	2700	1+	226	N	Female	2010		
176795618	T11-183	11/15/11	3320	Regen	200	N	Female	2010		
176795618		07/11/16	3233			T				
176795619	T11-114	11/14/11	2130	3+	320	N	Male	2008	11/11	
176795619	T12-6	03/20/12	2130	4+	319	R				
176795620	T11-138	11/14/11	2690	0+	170	N	Male	2011		
176795621	T11-160	11/15/11	3000	1+	191	N	Male	2010		
176795621	T12-22	03/20/12	3000	2+	203	R				
176795622	T11-132	11/14/11	2500	1+	200	N	Male	2010		
176795623	T11-162	11/15/11	3015	2+	295	N	Female	2009		
176795624	T11-148	11/15/11	4530	2+	212	N	Female	2009		11/11
176795624	T12-50	03/21/12	4530	2+	222	R			3/12	
176795624		09/22/16	4530			T				
176795625	T11-57	03/16/11	3280	1+	141	N	Male	2009		3/11
176795626	T11-170	11/15/11	3175	1+	209	N	Female	2010		
176795627	T11-171	11/15/11	3280	1+	180	N	Male	2010		
176795628	T11-58	03/16/11	3300	1+	136	N	Male	2009		
176795629	T11-81	03/16/11	3525	1+	164	N	Female	2009		3/11
176795630	T11-59	03/16/11	3300	1+	170	N	Female	2009		
176795631	T11-79	03/16/11	3515	1+	185	N	Female	2009	3/11	
176795632	T11-78	03/16/11	3500	0+	158	N	Male	2010		3/11
176795633	T11-74	03/16/11	3470	1+	156	N	Male	2009		
176795633		09/06/16	2950			T				

176795634	T11-86	03/16/11	3700	1+	174	N	Male	2009	3/11	
176795635	T11-169	11/15/11	3157	1+	194	N	Male	2010		
176795635	T12-27	03/20/12	3320	2+	204	R				
176795635	T12-186	11/27/12	3400	2+	208	R				
176795635	T13-301	11/13/13	3280	3+	218	R				
176795635		09/06/16	2975			T				
176795636	T11-83	03/16/11	3535	1+	170	N	Male	2009		3/11
176795637	T11-82	03/16/11	3525	1+	180	N	Male	2009	3/11	
176795638	T11-69	03/16/11	3460	1+	147	N	Female	2009		
176795639	T11-80	03/16/11	3515	1+	154	N	Female	2009		
176795639		10/07/16	3000			T				
176795640	T11-70	03/16/11	3460	1+	170	N	Male	2009		
176795641	T11-91	03/28/11	1300	1+	200	N	Female	2009		
176795642	T11-71	03/16/11	3470	1+	178	N	Male	2009	3/11	
176795642	T11-201	11/16/11	3940	2+	210	R				
176795643	T11-60	03/16/11	3300	1+	126	N	Female	2009		
176795643	T11-181	11/15/11	3290	1+	158	R				
176795644	T11-43	03/15/11	2450	1+	194	N	Male	2009		
176795645	T11-64	03/16/11	3440	1+	160	N	Female	2009		3/11
176795646	T11-46	03/15/11	2520	1+	172	N	NA	2009		
176795647	T11-40	03/15/11	2385	1+	181	N	Female	2009		
178695823	T11-232	11/16/11	4395	2+	274	N	Male	2009		
178695824	T11-186	11/15/11	3320	1+	195	N	Male	2010		11/11
178695825	T11-214	11/16/11	4100	2+	257	N	Male	2009		
178695826	T11-234	11/16/11	4395	1+	209	N	Male	2010		11/11
178695826	T12-251	11/28/12	4395	2+	236	R				
178695827	T11-215	11/16/11	4100	1+	175	N	Male	2010		
178695827	T12-43	03/21/12	4100	2+	190	R				
178695828	T11-233	11/16/11	4395	2+	226	N	Female	2009		
178695828		09/22/16	4380			T				
178695829 - i	T11-211	11/16/11	4100	1+	205	N	Female			11/11
178695829	T13-34	03/19/13	1960	0+	146	N	Male	2012		3/11
178695829		09/08/16	4100			T				
178695830	T11-185	11/15/11	3320	1+	176	N	Female	2010		
178695831	T11-212	11/16/11	4100	1+	218	N	Female	2010		
178695831		07/18/16	3830			T				
178695832	T12-40	03/21/12	4000	1+	210	N	Male	2010	3/12	
178695832	T12-221	11/27/12	4000	2	217	R				
178695833	T11-222	11/16/11	4230	1+	225	N	Male	2010		
178695833	T12-240	11/28/12	4230	2+	254	R				
178695833		09/19/16	4170			T				
178695834	T11-217	11/16/11	4160	1+	231	N	Female	2010		
178695835	T11-219	11/16/11	4200	1+	193	N	Female	2010		
178695835	T12-45	03/21/12	4200	2+	218	R				
178695836	T11-230	11/16/11	4300	2+	227	N	Male	2009		
178695836	T12-44	03/21/12	4200	3+	240	R			3/12	
178695836	T12-247	11/28/12	4300	3+	252	R				
178695837	T11-192	11/16/11	3500	Regen	204	N	Female	2010		
178695837		07/15/16	2470			T				

178695838	T11-206	11/16/11	4000	2+	240	N	Male	2009		
178695838	T12-215	11/27/12	3900	3+	269	R				
178695838	T13-162	03/20/13	4000	3+	277	R				
178695839	T11-220	11/16/11	4200	Regen	249	N	Female	2009		
178695839		09/19/16	4160			T				
178695840	T11-226	11/16/11	4270	1+	186	N	Male	2010		
178695841	T11-182	11/15/11	3320	1+	206	N	Female	2010		
178695842	T12-46	03/21/12	4270	2+	186	N	Female	2010	3/12	
178695842	T12-243	11/28/12	4270	2+	205	R				
178695843	T11-208	11/16/11	4000	1+	188	N	Male	2010		
178695844	T11-198	11/16/11	3560	1+	216	N	Male	2010		
178695845	T11-196	11/16/11	3525	2+	201	N	Male	2010	11/11	
178695845	T12-200	11/27/12	3560	3+	226	R				
178695846	T11-102	11/14/11	1925	1+	167	N				
178695847	T11-218	11/16/11	4200	1+	212	N	Female	2010		
178695848	T12-61	11/26/12	1850	0+	130	N	Female	2012		
178695849	T11-200	11/16/11	3700	1+	220	N	Female	2010		
178695850	T12-42	03/21/12	4100	1+	220	N	Female	2010	3/12	
178695850		09/19/16	4125			T				
178695851	T12-38	03/21/12	4000	2+	278	N	Female	2009	3/12	
178695852	T11-223	11/16/11	4230	2+	227	N	Male	2009		
178695853	T11-228	11/16/11	4300	2+	222	N	Female	2009		
178695854	T11-204	11/16/11	4000	1+	234	N	Female	2010		
178695855	T11-197	11/16/11	3525	1+	223	N	Female	2010		
178695856	T11-205	11/16/11	4000	2+	324	N	Male	2009	11/11	
178695857	T12-37	03/21/12	3900	1+	188	N	Female	2010	3/12	3/12
178695858	T11-108	11/14/11	2000	0+	140	N				
178695858	T12-4	03/20/12	1950	1+	164	R			3/12	
178695859	T11-210	11/16/11	4100	2+	228	N	Male	2009	11/11	
178695860	T11-209	11/16/11	4050	2+	227	N	Female	2009		11/11
178695861	T11-190	11/16/11	3405	1+	189	N	Male	2010	11/11	
178695862	T13-67	03/19/13	2600	1+	142	N	Female	2011		
178695863	T12-109	11/26/12	2325	ND	231	N	Female	2010	3/13	
178695863		08/29/16	2325			T				
178695864	T12-93	11/26/12	2150	2+	249	N	Female	2010		
178695865	T12-107	11/26/12	2315	1+	227	N	Male	2011		
178695866	T12-19	03/20/12	2975	2+	260	N	Male	2009		3/12
178695866		09/06/16	2870			T				
178695867	T12-9	03/20/12	2160	2+	255	N	Male	2009	3/12	
178695868	T13-8	03/19/13	1750	1+	145	N	Male	2012		
178695869	T12-257	11/28/12	4525	4+	257	N	Female	2008		
178695871	T13-27	03/19/13	1925	1+	198	N	Male	2012		3/13
178695872	T12-63	11/26/12	1900	0+	147	N	Female	2012		
178695872	T13-24	03/19/13	1900	1+	184	R			3/13	
178695873	T13-44	03/19/13	2125	0+	134	N	Male	2011		
178695874	T12-210	11/27/12	3800	3+	303	N	Female	2009		
178695874		07/18/16	3640			T				
178695875	T13-30	03/19/13	1935	1+	169	N	Female	2012		
178695875		08/19/16	2000			T				

178695876	T12-23	03/20/12	3020	1+	146	N	Female	2011		
178695876	T12-25	03/20/12	3300	1+	196	N	Male	2011	3/12	
178695876		10/07/16	3075			T				
178695877	T12-13	03/20/12	2250	1+	192	N	Female	2011	3/12	
178695877	T12-97	11/26/12	2270	2	194	R				
178695877		09/15/16	1160			T				
178695878	T12-35	03/21/12	3900	1+	222	N	Male	2011		
178695879	T12-100	11/26/12	2295	Regen	237	N	Female			3/13
178695879		08/29/16	2280			T				
178695880	T13-63	03/19/13	2450	1+	160	N	Male	2012	3/13	
178695881	T12-30	03/20/12	3500	2+	221	N	Female	2010		3/12
178695882	T12-242	11/28/12	4270	1+	256	N	Female	2011		
178695883	T12-34	03/21/12	3900	2+	226	N	Female	2010	3/12	
178695884	T12-76	11/26/12	2000	Regen	273	N	Female	2009		
178695884	T13-38	03/19/13	2000	Regen	303	R			3/13	
178695885	T12-249	11/28/12	4320	1+	145	N	Female	2011		
178695886	T13-19	03/19/13	1780	1+	149	N	Female	2012		
178695886		09/20/16	1700			T				
178695887	T12-31	03/21/12	3560	1+	169	N	Female	2011		
178695887	T12-208	11/27/12	3740	2+	211	R				
178695888	T13-12	03/19/13	1765	1+	135	N	Male	2012		
178695888		09/20/16	1795			T				
178695889	T12-18	03/20/12	2944	1+	206	N	Female	2011		
178695890	T12-253	11/28/12	4460	1+	207	N	Female	2011		
178695891	T12-32	03/21/12	3800	4	355	N	Male	2008	3/12	
178695892	T13-36	03/19/13	1995	0+	134	N	Male	2012		
178695892		08/19/16	2180			T				
178695893	T12-259	11/28/12	4630	3	301	N	Female	2009	11/12	11/12
178695894	T13-35	03/19/13	1980	1	152	N	Female	2011		
178695895	T12-36	03/21/12	3900	Regen/2	249	N	Female	2009		3/12
178695896	T12-59	11/26/12	1825	0+	158	N	Male	2012		
178695896	T13-23	03/19/13	1825	1+	209	R				3/13
178695896		10/10/16	1918			T				
178695897	T12-33	03/21/12	3800	3+	288	N	Female	2009		
178695898	T13-28	03/19/13	1925	1+	180	N	Female	2011		
178695899	T12-80	11/26/12	2015	1	130	N	Female	2011		
178695900	T12-255	11/28/12	4470	1+	147	N	Female			
178695900	T13-131	03/20/13	3500	1+	177	R				
178695901	T12-77	11/26/12	2000	1+	151	N	Female	2011		
178695901	T13-37	03/19/13	2000	1+	183	R				
178695901	T14-1	11/18/14	2130	2+	240	R				
178695901		07/15/16	3525			T				
178695902	T12-16	03/20/12	2835	2+	249	N	Female	2010	3/12	
178695903	T12-21	03/20/12	2960	1+	218	N	Female	2010	3/12	
178695903	T12-158	11/27/12	3065	1+	224	R				11/12
178695904	T12-24	03/20/12	3270	2+	190	N	Female	2009		
178695905	T13-79	03/19/13	2835	1+	139	N	Female	2011		
178695906	T13-29	03/19/13	1925	1+	139	N	Male	2011		

178695906	T15-1	11/09/15	1960	2+	252	R				11/15
178695906		08/04/16	1970		274	Relocated				
178695906		08/19/16	2006			T				
178695907	T12-10	03/20/12	2180	2+	260	N	Male	2009		3/12
178695908	T13-20	03/19/13	1795	1+	150	N	Female	2011		
178695909	T12-68	11/26/12	1970	1+	234	N	Female	2011		
178695909		08/11/16	1990			T				
178695910	T12-20	03/20/12	2975	1+	216	N	Female	2010	3/12	
178695910	T12-152	11/27/12	2990	1+	228	R				11/12
178695910		09/06/16	2975			T				
178695911	T12-222	11/27/12	4000	0+	139	N	Male	2012		
178695911	T13-164	03/20/13	4000	1+	160	R				3/13
178695912	T13-39	03/19/13	2000	1+	167	N	Female	2011		
178695912	T15-5	11/09/15	2015	3+	259	R				
178695913	T13-7	03/19/13	1750	1+	166	N	Female	2011	3/13	
178695914	T13-22	03/19/13	1805	1+	168	N	Female	2011		
178695915	T12-233	11/27/12	4100	2	236	N	Female	2010		
178695916	T12-17	03/20/12	2835	2+	219	N	Male	2009		3/12
178695916	T12-119	11/26/12	2500	2+	221	R				
178695917	T15-17	11/09/15	3044	2+	213	N	Male	2013		
178695918	T12-131	11/27/12	2750	2	239	N	Female	2010		
178695918		09/06/16	2950			T				
178695919	T13-5	03/19/13	1700	1+	139	N	Female	2011		
178695920	T13-14	03/19/13	1780	1+	167	N	Male	2011		
178695920		09/20/16	1790			T				
178695921	T12-230	11/27/12	4050	0+	141	N	Female	2012		
178695921	T13-166	03/20/13	4020	1+	180	R				3/13
178695922	T13-1	03/19/13	1680	1+	144	N	Female	2011		
178695924	T13-49	03/19/13	2150	0+	135	N	Male	2012		
178695925	T12-225	11/27/12	4000	0+	144	N	Male	2012		
178695925	T13-160	03/20/13	4000	1+	196	R			3/13	
178695925	T15-70	11/10/15	4125	3+	301	R				
178695926	T13-32	03/19/13	1960	Regen/2	250	N	Female	2011		3/13
178695926		08/11/16	1982			T				
178695927	T13-64	03/19/13	2465	0+	135	N	Male	2012		
178695928	T13-71	03/19/13	2700	1+	163	N	Female	2011		
178695930	T13-76	03/19/13	2810	1+	161	N	Female	2011		
178695931	T13-46	03/19/13	2130	1+	139	N	NA	2011		
178695932	T12-238	11/28/12	4200	0+	145	N	Male	2012		
178695933	T13-78	03/19/13	2835	2+	246	N	Female	2010	3/13	
178695934	T12-223	11/27/12	4000	0+	135	N	Male	2012		
178695935	T12-214	11/27/12	3890	0+	133	N	Female	2012		
178695935	T13-154	03/20/13	3900	1+	186	R				
178695936	T12-184	11/27/12	3320	1+	231	N	Female	2011		
178695937	T12-155	11/27/12	2990	1+	202	N	Male	2011		

178695937		09/06/16	2975			T				
178695938	T12-185	11/27/12	3320	0+	152	N	Female	2012		
178695938	T13-306	11/19/13	3320	1+	243	R				
178695939	T12-211	11/27/12	3800	2+	220	N	Female	2010		
178695939		07/08/16	3450			T				
178695940	T12-205	11/27/12	3580	2+	214	N	Female	2010		
178695940	T13-147	03/20/13	3800	3	233	R				
178695941	T12-127	11/27/12	2700	0+	152	N	Female	2012		
178695941	T13-75	03/19/13	2715	1+	191	R				
178695942	T12-124	11/27/12	2650	1+	226	N	Female	2011		
178695942	T13-70	03/19/13	2700	2+	246	R				
178695943	T13-13	03/19/13	1785	3+	290	N	Female	2009	13-Mar	
178695944	T13-17	03/19/13	1780	1+	167	N	Male	2011		
178695945	T12-130	11/27/12	2745	1	143	N	Female	2011		
178695945		09/15/16	1110			T				
178695946	T13-62	03/19/13	2450	1+	146	N	Male	2011		
178695946		09/01/16	2415			T				
178695947	T13-33	03/19/13	1960	1+	163	N	Male	2011		3/13
178695948	T13-18	03/19/13	1780	1+	132	N	Male	2011		
178695949	T13-80	03/19/13	2835	1+	156	N	Female	2011		
178695950	T13-69	03/19/13	2650	1+	147	N	Male	2011		
178695951	T13-26	03/19/13	1920	1+	161	N	Female	2011		3/13
178695952	T13-54	03/19/13	2260	3+	235	N	Female	2010		
178695953	T12-224	11/27/12	4000	0+	132	N	Female	2012		
178695954	T12-129	11/27/12	2740	1+	157	N	Female	2011		
178695955	T12-232	11/27/12	4100	0+	140	N	Female	2012		
178695956	T15-81	11/12/15	4300	3+	265	N	Female	2012		
178695956		09/19/16	4160			T				
178695957	T13-308	11/19/13	3320	Regen	275	N	Female	2010		
178695958	T13-302	11/19/13	3280	Regen/1	141	N	Female	2012		
178695959	T15-22	11/10/15	3290	1+	138	N	Male	2014		
178695960	T15-4	11/09/15	2000	1+	237	N	Female	2014		
178695961	T15-9	11/09/15	2650	1+	230	N	Male	2014	11/12	
178695963	T13-304	11/19/13	3280	1+	170	N	Female	2012		
178695964	T15-29	11/10/15	3430	1+	137	N	Male	2014		
178695965	T15-13	11/09/15	3000	2+	236	N	Female	2013	11/12	
178695965		09/06/16	2920			T				
178695966	T15-14	11/09/15	3010	2+	246	N	Female	2013		11/15
178695966		10/07/16	3070			T				
178695967	T15-40	11/10/15	3525	1+	133	N	Male	2014		
178695967	T16-6	11/15/16	3800	2+	197	R				
178695968	T15-85	11/12/15	4400	3+	299	N	Male	2012		11/15
178695968		07/15/16	3525			T				
178695969	T15-86	11/12/15	4480	2+	288	N	Male	2013		
178695969	T16-34	11/16/16	4480	3+	320	R				
178695970	T15-41	11/10/15	3560	1+	235	N	Female	2014		
178695970		07/15/16	3525			T				
178695971	T16-7	11/15/16	3800	2+	246	N	Female	2014		
178695973	T15-43	11/10/15	3810	1+	155	N	Male	2014		
178695974	T16-9	11/15/16	3860	2+	206	N	Female	2014		

178695975	T16-12	11/15/16	3910	0+	155	N	Male	2016		11/16
178695976	T16-17	11/15/16	4050	1+	180	N	Female	2015		
178695977	T15-44	11/10/15	3850	1+	245	N	Male	2014		
178695978	T15-45	11/10/15	3850	1+	186	N	Female	2014		
178695979	T15-48	11/10/15	3900	2+	315	N	Female	2013		
178695979	T16-11	11/15/16	3910	3+	333	R				11/16
178695980	T16-19	11/15/16	4100	1+	168	N	Female	2015		
178695981	T15-50	11/10/15	3900	2+	221	N	Male	2013		
178695982	T16-21	11/15/16	4100	1+	167	N	Female	2015		
178695983	T15-53	11/10/15	3940	2+	201	N	Female	2013		
178695984	T13-86	03/20/13	2980	0+	144	N	Male	2012		
178695984		10/07/16	3083			T				
178695985	T13-81	03/19/13	2835	1+	146	N	Male	2011		
178695986	T13-57	03/19/13	2310	1+	176	N	Female	2011		
178695986	T15-7	11/09/15	2315	2+	317	R				
178695987	T13-156	03/20/13	3900	1+	147	N	Male	2011		
178695987	T13-342	11/19/13	3900	1+	189	R				
178695987	T14-44	11/19/14	4125	3+	232	R				
178695987	T15-75	11/10/15	4200	3+	289	R				
178695987	T16-26	11/16/16	4132	4+	315	R				
178695988	T13-157	03/20/13	3940	1+	139	N	Male	2011		
178695988	T13-345	11/19/13	3940	1+	175	R				
178695989	T13-159	03/20/13	3965	1+	138	N	Male	2011		
178695989	T13-346	11/19/13	4000	1+	144	R				
178695990	T13-161	03/20/13	4000	1+	132	N	Male	2011		
178695990	T15-65	11/10/15	4110	2+	221	R				
178695991	T13-168	03/20/13	4100	2	240	N	Female	2010	3/13	
178695992	T13-170	03/20/13	4100	1	154	N	Male	2011	3/13	
178695993	T13-59	03/19/13	2315	1	134	N	Male	2011		
178695993		08/29/16	2315			T				
178695994	T13-150	03/20/13	3800	0+	135	N	Male	2012		
178695995	T13-155	03/20/13	3900	1+	184	N	Male	2011		
178695995	T13-343	11/19/13	3900	1+	237	R				
178695996	T13-136	03/20/13	3525	1+	177	N	Female	2011		
178695997	T16-22	11/15/16	4120	1+	162	N	Female	2015		
178695998	T13-110	03/20/13	3250	1+	148	N	Female	2011		
178695999	T13-106	03/20/13	3185	1+	152	N	Female	2011	3/13	
178696000	T13-99	03/20/13	3120	1+	144	N	Male	2011		
178696001	T13-103	03/20/13	3160	1+	125	N	Male	2011		
178696002	T13-94	03/20/13	3070	2	207	N	Female	2010	3/13	
178696002		10/07/16	3078			T				
178696003	T13-91	03/20/13	2980	0+	135	N	Male	2012		
178696003		09/06/16	2900			T				
178696004	T13-143	03/20/13	3700	1+	145	N	Male	2011		
178696005	T13-140	03/20/13	3555	1+	154	N	Female	2011		
178696005	T13-325	11/19/13	3525	1+	201	R			11/12	
178696006	T13-137	03/20/13	3525	1+	156	N	Female	2011		
178696006		07/15/16	3525			T				
178696007	T13-65	03/19/13	2495	0+	135	N	Male	2012		
178696008	T13-66	03/19/13	2595	1+	146	N	Female	2011		

178696008		09/01/16	2660			T				
178696009	T13-135	03/20/13	3500	1+	149	N	Female	2011		
178696009	T13-319	11/19/13	3490	1+	164	R				
178696009	T15-2	11/09/15	1970	2+	252	R	Female	2013		
178696009		08/11/16	1984			T				
178696010	T13-134	03/20/13	3500	3+	221	N	Female	2009		
178696010		07/08/16	3440			T				
178696011	T13-133	03/20/13	3500	1+	137	N	Male	2011		
178696011		07/15/16	3495			T				
178696012	T13-83	03/19/13	2950	1+	157	N	Female	2011		3/13
178696012	T14-12	11/18/14	2910	2+	201	R				
178696012		07/15/16	3450			T				
178696013	T16-8	11/15/16	3850	1+	149	N	Male	2015		
178696014	T16-25	11/15/16	4125	1+	142	N	Male	2015		
178696015	T16-29	11/16/16	4230	1+	187	N	Female	2015		
178696017	T17-98	11/15/17	2600	2+	209	N	Male	2015		
178696018	T17-129	11/15/17	2925	1+	237	N	Female	2016		
178696020	T17-77	11/14/17	4875	2+	251	N	Male	2015		
178696023	T13-174	03/20/13	4125	1+	156	N	Male	2011		
178696025	T13-117	03/20/13	3320	1+	167	N	Female	2011		
178696026	T13-121	03/20/13	3395	1+	159	N	Female	2011		
178696026	T13-312	11/19/13	3400	1+	192	R				
178696027	T13-125	03/20/13	3455	0+	128	N	Male	2012		3/13
178696027		07/15/16	3440			T				
178696028	T13-146	03/20/13	3800	Regen/3	307	N	Female	2009	3/13	
178696029	T13-148	03/20/13	3800	1+	148	N	Male	2011		
178696030	T13-145	03/20/13	3700	1+	164	N	Female	2011	3/13	
178696030		09/19/16	4160			T				
178696031	T13-163	03/20/13	4000	2	253	N	Female	2010	3/13	
178696032	T13-165	03/20/13	4000	1+	184	N	Female	2011	3/13	
178696033	T13-167	03/20/13	4050	1+	190	N	Female	2011	3/13	
178696033		09/08/16	4100			T				
178696034	T13-171	03/20/13	4100	1+	154	N	Female	2011		3/13
178696034	T14-49	11/19/14	4220	2+	195	R				
178696034		09/19/16	4160			T				
178696035	T13-111	03/20/13	3260	1+	135	N	Female	2011		
178696035	T13-303	11/19/13	3280	1+	150	R				
178696037	T13-172	03/20/13	4100	0+	143	N	Male	2012		
178696039	T13-95	03/20/13	3070	1+	155	N	Female	2011		
178696039		10/07/16	3010			T				
178696042	T13-112	03/20/13	3260	0+	129	N	Male	2012		
178696045	T13-119	03/20/13	3385	2+	240	N	Female	2010	3/13	
178696047	T13-118	03/20/13	3320	1+	137	N	Female	2011		
178696050	T13-124	03/20/13	3455	0+	127	N	Male	2012		
178696052	T14-18	11/18/14	3100	2+	201	N	Male	2012		
178696052	T15-18	11/09/15	3044	2+	243	R				
178696053	T14-10	11/18/14	2835	2+	251	N	Female	2012		
178696053		10/07/16	3010			T				
178696054	T14-48	11/19/14	4200	3+	281	N	Female	2011		
178696055	T14-26	11/18/14	3510	1+	266	N	Female	2013		

178696056	T13-349	11/19/13	5810	2+	374	N	Female	2011	
178696057	T14-7	11/18/14	2325	1+	177	N	Female	2013	
178696057	T15-8	11/09/15	2315	2+	221	R			
178696058	T14-42	11/19/14	4100	2+	216	N	Female	2012	
178696058		09/08/16	4100			T			
178696059	T14-46	11/19/14	4160	4+	345	N	Male	2010	11/14
178696060	T13-313	11/19/13	3420	1+	158	N	Male	2012	
178696061	T14-33	11/18/14	3560	0+	147	N	Male	2014	
178696062	T14-30	11/18/14	3525	1+	185	N	Male	2013	
178696063	T13-310	11/19/13	3400	2+	264	N	Female	2011	
178696063		07/15/16	3525			T			
178696064	T13-315	11/19/13	3435	1+	164	N	Male	2012	
178696065	T13-328	11/19/13	3560	1+	161	N	Female	2012	
178696066	T13-330	11/19/13	3560	1+	185	N	Female	2012	
178696067	T14-37	11/19/14	4020	2+	213	N-dorsal	Female	2012	11/14
178696067		09/19/16	4160			SHED			
178696068	T14-6	11/18/14	2315	1+	225	N	Male	2013	
178696068	T15-10	11/09/15	2700	2+	278	R			
178696068	T16-20	11/15/16	4100	3+	314	R			
178696069	T13-338	11/19/13	3720	1+	208	N	Male	2012	
178696069	T14-50	11/19/14	4240	2+	260	R			
178696070	T14-8	11/18/14	2700	3+	257	N	Male	2011	
178696071	T14-28	11/18/14	3525	3+	257	N	Female	2011	
178696071		07/18/16	3830			T			
178696072	T14-14	11/18/14	2925	3+	253	N	Female	2011	
178696072		07/08/16	3400			T			
178696073	T14-17	11/18/14	3085	1+	200	N	Female	2013	
178696073		09/06/16	2960			T			
181602619	T15-63	11/10/15	4100	2+	247	N	Female	2013	
181602619		09/08/16	4100			T			
181602620	T15-73	11/10/15	4160	3+	308	N	Male	2012	
181602621	T15-76	11/10/15	4200	2+	250	N	Female	2012	
181602622	T15-77	11/10/15	4250	3+	277	N	Male	2012	
181602623	T15-78	11/10/15	4250	2+	261	N	Male	2013	
181602624	T15-79	11/10/15	4250	3+	301	N	Female	2012	
181602625	T15-80	11/10/15	4270	3+	298	N	Male	2012	
181602625	T16-31	11/16/16	4270	4+	315	R			
181602636	T14-58	11/19/14	4875	1+	230	N	Male	2013	
181602641	T14-52	11/19/14	4270	3+	278	N	Female	2011	
181602644	T14-51	11/19/14	4240	2+	255	N	Female	2012	
181602651	T17-51	11/14/17	4270	Regen/2	205	N	Female	2015	
181602653	T17-74	11/14/17	4300	3+	234	N	Female	2014	
181602664	T17-75	11/14/17	4300	1+	206	N	Female	2016	
181602669	T17-20	11/13/17	4115	1+	183	N	Female	2016	
181602670	T17-18	11/13/17	4050	3+	225	N	Female	2014	
181602671	T17-25	11/13/17	4160	1+	243	N	Female	2016	
181602672	T17-5	11/13/17	3800	3+	246	N	Female	2014	
181602674	T17-48	11/14/17	4270	1+	249	N	Female	2016	

181602675	T17-22	11/13/17	4132	2+	217	N	Female	2015	
HDX Small Tags (12 mm)									
037909116696	T14-2	11/18/14	2180	1+	138	N	Female	2013	
037909120050505	T11-54	03/16/11	3250	1+	130	N	Male	2009	
0379091166848519	T17-9	11/13/17	3930	1+	130	N	Male	2016	
0379091166849626	T17-10	11/13/17	3930	1+	125	N	Female	2016	
0379091166850827	T14-11	11/18/14	2840	1+	168	N	Female	2013	11/12
0379091166850827	T15-12	11/09/15	2835	2+	243	R			
0379091166850868	T13-347	11/19/13	4000	1	174	N	Female	2012	
0379091166850923	T16-24	11/15/16	4120	1+	128	N	Female	2015	
0379091166851101	T17-3	11/13/17	3680	0+	136	N	Male	2017	
0379091166851632	T17-6	11/13/17	3870	0+	144	N	Male	2017	
0379091166852630	T17-33	11/13/17	4230	0+	125	N	Female	2017	
0379091166853173	T17-13	11/13/17	3950	1+	125	N	Female	2017	
0379091166854692	T13-105	03/20/13	3170	0+	118	N	Male	2016	
0379091166856471	T11-202	11/16/11	3950	0+	129	N	Male	2011	
0379091166856522	T13-84	03/19/13	2965	0+	113	N	Female	2012	
0379091166856536	T12-64	11/26/12	1900	0+	125	N	Female	2012	
0379091166856536	T13-25	03/19/13	1900	1+	171	R			
0379091166856561	T12-244	11/28/12	4270	1+	117	N	Male	2011	
0379091166856561	T16-30	11/16/16	4270	4+	260	R			
0379091166857756	T12-199	11/27/12	3500	0+	127	N	Male	2012	3/12
0379091166857756	T13-320	11/19/13	3500	1+	181	R			
0379091166857756	T13-128	03/20/13	3475	0+	139	R			
0379091166857756	T14-24	11/18/14	3500	2+	203	R			
0379091166857756	T15-37	11/10/15	3500	3+	255	R			
0379091166857828	T13-56	03/19/13	2305	0+	124	N	Male	2012	
0379091166858807	T12-60	11/26/12	1820	0+	123	N	Female	2012	
0379091166858815	T12-203	11/27/12	3560	0+	116	N	Male	2012	
0379091166858815	T13-142	03/20/13	3575	1	134	R			
0379091166858815	T13-332	11/19/13	3560	1+	157	R			
0379091166859100	T16-16	11/15/16	4020	1+	123	N	Male	2015	
0379091166860641	T12-196	11/27/12	3465	0+	124	N	Female	2012	
0379091166860641	T13-316	11/19/13	3435	1+	164	R			
0379091166860842	T12-189	11/27/12	3400	0+	126	N	Female	2012	
0379091166860842	T13-120	03/20/13	3395	1+	166	R			
0379091166860842	T13-311	11/19/13	3400	1+	205	R			
0379091166862177	T12-192	11/27/12	3440	0+	120	N	Female	2012	
0379091166965335	T14-20	11/18/14	3200	1+	125	N	Male	2013	
0379091166965853	T17-2	11/13/17	3700	1+	126	N	Male	2016	
0379091166966027	T14-25	11/18/14	3500	0+	116	N	Male	2014	
0379091166966027	T15-38	11/10/15	3500	1+	186	R			
0379091166966027	T17-23	11/13/17	4132	2+	305	R			
0379091166966111	T14-45	11/19/14	4132	2+	227	N	Male	2012	
0379091166966841	T14-16	11/18/14	2975	0+	116	N	Male	2014	
0379091166968371	T14-5	11/18/14	2300	1+	134	N	Male	2013	
0379091166968407	T16-27	11/16/16	4135	1+	128	N	Female	2015	
0379091166968407	T17-73	11/14/17	4300	2+	195	R			
0379091166968615	T17-8	11/13/17	3900	0+	130	N	Male	2017	

0379091166968655	T14-41	11/19/14	4050	1+	124	N	Female	2013	
0379091166969614	T13-314	11/19/13	3425	0+	136	N	Male	2013	
0379091166970644	T14-38	11/19/14	4030	1+	160	N	Male	2013	
0379091166970892	T17-40	11/13/17	4250	1+	126	N	Female	2016	
0379091166970964	T13-300	11/19/13	3240	0+	134	N	Male	2013	
0379091166970964	T14-21	11/18/14	3220	1+	169	R			
0379091166970964	T15-36	11/10/15	3500	2+	246	R			
0379091166971184	T17-31	11/13/17	4200	1+	143	N			
0379091166971210	T14-22	11/18/14	3320	0+	133	N	Female	2014	
0379091166971689	T17-24	11/13/17	4160	0+	127	N	Male	2017	
0379091166971717	T13-77	03/19/13	2810	0+	125	N	Male	2012	
0379091166971723	T17-1	11/13/17	3600	0+	143	N	Male	2017	
0379091166973031	T14-9	11/18/14	2835	1+	157	N	Female	2013	
0379091166973214	T14-40	11/19/14	4050	0+	111	N	Female	2014	11/12
0379091166973253	T14-47	11/19/14	4175	0+	105	N	Female	2014	
0379091166973253	T15-82	11/12/15	4300	1+	158	R			
0379091166973253	T16-33	11/16/16	4300	2+	210	R			
0379091166973264	T14-39	11/19/14	4030	0+	118	N	Female	2014	
0379091166973768	T12-236	11/28/12	4150	0+	117	N	Female	2012	
0379091166973989	T17-85	11/15/17	2495	0+	126	N	Male	2017	
0379091166974055	T17-30	11/13/17	4200	0+	129	N	Male	2017	
0379091166974231	T17-7	11/13/17	3900	0+	135	N	Male	2017	
0379091166974486	T14-54	11/19/14	4350	1+	155	N	Male	2013	
0379091166974520	T15-34	11/10/15	3490	1+	123	N	Male	2014	
0379091166974520	T16-1	11/15/16	3490	2+	198	R			
0379091166975332	T17-14	11/13/17	4000	1+	147	N	Male	2016	
0379091166975533	T14-3	11/18/14	2300	0	126	N	Male	2014	
0379091166975533	T15-6	11/09/15	2270	1	212	R			
0379091166975562	T14-53	11/19/14	4270	1+	154	N	Female	2013	
0379091166976262	T14-4	11/18/14	2300	1+	119	N	Male	2013	
0379091166976776	T15-26	11/10/15	3320	0+	111	N	Male	2015	
0379091166976776	T16-2	11/15/16	3490	1+	145	R			
0379091166976818	T14-55	11/19/14	4410	0+	116	N	Male	2014	
0379091166976818	T15-87	11/12/15	4480	1+	175	R			
0379091166977337	T16-18	11/15/16	4050	1+	141	N	Female	2015	
0379091166977618	T16-23	11/15/16	4120	1	117	N	Male	2015	
0379091166977618	T17-39	11/13/17	4250	2	192	R			
0379091166978125	T15-83	11/12/15	4300	1+	127	N	Female	2014	
0379091166978134	T17-17	11/13/17	4050	0+	136	N	Male	2017	
0379091166978311	T17-12	11/13/17	3950	1+	135	N	Female	2016	
0379091166978377	T14-13	11/18/14	2925	0+	145	N	Male	2014	
0379091166978848	T15-19	11/09/15	3044	1+	143	N	Male	2014	
0379091166978857	T15-3	11/09/15	2000	1+	141	N	Female	2014	
0379091166979352	T17-21	11/13/17	4125	1+	136	N	Male	2016	
0379091166979370	T14-19	11/18/14	3110	1+	138	N	Female	2013	
0379091166979877	T17-15	11/13/17	4000	1+	143	N	Female	2016	
0379091166980168	T17-19	11/13/17	4115	0+	120	N	Male	2017	
379091166980873.00	T17-35	11/13/17	4240	1+	118	N	Male	2016	

0379091166980909	T15-35	11/10/15	3500	1+	125	N	Male	2014		
0379091166981684	T14-32	11/18/14	3560	1+	119	N	Female	2013		
0379091166981940	T13-322	11/19/13	3515	1+	133	N	Male	2012		
0379091166981940	T14-31	11/18/14	3525	2+	178	R				
0379091166981940	T15-39	11/10/15	3525	2+	225	R				
0379091166981940	T16-5	11/15/16	3525	3+	326	R				
0379091200509490	T11-50	03/16/11	3235	1+	145	N	Female	2009		
0379091200509998	T11-29	03/15/11	2240	1+	165	N	Female	2009		
0379091200511567	T11-32	03/15/11	2290	1+	127	N	Male	2009		3/11
0379091200512557	T11-9	03/15/11	1780	1+	212	N	Male	2009		3/11
0379091200512586	T11-166	11/15/11	3110	0+	111	N	Male	2011		
0379091200512586	T14-35	11/18/14	3800	3+	300	R				
0379091200512586	T13-305	11/19/13	3300	2+	249	R				
0379091200512586	T12-180	11/27/12	3290	1+	177	R				
0379091200513599	T12-91	11/26/12	2130	1	129	N	Female	2011		11/12
0379091200513599	T13-47	03/19/13	2130	1+	144	R			3/13	
0379091200516133	T12-71	11/26/12	1975	0+	114	N	Female	2012		
0379091200516171	T11-45	03/15/11	2520	1+	115	N	Female	2009		
0379091200516705	T11-10	03/15/11	1930	1+	163	N	Female	2009		
0379091200518686	T10-101	11/17/10	4975	0+	112	N	Male	2010		
0379091200518690	T10-174	11/18/10	2975	1+	122	N	Female	2009		
0379091200518702	T11-38	03/15/11	2380	1+	134	N	Female	2009		
0379091200519737	T12-108	11/26/12	2315	0+	124	N	Male	2012		
0379091200519737	T13-61	03/19/13	2315	1+	154	R				
0379091200519784	T10-81	11/17/10	4700	0+	124	N	Female	2010		
0379091200520236	T11-35	03/15/11	2325	1+	132	N	Female	2009		
0379091200521253	T10-193	11/18/10	3157	ND	118	N				
0379091200521295	T11-16	03/15/11	2020	1+	187	N	Female	2009		3/11
0379091200524844	T10-225	11/19/10	3440	ND	118	N				
0379091200524844	T11-67	03/16/11	3450	1+	168	R			3/11	
0379091200524876	T10-175	11/18/10	2975	0+	115	N	Female			
0379091200525324	T10-149	11/18/10	2675	0+	126	N	Male			
0379091200525330	T10-139	11/18/10	2575	0+	121	N	Female			
0379091200526878	T10-134	11/18/10	2495	0+	113	N	Male			
0379091200526878	T11-26	03/15/11	2165	1+	157	R				
0379091200526912	T10-222	11/19/10	3425	ND	114	N				
0379091200526943	T10-167	11/18/10	2925	0+	120	N	Male	2010		
0379091200527423	T12-98	11/26/12	2285	0+	112	N	Female	2012		
0379091200527423	T13-55	03/19/13	2305	1+	148	R				
0379091200527976	T10-80	11/17/10	4580	0+	121	N	Male	2010		
0379091200527981	T10-213	11/19/10	3320	0+	112	N	Female	2010		
0379091200527981	T11-184	11/15/11	3320	2	191	R				
0379091200528925	T10-76	11/17/10	4530	0+	124	N	Female	2010		
0379091200529427	T10-147	11/18/10	2650	0+	122	N	Female	2010		
0379091200529505	T12-95	11/26/12	2230	0+	130	N	Female	2010		
0379091200529505	T13-53	03/19/13	2255	1+	164	R			3/13	
0379091200533088	T10-217	11/19/10	3320	0+	122	N	Male	2010		
0379091200533522	T10-87	11/17/10	4730	0+	114	N	Male	2010		
0379091200533593	T10-277	11/19/10	4300	0+	127	N	Female	2010		
0379091200534071	T10-158	11/18/10	2770	0+	120	N	Female	2010		

0379091200534071	T11-6	03/15/11	1741	1+	177	R				
0379091200535152	T10-226	11/19/10	3445	0+	122	N				
0379091200535152	T11-66	03/16/11	3445	1+	176	R			3/11	
0379091200537612	T11-49	03/16/11	3225	1+	173	N	Female	2009		3/11
0379091200537665	T11-36	03/15/11	2325	1+	138	N	Male	2009		
0379091200538182	T12-87	11/26/12	2110	0+	124	N	Male	2012		
0379091200538649	T11-17	03/15/11	2020	1+	171	N	Male	2009		
0379091200538717	T12-99	11/26/12	2290	1	116	N	Male	2011		
0379091200539656	T12-75	11/26/12	1995	0+	111	N	Male	2012		
0379091200539656	T13-42	03/19/13	2050	0+	118	R				
0379091200539685	T12-105	11/26/12	2310	0+	117	N	Male	2012		
0379091200540193	T12-111	11/26/12	2325	0+	114	N	Female	2012		
0379091200540220	T11-52	03/16/11	3240	0+	144	N	Male	2010		
0379091200540252	T12-101	11/26/12	2295	0+	126	N	Male	2012		
0379091200540771	T11-53	03/16/11	3240	1+	127	N	Male	2009		
0379091200540783	T11-25	03/15/11	2155	1+	168	N	Female	2009		3/11
0379091200541198	T11-19	03/15/11	2065	1+	165	N	Female	2009		
0379091200541745	T11-48	03/16/11	3225	1+	166	N	Female	2009	3/11	
0379091200542234	T11-14	03/15/11	2000	2+	184	N	Male	2008		
0379091200542234	T11-115	11/14/11	2205	3	206	R			11/11	
0379091200542243	T12-226	11/27/12	4020	0+	113	N	Female	2012		
0379091200542296	T10-204	11/18/10	3260	ND	118	N				
0379091200542799	T12-81	11/26/12	2085	1	116	N	Female	2011		
0379091200543315	T12-115	11/26/12	2380	0+	120	N	Female	2012		
0379091200543795	T11-37	03/15/11	2330	1+	138	N	Male	2009		
0379091200543795	T12-3	03/20/12	1900	2+	207	R			3/12	
0379091200543853	T11-5	03/15/11	1700	1+	200	N				
0379091200544335	T10-227	11/19/10	3455	0+	113	N				
0379091200544335	T11-193	11/16/11	3500	1+	207	R				
0379091200544335	T12-29	03/20/12	3500	2	223	R				
0379091200544335	T12-218	11/27/12	3940	2+	234	R				
0379091200544335	T13-130	03/20/13	3500	3	237	R				
0379091200544335	T13-324	11/19/13	3525	3+	243	R				
0379091200544342	T12-220	11/27/12	3945	0+	118	N	Male	2012		
0379091200544342	T13-158	03/20/13	3950	1+	166	R				
0379091200544359	T10-86	11/17/10	4725	0+	111	N	Female	2010		
0379091200544775	T10-221	11/19/10	3390	0+	118	N	Female	2010		
0379091200544775	T11-72	03/16/11	3470	1+	163	R				
0379091200544810	T12-72	11/26/12	1980	0+	121	N	Male	2012		
0379091200544851	T12-103	11/26/12	2295	1	120	N	Female	2011		
0379091200544871	T11-15	03/15/11	2000	2	204	N	Female	2009		3/11
0379091200544877	T10-33	11/16/10	2000	0+	120	N	Male	2010	11/10	
0379091200545312	T10-157	11/18/10	2770	0+	119	N	Male	2010		
0379091200545909	T12-94	11/26/12	2230	0+	114	N	Female	2012		
0379091200546336	T10-35	11/16/10	2000	0+	125	N	Female	2010		
0379091200546347	T10-132	11/18/10	2490	0+	119	N	Female	2010		
0379091200546350	T10-95	11/17/10	4875	0+	117	N	Male	2010		
0379091200546397	T11-34	03/15/11	2300	1+	166	N	Female	2009		
0379091200546415	T11-56	03/16/11	3255	1+	120	N	Male	2009		
0379091200546415	T12-41	03/21/12	4020	2+	202	R			3/12	
0379091200546830	T10-44	11/16/10	2055	0+	124	N	Male	2010		

0379091200546830	T11-21	03/15/11	2070	1+	175	R				
0379091200546830	T12-5	03/20/12	2000	2+	215	R			3/12	
0379091200546904	T12-216	11/27/12	3900	0+	111	N	Male	2012		
0379091200546904	T13-153	03/20/13	3840	1	139	R				
0379091200546904	T13-344	11/19/13	3900	1+	169	R				
0379091200547345	T10-54	11/16/10	2250	0+	114	N	Female	2010		
0379091200547373	T12-114	11/26/12	2380	0+	111	N	Female	2012		
0379091200547373	T13-11	03/19/13	1755	1+	149	R				
0379091200547420	T11-47	03/16/11	3225	1+	150	N	Male	2009	3/11	
0379091200547887	T10-55	11/16/10	2280	0	120	N	Male	2010		
0379091200547887	T11-116	11/14/11	2220	1	189	R			11/11	
0379091200547887	T12-12	03/20/12	2240	1+	195	R				
0379091200547961	T10-183	11/18/10	3050	0+	118	N				
0379091200548360	T10-155	11/18/10	2765	0+	119	N	Female	2010		
0379091200548455	T10-64	11/17/10	4410	0+	121	N	Female	2010		
0379091200548892	T12-84	11/26/12	2100	0+	115	N	Male	2012		
0379091200548908	T11-22	03/15/11	2070	1+	195	N	Male	2009		
0379091200548908	T12-1	03/20/12	1780	2+	233	R			3/12	
0379091200548908	T12-58	11/26/12	1825	2+	289	R				
0379091200549398	T11-7	03/15/11	1750	1+	171	N	Female	2009		
0379091200549999	T12-106	11/26/12	2315	0+	113	N	Male	2012		
0379091200550008	T11-42	03/15/11	2440	0	148	N	Male	2010		
0379091200550008	T11-134	11/14/11	2545	1	210	R				
0379091200550499	T12-83	11/26/12	2095	0+	113	N	Male	2012		
0379091200550516	T11-51	03/16/11	3235	1+	139	N	Male	2009		
0379091200551031	T12-212	11/27/12	3850	0+	112	N	Male	2012		
0379091200551031	T13-152	03/20/13	3840	1+	156	R			13-Mar	
0379091200551031	T14-43	11/19/14	4110	2+	205	R				
0379091200556088	T10-84	11/17/10	4710	0+	111	N	Male	2010		
0379091200556550	T10-82	11/17/10	4710	0+	113	N	Male	2010		
0379091200560246	T10-85	11/17/10	4725	0+	111	N	Female	2010		
0379091200561217	T10-255	11/19/10	3900	0+	120	N	Male	2010		
0379091200597558	T10-136	11/18/10	2515	0+	123	N	Male	2010		
0379091200598068	T10-109	11/17/10	5100	0+	115	N	Male	2010		
0380180914260244	T13-43	03/19/13	2100	0+	112	N	Male	2012		3/13
0380180914260492	T12-133	11/27/12	2775	0+	111	N	Female	2012		
0380180914260545	T13-74	03/19/13	2700	1+	128	N	Male	2011		
0380180914260557	T13-151	03/20/13	3800	0+	125	N	Female	2012		
0380180914260769	T12-178	11/27/12	3290	0+	115	N	Female	2012		
0380180914260769	T13-114	03/20/13	3290	1+	165	R				
0380180914260846	T12-254	11/28/12	4460	0+	112	N	Male	2012		
0380180914260849	T12-194	11/27/12	3440	0+	117	N	Male	2012		
0380180914261039	T13-21	03/19/13	1800	1+	124	N	Female	2011		
0380180914261077	T13-4	03/19/13	1700	0+	111	N	Female	2012		
0380180914261090	T13-89	03/20/13	2980	0+	119	N	Male	2012		
0380180914261090	T14-15	11/18/14	2925	2+	216	R				
0380180914261105	T13-100	03/20/13	3120	1+	117	N	Female	2011		
0380180914261262	T12-187	11/27/12	3400	0+	116	N	Female	2012		
0380180914261262	T13-41	03/19/13	2050	1+	166	R				
0380180914261297	T13-72	03/19/13	2700	0+	113	N	Male	2012		

0380180914261297	T15-11	11/09/15	2835	2+	285	R				
0380180914261348	T16-28	11/16/16	4160	1+	125	N	Male	2015		
0380180914261528	T12-148	11/27/12	2952	0+	112	N	Male	2012		
0380180914261596	T13-85	03/20/13	2980	0+	118	N	Male	2012		
0380180914261775	T13-123	03/20/13	3455	1+	125	N	Female	2011		
0380180914261784	T12-171	11/27/12	3185	0+	114	N	Female	2012		
0380180914261792	T12-193	11/27/12	3440	0+	116	N	Female	2012		
0380180914261792	T13-132	03/20/13	3500	1+	154	R				
0380180914261800	T12-137	11/27/12	2835	0+	128	N	Female	2012		
0380180914261856	T12-122	11/27/12	2600	0+	111	N	Female	2012		
038018091426203	T13-50	03/19/13	2150	0+	121	N				
0380180914262040	T12-132	11/27/12	2750	0+	119	N	Female	2012		
0380180914262102	T12-146	11/27/12	2950	0+	125	N	Male	2012		
0380180914262303	T12-235	11/27/12	4115	0+	129	N	Male	2012		
0380180914262303	T13-173	03/20/13	4115	1+	172	R				3/13
0380180914262387	T12-248	11/28/12	4300	0+	118	N	Female	2012		
0380180914262559	T13-2	03/19/13	1680	0+	127	N	Male	2012		
0380180914262615	T12-198	11/27/12	3490	0+	119	N	Male	2012		
0380180914262615	T13-129	03/20/13	3490	1+	140	R				
0380180914262632	T13-102	03/20/13	3160	1+	120	N	Female	2011		
0380180914262811	T12-204	11/27/12	3570	0+	114	N	Male	2012		
0380180914262811	T13-141	03/20/13	3575	1+	142	R				
0380180914262836	T13-92	03/20/13	2980	1+	127	N	Female	2011		
0380180914263128	T12-231	11/27/12	4100	0+	123	N	Female	2012	3/13	
0380180914263128	T13-169	03/20/13	4100	1+	163	R				
0380180914263325	T13-97	03/20/13	3070	0+	120	N	Female	2012		
0380180914263369	T13-9	03/19/13	1750	0+	125	N	Male	2012		
0380180914263565	T12-179	11/27/12	3290	0+	119	N	Female	2012		
0380180914263565	T13-113	03/20/13	3290	1+	164	R				
0380180914263629	T13-108	03/20/13	3185	1+	120	N	Female	2011		
0380180914263825	T12-120	11/26/12	2500	0+	119	N	Female	2012		
0380180914263866	T12-151	11/27/12	2990	0+	119	N	Male	2012		
0380180914263866	T13-93	03/20/13	3025	1	140	R				
0380180914263910	T12-177	11/27/12	3270	0+	131	N	Female	2012		
0380180914263910	T13-15	03/19/13	1780	1+	178	R				
0380180914263914	T12-149	11/27/12	2955	0+	126	N	Female	2012		
0380180914263914	T13-87	03/20/13	2980	0+	135	R				
0380180914264102	T12-121	11/26/12	2580	0+	116	N	Female	2012		
0380180914264409	T12-123	11/27/12	2630	0+	125	N	Female	2012		
0380180914264416	T12-206	11/27/12	3580	0+	116	N	Male	2012		
0380180914264416	T13-309	11/19/13	3320	1+	200	R				
0380180914264436	T13-6	03/19/13	1710	0+	119	N	Female	2012		
0380180914264584	T13-126	03/20/13	3470	0+	123	N	Male	2012		
0380180914264614	T12-57	11/26/12	1815	0+	119	N	Male	2012		
0380180914264625	T13-127	03/20/13	3475	0+	118	N	Male	2012		
0380180914264625	T13-321	11/19/13	3500	1+	150	R				
0380180914264647	T12-237	11/28/12	4160	0+	122	N	Male	2012		
0380180914264846	T12-234	11/27/12	4115	0+	116	N	Male	2012		
0380180914264846	T13-52	03/19/13	2185	1+	151	R				

0380180914264847	T12-90	11/26/12	2130	0+	128	N	Male	2012		
0380180914264847	T13-45	03/19/13	2130	1	147	R			13-Mar	
0380180914264900	T12-258	11/28/12	4530	0+	116	N	Male	2012		
0380180914264900	T14-57	11/19/14	4530	2	204	R				
0380180914264900	T16-36	11/16/16	4520	4	317	R				
0380180914265104	T12-159	11/27/12	3065	0+	115	N	Female	2012		
0380180914265143	T12-144	11/27/12	2925	0+	118	N	Female	2012		
0380180914265177	T12-142	11/27/12	2915	0+	111	N	Female	2012		
0380180914265388	T16-10	11/15/16	3860	1+	138	N	Male	2015		
0380180914265406	T13-96	03/20/13	3070	1+	121	N	Female	2011		
0380180914265422	T12-256	11/28/12	4490	1+	125	N	Female	2011		
0380180914265422	T13-115	03/20/13	3290	1+	161	R				
0380180914265439	T12-241	11/28/12	4230	0+	116	N	Female	2012		
0380180914265648	T13-116	03/20/13	3320	0+	118	N	Male	2012		
0380180914265676	T12-188	11/27/12	3400	0+	117	N	Male	2012		
0380180914265676	T13-307	11/19/13	3320	1+	254	R				3/13
0380180914265676	T14-23	11/18/14	3340	2+	283	R				
0380180914265904	T12-252	11/28/12	4460	0+	123	N	Male	2012		
0380180914265912	T13-122	03/20/13	3455	0+	120	N	Male	2012		
0380180914265919	T13-51	03/19/13	2165	0+	116	N	Female	2012		
0380180914266122	T16-14	11/15/16	4015	1+	140	N	Male	2015		
0380180914266122	T17-58	11/14/17	4300	2+	213	R				
0380180914266146	T12-201	11/27/12	3525	0+	116	N	Female	2012		
0380180914266146	T13-138	03/20/13	3525	1+	141	R				
0380180914266160	T12-260	11/28/12	4700	0+	111	N	Male	2012		
0380180914266196	T12-161	11/27/12	3080	0+	124	N	Female	2012		
0380180914266378	T13-101	03/20/13	3150	1+	120	N	Female	2011		
0380180914266443	T13-104	03/20/13	3170	1+	124	N	Male	2011		
0380180914266443	T13-326	11/19/13	3525	1+	153	R				
0380180914266671	T12-227	11/27/12	4020	0+	116	N	Male	2012	3/13	
0380180914266939	T12-209	11/27/12	3740	0+	111	N	Female	2012	3/13	
0380180914266939	T13-144	03/20/13	3700	0+	139	R				
0380180914266939	T13-337	11/19/13	3700	1+	157	R				
0380180914266939	T14-34	11/18/14	3800	1+	195	R				
0380180914266954	T12-207	11/27/12	3580	0+	126	N	Male	2012	3/13	
0380180914266979	T12-128	11/27/12	2700	1	122	N	Male	2011	3/13	
0380180914267228	T12-143	11/27/12	2920	0+	112	N	Female	2012		3/13
0380180914267228	T13-10	03/19/13	1755	1+	156	R				
0380180914267413	T12-245	11/28/12	4270	0+	111	N	Female	2012		
0380180914267438	T13-40	03/19/13	2015	0+	116	N	Male	2012		
0380180914267456	T12-134	11/27/12	2775	0+	120	N	Male	2012		
0380180914267456	T13-149	03/20/13	3800	0+	137	R				
0380180914267688	T13-60	03/19/13	2315	1+	126	N	Female	2011		
0380180914267961	T12-202	11/27/12	3525	0+	123	N	Female	2012		
0380180914267989	T13-31	03/19/13	1955	0+	119	N	Male	2012		

FDX small Tags (12 mm)

435927781A	T08-45	11/20/08	3525	1	120	N	Male	2007
43593A3B57	T08-46	11/20/08	3525	0	119	N	Female	2008
4359337208	T08-62	11/20/08	4040	0	122	N	Female	2008

43596F3F58	T08-47	11/20/08	3610	1	122	N	Female	2007		
43597C2365	T08-12	11/19/08	2650	1	125	N	Female	2007		
43597F0A70	T08-10	11/19/08	2610	Regen	110	N	Male	2008		
435A0A682F	T08-43	11/20/08	3525	1	124	N	Male	2007		
435B265D43	T08-42	11/20/08	3515	0	121	N	Male	2007		
4516321F57	T08-1	11/18/08	2050	0	123	N	Male	2007		
451659192B	T08-11	11/19/08	2650	0	114	N	Female	2008		
45165D1C1E	T08-49	11/20/08	3610	0	108	N	Female	2008		
45165D657F	T08-13	11/19/08	2650	1	130	N	Male	2007		
45165F6215	T08-44	11/20/08	3525	0	111	N	Male	2008		
4516612C43	T08-15	11/19/08	2650	0	112	N	Male	2008		
451663662F	T08-16	11/19/08	2650	0	110	N	Male	2008		
451663662F	T09-106	11/04/09	1935	1+	180	R				
451663662F	T10-216	11/19/10	3320	2+	213	R				
4516651F25	T08-18	11/19/08	2650	0	119	N	Male	2008		
4516687F10	T08-28	11/20/08	3320	0	117	N	Male	2008		
45166E242D	T08-3	11/18/08	2210	0	111	N	Male	2008		
4516766362	T08-41	11/20/08	3400	0	107	N				
451671065E	T08-71	11/21/08	4235	0	120	N	Male	2008		
4516722F4B	T08-35	11/20/08	3460	0	112	N	Male	2008		
4516726D06	T08-40	11/20/08	3400	0	110	N	Male	2008		
4516726D06	T11-73	03/16/11	3470	2+	194	R			3/11	
4516726D06	T11-191	11/16/11	3445	2+	204	R				11/11
451674037F	T08-51	11/20/08	3715	0	112	N	Female	2008		
45170C274F	T08-25	11/20/08	3215	0	110	N	Male	2008		
4517035E06	T08-8	11/19/08	2500	0	102	N	Female	2008		
4517041551	T08-38	11/20/08	3500	0	113	N	Male	2008		
4517042853	T08-9	11/19/08	2600	0	112	N	Female	2008		
4517087453	T08-17	11/19/08	2650	1	123	N	Male	2007		
451711564B	T08-39	11/20/08	3400	1	121	N	Female	2007		
4517214F2B	T08-6	11/18/08	2290	0	104	N	Female	2008		
45172B2513	T08-48	11/20/08	3610	0	112	N	Male	2008		
4517285E35	T08-32	11/20/08	3450	0	106	N	Male	2008		
4517322005	T08-61	11/20/08	4020	0	110	N	Male	2008		
4517322843	T08-7	11/18/08	2310	0	104	N	Male	2008		
45173D010D	T08-30	11/20/08	3300	1	125	N	Male	2007		11/08
451746740E	T08-2	11/18/08	2065	0	103	N	Male	2008		
45174F5C08	T08-19	11/19/08	2650	0	122	N	Male	2008		
4517503149	T08-31	11/20/08	3400	0	109	N	Female	2008		
4518186C42	T08-54	11/20/08	3900	0	113	N	Male	2008		
45181A270D	T08-4	11/18/08	2250	0	120	N	Male	2008		
45181A270D	T10-128	11/18/10	2490	2+	224	R			11/10	
4518323E56	T08-36	11/20/08	3460	1	120	N	Male	2007		
466A233260	T08-63	11/20/08	4040	0	115	N	Male	2008		
46764C7003	T08-60	11/20/08	4020	0	118	N	Male	2008		
4678795804	T10-7	01/23/10	1300	0	115	N				
467902522C	T08-53	11/20/08	3900	1	128	N	Female	2007		
4679082515	T08-55	11/20/08	3910	0	114	N	NA	2008		
46792F411D	T08-52	11/20/08	3870	0	115	N	Female	2008		
467970622C	T08-57	11/20/08	3920	0	110	N	Female	2008		

467A637D15	T08-56	11/20/08	3920	1	113	N	Female	2007
467A735231	T08-58	11/20/08	3920	0	114	N	Female	2007
467A784671	T08-89	11/20/08	4020	1	117	N	Male	2007
4A0D490865	T10-8	01/23/10	1300	0	115	N		
4A0D54191B	T09-147	11/04/09	2700	0+	115	N	Male	2009
4A0D544E11	T09-141	11/04/09	2590	0+	110	N	Male	2009
4A0D565826	T09-190	11/05/09	4070	0+	110	N	Male	2009
4A0D5A3C1D	T10-6	01/23/10	1300	1+	110	N	Male	2008
4A0D683D22	T09-187	11/05/09	4020	0+	120	N	Female	2009
4A0D6B0170	T10-5	01/23/10	1300	1+	115	N	Female	2008
4A0E147830	T09-175	11/05/09	3400	0+	110	N	Female	2009
4A0E1C105B	T09-149	11/04/09	2730	0+	115	N	Female	2009
4A0E1F186E	T09-194	11/05/09	4100	0+	110	N	Male	2009

Appendix C

Hydrologic Conditions Summary - Topanga

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2001 – Above Normal		
26–29 October	4	4
10–12 January	7.64	11.64
24–26 January	1.44	13.08
10–14 February	4.48	17.56
18–20 February	1.12	18.68
23–28 February	4.24	22.92
4–6 March	3.56	26.48
6–7 April	1.32	**27.8**
WY 2002 – Dry		
31 October	0.12	0.12
5 November	0.04	0.16
12–13 November	0.68	0.84
25 November	2.52	3.36
30 November	0.64	4
3–4 December	0.28	4.28
28 January	1.76	6.04
18 February	0.44	6.48
8 March	0.16	6.64
18 March	0.12	6.76
16 April	0.12	6.88
21 May	0.36	**7.24**
WY 2003 – Below Normal		
8–10 November	2.56	2.56
30 November–1 December	0.12	2.68
16–18 December	2.32	5
20–22 December	2.2	7.2
29 December	0.2	7.4
16–17 March	5.36	12.76
14–15 April	2.16	14.92
3–5 May	3	**17.92**

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2004 – Below Normal		
31 October–1 November	0.4	0.4
12 November	0.04	0.44
15 November	0.08	0.52
7 December	0.04	0.56
14 December	0.12	0.68
21 December	0.04	0.72
23–25 December	0.92	1.64
2 January	0.52	2.16
2 February	1.24	3.4
18 February	0.36	3.76
21–23 February	1.88	5.64
25–26 February	6.48	12.12
1–2 March	0.86	**13.16**
WY 2005 – Wet		
16–20 October	5.79	5.79
26–28 October	2.67	8.46
7–27 November	0.2	8.66
5–8 December	1.1	9.76
27–31 December	9.76	19.52
2–4 January	2.76	22.28
7–11 January	16.72	39
26–29 January	0.49	39.49
6–12 February	3.01	42.5
17–23 February	12.19	54.69
28 February–5 March	0.55	55.24
18–19 March	0.37	55.61
22 March	3.26	58.87
28 March	0.01	58.88
14 April	0.11	58.99
24 April	0.01	59
28 April	1.52	60.52
5 May	0.58	61.1
9 May	0.12	61.22
7 September	0.36	**61.58**

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2006 – Normal		
17–24 October	0.84	0.84
9–10 November	1.12	1.96
2–28 December	0.13	2.09
31 December–January	5.36	7.45
14 January	0.11	7.56
17–19 February	0.83	8.39
27–28 February	2.95	11.34
3 March	1.25	12.59
6–7 March	0.23	12.82
10–11 March	0.1	12.92
17 March	0.14	13.06
28 March–5 April	6.24	19.3
14–15 April	0.72	20.02
26 April	0.02	20.04
21–22 May	1.93	21.97
14 September	0.01	**21.98**
WY 2007 – Dry		
27 November	0.24	0.24
9–10 December	0.44	0.68
16 December	0.1	0.78
21 December	0.02	0.8
26 December	0.15	0.95
4 January	0.01	0.96
17 January	0.02	0.98
22–31 January	0.99	1.95
11 February	0.5	2.45
19 February	0.19	2.64
22 February	0.51	3.15
27 February	0.5	3.65
20 March	0.016	3.81
20–22 April	0.8	4.61
22 May	0.01	**4.62**

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2008 – Normal		
21–22 September	1.26	1.26
12–13 October	0.77	2.03
30 November	0.71	2.74
6–8 December	1.03	3.77
17–20 December	3.09	6.86
4–7 January	6.24	13.1
22–28 January	6.63	19.73
3 February	0.55	20.28
20–24 February	2.57	22.85
30 March	0.02	22.87
2 April	0.06	22.93
7 May	0.02	22.95
23–25 May	0.13	**23.08**
WY 2009 – Below Normal		
1–4 November	0.47	0.47
25–26 November	1.39	1.86
13–17 December	3.43	5.29
22–25 December	0.8	6.09
22–24 January	0.6	6.69
4–9 February	4.62	11.31
13–17 February	2.84	14.15
2–5 March	0.64	14.79
22–23 March	0.09	14.88
7 April	0.09	14.97
5 June	1.19	**16.16**
WY 2010 – Above Normal		
11-12 Oct	4.28	4.28
7 Dec	1.12	5.4
10-13 Dec	3.94	9.34
30 Dec	0.11	9.45
13 Jan	0.18	9.63
17-26 Jan	3.85	13.48
5-9 Feb	5.77	19.25
17-23 Feb	0.34	19.59
27 Feb	2.25	21.84
3-6 Mar	0.36	22.2
1-5 Apr	1.04	23.24
11-12 Apr	0.73	23.97
20 Apr	0.23	24.2
17-18 May	0.12	24.32
29-30 Jun	0.02	24.34
6-7 Jul	0.06	**24.4**

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2011 – Above Normal		
6 Oct	1.16	1.16
17-20 Oct	0.11	1.27
24-26 Oct	0.09	1.36
31 Oct	0.72	2.08
9 Nov	0.11	2.19
20-22 Nov	1.16	3.35
6 Dec	0.36	3.71
16-23 Dec	11.18	14.89
26-30 Dec	1.66	16.55
2-3 Jan	0.71	17.26
30 Jan	0.25	17.51
15-20 Feb	3.10	20.61
25-26 Feb	2.02	22.63
2-3 Mar	0.21	22.84
19-21 Mar	6.16	29.00
23-27 Mar	1.75	30.75
15-19 May	0.69	**31.44**
WY 2012 – Below Normal		
5 Oct	2.90	2.90
4-6 Nov	1.02	3.92
11-12 Nov	0.22	4.14
19-20 Nov	1.42	5.56
12-16 Dec	1.45	7.01
21-24 Jan	1.37	8.38
13-15 Feb	0.13	8.51
16-18 Mar	1.96	10.47
25-26 Mar	2.58	13.05
31 Mar	0.10	13.15
10-13 Apr	2.30	15.45
23-26 Apr	0.77	**16.22**
WY 2013 – Dry		
20 Oct / 23 Oct	0.02 / 0.03	0.02 / 0.05
8 Nov / 16-18 Nov	0.08 / 0.87	0.13 / 1.00
28 Nov - 3 Dec	2.55	3.55
12 Dec / 14-18 Dec	0.42 / 0.67	3.97 / 4.64
22-26 Dec	1.59	6.23
29 Dec	0.03	6.26
23-27 Jan	1.65	7.91
8 Feb / 19 Feb	0.06 / 0.23	7.97 / 8.20
6-8 Mar	1.06	9.26
30-31 Mar	0.18	9.44
23 Apr / 5 May	0.01 / 0.54	**9.99**

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
WY 2014 - Dry		
9 Oct	0.06	0.06
20-22 Nov	0.80	0.86
29 Nov / 7 Dec	0.03 / 0.18	1.07
2-9 Feb	0.27	1.34
26 Feb - 2 Mar	5.51	**6.85**
WY 2015 – Below Normal		
31 Oct - 1 Nov	0.42	0.42
21 Nov / 30 Nov - 4 Dec	0.01 /4.27	4.69
11-18 Dec	2.4	7.09
30 Dec	.02	7.11
10-11 Jan	1.77	8.88
26 Jan / 30 Jan	0.22 / 0.01	9.11
7 Feb / 22-23 Feb	0.03 / 0.41	9.52
28 Feb - 2 Mar	1.44	10.96
7 Apr	0.17	11.13
7 May / 14 May	0.04 / 0.68	11.85
9 Jun / 11 Jun	0.06 / 0.01	11.92
18-19 Jul	0.73 / 0.17	12.82
15 Sep	0.94	**13.76**
WY 2016 – Below Normal		
Oct 04, 2015	0.02	0.02
oct 18	0.01	0.03
Nov 03-04	0.25	0.28
Nov 24	0.03	0.31
Dec 10	0.01	0.32
Dec 13	0.21	0.53
Dec 19-22	0.58	1.11
Jan 05-10, 2016	3.47	4.58
Jan 19-20	0.08	4.66
Jan 31	1.11	5.77
Feb 17-18	0.74	6.51
Mar 6-14 (off and on)	3.44	9.95
Mar 28	0.04	9.99
April 7-9	0.49	10.48
May 4	0.01	10.49
June 11	0.05	10.54
Sept 12	0	**10.54**
WY 2017– Above Normal		
17-Oct	0.21	0.21
26-31 Oct	0.14	0.35
20-21 Nov	0.75	1.10
26 Nov	0.07	1.17

Rainfall period	Rainfall for period (in)	Cumulative rainfall for water year (WY) (in)
15-16 Dec	2.53	3.7
12/21-12/24	3.32	7.02
12/30-12/31	0.48	7.5
01/02-01/05	0.49	7.99
01/07/17	0.27	8.26
01/09-01/12	2.57	10.83
01/18-20	3.68	14.51
01/22-01/25	3.54	18.05
02/03/17	0.57	18.62
02/05-11	1.99	20.61
02/16-18	4.32	24.93
02/18-18	0.02	24.95
2/19-2/21	0.57	25.52
2/26	0.15	25.67
3/5	0.03	25.7
3/21-3/22	0.31	26.01
4/7-4/8	0.25	26.26
5/7	0.07	26.33
6/8	0.01	**26.34**
WY 2017– Above Normal		
1/8-1/9/2018	2.71	2.71
2/14/2018	0.01	2.72
2/26-3/4/2018	3.33	6.05
3/10-3/11/2018	0.93	6.98
3/13-3/16/2018	0.88	7.86
3/20-3/23/2018	2.05	9.91
5/2/18	0.02	**9.96**

Appendix D

Snorkel Survey Summary Data

SNORKEL SURVEY DATA

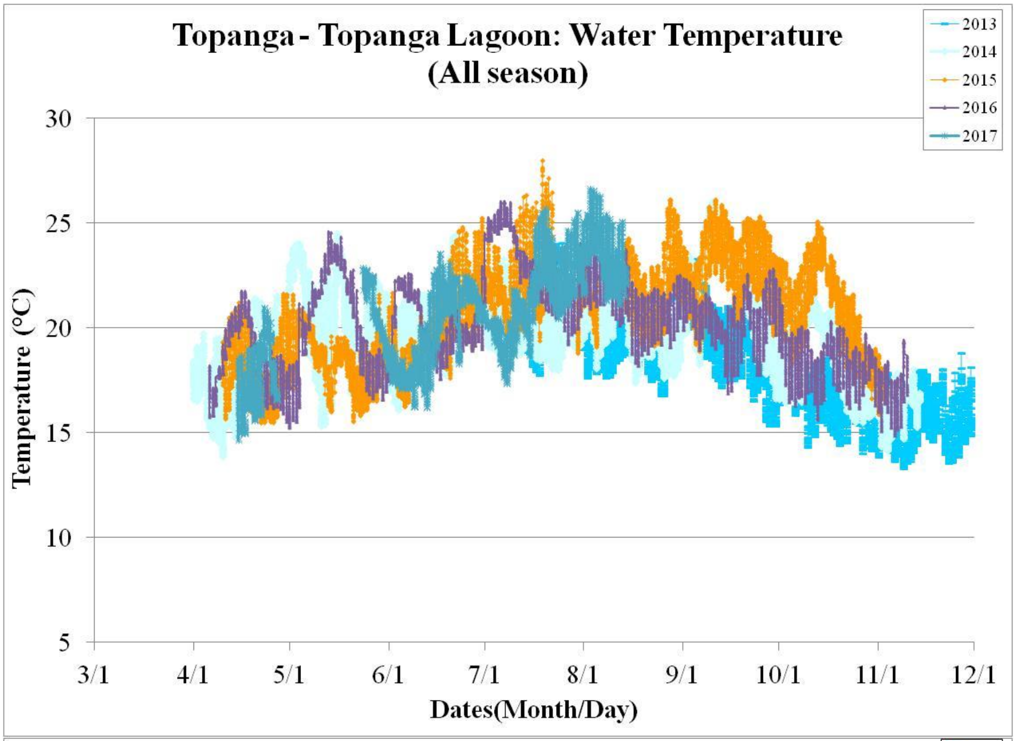
DATE	Total Trout	JUV (<10cm)	INT (11-25cm)	ADULT (>25cm)	# Locations	# Smolts	# Adults (>40cm)
2/19/10	211	28	169	14	103	7	0
3/12/10	149	8	126	15	78	28	0
4/9/10	200	49	135	16	71	25	0
5/21/10	420	283	122	15	113	0	1
6/24/10	343	232	93	18	98	0	0
7/16/10	326	185	122	19	77	0	0
8/20/10	281	130	140	11	93	0	0
9/17/10	266	123	135	8	96	0	0
10/15/10	278	105	161	12	83	0	0
11/12/10	197	82	104	11	60	0	0
12/10/10	117	40	73	4	45	0	0
Avg	**253**	**115**	**125**	**13**	**83**	**20**	**1**
1/14/11	242	62	159	21	91	0	0
2/11/11	159	18	125	16	68	0	0
3/11/11	303	15	246	42	118	0	0
4/15/11	129	4	113	12	70	0	0
5/13/11	113	9	81	23	56	0	0
6/17/11	103	1	76	26	40	0	0
7/12/11	76	1	57	18	39	0	0
8/19/11	63	0	41	22	38	0	0
9/23/11	43	0	26	17	24	0	0
10/21/11	70	0	48	22	37	0	0
11/9/11	47	0	31	16	35	0	0
12/16/11	18	0	13	5	15	0	0
Avg	**114**	**9**	**85**	**20**	**53**	**0**	**0**
1/13/12	22	0	16	6	20	0	0
2/17/12	17	0	10	7	13	0	0
3/16/12	13	0	5	8	9	0	2
4/12/12	88	82	5	1	45	0	0
5/18/12	219	195	13	11	80	0	2
6/21/12	154	136	10	8	53	0	2
7/13/12	152	115	27	10	60	0	1
8/17/12	102	67	32	3	48	0	0
9/14/12	155	94	48	13	63	0	4
10/19/12	102	58	35	9	46	0	0
11/20/12	76	46	26	4	42	0	0
12/14/12	45	17	26	2	22	0	0
Avg	**95**	**68**	**21**	**7**	**42**	**0**	**2**

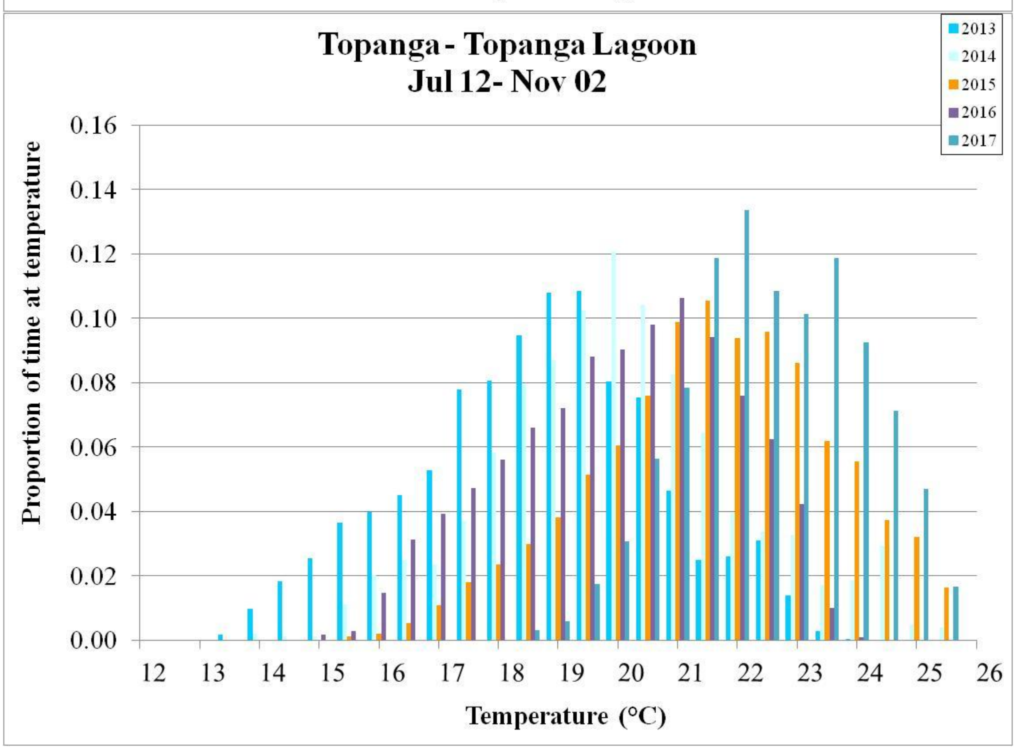
DATE	Total Trout	JUV	INT	ADULT	# Locations	# Smolts	# Adults (>40cm)
1/18/13	17	6	10	1	10	0	0
2/15/13	25	14	11	0	18	0	0
3/12/13	31	9	21	1	20	0	0
4/19/13	40	15	25	0	22	0	0
5/10/13	125	92	30	3	45	0	0
5/31/13	109	84	23	2	40	0	0
6/14/13	45	21	24	0	25	0	0
7/12/13	51	27	24	0	28	0	0
8/9/13	57	25	30	2	36	0	0
9/13/13	61	26	33	2	30	0	0
10/18/13	63	25	34	4	35	0	0
11/15/13	75	20	46	9	49	0	0
12/13/13	29	1	23	5	19	0	1
Avg	**56**	**28**	**26**	**2**	**29**	**0**	**1**
1/10/2014	57	11	45	1	37	0	0
2/14/2014	36	14	19	3	32	0	0
3/7/2014	53	14	27	12	35	0	2
4/4/2014	56	15	36	5	33	0	1
5/01/2014	78	25	47	6	38	0	0
6/06/2014	70	16	39	15	43	0	1
7/11/2014	51	13	31	6	32	0	0
8/08/2014	84	33	37	14	40	0	0
9/5/2014	72	31	27	14	40	0	1
10/17/2014	58	7	28	19	37	0	1
11/14/2014	46	5	30	11	31	0	0
12/19/2014	21	10	7	4	12	0	0
Avg	**57**	**16**	**31**	**9**	**34**	**0**	**1**
1/16/2015	18	4	9	5	14	0	0
2/13/2015	20	3	11	6	19	0	1
3/06/2015	25	1	14	10	18	0	2
4/10/2015	50	32	8	10	24	0	0
5/21/2015	130	112	16	2	34	0	0
6/11/2015	130	97	21	13	48	0	1
7/10/2015	95	58	18	16	48	0	6
8/14/2015	54	33	16	5	29	0	0
9/11/2015	50	17	18	12	31	0	0
10/09/2015	43	19	13	11	27	0	1
11/06/2015	42	23	13	6	27	0	0
12/04/2015	46	23	16	7	25	0	1
Avg	**59**	**35**	**14**	**9**	**29**	**0**	**1**
1/11/2016	21	10	7	4	12	0	4
2/4/2016	13	8	1	4	12	0	4
3/4/2016	26	7	12	7	19	0	0
3/28/2016	40	15	17	8	25	0	1
4/28/2016	51	9	33	9	33	0	1

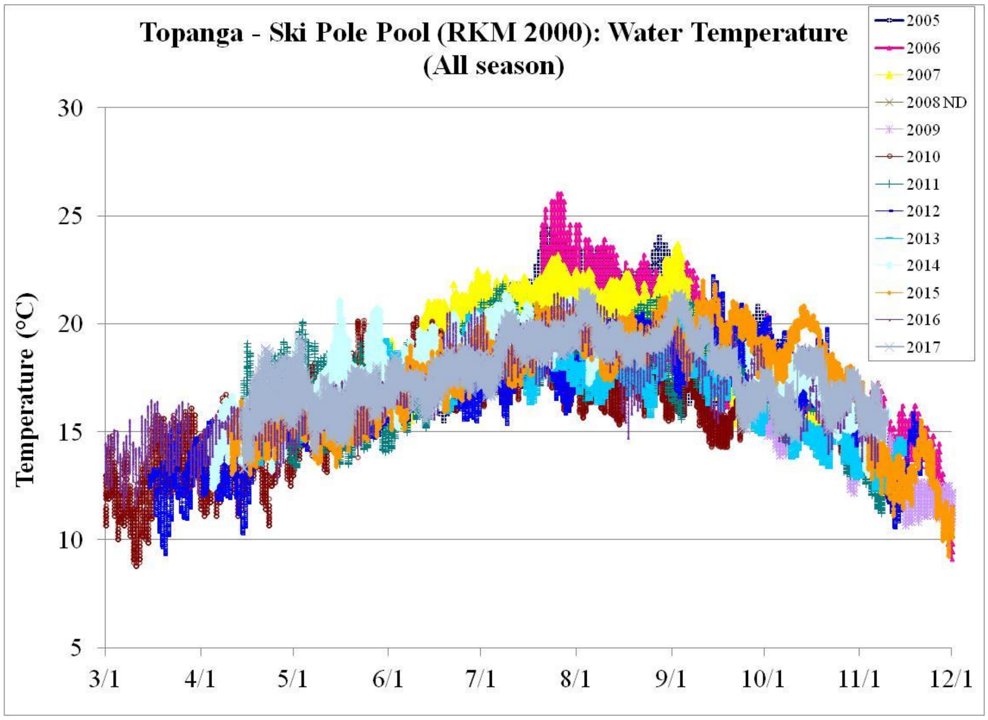
5/27/2016	55	17	29	9	30	0	2
6/24/2016	54	16	31	7	34	0	1
7/21/2016	49	13	22	14	39	0	2
8/19/2016	22	4	13	5	17	0	2
9/16/2016	37	10	17	10	23	0	1
10/14/2016	25	0	15	10	19	0	1
11/7/2016	36	9	21	6	20	0	2
12/15/2016	19	4	12	2	12	0	0
Avg	**34**	**9**	**18**	**7**	**23**	**0**	**2**
1/31/2017	20	2	6	2	8	0	0
2/24/2017	8	0	6	2	7	0	0
4/14/2017	54	23	23	8	21	0	1
5/11/2017	115	94	16	4	22	0	0
6/16/2017	137	112	19	6	27	0	2
7/21/2017	176	132	26	18	40	0	3
8/18/2017	115	88	16	11	31	0	2
9/15/2017	169	131	45	20	32	0	1
10/13/2017	98	80	15	6	29	0	0
11/6/2017	90	73	15	2	22	0	0
12/14/2017	76	39	32	5	15	0	2
Avg	**96**	**70**	**20**	**8**	**23**	**0**	**1**
1/23/2018	54	31	16	7	16	0	3
2/5/2018	70	35	29	6	22	0	2
3/8/2018	58	23	32	3	15	1	0
4/5/2018	48	29	15	6	25	0	0
5/3/2018	71	39	27	5	18	0	1

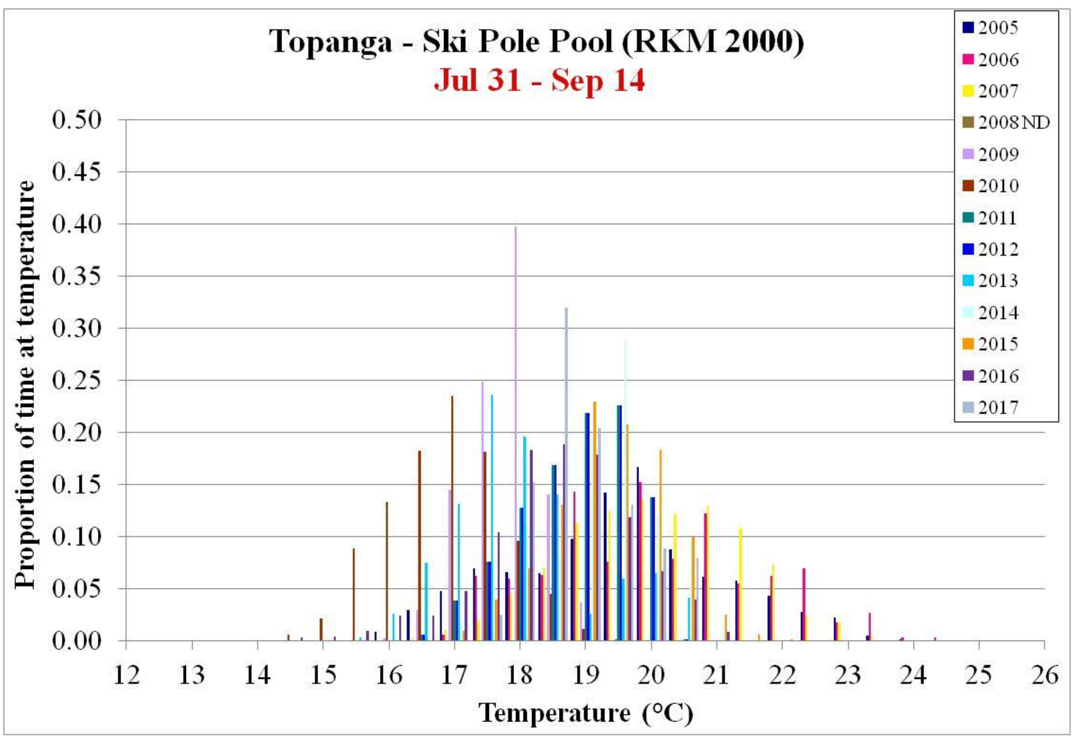
Appendix E

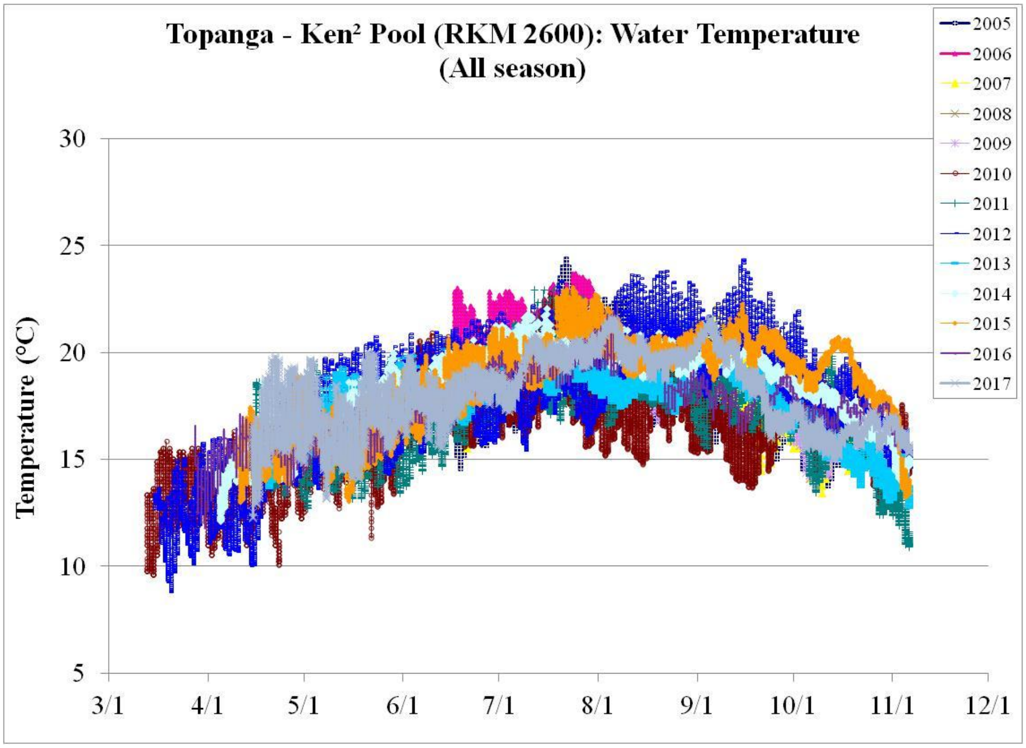
WATER TEMPERATURE SUMMARY

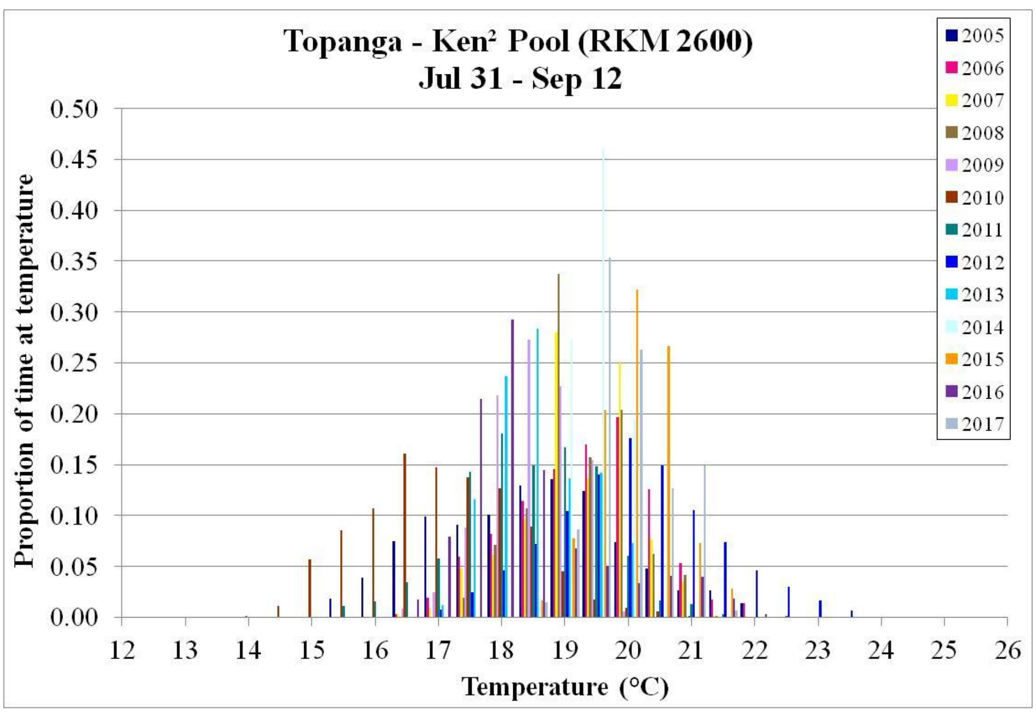

Topanga - Topanga Lagoon: Water Temperature
(All season)
2013
2014
2015
2016
2017
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
Dates(Month/Day)

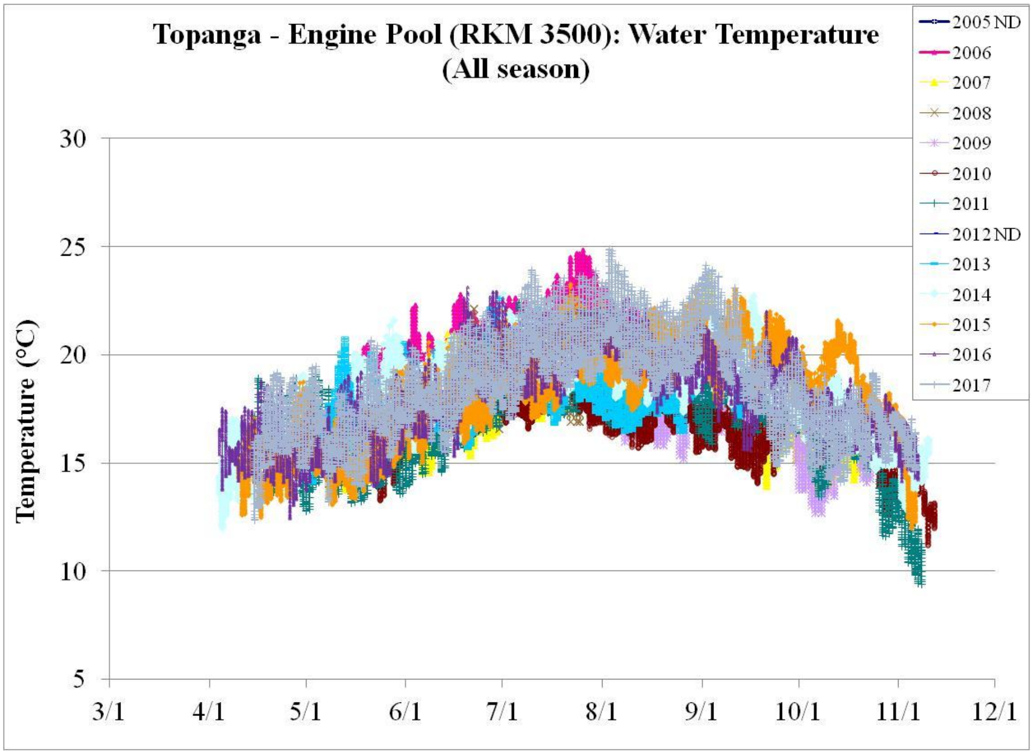

Topanga - Topanga Lagoon
Jul 12- Nov 02
2013
2014
2015
2016
2017
Proportion of time at temperature
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)

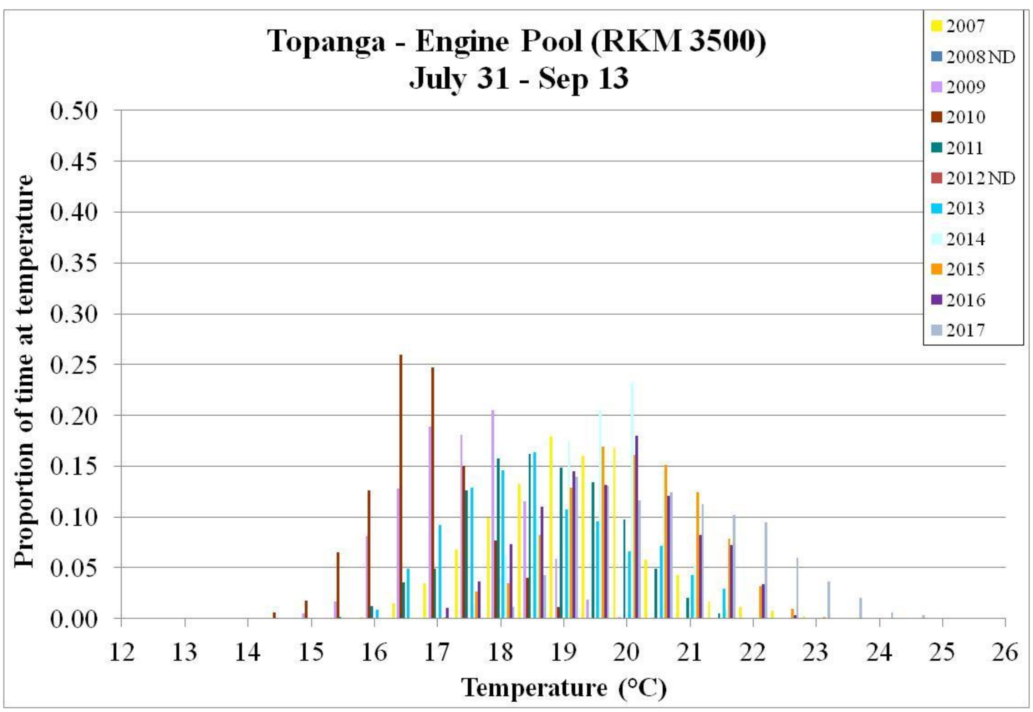

Topanga - Ski Pole Pool (RKM 2000): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005
2006
2007
2008 ND
2009
2010
2011
2012
2013
2014
2015
2016
2017

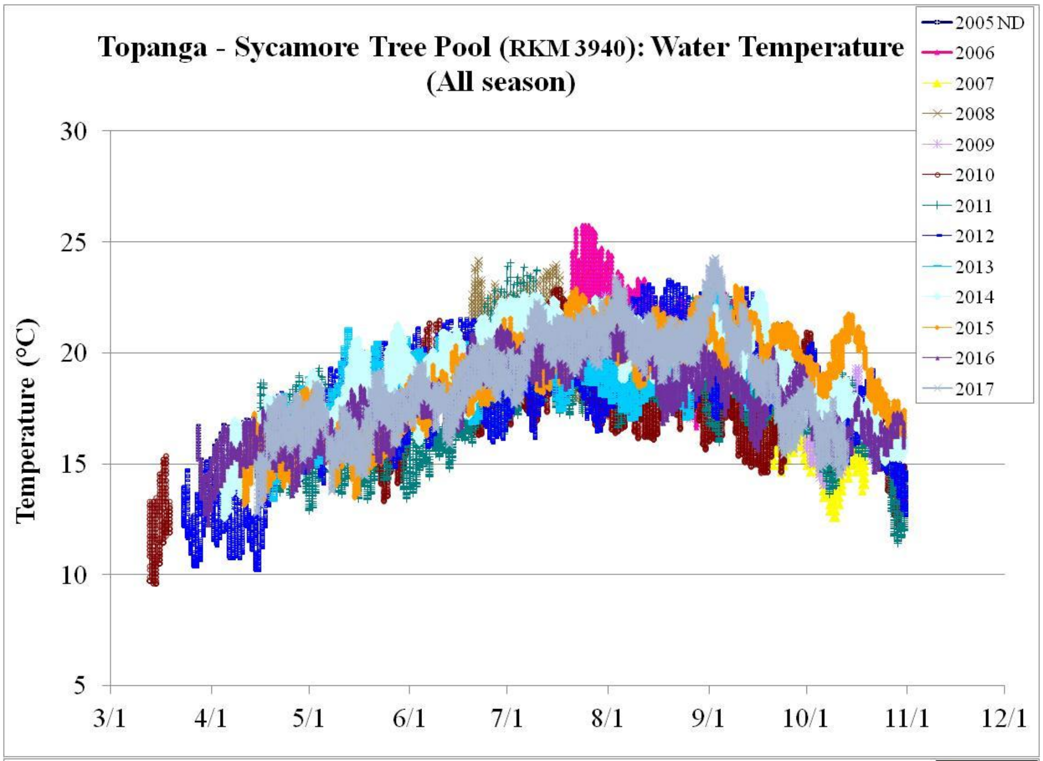

Topanga - Ski Pole Pool (RKM 2000)
Jul 31 - Sep 14
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2005
2006
2007
2008 ND
2009
2010
2011
2012
2013
2014
2015
2016
2017

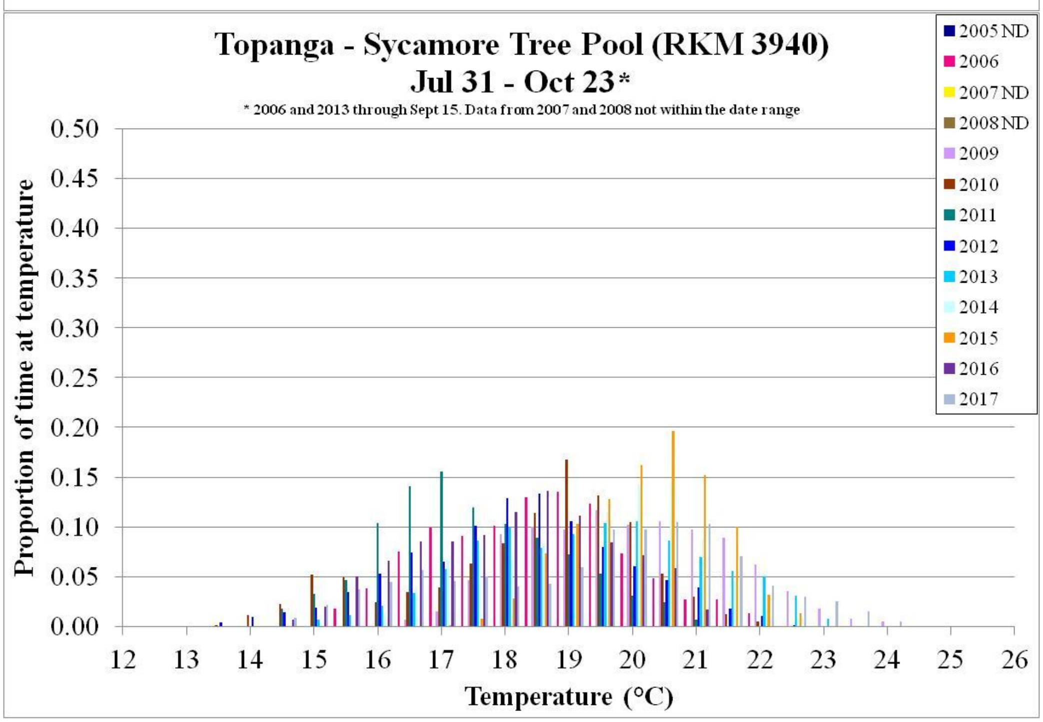

Topanga - Ken² Pool (RKM 2600): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

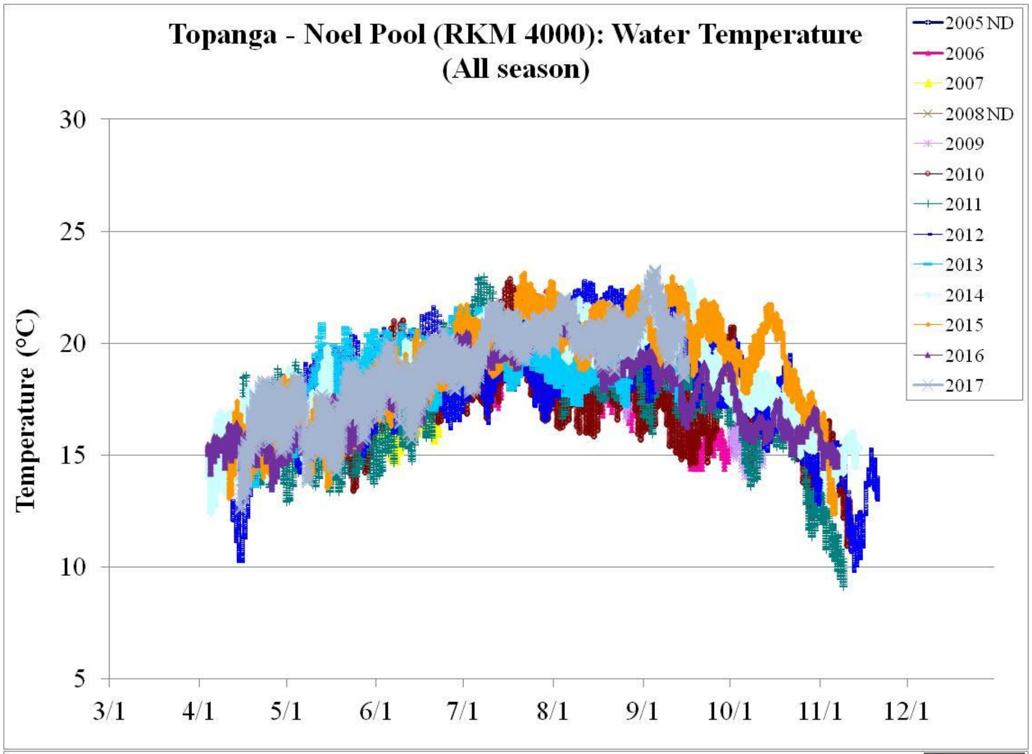

Topanga - Ken² Pool (RKM 2600)
Jul 31 - Sep 12
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

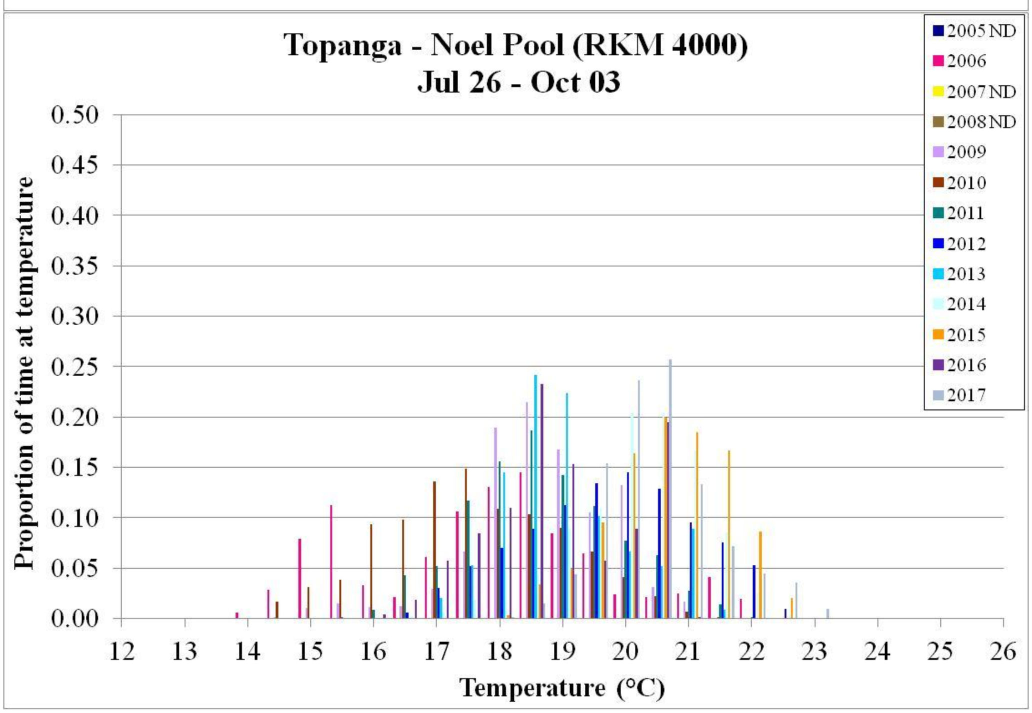

Topanga - Engine Pool (RKM 3500): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005 ND
2006
2007
2008
2009
2010
2011
2012 ND
2013
2014
2015
2016
2017

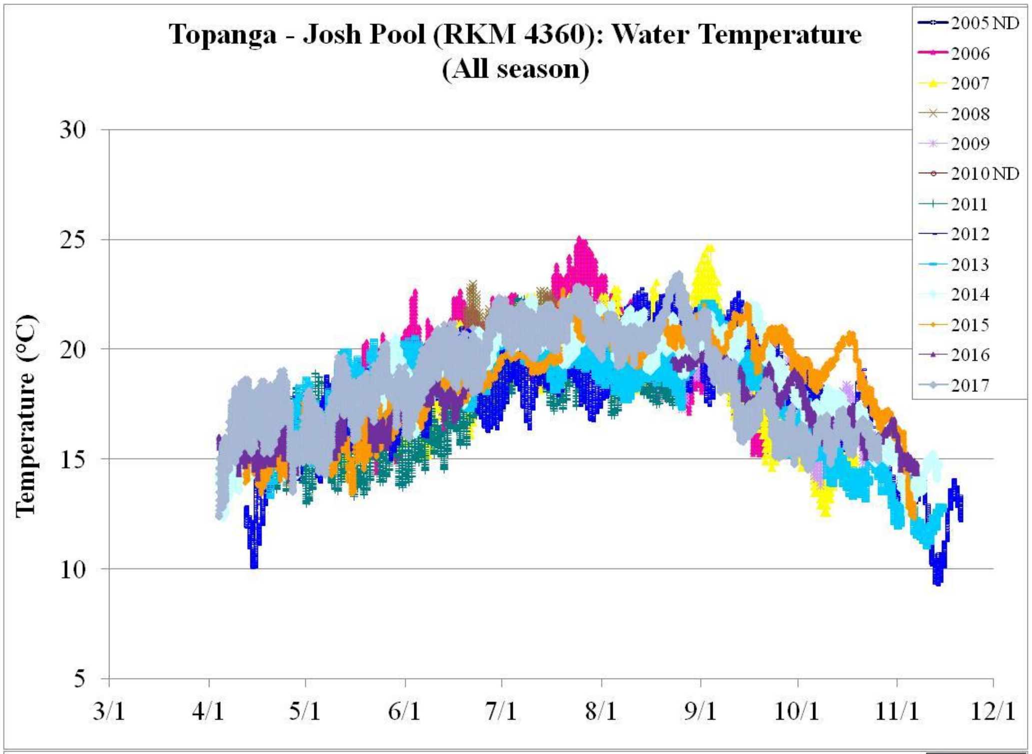

Topanga - Engine Pool (RKM 3500)
July 31 - Sep 13
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2007
2008 ND
2009
2010
2011
2012 ND
2013
2014
2015
2016
2017

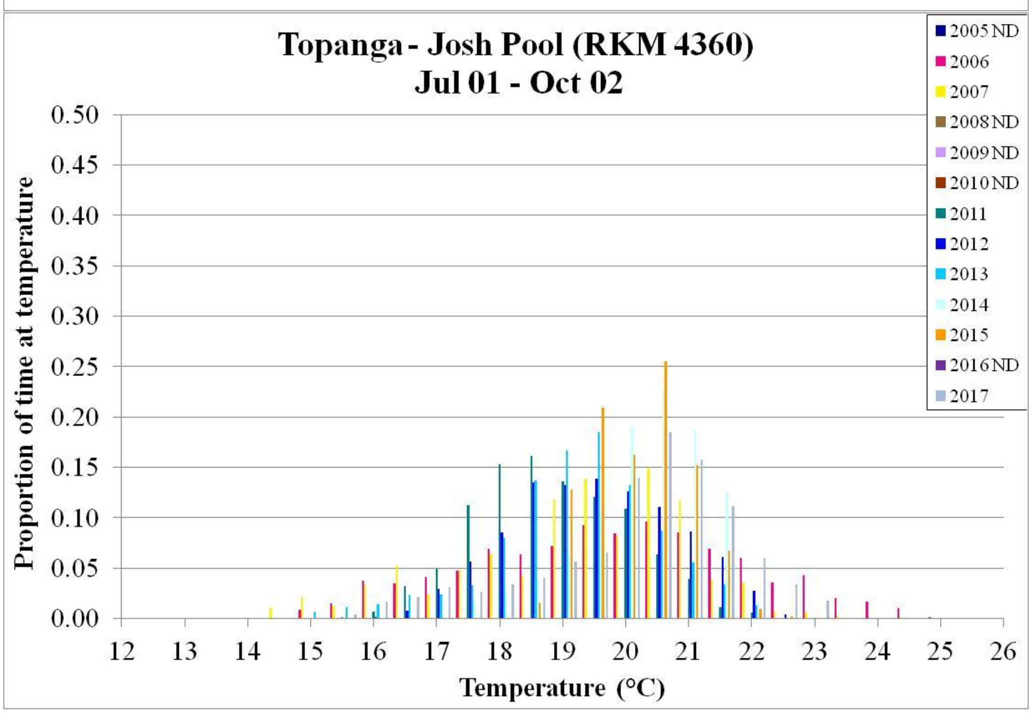

Topanga - Sycamore Tree Pool (RKM 3940): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005 ND
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

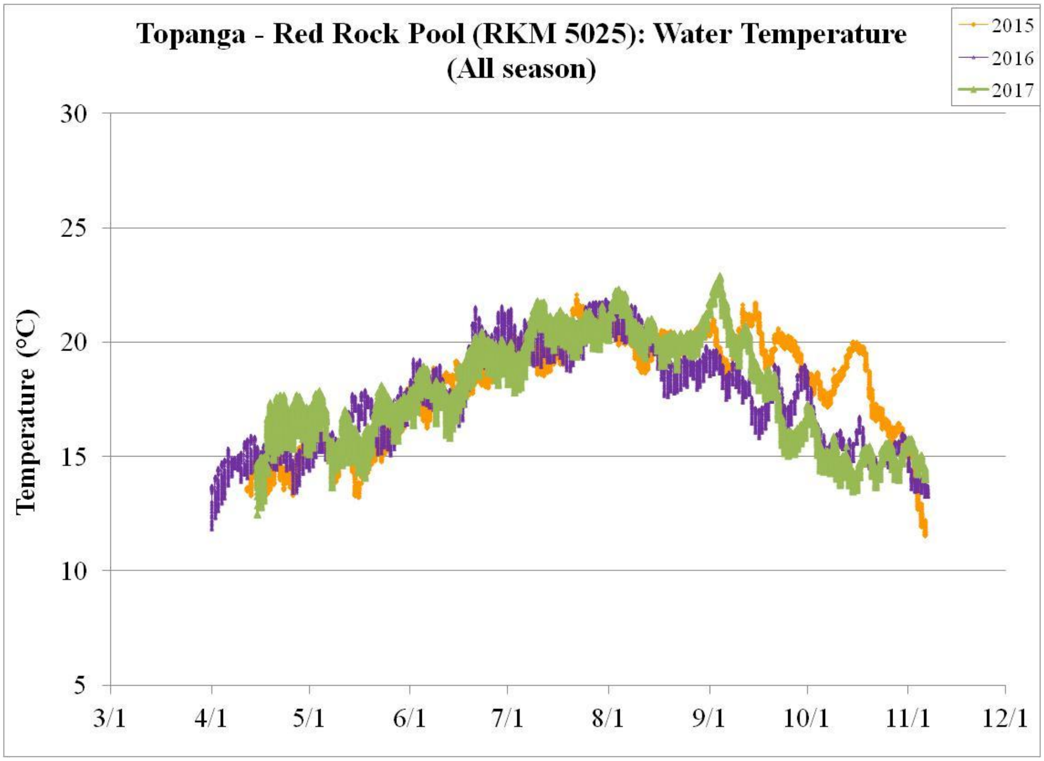

Topanga - Sycamore Tree Pool (RKM 3940)
Jul 31 - Oct 23*
* 2006 and 2013 through Sept 15. Data from 2007 and 2008 not within the date range
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2005 ND
2006
2007 ND
2008 ND
2009
2010
2011
2012
2013
2014
2015
2016
2017

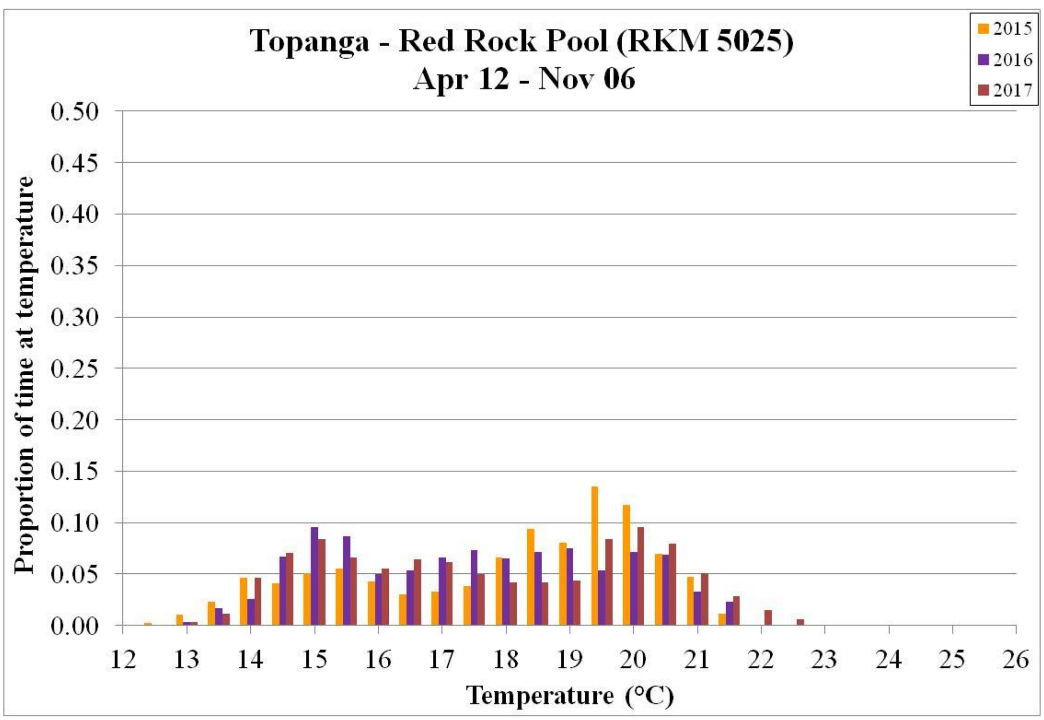

Topanga - Noel Pool (RKM 4000): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005 ND
2006
2007
2008 ND
2009
2010
2011
2012
2013
2014
2015
2016
2017

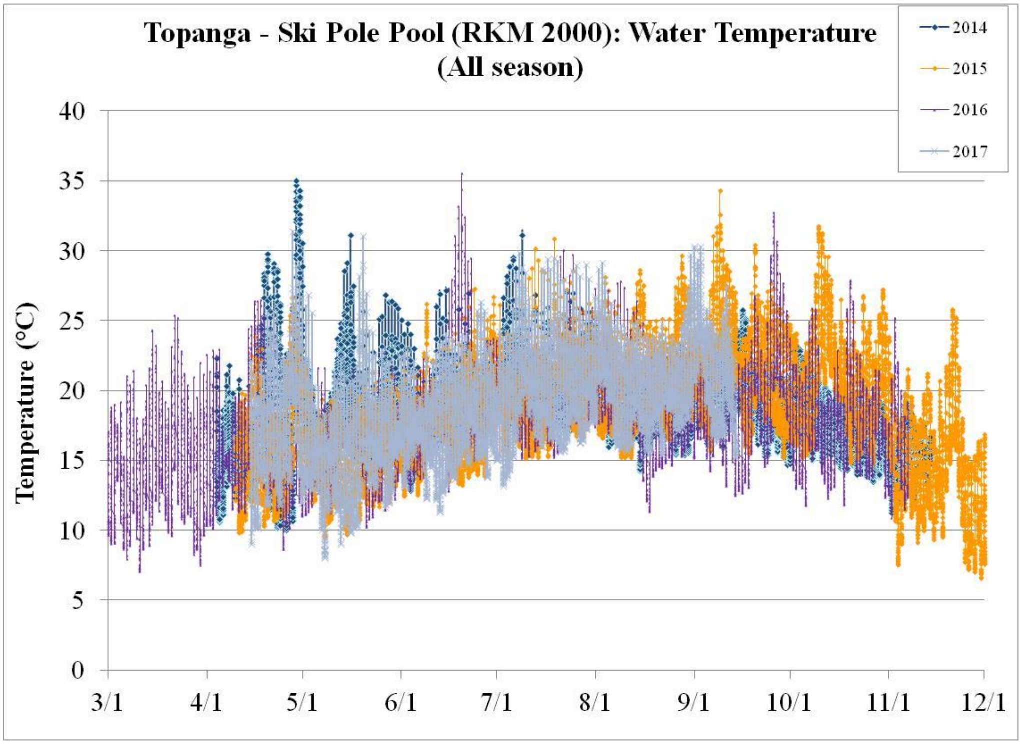

Topanga - Noel Pool (RKM 4000)
Jul 26 - Oct 03
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2005 ND
2006
2007 ND
2008 ND
2009
2010
2011
2012
2013
2014
2015
2016
2017

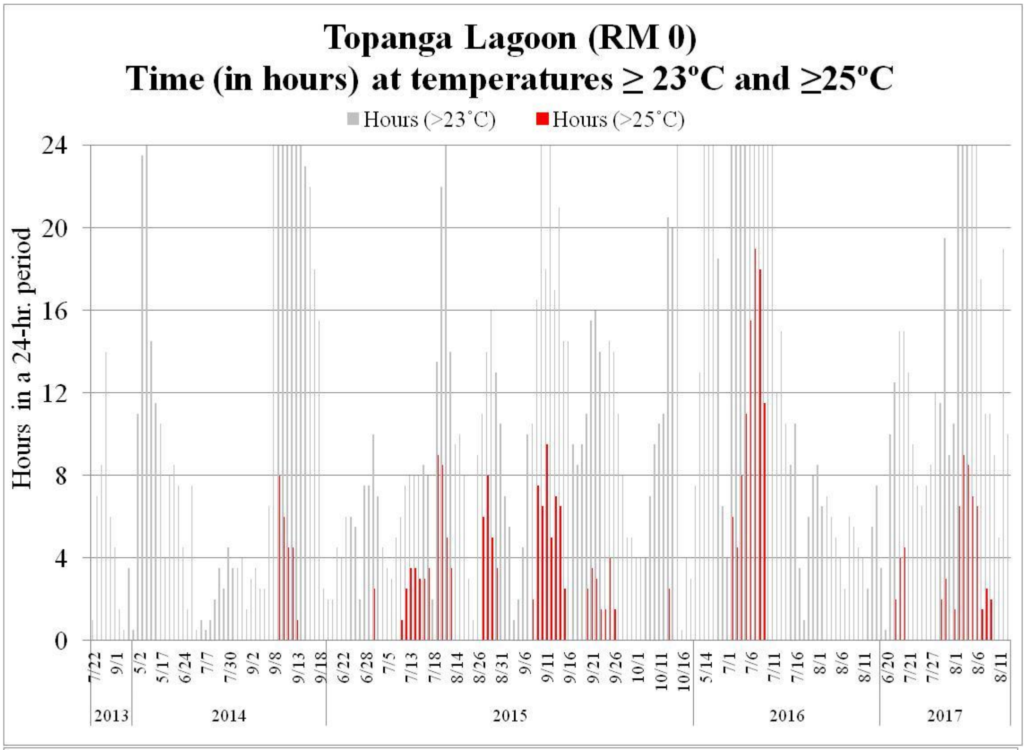

Topanga - Josh Pool (RKM 4360): Water Temperature
(All season)
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1
2005 ND
2006
2007
2008
2009
2010 ND
2011
2012
2013
2014
2015
2016
2017

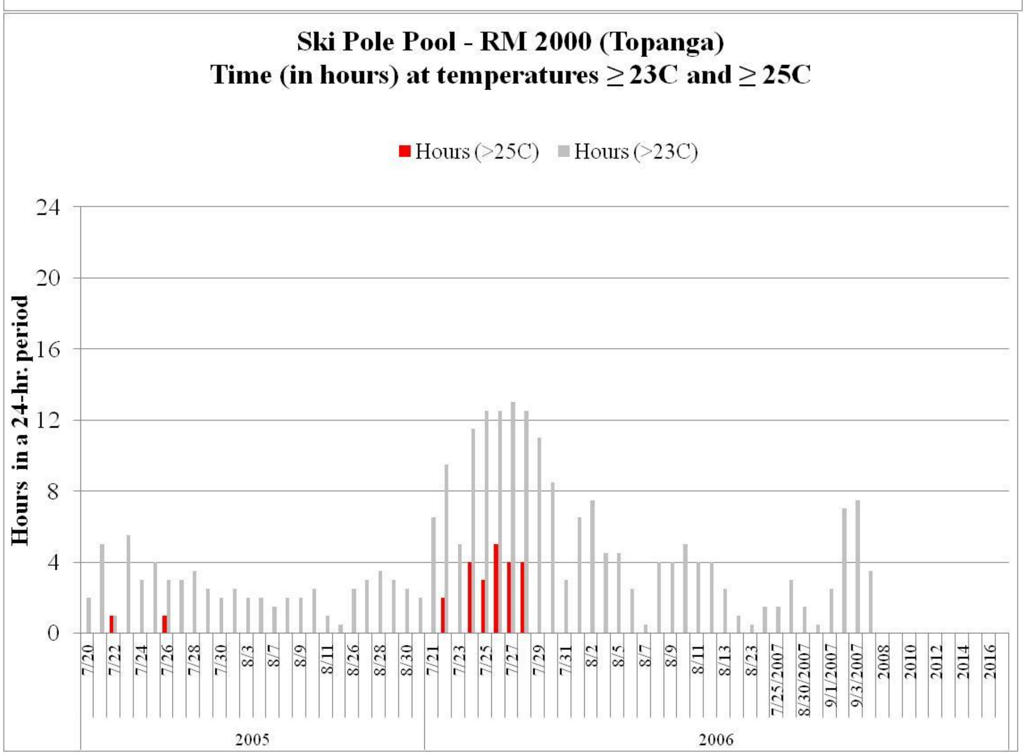

Topanga - Josh Pool (RKM 4360)
Jul 01 - Oct 02
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)
2005 ND
2006
2007
2008 ND
2009 ND
2010 ND
2011
2012
2013
2014
2015
2016 ND
2017

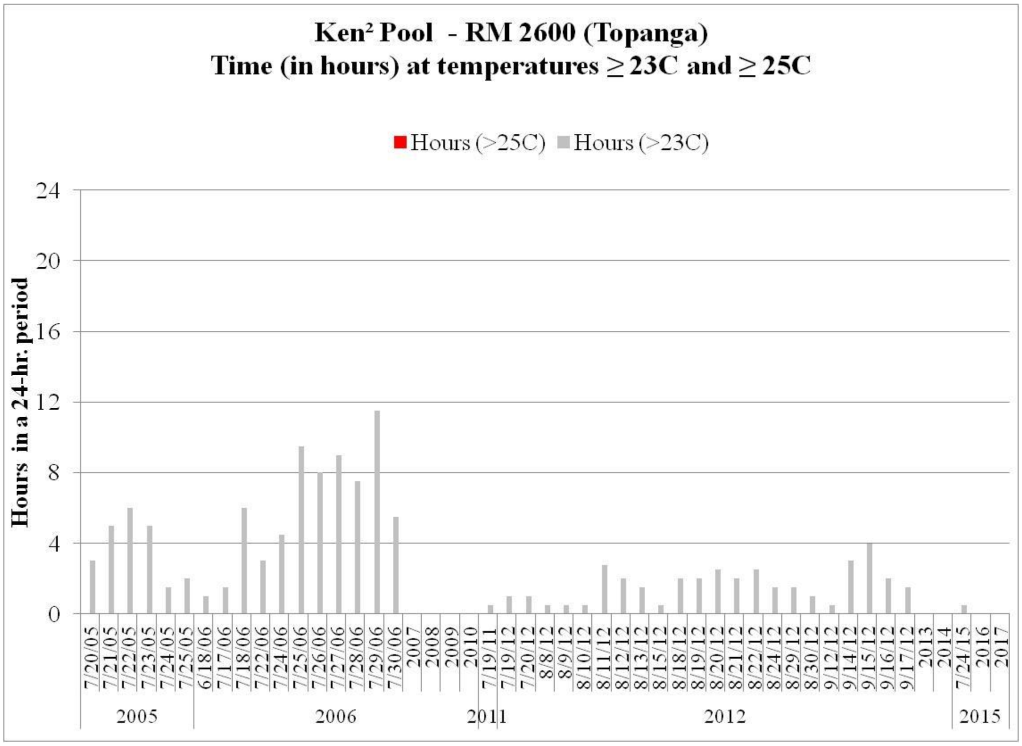

Topanga - Red Rock Pool (RKM 5025): Water Temperature
(All season)
2015
2016
2017
Temperature (°C)
30
25
20
15
10
5
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1

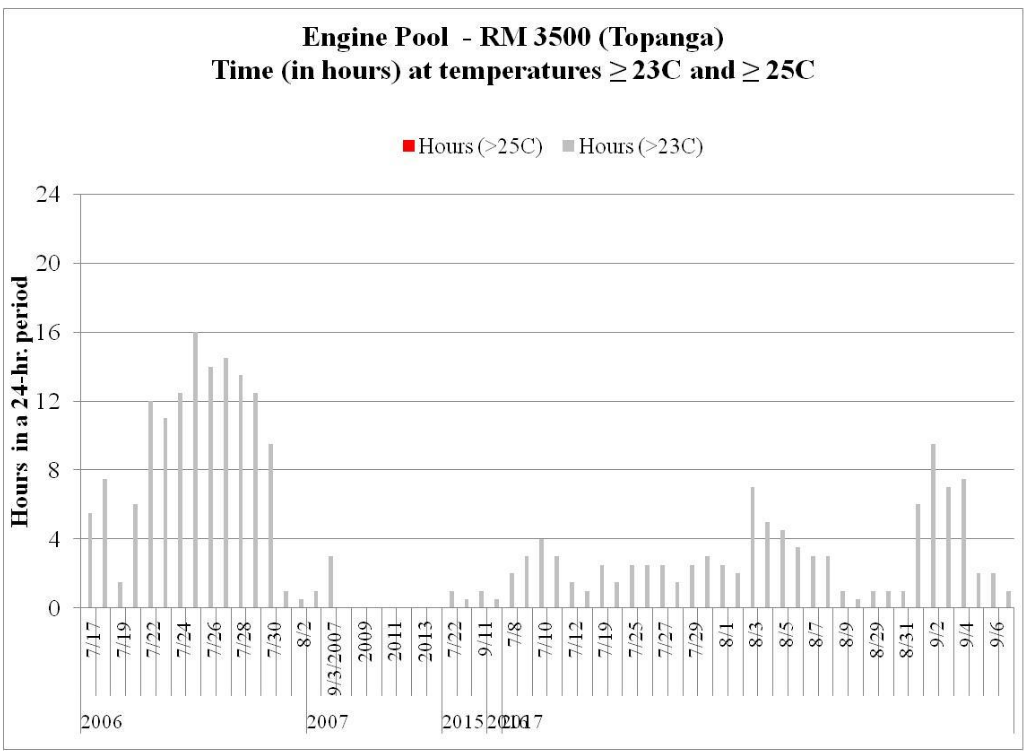

Topanga - Red Rock Pool (RKM 5025)
Apr 12 - Nov 06
2015
2016
2017
Proportion of time at temperature
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Temperature (°C)

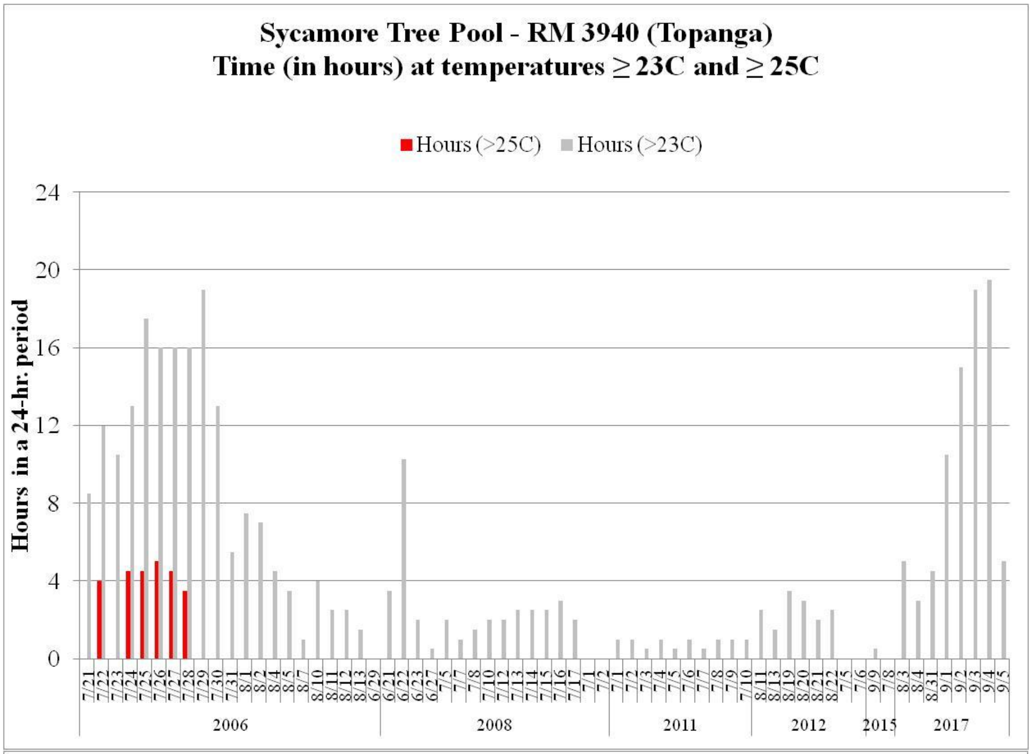

Topanga - Ski Pole Pool (RKM 2000): Water Temperature (All season)
2014
2015
2016
2017
Temperature (°C)
40
35
30
25
20
15
10
5
0
3/1
4/1
5/1
6/1
7/1
8/1
9/1
10/1
11/1
12/1

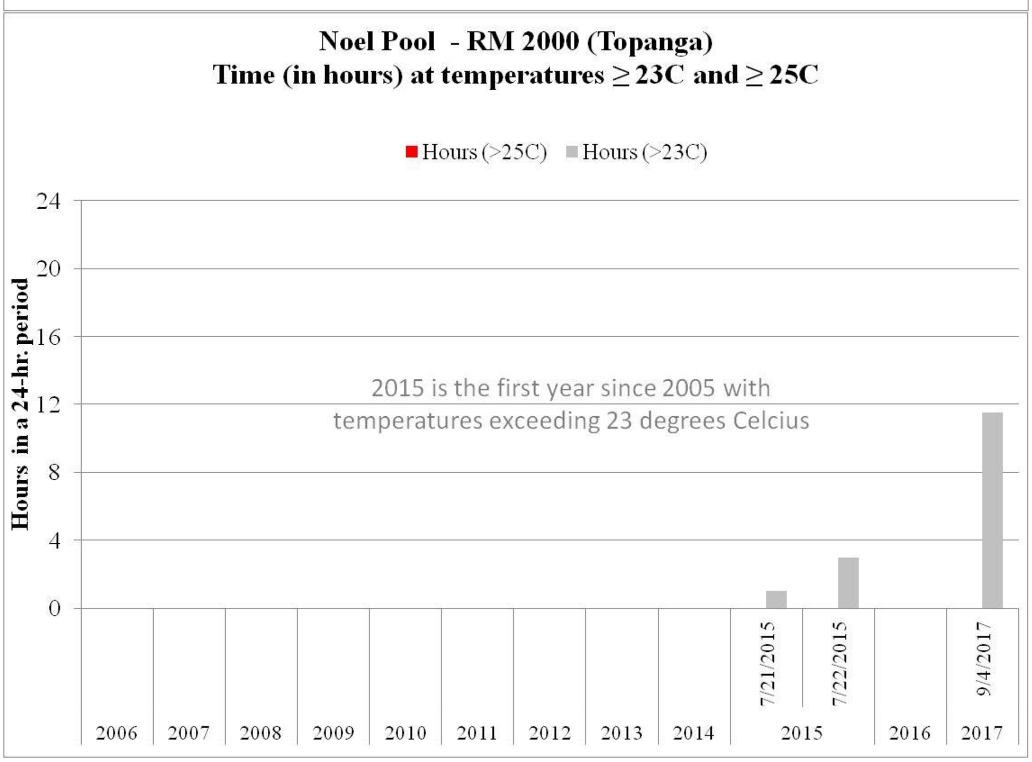

Topanga Lagoon (RM 0)
Time (in hours) at temperatures ≥ 23ºC and ≥25ºC
Hours (>23˚C)
Hours (>25˚C)
Hours in a 24-hr. period
2013
2014
2015
2016
2017

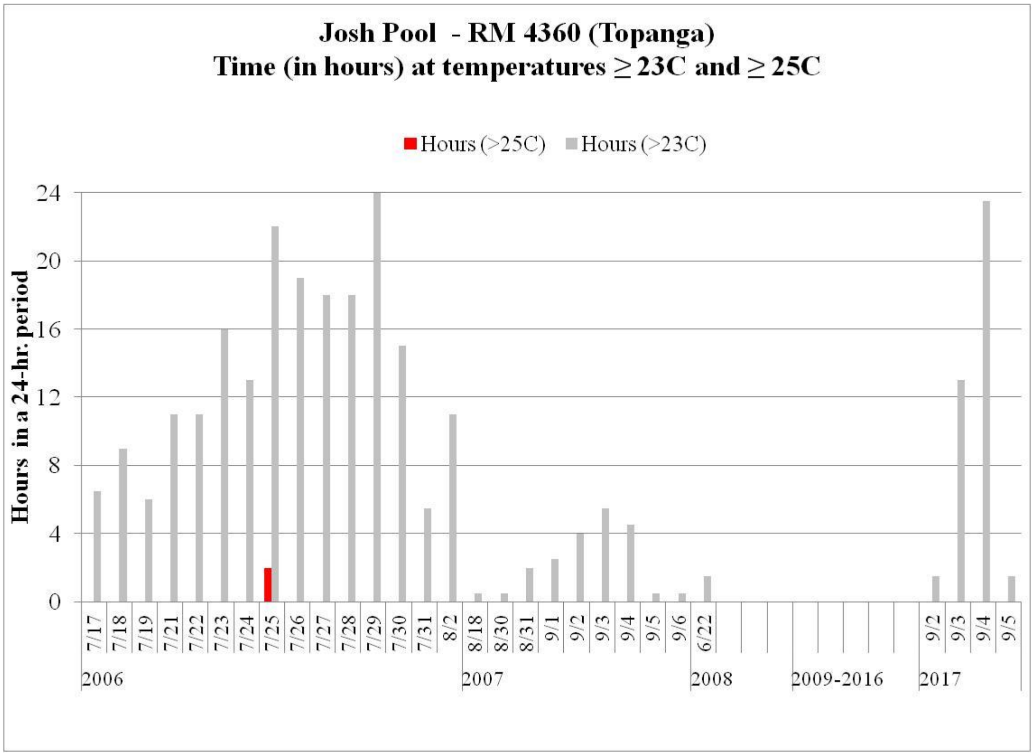

Ski Pole Pool - RM 2000 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
2005
2006

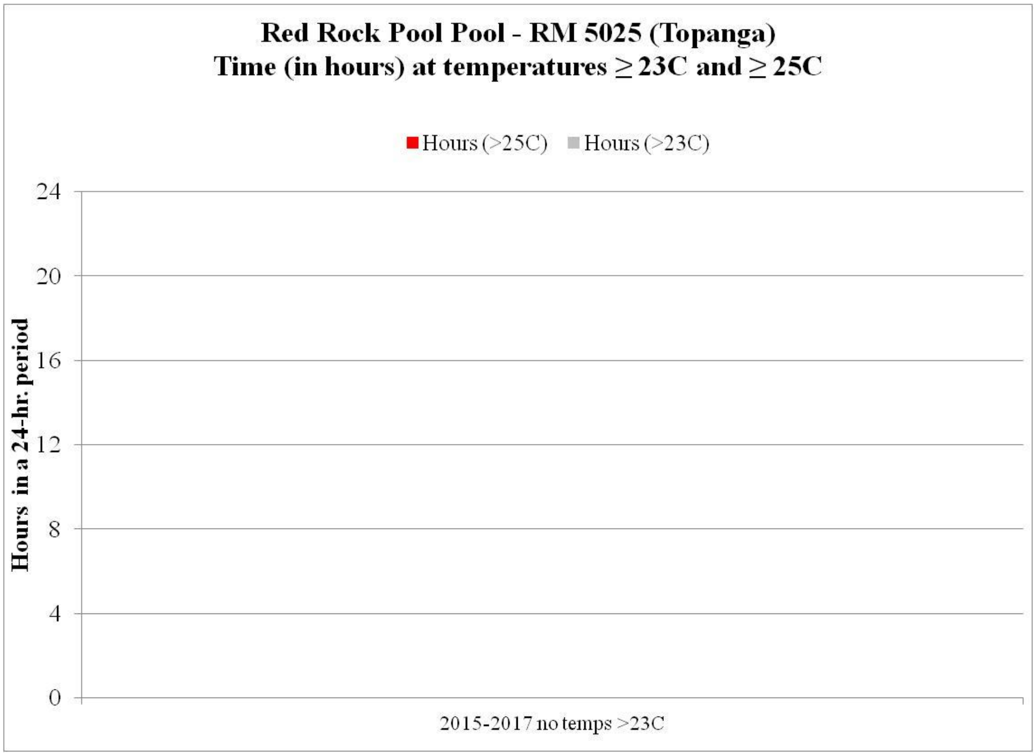

Ken² Pool - RM 2600 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
24
20
16
12
8
4
0
7/20/05
7/21/05
7/22/05
7/23/05
7/24/05
7/25/05
6/18/06
7/17/06
7/18/06
7/22/06
7/24/06
7/25/06
7/26/06
7/27/06
7/28/06
7/29/06
7/30/06
2007
2008
2009
2010
7/19/11
7/19/12
7/20/12
8/8/12
8/9/12
8/10/12
8/11/12
8/12/12
8/13/12
8/15/12
8/18/12
8/19/12
8/20/12
8/21/12
8/22/12
8/24/12
8/29/12
8/30/12
9/12/12
9/14/12
9/15/12
9/16/12
9/17/12
2013
2014
7/24/15
2016
2017
2005
2006
2011
2012
2015


Engine Pool - RM 3500 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
24
20
16
12
8
4
0
7/17
7/19
7/22
7/24
7/26
7/28
7/30
8/2
9/3/2007
2009
2011
2013
7/22
9/11
7/8
7/10
7/12
7/19
7/25
7/27
7/29
8/1
8/3
8/5
8/7
8/9
8/29
8/31
9/2
9/4
9/6
2006
2007
2015
2016
2017


Sycamore Tree Pool - RM 3940 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
24
20
16
12
8
4
0
2006
2008
2011
2012
2015
2017


Noel Pool - RM 2000 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
24
20
16
12
8
4
0
2015 is the first year since 2005 with
temperatures exceeding 23 degrees Celcius
7/21/2015
7/22/2015
9/4/2017
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Josh Pool - RM 4360 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
0
4
8
12
16
20
24
7/17
7/18
7/19
7/21
7/22
7/23
7/24
7/25
7/26
7/27
7/28
7/29
7/30
7/31
8/2
8/18
8/30
8/31
9/1
9/2
9/3
9/4
9/5
9/6
6/22
9/2
9/3
9/4
9/5
2006
2007
2008
2009-2016
2017


Red Rock Pool Pool - RM 5025 (Topanga)
Time (in hours) at temperatures ≥ 23C and ≥ 25C
Hours (>25C)
Hours (>23C)
Hours in a 24-hr. period
24
20
16
12
8
4
0
2015-2017 no temps >23C

Appendix F

Genetic Assignment Results

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M103799	ArGrMain	0.99961099	SYnzMain	0.00023099	SalTjara	0.000141	ArGrLBer	8.26E-06	SYnzHilt	3.34E-06
M027331	ArGrMain	0.99960812	SYnzMain	0.00020476	SYnzQuiota	8.98E-05	SYnzEFSC	7.67E-05	ArGrLBer	7.42E-06
M065235	ArGrMain	0.97472612	SalTjera	0.02299236	SYnzMain	0.00121006	SYnzHilt	0.00105014	SYnzSCrz	1.27E-05
M067368	ArGrMain	0.96466764	SYnzMain	0.01972457	SalTjera	0.01315793	SYnzHilt	0.00141858	SYnzSals	0.0010143
M045353	ArGrMain	0.96459447	SYnzMain	0.03125178	SYnzHilt	0.00414074	SYnzSals	5.28E-06	SaClaSaPa	3.30E-06
M038204	ArGrMain	0.90628436	SYnzMain	0.07250733	SYnzHilt	0.02109499	SYnzSals	6.70E-05	SaMaRey	2.65E-05
M027329	ArGrMain	0.87229814	SYnzMain	0.1276822	SYnzHilt	9.54E-06	SalTjara	5.91E-06	ArGrLBer	2.32E-06
M031363	ArGrMain	0.8479519	SYnzMain	0.09361991	SYnzSals	0.05806743	SYnzHilt	0.00035154	SanSim	8.67E-06
M031382	ArGrMain	0.82036343	SYnzMain	0.15998611	SYnzHilt	0.01882554	SYnzSals	0.00045161	SalTjera	0.00032772
M012440	ArGrMain	0.81609845	SYnzHilt	0.12894843	SYnzMain	0.05324324	SaMaRey	0.00057719	SalTjera	0.00042474
M062898	ArGrMain	0.77782881	SYnzHilt	0.18614713	SalTjera	0.02125983	SYnzMain	0.00690138	SYnzSals	0.003053
M011642	ArGrMain	0.77394215	SYnzHilt	0.22043611	SYnzMain	0.00553861	SaMaRey	6.43E-05	SaGaWFork	1.43E-05
M038189	ArGrMain	0.74313555	SYnzMain	0.24000038	SYnzHilt	0.01666569	SalTjara	0.00012666	SalTjera	3.38E-05
M031887	ArGrMain	0.73062859	SaGaWFork	0.19304922	SalTjera	0.0607032	SYnzMain	0.00707244	SYnzHilt	0.0045887
M102115	ArGrMain	0.72870942	SanSim	0.16662013	SYnzHilt	0.07309869	SYnzMain	0.0276782	SaMaRey	0.00317651
M020030	ArGrMain	0.70476998	SYnzMain	0.29500489	SYnzSCrz	0.00012413	SalTjara	9.22E-05	SalTjera	4.13E-06
M038190	ArGrMain	0.70392954	SYnzMain	0.160479	SYnzHilt	0.1344274	SalTjera	0.00061589	SaMaRey	0.00037932
M027330	ArGrMain	0.67244106	SYnzMain	0.31974036	SYnzWFSC	0.00376393	SYnzSCrz	0.00228001	SYnzHilt	0.00087677
M065301	ArGrMain	0.66377257	SYnzMain	0.24963668	SYnzSals	0.0472328	SYnzHilt	0.03722657	SalTjera	0.00111616
M065431	ArGrMain	0.60155909	SYnzHilt	0.25587752	SYnzMain	0.14213368	SaMaRey	0.00026938	SalTjera	0.00014268
M045411	ArGrMain	0.5763634	SYnzMain	0.21987248	SYnzHilt	0.20214535	SaMaRey	0.00105297	SalTjera	0.00027339
M031413	ArGrMain	0.51134669	SYnzMain	0.28674966	SalTjera	0.18905838	SaMaRey	0.00636662	ArGrLBer	0.00233006
M027333	ArGrMain	0.49974347	SYnzMain	0.328628	SalTjera	0.12433856	SYnzHilt	0.04717707	SaMaRey	4.94E-05
M038182	ArGrMain	0.49759631	SYnzHilt	0.49595862	SYnzMain	0.00641144	SalTjara	1.18E-05	SalTjera	1.02E-05
M031434	ArGrMain	0.37464878	SaGaWFork	0.3547531	SaClaLion	0.25778542	SanSim	0.00373297	SalTjera	0.00256917
M097904	FilHaCole	0.99999999	FilHaWyom	9.87E-09	SaGaWFork	4.19E-10	SaMaRey	6.09E-11	SYnzHilt	1.78E-11
M045412	FilHaCole	0.99846483	SYnzHilt	0.00128059	SaMaRey	0.00014014	SYnzMain	0.00011337	SYnzSals	4.47E-07
M102110	FilHaCole	0.99627138	SaMaRey	0.00162929	SaGaWFork	0.00119474	SYnzHilt	0.00088811	SYnzMain	8.82E-06
M045370	FilHaCole	0.99530246	SaMaRey	0.00467746	SYnzHilt	1.63E-05	SYnzMain	3.38E-06	SaClaSaPa	2.93E-07

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M097883	FilHaCole	0.99516768	SYnzHilt	0.0039183	SYnzMain	0.00087674	SanSim	2.10E-05	SaMaRey	1.58E-05
M065373	FilHaCole	0.98906272	SYnzHilt	0.00881959	SaMaRey	0.00169937	SaGaWFork	0.00020874	SYnzMain	0.00017327
M057061	FilHaCole	0.98220386	SYnzHilt	0.01742877	SYnzMain	0.00032652	SaMaRey	2.79E-05	ArGrMain	6.36E-06
M065210	FilHaCole	0.98017344	SYnzHilt	0.0114278	SaGaWFork	0.0049707	SaMaRey	0.00329054	SYnzMain	0.00013658
M031889	FilHaCole	0.97701329	SYnzHilt	0.01982989	SYnzMain	0.00315165	SaGaWFork	4.31E-06	SaMaRey	7.82E-07
M065214	FilHaCole	0.96274576	SaGaWFork	0.03501132	SYnzHilt	0.00204835	SYnzMain	0.00016434	SaMaRey	2.97E-05
M097896	FilHaCole	0.96264263	SaGaWFork	0.03349828	SYnzHilt	0.00315579	SaMaRey	0.00058311	SYnzMain	0.00011942
M038184	FilHaCole	0.95906009	SYnzHilt	0.03548007	SaMaRey	0.00486227	SYnzMain	0.00059756	SanSim	1.13E-08
M057053	FilHaCole	0.95495541	SYnzHilt	0.04483301	SYnzMain	0.0001137	SaMaRey	6.90E-05	SaGaWFork	2.23E-05
M062929	FilHaCole	0.95042875	SaGaWFork	0.04550845	SYnzHilt	0.00371696	SaMaRey	0.00021056	SYnzMain	0.00013279
M102095	FilHaCole	0.90585571	SaGaWFork	0.04685169	SYnzHilt	0.03630648	SYnzMain	0.00909977	SaMaRey	0.00183894
M031435	FilHaCole	0.89340734	SaMaRey	0.07115175	SYnzHilt	0.03436304	SYnzMain	0.00105995	SalTjera	1.48E-05
M102121	FilHaCole	0.89166399	SYnzHilt	0.06208979	SaGaWFork	0.03648937	SaMaRey	0.00845707	SYnzMain	0.00129159
M031428	FilHaCole	0.87887269	SYnzHilt	0.10782537	SYnzMain	0.01326257	SaMaRey	3.44E-05	SaGaWFork	2.98E-06
M102118	FilHaCole	0.80579405	SaMaRey	0.11235806	SYnzHilt	0.0737644	SYnzMain	0.00419419	SaGaWFork	0.00295922
M057062	FilHaCole	0.78718087	SaGaWFork	0.1001447	SYnzMain	0.05951402	SYnzHilt	0.05260959	SaMaRey	0.00041566
M038205	FilHaCole	0.62249712	SYnzHilt	0.36399099	SaMaRey	0.00880828	SYnzMain	0.00469785	ArGrMain	3.04E-06
M045462	FilHaCole	0.52018629	SYnzHilt	0.32402116	SaMaRey	0.12873692	SYnzMain	0.02510792	SaGaWFork	0.00193335
M065206	FilHaCole	0.51785942	SaGaWFork	0.39386427	SYnzHilt	0.08496465	SaMaRey	0.0018964	SYnzMain	0.00141499
M062995	FilHaCole	0.46333051	SYnzMain	0.28247132	SYnzHilt	0.17995462	SaMaRey	0.05511023	SaGaWFork	0.01858955
M065430	FilHaCole	0.39339284	SYnzHilt	0.33987793	SYnzMain	0.25372174	SaGaWFork	0.01003259	SaMaRey	0.00205676
M065416	FilHaCole	0.39285561	SYnzHilt	0.23509375	SaMaRey	0.17462681	SYnzMain	0.08579058	SaGaWFork	0.0638291
M063027	SaGaWFork	0.99989301	SYnzHilt	0.00010344	FilHaCole	2.03E-06	SYnzMain	1.52E-06	SaMaRey	7.65E-09
M062976	SaGaWFork	0.99989275	SYnzHilt	0.00010358	SYnzMain	1.82E-06	FilHaCole	1.15E-06	SaMaRey	6.53E-07
M038221	SaGaWFork	0.99983422	SYnzMain	6.04E-05	SYnzHilt	5.84E-05	FilHaCole	3.74E-05	SaMaRey	9.54E-06
M063001	SaGaWFork	0.9996681	SaMaRey	0.00022347	SalTjera	8.09E-05	SalTjara	8.54E-06	SYnzMain	7.36E-06
M038192	SaGaWFork	0.99960863	SYnzMain	0.00027387	SYnzHilt	8.93E-05	SaMaRey	2.48E-05	SalTjera	1.60E-06
M067356	SaGaWFork	0.99951955	SYnzHilt	0.00041069	SYnzMain	6.34E-05	SaGaEFork	2.34E-06	FilHaCole	2.05E-06
M062981	SaGaWFork	0.9994243	SYnzHilt	0.00043041	SaMaRey	8.03E-05	SYnzMain	4.42E-05	FilHaCole	2.08E-05
M065394	SaGaWFork	0.9993871	FilHaCole	0.00025383	SYnzMain	0.00024935	SYnzHilt	8.78E-05	ArGrMain	1.83E-05

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M053049	SaGaWFork	0.99860613	SYnzMain	0.00079983	SYnzHilt	0.00059348	ArGrMain	3.10E-07	SalTjera	1.46E-07
M031447	SaGaWFork	0.99771745	SYnzHilt	0.00134156	SYnzMain	0.00085734	ArGrMain	4.08E-05	SYnzSals	2.57E-05
M031451	SaGaWFork	0.99768979	SalTjera	0.00135317	SYnzMain	0.00045999	SaMaRey	0.00032519	SaClaLion	8.89E-05
M012442	SaGaWFork	0.99763669	FilHaCole	0.00137306	SYnzHilt	0.00094423	SYnzMain	4.50E-05	SaMaRey	9.84E-07
M103794	SaGaWFork	0.99750536	SYnzHilt	0.00247084	SaMaRey	1.64E-05	SYnzMain	5.39E-06	SaAnSaAnt	1.10E-06
M065226	SaGaWFork	0.9973037	SYnzHilt	0.0025947	SYnzMain	6.25E-05	SanSim	2.45E-05	ArGrMain	1.45E-05
M057079	SaGaWFork	0.99725999	SYnzHilt	0.00230155	SYnzMain	0.00042248	FilHaCole	1.59E-05	SaGaEFork	9.05E-08
M062934	SaGaWFork	0.99636698	SYnzHilt	0.00221092	SaMaRey	0.00090015	SYnzMain	0.0005033	FilHaCole	1.71E-05
M092339	SaGaWFork	0.99611157	SYnzHilt	0.00224242	FilHaCole	0.00158014	SYnzMain	3.37E-05	SaMaRey	2.70E-05
M031417	SaGaWFork	0.99594953	FilHaCole	0.00319694	SYnzMain	0.00049981	SYnzHilt	0.00030582	SaMaRey	4.63E-05
M062949	SaGaWFork	0.9926404	FilHaCole	0.00506407	SYnzHilt	0.00138253	SYnzMain	0.0009107	SaMaRey	2.13E-06
M065161	SaGaWFork	0.9923739	SYnzHilt	0.00760744	SYnzMain	1.29E-05	SaClaLion	1.71E-06	ArGrMain	1.66E-06
M102156	SaGaWFork	0.99007643	SYnzHilt	0.00618356	FilHaCole	0.00322819	SaMaRey	0.00035264	SYnzMain	7.00E-05
M067366	SaGaWFork	0.98974765	FilHaCole	0.01023787	SaGaEFork	1.40E-05	SYnzMain	2.60E-07	SYnzHilt	2.14E-07
M031420	SaGaWFork	0.98965014	ArGrMain	0.00667921	SYnzHilt	0.00220976	SaMaRey	0.00098702	SaClaSesp	0.00018595
M062973	SaGaWFork	0.98854951	SaMaRey	0.00965335	FilHaCole	0.00153922	SYnzHilt	0.00025627	SYnzMain	1.62E-06
M065424	SaGaWFork	0.98813456	SYnzMain	0.00666126	SYnzHilt	0.00508843	ArGrMain	9.85E-05	SaMaRey	1.58E-05
M038224	SaGaWFork	0.98794363	SYnzHilt	0.00978945	SYnzMain	0.0017656	FilHaCole	0.00048241	SaMaRey	1.41E-05
M062983	SaGaWFork	0.98781129	SYnzHilt	0.01085769	SYnzMain	0.00132147	ArGrMain	8.38E-06	SaMaRey	9.24E-07
M092302	SaGaWFork	0.98665394	SYnzHilt	0.0129937	SYnzMain	0.00021619	FilHaCole	0.00013593	SaMaRey	2.17E-07
M062931	SaGaWFork	0.98590474	FilHaCole	0.01213521	SaMaRey	0.00093693	SYnzHilt	0.00063657	SYnzMain	0.00038621
M065425	SaGaWFork	0.97788095	SYnzMain	0.01208571	SYnzHilt	0.00971867	SaMaRey	0.00020984	FilHaCole	5.14E-05
M038255	SaGaWFork	0.97696621	SYnzHilt	0.0128641	FilHaCole	0.00711369	SaMaRey	0.00202069	SYnzMain	0.00077057
M062930	SaGaWFork	0.97661888	SYnzHilt	0.0132029	SYnzMain	0.00651101	SaMaRey	0.00344122	ArGrMain	0.00022576
M062938	SaGaWFork	0.97620013	SYnzHilt	0.02310023	SYnzMain	0.00045025	ArGrMain	0.00019695	SaMaRey	4.78E-05
M062991	SaGaWFork	0.97580747	SaMaRey	0.0186901	SYnzMain	0.00328637	SYnzHilt	0.00198828	FilHaCole	0.00022366
M065240	SaGaWFork	0.97414352	SYnzMain	0.0181553	SYnzHilt	0.00516805	SaMaRey	0.0013849	ArGrMain	0.00065736
M062893	SaGaWFork	0.97333361	SYnzMain	0.01142713	SYnzHilt	0.0083628	SaMaRey	0.00365082	SYnzSals	0.00308806
M097895	SaGaWFork	0.97252994	SYnzHilt	0.02728583	SYnzMain	0.00018178	ArGrMain	1.74E-06	SaMaRey	5.98E-07
M102177	SaGaWFork	0.96430332	SYnzHilt	0.03549749	SYnzMain	0.00013534	SaMaRey	6.21E-05	SaClaSaPa	1.76E-06

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065417	SaGaWFork	0.96376218	SYnzMain	0.02108516	SYnzHilt	0.00684091	FilHaCole	0.00580237	SaMaRey	0.00241442
M065205	SaGaWFork	0.96017338	SaMaRey	0.03124023	SYnzHilt	0.00544919	FilHaCole	0.00111625	SYnzMain	0.00109729
M103782	SaGaWFork	0.95424662	SYnzHilt	0.03356745	SaMaRey	0.01099399	SYnzMain	0.00118043	SaClaSaPa	9.88E-06
M065159	SaGaWFork	0.95085293	SYnzMain	0.02201811	SaMaRey	0.01958142	SYnzHilt	0.00741303	SanSim	0.00012835
M065267	SaGaWFork	0.94670053	SYnzMain	0.03663043	SaMaRey	0.01130885	SYnzHilt	0.0039935	FilHaCole	0.00099049
M038254	SaGaWFork	0.93466318	SYnzHilt	0.02637678	SYnzMain	0.01691518	FilHaCole	0.01425487	SaMaRey	0.00569121
M062878	SaGaWFork	0.93198897	SYnzHilt	0.06566405	SYnzMain	0.00222757	SaMaRey	0.00010883	FilHaCole	9.19E-06
M065207	SaGaWFork	0.92903346	FilHaCole	0.03018291	SYnzHilt	0.02400944	ArGrMain	0.01078276	SYnzMain	0.00404979
M045452	SaGaWFork	0.92563079	SYnzHilt	0.0472905	SanSim	0.02487206	SYnzMain	0.00202173	ArGrMain	0.00014404
M097893	SaGaWFork	0.91541169	SYnzHilt	0.07312726	SaMaRey	0.00867256	SYnzMain	0.00278459	SanSim	2.17E-06
M011640	SaGaWFork	0.89837464	SYnzHilt	0.09314127	SaMaRey	0.00801865	SYnzMain	0.00032287	FilHaCole	0.00014228
M038209	SaGaWFork	0.89723189	SYnzHilt	0.07901288	SaMaRey	0.01855498	SYnzMain	0.00378029	FilHaCole	0.00140615
M038213	SaGaWFork	0.89010561	SYnzHilt	0.10219352	SYnzMain	0.00715028	SaMaRey	0.00044101	FilHaCole	0.0001061
M038216	SaGaWFork	0.8790355	SYnzHilt	0.1066235	SYnzMain	0.01431126	ArGrMain	2.76E-05	SaMaRey	1.72E-06
M092312	SaGaWFork	0.87614425	FilHaCole	0.12353955	SYnzHilt	0.00027923	SYnzMain	3.55E-05	SaMaRey	1.37E-06
M045467	SaGaWFork	0.87164432	SaMaRey	0.12650229	SYnzHilt	0.00100915	FilHaCole	0.00058975	SYnzMain	0.00019016
M065332	SaGaWFork	0.87028411	SYnzMain	0.11678935	SYnzHilt	0.01150807	SaMaRey	0.00076053	FilHaCole	0.00040056
M012441	SaGaWFork	0.86474067	SYnzHilt	0.12037342	SYnzMain	0.00678538	FilHaCole	0.00627626	SaMaRey	0.00142204
M065155	SaGaWFork	0.85650454	SYnzHilt	0.12433403	SYnzMain	0.01812576	FilHaCole	0.00065027	SaMaRey	0.00038537
M102171	SaGaWFork	0.84452333	SYnzHilt	0.15305495	SaMaRey	0.00175887	SYnzMain	0.00065042	SalTjera	7.93E-06
M062912	SaGaWFork	0.84010399	SYnzHilt	0.15768026	SYnzMain	0.00219921	ArGrMain	1.65E-05	SaGaEFork	2.58E-08
M045440	SaGaWFork	0.83674618	SYnzMain	0.15756882	SYnzHilt	0.0046625	SaMaRey	0.00091769	ArGrMain	5.55E-05
M065337	SaGaWFork	0.83148301	SYnzHilt	0.09611942	SaMaRey	0.03740731	SYnzMain	0.02749206	SalTjera	0.00740608
M092328	SaGaWFork	0.82504354	SYnzHilt	0.1420721	FilHaCole	0.02423521	SaMaRey	0.00712742	SYnzMain	0.00149418
M062942	SaGaWFork	0.76714783	SYnzMain	0.12566947	SYnzHilt	0.07372195	ArGrMain	0.02430205	SaMaRey	0.00780434
M062945	SaGaWFork	0.76677933	SYnzHilt	0.14621222	SaMaRey	0.03915783	ArGrMain	0.03050458	SYnzMain	0.01731018
M062882	SaGaWFork	0.76026699	SYnzHilt	0.22155229	FilHaCole	0.01201214	SYnzMain	0.00318795	SaMaRey	0.00288961
M038211	SaGaWFork	0.75158876	SaMaRey	0.15838681	SYnzHilt	0.04708285	SYnzMain	0.03792739	SYnzSals	0.00273083
M062986	SaGaWFork	0.71429658	SYnzHilt	0.2540399	SaMaRey	0.01723582	SYnzMain	0.0143417	FilHaCole	4.39E-05
M062979	SaGaWFork	0.69441881	SYnzHilt	0.21019542	SYnzMain	0.07739979	ArGrMain	0.01794313	SaClaSaPa	2.15E-05

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M063011	SaGaWFork	0.68628032	SaMaRey	0.17463153	SYnzHilt	0.11699748	SYnzMain	0.0219285	FilHaCole	0.0001257
M031425	SaGaWFork	0.67919781	SYnzMain	0.15735979	SYnzHilt	0.13721126	SalTjera	0.02185868	ArGrMain	0.00212616
M045430	SaGaWFork	0.67872608	SYnzMain	0.1947475	SaMaRey	0.09843506	SYnzHilt	0.02701346	SanSim	0.0006498
M057077	SaGaWFork	0.67187017	SYnzHilt	0.14946147	FilHaCole	0.11892036	SYnzMain	0.03130947	SaMaRey	0.02843825
M102102	SaGaWFork	0.66085941	FilHaCole	0.33913842	SalTjera	8.19E-07	SYnzMain	6.52E-07	SYnzHilt	6.42E-07
M062860	SaGaWFork	0.65079855	SYnzHilt	0.3064854	SYnzMain	0.02314155	SalTjera	0.01863924	FilHaCole	0.00042607
M038180	SaGaWFork	0.64686647	SYnzHilt	0.34574779	SYnzMain	0.00732297	SaMaRey	4.88E-05	SalTjera	6.50E-06
M045415	SaGaWFork	0.64353917	SYnzHilt	0.28848856	SYnzMain	0.06550022	SanSim	0.00109075	SaMaRey	0.00107127
M012434	SaGaWFork	0.64222552	SYnzHilt	0.30927715	SYnzMain	0.02321704	SaMaRey	0.01474431	FilHaCole	0.01045921
M102144	SaGaWFork	0.63031849	SYnzHilt	0.30362782	SYnzMain	0.05709389	ArGrMain	0.00853474	SaMaRey	0.000319
M065371	SaGaWFork	0.62706688	SYnzHilt	0.34797132	SYnzMain	0.02273171	SaMaRey	0.00101442	SaClaSaPa	0.00082087
M062936	SaGaWFork	0.61505971	FilHaCole	0.30285602	SYnzHilt	0.04976783	SYnzMain	0.02638183	SaMaRey	0.0059318
M065194	SaGaWFork	0.59675259	SYnzHilt	0.29054973	FilHaCole	0.10299863	SYnzMain	0.00586832	SaMaRey	0.00371018
M062902	SaGaWFork	0.59186909	SYnzHilt	0.33950505	ArGrMain	0.04597936	SYnzMain	0.02057704	SYnzSals	0.00197254
M031378	SaGaWFork	0.58893235	SYnzHilt	0.3027951	SaMaRey	0.091979	FilHaCole	0.0141496	SYnzMain	0.00205103
M038252	SaGaWFork	0.57791599	FilHaCole	0.42171781	SaMaRey	0.00036254	SYnzHilt	2.54E-06	SalTjera	7.81E-07
M062948	SaGaWFork	0.57226322	SYnzHilt	0.19112631	SaMaRey	0.17771108	SYnzMain	0.03661281	ArGrMain	0.01962202
M065418	SaGaWFork	0.56418417	SYnzHilt	0.27093191	SaMaRey	0.10461304	ArGrMain	0.04074182	SYnzMain	0.0110337
M045437	SaGaWFork	0.5154787	SYnzHilt	0.46197125	SYnzMain	0.02241653	SaMaRey	0.00011884	ArGrMain	6.95E-06
M053044	SaGaWFork	0.51490664	SYnzMain	0.36700271	SaMaRey	0.09445143	SYnzHilt	0.01710003	FilHaCole	0.00646455
M067363	SaGaWFork	0.48420798	SaMaRey	0.27947842	SYnzHilt	0.22974837	SYnzMain	0.00648905	SanSim	3.09E-05
M062943	SaGaWFork	0.47121795	SaMaRey	0.45036107	FilHaCole	0.03925184	SYnzHilt	0.02141201	SYnzMain	0.01770468
M062975	SaGaWFork	0.47027449	SYnzHilt	0.44489183	SYnzMain	0.08473874	SalTjera	9.00E-05	SaMaRey	2.84E-06
M045350	SaGaWFork	0.42195377	SYnzMain	0.26401548	SaMaRey	0.19543347	SYnzHilt	0.08462172	FilHaCole	0.03395515
M065152	SaGaWFork	0.41654105	SYnzHilt	0.40470924	SYnzMain	0.10758093	ArGrMain	0.07063986	SanSim	0.00045742
M067380	SalTjera	0.99964781	ArGrMain	0.0002968	SYnzMain	4.37E-05	SYnzSals	8.73E-06	SYnzHilt	2.97E-06
M038196	SalTjera	0.99482891	SYnzMain	0.00390687	SYnzHilt	0.00125736	ArGrMain	3.62E-06	SaGaWFork	2.26E-06
M038258	SalTjera	0.99353008	SYnzMain	0.00242807	SYnzSals	0.00158711	SaMaRey	0.00137763	SYnzHilt	0.00067014
M102099	SalTjera	0.99121016	SaGaWFork	0.00650865	SYnzMain	0.00220746	SYnzHilt	3.83E-05	ArGrMain	2.11E-05
M062959	SalTjera	0.99059578	SYnzMain	0.00670404	SYnzHilt	0.00165605	SYnzSals	0.00076229	SaMaRey	0.00027591

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065328	SalTjera	0.98383614	SYnzMain	0.01262527	SaMaRey	0.00310263	SYnzHilt	0.0003232	SYnzSals	9.85E-05
M053039	SalTjera	0.98198817	SYnzHilt	0.0130154	SaGaWFork	0.00256018	SYnzMain	0.00212547	FilHaCole	0.00030717
M092326	SalTjera	0.97782863	SYnzMain	0.01452999	SYnzSals	0.00672744	SYnzHilt	0.00086963	SaMaRey	3.49E-05
M062888	SalTjera	0.97704452	SYnzHilt	0.01275844	SYnzMain	0.00947196	SaMaRey	0.00050894	SYnzSals	0.00012917
M031419	SalTjera	0.970698	SaMaRey	0.0141043	SYnzHilt	0.01294956	SYnzSals	0.00106062	SYnzMain	0.00068711
M102097	SalTjera	0.96705082	SYnzMain	0.02934233	ArGrMain	0.00293334	SYnzSals	0.00048022	SYnzHilt	0.00010963
M067362	SalTjera	0.96388216	ArGrMain	0.03570412	SYnzMain	0.00025846	SYnzSals	7.55E-05	SYnzHilt	5.33E-05
M031440	SalTjera	0.96375056	SYnzMain	0.0206422	SYnzHilt	0.00783377	SYnzSals	0.0037972	SaMaRey	0.00129435
M067374	SalTjera	0.95934431	SYnzMain	0.03920895	SYnzHilt	0.00060528	SYnzSals	0.0005586	ArGrMain	0.00016921
M092337	SalTjera	0.95540584	SYnzHilt	0.04101823	SanSim	0.00109025	SYnzMain	0.00089144	ArGrMain	0.00071071
M065324	SalTjera	0.944005	SYnzHilt	0.0359996	SYnzMain	0.01996199	ArGrMain	2.07E-05	SalTjara	8.70E-06
M062987	SalTjera	0.93442575	SaGaWFork	0.03111283	SYnzHilt	0.02401585	SYnzMain	0.00992614	SaMaRey	0.00032892
M062996	SalTjera	0.92685369	SYnzMain	0.03098808	SalTjara	0.02041109	ArGrMain	0.01354184	SYnzHilt	0.00780539
M062958	SalTjera	0.91096171	SYnzMain	0.07091351	SYnzSals	0.00787312	SYnzHilt	0.0058603	ArGrMain	0.00401043
M065428	SalTjera	0.90144047	SYnzSals	0.07544552	SYnzHilt	0.01031529	SaMaRey	0.0087849	SYnzMain	0.00392648
M065379	SalTjera	0.8627092	ArGrMain	0.08907496	SYnzMain	0.03577648	SYnzSals	0.00474529	SYnzHilt	0.00464795
M065389	SalTjera	0.85775396	SYnzHilt	0.09248544	SYnzMain	0.02969417	SaGaWFork	0.01875741	FilHaCole	0.00076522
M045408	SalTjera	0.85475397	SYnzHilt	0.07938811	SYnzMain	0.05256973	SaGaWFork	0.00904776	SaMaRey	0.0038981
M031362	SalTjera	0.83917399	SYnzMain	0.1357141	SYnzHilt	0.02038681	ArGrMain	0.00385478	SaMaRey	0.00080413
M062880	SalTjera	0.83248989	SYnzMain	0.12173185	SYnzHilt	0.04176096	FilHaCole	0.00397929	SaMaRey	2.96E-05
M092341	SalTjera	0.81605738	SaMaRey	0.11579053	SaGaWFork	0.04595952	SYnzHilt	0.01805957	SYnzMain	0.00191469
M067361	SalTjera	0.73983401	SYnzMain	0.22441024	SaMaRey	0.02136682	SYnzHilt	0.01241806	SaGaWFork	0.0015361
M065171	SalTjera	0.65228447	SYnzMain	0.26842603	SYnzHilt	0.06763022	SaGaWFork	0.00949842	SanSim	0.0016169
M062964	SalTjera	0.61748887	SaMaRey	0.34369443	SYnzMain	0.0301208	SYnzHilt	0.00736143	SYnzSals	0.00113474
M031439	SalTjera	0.60010559	SYnzMain	0.19838454	SYnzHilt	0.14360452	SalTjara	0.03033154	ArGrMain	0.02513341
M065325	SalTjera	0.58369276	SYnzMain	0.38517397	SYnzHilt	0.016864	SaMaRey	0.01388552	ArGrMain	0.00019658
M086528	SalTjera	0.57582939	SYnzMain	0.3048697	SaMaRey	0.1147425	SYnzHilt	0.00404396	ArGrMain	0.00028392
M038239	SalTjera	0.56663056	SYnzHilt	0.32042009	SYnzMain	0.08777846	SaGaWFork	0.01551319	SaMaRey	0.00916005
M065378	SalTjera	0.51027829	SYnzMain	0.46044395	SYnzHilt	0.01922669	ArGrMain	0.00883498	SYnzSals	0.00067585
M102209	SalTjera	0.4204657	SYnzHilt	0.36162453	SYnzMain	0.15257974	SaMaRey	0.06066977	SaGaWFork	0.00444479

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M031380	SalTjera	0.39732073	SYnzHilt	0.35079821	SYnzMain	0.25112391	SaGaWFork	0.00045697	ArGrMain	0.0002645
M065333	SalTjera	0.38152851	SYnzMain	0.37322824	SYnzSals	0.21217879	SYnzHilt	0.03013114	SaMaRey	0.00199978
M031367	SalTjera	0.33179572	SalTjara	0.32306715	SYnzHilt	0.17402981	SaMaRey	0.10257727	SYnzMain	0.03670289
M031433	SaMaRey	0.9999767	FilHaCole	9.45E-06	SYnzHilt	9.18E-06	SaClaSaPa	2.86E-06	SYnzMain	1.81E-06
M102203	SaMaRey	0.99986846	SYnzHilt	9.71E-05	SaClaSaPa	3.31E-05	SYnzMain	9.63E-07	ArGrMain	3.86E-07
M041531	SaMaRey	0.99944698	SYnzMain	0.00035585	SYnzHilt	0.0001432	FilHaCole	5.34E-05	SaGaWFork	5.28E-07
M102176	SaMaRey	0.99937367	SYnzHilt	0.00044978	SaClaSaPa	9.37E-05	SaGaWFork	5.02E-05	SYnzMain	3.26E-05
M102169	SaMaRey	0.99920868	SYnzHilt	0.00071867	SaGaWFork	4.51E-05	SaClaSaPa	1.46E-05	SYnzMain	1.29E-05
M102191	SaMaRey	0.99903087	SYnzHilt	0.00088778	SanSim	6.65E-05	SYnzMain	9.77E-06	SaClaSaPa	3.82E-06
M045453	SaMaRey	0.9986322	SaGaWFork	0.00095883	SYnzMain	0.00033402	SYnzHilt	5.65E-05	SanSim	1.72E-05
M102198	SaMaRey	0.9981459	SYnzMain	0.00136919	SYnzHilt	0.00048396	SaClaSaPa	3.68E-07	SaGaWFork	3.15E-07
M031412	SaMaRey	0.99754495	SYnzHilt	0.00146478	SYnzMain	0.00047223	SaGaWFork	0.0003795	FilHaCole	0.00013839
M065248	SaMaRey	0.99636789	ArGrMain	0.00237029	SYnzMain	0.00107333	SYnzHilt	0.00018789	SaClaSaPa	3.99E-07
M038261	SaMaRey	0.99545533	FilHaCole	0.003635	SaGaWFork	0.00058671	SYnzHilt	0.00027701	SYnzMain	4.51E-05
M102188	SaMaRey	0.99480944	SYnzHilt	0.00383891	SanSim	0.00093464	SYnzMain	0.00021236	SalTjera	0.00016548
M102160	SaMaRey	0.98964516	SYnzMain	0.00502559	SYnzHilt	0.00482602	SanSim	0.00048288	SalTjera	1.67E-05
M102165	SaMaRey	0.98802463	SaClaSaPa	0.01105393	SYnzHilt	0.00084903	SaGaWFork	6.71E-05	SYnzMain	5.29E-06
M092350	SaMaRey	0.98752713	SYnzMain	0.00924556	SYnzHilt	0.00219796	FilHaCole	0.00102529	SaClaSaPa	2.94E-06
M102174	SaMaRey	0.98434737	SYnzHilt	0.01557907	SYnzMain	6.77E-05	SaClaSaPa	5.22E-06	SalTjara	4.28E-07
M103710	SaMaRey	0.98359285	SYnzHilt	0.01616284	SaGaWFork	0.00023965	SYnzMain	4.50E-06	SaClaSaPa	1.65E-07
M065201	SaMaRey	0.97965031	SYnzHilt	0.01936916	SYnzMain	0.00053802	FilHaCole	0.00041502	SalTjara	1.04E-05
M038219	SaMaRey	0.97918553	SYnzMain	0.00963002	SaGaWFork	0.00654357	SYnzHilt	0.00313836	SaClaSaPa	0.00125052
M102185	SaMaRey	0.97538107	SYnzMain	0.01535088	SYnzHilt	0.00548935	SaClaSaPa	0.00342131	SanSim	0.0003573
M102152	SaMaRey	0.9711291	SYnzMain	0.0264628	SYnzHilt	0.00228699	SanSim	0.00011435	ArGrMain	6.60E-06
M065306	SaMaRey	0.96942453	SYnzHilt	0.02319095	SYnzMain	0.00624772	SalTjera	0.00093222	SalTjara	0.00014597
M092352	SaMaRey	0.96511824	SYnzMain	0.02790869	SYnzHilt	0.00692574	ArGrMain	4.30E-05	SYnzSals	2.47E-06
M102128	SaMaRey	0.95624284	SYnzMain	0.02646977	SaGaWFork	0.0092695	SYnzHilt	0.00668502	SanSim	0.00132927
M031444	SaMaRey	0.95299842	SYnzHilt	0.03532096	SYnzMain	0.00841599	SaGaWFork	0.00206542	SalTjara	0.00098681
M102175	SaMaRey	0.95054546	SaClaSaPa	0.04714449	SYnzHilt	0.00139221	SYnzMain	0.00090822	SalTjara	4.73E-06
M031371	SaMaRey	0.94714925	SYnzMain	0.04233935	SYnzHilt	0.01051092	ArGrMain	2.64E-07	SanSim	1.94E-07

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M102189	SaMaRey	0.93263706	SYnzHilt	0.06408257	SYnzMain	0.00224768	SaClaSaPa	0.00102745	SalTjara	1.97E-06
M092349	SaMaRey	0.92668311	SalTjera	0.05168817	SYnzHilt	0.01061466	SYnzMain	0.00539896	SalTjara	0.00268824
M045359	SaMaRey	0.92626838	SYnzHilt	0.06744071	SYnzMain	0.00601449	SaClaSaPa	0.00011617	FilHaCole	9.45E-05
M102142	SaMaRey	0.91103089	SaGaWFork	0.03841199	SYnzMain	0.02920779	SaClaSaPa	0.01224631	SYnzHilt	0.00894694
M065273	SaMaRey	0.91044622	SYnzHilt	0.05718372	FilHaCole	0.01710086	SYnzMain	0.01513675	SanSim	0.00011382
M065311	SaMaRey	0.90011887	SYnzMain	0.06548878	SYnzHilt	0.03438719	ArGrMain	4.74E-06	SaGaWFork	2.57E-07
M027339	SaMaRey	0.89982247	SYnzHilt	0.06968299	FilHaCole	0.01783029	SYnzMain	0.0125467	SaGaWFork	4.39E-05
M038214	SaMaRey	0.89845334	SaGaWFork	0.06517369	SYnzHilt	0.03121718	FilHaCole	0.00436345	SaClaSesp	0.00040417
M102186	SaMaRey	0.89044459	SYnzHilt	0.1083475	SYnzMain	0.0006605	SaGaWFork	0.00054577	FilHaCole	1.42E-06
M053035	SaMaRey	0.89043428	SYnzHilt	0.09855495	SYnzMain	0.0109946	ArGrMain	1.09E-05	SaClaSaPa	4.05E-06
M065231	SaMaRey	0.88598125	FilHaCole	0.09013101	SaGaWFork	0.01372669	SYnzHilt	0.00628739	SYnzMain	0.00387066
M102134	SaMaRey	0.8836028	SYnzMain	0.09913774	SYnzHilt	0.01351082	SanSim	0.00356641	ArGrMain	0.00017552
M057060	SaMaRey	0.8832713	SYnzHilt	0.09988804	SYnzMain	0.01278439	SaGaWFork	0.00373014	SalTjera	0.00025494
M063010	SaMaRey	0.88199854	SYnzHilt	0.11105754	SYnzMain	0.00635303	SalTjera	0.00053611	SalTjara	2.81E-05
M102190	SaMaRey	0.87344349	SYnzHilt	0.07734131	SYnzMain	0.04911245	SalTjara	5.64E-05	SaClaSaPa	4.18E-05
M031437	SaMaRey	0.86134878	SYnzHilt	0.05802167	SYnzMain	0.04972299	SaGaWFork	0.02783485	FilHaCole	0.00306797
M045367	SaMaRey	0.85568955	SYnzMain	0.12055979	SYnzHilt	0.02245627	FilHaCole	0.00122482	SaGaWFork	5.45E-05
M031436	SaMaRey	0.85560905	SYnzMain	0.13745177	SYnzHilt	0.0068802	ArGrMain	5.46E-05	SaClaSaPa	4.28E-06
M102098	SaMaRey	0.85182267	SYnzMain	0.10378758	SYnzHilt	0.01263552	FilHaCole	0.01209429	SaGaWFork	0.01002724
M045455	SaMaRey	0.84909734	SaGaWFork	0.13799724	SYnzMain	0.00770563	SanSim	0.00341107	SYnzHilt	0.00178385
M038257	SaMaRey	0.84575602	SYnzHilt	0.09621895	SaGaWFork	0.05263577	SYnzMain	0.00531364	SaClaSaPa	5.21E-05
M062895	SaMaRey	0.83731658	SYnzMain	0.11272428	SYnzHilt	0.04986405	ArGrMain	3.92E-05	SalTjera	3.08E-05
M045366	SaMaRey	0.83539535	SYnzMain	0.12474665	SYnzHilt	0.0379544	SaGaWFork	0.00110346	ArGrMain	0.00076462
M092323	SaMaRey	0.82557882	SYnzHilt	0.11382614	ArGrMain	0.0564277	SalTjara	0.00245365	SaGaWFork	0.00085159
M102205	SaMaRey	0.81624247	SYnzHilt	0.16746447	SYnzMain	0.01607233	SaGaWFork	0.00014133	SalTjara	4.89E-05
M036640	SaMaRey	0.81066826	SYnzHilt	0.12888491	SYnzMain	0.05025875	FilHaCole	0.00938709	SalTjera	0.00073107
M102183	SaMaRey	0.75168658	SYnzMain	0.12725862	SYnzHilt	0.06613498	SanSim	0.05406132	SaClaSaPa	0.00072368
M102173	SaMaRey	0.73879219	SYnzHilt	0.23449679	SYnzMain	0.02644406	SaClaSaPa	0.00026587	SanSim	8.45E-07
M038212	SaMaRey	0.70560205	SYnzHilt	0.24557982	FilHaCole	0.02869639	SYnzMain	0.02009903	SaGaWFork	1.47E-05
M045418	SaMaRey	0.66608151	SYnzHilt	0.31517455	SYnzMain	0.01725822	SYnzSals	0.00109791	ArGrMain	0.00036139

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065385	SaMaRey	0.66593421	SYnzMain	0.29812197	SYnzHilt	0.0309511	SYnzSals	0.00362573	ArGrMain	0.00107726
M031450	SaMaRey	0.66262018	SaGaWFork	0.22804635	SYnzMain	0.073454	SYnzHilt	0.03578229	FilHaCole	8.34E-05
M092309	SaMaRey	0.65817843	SYnzMain	0.17996998	ArGrMain	0.14040171	SYnzHilt	0.01534967	SalTjera	0.00596802
M062926	SaMaRey	0.6562684	SYnzMain	0.3394893	SYnzSals	0.00367064	SYnzHilt	0.00051314	SalTjera	4.75E-05
M062874	SaMaRey	0.6552239	SYnzHilt	0.30950868	SYnzMain	0.03230447	FilHaCole	0.00295667	SaClaSaPa	5.11E-06
M102093	SaMaRey	0.65217041	SYnzMain	0.31573305	ArGrMain	0.0224854	SaClaSesp	0.00491084	SYnzHilt	0.00288505
M102131	SaMaRey	0.6502272	SYnzHilt	0.25203479	SaGaWFork	0.06322233	SYnzMain	0.03110817	FilHaCole	0.00296818
M063025	SaMaRey	0.62257416	SaGaWFork	0.27741414	SYnzMain	0.06418051	SYnzHilt	0.03290932	ArGrMain	0.00195306
M065423	SaMaRey	0.61642392	FilHaCole	0.28229216	SYnzHilt	0.09554725	SYnzMain	0.00324685	SaGaWFork	0.00218499
M062970	SaMaRey	0.60443781	SYnzMain	0.22782069	SYnzHilt	0.1185935	FilHaCole	0.03349872	SaGaWFork	0.01489947
M062967	SaMaRey	0.57792862	SYnzMain	0.30580124	SYnzHilt	0.11383782	SalTjera	0.00207081	ArGrMain	0.00032348
M062939	SaMaRey	0.57388339	SYnzMain	0.40606772	SYnzHilt	0.01493236	SalTjera	0.00480864	ArGrMain	0.00017635
M065350	SaMaRey	0.55110483	SaGaWFork	0.25892627	SYnzMain	0.18297071	SanSim	0.00363921	SYnzHilt	0.00334861
M102167	SaMaRey	0.5419008	SYnzHilt	0.26052842	SalTjera	0.19193078	SYnzMain	0.0054149	SaGaWFork	0.00014682
M065383	SaMaRey	0.53866106	SYnzMain	0.28939349	SYnzHilt	0.17124436	SalTjera	0.00039671	SYnzSals	0.00014036
M102119	SaMaRey	0.53323721	SYnzMain	0.21265997	SaGaWFork	0.0989055	SYnzHilt	0.08565419	FilHaCole	0.04564075
M027335	SaMaRey	0.53135632	SYnzMain	0.25792921	SYnzHilt	0.21068313	SaGaWFork	2.89E-05	FilHaCole	2.04E-06
M102168	SaMaRey	0.50780547	SYnzHilt	0.48117173	SaGaWFork	0.0096972	SYnzMain	0.00129082	SaClaSaPa	2.07E-05
M062982	SaMaRey	0.50490999	SYnzHilt	0.46181465	SYnzMain	0.02795142	FilHaCole	0.0042936	SaGaWFork	0.00103025
M062919	SaMaRey	0.50322809	SYnzMain	0.26429365	SYnzHilt	0.23242869	ArGrMain	2.36E-05	SaAnSaAnt	9.13E-06
M102200	SaMaRey	0.49288321	SYnzHilt	0.45800493	SYnzMain	0.0490083	SalTjera	8.79E-05	SaClaSaPa	1.28E-05
M102193	SaMaRey	0.49244908	SYnzHilt	0.46651822	SYnzMain	0.04101749	SaClaSaPa	1.34E-05	SalTjera	6.46E-07
M045364	SaMaRey	0.48808156	SalTjera	0.40056295	SaGaWFork	0.06121943	FilHaCole	0.03280469	SYnzHilt	0.01593035
M031374	SaMaRey	0.48790581	SYnzHilt	0.32344058	ArGrMain	0.13053707	SYnzMain	0.05688684	SYnzSals	0.00086981
M027332	SaMaRey	0.47606564	FilHaCole	0.42327723	SYnzHilt	0.07379182	SYnzMain	0.02680914	SYnzSals	4.19E-05
M038220	SaMaRey	0.47129372	SalTjera	0.46388597	ArGrMain	0.03343604	SYnzMain	0.00886025	SYnzHilt	0.00883876
M065384	SaMaRey	0.43093342	SYnzHilt	0.34802799	SYnzMain	0.21794147	SalTjera	0.00146675	SanSim	0.00085509
M092330	SaMaRey	0.41359027	SYnzHilt	0.2820463	SYnzMain	0.27849415	SanSim	0.02383305	FilHaCole	0.00112819
M031411	SaMaRey	0.38890778	SYnzMain	0.35383392	SYnzHilt	0.25715365	SalTjera	8.64E-05	SaGaWFork	1.60E-05
M102112	SaMaRey	0.37161089	SYnzHilt	0.34278792	SanSim	0.2514533	SYnzMain	0.03372744	SaGaWFork	0.00041997

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M102146	SaMaRey	0.36549118	SanSim	0.30902673	SaGaWFork	0.30862225	SYnzHilt	0.01131882	SYnzMain	0.00551364
M065266	SaMaRey	0.28678365	SYnzMain	0.22926447	FilHaCole	0.19241535	SYnzHilt	0.18397794	SaGaWFork	0.08423334
M102149	SanSim	0.99851878	ChorPen	0.00048669	SaMaRey	0.00048006	SYnzMain	0.00041646	SYnzHilt	8.79E-05
M102129	SanSim	0.98749306	SaGaWFork	0.00491596	SYnzMain	0.00330178	SYnzHilt	0.00268454	ArGrMain	0.00086228
M102127	SanSim	0.97529988	SYnzMain	0.01615481	SYnzHilt	0.00849863	SaMaRey	4.64E-05	ChorPen	2.78E-07
M102147	SanSim	0.97410468	SYnzHilt	0.01750767	SYnzMain	0.00806905	SaMaRey	0.00019954	ChorPen	0.00010433
M102122	SanSim	0.9606598	ChorPen	0.01724164	SYnzHilt	0.01612688	SYnzMain	0.00582595	SaMaRey	0.0001452
M102114	SanSim	0.9380672	SYnzMain	0.04707619	SaMaRey	0.01137006	SYnzHilt	0.00348414	FilHaCole	1.56E-06
M102139	SanSim	0.92398602	SYnzHilt	0.04817951	ChorPen	0.0186876	SYnzMain	0.00880235	SaMaRey	0.0003234
M102148	SanSim	0.69635512	SYnzMain	0.15691234	SYnzHilt	0.14446627	SaMaRey	0.00202809	SaGaWFork	0.00019271
M102145	SanSim	0.62573987	SYnzHilt	0.32197009	SYnzMain	0.026783	SaMaRey	0.02393963	ChorPen	0.0014922
M102136	SanSim	0.6060157	SaMaRey	0.3685184	SYnzMain	0.01490659	SYnzHilt	0.00819931	SaGaWFork	0.00165022
M062935	SanSim	0.60475649	SaMaRey	0.35239177	FilHaCole	0.01789151	SYnzHilt	0.01636672	ChorPen	0.0036981
M065414	SanSim	0.60059317	SYnzMain	0.30840547	SYnzHilt	0.08889688	SaGaWFork	0.00206175	ChorPen	3.95E-05
M102153	SanSim	0.42097654	SYnzMain	0.30633916	SaMaRey	0.20833437	SYnzHilt	0.06390798	SaGaWFork	0.000312
M063009	SYnzHilt	0.99860434	SaGaWFork	0.00057004	FilHaCole	0.00054971	SYnzMain	0.00027122	SalTjera	3.34E-06
M038179	SYnzHilt	0.99819929	SYnzMain	0.00130782	SaMaRey	0.00027606	ArGrMain	0.0001917	SaGaWFork	2.43E-05
M031409	SYnzHilt	0.99817125	SYnzMain	0.00161501	FilHaCole	0.00019567	SaMaRey	1.80E-05	SaClaSaPa	6.19E-08
M031364	SYnzHilt	0.99777544	SYnzMain	0.00207572	ArGrMain	0.00013156	SYnzSals	9.78E-06	SaGaWFork	6.25E-06
M065271	SYnzHilt	0.99764815	SYnzMain	0.00234577	SalTjera	4.00E-06	SalTjara	9.74E-07	ArGrMain	8.77E-07
M102164	SYnzHilt	0.99759591	SaGaWFork	0.00160687	SYnzMain	0.00067262	SaMaRey	0.00011982	FilHaCole	4.69E-06
M102166	SYnzHilt	0.99747331	SYnzMain	0.00241977	SaGaWFork	9.92E-05	SaMaRey	7.38E-06	SalTjera	1.86E-07
M038207	SYnzHilt	0.99728652	SYnzMain	0.00259508	SaGaWFork	8.34E-05	FilHaCole	3.46E-05	SaMaRey	3.98E-07
M031361	SYnzHilt	0.9971644	SaGaWFork	0.00172998	SYnzMain	0.00106072	SaMaRey	2.44E-05	ArGrMain	1.91E-05
M086444	SYnzHilt	0.9967011	SYnzMain	0.00231139	SaMaRey	0.00075504	SanSim	0.00015276	FilHaCole	7.92E-05
M038175	SYnzHilt	0.99559712	SYnzMain	0.00307736	SaGaWFork	0.00068898	ArGrMain	0.00062587	SaMaRey	8.62E-06
M065302	SYnzHilt	0.99502569	SYnzMain	0.00404398	SaGaWFork	0.00085709	SaMaRey	5.77E-05	SaClaSaPa	1.30E-05
M065263	SYnzHilt	0.99465711	SYnzMain	0.00525755	SaMaRey	5.98E-05	FilHaCole	2.03E-05	SaClaSaPa	3.71E-06
M086532	SYnzHilt	0.99417455	SaMaRey	0.00375425	SYnzMain	0.00206787	SaClaSaPa	2.13E-06	FilHaCole	5.40E-07
M031375	SYnzHilt	0.99395722	SYnzMain	0.00495139	ArGrMain	0.00040919	SalTjera	0.00030872	SaMaRey	0.00029581

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065166	SYnzHilt	0.99380431	SYnzMain	0.00616874	SaMaRey	1.92E-05	SaGaWFork	7.73E-06	FilHaCole	3.82E-08
M092347	SYnzHilt	0.99339034	SYnzMain	0.00659982	SaMaRey	9.38E-06	SYnzSals	2.95E-07	ArGrMain	9.37E-08
M031449	SYnzHilt	0.99181745	SYnzMain	0.00813183	FilHaCole	4.93E-05	SaMaRey	1.11E-06	SYnzSals	2.26E-07
M102094	SYnzHilt	0.99154745	SYnzMain	0.00755222	SaGaWFork	0.00081914	ArGrMain	6.55E-05	SaMaRey	9.57E-06
M065268	SYnzHilt	0.99138595	SYnzMain	0.003156	FilHaCole	0.00266273	SaMaRey	0.00167168	SaGaWFork	0.00104096
M065361	SYnzHilt	0.99110569	SYnzMain	0.00471854	FilHaCole	0.00287639	SaMaRey	0.00114258	SaClaSaPa	0.00013075
M053038	SYnzHilt	0.99035908	SYnzMain	0.00913917	SaMaRey	0.00044966	ArGrMain	2.02E-05	SYnzSals	1.82E-05
M102103	SYnzHilt	0.9901409	SYnzMain	0.00954644	ArGrMain	0.00020338	SaMaRey	0.00010751	SYnzSals	7.70E-07
M097885	SYnzHilt	0.99005389	SYnzMain	0.00975215	SaGaWFork	0.0001678	ArGrMain	2.31E-05	SaAnSaAnt	1.87E-06
M062908	SYnzHilt	0.98989858	SYnzMain	0.00901898	SaMaRey	0.00059538	SalTjera	0.00045308	FilHaCole	3.11E-05
M102194	SYnzHilt	0.98886145	SYnzMain	0.00788834	SaGaWFork	0.00293484	SaMaRey	0.00030954	SalTjara	3.36E-06
M065252	SYnzHilt	0.98833417	SYnzMain	0.01144433	SYnzSals	0.00014879	SaGaWFork	5.49E-05	ArGrMain	1.05E-05
M031373	SYnzHilt	0.98815058	SYnzMain	0.00778306	SaMaRey	0.00382524	SaGaWFork	0.00020547	ArGrMain	2.76E-05
M065255	SYnzHilt	0.98783082	SYnzMain	0.01048873	FilHaCole	0.00090607	SaMaRey	0.00067795	SaAnSaAnt	6.11E-05
M038256	SYnzHilt	0.98752884	SaMaRey	0.00737379	SYnzMain	0.00503385	SalTjera	3.64E-05	FilHaCole	2.28E-05
M063019	SYnzHilt	0.9875209	SYnzMain	0.01247781	ArGrMain	5.40E-07	SaMaRey	3.88E-07	SaGaWFork	1.82E-07
M038260	SYnzHilt	0.9873513	SYnzMain	0.0123199	SaMaRey	0.00032701	FilHaCole	8.78E-07	SalTjera	4.77E-07
M057054	SYnzHilt	0.98693251	SYnzMain	0.00961476	FilHaCole	0.00229913	SYnzSals	0.00115312	SaMaRey	2.94E-07
M065228	SYnzHilt	0.98641707	SYnzMain	0.00819695	SaGaWFork	0.00457198	SaMaRey	0.00036242	ArGrMain	0.00032632
M045413	SYnzHilt	0.98635709	SYnzMain	0.01080789	FilHaCole	0.00112605	SaMaRey	0.00084247	SalTjera	0.00049633
M062896	SYnzHilt	0.98588511	SYnzMain	0.01385945	SalTjera	0.00022696	ArGrMain	1.78E-05	SanSim	6.66E-06
M065180	SYnzHilt	0.98578265	SYnzMain	0.01378199	SaClaSaPa	0.00031987	SaMaRey	9.37E-05	SaGaWFork	8.74E-06
M065296	SYnzHilt	0.98551448	SYnzMain	0.01448516	SYnzSals	2.69E-07	SaGaWFork	8.92E-08	SaMaRey	1.23E-09
M062864	SYnzHilt	0.98546979	ArGrMain	0.01081989	SYnzMain	0.00365572	SYnzSals	1.98E-05	SaGaWFork	1.82E-05
M038173	SYnzHilt	0.98519076	SYnzMain	0.01479901	FilHaCole	8.67E-06	ArGrMain	1.51E-06	SaMaRey	4.66E-08
M065213	SYnzHilt	0.98444116	SYnzMain	0.01555324	SaMaRey	4.47E-06	SaClaSaPa	3.64E-07	SalTjera	3.12E-07
M065172	SYnzHilt	0.98402199	SYnzMain	0.01578328	SaMaRey	0.00013684	ArGrMain	4.65E-05	SYnzSals	5.68E-06
M065375	SYnzHilt	0.98396459	SYnzMain	0.0157326	SaGaWFork	0.00013635	FilHaCole	0.00012037	ArGrMain	2.86E-05
M027338	SYnzHilt	0.98360549	SYnzMain	0.01583205	FilHaCole	0.00041423	SaMaRey	0.00014684	ArGrMain	1.19E-06
M038187	SYnzHilt	0.98352211	SYnzMain	0.01496998	SaGaWFork	0.00070465	SaMaRey	0.00064618	FilHaCole	0.00014055

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M031370	SYnzHilt	0.98316804	SYnzMain	0.01480138	FilHaCole	0.00186612	SalTjera	0.00014843	ArGrMain	1.01E-05
M062891	SYnzHilt	0.98273497	FilHaCole	0.01522723	SYnzMain	0.00128126	SaMaRey	0.00073277	SaGaWFork	2.37E-05
M065187	SYnzHilt	0.9827256	SYnzMain	0.01054672	SaMaRey	0.00622725	ArGrMain	0.00043332	SaClaSaPa	5.73E-05
M062885	SYnzHilt	0.98224666	SYnzMain	0.01775022	SaMaRey	1.22E-06	SaGaWFork	9.16E-07	SaAnSaAnt	7.15E-07
M062947	SYnzHilt	0.98165843	SYnzMain	0.01133854	SanSim	0.00696762	SaMaRey	2.80E-05	ArGrMain	6.83E-06
M031443	SYnzHilt	0.98123866	SaMaRey	0.01143349	SYnzMain	0.00578546	FilHaCole	0.00153126	SalTjera	1.05E-05
M045421	SYnzHilt	0.98068345	SaMaRey	0.00975892	SYnzMain	0.00827147	FilHaCole	0.00128353	ArGrMain	1.28E-06
M057064	SYnzHilt	0.9796859	SYnzMain	0.01851266	FilHaCole	0.00175943	SaMaRey	4.13E-05	ArGrMain	4.08E-07
M102195	SYnzHilt	0.97942651	SYnzMain	0.01647163	SanSim	0.00229025	SaMaRey	0.00177747	SalTjara	3.26E-05
M065381	SYnzHilt	0.97903156	SYnzMain	0.01930037	SaMaRey	0.00146335	FilHaCole	0.00020266	ArGrMain	1.90E-06
M045458	SYnzHilt	0.97859894	SYnzMain	0.01912111	SaGaWFork	0.00220042	ArGrMain	6.96E-05	SaMaRey	9.29E-06
M065236	SYnzHilt	0.97807008	SYnzMain	0.01467691	SaGaWFork	0.00702073	SaMaRey	0.00018931	SalTjera	3.82E-05
M010160	SYnzHilt	0.97747499	SYnzMain	0.01795523	SaGaWFork	0.00258889	ArGrMain	0.00115554	SaMaRey	0.00080432
M062876	SYnzHilt	0.97744366	SYnzMain	0.0212015	FilHaCole	0.00056442	SYnzSals	0.00046628	SaMaRey	0.00017477
M062998	SYnzHilt	0.97668955	SYnzMain	0.0206894	ArGrMain	0.00099578	SalTjara	0.00064392	SalTjera	0.00060735
M102106	SYnzHilt	0.97662479	SYnzMain	0.02270825	ArGrMain	0.00052362	FilHaCole	6.11E-05	SaAnSaAnt	2.64E-05
M063031	SYnzHilt	0.97657116	SYnzMain	0.02342305	ArGrMain	4.59E-06	SalTjera	5.60E-07	SYnzSals	5.18E-07
M012444	SYnzHilt	0.97627829	SYnzMain	0.02218566	SaMaRey	0.00101649	SaGaWFork	0.00046886	ArGrMain	4.85E-05
M065165	SYnzHilt	0.97583126	SYnzMain	0.01617343	FilHaCole	0.0067588	SaMaRey	0.00074241	SYnzSals	0.00047648
M065363	SYnzHilt	0.97575224	SYnzMain	0.02419949	SaMaRey	4.24E-05	FilHaCole	3.70E-06	ArGrMain	1.11E-06
M102181	SYnzHilt	0.97575046	SaMaRey	0.02093737	SYnzMain	0.00311981	SaGaWFork	0.00014357	SalTjera	4.81E-05
M065212	SYnzHilt	0.97572439	SYnzMain	0.02427179	ArGrMain	1.17E-06	SalTjera	1.02E-06	SaMaRey	7.99E-07
M031405	SYnzHilt	0.97537205	SYnzMain	0.02439484	SaGaWFork	0.00014448	SaClaSaPa	7.30E-05	SaMaRey	1.55E-05
M063017	SYnzHilt	0.97452287	SYnzMain	0.02360657	SaMaRey	0.00137976	SYnzSals	0.00042831	SalTjara	6.01E-05
M063032	SYnzHilt	0.97421554	SYnzMain	0.02380175	SaMaRey	0.00197905	ArGrMain	3.53E-06	SaClaSaPa	6.61E-08
M031421	SYnzHilt	0.9740445	SYnzMain	0.02490787	SaGaWFork	0.00103729	FilHaCole	9.69E-06	ArGrMain	6.04E-07
M062906	SYnzHilt	0.97384284	SYnzMain	0.01532494	SaGaWFork	0.00587305	ArGrMain	0.00392581	SanSim	0.00055058
M102192	SYnzHilt	0.97368702	SYnzMain	0.02458025	SaMaRey	0.0014099	SalTjara	0.00030562	SalTjera	1.35E-05
M038202	SYnzHilt	0.97348102	SYnzMain	0.02233392	SaMaRey	0.00355645	SaGaWFork	0.00062766	FilHaCole	6.91E-07
M045361	SYnzHilt	0.97341476	SaGaWFork	0.015655	SYnzMain	0.01058897	SaMaRey	0.00033557	SaClaSaPa	3.68E-06

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M103779	SYnzHilt	0.97316306	SaGaWFork	0.0109928	SaMaRey	0.01063009	SYnzMain	0.00519575	SalTjara	1.60E-05
M038193	SYnzHilt	0.97287622	SYnzMain	0.02612988	SaMaRey	0.00067918	ArGrMain	0.00023618	SalTjara	7.03E-05
M031422	SYnzHilt	0.97270151	SaGaWFork	0.02141965	SYnzMain	0.00402246	SalTjera	0.00070618	FilHaCole	0.00068556
M062920	SYnzHilt	0.97266986	SYnzMain	0.02338397	SaGaWFork	0.0022073	SaMaRey	0.00120634	FilHaCole	0.00052664
M038178	SYnzHilt	0.9724583	SYnzMain	0.02512704	SaGaWFork	0.00224438	SaMaRey	0.00016853	ArGrMain	1.47E-06
M057080	SYnzHilt	0.97240398	SYnzMain	0.02715089	ArGrMain	0.00025129	SalTjera	9.61E-05	SaGaWFork	7.36E-05
M102201	SYnzHilt	0.97161815	SYnzMain	0.01658296	SaMaRey	0.00785326	SaClaSaPa	0.00352038	SaGaWFork	0.00041554
M065260	SYnzHilt	0.97136499	SYnzMain	0.02850826	SaGaWFork	0.00012516	SaMaRey	6.79E-07	SalTjera	6.62E-07
M062984	SYnzHilt	0.97067963	SYnzMain	0.02055494	SaMaRey	0.00558658	SalTjera	0.00315206	SanSim	1.77E-05
M038203	SYnzHilt	0.97061266	SYnzMain	0.02914234	SaMaRey	0.00014788	SYnzSals	6.18E-05	SaGaWFork	2.89E-05
M062859	SYnzHilt	0.97007637	SYnzMain	0.0229336	SaMaRey	0.0061176	SaGaWFork	0.00086862	ArGrMain	2.06E-06
M031416	SYnzHilt	0.96988269	SYnzMain	0.0299475	SaMaRey	0.00015275	SalTjera	9.76E-06	ArGrMain	6.48E-06
M065364	SYnzHilt	0.96950562	SYnzMain	0.02649895	SaMaRey	0.00396391	SYnzSals	2.63E-05	SanSim	1.77E-06
M038210	SYnzHilt	0.96923489	FilHaCole	0.02803891	SYnzMain	0.00258176	SaMaRey	0.00013577	ArGrMain	7.92E-06
M102207	SYnzHilt	0.9690251	SYnzMain	0.02840767	SaMaRey	0.00249036	SaGaWFork	7.44E-05	SalTjara	1.42E-06
M065393	SYnzHilt	0.96888707	SYnzMain	0.03108418	FilHaCole	1.27E-05	SaGaWFork	8.19E-06	ArGrMain	7.47E-06
M038228	SYnzHilt	0.96859752	SYnzMain	0.03138095	SaMaRey	2.06E-05	FilHaCole	4.87E-07	SanSim	2.55E-07
M065257	SYnzHilt	0.96823322	SYnzMain	0.02877698	SaGaWFork	0.0028948	SaMaRey	4.77E-05	FilHaCole	4.66E-05
M086531	SYnzHilt	0.96758308	SYnzMain	0.03236544	ArGrMain	2.32E-05	SaGaWFork	1.52E-05	SalTjera	1.09E-05
M062988	SYnzHilt	0.96692797	SYnzMain	0.03306969	SanSim	1.81E-06	SaGaWFork	3.99E-07	SaMaRey	5.59E-08
M065372	SYnzHilt	0.96653379	SYnzMain	0.0227963	ArGrMain	0.00941176	SalTjara	0.0008633	SaMaRey	0.00026079
M065427	SYnzHilt	0.96536264	SYnzMain	0.03274217	SaGaWFork	0.00148734	SalTjera	0.00038792	ArGrMain	1.14E-05
M057065	SYnzHilt	0.9652794	SYnzMain	0.03241493	SYnzSals	0.00171919	ArGrMain	0.00046133	FilHaCole	0.00010609
M038206	SYnzHilt	0.96228847	SYnzMain	0.03193214	SaMaRey	0.00545102	SalTjera	0.00028183	SYnzSals	2.87E-05
M041530	SYnzHilt	0.96170893	FilHaCole	0.01728206	SYnzMain	0.01280672	SaGaWFork	0.00719335	SaMaRey	0.00099494
M038198	SYnzHilt	0.96138059	SYnzMain	0.03855114	SalTjera	5.37E-05	ArGrMain	9.04E-06	SaMaRey	3.94E-06
M102157	SYnzHilt	0.96114617	SYnzMain	0.03854176	FilHaCole	0.00013786	SaMaRey	7.19E-05	SanSim	6.92E-05
M102211	SYnzHilt	0.96052191	SYnzMain	0.034512	SanSim	0.00332823	SaMaRey	0.00163202	ArGrMain	2.88E-06
M038177	SYnzHilt	0.96008532	SaGaWFork	0.03341827	SYnzMain	0.00622751	SalTjera	0.00012723	ArGrMain	6.52E-05
M065156	SYnzHilt	0.95824784	SYnzMain	0.04062562	FilHaCole	0.00102898	SaGaWFork	5.49E-05	SanSim	2.28E-05

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065229	SYnzHilt	0.95664632	SYnzMain	0.03723422	SalTjera	0.00311194	SaMaRey	0.00262163	SaClaSaPa	0.0002445
M053051	SYnzHilt	0.95604869	SYnzMain	0.02413106	ArGrMain	0.01401137	SYnzSals	0.00257749	SaMaRey	0.00202258
M097888	SYnzHilt	0.95444445	SYnzMain	0.04555095	SaMaRey	2.34E-06	ArGrMain	1.26E-06	SaGaWFork	5.92E-07
M097898	SYnzHilt	0.95342334	SaGaWFork	0.03500039	SYnzMain	0.01134237	SaMaRey	0.00011449	SaClaSaPa	8.47E-05
M053050	SYnzHilt	0.95267932	SYnzMain	0.04293675	ArGrMain	0.00414278	FilHaCole	0.00016416	SalTjera	7.07E-05
M065426	SYnzHilt	0.94957067	SYnzMain	0.05021874	SaGaWFork	0.00013836	SanSim	5.87E-05	ArGrMain	8.46E-06
M062907	SYnzHilt	0.94899211	SYnzMain	0.04674372	SaGaWFork	0.00214798	SaMaRey	0.00192595	FilHaCole	0.00010625
M102104	SYnzHilt	0.94733641	SYnzMain	0.05225372	ArGrMain	0.00028575	SanSim	7.26E-05	SaMaRey	4.09E-05
M102199	SYnzHilt	0.9463392	ArGrMain	0.03463242	SYnzMain	0.01832484	SaGaWFork	0.00039974	SalTjara	0.0001701
M031446	SYnzHilt	0.94415699	SYnzMain	0.05578149	SaMaRey	5.45E-05	SalTjera	2.78E-06	SYnzSals	2.13E-06
M065396	SYnzHilt	0.94380904	SYnzMain	0.05354204	SalTjera	0.00116433	FilHaCole	0.00075289	SaGaWFork	0.00068138
M102197	SYnzHilt	0.94352132	SaMaRey	0.03086082	SYnzMain	0.02527856	ArGrMain	0.00026858	SaGaWFork	4.23E-05
M102172	SYnzHilt	0.94347062	SaGaWFork	0.03550429	SYnzMain	0.0201402	SaMaRey	0.00085522	SalTjera	2.85E-05
M065276	SYnzHilt	0.94325634	SYnzMain	0.04737439	SYnzSals	0.00788137	ArGrMain	0.00146539	SalTjera	1.72E-05
M065335	SYnzHilt	0.94038952	SYnzMain	0.05150166	ArGrMain	0.00397139	SalTjera	0.00345853	SaGaWFork	0.00023928
M102141	SYnzHilt	0.94030499	SYnzMain	0.05929344	SanSim	0.00037936	SaMaRey	1.72E-05	SaGaWFork	2.16E-06
M065157	SYnzHilt	0.94020619	SaGaWFork	0.05297245	SYnzMain	0.00681416	SanSim	5.62E-06	SaMaRey	7.78E-07
M062956	SYnzHilt	0.9397299	SYnzMain	0.03680598	SYnzSals	0.02062239	SaMaRey	0.00140413	SaGaWFork	0.00034659
M065292	SYnzHilt	0.93971667	SYnzMain	0.05898609	SalTjera	0.00124047	SYnzSals	4.00E-05	ArGrMain	1.35E-05
M065185	SYnzHilt	0.93877231	ArGrMain	0.02581719	SYnzMain	0.02253672	SaMaRey	0.0063208	FilHaCole	0.00606364
M065398	SYnzHilt	0.93782397	SYnzMain	0.06180721	ArGrMain	0.00026699	SanSim	9.15E-05	SaGaWFork	5.26E-06
M102111	SYnzHilt	0.93644018	SYnzMain	0.05230446	SaMaRey	0.01017872	SalTjera	0.00086568	SYnzSals	0.00017252
M031445	SYnzHilt	0.93576047	SYnzMain	0.0625466	SaMaRey	0.0015044	ArGrMain	0.00017546	SalTjara	1.05E-05
M097897	SYnzHilt	0.9354809	SYnzMain	0.05868122	FilHaCole	0.00311488	SaGaWFork	0.00117617	SaMaRey	0.00105649
M063036	SYnzHilt	0.93476328	SYnzMain	0.0644361	SalTjera	0.00075875	SaGaWFork	2.72E-05	SaMaRey	1.30E-05
M067365	SYnzHilt	0.93419757	SYnzMain	0.06256979	SaGaWFork	0.00213867	SalTjera	0.00107835	ArGrMain	1.21E-05
M065410	SYnzHilt	0.93342302	SYnzMain	0.06202845	SaGaWFork	0.00442383	ArGrMain	6.51E-05	SaGaEFork	2.09E-05
M031438	SYnzHilt	0.93341422	SYnzMain	0.06657039	ArGrMain	1.25E-05	SalTjara	1.20E-06	SalTjera	7.83E-07
M092304	SYnzHilt	0.93266541	SYnzMain	0.04216084	SaMaRey	0.01675554	ArGrMain	0.00760246	FilHaCole	0.00031466
M038237	SYnzHilt	0.9326167	SYnzMain	0.06570691	SaGaWFork	0.00117843	SalTjera	0.00031591	ArGrMain	0.00015581

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M057067	SYnzHilt	0.931929	SYnzMain	0.0644011	SalTjera	0.00181885	SaGaWFork	0.00112152	SaMaRey	0.00052411
M063020	SYnzHilt	0.93188437	SYnzMain	0.06804483	SanSim	3.14E-05	SalTjera	2.32E-05	ArGrMain	1.57E-05
M062877	SYnzHilt	0.92985125	SYnzMain	0.03459725	SaMaRey	0.03291325	ArGrMain	0.00257885	SYnzSals	4.52E-05
M092319	SYnzHilt	0.92875644	SYnzMain	0.03554534	ArGrMain	0.0244897	SaGaWFork	0.01090389	SaMaRey	0.00026315
M027337	SYnzHilt	0.92846768	SYnzMain	0.06420378	SaGaWFork	0.00720816	SaClaSaPa	6.96E-05	ArGrMain	2.60E-05
M065370	SYnzHilt	0.92804372	SYnzMain	0.06006677	SaMaRey	0.01188241	FilHaCole	5.78E-06	SaClaSaPa	1.13E-06
M065222	SYnzHilt	0.9266942	SaMaRey	0.05598203	SaGaWFork	0.01311569	SYnzMain	0.00322234	FilHaCole	0.00088683
M065177	SYnzHilt	0.92620633	SYnzSals	0.04970766	SYnzMain	0.02298066	ArGrMain	0.00097606	FilHaCole	9.26E-05
M038188	SYnzHilt	0.92572739	SaMaRey	0.07360074	SYnzMain	0.00065655	SaGaWFork	1.46E-05	SaAnSaAnt	5.03E-07
M103781	SYnzHilt	0.9238323	SaMaRey	0.04003427	SYnzMain	0.03469146	SaGaWFork	0.00084305	ArGrMain	0.0005944
M065168	SYnzHilt	0.92378635	SYnzMain	0.07266223	SaMaRey	0.00197224	SanSim	0.00157346	ArGrMain	1.99E-06
M065279	SYnzHilt	0.92327466	SYnzMain	0.03830715	FilHaCole	0.03819247	SaMaRey	0.00018892	ArGrMain	3.23E-05
M038251	SYnzHilt	0.92262346	SYnzMain	0.05596634	SalTjera	0.02063876	ArGrMain	0.00073054	SYnzSals	3.07E-05
M045360	SYnzHilt	0.92208052	SYnzMain	0.07787213	FilHaCole	2.10E-05	ArGrMain	1.59E-05	SYnzSals	7.29E-06
M086539	SYnzHilt	0.92166342	SYnzMain	0.07284306	SaMaRey	0.0050237	SanSim	0.00026804	FilHaCole	0.00019625
M045457	SYnzHilt	0.91849863	SaGaWFork	0.0770635	SYnzMain	0.0042352	FilHaCole	0.0001121	SanSim	5.91E-05
M102162	SYnzHilt	0.91808598	SYnzMain	0.0678733	SaMaRey	0.01254992	SaGaWFork	0.00135714	SalTjera	0.00011184
M031369	SYnzHilt	0.91302325	SYnzMain	0.08683753	SalTjera	0.00012251	SanSim	1.15E-05	SalTjara	2.24E-06
M057073	SYnzHilt	0.90801524	SYnzMain	0.08085717	SaGaWFork	0.00821252	SaMaRey	0.00161953	FilHaCole	0.00129369
M065406	SYnzHilt	0.90796318	SYnzMain	0.08955158	ArGrMain	0.0024518	SalTjera	3.05E-05	SanSim	1.77E-06
M102196	SYnzHilt	0.90535913	SYnzMain	0.04592419	SaMaRey	0.03982231	ArGrMain	0.00554286	SaGaWFork	0.00167374
M065288	SYnzHilt	0.90524877	SYnzMain	0.0945018	SaGaWFork	0.00022588	ArGrMain	2.33E-05	SaMaRey	2.37E-07
M045371	SYnzHilt	0.89985415	SYnzMain	0.09995079	FilHaCole	0.00014557	ArGrMain	3.70E-05	SaClaSaPa	9.25E-06
M065191	SYnzHilt	0.89893765	SYnzMain	0.08716617	SaGaWFork	0.00903674	SaMaRey	0.00314158	SalTjera	0.00090521
M062953	SYnzHilt	0.89819776	SYnzMain	0.10173388	SanSim	4.05E-05	SaGaWFork	2.41E-05	ArGrMain	3.37E-06
M038233	SYnzHilt	0.89763138	SYnzMain	0.09535686	ArGrMain	0.0045054	SaMaRey	0.00227084	SaGaWFork	0.00016311
M057071	SYnzHilt	0.89666793	SYnzMain	0.09497859	SaMaRey	0.0058063	SaGaWFork	0.00235848	ArGrMain	0.00015046
M102116	SYnzHilt	0.89511711	SanSim	0.08018258	SYnzMain	0.02265589	SaGaWFork	0.00201096	SaMaRey	1.73E-05
M041526	SYnzHilt	0.89509565	SYnzMain	0.0950182	SaGaWFork	0.00910304	SalTjera	0.00074997	SaMaRey	2.45E-05
M062999	SYnzHilt	0.89407246	SYnzMain	0.10541462	SYnzSals	0.00045543	ArGrMain	5.65E-05	SalTjera	4.32E-07

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M031442	SYnzHilt	0.89269507	SYnzMain	0.07684413	ArGrMain	0.03043701	SalTjara	1.13E-05	SalTjera	7.13E-06
M062889	SYnzHilt	0.89213079	SYnzMain	0.10456597	SaMaRey	0.00231772	FilHaCole	0.00069187	ArGrMain	0.00027271
M038223	SYnzHilt	0.89031951	SaGaWFork	0.06596012	SYnzMain	0.04371744	FilHaCole	2.55E-06	SaMaRey	3.02E-07
M031360	SYnzHilt	0.88756012	SYnzMain	0.10791843	SaGaWFork	0.00409434	ArGrMain	0.00036023	SanSim	4.71E-05
M031372	SYnzHilt	0.8838309	ArGrMain	0.05904551	SYnzMain	0.05427844	SaMaRey	0.0024513	SaGaWFork	0.00034504
M065298	SYnzHilt	0.88355851	SYnzMain	0.11418713	SYnzSals	0.00160069	SalTjera	0.00037521	ArGrMain	0.00020952
M012438	SYnzHilt	0.88094597	SYnzMain	0.11887838	SalTjera	8.24E-05	SaGaWFork	6.44E-05	SaMaRey	1.60E-05
M062944	SYnzHilt	0.87884984	SYnzMain	0.10769629	SaGaWFork	0.01297955	SaMaRey	0.00046239	SanSim	5.25E-06
M063024	SYnzHilt	0.87880127	SYnzMain	0.12110064	SalTjera	8.48E-05	SaMaRey	9.67E-06	SaGaWFork	3.06E-06
M045442	SYnzHilt	0.87867529	SYnzMain	0.12046974	SaGaWFork	0.00082233	SaMaRey	1.97E-05	FilHaCole	1.01E-05
M062899	SYnzHilt	0.87370497	SYnzMain	0.10805476	SalTjera	0.01732761	ArGrMain	0.00081807	SanSim	4.17E-05
M038222	SYnzHilt	0.87288283	SYnzMain	0.09058562	SaGaWFork	0.03641557	FilHaCole	7.12E-05	SaMaRey	4.23E-05
M053042	SYnzHilt	0.87254028	SYnzMain	0.12528821	ArGrMain	0.00132159	SaMaRey	0.0006565	SaClaSaPa	0.00015766
M036642	SYnzHilt	0.87177792	ArGrMain	0.09305341	SYnzMain	0.0351392	SYnzSals	1.58E-05	SaMaRey	1.08E-05
M038201	SYnzHilt	0.87044444	SaMaRey	0.08035688	SYnzMain	0.04901697	SaGaWFork	0.00014941	FilHaCole	3.05E-05
M065250	SYnzHilt	0.87041706	SYnzMain	0.12957992	SalTjara	1.22E-06	ArGrMain	6.88E-07	SanSim	6.60E-07
M057052	SYnzHilt	0.87004677	SYnzMain	0.10628721	SaGaWFork	0.02279922	SaMaRey	0.00050428	FilHaCole	0.00034753
M065272	SYnzHilt	0.86886974	SYnzMain	0.08843711	SalTjera	0.034564	SaMaRey	0.00787522	ArGrMain	0.00015417
M063013	SYnzHilt	0.8669176	SYnzMain	0.13277335	SalTjera	0.00018723	SaMaRey	0.00011624	FilHaCole	5.12E-06
M065357	SYnzHilt	0.86541299	SYnzMain	0.13379776	SaGaWFork	0.00036088	ArGrMain	0.00027413	SanSim	0.00015333
M092340	SYnzHilt	0.86525043	SYnzMain	0.13465501	SaMaRey	9.41E-05	SaGaWFork	1.93E-07	SanSim	1.20E-07
M065167	SYnzHilt	0.86461876	SYnzMain	0.1351044	SaMaRey	0.00024632	ArGrMain	2.22E-05	SalTjera	5.12E-06
M065320	SYnzHilt	0.86454546	SaMaRey	0.07130923	SaGaWFork	0.02577987	FilHaCole	0.02292914	SYnzMain	0.01341416
M065247	SYnzHilt	0.86233594	SYnzMain	0.13753459	SaMaRey	7.54E-05	FilHaCole	4.99E-05	ArGrMain	3.11E-06
M065275	SYnzHilt	0.8596257	SaGaWFork	0.08413102	SYnzMain	0.05571852	SaClaSaPa	0.00047725	SaMaRey	2.04E-05
M031386	SYnzHilt	0.85906356	SYnzMain	0.13700227	FilHaCole	0.00168786	SaGaWFork	0.0016281	SaMaRey	0.00028072
M102161	SYnzHilt	0.85723239	SaMaRey	0.14174882	SYnzMain	0.00064461	SaClaSaPa	0.00027217	SaGaWFork	8.99E-05
M057075	SYnzHilt	0.8568477	SYnzMain	0.10754195	SaGaWFork	0.0337756	SaMaRey	0.00122123	SanSim	0.00047498
M045451	SYnzHilt	0.85648941	SYnzMain	0.14240729	SaGaWFork	0.00080947	SanSim	0.00023193	FilHaCole	6.15E-05
M038208	SYnzHilt	0.85640784	SYnzMain	0.14271165	SalTjera	0.00073733	ArGrMain	0.00013547	SalTjara	6.03E-06

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M062940	SYnzHilt	0.85609119	SaMaRey	0.09758192	SYnzMain	0.04089565	SaClaSaPa	0.00360834	SanSim	0.00157749
M065409	SYnzHilt	0.85527325	SYnzMain	0.13845927	SaGaWFork	0.00568789	SalTjera	0.00042207	ArGrMain	0.00012935
M045454	SYnzHilt	0.85367149	SYnzMain	0.14600755	SanSim	0.00020479	SaGaWFork	8.88E-05	SaMaRey	1.98E-05
M038229	SYnzHilt	0.85160615	SYnzMain	0.14839061	SYnzSals	2.64E-06	SalTjera	4.12E-07	SaMaRey	1.58E-07
M065289	SYnzHilt	0.85062766	SYnzMain	0.14621983	FilHaCole	0.0024078	ArGrMain	0.00040076	SaMaRey	0.00022244
M057049	SYnzHilt	0.84980988	SYnzMain	0.13659123	SaMaRey	0.0133042	FilHaCole	0.00018819	SYnzSals	8.69E-05
M065404	SYnzHilt	0.8490683	SYnzMain	0.13732521	ArGrMain	0.0126475	SaGaWFork	0.00045941	SaMaRey	0.00045605
M063008	SYnzHilt	0.84791085	SaGaWFork	0.12114559	FilHaCole	0.02136046	SYnzMain	0.00956726	SalTjera	1.24E-05
M062890	SYnzHilt	0.84478324	SYnzMain	0.12373606	SaGaWFork	0.02503219	SaMaRey	0.00601747	SanSim	0.00022945
M102182	SYnzHilt	0.84441142	SYnzMain	0.14335582	SaMaRey	0.01217341	SaClaSaPa	4.55E-05	SanSim	9.62E-06
M045416	SYnzHilt	0.84271849	SYnzMain	0.13678468	SaGaWFork	0.02044509	ArGrMain	4.89E-05	SaMaRey	2.61E-06
M010158	SYnzHilt	0.84022181	SYnzMain	0.15736287	SaGaWFork	0.00232906	ArGrMain	7.87E-05	SaMaRey	5.29E-06
M057074	SYnzHilt	0.84009038	SYnzMain	0.14591599	SalTjera	0.01210669	SaMaRey	0.00184281	SalTjara	3.95E-05
M038264	SYnzHilt	0.83868599	SYnzMain	0.15476072	SanSim	0.00528699	SalTjara	0.00125991	SaMaRey	3.00E-06
M102117	SYnzHilt	0.83806752	SYnzMain	0.13682489	SanSim	0.01469793	SaGaWFork	0.00868486	SaMaRey	0.00171182
M063029	SYnzHilt	0.8371133	SYnzMain	0.15707447	SalTjara	0.00419333	SaMaRey	0.00128662	SalTjera	0.00017955
M065407	SYnzHilt	0.83566459	SYnzMain	0.16431666	SaMaRey	1.34E-05	ArGrMain	2.21E-06	SaGaWFork	1.81E-06
M031366	SYnzHilt	0.83467344	SYnzMain	0.16132705	SYnzSals	0.00280439	SaMaRey	0.00116517	ArGrMain	1.68E-05
M041528	SYnzHilt	0.8339056	SYnzMain	0.11493184	SaMaRey	0.04846139	FilHaCole	0.00141392	SaGaWFork	0.00128537
M038174	SYnzHilt	0.83321273	SYnzMain	0.06523262	SaMaRey	0.05785808	FilHaCole	0.02208145	ArGrMain	0.01627973
M065223	SYnzHilt	0.83158689	SaMaRey	0.15087212	SYnzMain	0.01743281	SaClaSaPa	5.59E-05	SaGaWFork	4.78E-05
M045419	SYnzHilt	0.83156623	SYnzMain	0.16099049	SaGaWFork	0.0074058	SaMaRey	3.36E-05	ArGrMain	3.73E-06
M063023	SYnzHilt	0.82453186	SYnzMain	0.17499835	SaMaRey	0.00043748	SalTjera	2.39E-05	SanSim	4.65E-06
M038215	SYnzHilt	0.82409056	SYnzMain	0.171839	SYnzSals	0.00232485	SaMaRey	0.00143641	ArGrMain	0.00026812
M057050	SYnzHilt	0.82190826	SYnzMain	0.15889939	SYnzSals	0.01081229	FilHaCole	0.00456045	SaMaRey	0.00375477
M102206	SYnzHilt	0.82161785	SaMaRey	0.09331326	SaGaWFork	0.08180121	SYnzMain	0.00216558	FilHaCole	0.00109857
M065151	SYnzHilt	0.82088565	SaMaRey	0.09426123	SYnzMain	0.08479587	SalTjera	3.77E-05	ArGrMain	7.64E-06
M036643	SYnzHilt	0.82050156	SYnzMain	0.10433694	SaMaRey	0.07139731	ArGrMain	0.00319355	FilHaCole	0.00031166
M057070	SYnzHilt	0.82029209	FilHaCole	0.09951869	SaGaWFork	0.07418258	SYnzMain	0.00569284	SaMaRey	0.00030751
M045422	SYnzHilt	0.8190366	SYnzMain	0.16536635	FilHaCole	0.00676765	SalTjera	0.00469022	SaMaRey	0.00375937

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M057056	SYnzHilt	0.81504467	SYnzMain	0.18372602	SYnzSals	0.00076985	FilHaCole	0.0003976	ArGrMain	4.78E-05
M102180	SYnzHilt	0.81162746	SalTjera	0.1552154	SaMaRey	0.02648564	SaGaWFork	0.00449989	SYnzMain	0.00213008
M065360	SYnzHilt	0.81162022	FilHaCole	0.17850056	SYnzMain	0.00949966	SaMaRey	0.00035393	SaGaWFork	2.37E-05
M065374	SYnzHilt	0.81103222	SYnzMain	0.18735076	ArGrMain	0.00077384	FilHaCole	0.00054565	SaGaWFork	0.00026824
M031377	SYnzHilt	0.80940059	SYnzMain	0.19059622	ArGrMain	1.55E-06	SaMaRey	1.50E-06	SalTjera	1.33E-07
M063012	SYnzHilt	0.80915439	SYnzMain	0.19082852	SaGaWFork	9.84E-06	SalTjera	6.05E-06	SaMaRey	1.00E-06
M031426	SYnzHilt	0.80794774	SYnzMain	0.17272508	SaGaWFork	0.01931833	FilHaCole	7.07E-06	SaAnSaAnt	6.77E-07
M031376	SYnzHilt	0.80677645	SYnzMain	0.14592258	SaMaRey	0.04649674	FilHaCole	0.00077085	ArGrMain	2.58E-05
M065307	SYnzHilt	0.80643459	SaMaRey	0.16333514	SYnzMain	0.02664794	SaGaWFork	0.00278708	ArGrMain	0.00061717
M102208	SYnzHilt	0.80509651	SYnzMain	0.12613158	SaMaRey	0.03357703	SanSim	0.03221358	SaGaWFork	0.00276556
M065290	SYnzHilt	0.80036094	SYnzMain	0.19470894	SaMaRey	0.00469391	ArGrMain	0.0002301	SaClaSaPa	3.46E-06
M045362	SYnzHilt	0.80018829	SYnzMain	0.15735454	SaMaRey	0.03221359	SaGaWFork	0.00862285	FilHaCole	0.00131083
M102202	SYnzHilt	0.79792022	SYnzMain	0.10421701	SaMaRey	0.0881821	SaClaSaPa	0.00964684	ArGrMain	1.58E-05
M063035	SYnzHilt	0.79375259	SalTjera	0.10739497	SYnzMain	0.09882122	SaGaWFork	1.21E-05	FilHaCole	1.15E-05
M053048	SYnzHilt	0.79362736	SaMaRey	0.19576137	SYnzMain	0.01020306	FilHaCole	0.00039192	SaClaSaPa	1.57E-05
M057076	SYnzHilt	0.79252411	SYnzMain	0.20717922	SaClaSaPa	0.00017203	SalTjera	9.40E-05	ArGrMain	2.26E-05
M102105	SYnzHilt	0.78621896	SYnzMain	0.16099251	ArGrMain	0.05275694	SaMaRey	2.93E-05	FilHaWyom	1.41E-06
M065253	SYnzHilt	0.78554361	SYnzMain	0.20800445	SaMaRey	0.00352508	ArGrMain	0.00231121	SYnzSals	0.00058688
M063004	SYnzHilt	0.7848123	SYnzMain	0.21488116	ArGrMain	0.00030539	SYnzSals	7.06E-07	SaMaRey	1.40E-07
M063016	SYnzHilt	0.78457636	SYnzMain	0.21518819	SalTjera	0.00013422	FilHaCole	8.48E-05	SaGaWFork	9.77E-06
M057051	SYnzHilt	0.78426058	SYnzMain	0.20955676	ArGrMain	0.00510949	SaMaRey	0.00100101	FilHaCole	7.11E-05
M065382	SYnzHilt	0.78317812	SYnzMain	0.18558325	SaGaWFork	0.02938703	SanSim	0.00172416	ArGrMain	9.93E-05
M065195	SYnzHilt	0.78037084	SYnzMain	0.21903208	SalTjera	0.00020218	ArGrMain	0.000135	SalTjara	0.00012962
M067381	SYnzHilt	0.77996763	SYnzMain	0.21067246	SaGaWFork	0.00927128	SanSim	2.70E-05	ArGrMain	2.48E-05
M092342	SYnzHilt	0.77525946	SYnzMain	0.18722712	SaGaWFork	0.03311219	ArGrMain	0.00397704	SalTjera	0.00021394
M062985	SYnzHilt	0.77488326	SYnzMain	0.22510354	SaMaRey	1.00E-05	SalTjera	2.19E-06	FilHaCole	8.28E-07
M012439	SYnzHilt	0.77292802	SYnzMain	0.13732874	SaMaRey	0.07038434	SaGaWFork	0.01795866	ArGrMain	0.00104605
M102113	SYnzHilt	0.77229167	FilHaCole	0.18706574	SYnzMain	0.02210332	SaMaRey	0.01710647	SaGaWFork	0.00139873
M065186	SYnzHilt	0.77223562	FilHaCole	0.21210834	SYnzMain	0.01190978	SaMaRey	0.00316663	SaGaWFork	0.00057185
M063014	SYnzHilt	0.77221771	SYnzMain	0.12833314	SaMaRey	0.09860793	SalTjera	0.00030219	SanSim	0.00030205

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M102133	SYnzHilt	0.77217496	SYnzMain	0.12917279	SaMaRey	0.05897282	SanSim	0.03764757	FilHaCole	0.00200853
M038240	SYnzHilt	0.76782738	SYnzMain	0.22955856	SaMaRey	0.00143395	SanSim	0.00115744	SYnzSCrz	7.10E-06
M062892	SYnzHilt	0.76644362	SYnzMain	0.17676452	SaMaRey	0.0562721	SaClaSaPa	0.00025681	SaGaWFork	0.00025395
M063007	SYnzHilt	0.76594297	SYnzMain	0.2181635	SaClaSaPa	0.00674295	SaMaRey	0.00536798	SaGaWFork	0.00207371
M065297	SYnzHilt	0.76593684	SaGaWFork	0.20052522	SYnzMain	0.03325259	SalTjera	0.00023895	SalTjara	3.57E-05
M102158	SYnzHilt	0.76269335	SYnzMain	0.23375484	SaMaRey	0.00352564	SaGaWFork	1.39E-05	FilHaCole	1.14E-05
M031430	SYnzHilt	0.76232946	SaMaRey	0.16358058	SYnzMain	0.07374233	SaGaWFork	0.00028328	SanSim	4.86E-05
M062909	SYnzHilt	0.76210215	SYnzMain	0.23769417	ArGrMain	9.33E-05	FilHaCole	5.22E-05	SaGaWFork	4.94E-05
M065245	SYnzHilt	0.76074838	SYnzMain	0.23900836	ArGrMain	0.00024305	SalTjara	1.29E-07	SanSim	3.15E-08
M031414	SYnzHilt	0.75818226	SYnzMain	0.23995412	FilHaCole	0.00078861	SaMaRey	0.00053745	SalTjera	0.00034851
M065309	SYnzHilt	0.75810343	SalTjera	0.12832111	SaMaRey	0.06699074	SYnzMain	0.0398449	SaGaWFork	0.00436833
M038197	SYnzHilt	0.75665706	SaMaRey	0.14047135	SYnzMain	0.10281033	SalTjara	2.74E-05	SanSim	1.77E-05
M062870	SYnzHilt	0.75132745	FilHaCole	0.22316587	SYnzMain	0.02502634	SaMaRey	0.00045203	SaGaWFork	2.38E-05
M057057	SYnzHilt	0.74858171	SYnzMain	0.2475717	SaMaRey	0.00197875	ArGrMain	0.0018129	SaGaWFork	4.82E-05
M031441	SYnzHilt	0.7470006	SYnzMain	0.23884901	SalTjera	0.01365316	SaMaRey	0.00034658	ArGrMain	0.00011094
M062883	SYnzHilt	0.74634664	SaMaRey	0.15883531	FilHaCole	0.09260965	SYnzMain	0.0018929	SaGaWFork	0.00031277
M103778	SYnzHilt	0.74614853	FilHaCole	0.20317845	SaGaWFork	0.03828389	SYnzMain	0.0117794	SaMaRey	0.00050823
M057059	SYnzHilt	0.74411067	SYnzSals	0.11339529	SYnzMain	0.09628929	SaMaRey	0.04547361	FilHaCole	0.00043275
M062884	SYnzHilt	0.74260782	SYnzMain	0.25268553	FilHaCole	0.00415467	SYnzSals	0.00036588	SaMaRey	0.00015951
M062914	SYnzHilt	0.74176432	SYnzMain	0.2488614	ArGrMain	0.00779287	SaMaRey	0.0012153	SaGaWFork	0.0002333
M065369	SYnzHilt	0.73831381	SYnzMain	0.25362829	SaMaRey	0.0079183	FilHaCole	0.00012935	SaClaSaPa	1.01E-05
M102108	SYnzHilt	0.73815042	ArGrMain	0.19223178	SYnzMain	0.06837141	SYnzSals	0.00081503	SaMaRey	0.00034269
M065153	SYnzHilt	0.73663496	SYnzMain	0.26033963	SaGaWFork	0.00243384	ArGrMain	0.00028766	SaClaSaPa	0.00023781
M065291	SYnzHilt	0.73246278	SYnzMain	0.26317275	FilHaCole	0.0022369	SaGaWFork	0.00209395	SaMaRey	2.55E-05
M102107	SYnzHilt	0.73101815	SYnzMain	0.20459876	ArGrMain	0.06215578	SaGaWFork	0.00187613	SaMaRey	0.00028197
M063006	SYnzHilt	0.72348832	SYnzMain	0.27232632	SalTjera	0.00379709	SaMaRey	0.00030659	SanSim	4.97E-05
M065274	SYnzHilt	0.71749974	SaMaRey	0.14995339	SYnzMain	0.13124301	ArGrMain	0.00059112	SaGaWFork	0.00039017
M062977	SYnzHilt	0.7167398	SaGaWFork	0.27291106	SYnzMain	0.00943086	FilHaCole	0.00087261	SaMaRey	4.56E-05
M065256	SYnzHilt	0.7149796	SYnzMain	0.26045356	SalTjera	0.01457407	SaMaRey	0.0072876	ArGrMain	0.00260059
M102132	SYnzHilt	0.71437344	SYnzMain	0.09683856	SaMaRey	0.08506891	SaGaWFork	0.07914624	SanSim	0.02456617

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M102187	SYnzHilt	0.7141665	SYnzMain	0.25440637	SaMaRey	0.02788956	SalTjera	0.00322558	SYnzSals	0.0001673
M067357	SYnzHilt	0.7141478	SYnzMain	0.27889353	SaMaRey	0.00688445	SaGaWFork	7.37E-05	ArGrMain	2.89E-07
M065411	SYnzHilt	0.71392497	SaMaRey	0.27263279	SYnzMain	0.0124066	SaGaWFork	0.00054928	ArGrMain	0.00042994
M063033	SYnzHilt	0.71249042	SYnzMain	0.23404217	SalTjera	0.05346282	ArGrMain	2.03E-06	SaMaRey	2.00E-06
M065200	SYnzHilt	0.71218374	SYnzMain	0.28756159	SaGaWFork	0.0001772	SalTjera	6.39E-05	SaClaSaPa	8.69E-06
M065356	SYnzHilt	0.7118292	ArGrMain	0.11689513	SYnzMain	0.06039529	SaMaRey	0.05907864	SaGaWFork	0.03844318
M031431	SYnzHilt	0.70924399	SalTjera	0.20952395	SYnzMain	0.06295388	FilHaCole	0.01705151	ArGrMain	0.0012077
M097903	SYnzHilt	0.70025219	SYnzMain	0.26152719	SYnzSals	0.03811844	SaClaSaPa	5.16E-05	SaMaRey	4.73E-05
M102184	SYnzHilt	0.69974947	SaGaWFork	0.27376353	SaMaRey	0.02631166	SYnzMain	0.00012941	SaClaSaPa	4.37E-05
M102170	SYnzHilt	0.69888368	SaMaRey	0.23405578	SYnzMain	0.06507716	SaClaSaPa	0.00169792	SanSim	0.00022004
M063026	SYnzHilt	0.69543118	SYnzMain	0.15956522	SaMaRey	0.13993905	SaGaWFork	0.00450357	FilHaCole	0.00052781
M038247	SYnzHilt	0.68857113	SYnzMain	0.30907524	SaMaRey	0.00180845	SalTjera	0.00042407	SanSim	4.75E-05
M067383	SYnzHilt	0.6868891	SaGaWFork	0.31186891	SYnzMain	0.0009968	FilHaWyom	0.0002081	FilHaCole	3.35E-05
M062886	SYnzHilt	0.68402907	SYnzMain	0.30559758	SaMaRey	0.01003422	SYnzSals	0.00023083	SaClaSaPa	7.71E-05
M062933	SYnzHilt	0.68398169	SYnzMain	0.14560811	SaGaWFork	0.13781594	SaMaRey	0.03021364	SanSim	0.00233111
M062866	SYnzHilt	0.68358489	FilHaCole	0.20018577	SYnzMain	0.07754025	SaMaRey	0.03864568	SaClaSaPa	3.12E-05
M065224	SYnzHilt	0.68245845	SaMaRey	0.31513485	SalTjera	0.00166891	SYnzMain	0.00066311	FilHaCole	3.08E-05
M065323	SYnzHilt	0.68219345	SaGaWFork	0.1940195	SalTjera	0.07119365	SYnzMain	0.03999882	FilHaCole	0.00497415
M057066	SYnzHilt	0.67987978	SYnzMain	0.23762956	SaClaSaPa	0.04693476	SYnzSals	0.03451801	SaMaRey	0.00069007
M102178	SYnzHilt	0.67847017	SaMaRey	0.28875602	SYnzMain	0.03270913	SaGaWFork	6.11E-05	SaClaSaPa	3.09E-06
M065230	SYnzHilt	0.67576061	SYnzMain	0.30102373	SaMaRey	0.01367758	SanSim	0.00933676	ArGrMain	5.06E-05
M036644	SYnzHilt	0.67477798	SYnzMain	0.15093669	SaGaWFork	0.13351998	SaMaRey	0.03367722	FilHaCole	0.00698832
M097892	SYnzHilt	0.6699371	SYnzMain	0.2309202	ArGrMain	0.0955517	SaMaRey	0.00343137	SYnzSals	8.04E-05
M053037	SYnzHilt	0.66902838	SYnzMain	0.31817653	SaGaWFork	0.01233387	SaMaRey	0.0003315	FilHaCole	0.00012954
M065258	SYnzHilt	0.66799926	SYnzMain	0.31145357	SaGaWFork	0.0201194	SaMaRey	0.00037013	SanSim	2.30E-05
M062971	SYnzHilt	0.66553964	SYnzMain	0.33407764	SYnzSals	0.00014566	SalTjera	0.00013912	SaMaRey	8.60E-05
M057078	SYnzHilt	0.65976788	SYnzMain	0.28575681	SaGaWFork	0.05428002	SaMaRey	0.00011124	SanSim	3.70E-05
M065209	SYnzHilt	0.65876463	SYnzMain	0.33074178	SalTjera	0.01007043	SYnzSals	0.00027029	ArGrMain	0.00013255
M038172	SYnzHilt	0.65811863	SaGaWFork	0.28968756	SYnzMain	0.05218987	SaMaRey	2.84E-06	ArGrMain	6.74E-07
M065169	SYnzHilt	0.65316257	SYnzMain	0.34603915	SaMaRey	0.0006638	SanSim	0.00011996	ArGrMain	5.06E-06

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M062923	SYnzHilt	0.65060076	SalTjera	0.21473955	SYnzMain	0.13414112	SalTjara	0.00050545	ArGrMain	8.14E-06
M065419	SYnzHilt	0.65031114	SYnzMain	0.3492522	SanSim	0.00027528	ArGrMain	0.00012785	SalTjera	2.24E-05
M102159	SYnzHilt	0.64468653	SaMaRey	0.35334151	SYnzMain	0.00182916	SalTjara	0.00013282	SaGaWFork	4.40E-06
M065368	SYnzHilt	0.64098769	SYnzMain	0.28467793	FilHaCole	0.04230666	SaMaRey	0.03200865	ArGrMain	1.65E-05
M011643	SYnzHilt	0.63916106	SYnzMain	0.35891993	ArGrMain	0.00139086	SaMaRey	0.00033737	SalTjera	0.00012325
M065219	SYnzHilt	0.63540116	SYnzSals	0.28511777	SYnzMain	0.07934035	ArGrMain	7.28E-05	SaMaRey	5.39E-05
M053041	SYnzHilt	0.63539472	SYnzMain	0.36444423	ArGrMain	0.00013849	SYnzSals	1.15E-05	SaClaSaPa	5.68E-06
M086535	SYnzHilt	0.63125433	ArGrMain	0.20286229	SYnzMain	0.15381335	SaGaWFork	0.00867916	FilHaCole	0.00225406
M065388	SYnzHilt	0.62965496	SYnzMain	0.36882625	FilHaCole	0.00084202	ArGrMain	0.00064203	SalTjera	1.49E-05
M045459	SYnzHilt	0.62814356	SYnzMain	0.37091824	SaMaRey	0.00053794	ArGrMain	0.00019348	SaGaWFork	0.00017729
M045356	SYnzHilt	0.62554161	SYnzMain	0.2495655	ArGrMain	0.11851657	SYnzSals	0.00281602	SaMaRey	0.00253183
M065281	SYnzHilt	0.61954533	SalTjera	0.347177	SYnzMain	0.02524999	SaGaWFork	0.00778465	ArGrMain	0.00023923
M065403	SYnzHilt	0.61702099	SYnzMain	0.24158668	SalTjera	0.11680056	ArGrMain	0.02097401	SYnzSals	0.00358672
M067370	SYnzHilt	0.61623099	ArGrMain	0.35819715	SYnzMain	0.02553304	SaGaWFork	3.67E-05	SYnzSals	5.80E-07
M067367	SYnzHilt	0.61525629	SYnzMain	0.33631156	SaMaRey	0.02352553	ArGrMain	0.01677675	SYnzSCrz	0.00405864
M031398	SYnzHilt	0.61466406	SYnzMain	0.38511636	SaGaWFork	0.00012478	SalTjera	5.97E-05	SanSim	3.29E-05
M031400	SYnzHilt	0.61292497	SYnzMain	0.38687519	SalTjera	0.00015471	ArGrMain	3.90E-05	SYnzSals	5.58E-06
M065150	SYnzHilt	0.61186377	FilHaCole	0.16771806	SYnzMain	0.16180237	SaMaRey	0.05857983	SaGaWFork	2.79E-05
M065397	SYnzHilt	0.60806588	FilHaCole	0.26114735	SaGaWFork	0.11089995	SYnzMain	0.01220007	SaMaRey	0.00676678
M065365	SYnzHilt	0.60798612	SYnzMain	0.391964	ArGrMain	3.43E-05	SalTjara	1.10E-05	SaMaRey	3.64E-06
M065234	SYnzHilt	0.60494023	SaGaWFork	0.38780222	SYnzMain	0.00403659	FilHaCole	0.00180921	ArGrMain	0.00135576
M045414	SYnzHilt	0.59769764	SYnzMain	0.39876913	SYnzSals	0.00334256	ArGrMain	7.78E-05	SalTjara	4.68E-05
M031392	SYnzHilt	0.59676525	SYnzMain	0.40306156	SaMaRey	5.35E-05	SalTjera	4.70E-05	SYnzSals	3.83E-05
M092332	SYnzHilt	0.58886444	SYnzMain	0.39653117	SalTjera	0.01427936	SanSim	0.00018381	ArGrMain	0.00012566
M065353	SYnzHilt	0.58833112	SYnzMain	0.4103732	SaMaRey	0.00119461	FilHaCole	7.65E-05	SaClaSaPa	1.83E-05
M097889	SYnzHilt	0.58454508	SYnzMain	0.41450699	SYnzSals	0.00085455	SanSim	5.59E-05	SalTjera	2.65E-05
M038199	SYnzHilt	0.5777422	SYnzMain	0.40289223	ArGrMain	0.00704658	SalTjera	0.00661213	SalTjara	0.00539863
M065265	SYnzHilt	0.57753001	SYnzMain	0.42089584	SalTjera	0.00154364	SaMaRey	1.23E-05	SaGaWFork	1.01E-05
M065308	SYnzHilt	0.57283176	SYnzMain	0.41639363	SaGaWFork	0.01069001	SanSim	7.37E-05	ArGrMain	3.63E-06
M065387	SYnzHilt	0.57255058	SaGaWFork	0.19765848	SYnzMain	0.13761286	SalTjera	0.09135218	SanSim	0.0005785

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M038181	SYnzHilt	0.57253443	SYnzMain	0.4274491	SYnzSals	1.11E-05	ArGrMain	3.42E-06	SalTjera	1.90E-06
M065254	SYnzHilt	0.57212681	SYnzMain	0.42783649	SaMaRey	3.17E-05	SaClaSaPa	1.82E-06	ArGrMain	1.61E-06
M062992	SYnzHilt	0.56660713	SYnzMain	0.43337137	FilHaCole	2.04E-05	SaMaRey	3.50E-07	SaGaWFork	3.30E-07
M065196	SYnzHilt	0.56558501	SYnzMain	0.4343926	SanSim	1.90E-05	ArGrMain	1.64E-06	SalTjera	4.73E-07
M065204	SYnzHilt	0.56345174	SYnzMain	0.43654317	SaMaRey	3.96E-06	SaClaSaPa	3.48E-07	SalTjara	3.04E-07
M102120	SYnzHilt	0.56068894	SanSim	0.27897215	SYnzMain	0.12264313	SaMaRey	0.03676777	SaGaWFork	0.00092248
M102204	SYnzHilt	0.56003591	SYnzMain	0.27368935	SaMaRey	0.15547628	SalTjera	0.00974864	ArGrMain	0.0005614
M045417	SYnzHilt	0.55706323	SYnzMain	0.43991256	ArGrMain	0.00180368	SalTjera	0.00084763	SaClaSaPa	0.00017414
M053046	SYnzHilt	0.55659793	SYnzMain	0.44274471	SaGaWFork	0.00027064	SalTjera	0.00024026	ArGrMain	0.00011594
M062917	SYnzHilt	0.55607355	SYnzMain	0.43469202	SaMaRey	0.00298048	SaGaWFork	0.00251349	FilHaCole	0.00205094
M065179	SYnzHilt	0.55496108	SYnzMain	0.25680814	ArGrMain	0.12684705	SYnzSals	0.03564932	SalTjera	0.01683894
M062872	SYnzHilt	0.55242733	SYnzMain	0.23770964	FilHaCole	0.10399513	SalTjera	0.07649844	ArGrMain	0.01792012
M086529	SYnzHilt	0.54834828	SYnzMain	0.36702615	SalTjera	0.07879792	ArGrMain	0.00574634	SalTjara	5.73E-05
M062901	SYnzHilt	0.53698276	SYnzMain	0.35769446	ArGrMain	0.10480854	SalTjera	0.0004158	SaGaWFork	5.81E-05
M065270	SYnzHilt	0.53367816	SYnzMain	0.32660398	SalTjera	0.13025518	SalTjara	0.00596755	SaMaRey	0.00229431
M038230	SYnzHilt	0.5235696	SYnzMain	0.25457514	SalTjera	0.22183412	SaMaRey	1.01E-05	SaGaWFork	6.22E-06
M045463	SYnzHilt	0.5181191	SYnzMain	0.48188058	SaMaRey	2.98E-07	FilHaCole	1.23E-08	SaClaSaPa	2.83E-09
M102163	SYnzHilt	0.51661006	SYnzMain	0.44982824	SaMaRey	0.01960746	SanSim	0.01394453	SYnzQuiota	6.41E-06
M062918	SYnzHilt	0.51576992	SYnzMain	0.4689862	SaGaWFork	0.00762117	SaMaRey	0.00756589	FilHaCole	3.26E-05
M062903	SYnzHilt	0.51556039	SaGaWFork	0.44640619	SYnzMain	0.02655988	FilHaCole	0.01136497	SaMaRey	9.44E-05
M062952	SYnzHilt	0.51318475	SYnzMain	0.4744447	SaGaWFork	0.01233656	FilHaCole	2.51E-05	SanSim	4.59E-06
M057055	SYnzHilt	0.51197583	SaMaRey	0.34578937	SYnzMain	0.13915972	SalTjera	0.00264524	SYnzSals	0.00025986
M031448	SYnzHilt	0.5103035	SaMaRey	0.47298436	SYnzMain	0.01583633	FilHaCole	0.000873	SaGaWFork	1.38E-06
M063034	SYnzHilt	0.50909561	SYnzMain	0.46199433	SalTjera	0.0288962	SaGaWFork	1.10E-05	SalTjara	2.21E-06
M065199	SYnzHilt	0.50722426	SYnzMain	0.49141088	SaMaRey	0.00041535	SalTjera	0.00036809	SaGaWFork	0.00033756
M038176	SYnzHilt	0.50680612	SaMaRey	0.43960152	SYnzMain	0.04664216	SaGaWFork	0.0061268	SaClaSaPa	0.00082284
M065348	SYnzHilt	0.50449828	FilHaCole	0.29039012	SYnzMain	0.16390585	SaMaRey	0.02720933	SaGaWFork	0.01395519
M063005	SYnzHilt	0.50336684	SYnzMain	0.40129792	SaGaWFork	0.09529837	SalTjera	2.90E-05	ArGrMain	4.57E-06
M038232	SYnzHilt	0.50235421	SYnzMain	0.49764553	SYnzSals	2.02E-07	SalTjera	4.89E-08	SaGaWFork	7.23E-09
M062873	SYnzHilt	0.50093678	FilHaCole	0.42992301	SaGaWFork	0.02502534	SYnzMain	0.02050741	SaClaSaPa	0.01894873

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M063018	SYnzHilt	0.50001835	SYnzMain	0.49574523	FilHaCole	0.00360072	SaMaRey	0.00060892	SaGaWFork	1.89E-05
M097891	SYnzHilt	0.49978252	FilHaCole	0.37231076	SaGaWFork	0.12680743	SaMaRey	0.00058665	SYnzMain	0.00050631
M092356	SYnzHilt	0.4988104	SYnzMain	0.47316105	SaGaWFork	0.02787434	SaMaRey	0.00015181	FilHaCole	2.01E-06
M065162	SYnzHilt	0.49462671	SYnzMain	0.32690233	SaMaRey	0.17597339	SanSim	0.0014845	SaClaSaPa	0.00077608
M038248	SYnzHilt	0.4920246	ArGrMain	0.30763098	SaGaWFork	0.13668027	SYnzMain	0.06365552	SYnzSCrz	4.16E-06
M065377	SYnzHilt	0.49167969	SYnzMain	0.37828208	ArGrMain	0.10191333	SalTjera	0.02716194	SYnzSals	0.00041441
M038194	SYnzHilt	0.48879643	SaMaRey	0.45210598	SYnzMain	0.05897475	SaGaWFork	7.55E-05	SanSim	4.14E-05
M062924	SYnzHilt	0.48771862	SalTjera	0.4372398	SYnzMain	0.07146953	SaMaRey	0.00281316	SYnzSals	0.00060052
M102123	SYnzHilt	0.48690873	SanSim	0.41637906	SaMaRey	0.05848324	SYnzMain	0.03821056	FilHaCole	1.13E-05
M062916	SYnzHilt	0.48541485	SaMaRey	0.47278221	SYnzMain	0.03870409	SaGaWFork	0.00266608	FilHaCole	0.00042858
M065227	SYnzHilt	0.47938325	SYnzMain	0.46182013	SalTjera	0.05059934	SaGaWFork	0.0051348	SaMaRey	0.00277018
M038262	SYnzHilt	0.46518087	SYnzMain	0.38482368	SalTjera	0.13161865	ArGrMain	0.01660812	SaGaWFork	0.00170395
M041527	SYnzHilt	0.45076195	SaMaRey	0.2980997	SYnzMain	0.25087908	ArGrMain	0.00024188	SaClaSaPa	1.68E-05
M062905	SYnzHilt	0.44461682	SaGaWFork	0.36534274	SYnzMain	0.1872804	FilHaCole	0.00168611	SaMaRey	0.00069469
M062915	SYnzHilt	0.43409125	FilHaCole	0.38022877	SYnzMain	0.14240775	SaMaRey	0.04098867	SalTjera	0.00104129
M102126	SYnzHilt	0.42746701	SYnzMain	0.36494303	SanSim	0.13447814	SaMaRey	0.06933881	SaGaWFork	0.00377138
M031357	SYnzHilt	0.42217018	SYnzMain	0.35411519	SYnzSals	0.21433188	SaMaRey	0.00401033	SalTjera	0.00382489
M031403	SYnzHilt	0.39696339	SYnzMain	0.37544865	SalTjera	0.22579402	SaGaWFork	0.00092426	FilHaCole	0.00025059
M063030	SYnzHilt	0.38850736	SYnzMain	0.38284498	SalTjera	0.22667395	SaMaRey	0.00094338	SaGaWFork	0.00058352
M045444	SYnzMain	0.99994549	SYnzHilt	5.36E-05	ArGrMain	7.85E-07	SYnzSals	4.91E-08	SalTjera	2.96E-08
M103791	SYnzMain	0.99986908	SYnzHilt	0.00012189	ArGrMain	3.29E-06	SaClaSaPa	3.09E-06	SYnzQuiota	1.55E-06
M065164	SYnzMain	0.99949909	SYnzHilt	0.00033068	SaMaRey	7.80E-05	SanSim	6.49E-05	ArGrMain	1.40E-05
M045450	SYnzMain	0.99947225	SYnzHilt	0.0003628	SanSim	0.00011126	SaMaRey	3.79E-05	ArGrMain	1.13E-05
M065338	SYnzMain	0.99926243	SYnzHilt	0.00061877	SaMaRey	6.77E-05	ArGrMain	3.11E-05	SalTjara	8.39E-06
M092316	SYnzMain	0.99893515	SYnzHilt	0.00106431	ArGrMain	3.41E-07	SaMaRey	1.88E-07	SYnzSals	6.81E-09
M045464	SYnzMain	0.99890566	SYnzHilt	0.00109388	SanSim	2.77E-07	ArGrMain	1.36E-07	ChorPen	3.77E-08
M103789	SYnzMain	0.99865679	ArGrMain	0.00067688	SYnzHilt	0.00037708	SalTjara	0.00018314	SaClaSesp	9.90E-05
M065160	SYnzMain	0.99850562	SYnzHilt	0.00149406	SanSim	2.23E-07	SalTjera	9.47E-08	SaClaSaPa	5.06E-09
M065340	SYnzMain	0.99804007	SYnzHilt	0.00194586	ArGrMain	9.18E-06	SalTjara	4.45E-06	SaClaSaPa	3.03E-07
M045435	SYnzMain	0.99776588	SYnzHilt	0.00223354	ArGrMain	3.21E-07	SaMaRey	1.35E-07	SaGaWFork	9.41E-08

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M103800	SYnzMain	0.99694859	SYnzHilt	0.00225671	SYnzSals	0.00058371	SYnzQuiota	0.0001076	VenBear	3.86E-05
M092355	SYnzMain	0.99585083	SYnzHilt	0.00414772	ArGrMain	8.68E-07	SaMaRey	4.08E-07	SYnzQuiota	1.68E-07
M062963	SYnzMain	0.99569626	SYnzHilt	0.00313242	SYnzSals	0.00084194	SalTjera	0.0003111	SaMaRey	9.75E-06
M045428	SYnzMain	0.99518032	SYnzHilt	0.00395213	ArGrMain	0.00086463	SaGaWFork	2.37E-06	SaClaSaPa	3.88E-07
M045443	SYnzMain	0.99512273	SYnzHilt	0.00373441	SalTjera	0.00107555	SalTjara	5.28E-05	ArGrMain	1.33E-05
M065233	SYnzMain	0.99511314	SYnzHilt	0.00465349	ArGrMain	0.00016465	SaMaRey	6.76E-05	SYnzSals	8.16E-07
M063002	SYnzMain	0.99506079	SYnzHilt	0.00462806	SanSim	0.00031063	SaMaRey	3.33E-07	ArGrMain	1.84E-07
M092317	SYnzMain	0.99485565	SYnzHilt	0.00472038	ArGrMain	0.00040252	SaMaRey	1.52E-05	SaClaSaPa	5.08E-06
M045447	SYnzMain	0.99449213	SYnzHilt	0.00465577	SanSim	0.00084445	ChorPen	5.02E-06	ArGrMain	1.84E-06
M102213	SYnzMain	0.99322193	SalTjara	0.0032666	ArGrMain	0.00200188	SYnzHilt	0.00119573	SaMaRey	0.00020938
M065312	SYnzMain	0.99287882	ArGrMain	0.0061545	SYnzHilt	0.00094856	SaMaRey	1.02E-05	SYnzSals	3.81E-06
M103780	SYnzMain	0.99281849	SaMaRey	0.00466517	SYnzHilt	0.00213455	ArGrMain	0.00023548	SanSim	0.00013131
M027328	SYnzMain	0.9926941	SalTjara	0.00509062	ArGrMain	0.00105732	SYnzHilt	0.00081063	SYnzSCrz	0.00031596
M065283	SYnzMain	0.99261232	SYnzHilt	0.00693104	SalTjera	0.00043956	FilHaCole	1.27E-05	ArGrMain	3.18E-06
M065181	SYnzMain	0.99259963	SYnzHilt	0.006943	SalTjera	0.00034362	ArGrMain	0.00011099	SanSim	1.51E-06
M045427	SYnzMain	0.99249203	SYnzHilt	0.00736721	SaClaSaPa	6.68E-05	SalTjera	3.31E-05	ArGrMain	2.58E-05
M065220	SYnzMain	0.99214988	SYnzHilt	0.00780913	SYnzSals	1.67E-05	ArGrMain	1.39E-05	SaMaRey	9.44E-06
M062932	SYnzMain	0.99114738	SYnzHilt	0.00505461	SYnzSals	0.00271523	SalTjera	0.00071342	ArGrLBer	0.00019446
M020029	SYnzMain	0.99083713	SYnzQuiota	0.00740906	SYnzHilt	0.00157545	SYnzSCrz	7.52E-05	SYnzWFSC	5.07E-05
M092307	SYnzMain	0.99082849	SYnzHilt	0.00854473	SaMaRey	0.00043076	SanSim	0.00012765	ArGrMain	4.86E-05
M092353	SYnzMain	0.99049186	SYnzHilt	0.00949039	SalTjara	1.12E-05	ArGrMain	6.39E-06	SanSim	1.21E-07
M065344	SYnzMain	0.99034572	SYnzHilt	0.00965182	ArGrMain	2.18E-06	SYnzSals	1.14E-07	SYnzSCrz	1.03E-07
M031408	SYnzMain	0.99026053	SYnzHilt	0.00822202	SalTjera	0.00143895	ArGrMain	7.50E-05	SYnzSals	2.60E-06
M062990	SYnzMain	0.98996468	SYnzHilt	0.00622824	SaGaWFork	0.00248442	FilHaCole	0.00093302	ArGrMain	0.00019791
M065170	SYnzMain	0.98991871	SYnzHilt	0.00963975	ArGrMain	0.00033955	SaMaRey	7.12E-05	SalTjera	2.81E-05
M062925	SYnzMain	0.98824161	SYnzHilt	0.00999786	SalTjera	0.00088355	ArGrMain	0.00087368	SanSim	2.86E-06
M045424	SYnzMain	0.98780623	SYnzHilt	0.01095912	SYnzSals	0.0009768	ArGrMain	0.00021925	SaMaRey	1.69E-05
M103785	SYnzMain	0.98711523	SalTjara	0.01192606	ArGrMain	0.0008475	SYnzSCrz	8.23E-05	SYnzWFSC	1.36E-05
M065346	SYnzMain	0.98595566	SYnzHilt	0.00888624	ArGrMain	0.00514355	SYnzSCrz	7.70E-06	SalTjara	2.79E-06
M102135	SYnzMain	0.98483903	SYnzHilt	0.0151389	SanSim	1.94E-05	SaMaRey	2.31E-06	SaGaWFork	1.64E-07

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M031397	SYnzMain	0.98445969	SalTjera	0.00882363	SYnzHilt	0.00618595	SYnzSals	0.00040076	ArGrMain	0.00012982
M062955	SYnzMain	0.98407702	SanSim	0.013936	SYnzHilt	0.0019509	ArGrMain	2.28E-05	SaMaRey	3.97E-06
M065259	SYnzMain	0.98257318	SYnzHilt	0.01568799	SaMaRey	0.00140305	ArGrMain	0.00023171	SanSim	4.80E-05
M038238	SYnzMain	0.98249642	SYnzHilt	0.01160839	SanSim	0.0057836	SaMaRey	4.89E-05	SYnzSals	3.95E-05
M038253	SYnzMain	0.98080616	SYnzHilt	0.01914951	SanSim	2.23E-05	SalTjera	2.06E-05	ArGrMain	1.04E-06
M103787	SYnzMain	0.97965148	ArGrMain	0.02018405	SYnzHilt	9.51E-05	SalTjara	4.81E-05	SYnzQuiota	1.98E-05
M038241	SYnzMain	0.97962169	SYnzHilt	0.02033576	SYnzSals	2.81E-05	ArGrMain	1.42E-05	SalTjera	1.18E-07
M031383	SYnzMain	0.9785547	SYnzHilt	0.01324609	SalTjera	0.0059136	SYnzSals	0.0022658	ArGrMain	1.81E-05
M065176	SYnzMain	0.97626675	SYnzHilt	0.02159524	SaMaRey	0.00184221	ArGrMain	0.00016927	SalTjara	7.88E-05
M045425	SYnzMain	0.97574087	SYnzHilt	0.02425892	SanSim	1.13E-07	SaMaRey	7.58E-08	SalTjara	1.11E-08
M031387	SYnzMain	0.97313443	SYnzHilt	0.01853972	SalTjera	0.00819706	ArGrMain	0.0001285	SanSim	1.69E-07
M065326	SYnzMain	0.97275074	SYnzHilt	0.01495955	SYnzSals	0.01196367	SaMaRey	0.00030006	SalTjera	1.08E-05
M045358	SYnzMain	0.97273127	SYnzHilt	0.02718409	SaMaRey	6.20E-05	SanSim	9.61E-06	ArGrMain	8.19E-06
M045354	SYnzMain	0.9689247	SYnzHilt	0.02788488	SanSim	0.00207814	SaMaRey	0.00078485	ArGrMain	0.0002787
M065282	SYnzMain	0.96826027	SYnzHilt	0.0314417	ArGrMain	0.0001968	SaGaWFork	7.72E-05	SanSim	1.38E-05
M065208	SYnzMain	0.96784871	SYnzHilt	0.02746234	ArGrMain	0.00459727	SanSim	4.50E-05	SaGaWFork	2.52E-05
M038231	SYnzMain	0.96767085	SYnzHilt	0.02216927	SYnzSals	0.00527967	SalTjara	0.00305583	ArGrMain	0.00084663
M102096	SYnzMain	0.9668116	SYnzHilt	0.03275484	SaMaRey	0.00035603	ArGrMain	2.88E-05	SalTjera	2.27E-05
M065305	SYnzMain	0.96601526	SYnzHilt	0.03331813	SaGaWFork	0.0006392	SalTjera	1.28E-05	FilHaCole	7.38E-06
M045365	SYnzMain	0.96553664	SYnzHilt	0.03106632	SaMaRey	0.00315049	SaGaWFork	0.00020564	SaClaSaPa	3.43E-05
M062861	SYnzMain	0.96509836	SYnzHilt	0.02522507	SaMaRey	0.00936172	SalTjara	0.00022103	SaClaSaPa	7.65E-05
M065221	SYnzMain	0.964573	SYnzHilt	0.03529776	SanSim	0.00012734	SaMaRey	1.47E-06	SalTjara	3.09E-07
M038249	SYnzMain	0.96413018	SaGaWFork	0.0234273	SYnzHilt	0.01043003	FilHaCole	0.00158206	SalTjera	0.00041077
M062993	SYnzMain	0.96388031	SYnzHilt	0.01993605	ArGrMain	0.01603981	SaGaWFork	9.19E-05	SaMaRey	4.99E-05
M062965	SYnzMain	0.96365416	SYnzSals	0.01921661	SYnzHilt	0.00857549	ArGrMain	0.00598138	SalTjera	0.0019338
M062968	SYnzMain	0.96358091	SYnzHilt	0.02658066	SYnzSals	0.00689659	SalTjera	0.00217431	SaMaRey	0.00073518
M045436	SYnzMain	0.96084181	SYnzHilt	0.03038679	SaGaWFork	0.00876968	SalTjara	8.77E-07	SaClaSaPa	3.62E-07
M031410	SYnzMain	0.96025469	ArGrMain	0.02104631	SYnzHilt	0.01480949	SanSim	0.0021088	SaGaWFork	0.00171072
M063021	SYnzMain	0.95855283	SYnzHilt	0.04081121	SaGaWFork	0.00028462	SanSim	0.00020969	SalTjara	0.00012355
M062961	SYnzMain	0.95799931	SYnzHilt	0.02979479	SalTjera	0.01082318	SaMaRey	0.00102262	ArGrMain	0.00023855

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065251	SYnzMain	0.95775475	SYnzHilt	0.03595742	SaGaWFork	0.00438103	SanSim	0.00158593	SaMaRey	0.00030649
M045448	SYnzMain	0.95594984	SYnzHilt	0.04399575	SYnzSCrz	4.17E-05	ArGrMain	7.04E-06	SaClaSaPa	4.45E-06
M065345	SYnzMain	0.95564945	SYnzHilt	0.04421416	ArGrMain	0.0001362	SanSim	1.84E-07	SalTjera	7.08E-09
M038250	SYnzMain	0.95382758	SYnzHilt	0.04610081	SalTjera	5.30E-05	ArGrMain	1.32E-05	SaGaWFork	4.99E-06
M067369	SYnzMain	0.95323341	SYnzHilt	0.02179504	SalTjera	0.02174786	SYnzSals	0.00222067	SaMaRey	0.00097272
M045446	SYnzMain	0.95289073	SYnzHilt	0.04439224	SanSim	0.00251202	SaMaRey	0.00018535	ArGrMain	9.18E-06
M103788	SYnzMain	0.94499723	SalTjara	0.02962104	ArGrMain	0.02433327	ArGrLBer	0.00052848	SYnzHilt	0.00038247
M045357	SYnzMain	0.94482289	SYnzHilt	0.05146955	SaMaRey	0.00208165	SanSim	0.00160505	ArGrMain	1.45E-05
M103711	SYnzMain	0.94444936	SYnzHilt	0.05555055	ArGrMain	5.86E-08	SaMaRey	3.28E-08	SYnzSals	3.44E-09
M045439	SYnzMain	0.94387211	SYnzHilt	0.04362625	SaGaWFork	0.01183577	SaMaRey	0.00047019	ArGrMain	0.00018131
M065246	SYnzMain	0.9424802	SYnzHilt	0.05523786	SaMaRey	0.00221503	SanSim	5.58E-05	SalTjera	8.78E-06
M065217	SYnzMain	0.94202569	SYnzHilt	0.05730378	SaClaSaPa	0.00043868	SYnzSals	7.60E-05	ArGrMain	7.58E-05
M065238	SYnzMain	0.94009566	SYnzHilt	0.05781973	SaMaRey	0.00199368	ArGrMain	8.59E-05	SanSim	4.13E-06
M045423	SYnzMain	0.9400597	SYnzHilt	0.05993898	SanSim	4.69E-07	SaClaSaPa	4.10E-07	ArGrMain	2.73E-07
M041529	SYnzMain	0.93996566	SYnzHilt	0.05985749	SanSim	9.25E-05	SaMaRey	8.33E-05	ChorPen	9.32E-07
M065336	SYnzMain	0.93821344	SYnzHilt	0.06156225	SalTjera	0.0001932	SalTjara	2.73E-05	SanSim	2.54E-06
M011641	SYnzMain	0.93626313	SYnzHilt	0.0632391	SanSim	0.00032307	ArGrMain	0.00014782	SalTjera	1.24E-05
M097882	SYnzMain	0.93511407	SYnzHilt	0.06476676	SaMaRey	9.75E-05	ArGrMain	1.61E-05	SYnzSals	5.28E-06
M062994	SYnzMain	0.93503238	SYnzHilt	0.06300292	SalTjera	0.00172567	SaGaWFork	0.00011416	ArGrMain	8.67E-05
M062972	SYnzMain	0.93371893	SaMaRey	0.05551514	SYnzHilt	0.00416772	SalTjera	0.00341472	SYnzSals	0.00244307
M065178	SYnzMain	0.9328319	SYnzHilt	0.06671312	SaGaWFork	0.00034671	ArGrMain	7.28E-05	SalTjera	1.18E-05
M031384	SYnzMain	0.93236719	SalTjera	0.05955296	SYnzHilt	0.00727039	SYnzSals	0.00065693	ArGrMain	0.0001267
M062954	SYnzMain	0.93227065	SYnzHilt	0.05808425	SYnzSals	0.00797544	SalTjera	0.00111832	ArGrMain	0.00050535
M065317	SYnzMain	0.93167326	SYnzHilt	0.05889541	SalTjera	0.00757737	SaMaRey	0.00158138	FilHaCole	0.00013397
M065421	SYnzMain	0.9316328	SYnzHilt	0.04571434	ArGrMain	0.01764039	SalTjera	0.00500443	SanSim	5.52E-06
M065341	SYnzMain	0.93066893	SYnzHilt	0.06932611	SalTjara	3.76E-06	SanSim	8.95E-07	SalTjera	1.60E-07
M065243	SYnzMain	0.93024794	SYnzHilt	0.068413	ArGrMain	0.00111161	SaClaSaPa	0.00020275	SalTjera	8.98E-06
M065339	SYnzMain	0.92832462	SYnzHilt	0.06958225	SaMaRey	0.00190175	ArGrMain	0.00015997	SaClaSaPa	2.44E-05
M065287	SYnzMain	0.92648968	SYnzHilt	0.07349128	ArGrMain	1.40E-05	SaMaRey	4.55E-06	SYnzSals	3.60E-07
M086530	SYnzMain	0.92455016	SYnzHilt	0.06105022	SaGaWFork	0.01183251	SalTjera	0.00183584	SalTjara	0.00060204

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M031427	SYnzMain	0.92240177	SaMaRey	0.06242111	SYnzHilt	0.01484449	FilHaCole	0.00026943	VenNFMat	2.55E-05
M092351	SYnzMain	0.92138976	SYnzHilt	0.07860966	SanSim	5.72E-07	SaGaWFork	5.28E-09	SaMaRey	4.60E-09
M092338	SYnzMain	0.92109208	SYnzHilt	0.07888589	SaMaRey	1.82E-05	SalTjara	2.27E-06	SanSim	1.35E-06
M045465	SYnzMain	0.91975772	SYnzHilt	0.0740176	ArGrMain	0.00476799	SaGaWFork	0.00139329	SYnzSals	2.31E-05
M062913	SYnzMain	0.91972297	SYnzSals	0.06313806	SYnzHilt	0.01698714	SaMaRey	6.89E-05	ArGrMain	4.67E-05
M065237	SYnzMain	0.91815811	SYnzHilt	0.08119449	SaGaWFork	0.00034689	SaMaRey	0.00019446	ArGrMain	9.17E-05
M065184	SYnzMain	0.91780605	SYnzHilt	0.07932633	ArGrMain	0.00208885	SalTjera	0.00070229	SaClaSaPa	4.24E-05
M031423	SYnzMain	0.91754139	SYnzHilt	0.07922398	SaMaRey	0.00279613	SanSim	0.00018655	SalTjera	0.00017153
M065286	SYnzMain	0.91650657	SYnzHilt	0.05410783	ArGrMain	0.02878838	SanSim	0.00046104	SaMaRey	0.00011155
M045426	SYnzMain	0.91554038	SYnzHilt	0.08445133	SYnzSals	7.79E-06	SaClaSaPa	4.02E-07	ArGrMain	4.12E-08
M062962	SYnzMain	0.91293469	SalTjera	0.05311471	SYnzHilt	0.03310827	SaMaRey	0.00036736	ArGrMain	0.00036723
M067377	SYnzMain	0.91035388	SalTjera	0.04803047	SYnzSals	0.02654389	SYnzHilt	0.01041083	SaMaRey	0.00270053
M092345	SYnzMain	0.90885257	SYnzHilt	0.09088617	SaMaRey	0.00025971	FilHaCole	1.27E-06	SanSim	1.61E-07
M031396	SYnzMain	0.9085529	SYnzHilt	0.09093912	SalTjera	0.00043195	SaGaWFork	6.72E-05	ArGrMain	8.37E-06
M092344	SYnzMain	0.90731244	SYnzHilt	0.09241492	SaGaWFork	8.95E-05	SaMaRey	8.26E-05	SaClaSaPa	7.39E-05
M038259	SYnzMain	0.9054678	SYnzSals	0.04827272	SYnzHilt	0.02644792	SalTjera	0.01405621	SaMaRey	0.00387028
M065202	SYnzMain	0.90498655	SYnzHilt	0.0949085	ArGrMain	7.25E-05	SaClaSaPa	2.46E-05	SaGaWFork	3.17E-06
M097887	SYnzMain	0.90475799	SYnzHilt	0.09509601	SYnzSCrz	0.00010873	ArGrMain	2.18E-05	SYnzSals	8.16E-06
M031406	SYnzMain	0.90426776	SYnzHilt	0.09126839	SalTjera	0.002637	ArGrMain	0.00124702	SYnzSals	0.00057198
M045429	SYnzMain	0.90426684	SYnzHilt	0.09497842	SaMaRey	0.00072832	SanSim	2.64E-05	ArGrMain	5.68E-09
M067358	SYnzMain	0.90178943	SanSim	0.03735991	SaMaRey	0.02926817	SYnzHilt	0.02314141	SalTjera	0.00748924
M062989	SYnzMain	0.90148207	SYnzHilt	0.09830354	SaMaRey	0.00019955	FilHaCole	1.11E-05	SaGaWFork	2.53E-06
M065173	SYnzMain	0.89919875	SYnzHilt	0.08721374	SalTjera	0.01319875	SaGaWFork	0.00035171	ArGrMain	3.25E-05
M102100	SYnzMain	0.89793524	SalTjera	0.08483575	SYnzHilt	0.01189181	SaGaWFork	0.00389575	ArGrMain	0.00119526
M102137	SYnzMain	0.89663098	SYnzHilt	0.08621187	SaMaRey	0.01623644	SaGaWFork	0.00080055	SanSim	9.31E-05
M092358	SYnzMain	0.89541354	SYnzSals	0.0853258	SYnzHilt	0.01037915	SaMaRey	0.00708868	SalTjera	0.00163454
M065299	SYnzMain	0.89429076	SYnzHilt	0.10552546	SaMaRey	0.00018319	SaGaWFork	4.89E-07	SalTjara	4.58E-08
M031391	SYnzMain	0.89374982	SYnzHilt	0.10615554	SalTjera	5.63E-05	SYnzSals	3.09E-05	ArGrMain	7.17E-06
M097890	SYnzMain	0.89172415	SYnzHilt	0.10266863	ArGrMain	0.00540948	SanSim	0.00013366	SYnzSals	6.37E-05
M065189	SYnzMain	0.88938115	SYnzHilt	0.08485958	SalTjera	0.02197629	SaGaWFork	0.00276383	ArGrMain	0.00062447

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M062862	SYnzMain	0.88912347	SYnzHilt	0.11079191	SaMaRey	7.10E-05	FilHaCole	1.07E-05	ArGrMain	1.96E-06
M065269	SYnzMain	0.88543007	SYnzHilt	0.11431199	SanSim	0.00023161	SalTjara	1.26E-05	ArGrMain	1.10E-05
M065313	SYnzMain	0.88472944	SYnzHilt	0.1056662	SalTjera	0.00855945	SaMaRey	0.00051667	FilHaCole	0.00024516
M045410	SYnzMain	0.88430386	SYnzHilt	0.11434985	SanSim	0.00124435	SaMaRey	5.81E-05	SalTjera	2.00E-05
M031368	SYnzMain	0.88078528	ArGrMain	0.0518296	SalTjera	0.03353861	SYnzSals	0.02492993	SYnzHilt	0.00824591
M102210	SYnzMain	0.87619225	SYnzHilt	0.12258541	SaMaRey	0.00108979	SaGaWFork	8.98E-05	SalTjera	2.51E-05
M092301	SYnzMain	0.87179215	SYnzHilt	0.1177499	ArGrMain	0.00987584	SaClaSaPa	0.0002687	SYnzSals	0.00018786
M031390	SYnzMain	0.87099212	SYnzHilt	0.12584929	SalTjera	0.00176139	FilHaCole	0.00074351	SaGaWFork	0.00062004
M062863	SYnzMain	0.86841494	SYnzSals	0.09582447	SaMaRey	0.02825167	SYnzHilt	0.00543793	SalTjera	0.00203684
M045434	SYnzMain	0.86398729	SYnzHilt	0.13592478	SaMaRey	5.33E-05	ArGrMain	1.65E-05	SalTjara	9.10E-06
M045449	SYnzMain	0.86106026	SYnzHilt	0.13850824	SalTjera	0.00042062	SaMaRey	4.98E-06	SalTjara	4.27E-06
M092318	SYnzMain	0.8610533	SYnzHilt	0.13890524	ArGrMain	4.03E-05	SalTjera	8.87E-07	SalTjara	1.87E-07
M062858	SYnzMain	0.86100177	SYnzHilt	0.06878466	SanSim	0.05523706	SaMaRey	0.01425117	FilHaCole	0.00063542
M031415	SYnzMain	0.86036166	SYnzHilt	0.07359079	SaGaWFork	0.04196155	SaMaRey	0.023973	ArGrMain	6.04E-05
M062960	SYnzMain	0.85982216	SalTjera	0.08879063	SYnzHilt	0.0386616	SaMaRey	0.00692597	SYnzSals	0.00579472
M031379	SYnzMain	0.85977651	ArGrMain	0.08725924	SYnzHilt	0.0523443	SalTjera	0.0003424	SaMaRey	0.000236
M086538	SYnzMain	0.8577147	ArGrMain	0.05699712	SYnzHilt	0.05690851	SalTjera	0.02793616	SYnzSals	0.00036262
M067379	SYnzMain	0.85593396	SYnzHilt	0.1178166	SYnzSals	0.01925406	ArGrMain	0.00582355	SanSim	0.00060059
M031888	SYnzMain	0.84893774	SaMaRey	0.09836681	SYnzHilt	0.05192879	SaGaWFork	0.00030866	SanSim	0.00019623
M031393	SYnzMain	0.84724145	SYnzHilt	0.14254022	SalTjera	0.00927672	SanSim	0.00068188	SYnzSals	0.00025232
M097894	SYnzMain	0.84578168	SYnzHilt	0.15421589	ArGrMain	1.43E-06	SaGaWFork	9.32E-07	SanSim	3.63E-08
M102092	SYnzMain	0.84522635	SYnzHilt	0.15361447	SalTjera	0.00100232	SaMaRey	0.00013698	SalTjara	1.39E-05
M062921	SYnzMain	0.84401133	SYnzHilt	0.15165551	SalTjera	0.00373697	SaMaRey	0.00044201	ArGrMain	8.13E-05
M045363	SYnzMain	0.8414905	SYnzHilt	0.09277926	SanSim	0.05507073	SaMaRey	0.00997128	FilHaCole	0.00057469
M065183	SYnzMain	0.8403031	SYnzHilt	0.11506932	SalTjera	0.04445353	ArGrMain	0.00010874	SaGaWFork	5.91E-05
M062951	SYnzMain	0.83949486	SYnzHilt	0.0828241	SalTjera	0.06104671	SanSim	0.01375474	SaMaRey	0.00248671
M065241	SYnzMain	0.8390032	SYnzHilt	0.16098973	SanSim	6.06E-06	ArGrMain	5.29E-07	SaMaRey	3.50E-07
M063015	SYnzMain	0.83434813	SYnzHilt	0.13116799	SaGaWFork	0.02473825	SaMaRey	0.00608306	SalTjera	0.00347749
M065225	SYnzMain	0.83157866	SYnzHilt	0.16841489	SalTjera	6.15E-06	SaClaSaPa	1.24E-07	SanSim	1.13E-07
M067364	SYnzMain	0.83129061	SalTjera	0.11329268	SYnzHilt	0.02479795	ArGrMain	0.02457235	SYnzSals	0.00468635

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065319	SYnzMain	0.83094916	SalTjera	0.08022268	SYnzHilt	0.04195062	SYnzSals	0.04064625	ArGrMain	0.00608661
M065412	SYnzMain	0.83040187	SYnzHilt	0.16802383	SaMaRey	0.00152046	SYnzSals	2.29E-05	ArGrMain	1.74E-05
M065420	SYnzMain	0.82839089	SYnzHilt	0.16957292	ArGrMain	0.00193916	SYnzSals	4.24E-05	SaGaWFork	2.33E-05
M067373	SYnzMain	0.82503682	SalTjera	0.07486053	SYnzHilt	0.04640649	ArGrMain	0.02889215	SaMaRey	0.02303041
M031395	SYnzMain	0.82456968	SYnzHilt	0.17298833	SanSim	0.00196707	SalTjera	0.00038484	ArGrMain	6.63E-05
M065334	SYnzMain	0.82449116	SYnzHilt	0.1007502	SalTjera	0.07455543	ArGrMain	9.58E-05	SaMaRey	7.81E-05
M031432	SYnzMain	0.82208428	ArGrMain	0.16688321	SYnzHilt	0.00684856	SaMaRey	0.00283891	SalTjera	0.00085971
M038191	SYnzMain	0.81938698	SYnzHilt	0.11286271	ArGrMain	0.06674486	SaMaRey	0.00064723	FilHaCole	0.00033516
M038226	SYnzMain	0.80993571	SYnzHilt	0.18709469	SanSim	0.00279283	SYnzSals	0.00015326	ArGrMain	9.38E-06
M065405	SYnzMain	0.80772774	ArGrMain	0.11017549	SYnzHilt	0.06969438	SaGaWFork	0.01182219	SalTjera	0.0002787
M092348	SYnzMain	0.80567599	SYnzHilt	0.19414724	SaMaRey	0.00016924	SaGaWFork	5.52E-06	SYnzSals	8.98E-07
M092320	SYnzMain	0.79553949	SYnzHilt	0.20443597	ArGrMain	1.39E-05	SaClaSaPa	1.02E-05	SaGaWFork	4.18E-07
M065285	SYnzMain	0.79073096	SYnzHilt	0.19464352	ArGrMain	0.01427951	SaMaRey	0.00027669	SalTjera	5.12E-05
M038183	SYnzMain	0.78718966	SYnzHilt	0.21184285	SanSim	0.00095418	SaClaSaPa	6.95E-06	SaMaRey	4.78E-06
M053047	SYnzMain	0.782525	SYnzHilt	0.21296541	SaGaWFork	0.00365151	ArGrMain	0.00044351	SalTjera	0.00041193
M062869	SYnzMain	0.78210192	SYnzHilt	0.21769456	SaGaWFork	0.00011038	ArGrMain	7.85E-05	SalTjera	1.04E-05
M031402	SYnzMain	0.78129239	SYnzHilt	0.1852277	SaGaWFork	0.03299814	SalTjera	0.00034768	SanSim	6.83E-05
M102151	SYnzMain	0.77884496	SYnzHilt	0.13984364	SaMaRey	0.08128924	SalTjara	1.46E-05	SaGaWFork	4.65E-06
M038200	SYnzMain	0.77842927	ArGrMain	0.17736854	SYnzHilt	0.03512595	SaMaRey	0.00572612	SalTjera	0.00325777
M045445	SYnzMain	0.76751773	SYnzHilt	0.2270278	SalTjera	0.00543038	ArGrMain	2.06E-05	SalTjara	2.03E-06
M097884	SYnzMain	0.76736051	SYnzHilt	0.23263798	SYnzSals	9.43E-07	SalTjera	3.43E-07	ArGrMain	8.66E-08
M062946	SYnzMain	0.76590136	SYnzHilt	0.22976218	SalTjera	0.00390938	ArGrMain	0.00042428	SanSim	2.63E-06
M031401	SYnzMain	0.76153879	SYnzHilt	0.22510827	ArGrMain	0.01009582	SYnzSals	0.00322669	SalTjara	1.15E-05
M057069	SYnzMain	0.75919456	SYnzHilt	0.17158534	SaMaRey	0.06893836	SalTjara	0.00017548	SalTjera	3.76E-05
M065380	SYnzMain	0.74841762	SYnzHilt	0.24746132	ArGrMain	0.00211784	SalTjera	0.00190099	SalTjara	6.26E-05
M103786	SYnzMain	0.74721213	ArGrMain	0.13100847	SalTjara	0.11710767	SaClaSesp	0.00182521	SYnzWFSC	0.00142172
M102179	SYnzMain	0.74316042	SalTjera	0.17967354	SYnzHilt	0.07329729	ArGrMain	0.00189541	SaMaRey	0.00115301
M057063	SYnzMain	0.74291157	SYnzHilt	0.21678922	ArGrMain	0.02903571	SalTjera	0.01124507	SaGaWFork	1.41E-05
M045409	SYnzMain	0.74227641	SYnzHilt	0.23664638	SaMaRey	0.01141898	SanSim	0.00651192	FilHaCole	0.00240218
M031429	SYnzMain	0.74089076	SYnzHilt	0.25910877	SalTjera	1.83E-07	ArGrMain	1.31E-07	SanSim	1.22E-07

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065242	SYnzMain	0.73932183	SYnzHilt	0.26067548	SanSim	2.62E-06	SaMaRey	5.60E-08	SaGaWFork	1.43E-08
M065354	SYnzMain	0.73765245	SYnzHilt	0.19661022	ArGrMain	0.05248691	SaGaWFork	0.00803115	SYnzSals	0.00221504
M053045	SYnzMain	0.73751494	SYnzHilt	0.22404603	ArGrMain	0.03796082	SaClaSaPa	0.00026762	SalTjera	0.00020925
M053034	SYnzMain	0.73208015	SaMaRey	0.24163899	SYnzHilt	0.01861619	SaClaSaPa	0.00619791	ArGrMain	0.00084928
M092346	SYnzMain	0.73195852	SYnzHilt	0.24922015	ArGrMain	0.01702362	SalTjera	0.00133629	SaGaWFork	0.00045322
M065327	SYnzMain	0.72917544	SYnzHilt	0.2350786	SaMaRey	0.03104617	SaGaWFork	0.0046515	FilHaCole	2.45E-05
M065203	SYnzMain	0.7200734	SYnzHilt	0.2799212	SalTjera	4.94E-06	FilHaCole	2.30E-07	SaGaWFork	1.21E-07
M065359	SYnzMain	0.71709841	SYnzHilt	0.28160368	SaGaWFork	0.00070346	FilHaCole	0.00028039	SaMaRey	0.00023372
M065329	SYnzMain	0.71671461	SYnzHilt	0.25460556	SYnzSals	0.02769692	SalTjera	0.00080106	SaMaRey	0.00014055
M062887	SYnzMain	0.7161079	SaMaRey	0.15197984	SYnzHilt	0.12298057	SalTjera	0.00885291	ArGrMain	6.70E-05
M102154	SYnzMain	0.71287942	SYnzHilt	0.27646642	SaMaRey	0.00896019	SaGaWFork	0.00166081	SanSim	2.93E-05
M057083	SYnzMain	0.71075234	SYnzHilt	0.28616078	SYnzSals	0.00198959	SalTjera	0.00076408	ArGrMain	0.00030102
M063028	SYnzMain	0.71009128	SaMaRey	0.1896454	SYnzHilt	0.10023477	FilHaCole	1.96E-05	SanSim	7.91E-06
M062978	SYnzMain	0.70881625	SYnzHilt	0.29106153	SanSim	6.44E-05	SaMaRey	4.66E-05	ArGrMain	1.01E-05
M045368	SYnzMain	0.70689475	SYnzHilt	0.28881503	SanSim	0.00408007	SaMaRey	0.00018798	ArGrMain	1.41E-05
M102125	SYnzMain	0.70595186	SaMaRey	0.1141567	SanSim	0.09731816	SYnzHilt	0.08255011	SaGaWFork	1.48E-05
M065390	SYnzMain	0.70424516	SaMaRey	0.22691042	SYnzHilt	0.06884109	SYnzSals	1.73E-06	SanSim	9.20E-07
M031358	SYnzMain	0.703503	SYnzHilt	0.29598914	FilHaCole	0.00022709	SaMaRey	0.00018788	SaClaSaPa	9.11E-05
M065249	SYnzMain	0.69771343	SYnzHilt	0.30112507	SalTjara	0.00068914	SanSim	0.00045135	SalTjera	1.58E-05
M102101	SYnzMain	0.69205086	SYnzHilt	0.30457384	ArGrMain	0.0015427	SalTjera	0.00094443	SYnzSals	0.0006576
M097901	SYnzMain	0.68829156	SYnzHilt	0.28018696	SaMaRey	0.03129299	SYnzSals	0.00013406	ArGrMain	4.70E-05
M065386	SYnzMain	0.68342902	SYnzHilt	0.17766076	SalTjera	0.13594607	SaGaWFork	0.00168319	ArGrMain	0.00119186
M065197	SYnzMain	0.68247538	SYnzHilt	0.30754662	SaGaWFork	0.00793954	SaMaRey	0.00194024	SanSim	7.73E-05
M045441	SYnzMain	0.68091388	SYnzHilt	0.30717678	SanSim	0.01189901	SaMaRey	9.24E-06	ChorPen	9.87E-07
M062868	SYnzMain	0.67876888	SYnzHilt	0.32122348	SanSim	7.22E-06	SalTjara	2.04E-07	SalTjera	1.21E-07
M062875	SYnzMain	0.67726526	SYnzHilt	0.3227292	SYnzSals	3.73E-06	FilHaCole	1.07E-06	ArGrMain	5.83E-07
M065244	SYnzMain	0.675214	SaMaRey	0.17481215	SYnzHilt	0.14956403	SalTjara	0.00021777	SaGaWFork	7.61E-05
M065331	SYnzMain	0.67388923	SalTjera	0.18302903	SYnzHilt	0.13896748	SaGaWFork	0.00382996	ArGrMain	0.00022226
M045433	SYnzMain	0.67145511	SYnzHilt	0.32838472	SaMaRey	0.00010505	ArGrMain	4.41E-05	SanSim	7.14E-06
M065400	SYnzMain	0.66801716	SYnzHilt	0.31437375	SaGaWFork	0.01741404	ArGrMain	0.00012119	SalTjera	6.36E-05

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065355	SYnzMain	0.66697843	SYnzHilt	0.33280846	SaMaRey	0.00021224	SYnzSals	5.03E-07	SanSim	2.81E-07
M065315	SYnzMain	0.66646826	SYnzHilt	0.29631332	SalTjera	0.03679159	ArGrMain	0.00040171	SaGaWFork	1.87E-05
M062897	SYnzMain	0.66601519	SYnzHilt	0.13881255	ArGrMain	0.10630579	SaMaRey	0.05489042	SalTjera	0.02851071
M065192	SYnzMain	0.66464134	SYnzHilt	0.32617925	SalTjera	0.0065756	SaGaWFork	0.00242632	ArGrMain	0.00010334
M067375	SYnzMain	0.6635757	SaMaRey	0.14288771	SalTjera	0.11182356	SYnzSals	0.04758037	ArGrMain	0.02311591
M038227	SYnzMain	0.65923145	SanSim	0.33579494	SYnzHilt	0.00265701	SaMaRey	0.00230618	SalTjara	8.36E-06
M102138	SYnzMain	0.65824535	SYnzHilt	0.34175222	ArGrMain	1.39E-06	SanSim	3.74E-07	SaGaWFork	3.33E-07
M065193	SYnzMain	0.65272164	SalTjera	0.22712815	SYnzHilt	0.07447297	SalTjara	0.03240057	ArGrMain	0.01110703
M092300	SYnzMain	0.65196018	SYnzHilt	0.34610012	SaMaRey	0.00171682	SaGaWFork	0.00020924	ArGrMain	1.22E-05
M062910	SYnzMain	0.64614305	SYnzHilt	0.34108069	SaMaRey	0.01154288	SaGaWFork	0.00121146	ArGrMain	2.02E-05
M045355	SYnzMain	0.64476127	SYnzHilt	0.33272125	SaGaWFork	0.0202792	SalTjera	0.00113445	SaMaRey	0.00097859
M065392	SYnzMain	0.64308184	SYnzHilt	0.35398156	ArGrMain	0.00275937	SaMaRey	6.86E-05	SalTjera	6.83E-05
M102124	SYnzMain	0.64133855	SYnzHilt	0.35710839	SanSim	0.00123655	SaMaRey	0.00026419	SaGaWFork	3.93E-05
M086536	SYnzMain	0.63450832	SYnzHilt	0.19304601	ArGrMain	0.17167591	SanSim	0.00060991	SaGaWFork	0.00010153
M031356	SYnzMain	0.62847508	SYnzHilt	0.36935561	SaMaRey	0.00138164	ArGrMain	0.00078569	SaClaSaPa	1.89E-06
M038245	SYnzMain	0.62401273	SYnzHilt	0.37593063	SanSim	2.85E-05	SalTjera	2.28E-05	SYnzSals	3.35E-06
M063000	SYnzMain	0.62264841	SYnzHilt	0.37150997	SYnzSals	0.00408793	FilHaCole	0.00095095	SaGaWFork	0.00070622
M031418	SYnzMain	0.62163883	SYnzHilt	0.27684917	SaMaRey	0.08265091	SYnzSals	0.01788829	SaGaWFork	0.00055301
M065391	SYnzMain	0.62071364	SYnzHilt	0.37855756	SaMaRey	0.00034093	ArGrMain	0.00016333	SaGaWFork	0.00013993
M065198	SYnzMain	0.61888271	SYnzHilt	0.38108302	SalTjera	3.23E-05	SYnzSals	1.23E-06	ArGrMain	4.23E-07
M102150	SYnzMain	0.61555434	SYnzHilt	0.37382799	SaMaRey	0.00763738	ArGrMain	0.00231373	SaGaWFork	0.00039892
M065343	SYnzMain	0.61550502	SYnzHilt	0.38363368	SaClaSaPa	0.00049371	ArGrMain	0.00017368	SaGaWFork	9.83E-05
M031388	SYnzMain	0.60934393	SYnzHilt	0.38990726	SaGaWFork	0.00074788	SaMaRey	7.51E-07	SaClaSaPa	1.23E-07
M065163	SYnzMain	0.60614977	SYnzHilt	0.39139991	SaMaRey	0.00226556	ArGrMain	0.00017234	SYnzSals	9.52E-06
M065358	SYnzMain	0.60561118	SYnzHilt	0.391918	ArGrMain	0.00110927	SaGaWFork	0.00054869	SanSim	0.00049644
M062865	SYnzMain	0.60302027	SYnzHilt	0.39696426	FilHaCole	9.85E-06	SYnzSals	1.76E-06	SaMaRey	1.62E-06
M062871	SYnzMain	0.60214896	SYnzHilt	0.27894335	FilHaCole	0.0969182	SaGaWFork	0.02028015	SaMaRey	0.00156439
M102140	SYnzMain	0.60131753	SYnzHilt	0.38122752	SanSim	0.01456791	SaMaRey	0.00278222	ArGrMain	0.0001031
M031407	SYnzMain	0.60130714	SYnzHilt	0.39152031	SaMaRey	0.00715022	SalTjera	8.32E-06	SaGaWFork	7.37E-06
M031359	SYnzMain	0.60096681	SYnzHilt	0.38213958	SaMaRey	0.01612061	ArGrMain	0.00040584	SaGaWFork	0.00034631

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M065321	SYnzMain	0.6006222	SYnzHilt	0.30607515	SaGaWFork	0.03723503	SalTjera	0.02854141	SaMaRey	0.02457095
M038186	SYnzMain	0.60008088	SYnzHilt	0.39913562	ArGrMain	0.0004099	SaClaSaPa	0.00036909	SanSim	1.75E-06
M065399	SYnzMain	0.59632894	SYnzHilt	0.402048	SalTjera	0.00118957	ArGrMain	0.00026563	SaGaWFork	0.00015021
M067371	SYnzMain	0.59610526	SYnzSals	0.25206352	SYnzHilt	0.14363466	SalTjera	0.00774648	ArGrMain	0.00041355
M031399	SYnzMain	0.59489218	SYnzHilt	0.40334821	SanSim	0.00096309	SalTjera	0.00079542	SYnzSals	5.74E-07
M031394	SYnzMain	0.58848672	SYnzHilt	0.40363874	SalTjera	0.0078312	ArGrMain	2.29E-05	SanSim	1.65E-05
M062997	SYnzMain	0.58782757	SYnzHilt	0.37034276	ArGrMain	0.04150673	SalTjara	0.00012513	SYnzSals	0.00010666
M065318	SYnzMain	0.5844197	SalTjera	0.22903877	SYnzHilt	0.18471406	SaMaRey	0.00092699	SYnzSals	0.00078322
M065367	SYnzMain	0.58189818	SaGaWFork	0.22768985	SYnzHilt	0.1890456	SaMaRey	0.00134046	ArGrMain	2.46E-05
M057081	SYnzMain	0.58057042	SYnzHilt	0.37986396	SaMaRey	0.03915511	SanSim	0.00019049	SalTjara	0.00011681
M092311	SYnzMain	0.57942894	SaMaRey	0.28258801	SYnzHilt	0.13617264	SYnzSals	0.0017198	ArGrMain	4.61E-05
M057072	SYnzMain	0.57831394	SYnzHilt	0.41676065	SaMaRey	0.00485695	SanSim	2.50E-05	SaGaWFork	2.18E-05
M012435	SYnzMain	0.56873478	SaMaRey	0.3661486	SYnzHilt	0.06072009	ArGrMain	0.00409784	SaClaSaPa	0.0001219
M045456	SYnzMain	0.56227664	SaGaWFork	0.29565465	SYnzHilt	0.13732402	SaMaRey	0.00467266	SanSim	5.03E-05
M062879	SYnzMain	0.56227095	SYnzHilt	0.42268356	SaGaWFork	0.0090033	ArGrMain	0.00463076	SanSim	0.00139414
M062928	SYnzMain	0.55937044	SYnzHilt	0.44061148	ArGrMain	1.37E-05	SanSim	2.38E-06	SalTjera	8.26E-07
M045432	SYnzMain	0.55834869	SaMaRey	0.30946661	SYnzHilt	0.13211435	SanSim	6.20E-05	SaGaWFork	4.50E-06
M053043	SYnzMain	0.55669133	SYnzHilt	0.41618401	SaMaRey	0.01931209	SaClaSaPa	0.00453535	SalTjara	0.00178506
M031404	SYnzMain	0.5484851	SYnzHilt	0.44536694	SaGaWFork	0.00537783	SaMaRey	0.00041731	SanSim	0.00021429
M102130	SYnzMain	0.53844495	SYnzHilt	0.38744107	SanSim	0.07333256	SaMaRey	0.00077979	ArGrMain	1.41E-06
M065232	SYnzMain	0.53705042	SYnzHilt	0.27070394	SaMaRey	0.19212024	SanSim	8.59E-05	ArGrMain	1.83E-05
M045431	SYnzMain	0.53352761	SYnzHilt	0.39062918	SaMaRey	0.07443799	SanSim	0.00138277	ArGrMain	1.55E-05
M086534	SYnzMain	0.53339201	SYnzHilt	0.46539546	SaGaWFork	0.00092223	SaMaRey	0.00013507	ArGrMain	5.48E-05
M092357	SYnzMain	0.52686636	SYnzHilt	0.30792258	SaMaRey	0.13562332	FilHaCole	0.01664156	SaGaWFork	0.00970659
M065366	SYnzMain	0.52428503	SYnzHilt	0.3826171	SaMaRey	0.09173273	SaClaSaPa	0.00105635	SalTjera	0.00015369
M092306	SYnzMain	0.52108697	ArGrMain	0.33894845	SYnzHilt	0.07940739	SalTjera	0.03396572	SaGaWFork	0.02125829
M062900	SYnzMain	0.51541772	SYnzHilt	0.47057465	SalTjera	0.00805607	SaGaWFork	0.00504011	ArGrMain	0.00084397
M065413	SYnzMain	0.51305142	SYnzHilt	0.41026123	FilHaCole	0.07541895	SaGaWFork	0.00112008	SaMaRey	0.00014095
M031389	SYnzMain	0.51088199	SYnzHilt	0.48907014	SaGaWFork	4.29E-05	FilHaCole	4.29E-06	SaMaRey	6.14E-07
M062927	SYnzMain	0.51007725	SYnzHilt	0.3952863	ArGrMain	0.04749053	SalTjera	0.04490324	SaMaRey	0.0016467

Individual	pop1	perc1	pop2	perc2	pop3	perc3	pop4	perc4	pop5	perc5
M092334	SYnzMain	0.50883983	SYnzHilt	0.3726029	SaMaRey	0.11823677	ChorPen	0.00021711	SanSim	9.62E-05
M097902	SYnzMain	0.50858111	SYnzHilt	0.47034355	SaGaWFork	0.01293763	SaMaRey	0.00448262	ArGrMain	0.00352531
M038236	SYnzMain	0.50770897	SYnzSals	0.41226211	SYnzHilt	0.07598425	ArGrMain	0.003858	SalTjera	0.00014552
M031385	SYnzMain	0.50533896	SYnzHilt	0.47565404	SalTjera	0.01852754	SaGaWFork	0.00046684	ArGrMain	6.18E-06
M097886	SYnzMain	0.50381251	SYnzHilt	0.46929723	SaGaWFork	0.02460017	SaMaRey	0.00159586	SaClaSaPa	0.00062669
M102143	SYnzMain	0.50123402	SYnzHilt	0.49736256	SaGaWFork	0.00088836	SaMaRey	0.00025497	FilHaCole	0.00017661
M063022	SYnzMain	0.50062385	SYnzHilt	0.49566874	SaMaRey	0.00346919	SaGaWFork	0.00014603	SaClaSaPa	8.51E-05
M065316	SYnzMain	0.49474193	SalTjera	0.26053847	SYnzHilt	0.18669357	SYnzSals	0.05555731	ArGrMain	0.00205912
M045466	SYnzMain	0.48719188	SYnzHilt	0.44069655	ArGrMain	0.04860808	SaMaRey	0.01780895	SalTjera	0.00560722
M065211	SYnzMain	0.48192534	SaGaWFork	0.33038244	SYnzHilt	0.15752484	SalTjera	0.02915125	ArGrMain	0.0004298
M092303	SYnzMain	0.47005214	SYnzHilt	0.38205252	SaGaWFork	0.11171081	FilHaCole	0.03065693	SaMaRey	0.00353602
M065295	SYnzMain	0.46671195	SaMaRey	0.38613117	SYnzHilt	0.14549178	SalTjara	0.00062683	SYnzSals	0.00058713
M065422	SYnzMain	0.44590632	SYnzHilt	0.43734928	ArGrMain	0.10789401	SalTjera	0.00658486	SYnzSals	0.00224285
M045438	SYnzMain	0.42641262	SaGaWFork	0.36027553	SYnzHilt	0.10730358	SanSim	0.08486917	SaMaRey	0.02007976
M062937	SYnzMain	0.42354428	SYnzHilt	0.29246484	SalTjera	0.25422086	SaMaRey	0.02899697	FilHaCole	0.00058346
M031424	SYnzMain	0.42096859	SaMaRey	0.34948649	FilHaCole	0.21340821	SYnzHilt	0.01582409	SalTjera	0.00028554
M086537	SYnzMain	0.416709	SYnzHilt	0.31977341	SaGaWFork	0.1930752	SaMaRey	0.03651286	ArGrMain	0.03357906
M038246	SYnzMain	0.371702	SYnzHilt	0.37123687	ArGrMain	0.14366432	SaGaWFork	0.09250541	SalTjera	0.0134056
M012443	SYnzMain	0.36284177	SYnzHilt	0.30187097	ArGrMain	0.25235027	SaMaRey	0.07926603	SaGaWFork	0.00314907
M065154	SYnzMain	0.35538454	SYnzHilt	0.33662158	SaMaRey	0.1481674	SaGaWFork	0.14039707	ArGrMain	0.01480475
M053036	SYnzMain	0.32481929	SYnzHilt	0.28016312	SalTjera	0.11630831	SaMaRey	0.10749774	SaClaSesp	0.07077941
M092314	SYnzSals	0.98908385	SYnzMain	0.0054605	SaMaRey	0.00262948	SYnzHilt	0.0021279	SaClaSaPa	0.00045583
M038185	SYnzSals	0.93488368	SYnzHilt	0.05359101	SaMaRey	0.00757038	SYnzMain	0.00384906	SalTjera	7.12E-05
M065322	SYnzSals	0.88757667	SYnzMain	0.07991703	SalTjera	0.01682856	SYnzHilt	0.01461192	SaMaRey	0.00104629
M067378	SYnzSals	0.79377147	SYnzMain	0.10636983	SYnzHilt	0.08782871	SalTjera	0.01013974	SaMaRey	0.00104938
M031365	SYnzSals	0.77906758	SYnzMain	0.10852684	SYnzHilt	0.06850276	ArGrMain	0.02774496	SalTjara	0.01614795
M063003	SYnzSals	0.53040934	ArGrMain	0.38959153	SYnzMain	0.0502316	SaGaWFork	0.01107405	SalTjera	0.00609492
M067376	SYnzSals	0.49981634	SYnzMain	0.23150846	SalTjera	0.2177797	SYnzHilt	0.04607881	SaMaRey	0.00293084
M103709	SYnzSCrz	0.90264041	SalTjara	0.07691776	ArGrMain	0.01373356	SYnzCoch	0.00432504	SYnzQuiota	0.00226618

Appendix G

BIOS METADATA

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TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Mark-Recapture (PIT) Data

Abstract: The Resource Conservation District of the Santa Monica Mountains has been conducting a lifecycle monitoring project in Topanga Creek since 2008. Mark-recapture events are held every November (2008 on) and March (2011 on) in order to monitor the abundance and distribution of *Oncorhynchus mykiss* in Topanga Creek. Individual movement, age, growth, diet, and genetics are assessed as well. There are individual spreadsheets for each mark-recapture event held since 2008. Each spreadsheet includes the following worksheets: Pit tag data MASTER, Hab data, Scales, Fins, Lavage, Summary, Recaptures. Details of each worksheet are described below. There is also a spreadsheet that contains all mark-recapture data from all years (master PIT data), as well as recapture data from all years (master recapture data).

Purpose: Long-term lifecycle monitoring (age and growth, genetics, diet, movement) of southern steelhead (*Oncorhynchus mykiss*) in Topanga Creek.

Dates: November 2008, November 2009, November 2010, November 2011, November 2012, November 2013, March 2011, March 2012, March 2013, November 2014, November 2015, November 2016, November 2017

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheets & CMP ACCESS Database compatible EXCEL spreadsheet.

Field Definitions (& worksheet description):
Pit tagging data for individual events:
Pit tag data MASTER: includes all pit tag data and notes.
Pit tag number = number on pit tag implanted into individual
RCD ID number = ID given to individual based on creek, year, and sample number (T=Topanga; e.g., T11-100)
Date captured = date trout captured
Distance = distance (RKM) of capture location, upstream from Topanga lagoon
FL mm = fork length in millimeters
Condition code = condition of fish at capture (1=healthy, 2=injured, 3= dead)
Capture method = T (trap), E (electrofishing), A (angling)
N/R = new or recapture
Scales, Fin clip, lavage, branded = yes if taken, no if not taken (stable isotope samples were also taken during several sampling events)
Notes = any notes about individual taken during event

Hab data: includes all habitat data from units where fish were captured.
Date = survey date
Distance = distance (RKM) of capture location, upstream from lagoon
Pool name = name of known habitat unit
Hab type = type of habitat unit (pool, riffle, step pool, run, etc.)

Max depth = maximum depth of habitat unit (cm)
Avg depth = average depth of habitat unit (cm)
Canopy (% cover) = percent of total habitat unit shaded by canopy (trees, arundo, etc.)
Substrate = predominant substrate type in habitat unit (sand, gravel, cobble, boulders, bedrock, etc.)
Algae (% cover) = percent of total habitat unit with algae (could be up to 100% bottom, 100% mid-water, 100% surface for a total of 300% cover)
Shelter value = the value of the habitat unit for steelhead, ranges from 0.5 to 3 and recorded in 0.5 increments (0.5,1,1.5,2,2.5,3)
Instream % cover = percent of pool providing instream cover or shelter (typically undercut boulders or banks but could include deep areas or foliage like arundo, cattails or willow roots), typically recorded in 5% increments and typically ranges from about 0-25%, but could be higher depending on size of habitat unit and amount of cover
#trout = number of trout located in each habitat unit
Notes = any notes taken during survey

Scales: includes a list of all scale samples taken as well as age determinations based on scales. Fields are same as in Pit tag data MASTER, but only includes individuals that had scales sampled.
Notes = notes on scale samples

Fins: includes a list of all fin tissue samples taken.
Fields are same as in Pit tag data MASTER, but only includes individuals that had fin samples taken.

Lavage: includes a list of all lavage samples taken.
Fields are same as in Pit tag data MASTER, but only includes individuals that had lavage samples taken.

Summary: includes summary data from mark-recapture event, including total fish captured electrofishing, small and large tags inserted, young of year (yoy) under 110 mm FL, scales, fin clips, lavage samples, recaptures, and other information, as well as water quality data (depth, conductivity, water and air temperature, salinity, dissolved oxygen, and pH, and sometimes flow), taken at the beginning of each sampling date.

Recaptures: includes a list of all recaptured individuals.

PIT tag master data file:
Data log: includes notes on any edits to the data set.
Date = date of update
Name = name of person editing data
Updates = notes on what has been edited

MASTER TAG LIST: includes a list of captures of all tagged individuals.
PIT TAG # = number of pit tag inserted into individual
RCD ID number = ID given to individual based on creek, year, and sample number (T=Topanga; e.g., T11-100)
Date = date trout captured
Dist (m) = distance (RKM) of capture location, upstream from lagoon
Annular Rings = age determination based on scale sample analysis or estimated from other samples based on size

FL mm = fork length in millimeters
N/R = new or recapture
Lavage? = date individual was lavaged
Branded? = date individual was branded
NOTES = notes from events

MASTER Recaptures: includes a list of all individuals recaptured at least once.
Includes same data as master tag list except just for recaptured individuals and has it arranged across columns rather than rows. Also includes growth data as change in fork length over number of days between captures and movement as distance moved up or downstream.

No Tag List: includes a list of any individuals captured during mark-recapture events that were not tagged.

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Mark-Recapture Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Complete

Update Frequency: As needed.

File Location & Name:
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\Raw Data File Copies\ Mark Recapture
Names (date last updated) -

Pit tagging data for individual events:
1) PIT data Nov 2008 R.1 (2/14/13)
2) Pit data Nov 09-SA (2/14/13)
3) Pit tagging data_Nov 2010 (12/30/13)
4) Pit tagging data_Mar 2011 (12/30/13)
5) Pit tagging data_Nov 2011 (12/30/13)
6) Pit tagging data_Mar 2012 (12/30/13)
7) Pit tagging data_Nov 2012 (12/17/13)
8) Pit tagging data_Mar 2013 (12/17/13)
9) Pit tagging data_Nov 2013 (12/17/13)
10) Pit tagging data_Nov 2014 (11/21/14)
11) Pit tagging data_Nov 2015 (11/16/15)
12) Pit tagging data_Nov 2016 (1/5/2017)
13) Pit tagging data_Nov 2017 (1/23/2018)

Pit tag master data file:
14) PIT MASTER DATA.xlsx (3/14/18)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.
Theme: Lifecycle monitoring, age and growth, diet, genetics, southern steelhead, *Oncorhynchus mykiss*
Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

CMP Mark-Recapture (PIT) and REDD Data

Abstract: The Resource Conservation District of the Santa Monica Mountains has been conducting a lifecycle monitoring project in Topanga Creek since 2008. Mark-recapture events are held every November (2008 on) and March (2011 on) in order to monitor the abundance and distribution of *Oncorhynchus mykiss* in Topanga Creek. This data has been reformatted to be compatible with and then entered into the statewide Coastal Monitoring Program (CMP) database by CDFW. There are individual spreadsheets for all CMP required fields including tabs for header, Count, Individual, Sample,Tag, Surveyors, Clip Mark.

Purpose: To contribute Long-term lifecycle monitoring (age and growth, genetics, diet, movement) of southern steelhead (*Oncorhynchus mykiss*) in Topanga Creek to the CMP.

Dates: November 2008, November 2009, November 2010, November 2011, November 2012, November 2013, March 2011, March 2012, March 2013, November 2014, November 2015, November 2016, November 2017

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: CMP ACCESS Database compatible EXCEL spreadsheet.

Field Definitions (& worksheet description): CMP ACCESS Database compatible EXCEL spreadsheet.

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM CMP Lifecycle Monitoring
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Complete

Update Frequency: As needed.

File Location & Name:
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\Raw Data File Copies\ CMP Data
Names (date last updated) -
1) RCDSMM Efish_CMP_MASTERdatabase_12.16.17
2) Redd_DATA_CMP_5.4.18

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: Lifecycle monitoring, CMPsouthern steelhead, *Oncorhynchus mykiss*
Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Genetics Data

Abstract: The Resource Conservation District of the Santa Monica Mountains has been conducting a lifecycle monitoring project in Topanga Creek since 2008. Mark-recapture events are held every November (2008 on) and March (2011 on) in order to monitor the abundance and distribution of *Oncorhynchus mykiss* in Topanga Creek. Tissue samples were submitted over the years to the NMFS Genetic Tissue Repository, Santa Cruz, CA for analysis.

Purpose: To assess genetic characteristics of southern steelhead (*Oncorhynchus mykiss*) in Topanga Creek and the Santa Monica Bay.

Dates: November 2008, November 2009, November 2010, November 2011, November 2012, November 2013, March 2011, March 2012, March 2013, November 2014, November 2015, November 2016, November 2017. Randomly found carcass samples were also submitted between 2000-2018 from all creeks within the Santa Monica Bay.

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL spreadsheet.

Field Definitions (& worksheet description:
NMFS ID
Box Position
Sample ID.NMFS
Sample ID match.RCDSMM
TAG Number
PIT.TAG.RCDSMM
Collection Date
Date.RCDSMM
Collection Month
Collection Year
Scale.Age.RCDSMM
Est_age
Est_cohort
Length
Fork Length.RCDSMM
Weight
DIST.RCDSMM
New-Recap.RCDSMM
Capture_Method.RCDSMM
Lavage.RCDSMM
Branded.RCDSMM
Notes.RCDSMM
Sex

Batch_ID
ME
Genus
Species
Reported_Life_Stage
Estimated_Date
Picker
Pick_Date
Sample_comments
Repository_Creation_Date
Repository_Modification_Date
Hatchery
Reach_Site
Water_NAME
Watershed
Omy_AldA
Sex_ID
Many specific loci

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Genetics Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Complete

Update Frequency: As needed.

File Location & Name:
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\Raw Data File Copies\ Genetic Data
Names (date last updated) -
1) TopangaCrk_2018_report_tables 3.26.18.xlsx
2) TopangaCrk_2018_report_tables.xlsx
3) topangacrk_duplicate_samples genetics 2.20.18.xlsx
4) TopangaCrk_NFMS_RCDSMM_MASTER 3.12.18.xlsx
5) pop_codes.xlsx

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: genetics, southern steelhead, *Oncorhynchus mykiss*
Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Age, Growth, Movement and Diet Data

Abstract: Age, growth and diet data has been collected in conjunction with mark-recapture events. During each event, captured individuals were measured and scale samples were taken in order to determine age, and gastric lavage was used to induce vomiting of *Oncorhynchus mykiss* in order to gather information concerning these life history variables. There are three main data sets that contain all data on ages, growth rates and diet.

Age Data
The Age Data file contains worksheets for each sampling event where scales were taken, which includes data on individuals as well as ages determined based on scale analysis or estimated based on recapture data or data of others from same time period. Each event has an associated age-size frequency graph as well that shows the number of age x fish in each 10 mm size bin. There is also a worksheet that summarizes all age and size data for each cohort over time. This data set assumes that age determination based on scale analysis is correct.

Growth and Movement Data
This file includes data for recaptured individuals only. The change in fork length and change in distance between first and subsequent captures is calculated and used in analyses. Analyses include comparison among reaches in growth rates and movement, as well as movement and growth rates. Growth rates are compared to initial sizes, and movement is compared to initial distances.

Diet Data
This file contains all data from lavage samples 2010-2013. Lavage samples were taken every sampling period between November 2010 and March 2013 for a total of six events. Between forty and seventy samples were taken each year with an attempt to sample evenly between seasons, although this wasn't always the case.

Purpose: Assess age-size relationships among seasons and age classes, growth rates among seasons and years, and seasonal patterns of diet of *O. mykiss* in Topanga Creek.

Dates: November 2008, November 2009, November 2010, November 2011, November 2012, November 2013, March 2011, March 2012, March 2013, November 2014, November 2015, November 2016, November 2017

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheets.

Field Definitions:
Age Data
Fields in event worksheets include Pit tag number, RCD ID number, date, distance, annular rings, fork length and capture status (new or recapture). Mean, max, min and mode lengths (mm; FL)

for each age class are also included in each individual worksheet. That data is also found in the age cohort worksheet which includes a graph showing age-size data for each cohort.

Growth and Movement Data
Fields in the growth and movement data file include Pit tag number, RCD ID number, date, distance, annular rings, fork length and capture status (new or recapture). This file includes data for recaptured individuals only, and also includes calculated fields for growth rates and movement between captures.

Diet Data
Fields in the diet data file include Pit tag number, RCD ID number, date, distance, annular rings, fork length and capture status (new or recapture). It also includes data from lavage samples, including total number of prey items per stomach, percent of each prey type (aquatic vs. terrestrial or other) per stomach (#prey type/total #prey items), prey identification and enumeration, and presence of algae or sediment in stomach samples.

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Age, Growth and Movement Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Complete

Update Frequency: As needed.

File Location & Name (date last updated):
Age Data
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Age and Growth
Name - AGE DATA_2008 to 2015 (5/24/2016)

Growth and Movement Data
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Age and Growth
Name - O mykiss_growth and movement (1-13-14)

Diet Data
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Age and Growth

Name (2010-2011) - Steelhead gut sample analysis_2010-2011_Topanga (2-3-14)
Name (2011-2012) - Steelhead_stomach_contents_2011-2012_Topanga (9-9-13)
Name (2012-2013) - Steelhead_stomach_contents_2012-2013_Topanga (1-20-14)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.
Theme: Age and growth, diet, migration, lifecycle monitoring, southern steelhead, *Oncorhynchus mykiss*
Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Branding-growth data

Abstract: Occasionally, individuals were branded with the electrofisher during mark-recapture events. This data set includes a list of all branded individuals, as well as growth rates if they could be calculated based on recapture. It then compares growth rates of branded individuals (specifically those that were branded and then recaptured) with mean growth rates of similar sized individuals captured and recaptured in the same time period, to assess effects of branding on growth rates of individuals, and to assess the potential greater, long-term impact of electrofishing on the population of *O. mykiss* in Topanga Creek.

Purpose: Assess effects of branding on growth of *O. mykiss* in Topanga Creek.

Dates: November 2008, November 2009, November 2010, November 2011, November 2012, November 2013, March 2011, March 2012, March 2013, November 2014, November 2015, November 2016, November 2017

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheet.

Field Definitions:
The workbook contains the following worksheet:

- Data Log – this worksheet contains the date, name of person who made changes and changes made to workbook
- MASTER TAG LIST – this worksheet contains all data from the PIT Master file and was used to sort all branded individuals
- Recaptures – this worksheet contains all recapture data from recapture master
- All branded – this worksheet contains a list of all branded individuals and calculations of their growth rates (mm/day) between all captures and notes
- Branded growth – this worksheet contains a list of all branded individuals and, when possible, their growth rates between captures broken down by status: 1) branded on first capture and not recaptured, 2) branded on recapture, 3) branded on both captures, and 4) recaptured after branding. It also includes the average growth rates of similar sized, non-branded individuals captured and recaptured in the same time period for comparison. The difference between the branded individuals mean daily growth rate is subtracted from the mean daily growth rate of similar sized individuals captured and recaptured in the same time period, and the % above or below average is calculated to determine if branding has an affect on mean daily growth rates.
- Average growth rates by size – this worksheet contains a summary table of all mean daily growth rates for non-branded recaptured individuals by size class and capture-recapture period.

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Branding Data

Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Completed

Update Frequency: As needed.

File Location & Name (date last updated):
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Mark Recapture Data

Name - PIT MASTER DATA_03.14.18.xls (3/14/2018)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: branding, growth, electrofishing injury, lifecycle monitoring, southern steelhead, *Oncorhynchus mykiss*

Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Gastric Lavage-growth data

Abstract: Gastric lavage is a minimally invasive method used to collect stomach content samples from fish and other species, in order to assess diet of individuals. We used gastric lavage from 2010 to 2013 to collect data on the diet of *O. mykiss* in Topanga Creek in order to examine seasonal and annual variations in diet. Diet data is then compared to food availability data to look at prey preference, and growth rates to examine possible relationships between diet on growth. We summarized the data by looking at the percent frequency occurrence of different prey types and comparing those among six sampling seasons. We also looked at diet composition and the percent of prey that were aquatic macroinvertebrates versus terrestrial macroinvertebrates or invasive crayfish, native Arroyo chub or snails.

Purpose: Assess effects of gastric lavage on growth of *O. mykiss* in Topanga Creek.

Dates: November 2010, November 2011, November 2012, March 2011, March 2012, March 2013

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheet.

Field Definitions:
The workbook contains the following worksheet:

- MASTER TAG LIST – this worksheet contains all data from the PIT Master file and was used to sort all branded individuals
- MASTER LAVAGE – this worksheet contains all data for lavaged individuals.
- Lavage growth – this worksheet contains a list of all lavaged individuals and, when possible, their growth rates between captures broken down by status: 1) lavaged on first capture and not recaptured, 2) lavaged then recaptured, 3) lavaged on recapture, and 4) lavaged, recapture status unclear. It also includes the average growth rates of similar sized, non-branded individuals captured and recaptured in the same time period for comparison. The difference between the branded individuals mean daily growth rate is subtracted from the mean daily growth rate of similar sized individuals captured and recaptured in the same time period, and the % above or below average is calculated to determine if lavage has an affect on mean daily growth rates.
- Average growth rates by size – this worksheet contains a summary table of all mean daily growth rates for non-branded recaptured individuals by size class and capture-recapture period.

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Gastric Lavage Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Completed

Update Frequency: As needed.

File Location & Name (date last updated):
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Mark Recapture Data

Name - Lavaged-recapture data_updated Nov 26 2013.xls (1-15-14)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: Diet, gastric lavage, lifecycle monitoring, southern steelhead, *Oncorhynchus mykiss*

Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Migration Trapping Data

Abstract: As part of the lifecycle monitoring efforts, migrant trapping began opportunistically in 2002 when flows were sufficient to be able to set traps at a site known as Fish Camp, located approximately 1.3 RKM upstream of the lagoon. The criteria for selecting the location included accessibility, appropriate flow characteristics and sandy substrate to facilitate net installation. From 2002 to spring 2010, a downstream fyke net, composed of a 9.1m x 1.8 m seine with a 1.8m x1.8 m bag, (12 mm mesh) with a 60cm diameter hoop (fyke) net 1.4 meter long with 6 mm mesh sewn into the end of the bag seine, was used. This was placed across the creek (according to specifications of CDFW). No upstream debris barriers were installed, although they were kept available if needed. Leaf litter was removed from the net as needed during the course of the trapping. A Weir Trap built to meet CDFW specifications was installed approximately 5 meters downstream of the fyke net, to capture any upstream migrating fish. Beginning in fall 2010, a weir trap was used for capturing downstream migrants as well. It allows for efficient trapping in lower flows, and reduces the chance of fish getting caught up in a net. Traps are typically set after peak flow and kept in overnight. When fish are captured in either downstream or upstream migrant traps, they are removed from the traps and placed into a bucket with MS222 so that they can be processed. Processing includes assessing condition, measuring fork length, checking for a tag, tagging if new, and taking scale and fin clip samples. Fish are then returned to the creek in the direction of movement.

Purpose: Conduct fish trap surveys following major storm events just above the mouth of the creek to identify movements of adults and juvenile steelhead.

Dates: 2002 – 2018

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 106
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheet.

Field Definitions:
Date captured = date trout captured
Pit tag number = number on pit tag implanted into individual
RCD ID number = ID given to individual based on creek, year, and sample number (T=Topanga; e.g., T11-100)
Distance = distance (RKM) of capture location, for this dataset, it will typically be 1300 (Fish Camp)
FL mm = fork length in millimeters
Condition code = condition of fish at capture (1=healthy, 2=injured)
Capture method = T (trap)
Trap type = type of trap capture in (fyke or weir)
US or DS = caught in an upstream trap or a downstream trap
Capture time = time of capture

N/R = new or recapture
Scales, Fin clip, and lavage = yes if taken, no if not taken
Notes = any notes taken during trapping event

Access Constraints: CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Mark-Recapture Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Completed

Update Frequency: As needed.

File Location & Name (date last updated):
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Mark Recapture Data

Name - Topanga Trapping Data_2002-2013 (01-28-14)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: Migrant trapping, lifecycle monitoring, southern steelhead, *Oncorhynchus mykiss*

Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Instream Antenna Data

Abstract: As part of the lifecycle monitoring efforts, an instream antenna system has been set up in Topanga Creek in order to monitor instream migration of *Oncorhynchus mykiss*. The system includes an upstream and downstream antenna, allowing for detection of movement direction. The antenna was initially set up at the trapping location, a site known as Fish Camp, located approximately 1.3 RKM upstream of the lagoon. The criteria for selecting the location included accessibility, appropriate flow characteristics and sandy substrate to facilitate antenna installation. In Spring 2010, the antenna got blown out during a high flow event, and only one antenna could be replaced for the remainder of the season. As of fall 2011, the antenna system was set up further downstream at a location only about 0.5 RKM upstream of the ocean, to allow for better estimation of outmigration, rather than just instream movement. The location is also narrower and requires less cable, reducing chances of destruction during high flow events. This data set includes all detections recorded on the instream antenna while functional in Topanga Creek. Detection data includes the pit tag number of the individual, the date and time the individual passed an antenna, the position of the antenna (upstream or downstream), and information from previous captures such as size, age and distance.

Purpose: Monitor migration of tagged individuals, either outmigrant smolts or anadromous adults returning to Topanga Creek. The instream antenna can work in higher flows which can make it difficult to set traps, and therefore allows us to gain information on fish movement during times of high flows and low flows when traps are not set. When both upstream and downstream antenna are set and functional, it records movement direction as well as pit tag number, which we can then refer to in order to figure out size and age at last capture and estimate size and age when passing the antenna.

Dates: 2008 – 2018

Point of Contact: Contact information for an individual or organization that is knowledgeable about the data set.

Person's Name: Rosi Dagit
Organization's Name: Resource Conservation District of the Santa Monica Mountains
Telephone Number: 818-597-8627 ext. 107
E-Mail address: rdagit@rcdsmm.org

Data Type: EXCEL Spreadsheet.

Field Definitions:
This worksheet contains worksheets for each season of trapping (e.g., 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018). Each worksheet contains the following information:

- Dates deployed
- # days one or both antenna were operational
- Date, time, antenna hit (upstream or downstream or both), pit tag number, date last caught, capture status, location, size (mm), age at capture, estimated age at detection, RCD ID, notes, and lavage data, if applicable.

Access Constraints: CDFW and NMFS staff

Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Instream Antenna Data
Data Distribution: Limited to CDFW and NMFS staff and projects.

Progress: Completed.

Update Frequency: As needed.

File Location & Name (date last updated):
Location - (Rosi's Computer RCD) C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Antenna Data
Name - Topanga Antenna Detections_2008-2017 (3/27/2018)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: PIT tagging, instream antenna, lifecycle monitoring, southern steelhead, *Oncorhynchus mykiss*

Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay

TOPANGA CREEK STEELHEAD LIFECYCLE MONITORING

Instream Habitat Data

Abstract: This data set was collected by RCDSMM stream team and contains seven habitat surveys performed in the following seasons: 19 July 2001, 21 October 2002, 21 September 2003, 16 September 2004, 12 June 2005, 16 October 2005, 17 September 2006, and October 2017. Topanga Creek was surveyed from its mouth at Topanga State Beach, upstream to the confluence of Dix Creek just below the town of Topanga (5.9 RKM). Data was collected using the Habitat Inventory Data Form provided in the CDFW's CA Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds 1999). Additionally, a Stream Channel Type Worksheet was completed at every 100-meter interval. The physical stream characteristics (including pool volume measurements) were measured using meter tapes and mapping done visually. GPS data was collected for specific unique locations and at low flow passage barriers. Elevation was determined using calibrated altimeters. These habitat data and other physical attributes were initially entered into an Excel workbook and then imported into a MS Access database to facilitate making flexible, custom-designed queries. The outputs from the queries were used as summary tables and input data for graphs. Habitat data collected was used to assess habitat availability and quality for steelhead. It was also used in conjunction with habitat data collected during snorkel surveys to assess habitat preferences and to analyze variations in growth and density among habitat types.

Purpose: Document the amount, type and relative quality of steelhead habitat, describe any physical limitations, and identify problem areas and potential restoration sites.

Dates: 19 July 2001, 21 October 2002, 21 September 2003, 16 September 2004, 12 June 2005, 16 October 2005, 17 September 2006, October 2017

Point of Contact:

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Data Type: EXCEL Spreadsheet & ACCESS Database

Field Definitions:
Date = survey date
Distance (m) = distance upstream from the lagoon in meters
Site name = name of known habitat units
Habitat type = habitat unit type (pool, step pool, run, riffle, etc.)
Length (m), Width (m) = length and width of habitat unit in meters
Max depth (cm), Avg depth (cm) = maximum and average depths of habitat unit in centimeters
Canopy (% cover) = percent of total habitat unit shaded by canopy (trees, arundo, etc.)
Substrate = predominant substrate type in habitat unit (sand, gravel, cobble, boulders, bedrock, etc.)
Algae (% cover) = percent of total habitat unit with algae (could be up to 100% bottom, 100% mid-water, 100% surface for a total of 300% cover)
Shelter value = the value of the habitat unit for steelhead, ranges from 0.5 to 3 and recorded in 0.5 increments (0.5,1,1.5,2,2.5,3)

Instream % cover = percent of pool providing instream cover or shelter (typically undercut boulders or banks but could include deep areas or foliage like arundo, cattails or willow roots), typically recorded in 5% increments and typically ranges from about 0-25%, but could be higher depending on size of habitat unit and amount of cover
Notes = any notes taken during survey

Access Constraints: CDPR, CDFW and NMFS staff
Use Constraints: Please cite as RCDSMM Lifecycle Monitoring – Habitat Data
Data Distribution: Limited to CDPR, CDFW and NMFS staff and projects.

Progress: Complete.

Update Frequency: N/A – Project dataset is complete.

File Name and Location (as of date):
C:\Users\Any Contractor\My Documents\DFG Reports\Lifecycle Final Grant Report 2018\ Raw Data File Copies\Instream Habitat Data

Name- July 2001 (1st) Survey – Data.xls (3/4/2003)
October 2002 (2nd) Survey - Data Entry Template.xls (10/27/2002)
Sep03 instream survey.xls (10/3/2003)
Sep04Topanga.xls (10/26/2004)
Jun05Topangamap.xls (7/19/2005)
TopangaMapping2017.xls (4/26/2018)

Keywords (optional): Words or short phrases summarizing an aspect of the data set, used to allow people to find your dataset with quick keyword searches.

Theme: Instream habitat, southern steelhead, *Oncorhynchus mykiss*
Place: Topanga Creek, Southern California, Los Angeles County, Santa Monica Bay