May Pond Monitoring Report

Mid Klamath Watershed Council

Background and Introduction

May Pond, is an off-channel pond located in the lower half mile of Seiad Creek, approximately 1,700 feet upstream of its confluence with the Klamath River. The Mid Klamath Watershed Council (MKWC) began planning for the construction of May Pond in 2010 and completed construction in July 2013. Funding for this project was provided by US Fish and Wildlife Service and the National Fish and Wildlife Foundation, Coho Enhancement Fund (PacifiCorp).

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The landowner, Grider Creek Land Company, supports this project and signed a landowner agreement permitting pond construction and follow up monitoring and maintenance for 10 years, with the potential to renew the landowner agreement before it lapses.

Field reviews with the Karuk Tribal Fisheries Program, landowner, Rocco Fiori (Fiori GeoSciences, Inc.), USFWS, CDFW, USFS and others helped to inform data collection needs prior to construction. MKWC performed several topographic surveys by completing cross sectional and longitudinal surveys throughout the proposed outlet channel and the pond using a combination of a TRIMBLE RTK and a Spectra laser level. This site was a natural backwater alcove that the Karuk Tribal Fisheries Program had previously documented juvenile Coho usage during high water events. A natural spring at the top of the site kept the area wetted throughout the year. Based on this evidence along with data from several groundwater wells throughout the project area, we found that the feature would likely have good dissolved oxygen levels, ideal water temperature for rearing coho salmon, and adequate volumes of water. Groundwater wells are typically placed along a longitudinal line through the middle of the pond and also one placed at or near the location of proposed outlet/inlet channel. By strategically placing the wells at various locations of the project area, a more complete "picture" of groundwater can established. Readings of the wells are taken seasonally to help create a hydrological graph of the groundwater fluctuations. Typically readings are taken over a one to two year period. Along with water depth, temperature and dissolved oxygen (DO) readings are taken in each well which can help determine if the proposed pond will have suitable temperatures and DO post construction. Prior to construction, all necessary permits were secured, including a 1602 permit from CDFW, 401

certification from the State Water Resources Control Board, ESA consultation from NMFS and USFWS, NEPA documentation from USFWS, and 404 permits from the Army Corps.

Project Objectives

The May off channel pond (OCP) was constructed to augment limited winter rearing habitat for coho salmon in Seaid Creek. Off-channel habitats such as this provide juvenile coho refuge from high stream flows in the winter, and most constructed habitats also provide thermal refuge from excessive Klamath River mainstem water temperatures in the summer and fall months. While the May Pond was constructed solely for winter rearing habitat, ongoing water quality monitoring and population estimates show that coho are also utilizing this pond for summer rearing as well.

Construction

The wetted area of the constructed habitat is 5,585 square feet during base flow conditions (surveyed May 21, 2015 with survey grade Real Time Kinematics equipment).There is an ingress/egress channel at downstream end of the pond that connects to the creek at an angle of approximately 90 degrees. A high water connection channel was included in the design and connects to the creek approximately 80 feet downstream of the main connection. This channel was designed to connect during yearly high water events. The May Pond is 220' long and 20' wide**.** May Pond has a maximum depth of 6 feet and averages 4-5 feet through the center line during summer low flow levels. The bathymetry is varied to provide for cover and forage habitat. Excavation of the site began in October of 2012, but was delayed by weather and permitting restrictions for the remainder of the 2012 construction season. Project work commenced on July 8th and was completed on July 25th, 2013. In total, nine log/brush structures were installed in the pond to provide wetted complex cover, and over 300 native saplings were planted around the site.

Immediately following construction, native grass seed and weed-free straw were spread with a combination of hand work and hydro-seeding with the Karuk Tribe's Watershed Restoration crew to minimize erosion. Since then successive plantings with local schools and other partners have sped up the process of riparian vegetation establishment.

Monitoring Methods

MKWC coordinated with the Karuk Tribe Fisheries Program (KTFP) and Humboldt State University to conduct biological and physical monitoring of the May Pond and other constructed habitats from the time they were built and monitoring continues as of fall of 2018. MKWC Fisheries staff monitors each off-channel project site monthly for dissolved oxygen and temperature. In addition, twice-monthly ocular fish counts (snorkel dives) approximate the number of fish utilizing each site. Dive counts are done in conjunction with water quality sampling efforts throughout the year. Two divers enter the rear of the pond and proceed toward the outlet in lanes, counting juveniles by species. Dive counts are always rough estimates due to 5-10 foot visibility and high population numbers (see figure 3). These can be considered more presence/absence, or general abundance counts that help determine the best timing for the quarterly mark/recap efforts performed by KTFP. The low fish counts from snorkeling can sometimes be attributed to low visibility (a combination of excellent cover and presence of suspended plankton).

A YSI 550A handheld DO/Temp meter is used to collect samples at predetermined locations at each off-channel site, including adjacent tributaries. At May Pond, temperature and dissolved oxygen readings are taken at four separate locations with 1-3 readings of different depths of the water column per site to capture effects from stratification. These readings capture biological conditions from the top, middle and lower water columns. Two Hobo data temperature loggers are located in the pond at the top and bottom areas of the pond, with one data logger deployed in the creek above the pond site. They record temperature hourly throughout the year and provide a picture of yearly temperature fluctuations throughout May Pond. These loggers are deployed near the bottom of the pond in order to capture temperatures from the deepest areas of the pond. One Onset U26 temperature and dissolved oxygen logger is deployed along the center line of the pond at a depth of three and a half feet to capture yearlong dissolved oxygen and temperature data.

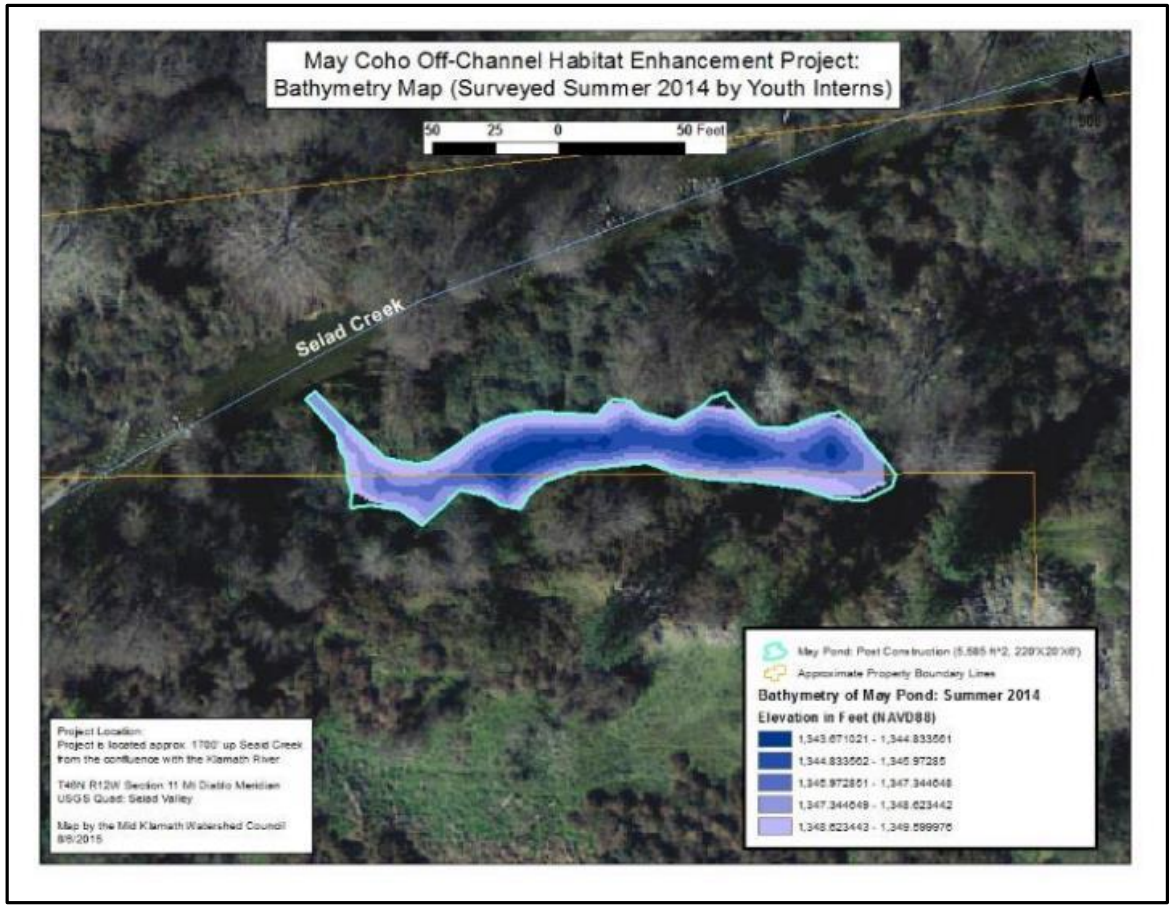

Figure 1A: Bathymetric survey map of May Pond. Map displays depths and perimeter of the pond.

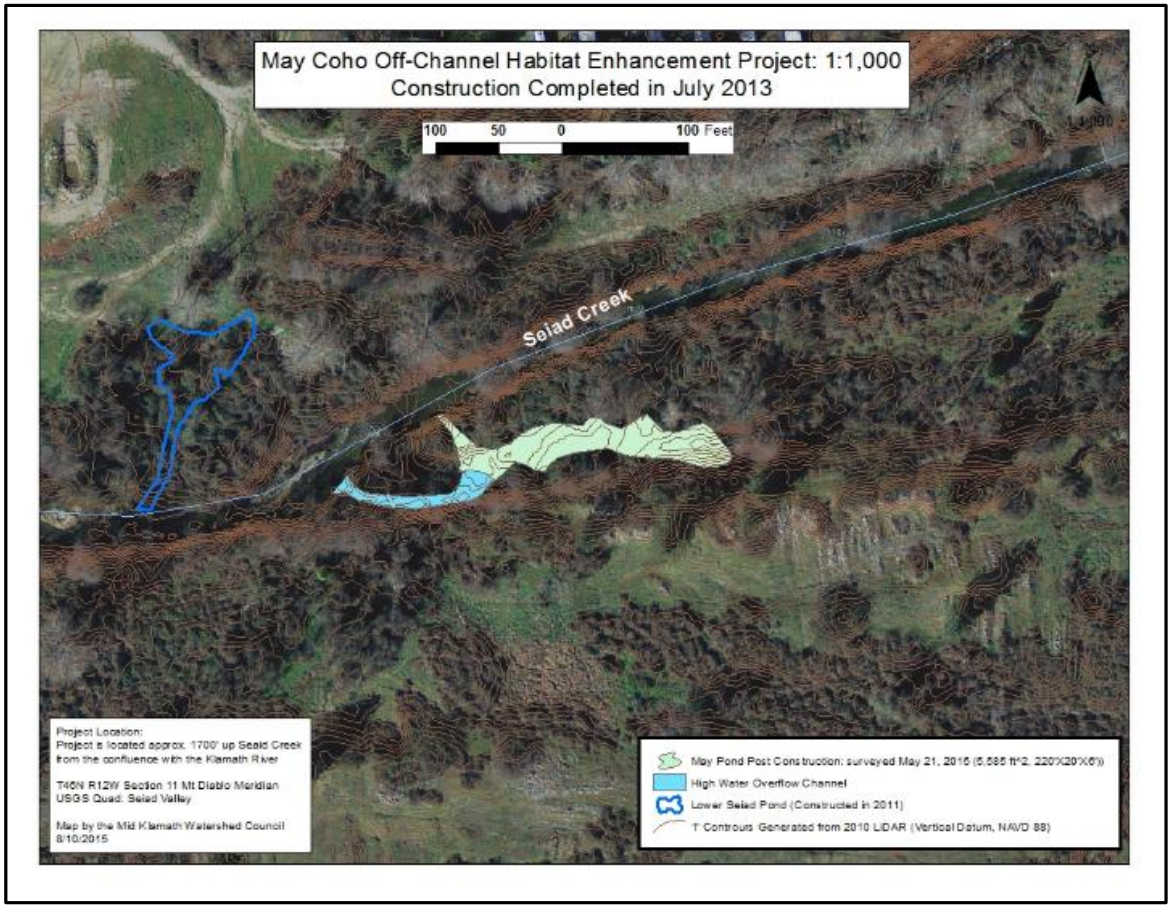

Figure 1B: Perimeter survey showing high water connection channel.

Project Photos:

Photo Descriptions: Top left, project site before construction. Before being built, the May Pond site was an extensive patch of Himalayan Blackberry. **Top right**, May Pond during construction. Cottonwood in center of photo is the same tree as in the top left photo. **Bottom right**, top of pond looking toward the connection with Seiad Creek.

Photo Descriptions: Top left, inlet channel before being connected to Seiad Creek. **Top right**, inlet channel after being connected with the creek. **Bottom left**, inlet channel the fall of 2014 **Bottom right**, Panorama of Seiad Creek and the May Pond ingress channel, spring 2014.

Photo Description: Top left, MKWC youth interns collecting temperature stratification data along cross section of May Pond. **Top right**, May Pond during summer of 2016**. Bottom right**, jack coho found in the pond during a winter coho spawner survey on Seiad Creek.

Results

Population Estimates/Dive Counts

May Pond provides excellent summer and winter refuge for coho juveniles. The Karuk Tribal Fisheries Program (KTFP) has been conducting Petersen mark/recapture studies on all of the ponds from the winter after they were constructed. The Lincoln Petersen Method was used to estimate population size, which required two sampling events in a closed environment within a three day time frame. Fish were marked by KTFP staff by either PIT tagging individual fish or by taking a small caudal fin clip. The following figure shows the results of population estimations by both Michelle Krall and the KTFP. The KTFP estimated there to be **1268** Coho in the winter of 2014, and Michelle Krall and the KTFP estimated for the spring **1034** Coho, the fall **942** Coho, and the winter of 2015 to be **1020** Coho. The winter of 2016 and 2018 estimates are a preliminary estimate created by MKWC fisheries staff from KTFP raw data. The downward trend of fish usage is most likely a matter of connectivity than of poor habitat conditions. Sedimentation of the inlet has made connection sporadic throughout the year (see lessons learned). MKWC is currently seeking funding to mechanically alter the outlet to address this issue.

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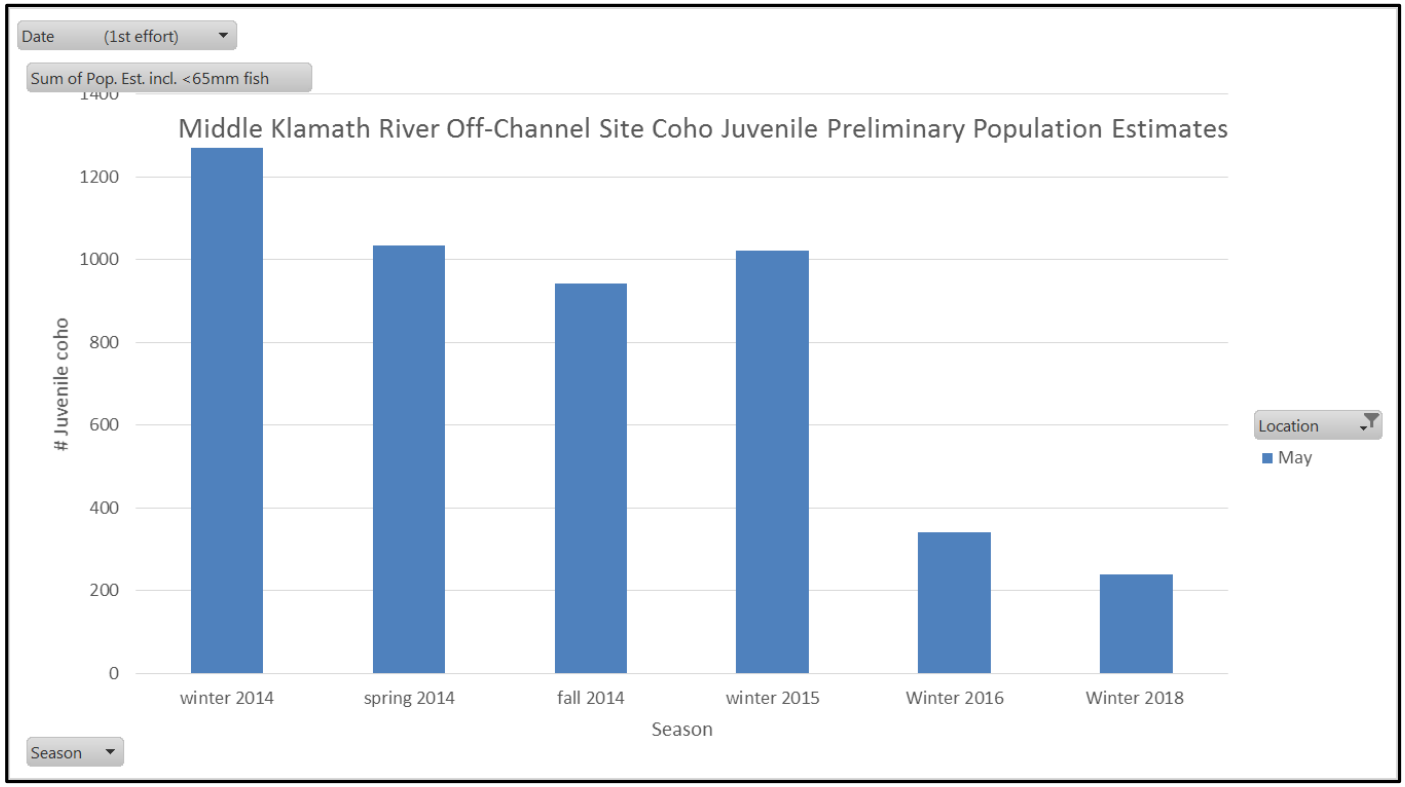


Figure 2: Population estimates for May Pond from the winter of 2014 through the winter of 2015. Data collected by the KTFP and Michelle Krall using Petersen mark/recapture method. 2016 and 2018 data was aquired by MKWC fisheries staff from KTFP biologists and are preliminary estimates.

Water Quality Sampling

Temperature

May Pond is heavily influenced by ground water which translates to very stable temperatures with small daily diel fluctuations throughout the year (see figures 5-7). Two HOBO temperature loggers are deployed at the top (depth of 5 feet) and bottom of the pond (depth of 2 feet). Along with these two loggers, a U26 temperature and DO logger is deployed along the center line of the pond at a depth of 3.5 feet. The average daily temperature over three years of monitoring is 11.8 degrees Celsius with a three year minimum temperature of 5.6 degrees Celsius and a three year maximum temp of 15.3 degrees Celsius. The difference in temperatures at a depth of six feet compared to a depth of one foot may be as little as 1.5 degrees in comparison to several other ponds along Seiad Creek that can have a stratification range of over five degrees Celsius. This stable temperature regime provides excellent growth conditions for juvenile salmonids rearing in the pond throughout the year. May Pond has the lowest daily and yearly temperature fluctuation of all constructed off-channel habitats created by MKWC and KTFP.

Dissolved Oxygen

Dissolved oxygen measurements were taken at the pond in several ways. An Onset U26 dissolved oxygen and temperature logger was deployed along the mid line of the pond at an approximate depth of three and a half feet deep. This logger recorded DO reading every half hour throughout the year to track DO trends (Figure 8). Spot readings were taken at various locations around the pond with a handheld YSI 550A temperature/dissolved oxygen meter. These readings were taken to measure DO and temperature readings at various depths throughout the pond to track physiological and biological differences within the habitat. As shown in Figure 4, 6 and 7, dissolved oxygen (DO) in the pond ranged from 1.15 mg/L to 11.03 mg/L over three years of monitoring. DO in the pond begins to stratify starting in the early summer months and tends to be more evenly mixed during the winter and spring months. Mean DO measurements in the pond are 4.92 throughout the four years of monitoring. According to the study by the California North Coast Reginal Water Quality Board, DO ranges of 4 mg/L and over and temperatures of >18 degrees Celsius are ideal for optimum salmonid growth and health (Carter 2005). While May Pond drops below this threshold a few times a year, these events tend to be short lived and are commonly seen in slow water habitats during summer months. Even at low ranges of DO, juvenile Coho were observed using the pond (Figure 5). By maintaining a connection with the creek, Coho can move between the pond and creek to find what habitat they find most suitable.

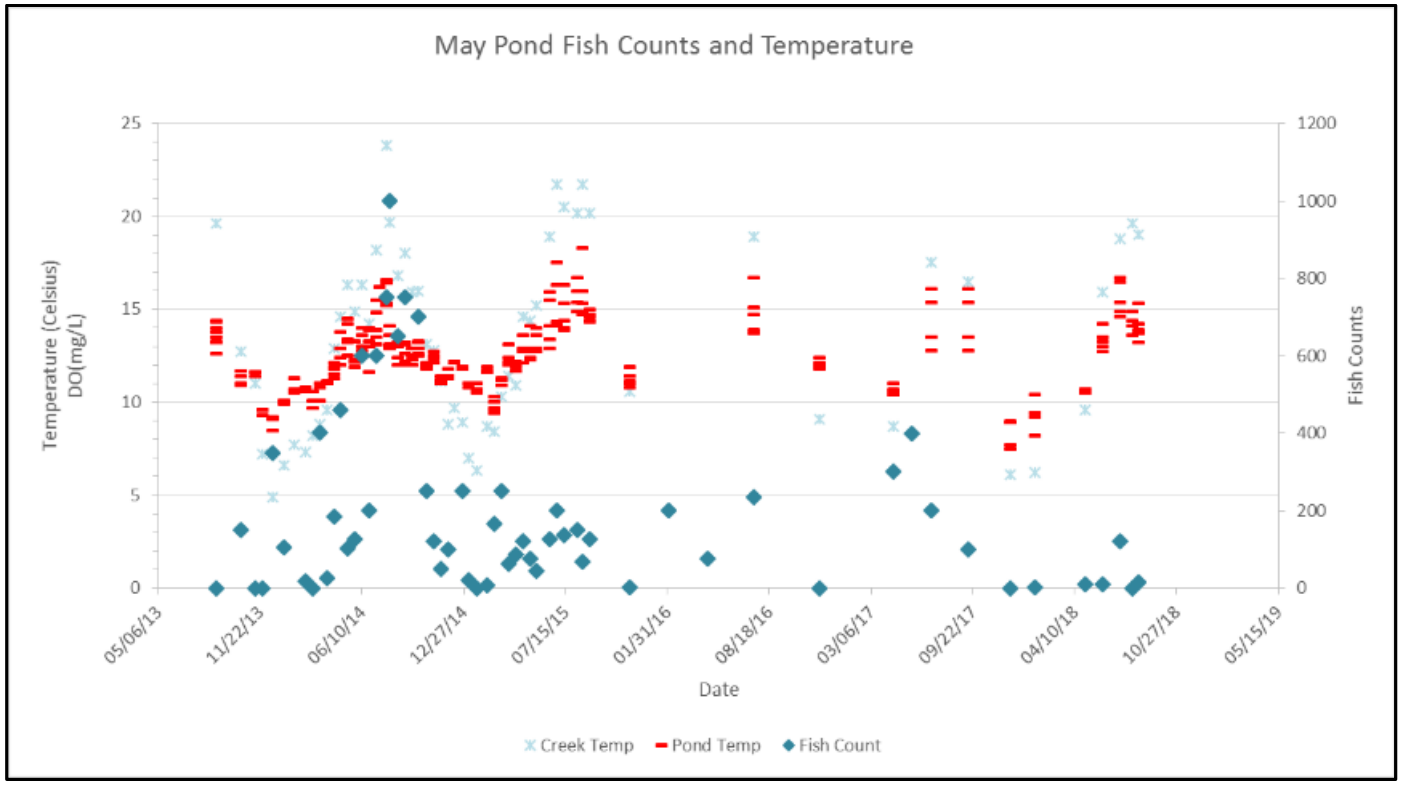


Figure 3: Ocular fish counts and temperature data collected by MKWC fisheries staff. Fish counts were collected by snorkel survey of the pond site. Temperature data was collected using a handheld YSI 550A. Average depth of readings was approximately two feet.

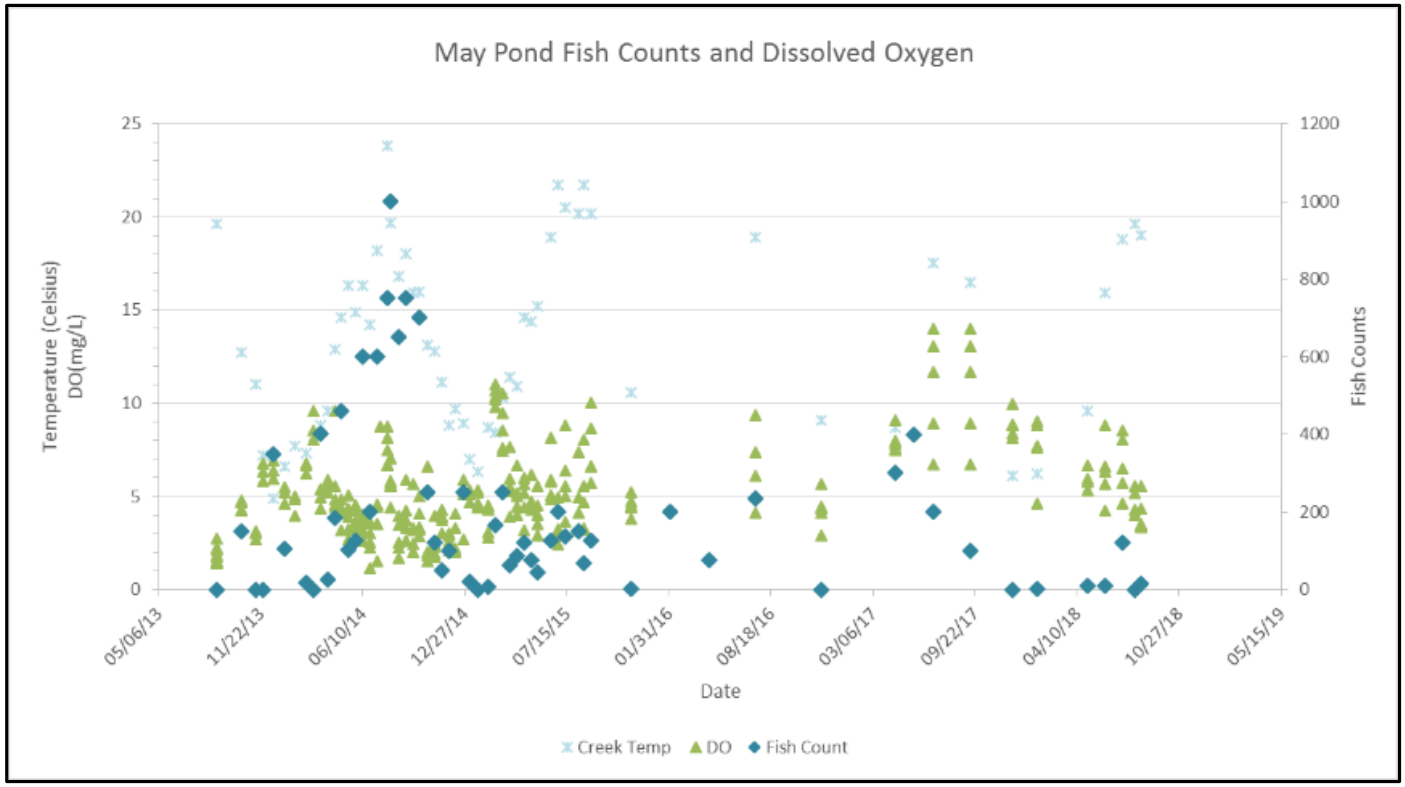


Figure 4: Ocular fish counts collected during snorkel surveys and dissolved oxygen readings collected during water quality monitoring visits.

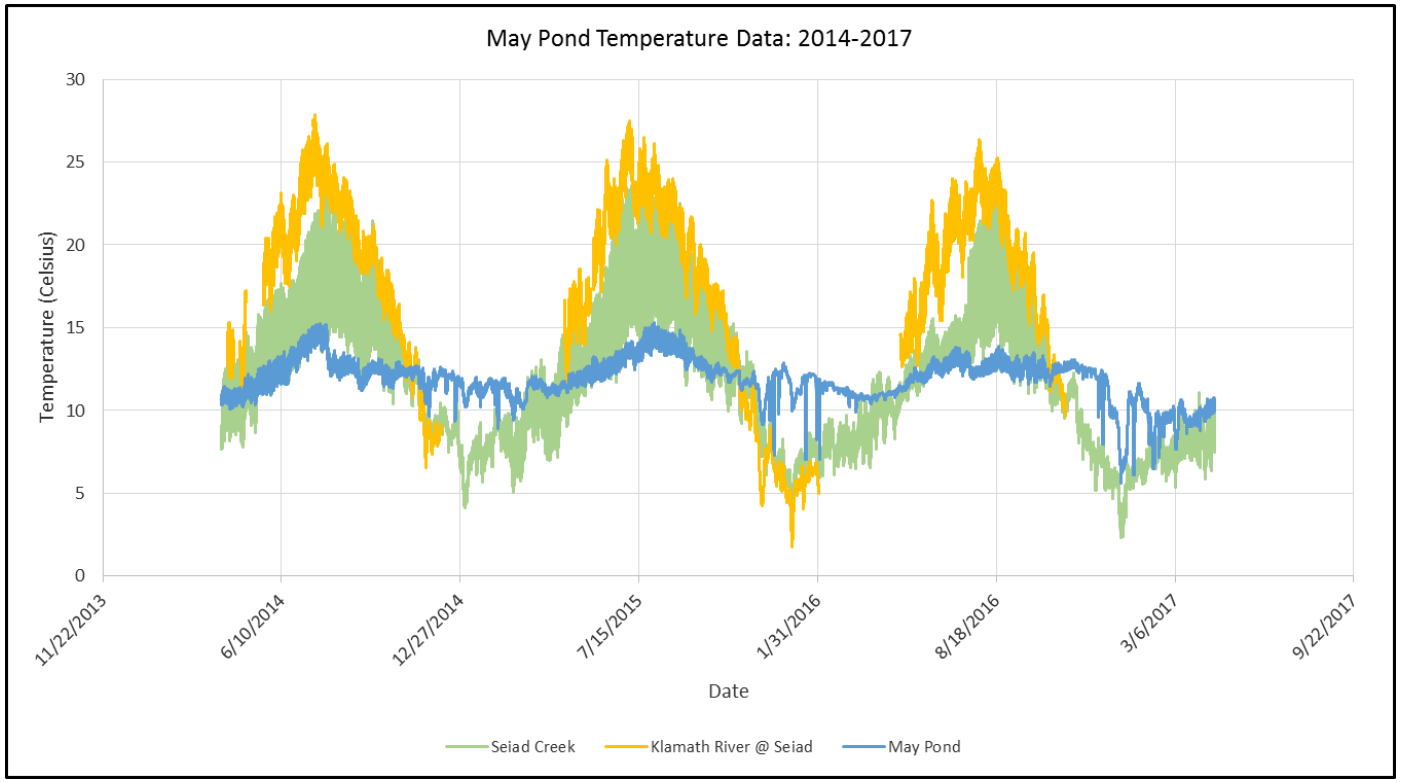
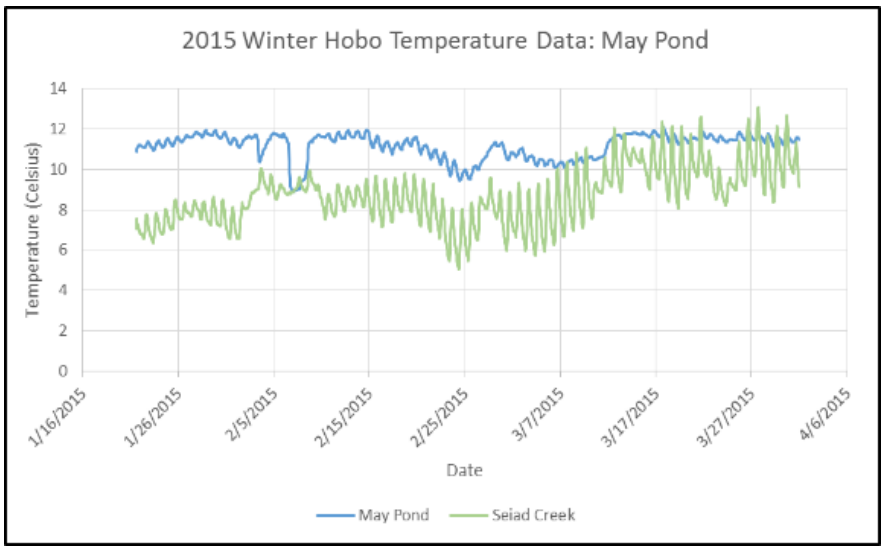


Figure 5: Hobo temperature data from May Pond along lower Seiad Creek. The logger is deployed at the upper most part of the pond at a depth of 4 feet. Creek temperatures were collected by another logger just upstream of the pond ingress channel. Klamath River temperatures are from the Karuk Tribes datasonde deployed in the main stem river near Seaid Creek.



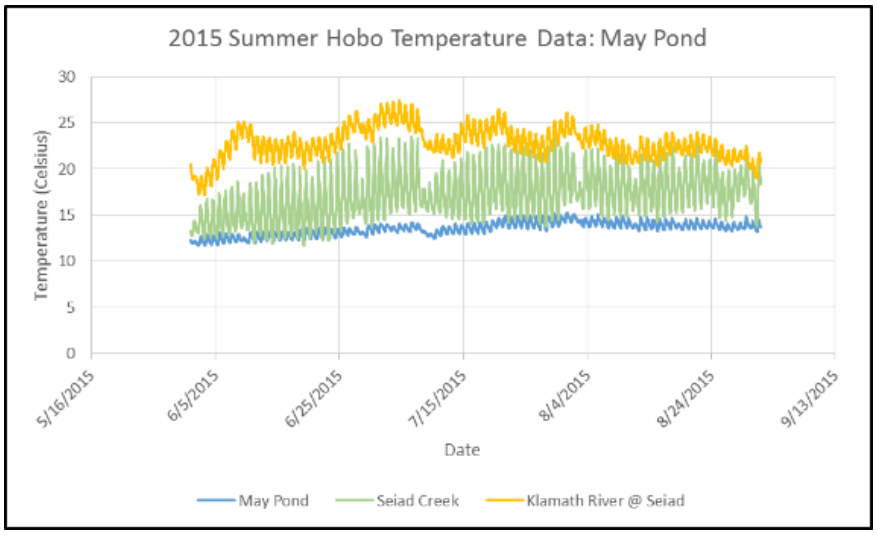
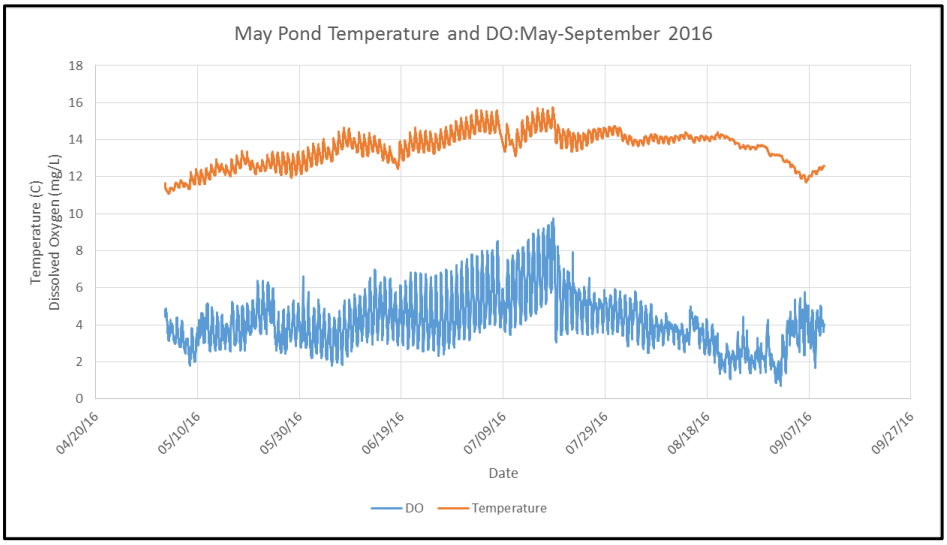


Figure 6: Temperature snap shots of winter and summer of 2015. Temperatures in May pond fluctuate less than five degrees Celsius on average all year long.



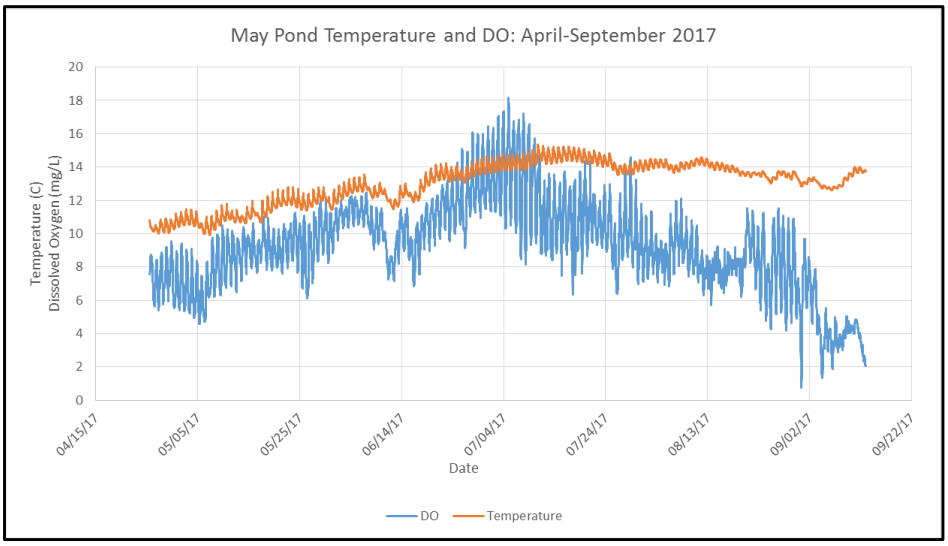


Figure 7: Temperature and dissolved oxygen (DO) data collected by U26 logger. U26 is deployed along the center line of the pond at a depth of 3.5 feet. Large and erratic fluctuations in DO are typically attributed to the growth and die off of aquatic vegetation and filamentous algae (see July and August 2017)

Juvenile Coho Growth Data

The Karuk Tribe Fisheries Program (KTFP) has conducted quarterly population estimates on May Pond beginning in February, 2014. Both during and between these population estimates, juvenile coho were seined and tagged by the KTFP and HSU graduate student Michelle Krall, allowing them to construct growth rates for individual fish based on days at large between PIT tagging and recapture measurements of growth and weight. Fish were seine netted, then transferred to buckets with a bubbler, anesthetized, then measured and weighed and returned to a recovery bucket before release back in to the pond. The following graph summarizes the data collected from May Pond by Michelle Krall. May Pond showed one of the highest summer growth rates of the studied ponds. Fish tagged and recaptured in May Pond showed some of the highest rate of growth per day (grams of growth per day) compared to other ponds along Seiad Creek and in the Seiad Valley.

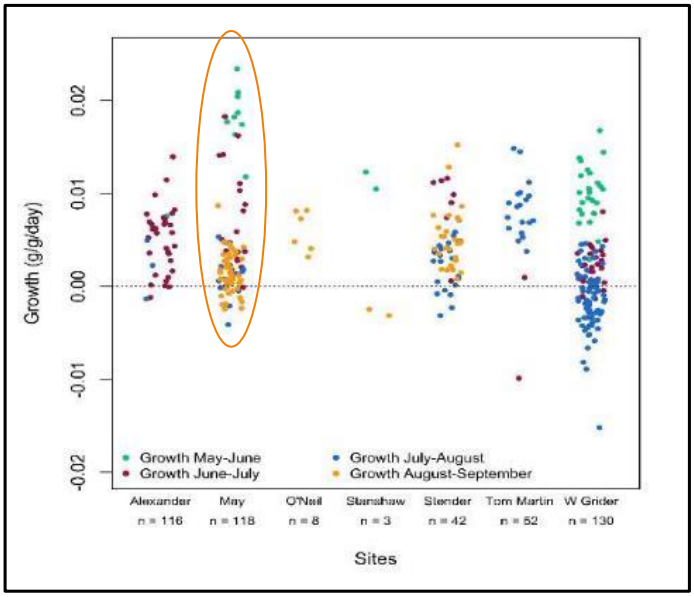


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Figure 8: Coho growth data collected and analyzed by Humboldt State University graduate student Michelle Krall. The n-value is the sample size for the location (Krall et. al 2014). Data was collected in 2014 during the height of the past drought, creating very stressful conditions for juvenile salmonids.

Natal and non-natal coho use: Passive Integrated Transponder (PIT tag) info

MKWC utilized the United States Geological Survey's (USGS) Klamath River Basin Pit Tagging Database to better understand non-natal juvenile coho movement to and from the constructed off-channel habitats. The Karuk Tribal Fisheries Program submits pit tag data to the USGS. During the summer of 2014, a coho that was tagged in a CDFW screw trap 4.2 miles up the Scott River on 5/24/2014 was detected in the May Pond on 6/17/2014 by Michelle Krall (HSU). This particular juvenile coho traveled 4.2 miles from where it was tagged on the Scott River, then 13 miles down the Klamath River, and then .3 miles up Seiad Creek into the May Pond.

Another case of non-natal use by fish from the Scott River are two juvenile coho that were tagged in the Scott River by CDFW and were then captured and transferred to Iron Gate Hatchery and held over for the summer. They were then released back into the Scott River in October of 2014 and were detected later in the year by the KTFP arrays at the May Pond (see figure 10). Further querying of the USGS database may reveal more cases of non-natal juvenile coho from the Scott, Shasta and other upriver basins utilizing the May Pond for rearing/refugia habitat as well as possible returning adult fish that utilized May Pond during their juvenile life stage. Juvenile coho from Horse Creek have also been detected moving into the May Pond showing that this off-channel feature is being utilized by both natal and non-natal coho. Coho tagged within the pond have been detected in several coastal tributaries such as Waukel Creek and Panther Creek near the Mouth of the Klamath.

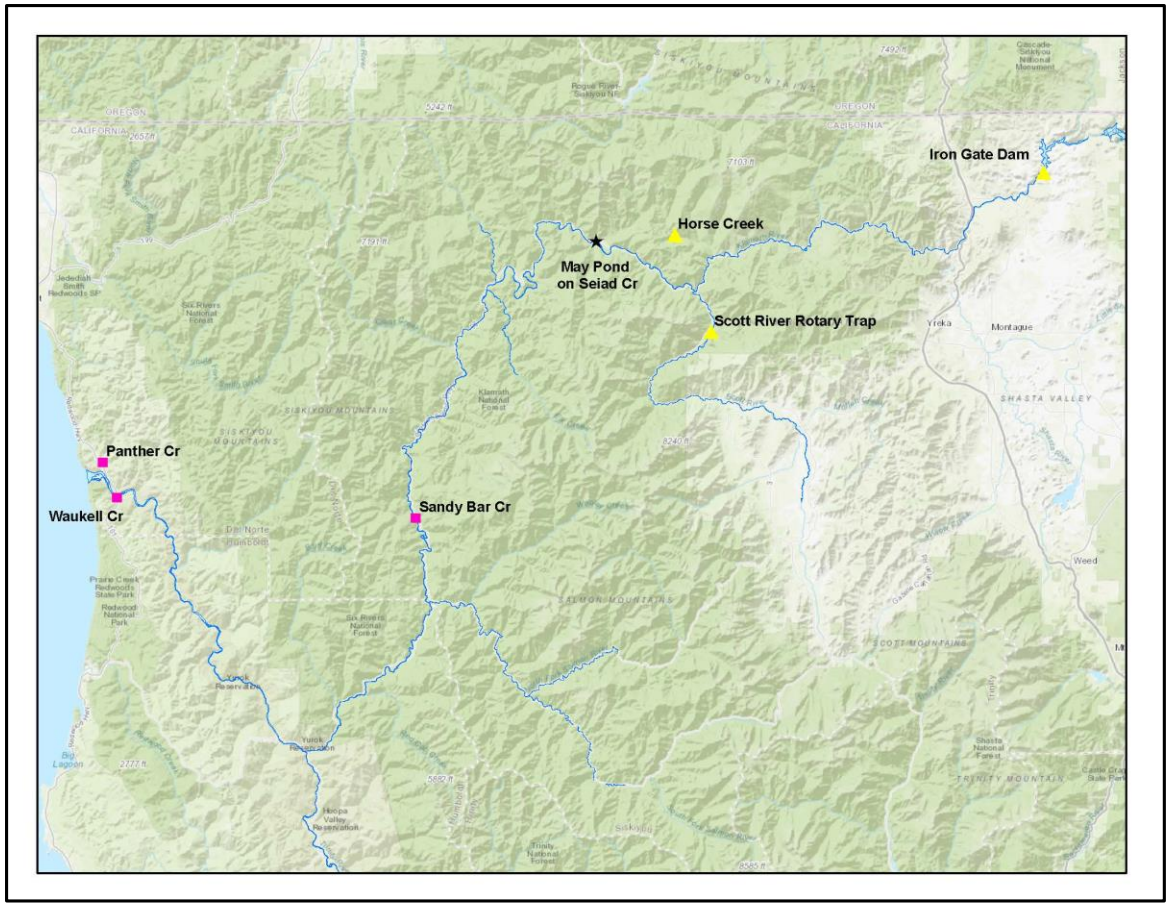

Figure 9: Map showing movement of natal and non-natal fish into and from May Pond. Yellow triangles represent non-natal fish that have moved into May Pond. Purple squares represent tagged coho that were either tagged or detected in May Pond and were later detected or handled downriver of the pond.

Connectivity

Deposition of fines within the ingress/egress channel occurs each winter at this site, and usually requires maintenance as flows drop out in the spring. Steady sedimentation has occurred since construction finished. During the past two wet winters (2016 and 2017) a large amount of debris was deposited at the inlet and to date the inlet has accumulated approximately five feet of sediment. This sediment plug has raised the water elevation in the pond several feet during the winter. With the higher surface elevation, a backwater overflow channel now acts as the main connection point to the creek. Even with this level of sedimentation at the inlet, over 400 coho moved into the pond through this new channel during the spring of 2017 and have resided within the pond all summer. MKWC is in the planning stage to address this issue at this site with the possibility of having a small excavator remove the sediment plug and install some small wood structures within the inlet to encourage a scouring flow. Another option is to leave the sediment in place and reshape the overflow channel to act as the main outlet for access of the pond. See lessons learned for more analysis. MKWC fisheries staff regularly (twice a year) digs out the channel to ensure connection to the creek.


Top of overflow connection channel that is acting as the new egress channel.


Overflow channel connection to creek
Seiad Creek

Non-native/Invasive presence

MKWC and the KTFP has observed Green Sunfish (Centrarchus macropterus) black bullhead catfish (Ameiurus melas) and Bullfrogs (Lithobates catesbeianus) using the pond during the summer months (May-September). Both of these species are prevalent with in the Klamath River and Lower Seiad Creek, but do not seem to have a significant effect on coho utilization within the pond. To date, large populations of these species have not been documented in the pond. Curly Pondweed (Potamogeton crispus), a common, non-native aquatic plant grows in small amounts within the May Pond and is not a special species of concern. Himalayan Blackberry and Common Teasel, both extremely prevalent throughout Siskiyou County, are also present around pond perimeter.

Lessons learned/Next Steps

The May Pond was the sixth off-channel pond constructed by MKWC and partners, following Stender Pond, Alexander Pond, Buma Pond, Lower Seiad Pond, and West Grider Pond. All ponds except West Grider were built on Seiad Creek. Lower Seiad Pond and May Pond were built in the lowest reach, below the Highway 96 bridge. This reach is hydrologically unique in that the Klamath River will push up into Seiad Creek during high flow events, causing Seiad Creek to deposit sediments between the Highway 96 bridge and the creek mouth rather than allow the creek to push sediment through the system. This effect compounds connectivity issues with the Lower Seiad and May Ponds as excessive deposition within their respective ingress/egress channels accumulates during high flow events.

Even though non native bullfrogs and sunfish have been observed utilizing this pond during the summer months, they do not seem to be having a negative effect on coho utilization based on the significant numbers of fish observed in this pond. The minimum dissolved oxygen levels observed in the pond (1.15 mg/l minimum and 5 mg/l average) are lower than recommended minimum DO levels (7 mg/l) that are found in the literature. We have observed, in this pond and many of our other constructed ponds, that coho can survive and exhibit significant growth rates at much lower DO levels than 7 mg/l.
Both of these early ponds were constructed with outlet channels configured at nearly 90 degree junction angles to the mainstem Seiad Creek channel. Over time this configuration has compounded the effects of the above mentioned deposition problem. The perpendicular positioning of the outlet channel only increases the cross sectional distance of the creek channel, allowing deposition to inundate a greater distance into the outlet channel. All off-channel projects constructed after the May Pond have experimented with varying junction angles at the outlets as well as introducing a hard point (wood or

rock) at the downstream end of the outlet. The most successful outlet channels (those that require the least amount of perennial maintenance) are those that can be constructed at a 20-30 degree junction angle to the creek channel, reducing the amount of deposition within the outlet channel. In addition, the hard point of wood or rock at the downstream end of the outlet channel tends to increase scour at the outlet and has helped maintain connectivity during the low flow summer and fall months.

The Lawrence Ponds, constructed in 2017, shows the latest design iteration of an ingress-egress channel. The downstream junction angle of the channel and large wood installed at the confluence will help reduce seasonal deposition within the constructed channel.