

DeCoursey Off -Channel Pond

Monitoring Case Study

Mid Klamath Watershed Council



Background and Introduction

The **DeCoursey Off Chanel Pond (O.C.P.)** is located approximately two tenths of a mile up **Middle Creek** from its confluence with Horse Creek (see figure 1).

This OCP was constructed by MKWC and was completed in the fall of 2014. Funding for this project came from USFWS, CDFW and PacificCorp. The landowners Tony and Elka Decoursey support this project and have 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. MKWC began project planning for the DeCoursey Pond 2012.

Field reviews with the Karuk Tribe, landowner, Rocco Fiori (Fiori GeoSciences, Inc.), USFWS, CDFW, USFS and others helped to inform data collection needs prior to construction. MKWC performed a topographic survey of the project zone, installed cross section profiles throughout the proposed outlet channel and the pond. This site was chosen primarily for its favorable groundwater input and existing abandoned side channel feature. Located within an abandoned Middle Creek side channel that had a spring located at the top of the area, this site was deemed to have adequate cold water input to provide high quality rearing habitat for juvenile salmonids looking to find refuge from high flows in Middle Creek or to escape the creek during periods where the stream becomes fragmented or completely dries up. These findings were confirmed based off of pre project monitoring of two 10 foot long ground water wells installed at the site. Depth of ground water was no more than six feet deep in the summer and groundwater temperatures ranged from 12-14 degrees Celsius.

With an ephemeral above ground spring located at the top of the project site as well as the nature of the vegetation in the area, we hypothesized that the feature would likely have good dissolved oxygen levels, ideal water temperature for rearing coho salmon, and adequate volumes of water due to shallow ground water in the area. Prior to construction, all necessary permits were secured, including a 1602 permit from CDFW, 401 certification from the State Water Resources Control Board, NEPA documentation from USFWS, NMFS, and 404 permits from the Army Corps.

Project Objectives

The DeCoursey O.C.P. was constructed to augment limited winter rearing habitat for coho salmon in Horse Creek. Off-channel habitats such as this provide juvenile coho refuge from high stream flows in the winter, and most constructed habitats also provide refugia from potentially lethal Klamath River mainstem water temperatures in the summer and fall. While the DeCoursey O.C.P. was constructed solely for winter rearing habitat, ongoing water quality monitoring and population estimates show that coho also utilize this pond for summer rearing.

Construction

The wetted area of the constructed habitat 6,240 square feet during summer base flow conditions. This increases by nearly 1000 square feet during average winter flows. There is an egress channel at the downstream end of the pond and the terminal end of the channel is approximately two feet wide during summer low flow conditions and approximately five feet wide during high flow conditions. DeCoursey O.C.P. has a maximum depth of 8 feet and averages four feet through the center line. The pond has a length of approximately 200 feet and average width of 15 feet as shown in figure 2 below. The bathymetry is staggered to provide varying depths for cover and forage habitat. Six large root wad structures were installed along the length of the pond to provide cover habitat. Following a fire in the area in 2016, large quantities of wood has fallen into the pond as alders die off from being burned.

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.



Photo 1: Yreka High School students planting native trees around DeCoursey Pond
Mid Klamath Watershed Council

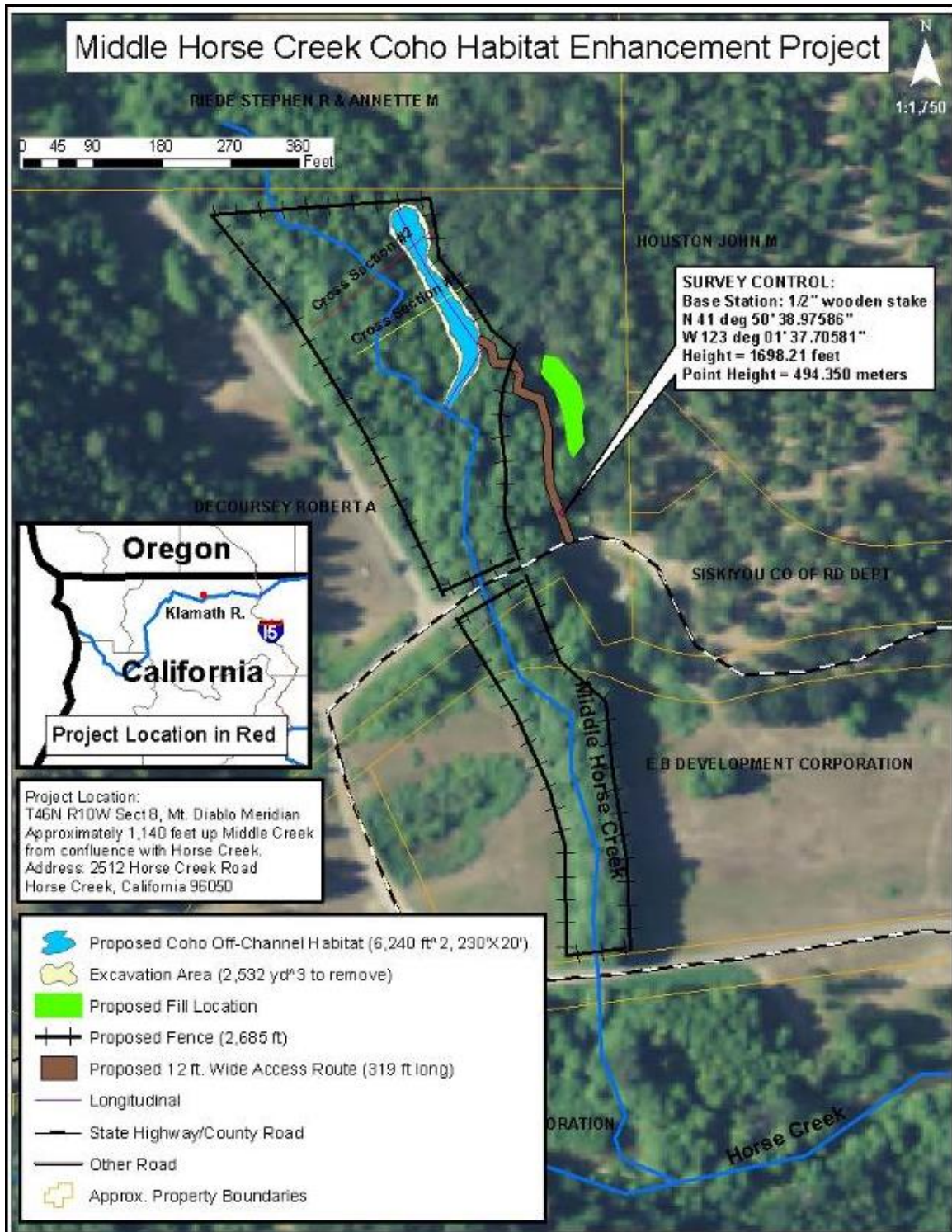


Figure 1: Plan view map of the DeCoursey off channel habitat feature on Middle Creek.

Monitoring

MKWC has coordinated with the Karuk Tribe to conduct biological and physical monitoring of the DeCoursey Pond and other constructed habitats from the time they were built to present. MKWC Fisheries staff monitors each off-channel project site twice each month for dissolved oxygen and temperature. In addition, bi-weekly ocular fish counts approximate the number of fish utilizing each site.

A YSI 550A handheld dissolved oxygen/temp meter is used to collect samples at predetermined locations at each off-channel site, including adjacent tributaries. At DeCoursey Pond, temperature and dissolved oxygen (DO) readings are taken at four separate locations with one to three readings at each location to capture effects from stratification. Limited readings for seasonal periods of time (January through August) were collected with a U26 dissolved oxygen and temperature logger for the DeCoursey Pond and include information on temperature and DO. This logger is set to collect data at 30 minute intervals to chart daily fluctuation of these biological factors. The Karuk Tribe has plans to begin conducting Petersen mark/recapture studies on the pond to create seasonal population estimates for this O.C.P.

MKWC senior technicians also conduct monthly snorkel surveys of the DeCoursey Pond to obtain ocular fish counts for presence absence of targeted species. This also correlates with structural monitoring of the habitat, specifically riparian vegetation recruitment, connectivity to the adjacent stream channel, and invasive species monitoring.



Photo 2: Juvenile Coho surface feeding in the pond, June 2016

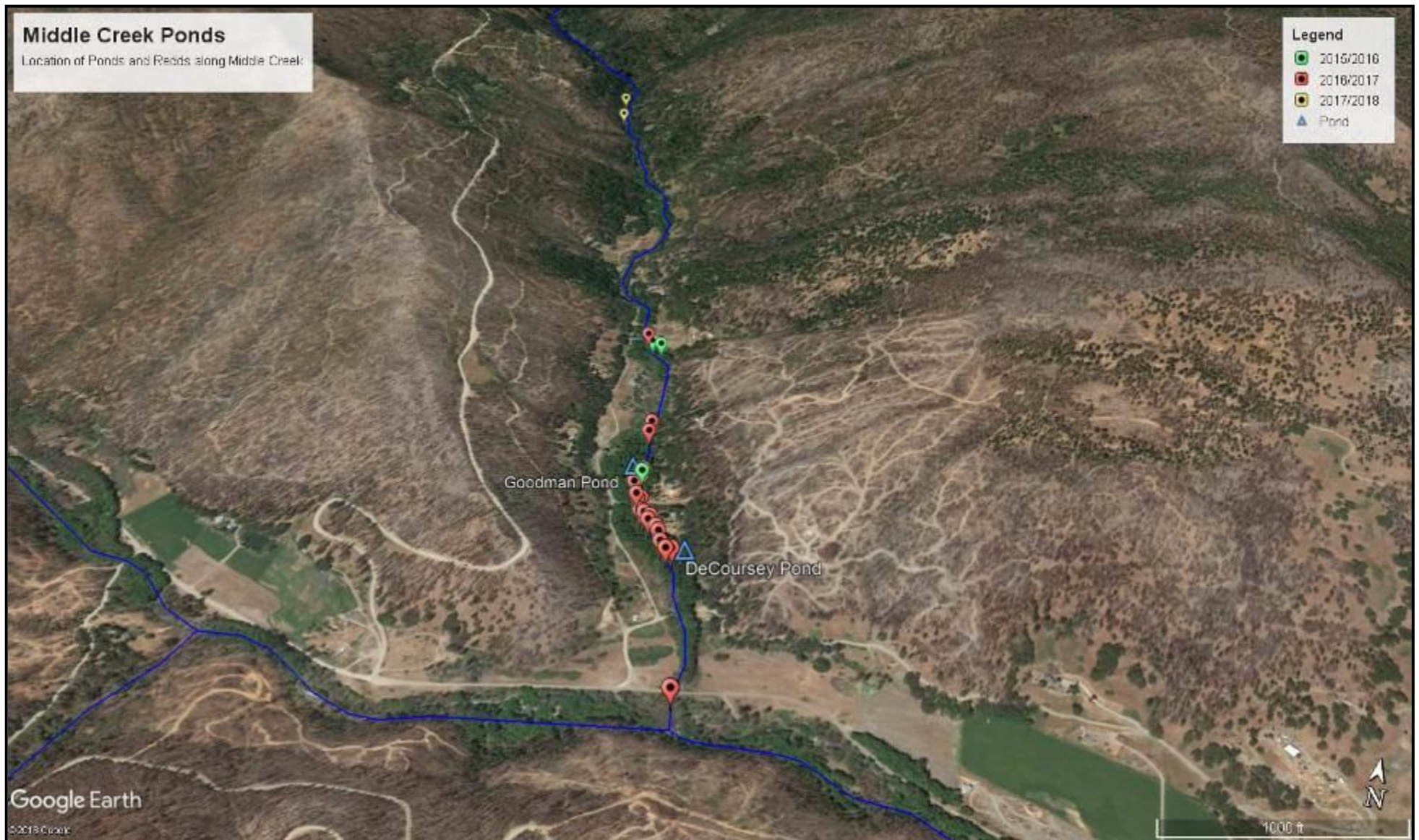


Figure 2: Topographic map of Middle Creek showing location of the two constructed off-channel ponds and three seasons of red locations. In 2016/2017 22 redds were recorded on Middle Creek. MKWC hypothesizes that the five year flood event recorded that year scoured away many of these redds base off of the lower fish counts recorded in the creek and ponds during the spring/summer of 2017.



Photo 3: DeCoursey Pond project site before construction 2014



Photo 4: DeCoursey pond winter after construction 2015



Photo 5: DeCoursey Pond winter of 2017



Photo 6: Outlet channel was re-enforced with large woody debris at its connection point

Results

Fish Population Estimates/Dive Counts

DeCoursey O.C.P. has been found to provide optimal conditions for both summer and winter refuge for coho juveniles since we have been monitoring this feature in 2014. Like other constructed off-channel ponds MKWC has constructed, DeCoursey Pond provides extremely stable temperatures throughout the year, with a yearly fluctuation of around six degrees Celsius. This is likely attributed to the perennial ground water input to the pond and the riparian forest surrounding the feature. Low fish counts in the 2017 and 2018 years could be attributed to the vastly increased cover within the pond after the 2016 Gap Fire. Large amounts of wood within the pond have made it difficult to obtain accurate counts and we have now switched our protocols from ocular counts to presence/absence surveys due to the difficulty obtaining accurate survey data. We hypothesize that all of the fish using the DeCoursey Pond are natal to Middle Creek because of an old, undersized culvert crossing near the mouth of the creek. This culvert can be an adult barrier in low flow years and seems to be a barrier to upstream juvenile migration year round. This hypothesis is based off of the presence/absence counts collected by MWKC staff. Figure one illustrates a trend where young of the year are documented moving into the ponds in May and June followed by a large outmigration in the late fall with small numbers staying in the pond overwinter. Fish counts were collected by senior MKWC staff during snorkel surveys.

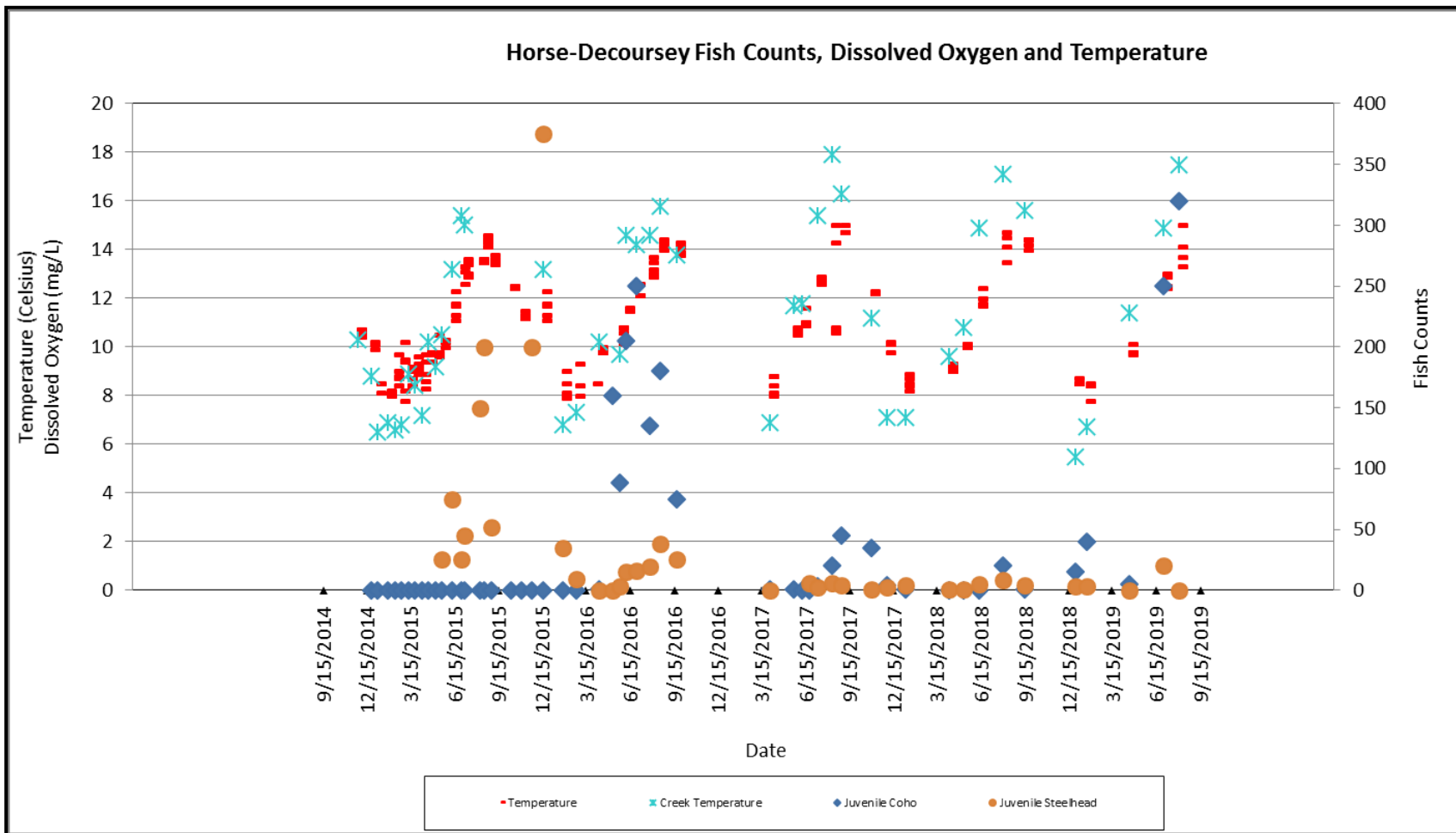


Figure 3: Spot temperature readings and ocular fish counts collected by MKWC during field visits to DeCoursey



Photo 6: Culvert crossing on Middle Creek during high water event in December 2016



Photo 7: Culvert during low flows in December of 2015



Photo 8: Dry creek channel in July of 2015

Water Quality Sampling

DeCoursey Pond is heavily influenced by ground water which translates to very stable temperatures with small daily diel temperature fluctuations throughout the year (see figures). Two HOBO temperature loggers are deployed at the top (depth of 5 feet) and bottom of the pond (depth of 4.5 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 11.7 degrees Celsius with a three year minimum temperature of 2.98 degrees Celsius in the lower half of the pond and 7.89 degrees Celsius in the top half of the pond and a three year maximum temp of 15.29 degrees Celsius. The difference in temperatures at a depth of five feet compared to a depth of one foot is approximately .4 degrees Celsius during the summer (based off of three years of monitoring). This stable temperature regime provides excellent growth conditions for juvenile salmonids rearing in the pond throughout the year. This type of thermal stability is a common characteristic of habitats with strong groundwater connections.

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 5 and 6). 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 15.82 mg/L over four 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 Regional 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. The following figures summarize the water quality sampling results for the DeCoursey Pond.

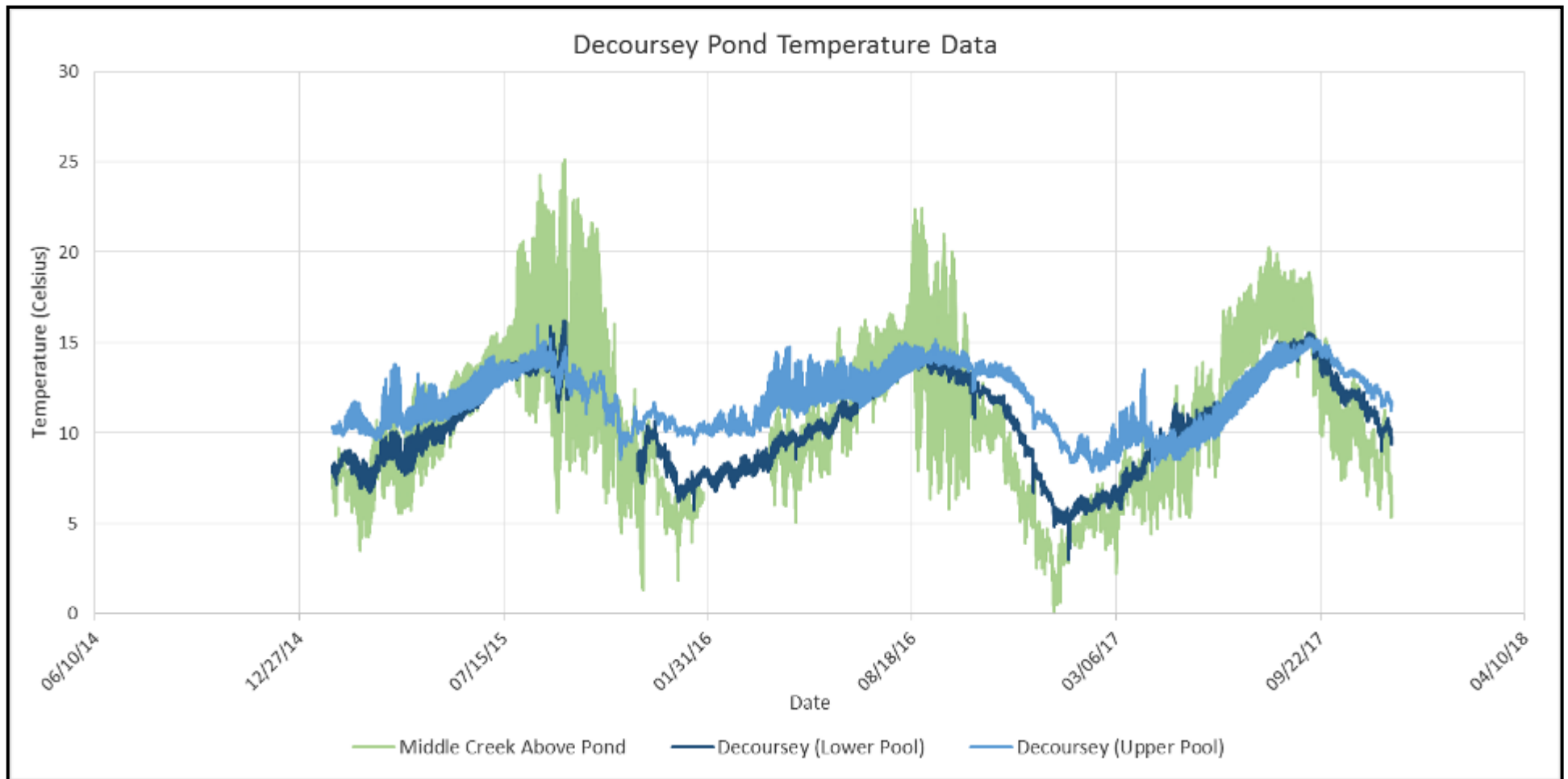


Figure 4: Temperature data collected by Hobo temperature logger deployed in the pond and creek. Loggers are set to take a reading once an hour. Two loggers are deployed in the pond, one in the lower pool which connects to the creek and one in the upper pool. One logger is deployed above the pond in Middle Creek. High spikes in creek temperature in 2015 and 2016 indicate the creek went subservice. The creek stayed connected during the summer of 2017.

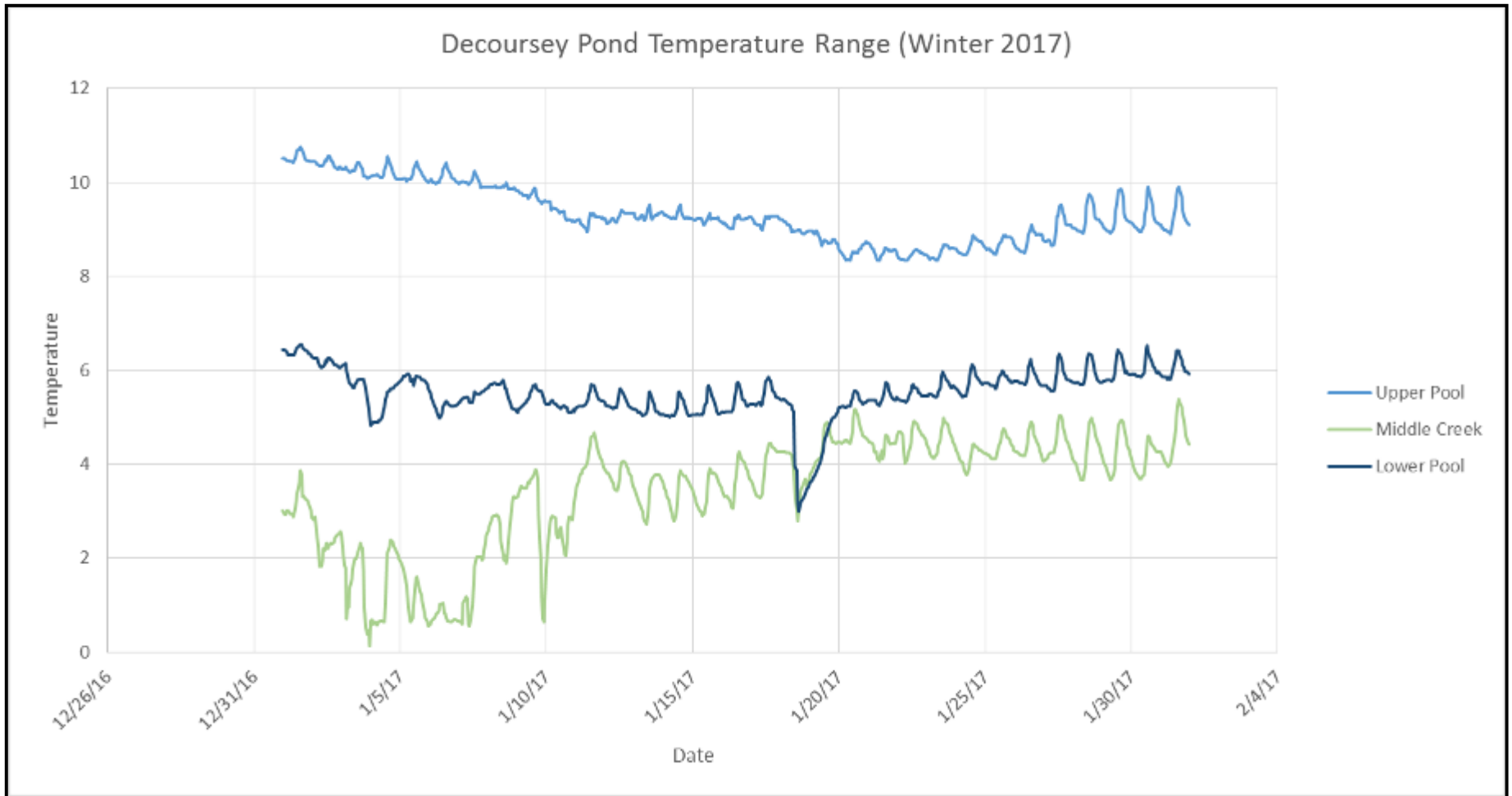


Figure 5: Monthly temperature snap shots collected by Hobo data loggers. Temperature in the pond are several degree warmer all winter than temperature in the adjacent creek. The upper pool of the pond is on average almost 4.5 degrees warmer/day than Middle Creek.

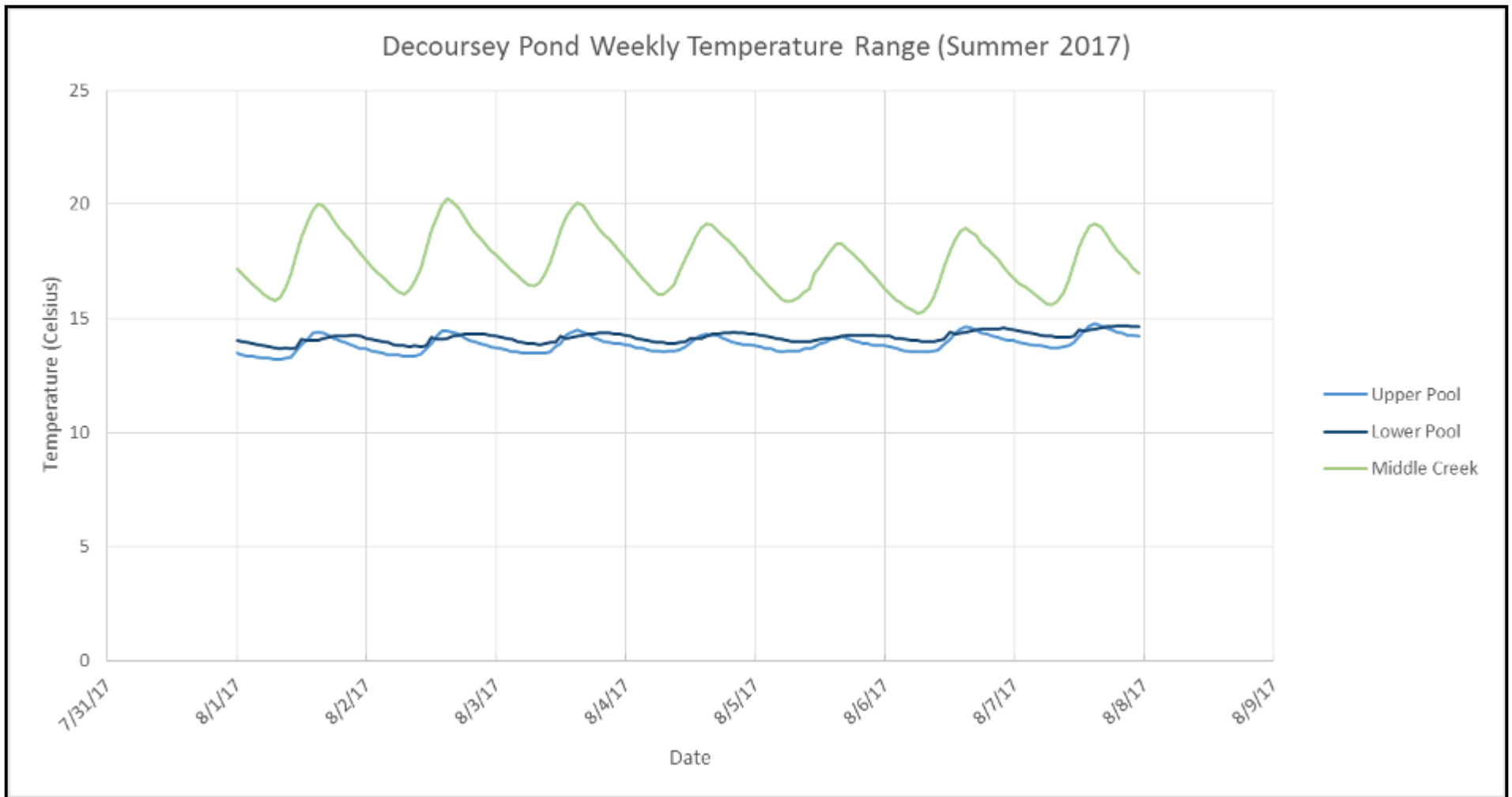


Figure 6: Weekly temperature fluctuation graph. DeCoursey pond had very little diel temperature change during hot summer months. Daily variation is approximately 1.5 degrees Celsius a day. This graph illustrates one of the hottest weeks of the year 2017 temperatures in the pond never peaked over 15 degrees Celsius, well below stressful levels for juvenile salmonids.

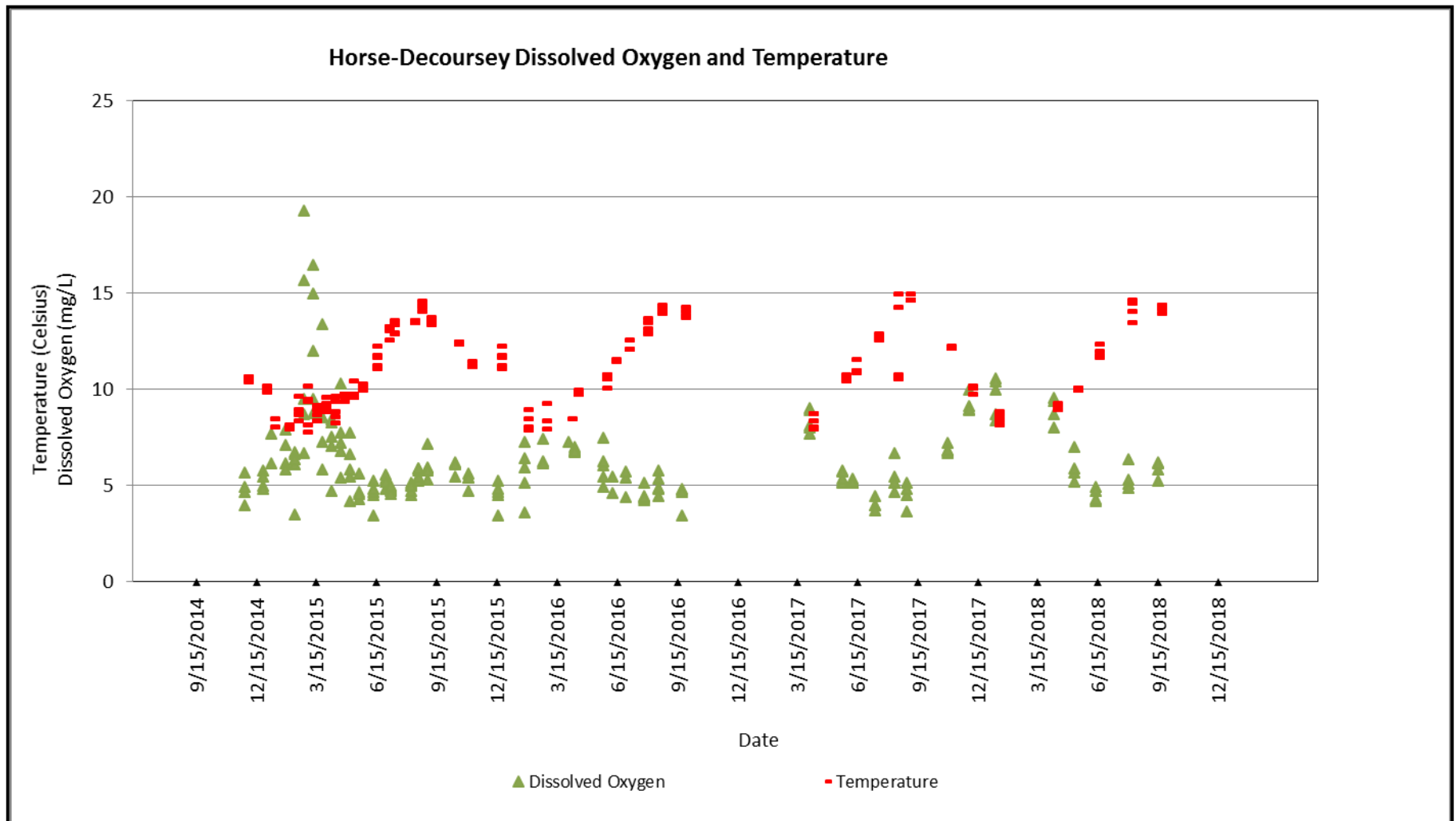


Figure 7: Temperature and dissolved oxygen readings taken with a handheld YSI during site visits by MKWC staff. Temperature and DO readings are well within suitable levels for juvenile salmonids.

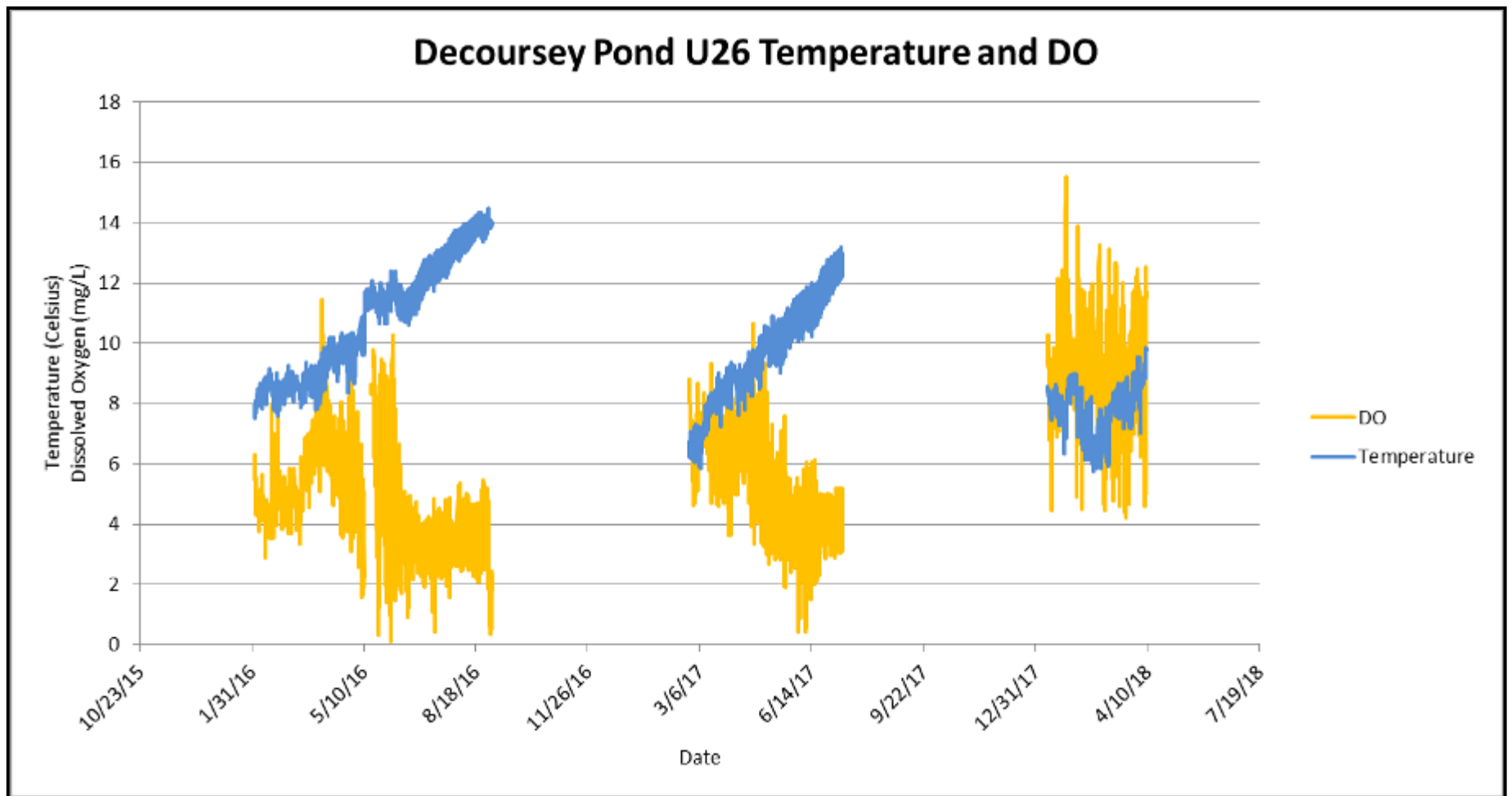


Figure 8: Temperature and DO readings taken with a U26 logger. Readings were taken every half hour for periods of up to six months. High readings of DO in spring of 2018 could be attributed to algal blooms that occurred during that time period. This can cause erratic DO levels within the pond during the growth and subsequent die off of algae.

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

Few coho juveniles have been PIT tagged at the DeCoursey Pond to date. Capture events have become difficult with large amounts of downed alders falling into the pond after the Gap fire of 2016, making it increasingly harder to place seine nets in the pond. MKWC and the tribe are in the process of acquiring a set of PIT tag arrays to install at the egress channel of this pond.

Invertebrate Sampling

No invertebrate sampling has occurred to date. MKWC senior staff have documented damselfly and dragon fly larvae within the pond. This is a good indicator of excellent water quality within the pond.

Connectivity

DeCoursey Pond has a perennial connection to Middle Creek. Little to no maintenance has been required to date due to the placement of a small root wad structure at the mouth of the creek. MKWC senior staff bolstered this root wad structure with slash and small logs in 2016 (see photos below). A minimum amount of work has helped to create a stable connection from the creek to the pond.



Photo 9: Egress channel of DeCoursey Pond October 2017



Photo 10: Photos of egress channel to DeCoursey Pond.

Non-native/Invasive presence

No non-native fish or amphibian species have been detected within the DeCoursey Pond. This could be attributed to the general temperature profiles of the creek and pond, which on average stay much cooler than other tributaries of the Klamath that have large amounts of invasive aquatic species. The culvert crossing middle creek might also prevent migration of non-native species, or that the pond is located several miles from the Klamath River mainstem. While aquatic animal species are not present, several species of prevalent invasive plants are located around the pond. These include Himalayan Blackberry, Poison Hemlock, Eurasian Nettle (stinging nettle) and several non-native grasses yet to be identified. These plants were present before construction and are widespread within the Horse Creek valley. MKWC is currently working on a plan to help manage these plant species around the pond and encourage native plant growth. Several tree plantings have taken place since construction and a large scale channel reconfiguration project of Middle Creek is in the planning stages of development. This project has a large scale native planting plan built into the design.

Lessons learned/Next Steps

Despite having found abundant groundwater at this site in 2012 and 2013, and reports of perennial surface flow in Middle Creek from local residents, the summers of 2014 and 2015 both saw the lower one mile of Middle Creek dry up during the summer and early fall months. This was the first project MKWC constructed adjacent to a dry creek channel. The results of groundwater monitoring at the site throughout the summer of 2014 gave us confidence that the pond could be dug to a depth that would maintain an adequate amount of quality water throughout the driest seasons. The pond was dug approximately five feet deeper than designed to accommodate the historically low groundwater elevations, and though it did maintain the desired depth and quality of water throughout the summer of 2015, the extra depth significantly added to the amount of fill removed from the pond, and without increasing the footprint of the pond, the excavated edges became very steep and vulnerable to erosion. In hindsight, we would have altered the footprint of the pond, decreasing its length and increasing its width to maintain the original design's square footage while not sacrificing overhead canopy cover.

This project was the first off-channel feature constructed in the Horse Creek valley, and as such was considered an ambassador project for the local community. The project area was highly visible from Horse Creek Road, and many local residents would stop to ask questions and view progress on the pond. This became a good opportunity to answer questions, address concerns, discuss future projects, and learn valuable local history, both social and geomorphic.

Citation Notes:

Hillemeier, D., Silloway, S., Soto, T., Corum, A., Kleeman, M.,
Lestelle, L. (2009)

**“The Role Of The Klamath River Mainstem Corridor In The Life History And
Performance Of Juvenile Coho Salmon (*Oncorhynchus kisutch*)”**

Carter, K. (2005)

**“The Effects of Dissolved Oxygen on Steelhead Trout, Coho Salmon, and Chinook Salmon
Biology and Function by Life Stage”**

California Regional Water Quality Control Board, North Coast Region