YUROK TRIBE
ENVIRONMENTAL PROGRAM

Wetlands Program Development Grant

Wetlands Species and Water Temperature Analysis
October 1, 2013 through September 30, 2015

Prepared by the Yurok Tribe Environmental Program
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INTRODUCTION AND BACKGROUND

The Yurok Indian Reservation (YIR) is currently the largest federally recognized Native American Tribe in the state of California. It is located in the northwestern portion of California. The reservation encompasses 46 miles of the Klamath River from the Pacific Ocean (Fig.1), upriver to the town of Weitchpec, along with a mile of land extending from both sides of the Klamath River the entire distance.

Figure 1. Map of Yurok Reservation Boundary

The Yurok Tribe Environmental Program's (YTEP) Wetlands Program is dedicated to the inventory, monitoring, assessment and protection of wetlands within the Yurok Reservation. YTEP's Wetland Program also works in coordination with and support of the Yurok Tribe's efforts in wetlands restoration as implemented by the Yurok Tribe Fisheries Program (YTFP) and Yurok Tribe Watershed Restoration Department (YTWRD). The Tribe's wetlands restoration efforts are driven by the desire to protect salmonids and other native fish that rely on Klamath River wetlands for critical habitat. YTEP's Wetlands Program intends to support tribal wetlands protection and restoration efforts by collecting a range of

Figure 2. Klamath River Estuary Wetland Complexes covered in this report. *McGarvey Creek Alcove is not displayed, but can be seen in Figure 9

baseline environmental data on wetland complexes within the Yurok Reservation and developing a tribal regulatory framework for wetlands protection.

This report summarizes the methods and results of vegetation and wildlife surveys and water temperature monitoring conducted on wetlands of the Klamath River Estuary (KRE) within the Yurok Indian Reservation (YIR) boundaries for water year 2014 (WY14) and 2015 (WY15) (Fig.2). The Yurok Reservation, specifically areas adjacent to the KRE, contain several wetland complexes in various ecological conditions that serve as critical habitat for anadromous salmonids, especially for ESA listed Coho salmon. Understanding and improving the functional role of KRE wetlands (i.e.: critical fish habitat) is a unifying goal for all three tribal programs that work with wetlands resources. The Yurok Tribe Environmental Program Wetlands Program Plan, 2014 that was developed prior to conducting any vegetation or wildlife surveys used traditional ecological knowledge; fisheries and watershed programs experience and expertise; and our own departmental expertise in water quality, environmental monitoring, bioassessments, and environmental regulation to contribute to restoration of the Klamath River and its fisheries.

Bioassessments meet Objective One: Develop a monitoring and assessment strategy consistent with *Elements of a State Water Monitoring and Assessment Program for Wetlands* that states and tribes can use to manage wetlands according to their objectives; and Objective Two: Implement a sustainable monitoring program consistent with the wetlands monitoring strategy; as laid out in the *Core Elements of an Effective State and Tribal Wetland Program* (EPA, 2008). In addition to meeting these objectives these bioassessments work towards understanding wetland ecosystems, their community structure, and presence of culturally significant species as a means of informing wetland restoration projects with the ultimate goal of protecting salmonid resources (Patterson, 2009).

Vegetation and Wildlife

YTEP conducted this study which focuses on the KRE Wetland Complexes (WC), and more specifically the South Slough WC, Richardson WC, and Waukell WC. YTEP's goal in this study was to identify a baseline set of flora and fauna species that are known indicators of wetland condition and function in addition to being culturally significant to the Yurok Tribe. Sea level rise due to climate change is another factor that YTEP is looking to investigate with the outcome of this study. YTEP will be able to use the results from this bioassessment to identify vegetation and wildlife that are possible threatened in future sea level rise.

A number of considerations went into choosing species surveys and site locations.

To help identify culturally significant species, YTEP compiled a list with photos of known species to be found in the KRE Wetland Complexes and distributed them to the Yurok Tribe Culture Committee (YTCC). The YTCC members are Yurok Elders whose historical and cultural knowledge is a fundamental resource. YTEP used the information collected by the YTCC to categorize which species are currently or historically culturally significant that were identified by YTEPs' bioassessment surveys.

Four different types of surveys were conducted from July 2014 through September 2015.

- **Vegetation:** Plants serve as excellent indicators of wetland condition because of their rapid growth rates, relatively high levels of species richness, and direct response to environmental change (Fennessy et. al 2001).

- **Avian:** Collectively, birds serve as excellent indicators of wetland condition because of their direct and indirect sensitivity to vegetation and water quality, as well as anthropogenic disturbances (EPA, 2002). Birds are highly visible and people tend to notice a change in their normal activity due to their

- **Herpetofauna:** Indicators of ecosystem health, herpetofauna are adversely impacted by human induced processes (e.g. habitat loss or degradation, acid deposition, climate warming, increases in UV radiation, spread of toxic substances, etc.). The unique characteristics of amphibians, for example (e.g. permeable skin, unshelled eggs, aquatic and terrestrial life histories, etc.), enhance their role as effective biomonitors, allowing unique insight into processes of environmental deterioration (EPA, 2002).

- **Mammals:** While wetlands house an array of flora, herpetofauna, and waterfowl, many mammals, in addition, are strongly associated with wetlands as well (EPA, 2012); including, the beaver, raccoon, river otter, mink, muskrat, as well as the elusive fisher and marten. And thus, wetland mammal surveys hold the potential to serve as excellent indicators of wetland condition, for mammals are sensitive to the presence and type of wetland vegetation and its juxtaposition with open water; the increasing destruction of riparian vegetation, therefore, is linked to the presence and species richness of wetland mammals (EPA, 2012)

Temperature

The primary focus of monitoring temperatures in KRE wetlands was to better understand water quality conditions in wetlands in support of fisheries restoration efforts undertaken by the Yurok Tribal Fisheries Program (YTFP). Several studies have indicated that wetland habitats within the KRE and adjacent tributaries can improve juvenile fish survival by offering alternative food sources, increased temperatures (metabolism), and thus increased growth rates. In recent years YTFP has been initiating wetlands restoration projects in the flood plains of several KRE tributaries. These habitats provide high flow refugia and rearing habiatat for juvenile salmonids. Previous monitoring by YTFP has showed the juvenile salmon can utilize these habiats and withstand low dissolved oxygen levels, likeley a result the fish's metabolism and ability to seek out higher levels of dissolved oxygen in nearby habiats. A better understanding of the temperature conditions in both restoration sites and natural wetland sites , along with how these sites are utilized by salmonids is important in understanding restoration project objectives and and can influence future restoration and monitoring actions.

PROJECT AREA AND METHODS

Vegetation and Wildlife

To ensure that the KRE Wetland complexes were properly represented in each survey, YTEP chose study sites based on survey protocols and hydrogeomorphic (HGM) classification system (EPA 2002), Wetland types covered in this project include Estuarine, Marine, and Riverine Wetlands, Freshwater Forested Shrub Wetlands, Freshwater Pond Wetlands, and Freshwater Emergent Wetlands. Each survey method required special consideration of where to conduct each survey with its own parameters and limitations.

Vegetation

Vegetation surveys were conducted in the Richardson Creek Wetlands Complex in the July 2014 and in the South Slough Wetland Complex in April 2015 (Fig.3). Plant survey methodology and protocol have been adopted from the U.S. Environmental Protection Agency 'Methods for Evaluating Wetland Condition' handbooks. Once the survey site is established (i.e. South Slough, Richardson Creek) transects will be systematically established. This will be done through the creation of a 100 meter baseline, established along the wetland boundary and parallel to its longest axis. Transects will then be located at fixed intervals (20 meters apart) perpendicular to the baseline (Fennessy et. al 2001). Transects intersect the baseline, extending fifteen meters in each direction. All vegetation in each quadrat of the transect will be sampled. Quadrats will be spaced five meters apart along the transect, with three quadrants on each side of the baseline for a total of six quadrats per transect. The size, shape, and number of quadrats to be sampled must undergo several considerations. The two primary issues regarding quadrat shape for surveying plant communities include the edge effect and habitat heterogeneity (Krebs, 1999). While rectangular quadrats are considered to be the most accurate in regards to habitat heterogeneity (e.g. crossing more patches and thus detecting more plant species), sampling accuracy decreases as quadrant shape lengthens; the longer the perimeter of the quadrat, the likelihood of individual field personnel making subjective decisions as to whether a plant species is 'inside' or 'outside' the quadrat is increased. Round quadrats are often considered to be the most accurate because they possess the smallest ratio between its perimeter and area (Krebs, 1999). To account for this consideration, quadrats will be established utilizing a three meter rope, placed at each five meter interval along the transect. The rope will then be extended a full 360 degrees, forming a circle. All vegetation within the circular quadrat will then be sampled. Species detected will then be recorded onto a standardized data sheet.

Figure 3. Map of baseline and transects of vegetation surveys in the South Slough and Richardson Creek Wetland Complexes.

Avian

Birds shall be inventoried using a protocol referred to as point counts, wherein all habitats within the site are included and species either seen or heard are counted. This method is particularly useful in areas where vision is obstructed by trees, shrubs, or tall grasses (EPA, 2002). Birds are tallied at fixed points wherein the surveyor must record bird sightings or hearings for a full five minutes. No points shall be closer than 200 meters away from each other and no points shall be less than 100 meters from the wetland perimeter (EPA, 2002). Transects will not be utilized within this survey as using transects decreases the flexibility necessary to situate points in the full range of vegetation strata and hydrologic zones (EPA, 2002). Further, points shall not be located randomly, but rather in a manner in which the surveyor anticipates will yield the most avian richness (EPA, 2002). All species heard or seen will then be

Figure 4. Map of avian point count surveys conducted in South Slough, Richardson Creek, and Waukell Creek Wetland Complexes

recorded onto a standardized data sheet. YTEP established nine point count locations. Four sites in the South Slough, three sites in Richardson Creek, and three sites in Waukell creek (Fig.4)

Mammals

Mammals, in particular carnivores, are difficult to study due to their relatively wide home ranges, low densities, and their tendencies to be solitary and nocturnal (Clark et. al 1983). Despite these elusive qualities, several survey techniques have been developed including direct counts through capture, counts of signs (e.g. dens, tracks, or droppings), questionnaires, trapping, and eliciting responses to anthropogenic stimuli (e.g. scent stations, response to sirens, etc.). Unfortunately, such methods vary greatly in effectiveness across species and habitat type (Clark et. al 1983). To accommodate such limitations, this survey will use a mud track sampling technique as explained by Conover and Linder (2009).

Mud Track Plots

Conover and Linder (2009) argue that the active component of mammal survey techniques (e.g. scent lures or bait) bias detectability wherein the aversion or attraction to bait or lures are variable, and therefore detract from the efficacy of spatially explicit habitat research. Mud track surveys aim to overcome this obstacle vis-à-vis the utilization of natural ground substrates, and thus sampling mammalian occupancy with minimal bias of natural movements (Conover et. al 2009). The mud track plots will be one square meter, established by removing standing vegetation and scraping the ground dry with the flat side of a hand shovel, thereby maximizing track detail on the surface (Fig.6). Gloves are to be worn during preparation to minimize anthropogenic traces that could potentially influence mammal behavior. Plots are to be re-scraped between data collection periods. Plots are to be located at no less than fifty meters apart. YTEP established seven mud track plot sites. Four sites in the South Slough, and three sites in Richardson Creek (Fig.7). Species identification is to be confirmed through pad measurements and photographs of the tracks left behind (Conover et. al 2009). In addition to protocol requirements YTEP chose site locations based visual evidence of mammal activity (Fig. 5).

Figure 5. All three images were taken when deciding mammal track plot sites in the South Slough Wetland Complex.
Left: Beaver track in mud.
Center: Tree chewed down by beavers.
Right: Bobcat tracks in mud.

Figure 7. Map of mammal mud track plots in the South Slough and Richardson Creek Wetland Complexes.

Figure 6. Example of the creation of a mud track plot. Top image shows site before, bottom image shows site after.

Herpetofauna

Aquatic survey methodology and protocol have been adopted from the U.S. Environmental Protection Agency 'Methods for Evaluating Wetland Condition' handbooks and US Geological Survey (USGS) California Tiger Salamander survey protocols. Combinations of methodologies are utilized, and thus increasing the likelihood of accurate representations of present amphibians (EPA, 2002, amphibians). The two different types of methodologies used are Visual Encounter Surveys (VES) and Pitfall Traps. There are two pitfall trap sites located in the Richardson Creek Wetland Complex and three pitfall trap sites in the South Slough Wetland Complex (Fig. 8). YTEP conducted visual encounter surveys in between pitfall trap sites at each location to ensure coverage of the whole project area.

Visual Encounter Survey

The visual encounter survey (VES) methodology is employed (Heyer et. al 1994). Once the survey site is established (i.e. South Slough, Richardson Creek) transect of a pre-established length will be systematically determined as means of ensuring standardized surveying procedure. The surveyor will then utilize the basic technique for conducting aquatic surveys through the use binoculars to scan for basking frogs, slowly walking the transect (in the water or on the adjacent bank) while visually searching for eggs, larvae, and adults(Feller et al. 1995). Surveyors will also take note of reptiles, namely different species of turtles and snakes. While not the primary focus of aquatic surveys, reptiles are important predators of amphibians and must be recorded (Feller et al. 1995). No animals, however, will be captured. The number of eggs, larvae, and adults of each species will then be recorded on the appropriate data sheets.

Pitfall Traps

The pitfall trap surveys were adapted from the USFS CA Tiger Salamander sampling protocol (Fisher et al. 2008). The timing of surveys will vary depending on the research objectives and staff availability. Since YTEP is surveying exclusively for amphibians, it is recommended that traps be opened after rainfall to maximize capture. Traps are constructed of wooden guidance fencing, a 5 gallon bucket with holes drilled into bottoms for drainage, sponges in bucket to keep environment moist, mesh screen above sponges to be able to remove species with little to no contact, lid to close trap when not in use, and cover to protect species from exposure (Fig.8). Foliage and duff will also be placed above mesh screen to create a more natural environment for trapped species to reside until they can be released. Pitfall traps should not be placed in a manner that will disturb or destroy rodent burrows or other refugia that could be used by target species. When not in use, traps should be closed in a manner that precludes entry by target species and other animals. Pitfall buckets should be opened before sunset if there was any rain during the day, or if at 2 PM rain is forecast for the remainder of the day or subsequent night with 70% or greater probability. Traps will be checked the next morning, and unless it is still raining or more rain is forecast, the traps can be closed until the next rain event. When in use, pitfall traps should be checked as often as necessary, but at a minimum one time a day, with one of these checks occurring between one hour before sunrise and noon. All found species will be recorded on datasheets. YTEP surveys were conducted during the spring and summer months of 2015.

Figure 8. Left: Map of pitfall trap locations in the South Slough and Richardson Creek. Right: Installation of a pitfall trap.

Temperature

Each selected Wetland Complex (WC) contained two data loggers to capture spatial changes throughout each complex. In some WC's only one temp recorder was used due to equipment failure or theft. Sites are labeled based on the Wetland they are located in and then given a 1 indicating being 'upstream' or 2 indicating being 'downstream'. YTEP deployed HOBO U22 (manufactured by Onset Inc.) continuous water temperature loggers (Fig. 9) in selected WCs from September 2013 to October 2015 (figure 9). In addition to monitoring in four of the complexes, two wetland restoration projects were also monitored (Fig. 9) Panther Creek WC is labeled PRT1 and PRT2. Spruce Creek is labeled SPR1. Waukell Creek WC is labeled WKL. South Slough WC is labeled SLT1 and SLT2. Salt Creek WC is labeled SLT1 and SLT2. McGarvey Creek Alcove is labeled MCA1 and MCA2.

During the project time period, YTEP collected water temperature data within each WC (excluding Richardson Creek Wetland Complex and Turwar Alcove) Temperature data was collected to provide background information on these wetland habitats and followed the procedures outlined YTEP's USEPA-approved quality assurance document for water quality monitoring in wetlands (Patterson, 2010). In 2010 YTEP implemented a comprehensive water quality study to characterize several important water quality

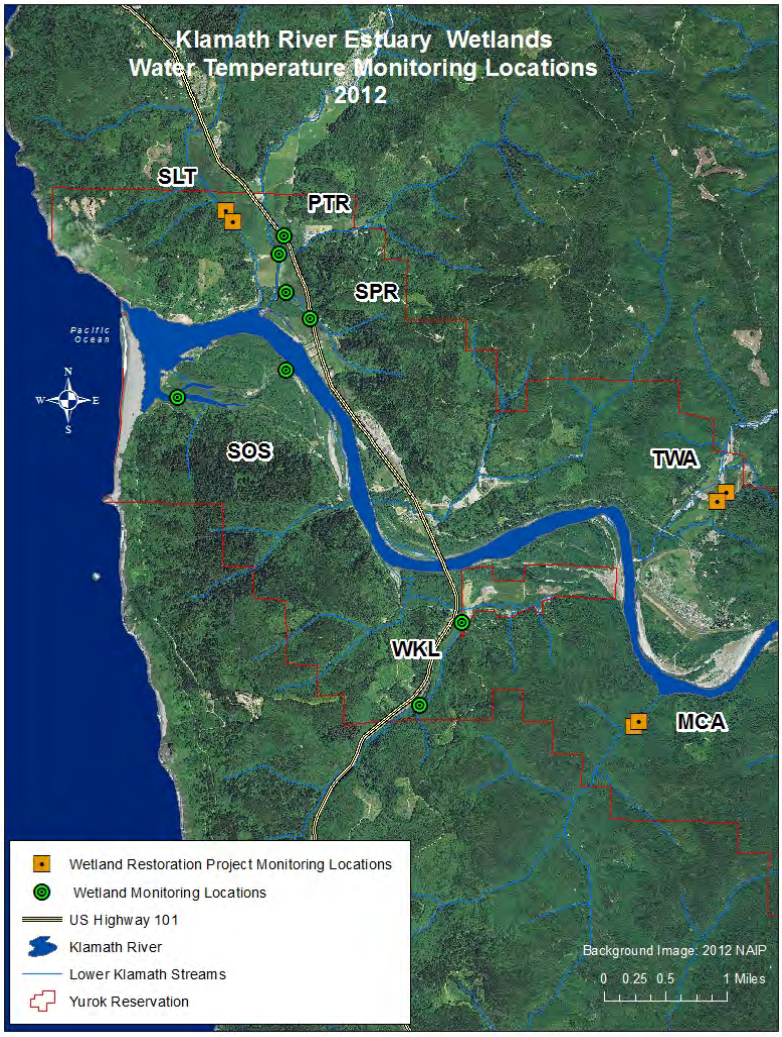


Figure 9: Left: Water monitoring locations established in 2012. All locations displayed are covered in this report excluding the Turwar Creek Alcove (TWA). Right: HOBO U22 continuous water temperature logger

parameters and their relationship to juvenile salmonid habitat function. For staffing and funding reasons a comprehensive approach to water quality monitoring was not implemented in this study. For more in depth look at KRE WC water quality refer to the report "Klamath River Estuary Wetlands 2010 Water Quality Monitoring Report – *Investigating Relationships with CRAM, Water Quality and Juvenile Salmonid Habitat Function* (Patterson and Beesley 2011).

Temperature data here within the following report has been evaluated based upon the optimal temperatures (thresholds) for juvenile salmonids. Water temperature plays a critical role in dissolved oxygen (DO) saturation levels as well the solubility of other constituents (pH, conductivity, etc.) It can also affect the survival of fish, aquatic organisms, and vegetation. The criteria for temperature used in scoring this parameter was based on an appendix document of the Klamath River TMDL- Appendix 4 Effects of Temperature, DO/Total Dissolved Gas, Ammonia, and pH on Salmonids (Carter, 2008). The document specifically outlines 16 degrees Celsius as the upper threshold for optimal conditions for juvenile salmonid rearing. Based on the lethality of high water temperatures the annual trend that is calculated based on continuous data is derived from daily maximum temperatures (Patterson, 2010).

The lower limit is not specifically defined, however the decreased feeding and metabolism associated with extremely cold water. From the literature reviewed, 10 degrees Celsius is the value that has been identified as the lower limit of the preferred range in juvenile rearing (Carter, 2008). Because absolute values for the lower end of the optimum temperature range differ depending on literature some subjectivity will undoubtedly remain, however YTEP has adopted this value for the purposes of this report and will keep this value in "adaptable" status into the future (Patterson, 2010).

RESULTS

Herpetofauna

Overall there were 21 pitfall surveys conducted for Herpetofauna. 10 in the south Slough Wetland Complex and 11 in the Richardson Creek Wetland Complex. As mentioned in the methods section, Pitfall traps were used partnered with Visual Encounter Surveys (VES). The NWI wetland classes covered in the South Slough include Estuarine and Marine Wetlands and Freshwater Forested Shrub Wetlands. The NWI wetland classes covered in the Richardson Creek include Freshwater Forested Shrub Wetlands, Freshwater Pond Wetland, and Freshwater Emergent Wetlands.

South Slough WC

Through the whole survey period between May 11th and August 12th, there were no herpetofauna found in the pitfall traps. There was one Pacific Tree Frog (Pseudacris regilla) found in a VES. The Pacific Tree Frog was identified as a culturally Significant Species in by the Yurok Tribe Culture committee.

The South Slough Wetland Complex is one of the more dynamic sites when looking at water level and quality. Typically the complex is tidally influenced and has a range coinciding with mixed semi-diurnal tides of the Pacific Ocean. Depending on the Sandbar configuration tidal range in the estuary can be between 5 and 10 feet. During times of low water level in the Klamath River, typically summer months, the mouth of the Klamath River may become closed off, blocking the output of flow into the Pacific Ocean. This causes the estuary to back up and experience increased water levels and reduced tidal fluctuation. This occurrence in August of 2015 caused flooding at two of the pitfall trap sites. Neither

sites were in use at the time and were removed to protect equipment and prevent sites from being washed out.

Richardson Creek WC

Through the whole survey period between May 4th and July 14th, there were two instances of species found in the pitfall traps (Fig.10). The first Instance occurred on June 2nd and the second instance occurred on July 10th. In both occurrences the same species of salamander was found: Northwestern Salamander (Ambystoma gracile). In both cases the traps were open due to a rain event. During the visual encounter surveys, a number of species were identified in the Richardson Creek Wetland Complex. During the surveys conducted between April and July of 2015, the American Bullfrog could be heard calling throughout the whole freshwater pond wetland classification area. The sound was strong and very loud, even causing some interference with avian point count surveys conducted during the same time period. More specifically on the dates of 5/19, 5/20 , and 7/1 of 2015 during each of which a rain event was occurring, YTEP recorded seeing one adult Pacific Tree Frog (Pseudacris regilla), one Western Toad (Anaxyrus boreas), and an adult Rough Skinned Newt (Taricha granulosa) (Fig.11). All three species recorded in the VES in Richardson Creek were identified as culturally significant by the Yurok Tribe Culture Committee.

Figure 10. Species found in Pitfall Traps in Richardson Creek WC Left: Northwestern Salamander found on 6/2/15. Right: Northwester Salamander found on 7/10/15.

Figure 11. All three instances of species found during visual encounter surveys in Richardson Creek WC. Left: Top image shows a Western Toad found on 5/19/15. Bottom image shows a Pacific Tree Frog found on 5/20/15. Right: Rough Skinned Newt found in a visual encounter survey on 5/20/15

Mammals

Overall there were 30 mammal track plots conducted between July 2014 and August 20215. 15 surveys were conducted in the South Slough and Richardson Creek Wetland Complexes respectively. The majority of the surveys were conducted during the 2015 sampling period. The HGM wetland classes covered in the South Slough include Estuarine and Marine Wetlands and Freshwater Forested Shrub Wetlands. The HGM wetland classes covered in the Richardson Creek include Freshwater Forested Shrub Wetlands, Freshwater Pond Wetland, and Freshwater Emergent Wetlands.

Though all of the KRE Wetland Complexes are in a rural area, the South Slough has the least accessible location to humans than all the other surrounding wetlands. Its location in the Klamath River Estuary isolates the habitat from human activity with its island like and braided channel characteristics. Because of this isolation, YTEP noted higher instances of animal activity not only in the mammal track plots, but also in the areas surrounding each plot. This proposed challenges for YTEP at the sites that housed both a pitfall trap for the herpetofauna surveys and mud plot sites. There were two occurrences where pitfall traps were completely removed from the ground, including the five gallon bucket with all of its contents and guidance boards (Fig.12). In addition to the sites being de constructed there was more evidence that linked black bears to being the main suspect in the vandalism. Bite and claw marks were found in the buckets and sponges.

Figure 6. Image of pitfall traps being vandalized and removed from the ground. Claw and bite marks in bucket and sponge indicate Black Bear activity.

South Slough WC

Through the whole survey period beginning on 5/12 through 8/6 0f 2015 YTEP recorded tracks from seven species: Black Bear (Ursus americanus), Coyote (Canis latrans), Black Tail Deer (Odocoileus hemionus columbianus), Raccoon (Procyon lotor), Water Shrew (Sorex palustris), Brush Rabbit (Sylvilagus bachmani), and North American Beaver (Castor Canadensis). A few examples of prints found can be seen in figure 13. Out of these species recorded, only the raccoon and beaver were identified by the Yurok Tribe Culture Committee (YTCC) as culturally sensitive species. Though it is important to note that the other species identified in YTEP's mud track plot surveys were not included in the species list provided to the YTCC. That being said, it is common knowledge that black tail deer and black bears are harvested for subsistence by Yurok Tribal members and can be considered culturally significant species.

Figure 13. Left: Both images show black bear prints found on in the South Slough on 5/14/2015. Top left image shows front and hind paw of an adult bear. Bottom image shows two front paws of a juvenile bear. These prints could indicate a mother bear with her cub. Right: image of a deer track found in the South Slough on 6/10/15.

Richardson WC

Throughout the survey period from 8/18/14 through 6/30/2015 YTEP recorded tracks from six species: black bear (Ursus americanus), coyote (Canis latrans), black tail deer (Odocoileus hemionus columbianus), raccoon (Procyon lotor), brush rabbit (Sylvilagus bachmani), bobcat (Lynx rufus), and Mountain Lion (Puma concolor). A few examples of prints and animals found can be seen in figure 14. Out of these six, only the bobcat and mountain lion prints weren't also recorded out in the South Slough Wetland Complex. Out of these species recorded, only the raccoon, was identified by the Yurok Tribe Culture Committee (YTCC) as culturally sensitive species. Though it is important to note that the other species identified in YTEP's mud track plot surveys were not included in the species list provided to the YTCC. That being said, it is common knowledge that black tail deer and black bears are harvested for subsistence by Yurok Tribal members and can be considered culturally significant species.

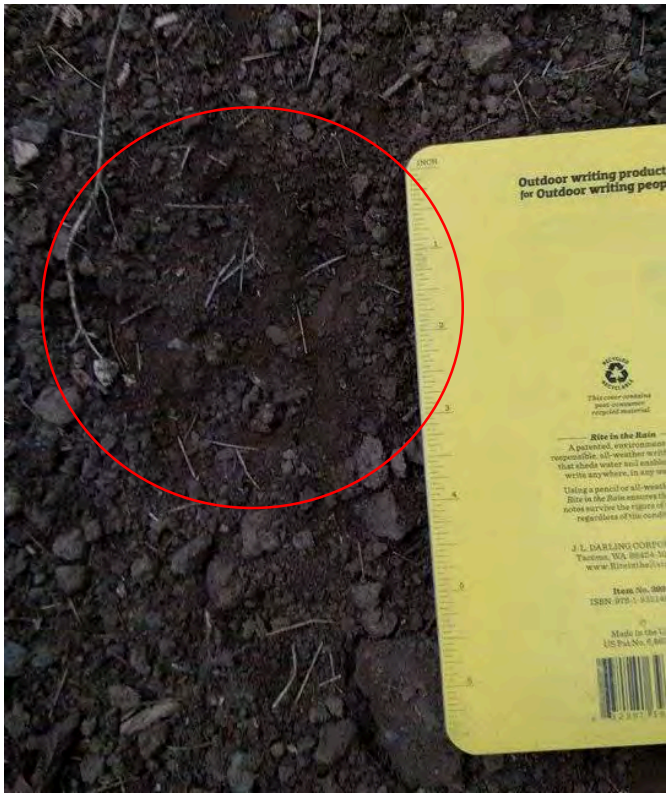


Figure 7. Left: image of a Mountain Lion track in Richardson Creek WC. Though the image is very faint, in person it was a very clear print. A field book was placed next to it for size reference, the print was 3.5" in length. Right top: Mountain Lion scat found about ¼ mile north of track location. Bottom right: brush rabbit spotted in next to mammal mud track plot

Avian

Overall there were 11 avian point count surveys conducted between 4/8/2015 and 9/25/2015. The KRE Wetlands covered were the South Slough, Richardson, and Waukell Wetland Complexes. These surveys were split into two periods following the Napa River Watershed Monitoring Bird Consensus Schedule. This monitoring schedule is based on a "Prime Birding Window" which refers to the portion of the season which was has held the highest populations of representative species in previous studies. If possible, it is best to time your consensus for the periods (Napa 2003). YTEP conducted avian surveys during the spring and fall suggested windows (Fig.15). For spring it is suggested that surveys be conducted between April 15th and May 30th. For fall the suggested survey window is August 15th through September 30th. The HGM wetland classes covered in the avian point count surveys include Estuarine and Marine Wetlands and Freshwater Forested Shrub Wetlands, Freshwater Pond Wetland, and Freshwater Emergent Wetland.

Out of all three wetlands surveyed there were 62 bird species identified. Out of the 62 species 14 were identified as culturally significant by the Yurok Tribe Culture Committee (YTCC). (Tables 1,2,3)

South Slough WC

Throughout the survey period beginning on 4/8/2015 through 9/24/2015 YTEP recorded a total of 55 species in the South Slough Wetland Complex. Twelve species out of the 55 were identified by the YTCC as culturally significant (Table 1).

Richardson Creek WC

Throughout the survey period beginning on 4/22/2015 through 9/25/2015 YTEP recorded a total of 29 species in the Richardson Creek Wetland Complex. Four out of the 29 species were identified as culturally significant by the YTCC (Table 2).

Waukell WC

Throughout the survey period beginning on 4/8/2015 through 9/25/2015 YTEP recorded a total of 18 species, none of which were identified by the YTCC as culturally significant (Table 3).

Figure 8. Student volunteer Matee Wolf conducting avian point count surveys in the South Slough (left) and Waukell (right) wetland complexes.

South Slough WC	
Species Detected	**Culturally Sensitive Species**
American Robin	Bald Eagle
Anna's Hummingbird	Belted King Fisher
Barn Swallow	Bufflehead
Black Capped Chickadee	Common Merganser
Black Phoebe	Common Loon
Black headed Grosbeak	Great Blue Heron
Brown Headed Cow Bird	Green Heron
Brown Pelican	Mallard
Canada Goose	Osprey
Caspian Tern	Red Shouldered Hawk
Common Yellow Throat	Red Tailed Hawk
Crow	Western Grebe
Double Crested Cormorant	
Downy Woodpecker	
Fox sparrow	
Greater Yellow Leg	
Horned Grebe	
House Finch	
Mallard	
Marsh Wren	
Morning Dove	
Northern Rough Wing Swallow	
Orange Crowned Warbler	
Osprey	
Pacific Slope Fly Catcher	
Pacific Wren	
Raven	
Red Shouldered Hawk	
Red Tailed Hawk	
Ruby Crowned Kinglet	
Allen's Hummingbird	
Sand Piper	
Song Sparrow	
Spotted Towhee	
Steller's Jay	
Surf Scoter	
Tree Swallow	
Turkey Vulture	
Warbling Vireo	
Western Grebe	
Western Gull	
Wilson's Warbler	
Wren Tit	

Table 1: Species identified in avian point count surveys in the South Slough WC. The South Slough has a larger variety of avian species due to its location in the Klamath River Estuary. The range of HGM wetland classes vary from estuarine and marine wetlands to freshwater forested shrub wetlands which leads to a dynamic wetland ecosystem that supports a wider array of species.

Richardson WC	
Species Detected	**Culturally Sensitive Species**
American Robin	Coot
Anna's Humming Bird	Great Blue Heron
Bank Swallow	Mallard
Black Capped Chickadee	Wood Duck
Chestnut backed Chickadee	
common yellow throat	
Dark-eyed Junco	
Double Crested Cormorant	
Hairy Woodpecker	
Marsh Wren	
Northern Flicker	
Northern Roughwinged Swallow	
Orange Crowned Warbler	
Pacific Wren	
Raven	
Redwinged Blackbird	
Ruby Crowned Kinglet	
Song Sparrow	
Steller's Jay	
Tree Swallow	
Varied Thrush	
Violet Green Swallow	
Wilsons Warbler	
Wren Tit	
Yellow Billed Cuckoo	

Table 2: Species identified in avian point count surveys in the Richardson Creek WC. Richardson Creek WC is unique with its Freshwater Pond HGM classification. The pond provides habitat year round for different types of water fowl that may not be found in a wetland that is dry during certain times of year.

Waukell WC	
Species Detected	**Culturally Sensitive Species**
American Robin	
Anna's Humming Bird	
Black Capped Chickadee	
Brown Creeper	
Common Yellow Throat	
Crow	
Downy Woodpecker	
Fox Sparrow	
House Finch	
Marsh Wren	
Orange Crowned Warbler	
Pacific Slope Fly Catcher	
Pacific Wren	
Red Shouldered Hawk	
Song Sparrow	
Steller's Jay	
Wilsons Warbler	
Wren Tit	

Table 3: Species identified in the Waukell WC. There were no culturally significant species identified in Waukell. This is most likely a result of the Waukell WC being mostly dry during the spring and fall survey periods, leading to a species list comprised mostly of song birds and an occasional corvid or hawk. The YTCC did not list any songbirds as culturally significant.

Vegetation

Overall there were two vegetation surveys conducted. The first one was conducted in the Richardson Creek Wetland Complex in July of 2014. The second survey was conducted in April of 2015 in the South Slough Wetland Complex. After doing a visual inspection of the Waukell Wetland Complex, it was determined to be too overgrown with invasive species of berries and grasses to be able to conduct a representative survey. Furthermore, the HGM wetland classes represented in the Waukell Wetland Complex are also present in the Richardson Creek Wetland Complex, in which case YTEP could assume that similar plant species would be found in both. Over all there were 90 plant species identified in the South Slough and Richardson Creek Wetland complex. 23 of those species were identified as culturally significant by the Yurok Tribe Culture Committee (YTCC).

Richardson Creek WC

During the vegetation survey conducted in the Richardson Creek Wetland Complex on July 17th, 2014, YTEP recorded a total of 49 species. Sixteen of those species were identified as culturally significant by the YTCC (Table 4).

South Slough WC

During the vegetation survey conducted in the South Slough Wetland Complex on April 1st, 2015, YTEP recorded a total of 44 species. Nine of those species were identified as culturally significant by the YTCC (Table 5) (Fig.16).

Figure 9. YTEP staff conducting vegetation survey in South Slough Wetland Complex

Richardson Creek	
Species Detected	Culturally Sensitive Species
American Speedwell	Alder
Blue Elderberry	California Bay
California Blackberry	Coltsfoot
Cascara	Common Bedstraw
Chickweed	Common Horsetail
Coast Redwood	Creeping Buttercup
Common Selfheal	Lady Fern
Curly Dock	Reed Canary grass
Currant	Rough Horsetail
Douglas Fir	Salmonberry
Duckweed	Sitka Spruce
English Ivy	Skunk Cabbage
Evergreen Huckleberry	Small-flowered Bulrush
Foxglove	Stinging Nettle
Himalayan Blackberry	Toad Rush
Indian Plum	Yellow Pond Lily
Manroot	
Miner's Lettuce	
Pacific Bleeding Heart	
Pacific Rhododendron	
Piggy-back Plant	
Poison Hemlock	
Red Huckleberry	
Redwood Sorrel	
Salal	
Sweet Vernal Grass	
Thimbleberry	
Twinberry	
Water Parsley	
Water Shield	
Water-milfoil	
Western Sword Fern	
Wild Ginger	

Table 4: Vegetation species identified in the Richardson Creek WC.

South Slough Vegetation	
Species Detected	**Culturally Significant Species**
Alfalfa	California Blackberry
Baltic rush	Coast Willow
Beach Tansy	Common Horsetail
Black Mustard	Giant Horsetail
Boadleaf Lupin	Red Alder
Bunchgrass	Rough Horsetail
Cat's Paw Dandelion	Scouler's Willow
Creeping Bentgrass	Slough Sedge
Creeping Buttercup	Tussok, soft rush
Creeping spike-rush	
Cress Mustard	
Curly Dock	
Cutleaf Blackberry	
Dandelion	
European Beach Grass	
False Dandelion	
Hairy Willowherb	
Himalaya Blackberry	
Lanceleaf Plantain	
Morning Glory	
Ocean Spray	
Ox-eye daisy	
Plantain Maritimus	
Potentilla	
Raspberry	
Ryegrass	
Small-flowered bulrush	
Spinyfruit dandelion	
Thistle	
timothy, meadow	
White Clover	
Wild Carrot	
Wild Mustard	
Wormwood	
Yarrow	

Table 5: Vegetation species identified in the South Slough WC. Due to location of the South Slough WC, there were a number of salt tolerant and freshwater species identified. There were two HGM wetland classifications surveyed along the baseline transect of this survey to ensure that all ranges of species were included.

Temperature

From May to October in 2014 and 2015, water temperatures were clearly stratified throughout the complexes (Figure 17). Rather, the temperature data can be best used to evaluate optimal conditions for juvenile salmonids. By evaluating temperature and food sources, the functionality of WCs as rearing habitat becomes better understood. Water temperature data for each site has been analyzed using the following statistics, the daily average 7 day average temperature (Figure 17), the daily maximum seven day running average temperature, and the daily minimum 7 day running average temperature (Figures 18-23).

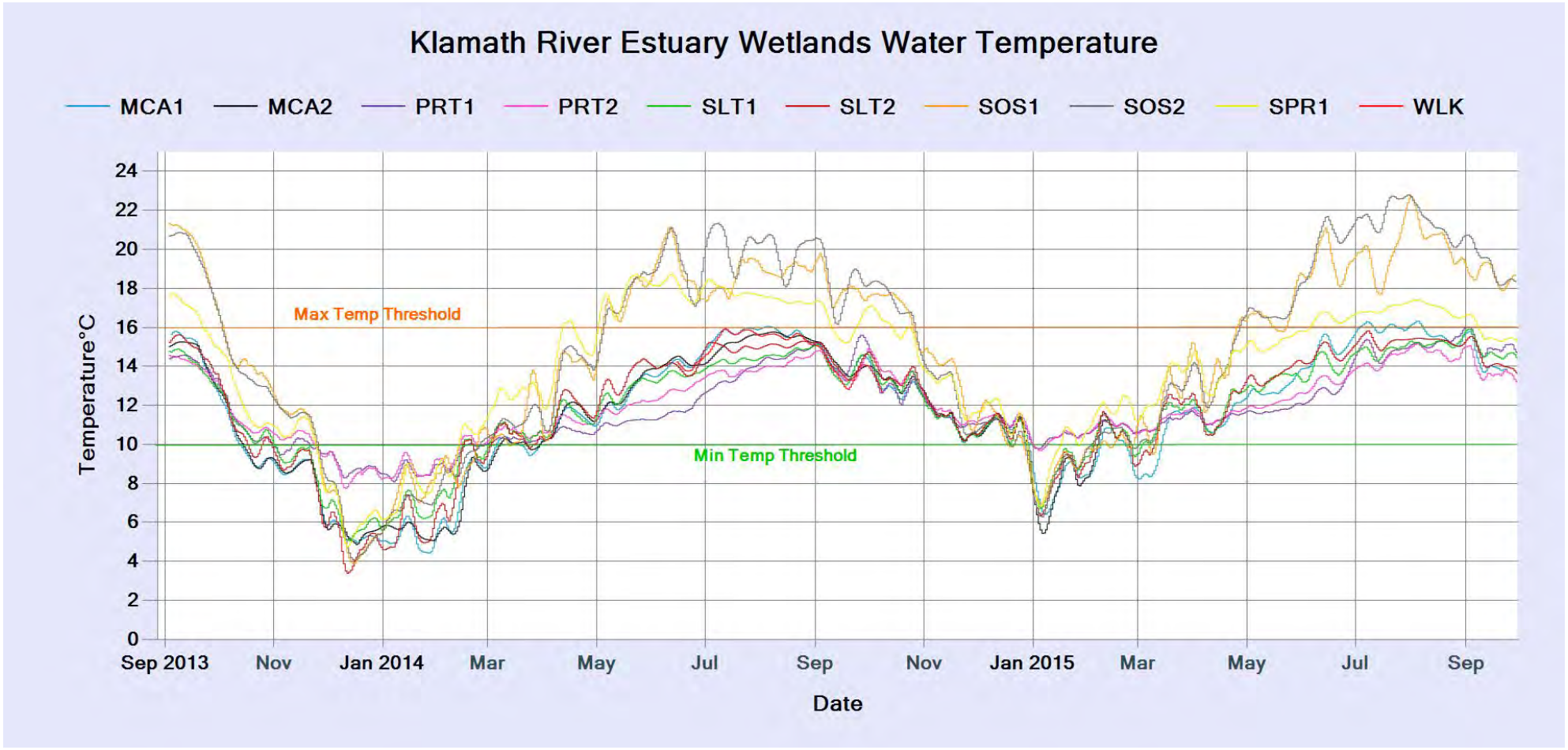
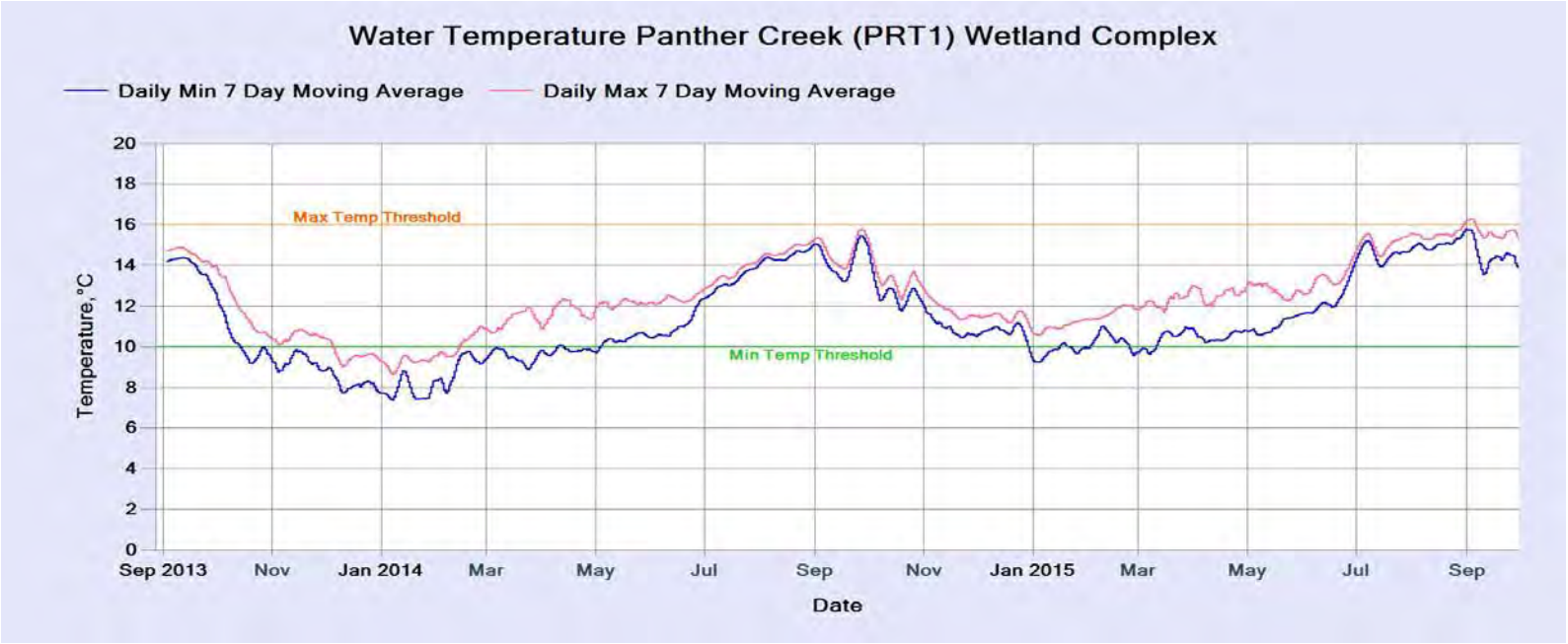


Figure 17: Water Temperature, all sites. During winter months all sites were similar in temperature, below optimal conditions for juvenile salmonids; yet Panther Creek WC (PRT1 & PRT2) was visibly warmer. During summer months significant stratification exists, showing Panther (PRT1 & PRT2) and Waukell (WKL) to be the coolest, while the South Slough (SOS1 & SOS2) and Spruce (SPR1) complexes exceeded optimal conditions



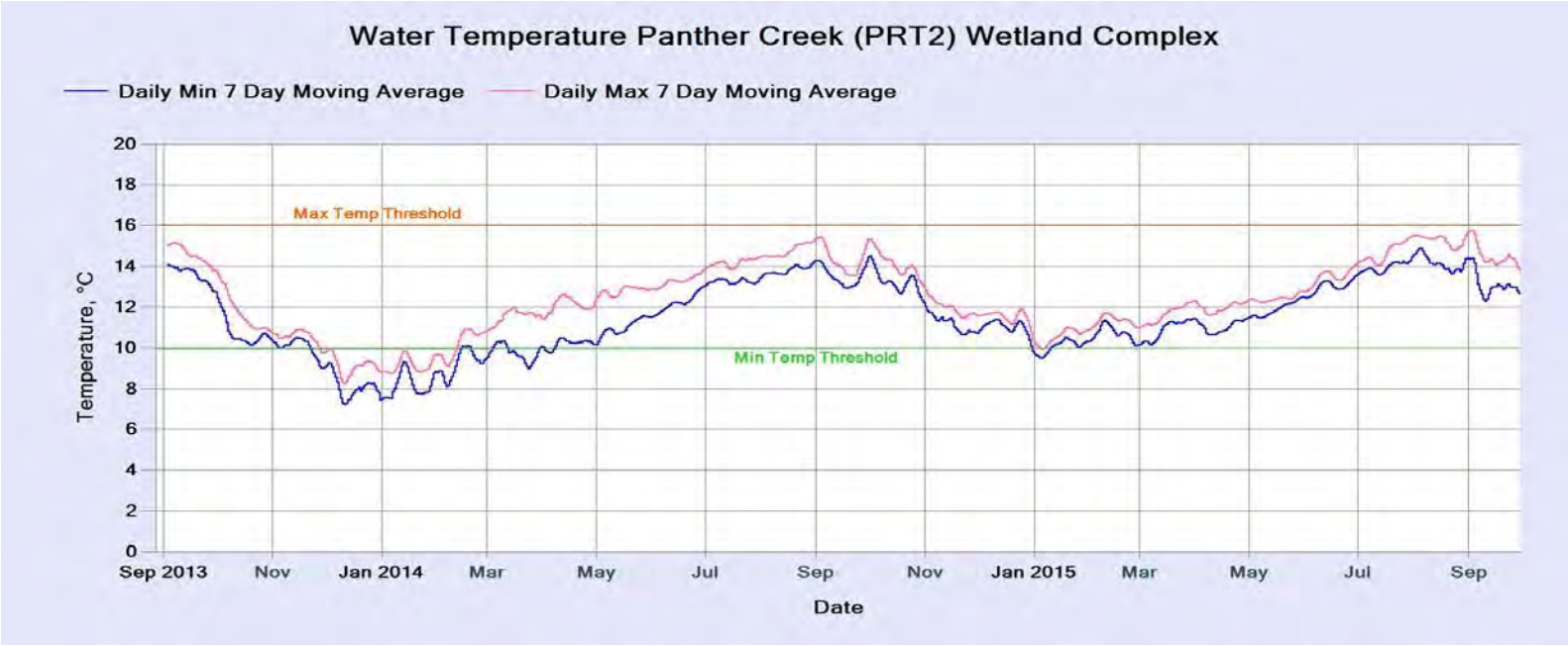


Figure 18: Water Temperature, Panther Creek Wetland Complex. Appearing to be the most optimal of all complexes, Panther Creek WC showed cool temperatures in summer warmer temperatures in the winter when compared to other complexes. Temperatures are relatively stable throughout the seasons, and on a daily basis.

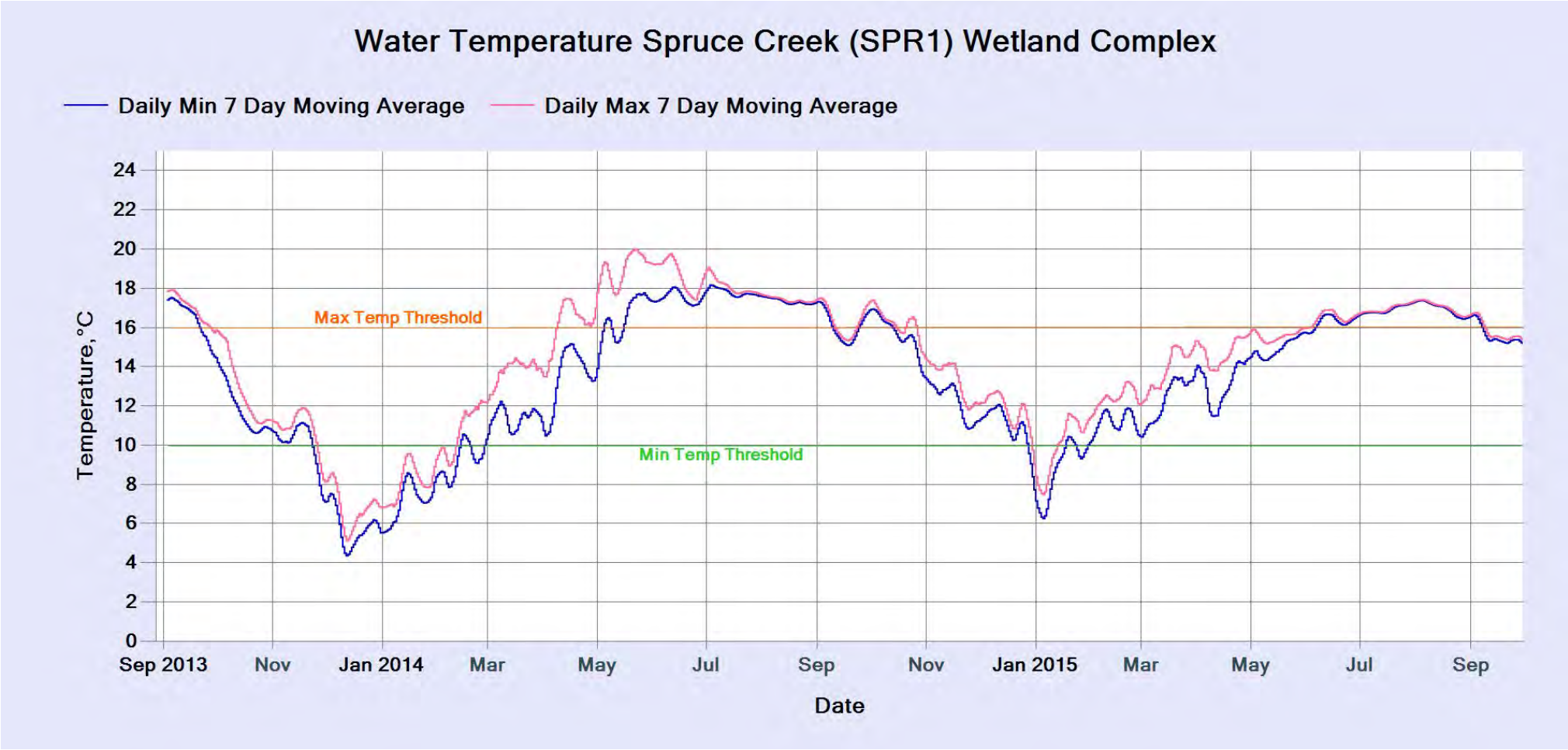


Figure 19: Water Temperature, Spruce Creek WC. Optimal temperatures here were present in the spring months, April to May and in fall months September -December. Due to the extremely low rainfall and cold air temperatures, water temperature daily minimums plummeted in January 2014 and 2015.

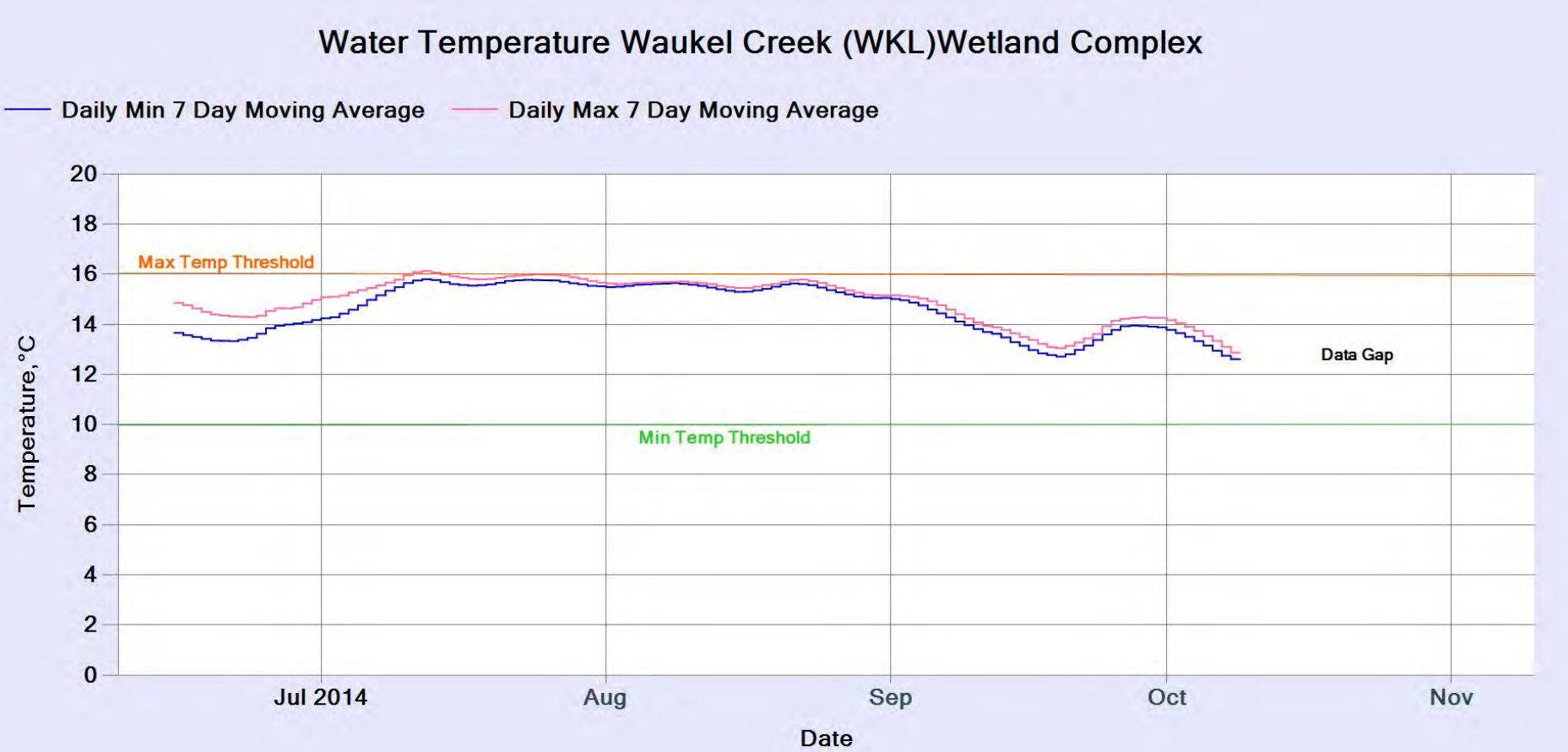
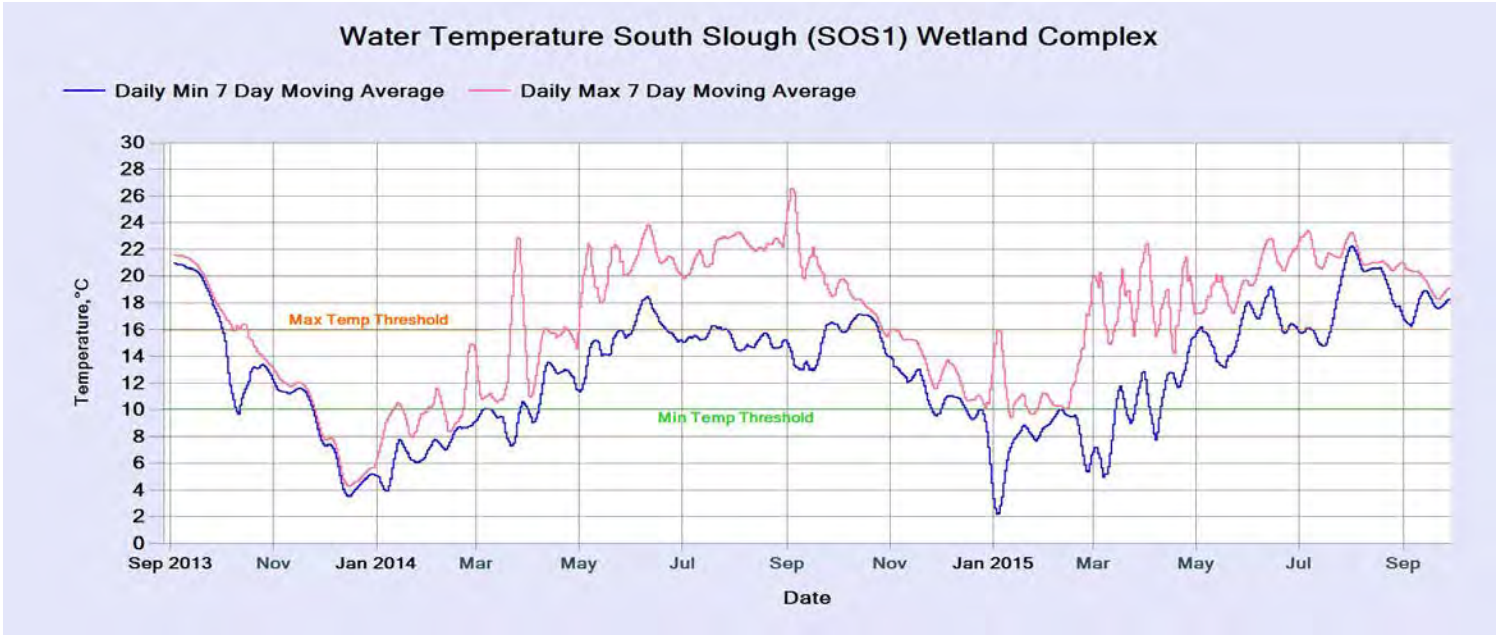


Figure 20: Water Temperature, Waukell Creek WC from June 2014 through October 2014. The Yurok Tribe Fisheries Department (YTFD) manages this temperature probe and due to issues with site location were only able to retrieve data from June-October 2014. Waukell displays optimal temperatures during the summer and fall months, remaining below the temperature threshold. There is a data gap at the end of the sampling period due to probe being out of water when retrieved.



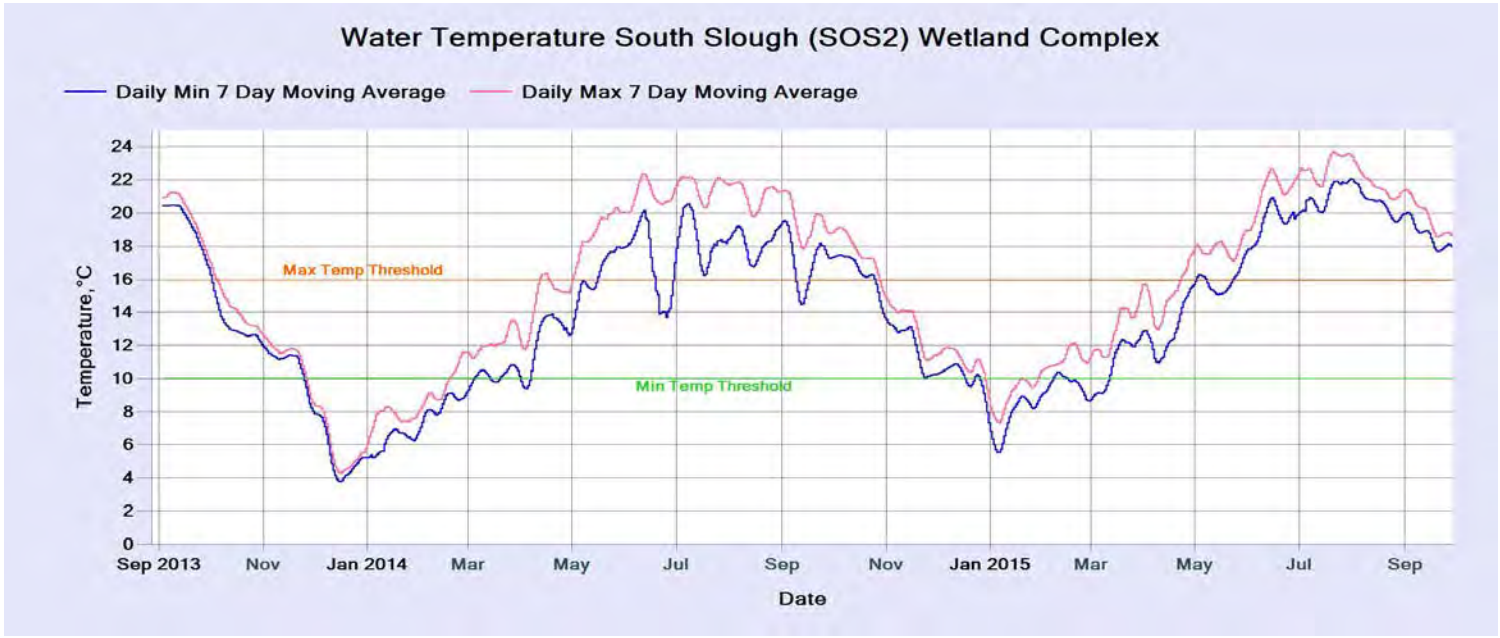
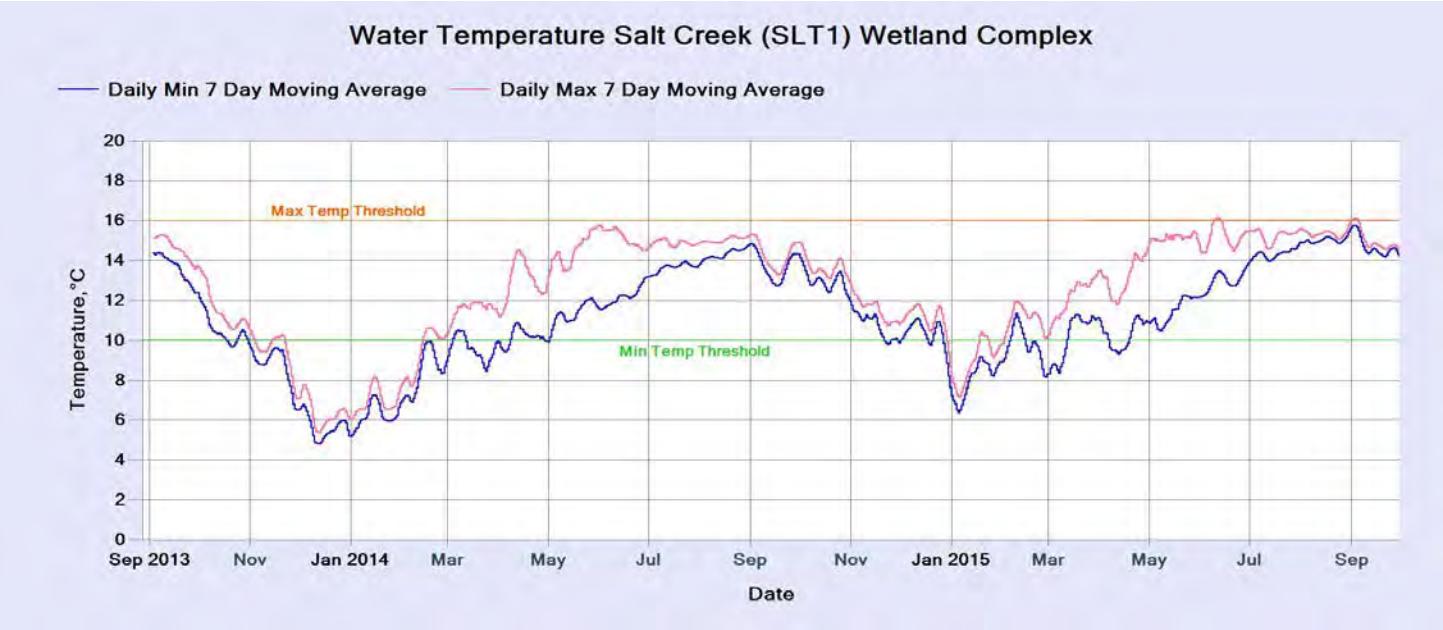


Figure 21: Water Temperature, South Slough WC. Of all sites the extremes were located here. In summer it is the warmest, significantly exceeding maximum threshold from May through October. Minimum temperatures in winter fell well below optimal beginning in December, and extending through April. Optimal conditions here existed for the shortest time of all complexes with year round standing water.



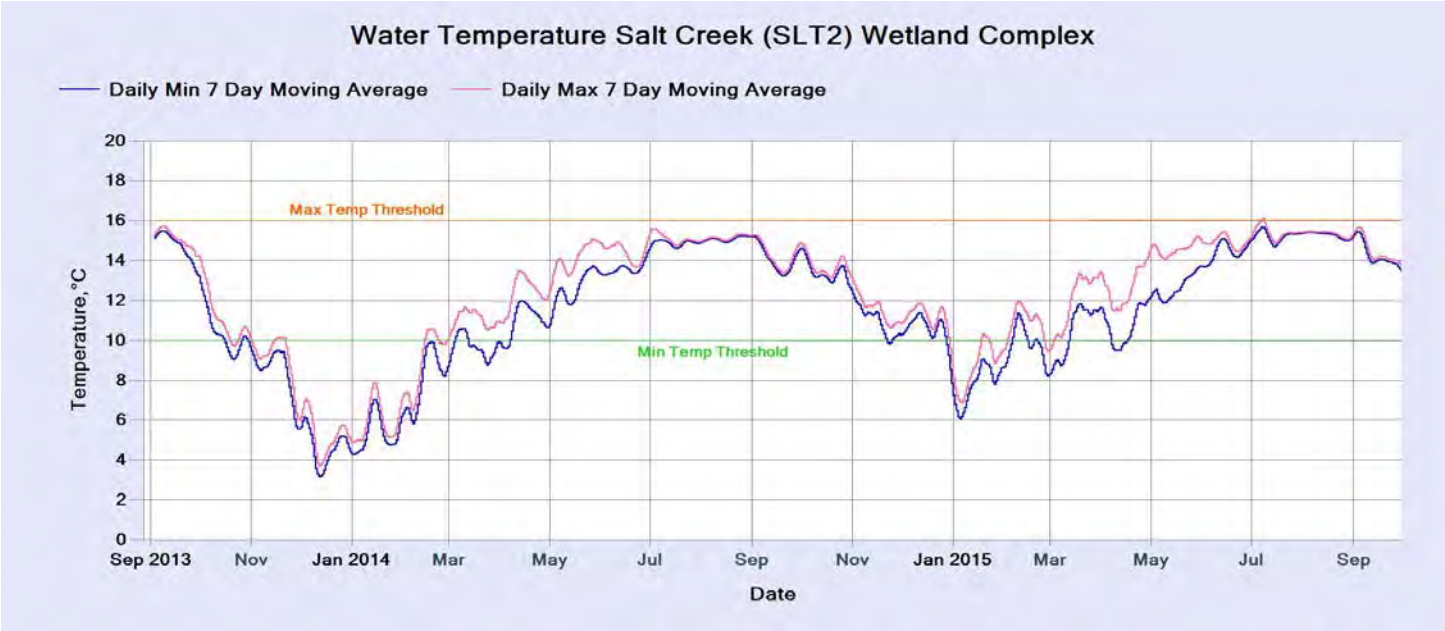
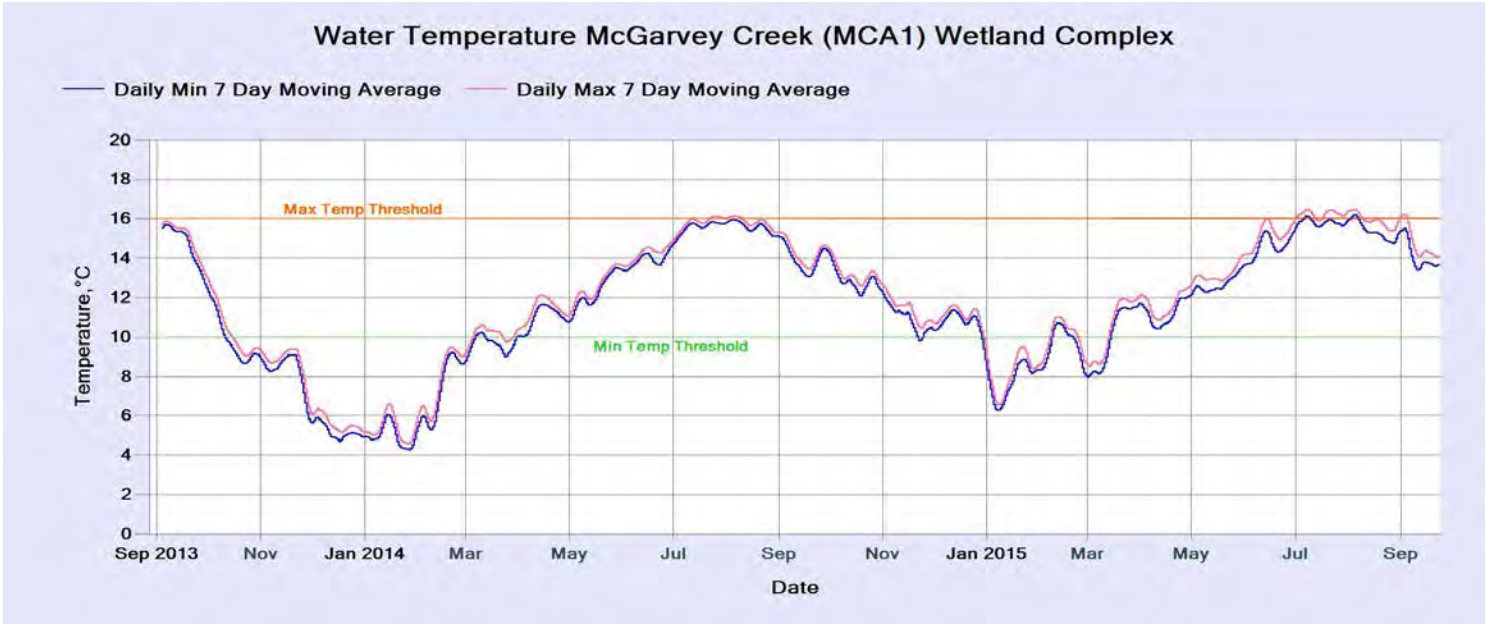


Figure 22: Water Temperature, Salt Creek WC. Water temperatures here were optimal for most of the year, excluding the winter when temperatures dropped below optimal. However, a significant daily variation between minima and maxima is observed in the spring and summer



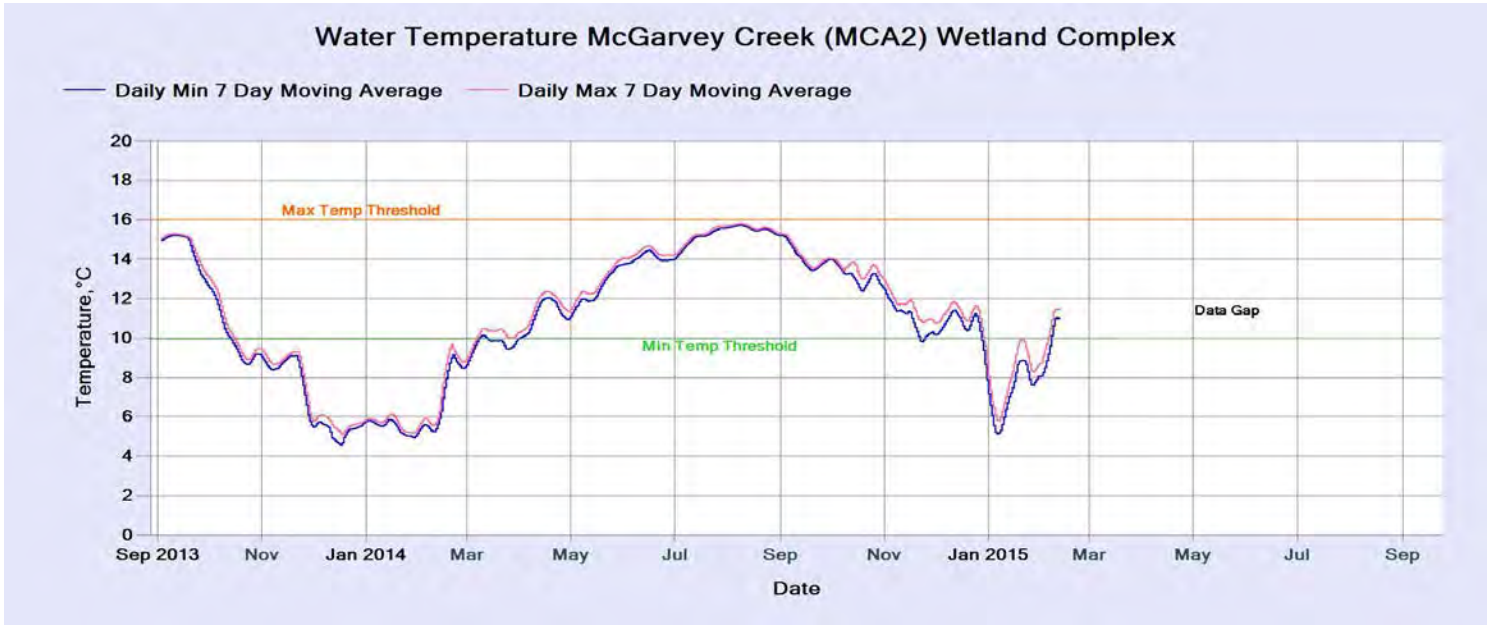


Figure 23: Water Temperature, McGarvey Creek Alcove. Water temperatures were optimal for most of the year, dropping below minimum threshold temperature for winter months. The daily minima and maxima are very close throughout the year in this complex. At McGarvey site MCA2 there is a data gap at the end of the sampling period because the probe was out of water due to low water levels.

CONCLUSION

The Klamath River Estuarine Wetland Complexes (KREWC) are a dynamic set of ecosystems that are continuously changing and are vulnerable to climate change and sea level rise.

For the vegetation and wildlife surveys, this a first step in creating a baseline set of data that displays what species are found in the KREWC. The results from these bioassessments will help the Yurok Tribe to better understand the condition of the KREWC and help to predict what species might be affected by salt water intrusion due to rising sea levels.

YTEP identified 165 species through the four types of surveys conducted. The majority of those species were from the vegetation and avian surveys (tables 1-5). Out of those species 44 were identified by the Yurok Tribe Culture Committee (YTCC) as culturally significant.

One challenge that YTEP faced while conducting these surveys is acquiring the cultural knowledge to identify species that are culturally significant to the Yurok Tribe. It is difficult to obtain a written record of what species that might have been or still are culturally significant. That is why the YTCC is such an important resource, though consulting the YTCC can be somewhat limiting. The YTCC is comprised of around 20-25 Yurok Elders who reside throughout the whole Yurok Reservation. Species that might be culturally sensitive to one region of the reservation, might not be in another region and vice versa. Out of the whole committee only four members were able to complete and return the species list that YTEP distributed. In addition to the low response from the YTCC, the species list provided did not include a majority of species that were eventually identified by YTEP. Now that YTEP has a better grasp of what can be found in the KREWC, they can present their findings to the YTCC for a second review.

As for temperature monitoring in the KREWC, this is a continuation of an established data set that YTEP has been building since 2010 and will continue in future grants. For each sampling period similar trends are displayed for each monitored wetland complex. From this survey period results YTEP can confirm a recurring trend of poor water quality conditions in the South Slough WC. More specifically, YTEP will be able to use the temperature data collected in the South Slough over the past five years to support reasoning in launching a gauging station in the South Slough WC to provide a more permanent monitoring plan and to establish long term water quality conditions. This type of long term monitoring will help support possible affects from climate change and sea level rise. Furthermore future collected data could help to support future dam removal on the Klamath and Upper Klamath Basin water quality issues.

Overall, YTEP considers the project a success and the data collected very useful. This understanding can lead to better management planning and implementation for future wetlands development and restoration projects.

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