Year End Report: Reed Canarygrass Pilot Study

In 2019, 10,000 Years Institute (10KYI) partnered with Coast Salmon Partnership (CSP) to develop and implement a pilot study investigating the relationship between reed canarygrass (*Phalaris arundinacea)* and its effect on water velocity, water temperature, dissolved oxygen, and sediment accumulation in coastal Olympic Peninsula streams. The methods developed in this pilot are proposed for use in a multi-watershed scale study to address the unique and understudied threat posed by reed canarygrass to coldwater refugia.

Site Selection

The ideal sites for the pilot study and subsequent long-term study were determined to be paired sites in local watershed with similar

- Reed canarygrass density
- Confinement
- Gradient
- Shading
- Groundwater influence
- Previous temperature monitoring

10KYI met with partners from the Quileute Tribe, Pacific Coast Salmon Coalition, Trout Unlimited, and Washington Department of Fish and Wildlife to develop a list of thirty-five potential sites (Map, Figure 1) within reasonable distance to 10KYI's base of operations (Appendix 1).

Locating paired study sites in the same watershed with similar characteristics and property access for 10KYI staff proved difficult. Many suitable sites had been previously treated for reed canarygrass.

In the Hoh and Quillayute watersheds, many proposed sites had poorly defined stream channels and ponded wetlands instead of streams. These sites were dismissed on the grounds that stream velocity could not be measured with the equipment and methods chosen for this study.

In the Quinault watershed, suitable study sites on Merriman Creek and Zeigler Creek – representing a paired study reach of untreated and treated streams, and Irely Creek in Olympic National Park - were located but access for the study has not yet been obtained. Due largely to concerns over the perceived toxicity of herbicide used for RCG control, landowners along Merriman Creek proved hesitant to allow 10KYI access.

Irely Creek is an ideal site due to a well-inventoried reed canarygrass population and almost twenty years of past stream temperature data. A research permit application for the 2020 field

season has been submitted, and will be reviewed. The last required submission is a “Minimum Requirements Worksheet”, which is almost complete.

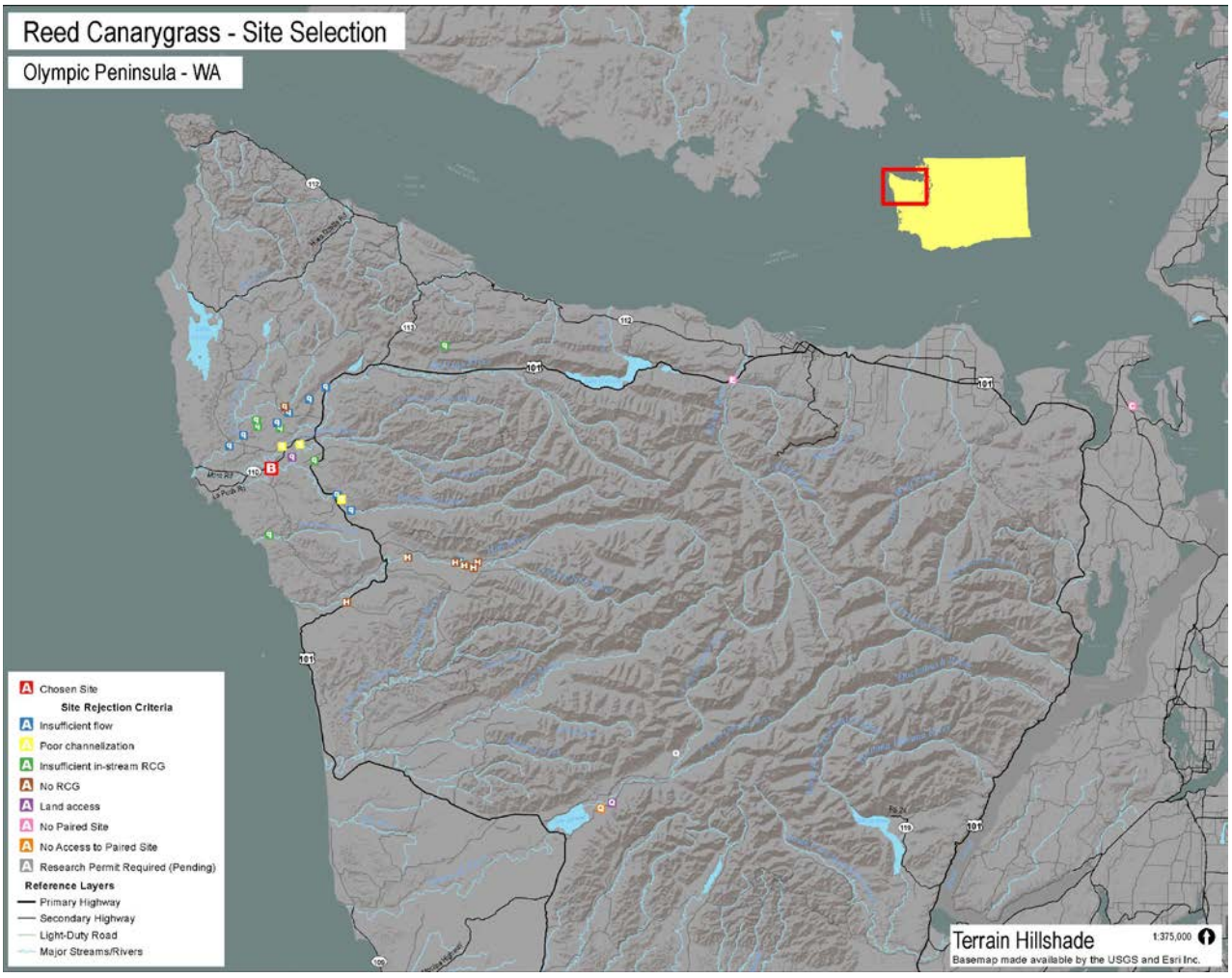

Figure 1. All potential sites considered for the 2019 Reed Canarygrass Pilot Study. Thirty-five sites were considered before Wilson Creek was chosen.

Pilot Study Site: Wilson Creek

Facing time constraints, the 2019 pilot study was designed and implemented at one site, Wilson Creek, a small tributary on the Bogachiel River (Figure 2). The stream runs through the historic Dilly Farm, and the property owners have enthusiastically embraced the study concept. Located seven miles from the city of Forks, the stream has no reed canarygrass at the top of the study reach and dense reed canarygrass downstream.

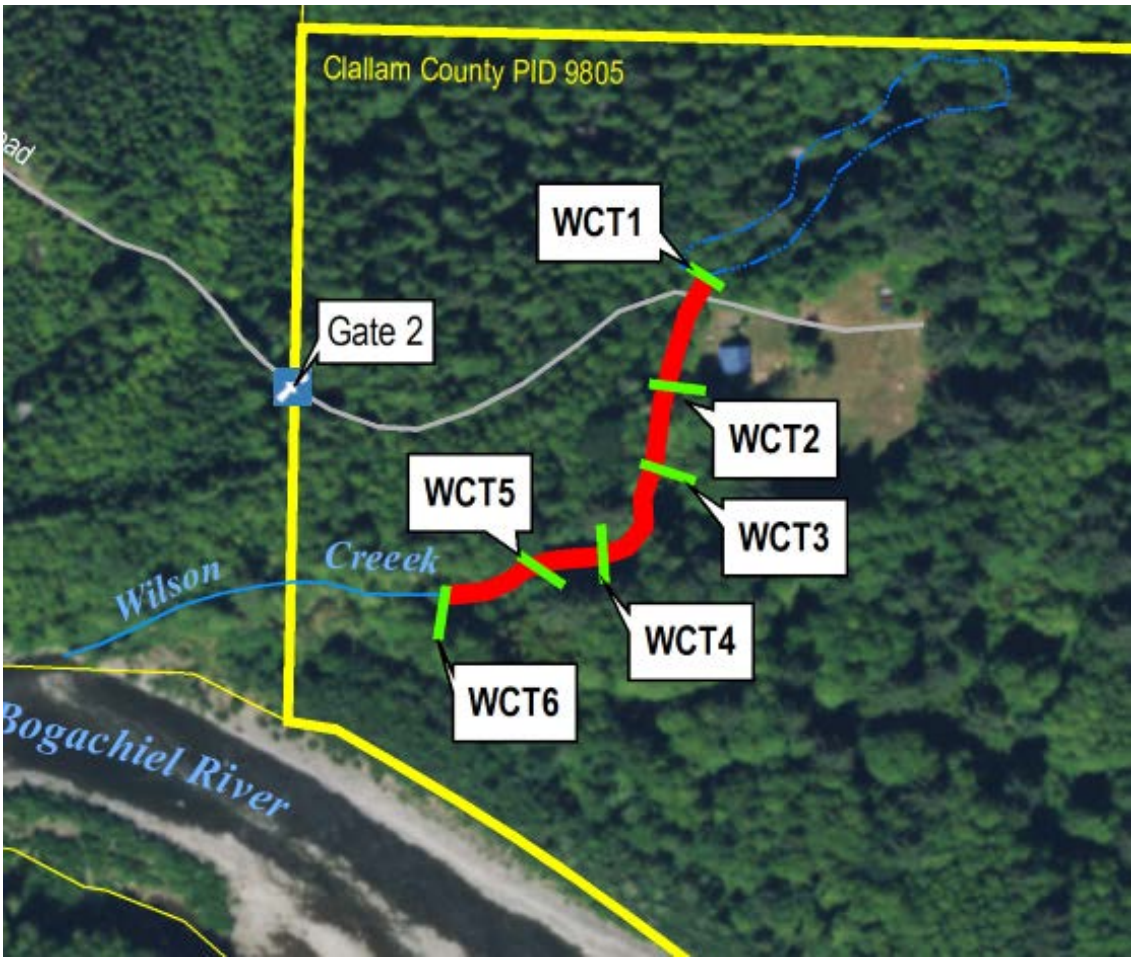

Figure 2. Wilson Creek showing its headwater pond outlined in blue, study reach (highlighted in red), and approximate location of cross-sectional transects (in green).

Wilson Creek is an old Washington Department of Fish and Wildlife SSHEAR site, originating from a spring-fed pond connected to the creek by a step-culvert installed where the creek crosses the road. The study reach, highlighted in red in Figure 2, is 400 meters long and approximately half the total length of the creek. Based on observations of past backflow events at Wilson Creek by the landowners and Pacific Coast Salmon Coalition volunteer, Wayne Haag, the end of the study reach was set at an elevation assumed to be upstream of flooding from the Bogachiel River. This decision was made to avoid an effect of flood flows on Wilson Creek temperature data.

Site Set Up

Five sections were established in the study reach, to be monitored at the cross-sectional transects (hereafter referred to as “transects”) at the bottom of each section. An upstream reference transect was established at the culvert outflow from the pond to monitor the speed

and temperature of water leaving the pond. Transects were located at natural breaks in habitat changes of the stream, such as between shading or hydrologic controls.

Transects extend thirty feet into the riparian zone on each bank, measured from the Ordinary High Water Mark, and marked with flagged rebar. One HOBO Pendant temperature logger was installed at each transect in well mixed areas of the stream. Loggers were attached to the lid of crab bait cages (Figure 3) secured to rebar installed in the stream (Figure 4).

Figure 3. Hobo Pendant logger secured to lid of a crab bait cage.

Figure 4. Hobo logger installed in the stream, protected from high flows and debris by the crab bait cage.

Field Visits

Field visits collected data for the following variables:

- Stream velocity
- Water temperature
- Dissolved oxygen
- Photosynthetically active radiation (PAR)
- Sediment
- Vegetation

Site installation took place between August 12th and August 14th. Eight site visits occurred after site installation. The first five field visits were conducted weekly to measure stream velocity, water temperature, dissolved oxygen, and PAR. This aided quickly developing standard operating protocols for the project. Beginning in September, field visits occurred bi-monthly as initially planned. Vegetation surveys along each transect and a pebble count where applicable (Transect 2) occurred between September 25th and October 2nd.

Each field visit included managing the spread of reed canarygrass seeds beyond the study site by clipping seed heads in Wilson Creek, around Wilson Pond, and generally around the Dilly Farm property. Over the course of the field season, crew spent approximately twenty--one hours looking for and clipping a total of 296 seed heads throughout the pond, study reach, and lawn area of the property. Reed canarygrass plants reportedly produce up to 600 seeds per stem, lasting four or more years.

Results

The vegetation surveys determined the reed canarygrass abundance at each transect, shown in Table 1.

Sediment was characterized at each transect at the beginning and end of the season and saw no change. The pebble count conducted at Transect 2 found 62% of sediment to be between seventeen and sixty-four milimeters (Figure 5).

Table 1. Results of each transect's vegetation survey, sediment, and average photosynthetically active radiation (PAR).

Transect	RCG Density	Sediment	Average PAR
1	None	Cobble	9.90
2	High	Gravel	32.70
3	High	Sand	88.13
4	Low	Silt	44.43
5	Medium	Silt	165.66
6	Low	Silt	40.01

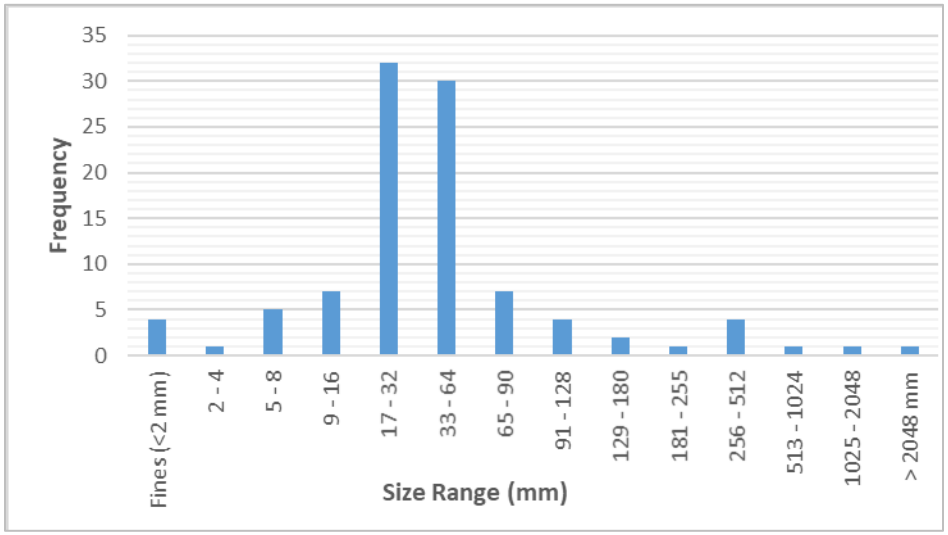

Figure 5. Frequency distribution of pebble sizes observed in a 100-count pebble survey at Transect Two.

Water velocity (Figure 6) was fastest at Transects 2 and 3, and slowed down in the downstream transects where the stream becomes characterized by pools created by large woody material at Transects 4 and 5.

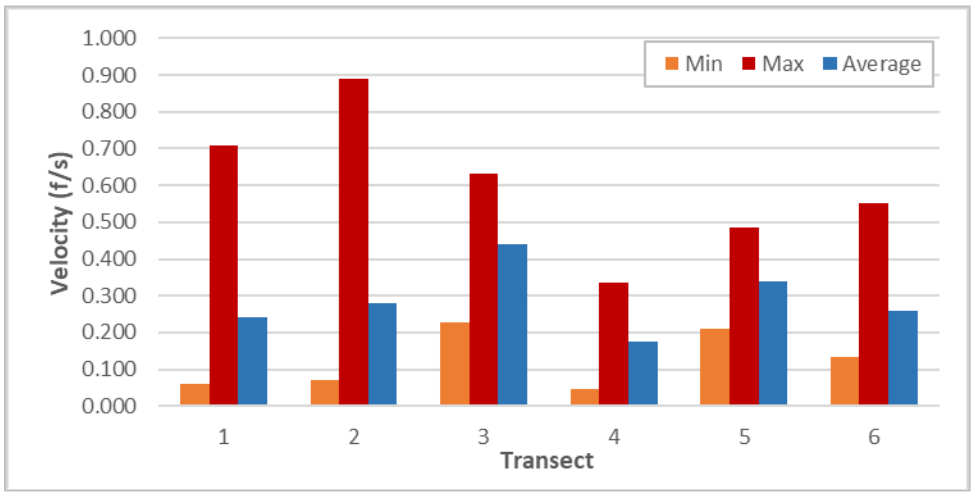

Figure 6.Minimum (orange), maximum (red), and average (blue) velocities at each transect.

Temperature data was recorded by the HOBO Pendant loggers every twenty minutes. Water logging data for the full field season, shown below in Figure 7, showed an increase in daily variation as water moved downstream. Water temperature trends were slightly different in warmer months (August 13th through September 29th) than over the full field season (see Figures 8 and 9). Temperature loggers have been left at the site to capture winter temperatures at Wilson Creek.

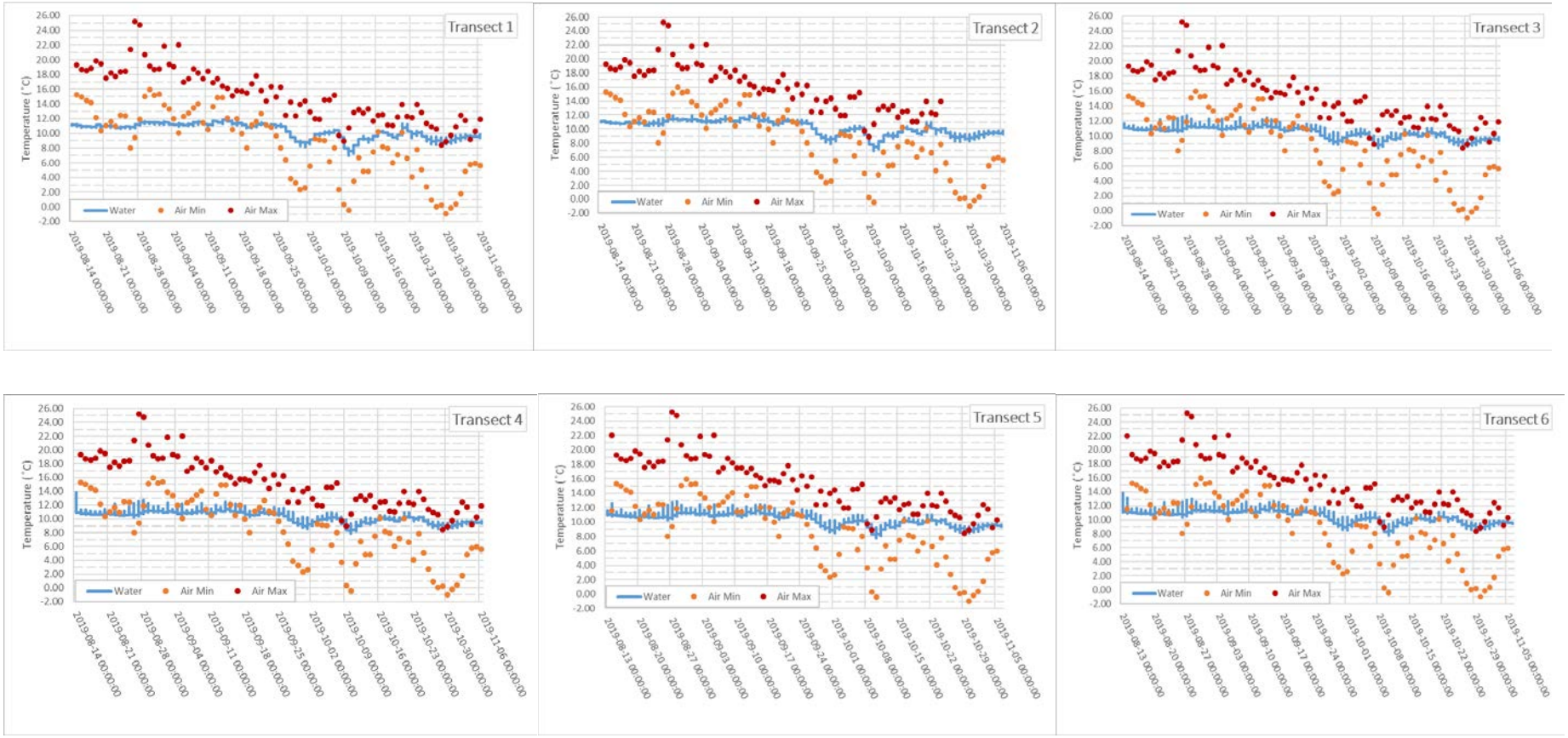

Figure 7. Water temperature at Transects 1-6 for the entirety of the pilot study. Daily minimum and maximum air temperatures are shown in orange and red, respectively.

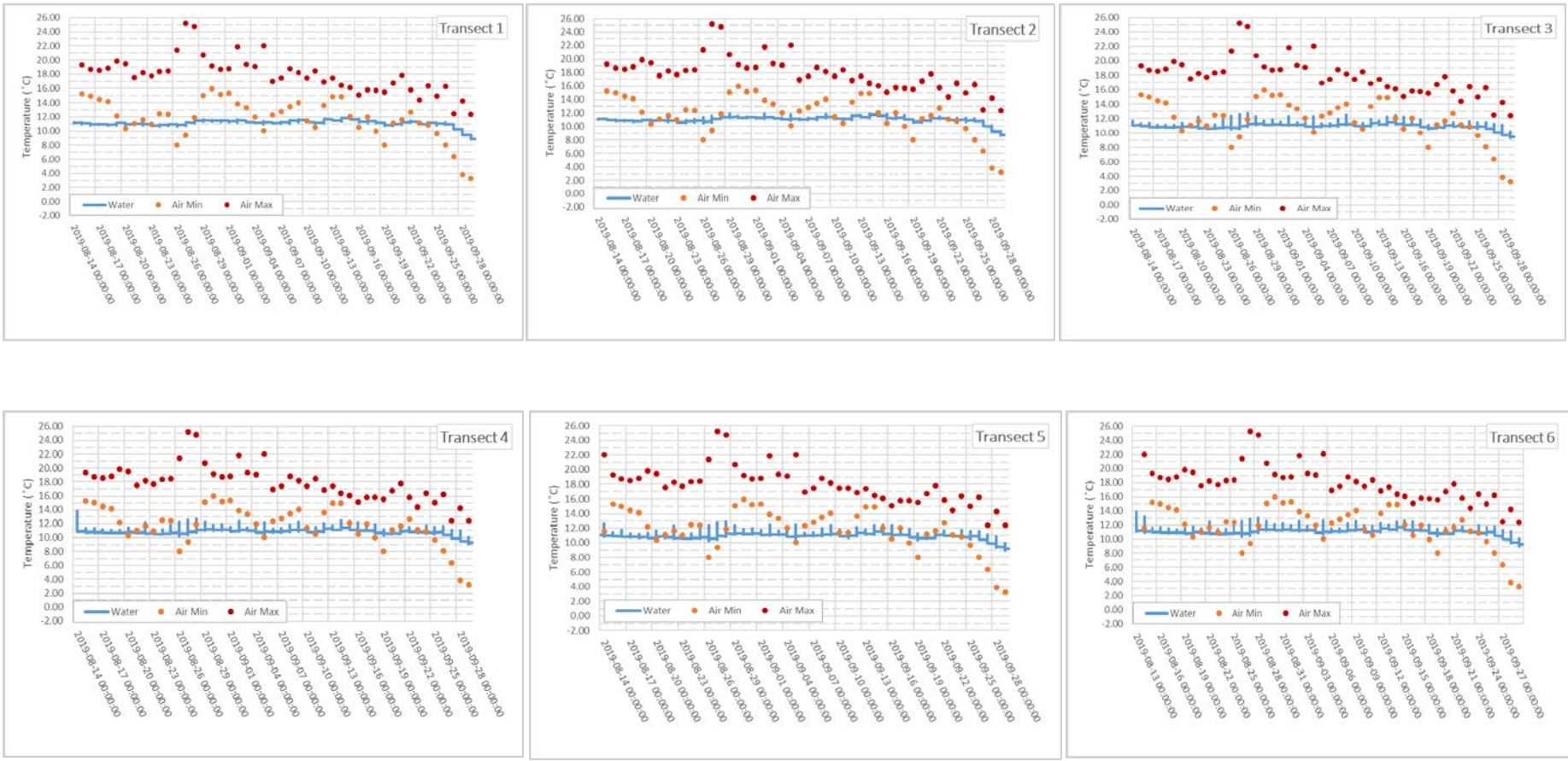

Figure 8. Daily water temperature at Transects 1-6 during the summer months, August 14th – September 29th. Daily minimum and maximum air temperatures are shown in orange and red, respectively.

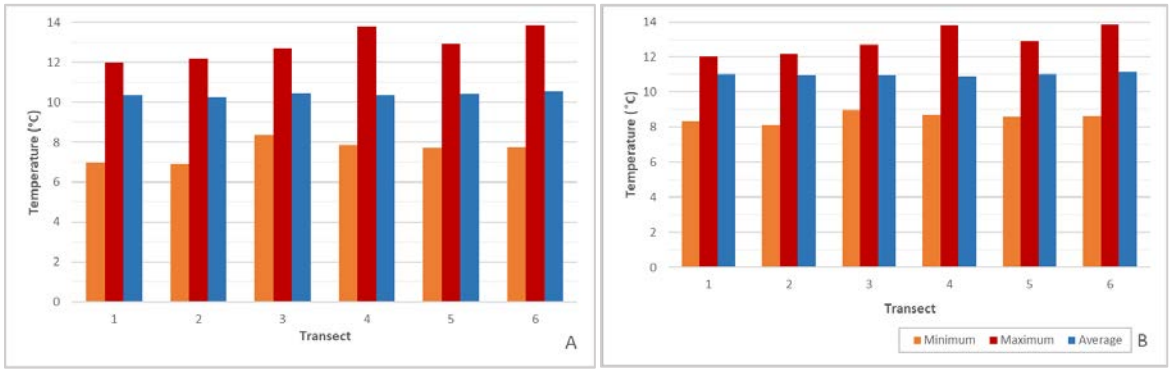

Figure 9. Minimum, maximum, and average water temperature over the full field season (A) and the summer months (B).

Dissolved oxygen was measured in multiple locations across each transect at regular site visits measuring water velocity. The old Hanna Instruments dissolved oxygen meter did not work well in cold weather and stopped working entirely at the end of the season. Dissolved oxygen is summarized in Figure 10.

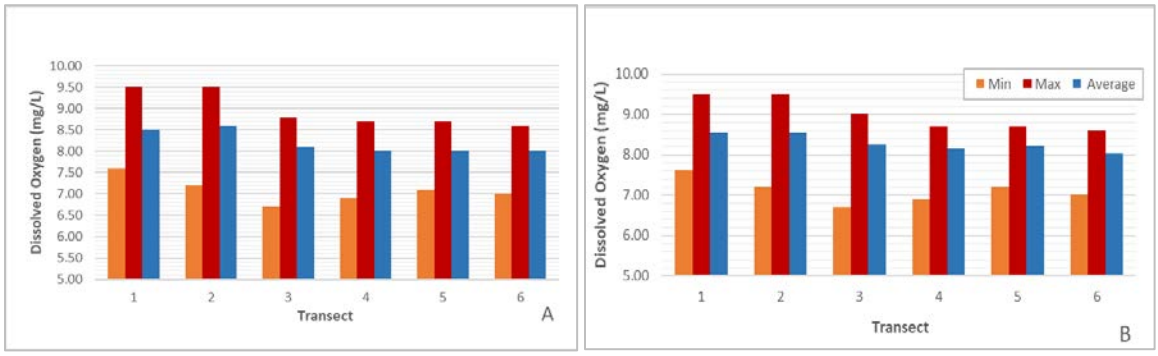

Figure 10. Minimum, maximum, and average dissolved oxygen at each transect over the full field season (A) versus the summer months (B).

Challenges

Three significant challenges arose over the course of the pilot study. The Hanna Instruments dissolved oxygen meter stopped working altogether at the end of the season. Placing a temperature logger at the spring that drains into Wilson Creek just above Transect 3 was not possible because the water level at the spring was too shallow to fully submerge a HOBO Pendant logger. The temperature data from Transect 3 therefore represents water from Wilson Creek and the spring outflow, but as the stream is not well mixed again until Transect 4, the extent of the influence from the spring is not known. Finally, a backflow event from the Bogachiel River flooded water up to the culvert and submerged the air temperature logger. No discernable signal from the Bogachiel River can be seen in the air temperature data, so it may be the case the flooding event was too short to be captured by a temperature logging interval. These are all important to learning what can happen in study implementation!

Next Steps

Moving forward, securing more funding is vital to expand the project to additional study sites including Irely Creek, as well as to continue at Wilson Creek. Following a meeting with the executive director of the Coast Salmon Partnership, Mara Zimmerman, more sites are being considered.

Necessary for expanding the study is to determine the minimum number of study sites required to detect significant change in target variables over time and determining a standard study reach length to be used at all sites. Less intensive monitoring, incorporating less frequent site visits and fewer transects, could be used at a broader-scale study. High intensity efforts (like those made on Wilson Creek) could be incorporated at key sites of interest.

Sites being considered to include in the future are spring-fed streams with similar physical conditions (Table 2). Each pairing includes a stream with an established reed canarygrass monoculture and a reference stream without an established reed canarygrass population. Paired sites would ideally be in the same watershed. However, choosing sites representative of the small cold-water streams of the western Olympic Peninsula would be prioritized.

Table 2. Paired reed canarygrass established sites and reference sites under consideration.

Established Reed Canarygrass	Reference
Calawah Springs	Young Slough
Wilson Creek	Mina-Smith Creek
Irely Creek	Zeigler Creek
Indian Creek	Little River
Upper Lacey Seep	Hoh Springs
Makah Reservation Stream	Makah Reservation Stream

Many sites shown in Table 2 are located on land belonging to Washington Department of Natural Resources or The Nature Conservancy. Irely Creek is within Olympic National Park and a research permit proposal has been submitted. They will discuss the application pending the completion of a Minimum Requirements Worksheet. Landowners along Zeigler Creek are supportive of the project and provide 10KYI staff access.

Conclusion

The proposed sites are small, spring-fed streams used for salmonid winter refugia and summer rearing. Climate change is predicted to alter the temperature regimes of aquatic habitats, particularly surface-water dominated habitats. As the effects of climate change increase in reach, pace, and severity, streams like Irely and Wilson Creek will become critical to the survival of salmonid species and other organisms requiring cold water habitat. Implementing a study at

a multi-watershed scale using methods developed during this pilot study would address the unique and understudied threat posed by reed canarygrass to coldwater refugia.

We deeply appreciate the support from the Coast Salmon Partnership and Foundation that allowed us to develop this pilot study. Thank you!

Appendix A.

Table showing all sites surveyed for the Reed Canarygrass Pilot Study and reason for rejection.

Watershed	Site	Reason for Rejection
Chimacum	Chimacum Creek	No Paired Site
Elwha	Indian Creek	No Paired Site
Hoh	Canyon Creek	Poor Channelization
Hoh	Elk Creek	No RCG
Hoh	Pole Creek (SSHEAR)	Insufficient Flow
Hoh	Hoh Springs (SSHEAR)	No RCG
Hoh	Upper Hoh Wetland	Poor Channelization
Hoh	Young Slough (SSHEAR)	Poor Channelization
Hoh	Nolan Channel (SSHEAR)	Poor Channelization
Quillayute	Bear Creek at FS30	Insufficient In-Stream RCG
Quillayute	Box Springs	Insufficient Flow
Quillayute	Black Creek	Insufficient In-Stream RCG
Quillayute	Calawah Springs (SSHEAR)	Poor Channelization
Quillayute	Colby Springs	Insufficient Flow
Quillayute	Dowan Creek Road (SSHEAR)	Insufficient Flow
Quillayute	Ed's Creek	Insufficient In-Stream RCG
Quillayute	Elkhorn Springs (SSHEAR)	Insufficient Flow
Quillayute	Gunderson Creek on Dickey	Insufficient Flow
Quillayute	Gunderson Creek at T1010	Insufficient Flow
Quillayute	La Forest (SSHEAR)	Poor Channelization
Quillayute	Lagabina Wetland	Insufficient Flow
Quillayute	Mina-Smith Creek	Insufficient In-Stream RCG
Quillayute	Mill Creek at Russel Road	Insufficient In-Stream RCG
Quillayute	Mill Creek Tributary at Sportsmen's Club Road	No RCG
Quillayute	Powell Springs (SSHEAR)	Poor Channelization
Quillayute	Goodman Tributary 1	Insufficient In-Stream RCG
Quillayute	Rootstock (SSHEAR)	Land Access
Quillayute	Thunder Creek Site 1	No RCG
Quillayute	Thunder Creek Site 2	No RCG
Quillayute	Unnamed Tributary at Sportsmen's Club Road	Insufficient Flow
Quillayute	Undi Road (SSHEAR)	Poor Channelization
Quillayute	Wilson Creek (SSHEAR)	NA, Site Chosen
Quinault	Irely Creek	Research Permit Required
Quinault	Merriman Creek	Land Access
Quinault	Zeigler Creek	No Access to Paired Site