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Ecocultural Monitoring and Erosion Mitigation in Powers Creek, a Baduwa’t Tributary, in Blue Lake, California

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Environmental Science & Management: Ecological Restoration Capstone 2024

California Polytechnic University, Humboldt

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I. Abstract

Riparian areas are of great ecological and cultural importance. They provide a variety of ecosystem services, protecting water quality, minimizing climatological changes, and acting as valuable wildlife habitat. They are often also places of connection and access to resources for indigenous communities. Powers Creek, a tributary of the Baduwa't, is one such place for the Blue Lake Rancheria tribal community. Through the utilization of the process-based restoration methodology, our team was able to develop dynamic, place-based solutions for the environmental ails impacting Powers Creek. On-site vegetation and rock weirs were employed as low-tech bioengineering technologies in order to slow bank erosion. Culturally important species planted near the creek were identified, denoted as living, dead, or unknown, and mapped for use in future restoration efforts. In enacting this restoration plan, our team discovered that vegetative mortality rates were high, and that there was no long-term monitoring plan in place to track bank erosion. Thus, we determined that incorporating prescriptive methods alongside increased opportunities for management and monitoring into future restoration of Powers Creek could improve hydrological conditions and increase access to cultural resources for the Blue Lake Rancheria community.

II. Acknowledgments

Thank you to Jacob Pounds and the Blue Lake Rancheria for hosting and offering guidance throughout this restoration project, as well as to Daniel Lipe for organizing our team and offering us his knowledge and expertise. Additionally, we recognize that this project occurred on the ancestral and present territory of the Blue Lake Rancheria tribe and the many

indigenous lineages this community represents. We would not have been able to expand our understanding and experience without their continued support, contribution, and knowledge.

III. Introduction

Riparian ecological zones are of critical importance, offering a myriad of ecosystem services, hosting diverse species, and helping combat climatological and hydrological changes (Ohmart, 1996). Without them, the economic and environmental strain placed on surrounding communities would be immense. For instance, riverine ecosystems aid in water quality protection, minimize the impacts of flooding, provide wildlife habitat, offer a host of recreational opportunities, and help stabilize the local climate (Bentrup & Hoag, 1998). Unfortunately, approximately 90 percent of riparian areas have been impacted by anthropogenic forces. A few of the most impactful anthropogenic forces that adversely impact riparian areas quality and resiliency include pollution, urban development, and agriculture (Miller, 2019). As a result, riverine ecosystems may experience a disconnect from their floodplains or changes in channel shape, loss of native vegetation and aquatic species, soil degradation or erosion, and adverse impacts on water quality (Ohmart, 1996; Castellano et al., 2022). Restoring riparian areas can aid in retaining the full scope of resources and value these ecosystems provide. Though countless techniques may aid in the restoration of degraded riparian ecosystems, this study will center on an approach known as process-based restoration (PBR).

Simply put, PBR is a low-tech, iterative process that accounts for the dynamic nature of riparian and other ecosystems (Beechie et al., 2010). Rather than trying to meet a uniform standard for success, PBR encourages creative, place-based solutions for environmental ails. For example, while prescriptive restoration methods may focus on permanent bank stabilization, which may lead to stream incision and a disconnect from the floodplain, PBR would encourage stream meander and groundwater recharge. Due to the place-based, relational nature of this methodology, process-based restoration can more readily account for the resources deemed culturally important by native communities than prescriptive Western restoration methods (Pounds, personal communication, 2024). This characteristic was highly valued throughout the completion of this project due to fieldwork occurring on Blue Lake Rancheria tribal land.

In addition to their ecological importance, riparian areas are often also of great cultural significance. The Blue Lake Rancheria tribal community in particular has a profound, generations-old connection to the Baduwa't (Mad River) watershed. However, colonization, in both historic and contemporary contexts, has altered how indigenous communities and the human population as a whole interact with the natural world (Karuk Media, 2019). As the initial keepers and managers of the land, indigenous peoples hold a wealth of knowledge about restoration and interaction with the natural world. However, environmental degradation frequently limits access to cultural resources and aids in the denial of tribal sovereignty; thus, restoration efforts must be culturally informed and considerate of the myriad ways in which certain natural spaces are intrinsically connected to the health, well-being, and identity of native communities (Currier et al., 2023).

Despite their inherent similarities, it is important to recognize that Traditional Knowledge (TK) and PBR are separate ideological frameworks. Process-based restoration, as described above, is more holistic than prescriptive approaches; however, its roots are still found within the field of Western science and are not necessarily informed by indigenous ways of interacting with the land. Additionally, students involved in this project are not local tribal members and are therefore not the bearers and arbiters of the Blue Lake Rancheria's indigenous knowledge, but work as allies of the tribe. Indigenous peoples must be granted complete jurisdiction over the sharing of their intellectual and cultural property, rather than being made to interact with a rhetoric dominated by colonial and Western voices (Ermine et al., 2017). We are employing PBR as our methodology because it allows us to freely interact with the land and incorporate indigenous knowledge and practices without getting caught up in rigid procedural politics or theories. Though the decisions we made are based on the goals and objectives developed by the Blue Lake Rancheria, this study centers around the application of process-based solutions in contrast to prescriptive approaches, rather than discussing TK specifically.

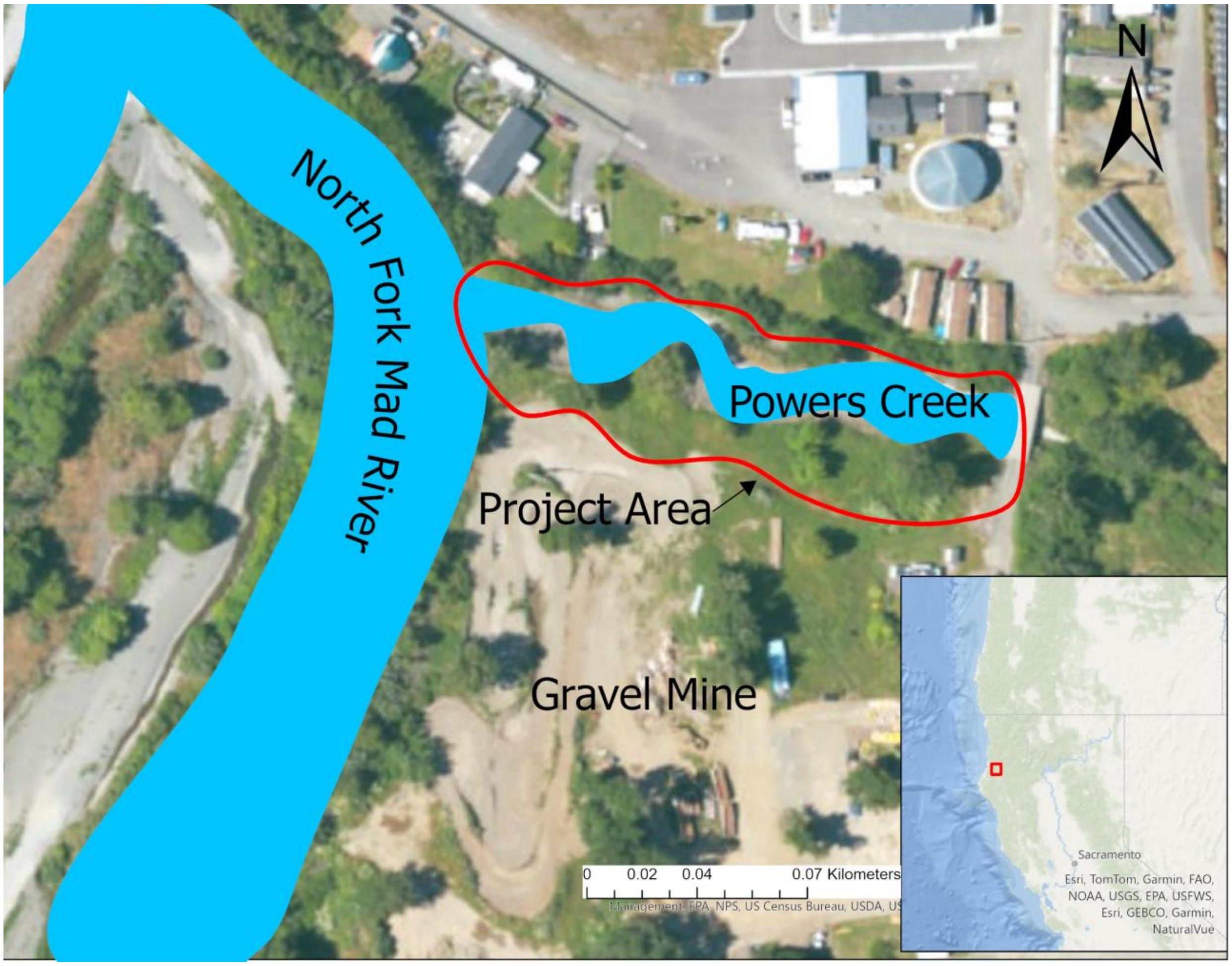

Figure 1: Locator map depicting the Humboldt Bay region and Blue Lake, California

This study focused on Powers Creek, a seasonal tributary of the Baduwa't located in Blue Lake, California on the Blue Lake Rancheria tribal territory (*see Figure 1)*. Specifically, we worked within the downstream portion of the creek, near its confluence with the Baduwa't. The region Blue Lake Rancheria was established in has been used by the Wiyot people since time immemorial before being stolen by European colonizers. The Tribe was originally established as a refuge for "homeless Indians" in 1908 and was terminated in 1958 during the "era of termination." In 1983, Blue Lake Rancheria was reinstated as a federally recognized tribe (Blue Lake Rancheria, 2024). Since then, Powers Creek has been an invaluable resource, providing drinking water, flood protection, and groundwater storage to the Blue Lake community, as well as critical habitat for salmonids and other aquatic species (Mad River Alliance). However, Powers Creek has been adversely affected by an array of anthropogenic factors, including climate change, industrial pollutants, agricultural grazing, and stream incision (Pounds, personal communication, 2024). Ongoing and continuous efforts to improve in-stream health and the quality of the riparian corridor are led by the Baduwa't Watershed Council and local partners (Mad River Alliance).

The region surrounding Powers Creek was formerly a mill site and a ranch (Pounds, personal communication, 2024). Currently, the southern area of the creek is used for commercial gravel mining while the northern area is owned by private residents and the Blue Lake Rancheria (*Figure 1*). The stream in its entirety has been degraded by surrounding land use impacts from residential development and former mill sites. Additionally, prior restoration was completed on-site in 2021, during which rip-rap was placed on the northern stream bed to avoid flooding nearby homes and critical infrastructure (see *Figure 2* for rip-rap). The creek is incised with silty banks that are destabilized due to a lack of vegetation west of the footbridge (*Figure 3*). High flows in the winter often wash out the banks of the area and dramatically change the shape of the creek. Stabilizing the banks of the creek by introducing culturally and ecologically important vegetation will protect nearby structures from flooding, provide optimal habitat for salmon passage, and offer a variety of other ecosystem services. By restoring the area via the use of process-based methodologies, native riparian species can reintegrate into more robust populations. Creating an environment where native species can thrive is important to reduce non-native populations which can decrease biodiversity and produce monocultures (Hager, 2004).

The goal of this project was to contribute to long-term restoration objectives by employing process-based restoration methodologies, including seedling data collection and low-tech bioengineering of the river bank. Monitoring was completed via surveying and mapping the previously planted species that have cultural significance to the tribe (Hendryx, 2018). The survey included information about plant mortality which will guide future decisions about planting and restoration techniques. With this in mind, our objective was to create the conditions necessary for supporting a gallery of species traditionally used for food, fibers for basketry and regalia, and medicine that is readily harvestable (Pounds, personal communication, 2024). For example, *Salix* was utilized on-site in several instances, including during the bank stabilization process. This species holds great cultural significance, providing materials for basketry and offering a host of medicinal benefits (Davis & Hendryx). *Salix* is also a great tree for soil stabilization. Once planted, cut portions of *Salix* stems will generate roots in a few months, providing a quick solution to erosion. The methods utilized during bank stabilization allowed us to examine the benefits and drawbacks of avoiding highly structured and formulaic restoration methods whilst also fulfilling landowner objectives, such as paying more attention to biotic responses as the project progressed (Hilderbrand, et al., 2005). By utilizing PBR and nature-based solutions, we aim to develop optimal conditions that increase the capacity for the land to possess its greatest ecological function and resiliency (Laser, 2007). In doing so, we hope to find that low-tech, process-based solutions prove to be the most effective at improving riparian conditions.

IV. Methods

A. Contextual Framework

Before discussing in-field methodology, it is important to develop an understanding as to why certain decisions were made. Hydrological energy is concentrated when a stream lacks the space to meander and floodplain connection. This leads to stream incision and limits the water remaining in the system for groundwater and soil recharge (Loos and Shader, 2016). An upstream portion of the creek had recently flooded, causing the floodplain bank to erode (*Figure 3*). Looking at the post-erosion reference image (*Figure 3*), much of the vegetation and supporting bank had been washed away. Furthermore, the presence or absence of native vegetation can cause huge variability in the character of riparian areas. Thus, recent and long-term changes in stream conditions had to be accounted for as we pursued a place-based and iterative methodology within which to frame our restoration efforts.

The initial restoration in 2021 opened and widened the flood plain from the urban stream. When the floodplain was widened it allowed for an opportunity to plant native cultural keystone plant species. Vegetation plays a critical role in riparian areas, as it allows disturbance and complexity for surface water, which leads to movement of flow for disposition in areas of the stream (Maestas, 2018). Riparian plants also allow for healthy soil structure below the surface that encourages stabilization, roots also play the role of water absorption that enhances the groundwater recharge (Maestas, 2018).

Figure 2: May 2023 pre-erosion. Blue Lake Rancheria; Facing downstream Powers Creek with the destabilized bank on the left. (Jacob Pounds).

Figure 3: February 2024 post-erosion. Facing upstream Powers Creek with destabilized bank erosion on the right (Daniel Price).

B. Bank Erosion Mitigation

Figure 4: Constructed Rock weirs (Daniel Price).

Figure 5: Salix spp. and Juncus spp. transplant on the eroded bank (Daniel Price).

Our team diverted hydraulic energy away from the affected bank to limit continued erosion at Powers Creek. The team added two stone weirs (*Figure 4*) to direct the energy away from the stream while still allowing for fish passage as needed. The large stones were sourced from Powers Creek to minimize cost and the need for heavy machinery. Rough-edged rocks were placed near the bottom to enhance stability while smoother rocks were placed on top. The upstream weir was slightly smaller than its counterpart and placed at the toe of the eroding bank, with the larger, secondary weir placed approximately a meter downstream. In between the rock weirs, we placed *Salix* stakes to stabilize the weirs. On the eroded bank itself, we established transplants of *Juncus* and *Salix* (*Figure 5*). *Juncus* individuals were dug up from the floodplain and deposited along the base of the eroding riverbank. *Salix* stakes and whips were taken from nearby mature willows and cut flat on one side and angled on the other; the angled ends were hammered into the bank with rubber and wooden mallets up (Krabeel, 1933). Hammering too hard can cause willow stakes to split and provide less structural advantage, so we took precautions to ensure the specimens were placed gently.

C. Geospatial Vegetation Inventory

Revegetation was conducted on the south bank of the creek in December 2020 and March 2021. The species of trees planted included *Acer macrophyllum, Aesculus californica, Fraxinus latifolia, Sequoia sempervirens, Picea sitchensis, Pseudotstuga menziesii,* and *Quercus spp*. The seedlings were caged for protection from wildlife and ungulate browsing. We mapped the vegetation as GPS points within the Gaia GPS application by walking the entire planting area and flagging each caged plant as alive, dead, or unknown for assessment of mortality, and then providing each species group with its own set of numbers and species ID. Each cage's status was determined by the plant's visual cues and its flexibility. We used neon yellow flagging to mark all living individuals and neon pink flagging to mark all dead and unknown individuals (*Figure 6*). For example, a cage with a living big-leaf maple was flagged with yellow, and the flagging was marked with the notation “BLM - 1”.

Species IDs and their associated number were collected on a spreadsheet in columns marking the number and whether the specimen was dead or alive. Dead individuals were assigned a *0* and living individuals a *1*. This spreadsheet can be fully referenced in *Appendix A*. The data was cross-referenced with the Gaia points to remove any accidental duplicates. 143 total cages were flagged and mapped. We then utilized ArcGIS Pro to create a map with the Gaia data by exporting the data from the app and importing it to the ArcGIS program. Each point was assigned a georeferenced location, and each condition was assigned a color: green for living individuals, red for dead individuals, and blue for the unknown category.

Figure 6: Flagging present on cages (Daniel Price).

V. Results

A. Bioengineering of River Bank

The collective utilization of the aforementioned bioengineering methods proved to be effective (*Figures 2 & 3*). Several sizable precipitation events occurred during and after implementation. More specifically, during the addition of *Juncus* and *Salix* onto the eroding slope, we experienced a minor erosion event which covered up the majority of the individuals we had planted. Despite this, the vegetation remained in place, and the *Salix* had begun to sprout in the following weeks. Though we did not gather quantitative data regarding water velocity and erosion rates before and after on-site implementation, qualitative interactions with the site made clear that these methods were useful in the case of Powers Creek. For instance, sediment buildup on the weirs is indicative of decreased water velocity, as slower water allows smaller sediment size classes to settle out (*Figure 7*) (Salant et al., 2012). In streams with heightened velocities, which are usually also incised streams lacking in structural complexity, fine sediments are being moved too quickly to be deposited onto the riverbed (Salant et al., 2012). In short, adding complexity to the stream succeeded in developing a slow-water habitat in Powers Creek.

Figure 7: Fine sediment behind rock weirs at the toe of the eroded slope (Sebastian Castillo)

B. Geospatial Vegetation Analysis

The geospatial data gathered in the field provided us with useful information regarding the mortality rates of planted vegetation. *Fraxinus* and *Quercus* had the lowest percent mortality, and therefore the highest rate of survival, while *Picea* and *Pseudotsuga* had the highest percent mortality (*Table 1*). Additionally, eighteen individuals were labeled as unknown. This indicates that the specimen was either undetectable or had never sprouted. Since data was not collected at the time of the plantings which occurred in 2020 and 2021, there was no reference data to cross-reference for species identification. Unlocated individuals were assumed dead and are included in that category in *Table 1*.

Table 1: Count of planted individuals that were living, dead, or unknown near Powers Creek. These trees were planted in December of 2020 and March of 2021.

Species	Alive	Dead	Total	Percent Mortality
Acer macrophyllum	**15**	**6**	**21**	**28%**
Fraxinus latifolia	**12**	**1**	**13**	**7.6%**
Picea sitchensis	**4**	**21**	**25**	**84%**
Pseudotsuga menziesii	**6**	**14**	**20**	**70%**
Sequoia sempervirens	**22**	**9**	**31**	**29%**
Quercus spp.	**13**	**0**	**13**	**0%**
Aesculus californica	**1**	**1**	**2**	**50%**

Species	Alive	Dead	Total	Percent Mortality
Unknown	**N/A**	**N/A**	**18**	**N/A**

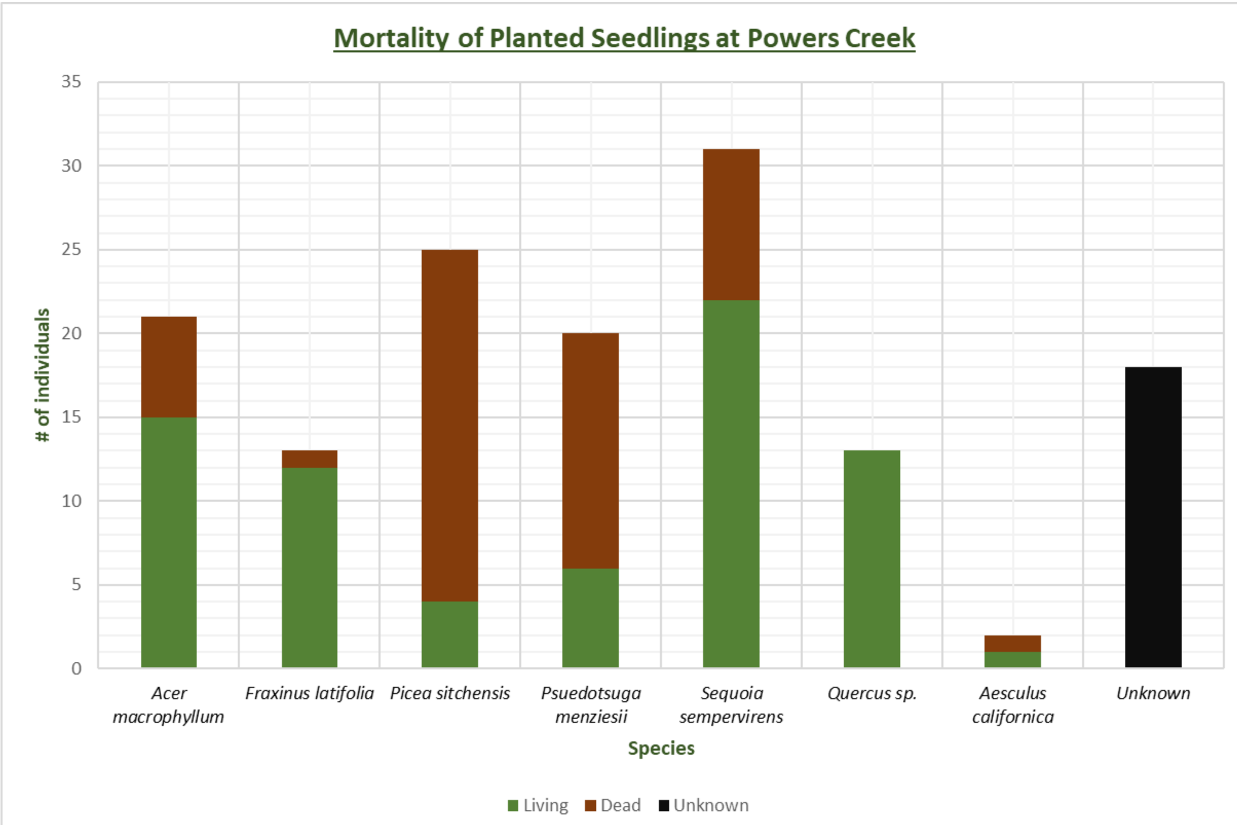

Figure 8: This stacked bar chart indicates the species planted near Powers Creek in 2020 and 2021. The green portion of the chart indicates a living individual, and the brown portion of the chart indicates a dead individual. The black bar on the right-hand side of the chart is representative of our margin of error, as not all species on site were able to be identified.

Similar implications are examined in *Figure 8*. This graph provides a visual representation of the relative survival and mortality rates for each planted species identified in the Powers Creek riparian zone. For instance, it becomes apparent that though the greatest number of *Sequoia* survived, *Quercus* and *Fraxinus* took the lead in terms of percentage. Furthermore, the gray bar is indicative of individuals we were not able to identify, making it clear that the margin of error within this data set must be granted careful consideration (*Figure 8*). Additionally, it is important to note that individuals included in the unknown category may have been a species type that was not included in our data collection (*Table 1*). In other words, there are potential species that experienced 100% mortality, for which data was never collected.

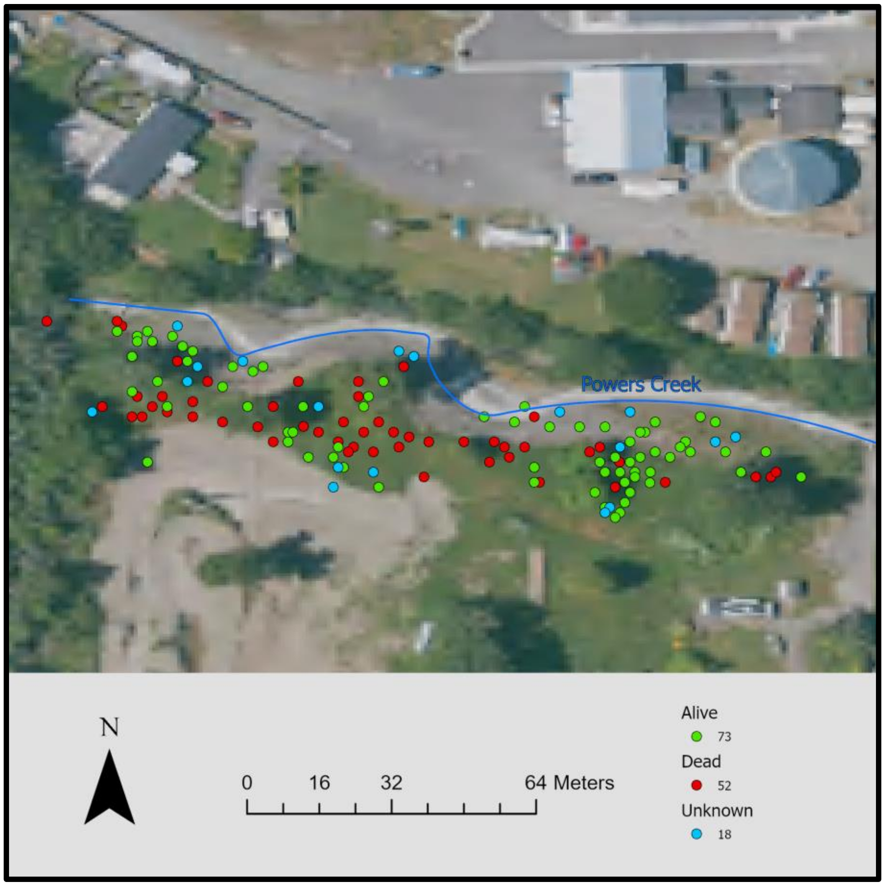

Figure 9: Mortality map denoting the survival rates of planted vegetation, unknown specimens, and the location of Powers Creek

Our team also produced a map representing vegetative mortality (*Figure 9*). This allowed us to examine spatial distribution as it relates to survival and mortality. This geospatial analysis revealed that mortality rates were higher in certain regions of the site. For instance, Powers Creek is composed of a floodplain as well as a higher riparian shelf; mortality rates are lower on the floodplain, likely due to increased access to water. Alternatively, mortality was overall higher on the upper riparian shelf but was greatest in areas with minimal shade. As depicted in *Figure 9*, the eastern portion of the shelf had a higher survival rate, while the western portion had a lower survival rate. The most probable reason for this is the presence of mature nurse trees on the eastern shelf. Furthermore, it is important to recognize that Powers Creek is a seasonal tributary, and experiences significant changes in its shape and hydrologic character throughout the year. A blue line was added to the map to indicate the relative location of the creek, but there may be spatial inaccuracies in the georeferenced location of on-site vegetation due to the nature of Powers Creek and mapping in general.

VI. Discussion

A. Bioengineering of River Bank

As aforementioned, on-site erosion mitigation was overall successful. Though the natural processes of bank erosion and deposition will continue on-site, the stability of the slope has been improved via the utilization of stone weirs, *Juncus* transplants, and *Salix* stakes. The weir structures will remain in place to encourage sediment sorting and divert powerful flows during future precipitation events. Though monitoring post-mapping will not be completed as a part of this project, we hope that the vegetation will remain in place to continue to stabilize the bank via root-soil interactions, without vegetation on the center bar inhibiting the natural movement of the creek. By employing natural, impermanent elements as a means of low-tech bioengineering, we have ensured that Powers Creek will continue to meander and gain in-stream structural heterogeneity.

Despite being a seasonal tributary, the creek provides an important habitat for salmonids and other fish species, neotropical birds, as well as elk, deer, and other mammals, some of which are culturally important species that will be used for generations. The quantitative interactions between our team and the site produced a host of useful information to be utilized in future restoration efforts. Should water velocity become a concern in other parts of Powers Creek during future wet seasons, weirs and on-site vegetation could effectively reduce erosion and control powerful flows. In slowing the velocity of the water, we were able to create areas of shallow gravel where young salmonids can safely inhabit during rainy seasons (Larsen & Woelfle-Erskine, 2018). Improving the conditions for these species and protecting riparian health benefits both the ecological and anthropogenic communities that rely on Powers Creek.

B. Geospatial Vegetation Review

The vegetative mapping completed on-site provided us with a visual representation of the site as it relates to the survival rates of seedlings. Comparing this information with flagging and the data gathered in *Table 1* allowed us to consider the interplay between species type, spatial variation, and local ecological conditions in terms of their impacts on the mortality of identified vegetation. This map layer can be utilized for future restoration efforts in the area to track mortality data. We recommend this information be used in future restoration efforts to increase rates of survivability by shedding light on which species survived and why.

Mortality of caged trees occurred for multiple reasons, but most were in areas without mature tree cover to provide cooling and shelter for heat-intolerant trees like *P. sitchensis.* This species is a food target for a lot of the native wildlife like elk and deer, and because Powers Creek is located so far south in the tree's range deer are especially a problem (Harris). As such, browsing pressure is an additional potential factor influencing the mortality of planted species near the creek. Another possible reason for the high mortality of the upper shelf could be competition from untamed weedy vegetation such as non-native grasses, poison oak (*T. diversilobum)*, and Scotch broom (*Cytisus spp.)*. Vegetative competition was not managed following planting in 2021 or subsequent years.

C. Recommendations for Future Restoration

Prescriptive science requires consistent monitoring utilizing an established methodology. PBR allows for fast-acting solutions that are less planned but adaptive to situations as they are addressed. By incorporating both approaches we can implement a plan that includes in-depth monitoring to track failed restoration attempts while also allowing mitigating problems with fast-acting low-tech approaches.

Though our team was not capable of completing monitoring as a part of this project within the allotted time frame, we suggest continued work to include more frequent evaluation of seedling and transplant viability, especially during the dry months. Seedlings should be watered, provided with release treatments, and re-planted where necessary. We believe that survivability would have increased if more resources were allocated to tending the seedlings in their most vulnerable time. More resources include a greater labor force which requires more funding. However, simple periodic weeding around the seedlings in the cages would have reduced competition for sunlight and water. A buffer in which weedy vegetation is removed around each tree could be accomplished at a low cost with volunteer work to get rid of unwanted species. Though planting took place before the rainy season, water was not provided to the seedlings after planting. We suspect that this is another cause of the high mortality rate.

A soil analysis of the area, especially the upper shelf, is important to inform decisions about which species would be most suitable there. *P. sitchensis* had a very high mortality rate, possibly due to the quality of the soil. Updating the vegetation map with dead and living individuals must be an ongoing process to preserve the quality of the data. This information is vital to understanding the dynamics of the area to improve survivability.

Additional monitoring may include repeated evaluation of the eroded bank, with the potential to add more *Juncus* and *Salix* as needed. Continued interactions with the site may provide further indication of the long-term benefits of low-tech bioengineering on stream health and erosion mitigation. Rehydrating *Salix* stakes and *Juncus* transplants during dry seasons will help the initial plants be established. Once established, the plants can then require less assistance. When doing an initial assessment, it is recommended to take initial surveys of the sediments present. Since the approach to bioengineering is an adaptive approach, we recommend a method that tracks the movement of the sediments and the flow during every visit. During the heavy rain seasons, it would be recommended to remove the large head cut from the eroded site to allow a more gradient slope. The steep head cut allows for water to gain velocity that will negatively erode and impact the loose soils at the surface of the bank (Wheaton, 2019). Implementing a terrace that lessens the slope allows for slower water movements that minimize the rate of runoff (Maestas, 2018).

VII. Closing Remarks

Regarding PBR and TK, it is critical to keep both of these methodologies in mind when restoring Powers Creek. Utilizing the in-situ resources helps restorationists implement a plan, observe and listen, and then quickly adapt to address new or failed issues. The pragmatic approach can also establish an understanding of different systems if worked on in a continuous cycle. This and prior projects were driven by low funding and a very hands-off, process-based methodology which may have contributed to the high mortality rate. In a prescriptive approach, robust testing, surveying, monitoring, and treatment plans can be implemented to identify problems before they create mortality. Though this approach could take longer to initiate as careful attention is needed to address any issues within the system, it provides a more robust framework for a monitoring process. Enhancing the creek for its cultural purposes is just as important as restoring its ecological role. The need for accessible cultural keystone species is critical for future intended utilization because it cultivates a sense of connection to a place where future stewards can forage, gather, and build community. This is critical for the restoration project considering it is currently owned by the tribal agency. Facilitating this bond between people and land will increase the likelihood that riparian restoration by indigenous management practices will continue far into the future.

VIII. Appendix

A.

Maple	*Acer macroph*	Oregon Ash	*Fraxinus latifo*	Sitka Spruce	*Picea sitchens*	Douglas Fir	*Pseudotsuga .*	Redwood	*Sequoia semp*	Oaks	Quercus sp.	Buckeye	Aesculus calif	Unknown
Count	Dead/Alive	Count	Dead/Alive	Count	Dead/Alive	Count	Dead/Alive	Count	Dead/Alive	Count	Dead/Alive	Count	Dead/Alive	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1	2
2	1	2	1	2	1	2	1	2	1	2	1	2	0	3
3	1	3	1	3	1	3	0	3	1	3	1			4
4	1	4	1	4	0	4	0	4	1	4	1			5
5	1	5	1	5	0	5	0	5	1					6
6	1	6	1			6	1	6	1	6	1			7
7	1	7	0			7	1	7	1	7	1			8
		8	1			8	0	8	1	8	1			9
		9	1	9	0	9	0	9	1	9	1			10
10	1	10	1	10	0	10	1	10	1	10	1			11
		11	1	11	0	11	0	11	1	11	1			12
12	1	12	1	12	0	12	1	12	1	12	1			13
13	1	13	1	13	0	13	0	13	1	13	1			14
14	1			14	0	14	0	14	1	14	1			15
15	0			15	0	15	0	15	1					16
16	0			16	0	16	0	16	1					17
17	0			17	1	17	0	17	1					18
18	1			18	0	18	0	18	1					
19	0			19	0	19	0	19	1					
20	0			20	0	20	0	20	0					
21	1			21	0			21	1					
22	1			22	0			22	1					
23	1			23	0			23	0					
24	1			24	0			24	0					
				25	0			25	0					
				26	0			26	0					
				27	0			27	0					
				28	0			28	0					
								29	0					
								30	0					
								31	1					
Total dead	6		1		21		14		9		0		1	52
Total alive	15		12		4		6		22		13		1	73
Total unknown														18
Total flagged														143

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