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Eco-Cultural Restoration of Mouralherwaqh: Site Description and Invasive Species Treatment Plan in King Salmon, California

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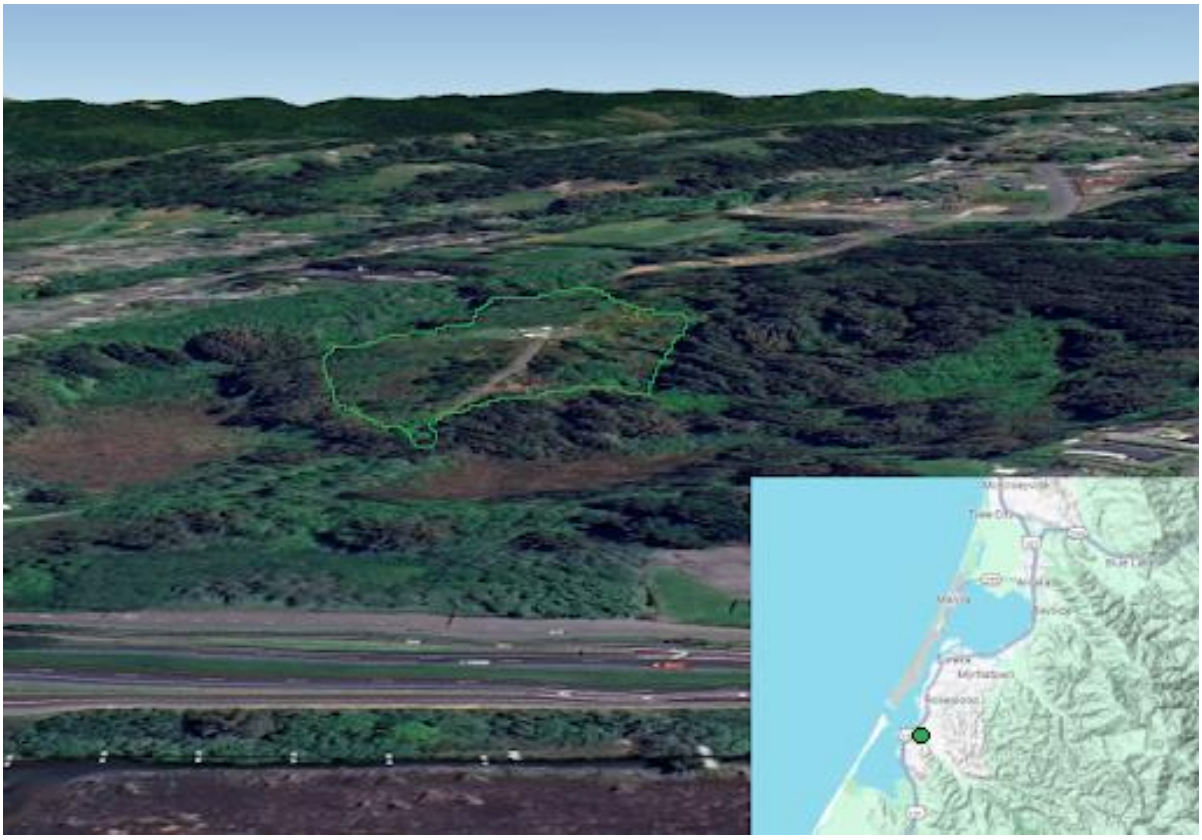

Image: Eco-Cultural Restoration site Mouralherwaqh (outlined in green), owned by the Wiyot Tribe and located in King Salmon, California.

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Introduction

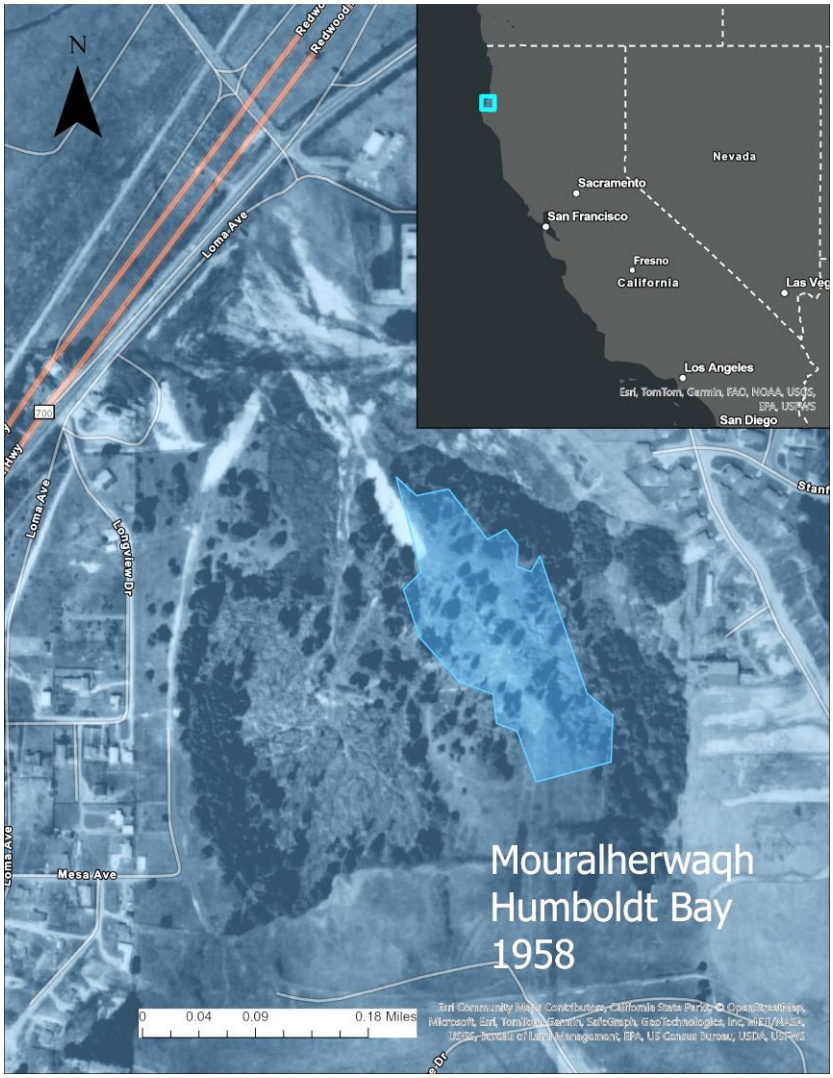
Abstract

In July of 2022, the Wiyot Tribe reacquired one of their first pieces of ancestral forest within the Mouralherwaqh "more-RAH-shore-wahg" village area (Wiyot, 2022). Before this repatriation, the Tribe stewarded less than 1% of their ancestral lands; after, the Tribe's land holdings increased by 10% (Cal Poly Humboldt, 2022). Mouralherwaqh is an approximately 48-acre coastal site located near present day King Salmon, California and has high ecological and culturally significant values (Wiyot, 2022). Prior to the change of ownership, Mouralherwaqh was privately-owned and in 2014 underwent a clear-cut timber harvest within eight-acres of the site. An overgrowth of non-native plant species currently inhabit the project site due to a lack of maintenance post-timber harvest. Once the property became available for purchase in 2021, the Wiyot led the acquisition in partnership with Cal Poly Humboldt (CPH) Environmental Science and Management (ESM) professor, Laurie Richmond, Ph.D. This partnership was born out of the CPH Sea Level Rise Institute of which Adam Canter (Natural Resource Director for the Wiyot Tribe) and Richmond are co-chairs. The intentions of the acquisition are for Tribal gatherings such as ceremonies, dances, and educational opportunities. The acquisition of Mouralherwaqh has allowed for the Tribe to begin the development of an eco-cultural restoration and management plan prioritizing cultural connections and protection of water quality (Cal Poly Humboldt, 2022), focused within the eight-acre plot. This project created collaborations with CPH, allowing students within the departments of Environmental Science and Management, and Environmental Engineering to play supportive roles in collecting research for the Tribe. These efforts are supported by Humboldt's five-year strategic plan.

Location

Located about 0.5 miles northeast of Fields Landing, in Public Land Survey System (PLSS) Section 17 Township 4 North Range 1, more specifically (40.731582N, 124.207637W), West of Humboldt County, Mouralherwaqh is right next to what is now South Bay Elementary and Middle School, near the unincorporated community of King Salmon as seen in **Map 1**. It is surrounded by residential areas on present day Humboldt Hill, originally known as Raqhlhirilh Hulu Mou'lilh in Solatluk, the Wiyot's native language; this name is referred to as "wolfs house" (Rri'nilh, 2024). Mouralherwaqh is one of the final undeveloped and coastal freshwater wetlands on the historic outskirts of Wigi, which is the original name of Humboldt Bay, located near present day King Salmon Slough (*Cal Poly Humboldt*, 2022). The

location of the site is significant for its proximity to Wigi, and its elevations that provide overlooking views of the Wigi landscape.



Map 1: Location of the Wiyot Tribe's coastal property Mouralherwaqh, in King Salmon, California, Humboldt County. Highlighted (in blue) are eight-acres that were clear-cut in 2014.

Need for Project

The land has been unmanaged since a timber harvest in 2014. The harvest included an eight-acre clear-cut, as well as a group selection harvest just west of that cut. Since the disturbance the primary vegetation that has emerged in the eight-acre site has been invasive non-native plant species. However, scattered throughout this invasive vegetation are remnants of native and culturally important species. The site's current vegetative state necessitates the removal of invasive plant species to promote the growth of native

and culturally significant species. It is expected that improving the ecological state of the site will enhance environmental diversity and ecological productivity for all species and individuals that are impacted and nourished by this place.

The partnership for this project between the Tribe and Cal Poly Humboldt (CPH) affords the students a unique opportunity to apply academic insights while contributing positively to indigenous communities. This is an opportunity for CPH students to gain more diverse perspectives such as that of Traditional Ecological Knowledge and Indigenous Science, which highlight healthy connections between land and people. From this experience, they learned valuable practices such as listening to and achieving community goals while prioritizing Tribal voices, which are essential skills to apply in their careers within ecological restoration.

Goals and Objectives

The overarching goal of the project as outlined in the Cal Poly Humboldt 2022 article on Reclaiming Mouralherwaqh, is to restore and manage coastal prairie habitat. Their priorities include:

1. Removing invasive species
2. Enhancing watershed and water quality
3. Planning for adaptation to sea-level rise
4. Interpreting cultural history
5. Botanical, wildlife and avian monitoring
6. Enhancement and propagation of culturally important plant species

Primary goals of this project/treatment plan were two-fold, first to determine representative description of the vegetation present within the eight-acres of clear-cut at this site. Second, revealing target non-native invasive plant species that pose the greatest threat to the land's native and culturally significant plants. This tailored treatment plant is intended for the use of the Wiyot Tribe. By focusing on these goals, this treatment plan can be used to enhance the ecological productivity, environmental diversity and usability of the land for the Tribe.

To assist in formulating a restoration plan, the Wiyot Tribe reached out to the CPH Department of Environmental Science and Management (ESM) Ecological Restoration, giving students a chance to contribute ideas to heal the land. This report serves as a contribution to the supporting role CPH plays in the project, incorporating student and faculty engagement into the overall restoration of Mouralherwaqh.

In addition to ESM efforts, the CPH Engineering masters cohort is working with a culvert on site that connects coastal wetlands to a stream within Mouralherwaqh. They are looking at possible ideas and solutions for working with the culvert, and also providing other potential solutions including a bridge and having no culverts.

Land History

The Tribe holds high value for this site with respect to its ancestral and cultural history. In the early 20th century, the original name of the village site - Mouralherwaqh - was told to JP Harrington by Wiyot matriarch Birdie James, who shared, “There used to be freshwater there but they have been dredging the slu [slough] there and no more freshwater there, ducks used to go there and drink water” (*Cal Poly Humboldt*, 2022). Unfortunately, there is very limited documentation of land-use history and relationship between the Tribe and Mouralherwaqh prior to private ownership.

Under private ownership of Mouralherwaqh, a Timber Harvest Plan (THP) was prepared and published in 2013 by Timberland Resource Consultants (TRC), and signed off by the private owners of the land. The THP gave a pre-project description of the site area having closed canopy spruce with some areas of dense shrubs and some thick brushy coastal scrub on the edges of the unit (*THP, 2013*). The site overall was not being used, and no sources have been found on development of the area (Z. Erickson, personal communication, April 24, 2024). This same document was able to protect some of this coastal forest from logging because it was habitat to sensitive avian species (*THP, 2013*).

Mouralherwaqh next appeared to the public when it was listed on the online real estate market. Upon its discovery on the market in 2021, the parcel immediately became an acquisition target. The Wiyot Tribe led the acquisition effort, collaborating with Cal Poly Humboldt (CPH) specifically with Dr. Laurie Richmond, as well as Humboldt Baykeeper, and Friends of the Dunes. The Water Quality, Supply, and Infrastructure Improvement Act of 2014 set aside 800 million dollars for projects aligning with the integrated regional water management plan. In 2022, the Grant Program initiated the solicitation and allotment of these funds, where the Wiyot Tribe received a 1.2 million dollar grant (California, 2024; Wiyot, 2022).

The push to secure the land was driven by its rich cultural significance and its placement within the Mouralherwaqh village area. Before the grant was initiated this area was scheduled for development but as it is coastal land, it is now protected by the California Coastal Act as it is in the “coastal zone” (Frankel & Parry, 2017). Traces of the development efforts remain on the property, including an unfinished road

that begins at the gate entrance, and drives through the clear-cut; sitting above the wetland culvert, with only a small portion of the road paved with gravel.

After being granted funds to regain stewardship of their first piece of forestland, the Tribe prioritized the eco-cultural revival of Mouralherwaqh. The Wiyot Tribe and its staff are leading this revival, beginning with focusing on inviting Wiyot citizens to Mouralherwaqh to start shaping and setting restoration goals.

Existing Environment

Natural Resources

Soils

The area is characterized by the Hookton-Tablebluff-Cannonball complex. This terrain is not classified as prime farmland, primarily due to its topography and soil composition. The Hookton soils, covering 35 percent of the complex, share similar landform positions but are derived solely from mixed alluvium, presenting a loam profile that supports moderately to somewhat poorly drained conditions. Tablebluff's component, comprising 40 percent of the area, occupies back and side slopes and is formed from eolian deposits over mixed alluvium. Its soil profile is predominantly loam and silt loam, transitioning into clay loam at greater depths, indicating a moderately well-drained system with a high capacity for water transmission. Cannonball soils, making up 15 percent of the complex, are located on marine terraces and are characterized by silt loam and clay loam profiles, suggesting moderate to high water transmission rates and a moderately well-drained system (NRCS, 2024).

Topography

Mouralherwaqh contains predominantly flat surfaces with varying elevations. The slopes that define these areas are north-facing (*THP*, 2013) ranging from 9 to 15 percent. The elevations range between 30 to 820 ft, and contain disturbance such as skid trails and landings (*THP, 2013*). A map of the topography of the site can be seen in **Map 2**.

Map 2: Topography map of Mouralherwaqh sourced from CalTopo.

Climate

Coastal Humboldt County is typically characterized by temperate climates. Specifically, the forests in Humboldt County are classified as temperate rainforests, experiencing an average annual rainfall of 40 inches in the drier areas and exceeding 100 inches in regions with the highest precipitation. The majority of this rainfall occurs between November and March. Winters typically experience average highs ranging between 50°F and 60°F, while summer temperatures occasionally reach 70°F. Summer months are often characterized by foggy conditions, with the occasional sunny days (USGS, 2024).

Hydrology

The Mouralherwaqh site has two riparian areas, with marshlike qualities that are drained from the slightly higher areas to the east, but are hydrologically disconnected from other local watersheds.The Tribe has no historical knowledge or evidence of the wetlands being connected. Aerial imagery of the site in the 1940's showed separation between the wetlands (Z. Erickson, personal communication, February 21, 2024). Groundwater and seawater intrusion and salinity may be factors due to proximity to the bay, but this is still a relatively new site and research is ongoing.

Vegetation

The existing vegetation at the project site includes 35 species identified during surveying found in **Table 2**. The entire observed plant community for the site is listed in **Table 1**. The native species dominating this site are California blackberry (*Rubus ursinus)*, bracken fern (*Pteridium aquilinum)*, the wetland plants rushes (*Juncus sp.)* and sedges (*Carex sp.)*, along with some coyote brush (*Baccharis pilularis)* and cascara buckthorn (*Frangula purshiana)*. There are also many non-native species that have invaded this site following the clear-cut in 2014. The most prominent three are pampas grass (*Cortaderia selloana)*, Spanish heath (*Erica lusitanica)* and scotch broom (*Cytisus scoparius)*. Other invasive species of concern are Himalayan blackberry (*Rubus armeniacus)* and Monterey Pine (*Pinus radiata)*. The Tribe identified the targeted species for this project as Himalayan blackberry and the top three invasives: Pampas grass, spanish heath, and scotch broom. This project site is surrounded by a coastal Sitka Spruce (*Picea sitchensis*) forest. There are several categories of vegetation present at this site. There are riparian and wetland areas, grass dominated areas and shrublands, sometimes interspersed with Monterey pine saplings.

Table 1: List of observed plant species.

Common Name Invasive (I) Native (N)	**Scientific Name**	**USDA Code**	**Solatluk**
Grand fir (N)	*Abies Grandis*	ABGR	burayuplhi'

Common Name Invasive (I) Native (N)	**Scientific Name**	**USDA Code**	**Solatluk**
Tri-corner onion (I)	*Allium triquetrum*	ALTR4	
Redwood manzanita (N)	*Arctostaphylos columbiana*	ARCO3	ghusuwulhwat
Coyote brush (N)	*Baccharis pilularis*	BAPI	
Sedge (N)	*Carex sp.*		
Deerbrush ceanothus (N)	*Ceanothus integerrimus*	CEIN3	
Bull thistle (I)	*Cirsium vulgare*	CIVU	
Pampas grass (I)	*Cortaderia selloana*	COSE4	
California hazel (N)	*Corylus avellana*	COAV80	dubulush
Cottonester (I)	*Cotoneaster sp.*		
Scotch broom (I)	*Cytisus scoparius*	CYSC4	
Spanish heath	*Erica lustiana*	ERLU	
Cascara (N)	*Frangula purshiana*	FRPU7	
Fuschia (I)	*Fuchsia magellanica*	FUMA	

Common Name Invasive (I) Native (N)	**Scientific Name**	**USDA Code**	**Solatluk**
Salal (N)	*Gualtheria shallon*	GASH	viqhululhwat
English ivy (I)	*Hedera helix*	HEHE	
Cow parsnip (N)	*Heracleum maximum*	HEMA80	wough
Velvet grass (I)	*Holcus lanatus*	HOLA	
Douglas iris (N)	*Iris douglasiana*	IRDO	
Rush (N)	*Juncus sp.*		
Twinberry (N)	*Lonicera involucrata*	LOIN5	
Western lily of the valley (N)	*Maianthemum dilatatum*	MADI	
Coastal manroot (N)	*Marah oreganus*	MAOR3	
Sitka spruce (N)	*Picea sitchensis*	PISI	du'k
Monterey pine (I)	*Pinus radiata*	PIRA2	
Sword fern (N)	*Polystichum munitum*	POMU	
Bracken fern (N)	*Pteridium aquilinum*	PTAQ	

Common Name Invasive (I) Native (N)	**Scientific Name**	**USDA Code**	**Solatluk**
Buttercup (N)	*Ranunculus repens*	RARE	
Red currant (N)	*Ribes sanguineum*	RISA	huwutshi
Himalayan blackberry (I)	*Rubus armeniacus*	RUAR9	
Thimble berry	*Rubus parviflorus*	RUPA	boukshughutsguqi’
Salmonberry (N)	*Rubus spectabilis*	RUSP	we’daw
California blackberry (N)	*Rubus ursinus*	RUUR	mip
Dock (N)	*Rumex occidentalis*	RUOC3	
Nightshade	*Solanum sp.*		
Hedge nettle (N)	*Stachys sp.*		
Evergreen huckleberry (N)	*Vaccinium ovatum*	VAOV2	vou’gulhat
Red huckleberry (N)	*Vaccinium parvifolium*	VAPA	

Cultural Resources

Some of the highly encouraged native plant species selected by the Wiyot Tribe include: Redwood manzanita (ghusuwulhwat), California hazel (dubulush), Salmonberry (wutwurrulha't), Thimbleberry (boukshughutsguqi'), and Huckleberry (vou'gulhat). All of these species are already present on site, and identified as culturally significant plants. California hazel (dubulush) can be used in many ways: to create baskets, ropes, and hooks, as a food source from harvesting nuts, and creating dyes out of the plant roots (*Native American Ethnobotany Database*, 2024). Redwood manzanita (ghusuwulhwat), was identified by Wiyot Tribe Natural Resources (Shawir Darrudaluduk) Department as a source of firewood used for ceremonies. The online Native American Ethnobotany Database states other uses by neighboring Tribes, such as the Karuk who use the plants berries as a source for food and beverage, and the wood to create spoons, walking canes, or reels for string (*Native American Ethnobotany Database*, 2024). Salmonberry (wutwurrulha't), Thimbleberry (boukshughutsguqi'), and Huckleberry (vou'gulhat) are three species of berries are all used as a food source, either by eating the berries fresh or consuming them as dried fruits (*Native American Ethnobotany Database*, 2024).

Site Surveys

Methods

Vegetative Surveys

For this project various surveys were conducted including plant identification, percent cover, and mapping of dominant vegetation. This includes identification of vegetation that is culturally significant to the Wiyot Tribe and native to the region. This began with the examination and direction of a digital site map provided by the Wiyot Tribe's Natural Resources Department (WNRD) (see Appendix D). The provided map divided the entire property into 34 representative points. Nine of these points are within the clear-cut area that was designated as our project site. The map, hosted on the offline mobile maps app Avenza, outlines predetermined survey plots strategically scattered across the site for the purpose of accurate representation. Equipment used for surveying included a 50m measuring tape, a clinometer, a mirror compass, and the GPS-enabled mobile app, Avenza.

Surveys were conducted through March and April of spring 2024. Upon arrival at each designated plot, our team began with a vegetation assessment protocol outlined by the WNRD. Initially, this process

involved setting up a 10m² plot through a randomly generated azimuth direction. The plot was then subdivided into four equal quadrats, a strategy intended for a nuanced examination that would ensure a thorough and balanced assessment. However, after surveying the second plot, challenges such as dense vegetation and limited visibility hindered the ability to accurately assess percent cover. To address these issues, the methodology was revised for subsequent surveys. Due to vegetation density, the quadrat size was modified from the original 10m², to 3m² plots (see Discussion for details).

Once plot boundaries were established, our team encircled each quadrat to accurately identify and record every plant species present. Identification was facilitated by a previously documented identification key provided by the WNRD (see Appendix C). Each species was confirmed by at least one other team member and recorded on site-specific datasheets provided by the WNRD (see Appendix D). If a plant species was not recognized, a small sample was collected to be analyzed with the assistance of Cal Poly Humboldt's Herbarium Department.

The entire team initially practiced estimating percent coverage until they consistently agreed on percentage estimations that fell within the same coverage category. Percent cover classification was based on the standardized cover classes and diagrams used by the California Native Plant Society (CNPS) and California Department of Fish and Wildlife (CDFW) (see Appendix D). The Wiyot Tribe's target invasive species, and the identification of the top three dominant invasives found through plot surveys, provided the basis of analysis for this treatment plan's tailored removal-method recommendations.

Botanical Plot Codes			
Quad ID	N, E, S, W	**Height Class**	1=<0.5m, 2=0.5-1m, 3=1-2m, 4=2-5m, 5=5-10m, 6=10-15m, 7=>15m
Quad Dist	Distance from Plot center		
Stratum	T=Tree, A=Sapling, E=Seedling, S=Shrub, H=Herb, N=non-vascular		
% Cover Intervals (SEE DIAGRAM BELOW)	r = trace, <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%		
Lifestage	0=dormant, 1=vegetative, 2=budding, 3=flowering, 4=gone to seed		
Access	1=on trail, 2=<3m from trail, 3=>3m from trail, 4=>10m from trail		

Figure 1: Key for data sheet category recordings, provided by the Wiyot Tribe's Natural Resources Department.

Data Analysis

The data collected from the field was organized into an Excel spreadsheet, following the same format as the written data sheets. This spreadsheet was used to analyze and compute total cover percentages to extrapolate species dominance. Once all nine plots were input, a comprehensive list with all species'

common name, scientific name, species code and cover class values, was compiled, totaling 35 species **Table 3**. All cover class values were converted to their mean percentage through the find and replace function in Excel (r=0.5% 1=1% 2=3% 3=10% 4=20% 5=37.5% 6=62.5% 7=87.5%). This was done to convert the range that each value represented from **Figure 1**, into calculable numbers, which is most accurate when the mean value of the range is used. All 35 species' cover percentage was calculated representing how much of the eight-acre site they cover. This was done by taking the sum of all plots by species when present, divided by the total number of plots (9) through the use of formulas in the Excel application. Pie charts were formed to visualize the dominance that each species had on the plot through its percent cover. **Figure 2** is a depiction of relative cover by species, where all individuals with less than one percent cover were combined into the "other" category.

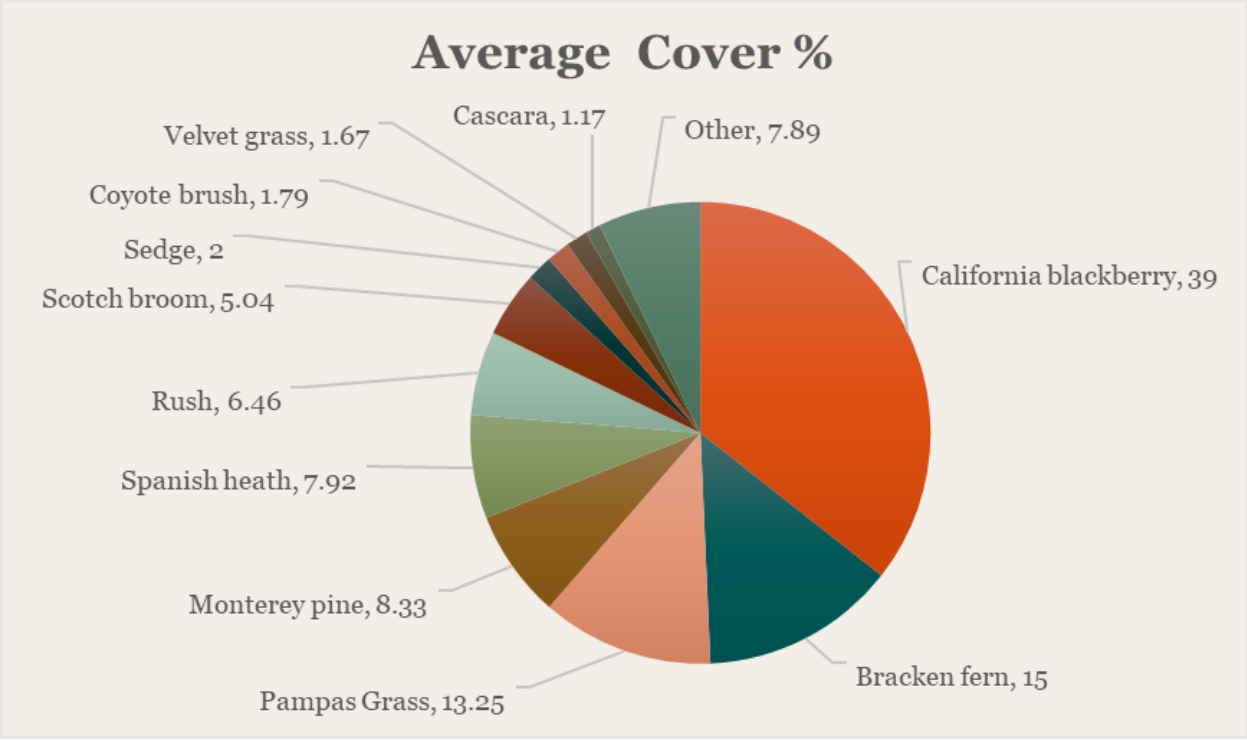


Figure 2: Percent cover of all species

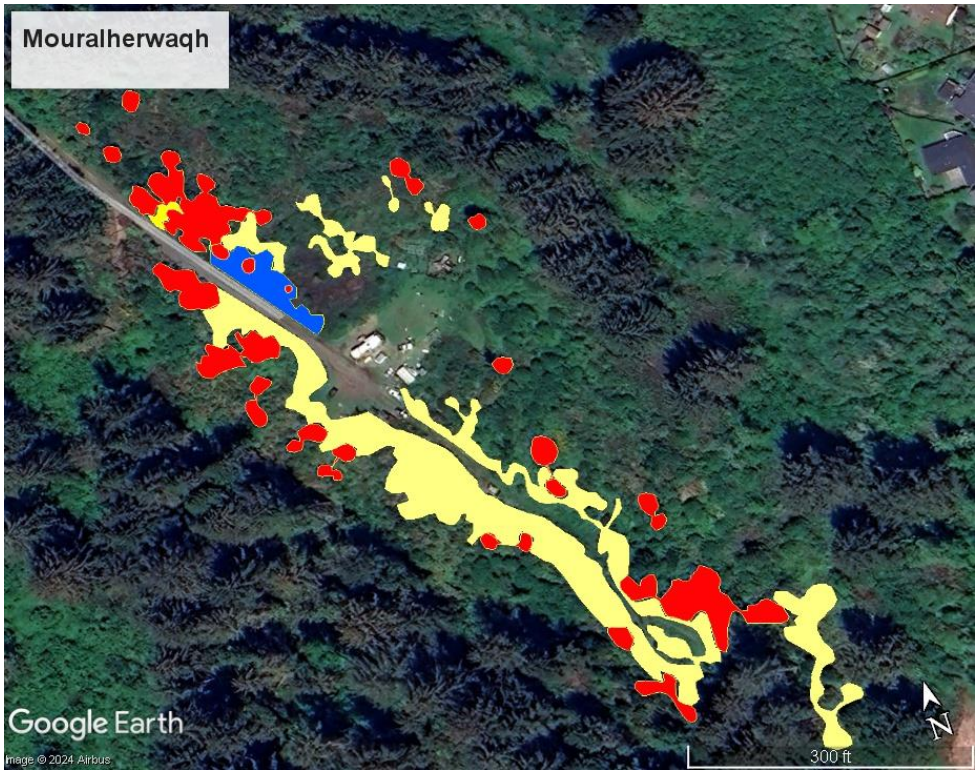
Table 3: List of species surveyed on site and their average absolute percent cover.

Common Name	Native(N) / Invasive(I)	Scientific Name	USDA Code	Average Absolute Cover %
Grand Fir	N	*Abies Grandis*	ABGR	0.25
Coyote brush	N	*Baccharis pilularis*	BAPI	1.79
Sedge	N	*Carex sp.*		2
Deerbrush ceanothus	N	*Ceanothus integerrimus*	CEIN3	0.25
Bull Thistle	I	*Cirsium vulgare*	CIVU	0.25
Pampas grass	I	*Cortaderia selloana*	COSE4	13.25
Cottonester	I	*Cotoneaster sp.*		0.04
Scotch broom	I	*Cytisus scoparius*	CYSC4	5.04
Spanish heath	I	*Erica lusitanica*	ERLU	7.92
Cascara	N	*Frangula purshiana*	FRPU7	1.17
Fuschia	I	*Fuchsia magellanica*	FUMA	0.25
Salal	N	*Gualtheria shallon*	GASH	0.13
English ivy	I	*Hedera helix*	HEHE	0.29
Cow parsnip	N	*Heracleum maximum*	HEMA80	0.13
Velvet grass	I	*Holcus lanatus*	HOLA	1.67
Douglas iris	N	*Iris douglasiana*	IRDO	0.04
Rush	N	*Juncus sp.*		6.46
Twinberry	N	*Lonicera involucrata*	LOIN5	0.92
False lily of the valley	N	*Maianthemum dilatatum*	MADI	0.04
Manroot	N	*Marah oregana*	MAOR	0.25
Sitka Spruce	N	*Picea sitchensis*	PISI	0.25
Monterey pine	I	*Pinus radiata*	PIRA2	8.33
Sword Fern	N	*Polystichum munitum*	POMU	0.54
Bracken fern	N	*Pteridium aquilinum*	PTAQ	15
Buttercup	N	*Ranunculus repens*	RARE	0.08
Red currant	N	*Ribes sanguineum*	RISA	0.33
Himalayan	I	*Rubus armeniacus*	RUAR9	0.88

Common Name	Native(N) / Invasive(I)	Scientific Name	USDA Code	Average Absolute Cover %
blackberry				
Thimbleberry	N	*Rubus paviflorus*	RUPA	0.92
Salmonberry	N	*Rubus spectabilis*	RUSP	0.67
California blackberry	N	*Rubus ursinus*	RUUR	39
Dock	N	*Rumex occidentalis*	RUOC3	0.04
Nightshade	I	*Solanum sp.*		0.04
Hedge Nettle	N	*Stachys sp.*		0.38
Evergreen huckleberry	N	*Vaccinium ovatum*	VAOV2	0.88
Red huckleberry	N	*Vaccinium parvifolium*	VAPA	0.04

Invasive Plant Mapping

To map invasive species two methods were practiced. Ground based mapping was employed, this method involved utilizing a georeferenced map of the area, supported by a GPS-enabled application such as Avenza or Gaia GPS via smartphone. Areas dominated by invasive species were visually identified and plotted by finding the edge boundary of a specific patch and walking around that boundary while creating a GPS track or line. Digital mapping was also employed, using Google Earth, with the most recent overhead imagery, combined with Humboldt ArcGIS, Eureka 2023 aerial Imagery. Polygons were created for Spanish heath, scotch broom, and Monterey Pine. These species were easily identifiable from the overhead imagery by looking at the colors of vegetation. Polygons were created in Google maps, and species were identified in the Humboldt County GIS imagery. A map was created to aid in the visual interpretation of numerical data to gauge the prominence of each species in relation to each other as seen in **Map 3**.



Map 3: Invasive mapping from overhead imagery of Spanish heath (blue), scotch broom (yellow) and Monterey Pine (red).

Implementation Plan

Proposed Project

This project proposes restoring the site to conditions that would reflect a history of Tribal usage and management. Attainable by utilizing TEK (Traditional Ecological Knowledge) to recreate a healthy and harmonious environment for Wiyot traditional Tribal usage.

Potential site usage could include traditional ceremonies, gathering practices, and community-building activities, including the passing on of generational knowledge and spiritual connection to place *(Wiyot, 2022)*. As this project will be ongoing within these reacquired ancestral lands and spearheaded by the Tribe, this project will exemplify sensitivity to Tribal values. This should take precedence over expediency, and the normal pressures to produce results for public consumption. The remaining culturally important species need to be identified, protected and efforts need to be made to bring back these species once again to a thriving state. Enhancing these environments and species can be accomplished through

providing opportunities for the Tribe to once again be engaged in reciprocal relationships with their homelands like Mouralherwaqh. The healing of this land will contribute to the healing of the Wiyot people. It will also preserve traditional lands and land use in the face of ongoing climate change and land loss due to rising sea levels. Additionally, it will return this land to support Tribal objectives.

Methods

Our research pointed us toward several different methods with the potential to meet the requested restoration objectives. A summary of the following methods can be seen in **Table 4**.

No Action

A no action treatment method would involve a complete hands-off approach and let the site continue its clementsian succession process. This theory of succession assumes that a climax community is reached through a linear trajectory and ends with a coniferous forest (J. Luong, personal communication, February 15, 2024), which would eventually re-establish a forest much like it was before the clearcut when indigenous management was not being practiced. The native species present, would be challenged to maintain their presence and dominance that they currently hold, but some may persist, there is no way to know the exact outcome.

Manual

Manual removal involves both hands and handheld tools to aid in the removal of unwanted vegetation. This approach utilizes several effective tools:

Weed Wrench: Grasps the base of a plant, typically a shrub, leveraging it out of the ground.

Spade Shovel: Excavates roots of established plants.

Folding Saw: Quickly cuts through woody stems, useful when total plant removal is impractical, or for branch cutting.

Long-Handled Loppers: Ideal for slicing through herbaceous stems and accessible woody stems; the extended handles enhance reach, particularly beneficial for tackling Himalayan blackberry bushes.

McLeod: A dual-purpose tool with a rake on one side and a blade on the other, suitable for managing and cutting dense, viny shrubs.

Each tool is applicable in different situations at varying levels of success, see **Table 5** for details.

Mechanical

Mechanical removal employs various powered tools to eradicate invasive vegetation, enhancing efficiency and scale. This approach utilizes several potent tools:

Mowers: These machines come in a variety of sizes. These machines can cut down large swathes of herbaceous to smaller woody vegetation quickly. The mowers can only cut what it can drive over, limiting the effective height. This makes it ideal for large, more open spaces.

Masticators: These machines are usually attached to tractors or similar large equipment and are used to grind down small to medium woody vegetation, turning them into mulch. This method is highly effective at removing dense shrubby vegetation.

Weed/Brush Eaters: Similar to mowers, weed and brush eaters cut everything from herbaceous to medium sized woody vegetation however they are small enough to be carried and operated by a person. These tools trade speed and a large area of treatment of a mower for precision and maneuverability making it better for tight spaces.

Chainsaws: These are small and highly portable tools that are essential for cutting any sized woody vegetation. This makes it ideal for removing trees and shrubs in a fast and effective manner.

All work done with mechanical tools should be closely supervised by employees of the Wiyot Natural Resources Department.

Herbivory

Herbivory is the use of grazing animals such as sheep, goats, cows, and even horses, to remove vegetation. Cows and horses graze existing vegetation and have minimal effects on roots, sheep pull forbs out by the roots and can remove non-herbaceous plants from an area if left on site for a sufficient duration. Due to the invasive species composition of primarily herbaceous plants, goats, as primarily herbaceous grazers, would be the optimal choice. Goats will eat plants of up to 7 feet high and up to 1 inch in diameter. They eat an average of 3% of their body weight in dry vegetative graze, or around 12 pounds of wet weight daily for a 100 pound goat (Burrows et al., 2015). With this rate of consumption in mind a land owner can calculate how long the area should be grazed, and by how many goats would be needed to clear how much vegetation.

Restorative Fire

The application of fire can vary greatly depending on who is practicing it and where it is being implemented. Safety precautions need to be implemented such as a pre-burn fuels reduction and fire breaks, and access to fire smothering equipment. The implementation of fire as a land management tool must be overseen by either a Burn Boss or Cultural Fire Practitioner (CAL FIRE, 2023), which falls within the sovereign authority of the Tribe (Clark et al. 2024). The Wiyot Tribe has their own Cultural Burning practices that can be implemented. While prescribed fire and Cultural Burning may have similar objectives relating to restoration and ecological resilience, cultural burning is more Tribe specific with its intentions (Clark et al. 2024). Cultural intentions may relate to ceremony, fuel reduction, or tailoring the environment for a certain plant.

Other prescribed fire methods involve using a drip torch to apply fire to specific locations in a controlled manner (Weir et al. 2017). Part of fuels reduction includes pile burning, where vegetation from the surrounding area is brought to a central location and safely incinerated. Another is broadcast burning, a process where an area is prepared to be carefully set aflame (CAL FIRE, 2023). Flaming is another potential method where seedlings are exposed to a high intensity open flame, either wilting them, forcing them to expend energy to regrow, or completely incinerating them.

Discussion

Table 4: Treatment strategy for the project site regarding top three dominating invasive plant species, and target species of interest, Himalayan blackberry.

Common Name (Scientific name)	Manual Treatment	Mechanical Treatment	Prescribed Burning	Grazing
Pampas grass (*Cortederia selloana*)	Yes, Crown removal with shovels and cutting of removal of inflorescences to prevent spread of seeds	Chainsaws or brush eaters can be used to expose the root crown for removal, however other methods become impractical due to excessive disturbance	Not recommended. Often promotes growth and invasion.	Potentially useful, but has not been practiced in North America.

Common Name (Scientific name)	Manual Treatment	Mechanical Treatment	Prescribed Burning	Grazing
Scotch broom (*Cytisus scoparius*)	Yes, however complete extraction of the root system is required, and growth is stimulated post disturbance	Yes, however the entire root structure needs to be removed or destroyed and an intensive post treatment plan will be necessary as cutting will stimulate growth.	Not recommended without extensive post burn management as fire stimulates the seeds of this species to germinate.	Goats are recommended for herbivory management, however the plant is toxic to most other species
Spanish heath (*Erica lusitanica*)	Good for young individuals, however extremely difficult to remove the entire root mass.	Yes, with brush cutters or other tools it is possible to effectively kill root mass after removing above ground biomass.	Not recommended, stimulates growth and seed germination	Goats are known to not eat things toxic to them so
Himalayan blackberry (*Rubus armeniacus*)	Yes, but the removal of canes, roots, and root crowns is required	No, would require extreme disturbance of soil.	Yes, but only effective with intensive post burn management	Yes, Goats readily consume the plant.

Succession is an important biological principle to consider whenever managing invasive species. Seeding or planting of native prairie species is often a critical step to take following treatment of invasives. Similarly, it is important to consider population dynamics (Luken, 1997). Most of the invasives discussed here are capable of significant and rapid expansion. These types of aggressive species are often top priorities for land managers because inaction would result in greater short-term impacts as well as higher costs for management in the future to address these impacts. Existing native species populations should always be considered; since most invasive treatments are done to enhance native biota, managers should select techniques that have the least impact on them. This may be done with careful timing treatments to occur when native plant species have senesced for the year (Gonzales and Clements, 2010).

Evaluations of the identified top three invasive species and target invasive species of interest are detailed in Appendix B. A breakdown of considerations and recommendations within the different avenues of treatment methods are discussed below.

Treatment Methods

No action

Due to the severity of invasive species overgrowth observed at Mouralherwaqh, a no-action plan alternative is not recommended, as the domination of invasive species would continue to grow, causing a further decline in native and culturally significant plant species.

Manual

Manual removal methods can be the most feasible in both early stages and maintenance. When the plants desired for removal are too tall for mowers, too shrubby for chainsaws, and too dense for fire, using hand tools can be the best option. When managing invasive species regrowth, they are still young and small so more broad scale tools may become excessive. Pampas grass has very prolific seed heads, producing up to 100,000 seed per inflorescence, and each plant can produce many inflorescences in a season (Machi, 2024). To minimize the dispersal of seeds the seed heads need to be removed before any treatment that can move the plant and release seeds. Long handled loppers are a great tool for this task. A bag should also be placed around the seed head before harvesting to capture seeds that may fall while cutting.

With the scotch broom and Spanish heath being too dense for certain methods, loppers, folding saws, and machetes can be used to cut the base of the main stem to remove the bulk of the above ground vegetation. This can be followed by a variety of treatments, and if desired, the digging up the root mass can be done by using a spade shovel. Additionally, a McLeod, with its blade head, can cut back dense shrubbery and could be used to target some of the shrub communities.

A weed wrench can be very effective while managing resprouts post removal. This wrench can quickly remove the entire tap root of scotch broom without disturbing the area around, and is the only tool that can both remove the vegetation and roots in one go with minimal disturbance. However, it does not have much other application than young to midsized scotch broom.

It is also worth mentioning that, while Hymalayan blackberry is not one of our most dominating species on this site, it has a high invadability rating and can be managed now to minimize the severity in the future. Long-handled loppers are advisable to avoid the armaments of blackberry, and offer the leverage

and distance needed to cut blackberry canes as close to the ground as possible. Blackberry canes are often very thick and concealed in other shrubs. This should be followed by pulling up the canes by hand to ensure that all stolons are removed, as this plant can send out roots and propagate a new shoot when a branch reaches the ground (Humboldt Trails Council, Personal Experience). This treatment does require successive treatment until the plant no longer has enough photosynthetic material to keep re-sprouting. The manual techniques described are most effective on small infestations and in areas containing sensitive plant buffers.

Table 5: Effectiveness of treatment tools of targeted four invasive species. Formulated based on practices used by restoration organizations such as Humboldt Trails Council and the Watershed Stewards Program.

Plant name	Gloved Hands	Long Handled Loppers	Weed Wrench	Spade Shovel	Folding Saw	McLeod
Pampas grass (*Cortaderia selloana)*	Effective for young sprouts	Good for cutting off seed heads	Not generally effective	Needed to dig out roots to fully control propagation of species	Not generally effective	May be effective for cutting back foliage before removing root base
Scotch broom (*Cytisus scoparius)*	Effective for young sprouts	May be effective for midrange mature stems	Very effective when young	Good for removing mature roots	When stem is too thick for loppers, good for mature stems	Not generally effective
Spanish heath *(Erica lusitanica)*	Effective for young sprouts	May be effective for midrange mature stems	May Be Effective when young	Good for removing mature roots	When stem is too thick for loppers, good for mature stems	Not generally effective
(Rubus armeniacus)	Good for pulling up rooted stolons	Good for cutting mature stalks near soil surface	Not generally effective	Not generally effective	Not generally effective	Good for thick brambles when no other species interfere

Mechanical

While this site has sensitive cultural species, by surveying them ahead of time and establishing a 5m^2 manual removal-only buffer zone around them, this kind of equipment can be safely operated around them (Cal Fire, 2024) . When managing the top three invasive species and included Himalayan blackberry within this project site, the use of mechanical removal is most effective with two of those species, Spanish heath and Himalayan blackberry (Chow, 2024, Farber et al., 2020). While mechanical removal is slightly impractical for removing scotch broom, as this stimulates regrowth, it could be useful to take down the extremely large stands of it that have grown since the 2014 cutting (California Invasive Plant Council, 2024). This method could be great for long-term management or initial clearance where one of the previously mentioned methods is used afterward. Chain saws, masticators, and brush cutters would be most likely used for initial clearance. Mowers can be implemented after the initial biomass has been removed to cut back resprouts of scotch broom and Spanish heath and help select for grasses and forbs.

There are some issues for managing the site purely through mechanical methods. Any machine brought to the site has the potential to release oils and other pollutants associated with the maintenance and fueling of that machine. This can be mitigated by following guidelines on appropriate storage of hazardous materials and ensuring that all machines are in proper working order before entering the site. Larger machines have a much heavier impact on the surrounding environment than smaller hand based tools such as crushing vegetation under wheels or tracks. This means that buffers around sensitive species will need to be established and cleared before mechanical treatment. Machine operated equipment also creates more noise that may disturb nearby wildlife. Wildlife surveys should be conducted before mechanical equipment is implemented on the site.

Herbivory

Within the site are several culturally important or sensitive species, which would need a hand-pull buffer, as well as a grazing fence to exclude animals from damaging or destruction of these plants. Other considerations are the Riparian zones in the south and west, and a riparian buffer of a minimum of 50 feet would need to be placed as well (*Vol-1-Apdx-A1-Agencies.Pdf*, 2024). These buffer fences will have extra costs. Additionally, to inhibit the introduction of new invasive species to the site, a 24-hour isolation of grazing animals will be implemented (Burrows et al., 2015). During this time the goats will be fed sterile grain or other fodder, this is recommended to avoid the introduction of offsite seeds (Burrows et al., 2015). Coastal conditions and very high precipitation on site allow for an extended growing season, and more than one annual treatment may be needed per year while soil seed stock is being reduced. Usage of goats as browsing vegetative management is a strong tool for non-chemical, non-mechanical alternatives

to hand clearance for the initial broad removal of invasive species within the area of interest. As expediency isn't the main focus of this restoration project, smaller areas could be surveyed and a finer focus on primary species could be used, rather than the coarser scale that a larger area would tend to necessitate, as long as the rotation of areas is done frequently enough to avoid excessive trampling or erosive concerns, as well as avoiding health concerns for the animals.

Restorative Fire

Prairie ecosystems require the disturbance of fire in order to maintain their plant communities and heterogeneous ecosystems (Loud, 1918) which has historically been tended to by indigenous fire use (Clark et al. 2024). Fire can be a powerful tool in the restoration of balance within a disturbed and unhealthy site depending on when and how it is used. In fact, cultural burning is essential for ongoing management since fire-adapted species thrive and are usable for cultural practices like basketry only after being subjected to controlled, beneficial fires. Cultural burning would aid in restoring and maintaining this site within its natural balance as this was historically practiced by the Wiyot. When applied deliberately, it can eliminate excessive biomass and rejuvenate the land, echoing the traditional practices maintained for thousands of years before being disrupted by European colonization. However, when discussing this option with an employee of the WNRD, it is considered to be an inviable option due to excessive biomass, in conjunction with the proximity to nearby residential areas and a school. (Ray et al., 2012)

Fire is only recommended following sufficient fuels reduction and fuel break construction. Fire is necessary to promote diversity on the landscape, release energy stored in plants, and cycle nutrients. Fire plays a crucial role in succession and maintenance of a rangeland’s desired state, such as coastal prairie. It is further important to be used during restoration as the native vegetation that is adapted to this site requires fire to thrive as it has evolved with it and the nutrient cycling from this practice aids in the regeneration of soil health required by such species (J. Luong, personal communication, February 29, 2024).

However, the invasive species on site are also fire adapted, so special considerations must be taken. Both Spanish heath and scotch broom are fire followers, and adapted to thrive post fire. Spanish heath has fire adaptations that allow it to resprout post fire, as well as activate seeds that had been dormant in the seedbank. While this sounds problematic that more would sprout, this is also an opportunity to deplete the seed bank within a few years of successive burnings rather than let them persist in the soil, potentially popping up many years later to compete with reestablished native species (Mather, 1990). Timing fire with the phenology of these plants can aid in the effectiveness of this tool. In spring, just before the plants

bloom can be effective for minimizing seed dispersal, and re-growth will not be able to recover in time to produce flowers that season, effectively draining the seedbank (Srinivasan, 2012).

Invasive Plant Mapping

Our original invasive plant mapping efforts were extremely unsuccessful. Due to the extreme thickness of the brush it was difficult to maneuver around the different patches of scotch broom, Spanish heath, and pampas grass. This led to our team pushing our way through and even crawling to create perimeters around groups of plants. It was also discovered that some of the devices present were struggling with GPS accuracy. Oftentimes along the road an error of plus or minus 10ft, but after entering the dense vegetation could reach up to 50 ft. The amount of time this kind of mapping requires is also fairly intense, making it hard to accomplish alongside other goals of our project. Due to this, our mapping plan was adapted to use Google Earth to illustrate overhead imagery of visible target invasive plant species. With high resolution imagery, vegetation identification can be done with a fair degree of accuracy, but the level of visual acuity from available high resolution overhead is still too grainy, leading to a recommendation of aerial drone imagery. See **Table 3** for areas and averages of species from Google Earth Pro polygons.

Avoidance Measures

Sensitive Species

To avoid damaging or harming the environment of sensitive culturally desired species, it is recommended to survey the site for all current cultural and sensitive taxa and create pins for each on a map. Then establish a $5m^2$ buffer zone around the plant (Cal Fire, 2024). This will allow for preventive measures to be placed at appropriate distances for any of the suggested restoration methods.

Nesting Seasons

The Great Blue Heron (*Ardea herodias*) and Great Egret (*Ardea alba*) are known to nest within the boundaries of the project site (Z. Erickson, pers. Comm., 2024). The nesting and breeding season for the two bird species range from March through June (Kelly et al, 1993). Recommended buffer distances for wading birds (herons, egrets, ibises) range from 50-100m, depending on disturbance types; be it daily human visitation, loud motors, or heavy construction (Carney et al, 1999).

Community Involvement

Wiyot Community Management

The Wiyot Tribe Natural Resources Department has expressed that they are interested in organizing youth education days that facilitate connection to the land and their heritage. This may involve an invitation for the Wiyot community and youth to help during the restoration process. This may also be a good opportunity to bring Elders and youth together during the re-planting phase to pass on the Traditional Ecological Knowledge, that has been disconnected from this place for centuries, of how to steward the land in a reciprocal relationship.

External Groups

The acquisition of Mouralherwaqh was supported by partnerships from Cal Poly Humboldt, Humboldt Baykeeper, and Friends of the Dunes (Salmon, 2022). The Wiyot Tribe also has partnerships with College Corps, giving them college interns as their community partners to collaborate with and work on site.

Future connections to the community can involve collaborating with community volunteer groups. Because of the previous partnership with Friends of the Dunes, it would be possible to set up a volunteer day with their volunteer base. The Trail Stewards, in conjunction with the Redwood Audubon Society, are currently working on restoration on Wigi and could potentially be open to expanding their efforts to Mouralherwaqh as the goals for this site are to restore the coastal prairie which is shared with Wigi (Humboldt Trails Council, 2024).

If the Wiyot desire, they can host a volunteer day open to the community. This would involve a lot of planning and prepping of the site and tools required. All volunteers would need to sign a liability release, so someone would need to develop this document and potentially go through a permitting process for this. With public involvement, the methods used for operation safety needs to be considered. That being said, this might be better suited for after mechanical treatments have been implemented, if the Tribe decides to go that route. Using manual tools is more manageable with untrained volunteers when training how to use the different tools. This type of event would also require picking out accessible target areas and species, potentially multiple groups for different locations on the site. Additionally, all tools necessary for a large group to contribute would need to be acquired and supplied in advance which involves financial planning.

With the Tribe’s connection with CPH students already, involvement with the Natural Resources Club is another potential collaboration. This type of volunteer day would be similar to a community volunteer day, but it would reach all the students involved with the club. Many of the students involved with this

club are passionate about restoration and would be grateful to participate in the restoration of such a culturally significant place.

Project Considerations and Compliance

Safety Protocol and Site Logistics

All work on the site will be supervised by a WNRD representative. This representative will be the lead for the day and meet with anyone working on the site at a predetermined location before starting work as well as holding any important documents for the project such as permits, MSDS sheets, emergency procedures and plans and anything else needed. At the beginning of the work day, the crew-lead will ensure that all workers have the proper personal protective equipment (PPE), have been properly trained on all tools they will be using for the day, discuss any site or environmental hazards that may exist with that day's team, and ensure everyone working on the site is following all OSHA (Occupational Safety and Health Association) safety standards and regulations (OSHA, 2024).

The lead will also ensure that all hazardous materials are stored on site and the fueling or maintenance of mechanical tools is performed at least 30 meters or 100 feet away from any body of water or wetland. In the instance of prescribed or cultural burning implementation, any application of fire must be preceded by rigorous risk assessments and strategic planning to ensure safety and efficacy.

Regulatory Conformance and Permitting

The restoration required for this treatment plan and future restoration initiatives fall under the California Coastal Act's definitions of "major vegetation removal" and "development". Additionally, classifying areas within or adjacent to the project site as an Environmentally Sensitive Habitat (ESHA) necessitates a Coastal Development Permit (CDP) (California Coastal Commission (CCC, 2020). The city of Eureka's Development Services provides a CDP Application Guide on their website. See Appendix E for additional information, and the County's legal definition of major vegetation removal, and ESHA.

Post-Project Monitoring

Monitoring methods

Vegetation surveys

Long term monitoring using the initial vegetative survey method with a $3m^2$ plot is recommended to measure any changes on the landscape and in the plant community. This survey will gather quantitative data that can be analyzed to better predict community shifts and the amount of work needed to eradicate the current invasive species from the landscape.

Photo Point Surveys

To further measure and understand the changes to the landscape as restoration is completed, it is recommended to set up photo points at each vegetative survey location. Including this photo survey as a step of the vegetation monitoring protocol will allow for the rapid collection of qualitative data that may not be readily apparent in vegetation surveys. The photos should be taken from an easily repeatable point, azimuth, and time of day to ensure that over many years that photos are easy to compare to each other. It is also recommended to use satellite imagery of the site over time to help visualize the restoration work.

Water monitoring

Regular water sampling should be performed after intensive restoration efforts have been started. This will ensure that the sudden removal of large amounts of vegetation does not dramatically increase the sediment loads to nearby waterways and wetlands. If sediment loads are drastically increased it may be necessary to halt restoration work until the proper mitigation methods can be employed.

Project Recommendations

Mapping

Future invasive plant mapping efforts are recommended to be done digitally, through the use of high-resolution aerial imagery. This imagery can be obtained either through a drone flight of the site or another source. Then creating polygons around groups of invasive species in ArcPro and ground truthing the results.

It is also recommended that a map of all of the culturally important species on the site be made. This will help future restoration planning and efforts avoid sensitive vegetation and better protect it. Using the same site map that was used for locating vegetative survey locations, a wandering style assessment can be performed throughout the site. Using the tracking feature to see what areas have been covered by the surveyor, large areas can be covered effectively and thoroughly.

Vegetation Disposal

With the amount of vegetation present, burning piles of the removed vegetation may cause hazards for larger volumes, so disposing of vegetation off-site may be necessary. Renting large waste bins to transport the vegetation to green waste disposal areas nearby is a feasible disposal alternative. The WNRD expressed interest in transporting some organic waste off site, but they would like to keep as much of the organic waste as possible on site as to utilize methods of disposal like pile burning, composing, and chipping (Z. Erickson, personal communication, April 24, 2024).

Treatment Plan

Based on the results of this study, the suggested treatment methods should be approached as a three phased treatment plan. The phases are as follows:

1. Phase 1 - Pre-restoration
2. Phase 2 - Initial invasive species clearance
3. Phase 3 - Long-term maintenance

Pre-Restoration Phase: Mapping and Preparation

The recommended first phase begins with pre-restoration efforts concentrated on research, mapping, and preparation of the land. In this phase, surveys should be conducted to document the presence and location of all native, cultural and sensitive taxa. Using this data, maps should be created to delineate locations with sensitive species presence, to establish avoidance measures to avoid damaging or harming the environment and species within it. Based on observed species presence, avoidance measures should take place including but not limited to establishing appropriate distances for any planned restoration methods, and researching intervals and seasonality of nesting and blooming times for flora and fauna within the area to determine the best time for restoration. Some examples of avoidance strategies include establishing buffer zones of $5m^2$ around native and culturally significant plant species, and buffer distances from 50-100m for wading birds (herons, egrets, ibises).

Phase 1: Initial Invasive Species Clearance

Phase one of the restoration process should concrete on an initial clearance of the invasive plant species to reduce density and fuel loads. This phase should be approached utilizing a combination of manual and mechanical techniques for plant removal. Manual removal has a wide range of usage and is scalable for various sites and needs. Manual hand tools such as axes, shovels, weed wrenches or McLeod can be used to remove a variety of species including pampas grass, and scotch broom if using grubber techniques. These techniques can be initial treatments or long-term management. They are usually the easiest for volunteer groups to participate in, and would have the smallest impact on the surrounding environment. Mechanical tools include hand powered tools such as chainsaws, weedwackers, and larger equipment such as a mower, chain flail, or masticator. These tools usually speed up vegetation clearance considerably, and are less labor intensive for individuals.

Phase 2: Long-Term Maintenance

Phase two of the treatment plan should approach long term management of the site, exploring larger scale options such as implementing grazing, and traditional ecological knowledge such as fire and cultural burning. After the first phase of restoration, goats can be brought into the site to rotationally graze the area to clear vegetation as they can eat plants up to 7 feet high and up to 1 inch in diameter. To keep the goats within designated areas and to protect other species, fences should be installed throughout their presence. Other than establishing boundaries for the goats, there is fairly low involvement of other workers on site besides the one person who herds the goats. Their grazing can help support the next phases of restoration at this site by reducing flammability. Traditional ecological knowledge, fire or cultural burning should be considered as a restoration phase once the vegetation density has decreased and there are lower fuel loads on site. It is important to acknowledge that each Tribe uses fire differently, and have done so for millennia. Therefore, methods and preferences are determined by each individual Tribe, highlighting the importance of supporting the Wiyot Tribe’s preferred method, and having them appoint their preferred Tribal Cultural Fire Practitioner to see out the project. Utilizing fire restoration has usually been determined to be extremely effective and a good treatment for the vegetation seed banks.

Vegetative Monitoring

With the Tribal reacquisition of the site, it is viable for monitoring to continue in perpetuity, as invasive establishment will continue to be a challenge. It is also recommended that as restoration happens and the site's coastal prairie grows, to expand the number of monitoring plots within the clear cut. This is to

compensate for the reduction in quadrat size from $10m^2$ to $3m^2$ as well as the growth of the desired plant community.

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Appendices

Appendix A. Invasive Non-Native Plant Species Found within the Project Site

Common Name	Scientific Name	Cal-IPC Rating
Cotoneaster	*Cotoneaster sp.*	Moderate
English ivy	*Hedera helix*	High
Fuchsia	*Fuchsia magellanica*	Not Listed
Himalayan blackberry	*Rubus armeniacus*	High
Monterey pine	*Pinus radiata*	Not Listed
Pampas grass	*Cortaderia selloana*	High
Scotch broom	*Cytisus scoparius*	High
Spanish heath	*Erica lusitanica*	Limited
Tri-corner onion	*Allium triquetrum*	Not Listed

Appendix B. Description and Method Assessment of Target Invasive Plant Species

The following is a list of targeted invasive plant species, their descriptions, life history, and threats posed by them.

Himalayan blackberry (*Rubus armeniacus*) is an evergreen, winter deciduous shrub. Its roots are generally found within the top 2 feet of soil, although they can extend down to 7 feet in looser soil conditions. New plants are capable of sprouting from root buds and, in favorable conditions, from root fragments as well. The shrub produces white to pinkish flowers that are capable of self-pollination. Its seeds remain viable for long periods in seed banks. The Cal-IPC has classified the Himalayan blackberry as having a high level of invasiveness. With a thin epidermis it is considered fire-sensitive, though it is known to sprout vigorously after fire or other disturbances (Cal-IPC, 2024).

Mowing is a cost-effective treatment used to control large areas of blackberry, and results in a short-term plant canopy reduction to provide an opportunity for native plants to grow and survive (Ditomaso, 2002; Dennehy et al., 2011). Hand removal is a slow, labor-intensive but effective method to control areas of blackberry, requiring the thorough removal of stems, root crowns, and plant fragments (Soll, 2004). However, a 2016 study comparing the two found that neither proved truly effective on their own. Instead, an integration of the two is recommended. This integration would involve an initial mowing treatment followed by hand removal within two months (Chow, 2016).

Scotch broom (*Cytisus scoparius*) typically thrives in disturbed areas like river banks, road cuts, and forest clearcuts, though it can also spread into undisturbed grasslands, shrublands, and open canopy forests. This deciduous shrub features yellow, pea-shaped flowers that grow singly or in pairs along its erect branches. Each seedpod can hold up to 9 seeds, which can stay viable in the soil for up to 60 years. The Cal-IPC has classified scotch broom as having high invasiveness due to its severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. It grows quickly, forming dense thickets that are difficult for wildlife to penetrate and do not provide edible resources. Additionally, it can hinder the regeneration of other plant species and increases the risk of fires. Scotch broom's ability to fix nitrogen in the soil can inadvertently enhance the growth of other invasive plant species by improving soil fertility (Cal-IPC, 2024).

Dougherty et al (2004) found that manual methods are the most selective and can minimize effects on desired sensitive and native vegetation. For scotch brooms, this would include hand pulling of small plants and the use of weed wrenches on whole large plants. Hand pulling is most effective when soil is

moist, and weed wrenches have proven most effective for their added leverage in removing plant base and roots, thus eliminating the possibility of resprouting (Ussery et al., 1998)

Spanish heath (*Erica lusitanica*) is usually found along roadsides and in disturbed areas but also spreads into various native vegetation types, including wet and dry forests, grasslands, and riparian areas. It tends to form dense monocultures in areas with sparse canopy cover. Spanish heath is a woody evergreen perennial that reaches up to 7 feet in height, with brittle stems and small, densely clustered pointed leaves. It blooms from late autumn to early spring, producing white or pinkish flowers that appear in loose clusters at the stem ends. Each flower can generate hundreds of tiny, dust-like seeds that spread via wind, water, soil, and animal movement. The plant is capable of rapid regrowth after being cut down or burned. The Cal-IPC has given Spanish heath a rating of Limited Invasiveness (Cal-IPC, 2024).

With a winter flowering period along with the plant's encouraged regrowth after cutting or burning, hand removal of small plants and use of a weed wrench on larger plants during the months of March to August is recommended. Care must be taken as the plant's woody and narrow diameter can break off easily, and remaining roots will reshoot. Species-specific research on removal methods (outside of herbicide) for Spanish heath is limited.

Pampas grass (*Cortaderia selloana*) is frequently found in open, sunny landscapes such as meadows, along highways, and in coastal areas where it is often planted as an ornamental due to its striking appearance. It is characterized by its tall stature, reaching up to 10 feet in height, and is known for its large, feathery plumes that range in color from silver-white to pale pink. Pampas grass forms dense thickets that can dominate the landscape, outcompeting native vegetation and reducing biodiversity. Its deep roots make it difficult to remove once established, and its ability to produce numerous seeds—each plant can generate over one million seeds annually—facilitates rapid spread and colonization of large areas. The seeds are dispersed by wind and can travel significant distances. The plant's dense growth and dry foliage also pose a significant fire risk, especially in arid climates. While pampas grass can provide some erosion control, its environmental impacts are generally negative, particularly regarding native species displacement and fire risk. Cal-IPC has given pampas grass a high rating of invasiveness (Cal-IPC, 2024).

Appendix C. Species Identification Key Provided by Wiyot Tribe

Mouralherwaqh, Humboldt County, California **1**

Plants of Mouralherwaqh

Zachary J. Erickson[1], Author[2], Author[3], & Author [4]
[1]Wiyot Tribe Shawir Darrudaluduk, [2]Author's Institution [3]Author's Institution, & [4] Author's Institution

[0000] version 1 7/2023

1 *Scrophularia californica* - **CA bee plant** SCCA

2 *Rubus ursinus* mip **blackberry, California** RUUR

3 *Rubus armeniacus* - **blackberry, Himalayan** RUAR

4 *Erechtites minima* - **burnweed, coastal** ERMI

5 *Frangula purshiana* dételh **cascara** FRPU

6 *Petasites palmatus* - **coltsfoot** XX

7 *Symphytum sp.* - comfrey XX

8 *Heracleum maximum* wough **cow parsnip** XX

9 *Malus fusca* - **Oregon crabapple** XX

10 *Ranunculus repens* - **creeping buttercup** XX

11 *Marah oregamus* - **coastal manroot** XX

12 *Pseudotsuga menziesii* burayuplhi' **Douglas-fir** XX

13 *Sambucus racemosa* ti'malhat **elderberry, red** XX

14 *Erica lusitrana* **Erica** XX

15 *Vaccinium ovatum* vou'gul **huckleberry, evergreen** XX

Mouralherwaqh, Humboldt County, California

Plants of Mouralherwaqh

3

Zachary J. Erickson[1], Author[2], Author[3], & Author [4]

[1]Wiyot Tribe Shawir Darrudaluduk, [2]Author's Institution [3]Author's Institution, & [4] Author's Institution

[0000] version **1** 7/2023

31 *Iris douglasiana*
-
iris, Douglas
XX

32 *Maianthemum dialatatum*
-
lily-of-the-valley, false

33 *Maianthemum stellatum*
-
lily-of-the-valley, star flowered

34 *Hosackia sp.*
-
Lotus
XX

35 *Andiantum aleuticum*
siswaqi'
Maidenhair fern
XX

36 *Arctostaphylos columbiana*
ghus
manzanita, hairy
XX

37 *Claytonia perfoliata*
-
miner's lettuce
XX

38 *Plantago majoris*
-
plantain, broadleaf
XX

39 *Plantago lancealata*
-
plantain, narrowleaf
XX

40 *Alnus rubra*
wit
Red alder
XX

Mouralherwaqh, Humboldt County, California

Plants of Mouralherwaqh

4

Zachary J. Erickson[1], Author[2], Author[3], & Author [4]
[1]Wiyot Tribe Shawir Darrudaluduk, [2]Author's Institution [3]Author's Institution, & [4] Author's Institution

[0000] version 1 7/2023

46 *Sanicula crassicaulis*
-
sanicle, pacific
XX

47 *Carex abapta*
-
sedge, slough
XX

48 *Picea sitchensis*
da'k
Sitka spruce
XX

49 *Lysichiton americanus*
-
Skunk cabbage
XX

50 *Juncus effusus*
-
soft rush
XX

51 *Rubus parviflorus*
boukshughutsgaqi'
Thimbleberry
XX

52 *Lonicera involucrata*
-
twinberry
XX

53 *Oenathe sarmentosa*
-
water parsley
XX

54 *Rumex occidentalis*
-
western dock
XX

55 *Asarum caudatum*
-
wild ginger
XX

56 *Salix lucida*
tgulh
willow, shining
XX

57 *Salix sitchensis*
-
willow, Sitka
XX

58 *Ribes menziesii*
-
canyon gooseberry
XX

59 *Ribes sanguineum*
-
red flowering currant
XX

60 -
XX

Appendix D. Documents provided by Wiyot Tribe Natural Resources Department.

Plant Data Sheet

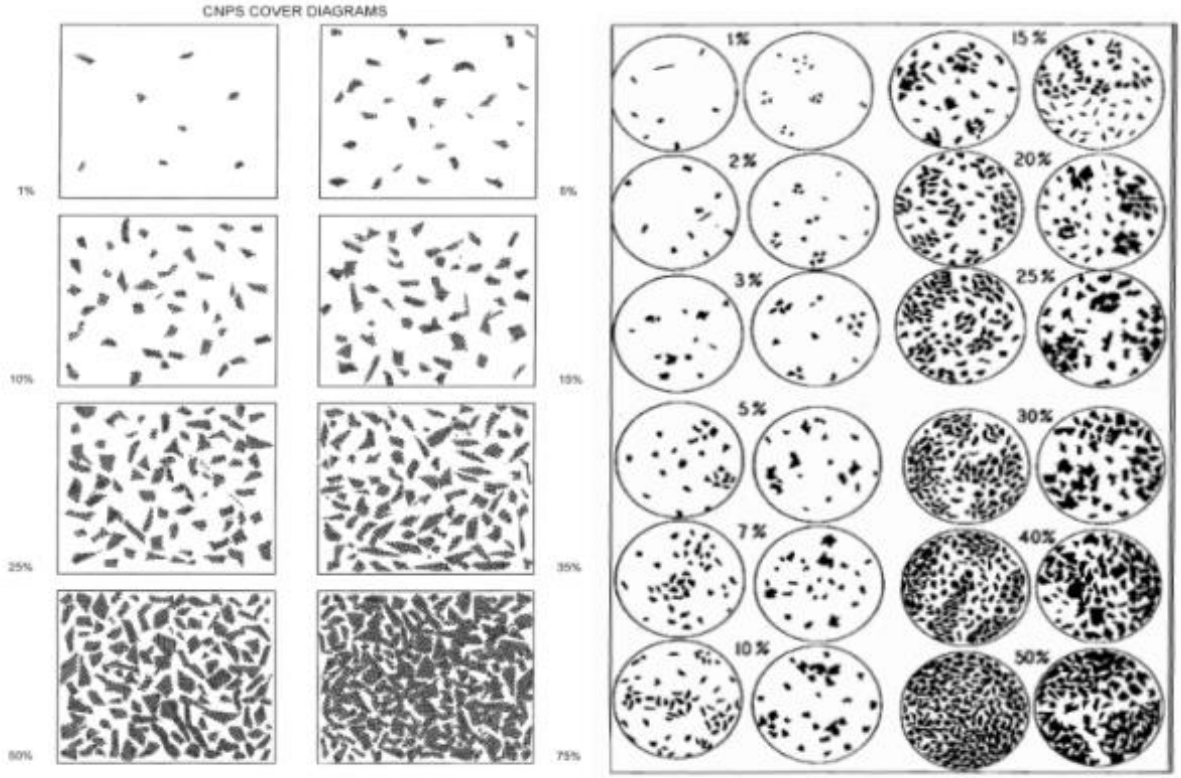
Wiyot Tribe Natural Resources Department

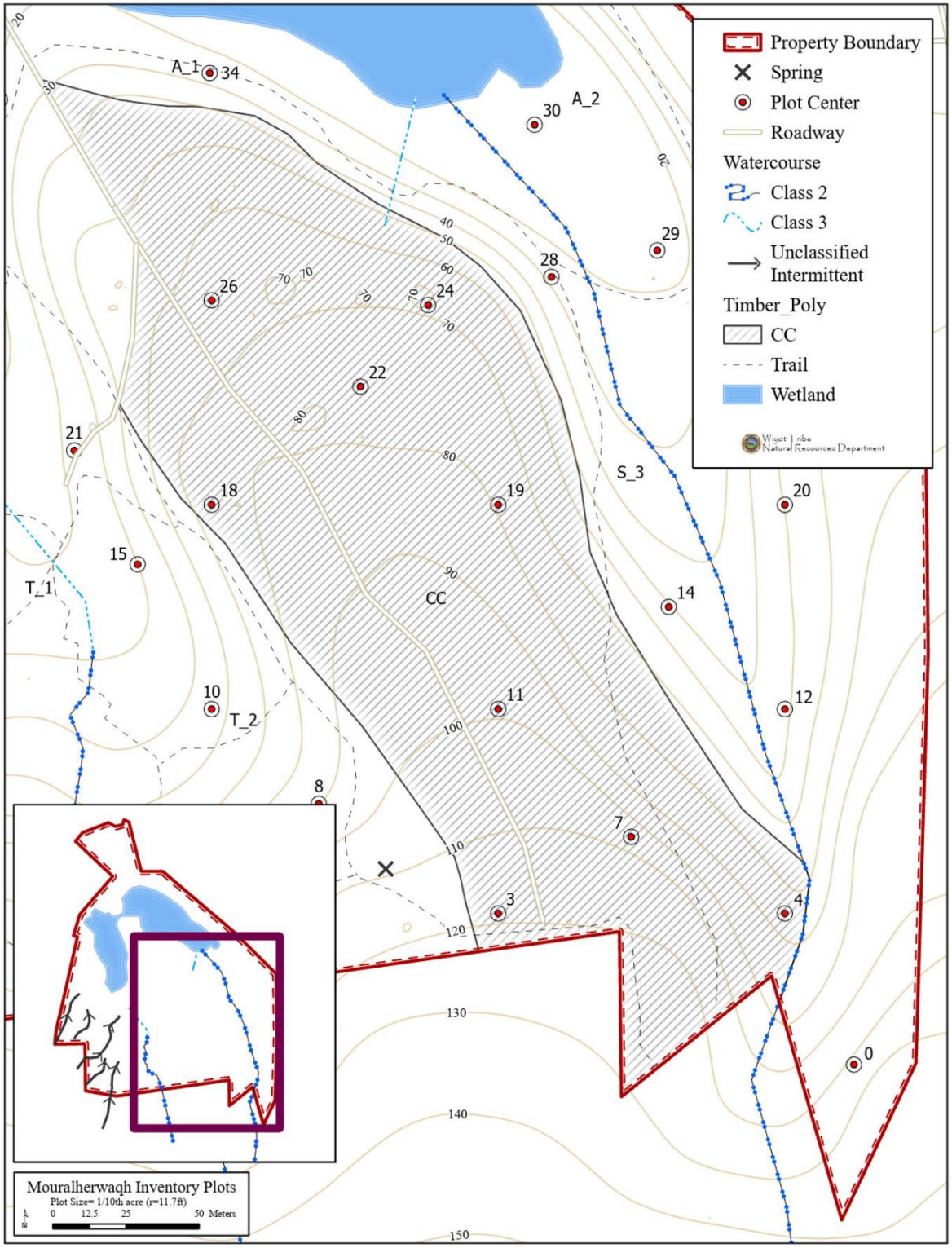
Plot ID		**Initials**		Page __ of ___
Date				
Location		**Notes**		
Plot Type				
Canopy Closure	Hits:		Total:	

Sp Code	Species	% Cover	Native?	Lifestage	Stratum	Height Class	Access			Notes

Botanical Plant Code Key, and Cover Estimation Guide

Botanical Plot Codes			
Quad ID	N, E, S, W	**Height Class**	1=<0.5m, 2=0.5-1m, 3=1-2m, 4=2-5m, 5=5-10m, 6=10-15m, 7=>15m
Quad Dist	Distance from Plot center		
Stratum	T=Tree, A=Sapling, E=Seedling, S=Shrub, H=Herb, N=non-vascular		
% Cover Intervals (SEE DIAGRAM BELOW)	r = trace, <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%		
Lifestage	0=dormant, 1=vegetative, 2=budding, 3=flowering, 4=gone to seed		
Access	1=on trail, 2=<3m from trail, 3=>3m from trail, 4=>10m from trail		




Property Boundary
Spring
Plot Center
Roadway
Watercourse
Class 2
Class 3
Unclassified Intermittent
Timber_Poly
CC
Trail
Wetland
Wiyot Tribe Natural Resources Department
A_1
A_2
S_3
T_1
T_2
CC
34
30
29
28
26
24
22
21
18
19
20
15
14
10
11
12
8
7
3
4
0
Mouralherwaqh Inventory Plots
Plot Size= 1/10th acre (r=11.7ft)
0 12.5 25 50 Meters

Appendix E. Coastal Development Permitting

This type of development requires a permit issued by the Commission or a certified local coastal program (LCP) such as the Humboldt County LCP. The Act requires a permit when vegetation removal meets the requirements to be considered development, which is defined as:

> *"the removal or harvesting of major vegetation other than for agricultural purposes, kelp harvesting, and timber operations which are in accordance with a timber harvesting plan".*

As the Act does not define "major vegetation," issuance of a CDP must be evaluated on a case by case basis, and depends on scope, methods, and the type of vegetation being removed (Kraemer, 2016). Humboldt County defines major vegetation removal as the removal of one or more trees exceeding 38" DBH, the removal of more than 1/10th of an acre of trees, if the removal of any vegetation results in significant environmental impact, if it is within an environmentally sensitive habitat, or the vegetation removal can result in exposure to wind damage (Humboldt County, 2024).

This permit is essential for ensuring that all developments within the Coastal Zone adhere to the stringent standards set forth by the Act, which aims to protect, conserve, and, where possible, restore the environmental quality and resources of the Coastal Zone. The process involves a thorough review by the CCC to assess the potential impacts of the proposed development on the coastal environment (CCC, 1994).

The permitting process includes several key steps: submission of a detailed application, a site evaluation, public consultation phases, and a review of the environmental impact assessments. This procedural adherence is crucial for mitigating any adverse effects on coastal ecosystems and for promoting sustainable development practices within the coastal area. Additionally, the permit ensures that the development does not impede public access to coastal areas, which is a fundamental requirement under the California Coastal Act (CCC,1994).

The outcome of this permitting process will influence the project's timeline and operational protocols, as adherence to regulatory conditions must be maintained throughout the duration of the project. It is also critical for the project team to stay updated with any changes in coastal development policies and to maintain open lines of communication with the CCC to facilitate smooth project progression and compliance.

Definitions; Humboldt County Code

The City of Eureka's Coastal Land Use Plan (2023) has adopted the CCA's definition (2024) of environmentally sensitive habitat areas to mean "any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments."

64.1 VEGETATION REMOVAL, MAJOR

64.1.1 **Purpose.** The purpose of these provisions is to: (1) preserve and protect major vegetation within the County Coastal Zone that directly and indirectly prevents soil erosion, landslide and flood hazard; (2) reduce runoff, provide windbreaks or provide protection to adjacent trees from irreparable wind damage; and (3) protect property values and the local economy by maintaining the visual quality of the County, while respecting and recognizing individual rights to develop, maintain, and enjoy private property to the fullest possible extent. (Former Section CZ#A314-20(A))

64.1.2 **Major Vegetation Removal Permitted With a Special Permit in All Zones as an Accessory Use.** Major vegetation removal may be permitted with a Special Permit in all zones, as an accessory use associated with a specified principal or conditionally permitted use. Major vegetation removal may be permitted with a Special Permit in conjunction with or prior to the establishment of a principal or conditionally permitted use. (Former Section CZ#A314-20(B))

64.1.3 **Applicability.** These regulations shall apply to major vegetation removal as defined in this section, within the Humboldt County Coastal Zone, except that the following development shall be exempt: (Former Section CZ#A314-20(C))

64.1.3.1 Timber management and timber harvesting activities regulated by the California Department of Forestry and the Board of Forestry, and forest improvement activities carried out under the Forest Incentives Program (FIP), Agricultural Conservation Program (ACP), or California Forest Improvement Program (Cal FIP); (Former Section CZ#A314-20(C)(1))

64.1.3.2 Major vegetation removal necessary to carry out activities authorized by: (1) an approved building permit, Coastal Development Permit, Use Permit, or Special Permit; or (2) satisfying improvement requirements of an approved subdivision; (Former Section CZ#A314-20(C)(2))

64.1.3.3 Major vegetation removal subject to the Coastal Streams and Riparian Corridor regulations; and (Former Section CZ#A314-20(C)(3))

64.1.3.4 Major vegetation removal associated with general agriculture, in zones where the General Agriculture use type is a principal permitted use, except where the Director determines that pursuant to subsection 313-64.1.4.3., that the major vegetation removal may result in a significant environmental impact. (Former Section CZ#A314-20(C)(4))

64.1.4 **Definition of Major Vegetation Removal.** For purposes of this section major vegetation removal shall be defined to include one or more of the following: (Former Section CZ#A314-20(D))

64.1.4.1 The removal of one or more trees with a circumference of thirty-eight inches (38") or more measured at four and one-half feet (4½') vertically above the ground; (Former Section CZ#A314-20(D)(1))

64.1.4.2 The removal of trees within a total aggregate contiguous or non-contiguous area or areas exceeding 6,000 square feet, measured as the total of the area(s) located directly beneath the tree canopy; or (Former Section CZ#A314-20(D)(2))

64.1.4.3 The Director may determine that a proposal to remove woody vegetation constitutes major vegetation removal if the Director finds that it may result in a significant environmental impact pursuant to this section. In making a finding that the proposed major vegetation removal may result in a significant environmental impact, the Director shall review the proposal and determine if any of the following conditions exist or are proposed: (Former Section CZ#A314-20(D)(3))

64.1.4.3.1 The major vegetation removal involves the use of heavy equipment; (Former Section CZ#A314-20(D)(3)(a))

64.1.4.3.2 The major vegetation removal:

64.1.4.3.2.1 is proposed on either a steep slope (15% or greater), or on a slope designated on the Geological Map of the General Plan with slope stability index of “2” - moderate instability, or “3” - high instability; and (Former Section CZ#A314-20(D)(3)(b))

64.1.4.3.2.2 may result in soil erosion or landslide; (Former Section CZ#A314-20(D)(3)(b))

64.1.4.3.3 The major vegetation removal is located within or adjacent to an environmentally sensitive habitat as identified in the applicable coastal area plan; or (Former Section CZ#A314-20(D)(3)(c))

64.1.4.4 The major vegetation removal may result in significant exposure of adjacent trees to wind damage. (Former Section CZ#A314-20(D)(3)(d))

64.1.5 **Appeal of the Director's Determination of Major Vegetation Removal.** Appeals may be filed pursuant to the appeal procedures in Chapter 2, Section 312-13.

https://humboldt.county.codes/Code/313-64

Appendix F. Tables

Table 6: Estimated area of invasive plants from Google Earth map.

Spanish heath perimeter avg	Area acreage average	Scotch broom per average	average acreage	Pine per average	acreage average
130	0.11	238.6285714	0.165	59.442	0.025
Spanish heath perimeter (M)	area (acres)	Scotch broom (M)	area (acres)	Pine (M)	area (acres)
130	0.11	1106	0.78	43.6	0
		82.2	0	55.6	0
		173	0.1	52.6	0
		42.1	0	106	0.1
		34.2		72.8	0.1
		188	0.11	16.9	0
		44.9	0	8.24	0
				278	0.18
				22.3	0
				16.8	0

Spanish heath perimeter avg	Area acreage average	Scotch broom per average	average acreage	Pine per average	acreage average
				25.3	0
				43.4	0
				19.5	0
				21.3	0
				60.3	0
				173	0.12
				39.5	0
				59.4	0
				25.9	0
				48.4	0
Total acres	0.11		0.99		0.5

Appendix G. Field Datasheets

Plot ID	3	**Slope**	1°%			
Date	4/5/24	**Aspect**				
Location	40.730423, -124.207199	**Azimuth**	258			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken fern	4	N	1	N	4
RUUR	California blackberry	5	N	1	S	4
CYSL	Scotch broom	5	I	3	S	4
	Graminoid	5		1	H	1

Plot ID	4	**Slope**	12%			
Date	4/5/24	**Aspect**	E			
Location	40.730446, -124.206260	**Azimuth**	310			

Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
RUUR	California blackberry	3	N	3	S	3
BAPI	Coyote brush	3	N	1	S	3
HEHE	English ivy	r	I	1	S	2
MADI	False lily of the valley	r	N	1	H	2
COSE	Pampas grass	7	I	4	H	4
POMU	Sword fern	2	N	1	H	2
LOIN	Twinberry	3	N	2	S	3

Plot ID	7	**Slope**	42°			
Date	4/5/24	**Aspect**	E/SE			

Location	40.730619, -124.206638	**Azimuth**				
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken fern	4	N	0	H	2
RUUR	California blackberry	2	N	1	S	1
FRPU	Cascara	3	N	2	S	4
BIPI	Coyote brush	3	N	1	S	2
FUMA	Fuchsia	2	I	1	S	3
RUAR	Himalayan blackberry	r	I	1	S	1
COSE	Pampas grass	6	I	4	H	3
RISA	Red flowering currant	r	N	3	S	1
PISI	Sitka spruce	2	N	1	T	4
POMU	Sword fern	2	N	1	H	1
RUPA	Thimbleberry	3	N	2	S	3

Plot ID	11	**Slope**	12%			
Date	4/5/24	**Aspect**	W/NW			
Location	40.731047, -124.207215	**Azimuth**	347			

Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken fern	r	N	1	H	1
CIVU	Bull thistle	2	I	1	H	1
RUUR	California blackberry	7	N	2	S	3
HOLA	Velvet grass	4	I	1	H	2
	Nightshade	r	N	3	H	1

Plot ID	18	**Slope**	6°			
Date	3/29/24	**Aspect**	E/NE			
Location	40.731652, -124.208285	**Azimuth**	301			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
RUUR	California blackberry	5	N	1	H	2
FRPU	Cascara	1	N	1	S	2
BAPI	Coyote brush	1	N	1	S	2
HEHE	English ivy	2	I	1	H	1
VAOV	Evergreen	3	N	1	S	2

	huckleberry					
ABGR	Grand fir	2	N	1	T	4
RUAR	Himalayan blackberry	3	I	1	S	2
PIRA	Monterey pine	5	I	1	T	4
COSE	Pampas grass	4	I	4	H	3
RISA	Red flowering currant	2	N	3	S	2
VAOV	Red huckleberry	r	N	1	S	2
GASH	Salal	1	N	1	H	1
RUSP	Salmonberry	2	N	3	S	2
CYSL	Scotch broom	2	I	3	S	3
PISI	Sitka spruce	5	N	1	T	4
ERLU6	Spanish heath	5	I	4	S	3
POMU	Sword fern	r	N	1	H	1
RUPA	Thimbleberry	r	N	1	S	1
	Cotoneaster	r	I	1	S	2
	Forbs	2			H	1
	Graminoids	5			H	1

Plot ID	19	**Slope**				
Date	4/5/24	**Aspect**				
Location		**Azimuth**	303			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken fern	2	N	1	H	1
RUUR	California blackberry	5	N	1	S	1
FRPU	Cascara	4	N	1	S	2

Plot ID	22	**Slope**	5°			
Date	3/22/24	**Aspect**	N/NW			
Location	40.732032, -124.207746	**Azimuth**	140			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken Fern	5,4,5,5	N	0	N	3
RUUR	California blackberry	6,6,6,6	N	1	S	2
HEMA	Cow parsnip	r,r,r,0	N	1	H	1
BAPI	Coyote brush	r,0,0,0	N	2	S	2

RUAR	Himalayan blackberry	2,2,r,2	I	1	S	2
COSE	Pampas grass	0,0,2,0	I	1	H	3
RUOC	Doc	0,r,0,0	N	1	H	1
RISA	Red flowering currant	r,0,0,0	N	3	S	2
RUSP	Salmonberry	2,r,0,1	N	3	S	2
CYSL	Scotch broom	3,0,0,0	I	3	S	2
LOLA	Twinberry	0,0,1,0	N	1	S	2
	Buttercup	0,r,0,r	I	1	H	1
	Hedgenettle	0,1,r,2	I	3	H	1
	Rush	3,3,4,5	N	1	H	1
	Sedge	3,3,1,2	N	0	H	2

Plot ID	24	**Slope**				
Date	4/5/24	**Aspect**				
Location		**Azimuth**	214			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	bracken fern	1	N	0	H	1
RUUR	California blackberry	3	N	1	S	1

IRDO	Douglas Iris	r	N	3	H	1
MAOR	Manroot	2	N	1	H	1
PIRA2	Monterey pine	6	I	1	T	3
COSE4	Pampas grass	1	I	4	H	3
GASH	Salal	r	N	1	H	1
ERLI	Spanish heath	4	I	4	S	2

Plot ID	26	**Slope**	17%			
Date	4/5/24	**Aspect**				
Location	40.732273, -124.268328	**Azimuth**	112			
Species Code	**Species**	**Cover Class**	**Native**	**Lifestage**	**Stratum**	**Height Class**
PTAQ	Bracken fern	2	N	0	N	2
RUUR	California blackberry	4	N	1	S	4
CEIN3	Deerbrush ceanothus	2	N	1	S	3
VAOV	Evergreen huckleberry	r	N	1	S	1
PIRA	Monterey pine	6	I	1	T	5
COSE	Pampas grass	3	I	1	H	4
RUSP	Salmonberry	r	N	1	E	1

CYSL	Scotch broom	3	I	3	S	4
ERLU	Spanish heath	5	I	1	S	4
RUPA	Thimbleberry	r	N	1	S	2

Common Name	Native(N)/ Invasive(I)	Scientific Name	USDA Code	3	4	7	11	18	19	22a	22b	22c	22d	24	26	Average % Cover (when present)	True average % (across all plots)
Bracken fern	N	*Pteridium aquilinum*	PTAQ	20		20	0.5		3	37.5	20	37.5	37.5	1	3	18.00	15.00
Bull Thistle	I	*Cirsium vulgare*	CIVU				3									3.00	0.25
Buttercup	N	*Ranunculus repens*	RARE								0.5		0.5			0.50	0.08
California blackberry	N	*Rubus ursinus*	RUUR	37.5	10	3	62.5	37.5	37.5	62.5	62.5	62.5	62.5	10	20	39.00	39.00
Cascara	N	*Frangula purshiana*	FRPU7			10		1	3							4.67	1.17
Deerbrush ceanothus	N	*Ceanothus integerrimus*	CEIN3												3	3.00	0.25

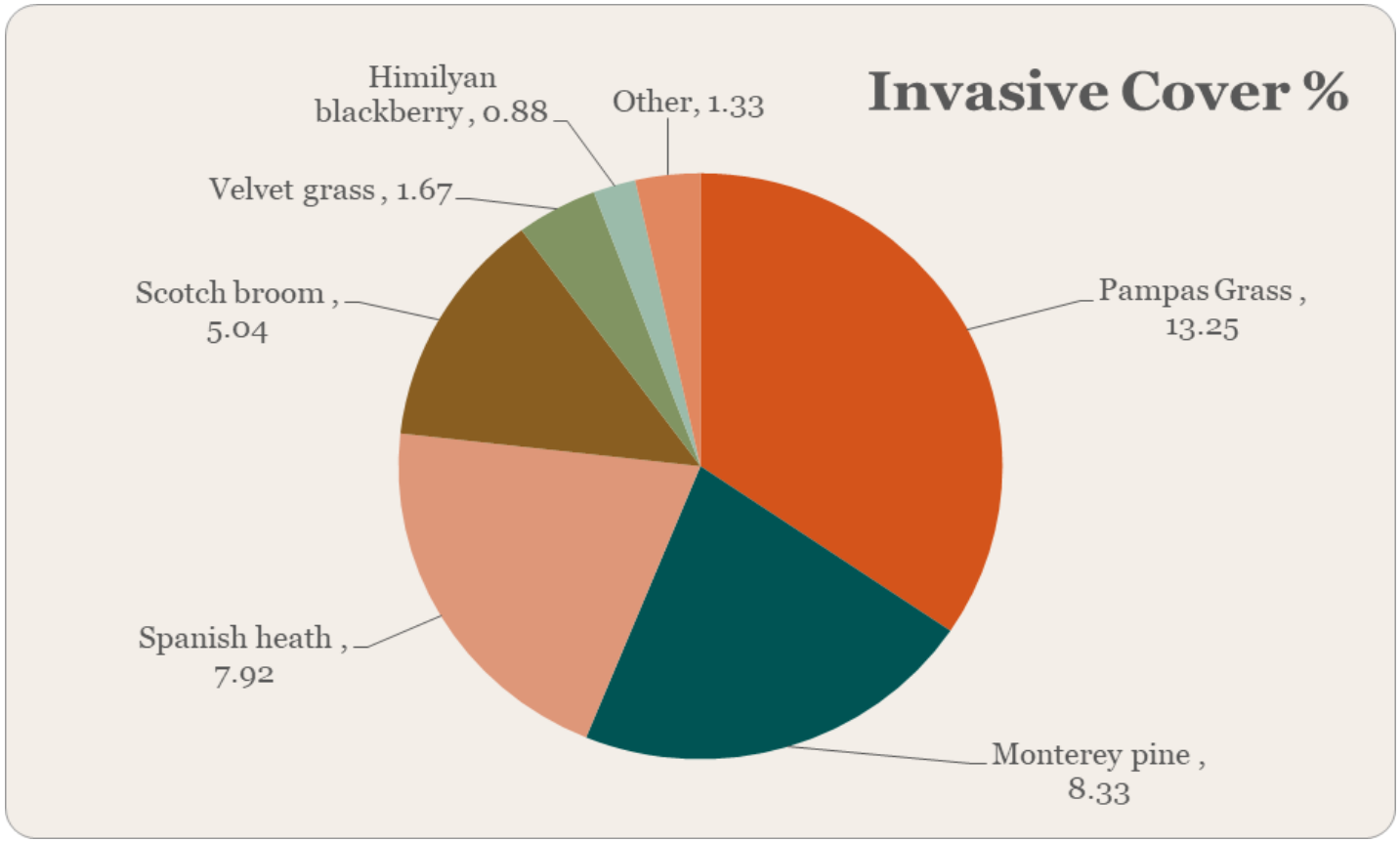
Common Name	Native(N)/ Invasive(I)	Scientific Name	USDA Code	3	4	7	11	18	19	22a	22b	22c	22d	24	26	Average % Cover (when present)	True average % (across all plots)
Cottonester	I	*Cotoneaster sp.*						0.5								0.50	0.04
Cow parsnip	N	*Heracleum maximum*	HEMA 80							0.5	0.5	0.5				0.50	0.13
Coyote brush	N	*Baccharis pilularis*	BAPI		10	10		1		0.5						5.38	1.79
Dock	N	*Rumex occidentalis*	RUOC 3								0.5					0.50	0.04
Douglas iris	N	*Iris douglasiana*	IRDO											0.5		0.50	0.04
English ivy	I	*Hedera helix*	HEHE		0.5			3								1.75	0.29
Evergreen huckleberry	N	*Vaccinium ovatum*	VAOV 2					10							0.5	5.25	0.88

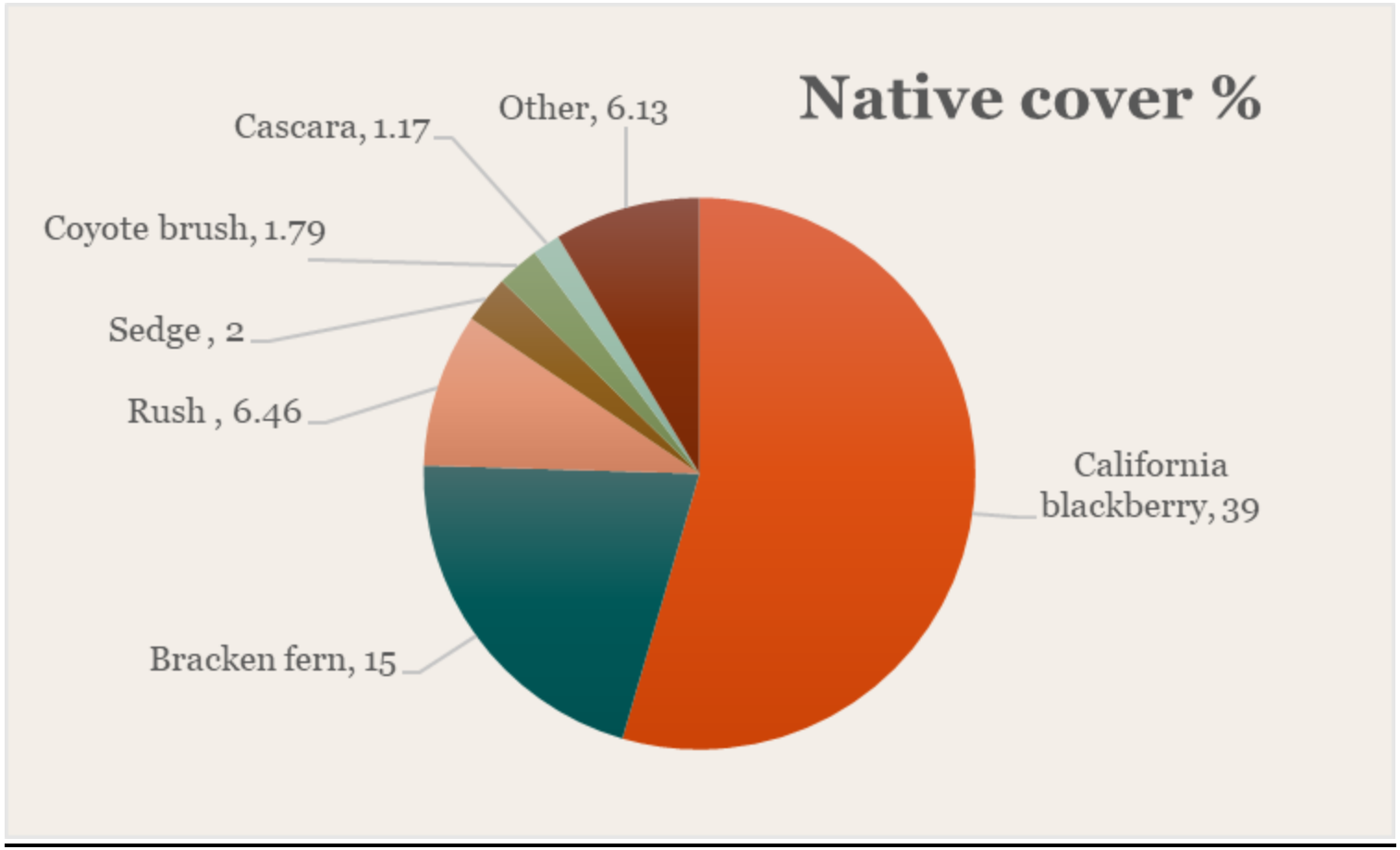
Common Name	Native(N)/ Invasive(I)	Scientific Name	USDA Code	3	4	7	11	18	19	22a	22b	22c	22d	24	26	Average % Cover (when present)	True average % (across all plots)
False lily of the valley	N	*Maianthemum dilatatum*	MADI		0.5											0.50	0.04
Fuschia	I	*Fuchsia sp.*				3										3.00	0.25
Grand Fir	N	*Abies Grandis*	ABGR					3								3.00	0.25
Hedge Nettle	N	*Stachys sp.*									1	0.5	3			1.50	0.38
Himilyan blackberry	I	*Rubus armeniacus*	RUAR9			0.5		10								5.25	0.88
Manroot	N	*Marah oregana*	MAOR											3		3.00	0.25
Monterey pine	I	*Pinus radiata*	PIRA2					37.5							62.5	50.00	8.33
Nightshade	I	*Solanum sp.*					0.5									0.50	0.04

Common Name	Native(N)/ Invasive(I)	Scientific Name	USDA Code	3	4	7	11	18	19	22a	22b	22c	22d	24	26	Average % Cover (when present)	True average % (across all plots)
Pampas grass	I	*Cortaderia selloana*	COSE 4		62.5	62.5		20				3		1	10	26.50	13.25
Red Currant	N	*Ribes sanguineum*	RISA			0.5		3		0.5						1.33	0.33
Red huckleberry	N	*Vaccinium parvifolium*	VAPA					0.5								0.50	0.04
Rush	N	*Juncus sp.*								10	10	20	37.5			19.38	6.46
Salal	N	*Gualtheria shallon*	GASH					1						0.5		0.75	0.13
Salmonberry	N	*Rubus spectabilis*	RUSP					3		3	0.5		1		0.5	1.60	0.67
Scotch broom	I	*Cytisus scoparius*	CYSC 4	37.5				3		10					10	15.13	5.04

Common Name	Native(N)/ Invasive(I)	Scientific Name	USDA Code	3	4	7	11	18	19	22a	22b	22c	22d	24	26	Average % Cover (when present)	True average % (across all plots)
Sedge	N	*Carex sp.*								10	10	1	3			6.00	2.00
Sitka Spruce	N	*Picea sitchensis*	PISI			3										3.00	0.25
Spanish heath	I	*Erica sp.*						37.5						20	37.5	31.67	7.92
Sword Fern	N	*Polystichum munitum*	POMU		3	3		0.5								2.17	0.54
Thimbleberry	N	*Rubus parviflorus*	RUPA			10		0.5							0.5	3.67	0.92
Twinberry	N	*Lonicera involucrata*	LOIN5		10							1				5.50	0.92
Velvet grass	I	*Holcus lanatus*	HOLA				20									20.00	1.67

Appendix H. Figures




Native cover %
Other, 6.13
Cascara, 1.17
Coyote brush, 1.79
Sedge , 2
Rush , 6.46
California blackberry, 39
Bracken fern, 15