Habitat Expansion for Wolf's Evening Primrose (*Oenothera wolfii)* at Luffenholtz Beach

The wolf's evening primrose (Oenothera wolfii) is listed as rare, threatened or endangered by the California Native Plant Society (1B.1). This project increased available habitat for one of nine populations known to exist in California by removing the invasive species English ivy (Hedera helix) from suitable primrose habitat.

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INTRODUCTION

Plant communities are an essential feature of ecosystems. Plants influence their environment in various ways. For example plants alter their ecosystems by inserting their roots into the soil or by providing habitat for bacteria or fungi. These factors affect the ecosystems deeper by working together to create and maintain certain soil chemistry and habitat qualities. Likewise, invasive species that are exotic to their host ecosystem can alter and influence their new surroundings the same way (Waidenhamer et al 2010). In some cases, plants have the ability of increasing the availability of nutrients through various means such as enabling the mineralization of nitrogen or by exuding weathering compounds that break down the soil media that can provide more nutrients to the environment (Waidenhamer et al 2010).

Invasive species like English Ivy (*Hedera helix)* can have the ability to encroach into an area making it their own and over time excluding the natives found within that habitat to the environments' overall detriment. Exotics that are invasive can completely alter the fire regime, nutrient availability and hydrology in a native ecosystem. These changes can greatly diminish the abundance or survival of native species (Richard et al. 2000). *Hedera helix* is a tenacious growing perennial that is also a common house hold ornamental and landscaping species. *Hedera helix* alters the ecosystem's structure and composition by out-competing the native species and commonly creating an ivy understory with low diversity and native composition (Dlugosch, 2005).

Invasive species not only influence abiotic environmental factors like soil stability, hydrology and nutrients, but some also act on biotic ecosystem composition by diluting the genetics of the native plant species. Wolf's evening primrose (*Oenothera wolfii)* is considered to be in peril by the California Native Plant Society (CNPS).

The CNPS rating is due in part to the loss of native habitat by invasive species and degradation but there is also forthcoming information on the *O. wolfii's* hybridization with the garden ornamental *Oenothera glazioviana* (Dewoody, 2008).

Efforts have been undertaken to remove *H. helix* from known *O. wolfii* habitats to support and encourage the survival of the imperiled species. Humboldt County's Luffenholtz Beach Park in California, is known as one of few natural ranges for the primrose *O. wolfii.* The associated parking area is overrun with *H. Helix* and there is also evidence of the garden *O. glazioviana* from nearby gardens. In light of the plant's predicament and previous efforts made towards reclaiming *O. wolfii's* habitat from invasive species, Humboldt State University students have continued to expand on the hard work and progress towards habitat recovery ensuring *O. wofii's* persistence on California's landscape.

PROBLEM STATEMENT, GOALS AND OBJECTIVES

Problem Statement

The recently eradicated invasive species, *Hedera helix,* has reestablished itself adjacent to the Luffenholtz parking lot area, and by doing so, threatens the local native plant diversity which includes the endangered *Oenothera wolfii.*

Goals

- Decrease the abundance and impacts of English Ivy in treated area
- Increase abundance of Wolf's Evening Primrose
- Increase the resilience of the native plant community and resistance to further English Ivy invasion in treated area
- Maintain slope stability in treated area

Objectives

- Eradication of English Ivy by at least 95% in the treated area
- Observe an increase in the number individuals of the local population of Wolf's Evening Primrose to greater numbers than present prior to restoration activities.
- Observe an increase in native species abundance, richness and diversity
- Observe no long-term increase in erosion rates resulting from restoration activities in the treated area

BACKGROUND

Lufenholtz beach is located near Trinidad, in Humboldt County, California. This area of the Pacific Northwest has a Mediterranean climate that receives most of its precipitation (in the form of rain) between the months of October, and May. Annually the area receives an average of 38.1 inches of rain. The late spring, summer, and early fall months provide vegetation with a surfeit amount of precipitation in the form of fog, which gets caught by the foliage where it coalesces and falls to the ground, percolates into the soil and becomes available to the plants. The area to be restored and its surroundings have slopes that range from 0% terraces to 100% vertical cliffs. The primary vegetation in the local area consists of plant species that are capable of enduring the harsh conditions created by the adjacent sea. The Pacific Ocean produces high winds that can shape the landscape and the salts carried in the wind create growing conditions that most plants can't tolerate. The immediate area to be restored is on a south facing 12% slope protected from the northwesterly winds. It also includes an alder overstory that protects the understory from high winds and salt spray. Beneath the alder, the understory is composed primarily of sword fern, licorice fern, California blackberry, English ivy, coyote brush, Pacific reed grass, and many other less common species.

This unique Mediterranean climate allows the Pacific Northwest's wide array of plant species to proliferate year round. Exotic species, though, also benefit from the constant supply of water, and need to be managed properly to prevent invasive plants from negatively affecting the local native flora and fauna, especially in areas where locally threatened or endangered species are known to be found.

ENGLISH IVY

English ivy, a perennial climbing vine introduced from Europe in the early 18th century, is listed by the USDA's Department of Agriculture as a class C and B noxious weed in the states of Washington and Oregon respectively (NRCS, 2012). Although it is not currently listed in California, the species is nonetheless very problematic and has been the target of many restoration projects. The species is both drought and salt intolerant and has been thriving in the protected understory of the coastal vegetation. It can reproduce from seed which is dispersed by mammals feeding on its fruit. It can also clone itself via stolons or stem fragments that come in contact with soil (NPS, 2010). It outcompetes other vegetation by climbing above other plant species, even the overstory, and shading everything beneath it.

WOLF'S EVENING PRIMROSE

Wolf's evening primrose, a native plant to Humboldt County, has been listed by the California Native Plant Society as rare, threatened, or endangered in California and elsewhere, and listed as globally imperiled. *Oenothera wolfii* prefers ruderal costal bluff scrub, dune, and prairie habitats but is threatened by road maintenance, foot traffic, invasive plants, and by hybridization with the cultivar *Oenothera glazioviana* (CNPS, 2010). There are only sixteen populations of this *O. wolfii* known to exist. Seven of these populations are in Oregon, and the remaining nine are in California. Adjacent to the

Luffenholtz parking lot, there are over 100 identified individuals due to restoration efforts in previous years.

Loss of habitat due to road construction is obvious, but the other two factors leading to the endangerment of *O. wolfii* are a little more subtle and less directly influenced t by human activity. On our site and the surrounding area, English ivy is the dominant vegetation. It has already smothered a significant portion of *O. wolfii* habitat, and without active management, it would undoubtedly consume this entire population. A polluted genome is the other threat posed to *O. wolfii*. *Oenothera wolfii* is an inbreeding plant which cannot accept pollen from any other species. The cultivar *O. glazioviana,* however, is an out-breeding species that accepts pollen from *O. wolfii* and produces hybrid offspring. These offspring result in introgression, or backcrossing which pollutes the rare genetically pure strands of *O. wolfii.* There is a population of *O. glazioviana* within a half mile radius of our site, however, our site has remained pure and is not the primary threat. The leading threat to the *O. wolfii* population located on our site is loss of habitat caused by English Ivy.

PREVIOUS RESTORATION

Successful restoration projects aimed at removing English ivy are abundant, but their successes aren't easy. Once the plant establishes itself, it has a rapid growth rate and can propagate through seeds, stolons, and via fragments of six inches or greater of plant material. Because of English ivy's tenacious capability to survive, it makes eradicating the species very difficult. Successes have come in varying forms but the most successful techniques are to remove as close to 100% of the plant as possible. This means removing all above and below ground plant tissue.

In 2011 the Luffenholtz County Park Enhancement Plan was developed to allow for the removal of *H. helix* along a section adjacent to the Luffenholtz Beach parking lot, with the objective of maintaining

native plant species habitat and increasing local biodiversity. In the fall of 2011, a restoration effort removed approximately 1,260 cubic feet of *H. helix* through manual removal and light machinery such as chainsaws and weed whackers. After the ivy was removed, native plants including *O. wolfii* were seeded and transplanted. The project was considered a success after a post-restoration survey revealed an increase in biodiversity and *O. wolfii* occurrences (Hawley-Jones et al. 2011).

In a post project survey approximately twelve months after this restoration took place, *H. helix* was found to occur in 66% of the plots, although its cover never exceeded 25% of any single plot. Other exotic species such as velvet grass (*Holcus lanatus)* were also found in many of the plots. The *H. lanatus* was potentially spread by the previous restoration's spread of unsterilized hay in an attempt to reduce erosion. Regardless of new invasives found, *O. wolfii* has increased its population at this site from eleven individuals to over 100. Although this restoration site was successful in increasing biodiversity, and occurrences of a sensitive species, *H. helix* still threatens the area with clones that have sprouted from the slash during the restoration process, and from seed due to large ivy populations adjacent to the restoration site. To maintain suitable *O. wolfii* habitat, this area requires constant active management to prevent reestablishment of *H. helix.*

ALTERNATIVES

IVY REMOVAL

HERBICIDE

Herbicide is a common technique used to remove invasive species and can be a fast and cost effective manner of removing unwanted plants. These herbicides are absorbed and sent to the roots killing the plant (Sweaingen and Diedrich 2009). Common herbicides such as triclopyr and glyphosate could be used on *H. helix*. Herbicides like glyphosate enter the plant and prevent new growth by hindering

aromatic amino acid synthesis of these plants (University of Rhode Island 1999). Since animals have different metabolisms, they do not generate aromatic amino acids, making herbicides very safe for animals. Some herbicides, after touching the soil, have a reaction to the soil and become inactive. This means that some of these herbicides, particularly glyphosate, are fairly safe. An example of a glyphosate herbicide is Rodeo. According to its material safety data sheet, Rodeo has very little impact on humans. In fact the only impact is that slight eye irritation can occur (Dow AgroSciences 2004). Overall if glyphosate would be used, it could be very safe on the environment. Herbicides are also important because they can prevent major soil disturbance that manual and mechanical removal can cause. Since the ivy at Luffenholtz is on steep slopes, a less disruptive removal technique would be extremely beneficial.

Though herbicides can be fairly safe and a good alternative, there are many road blocks preventing this technique from being used at Luffenholtz County Park. One example of a possible problem involves the waxy leaves of ivy. The purpose of a waxy surface for most plants is to prevent water loss. The waxy leaves however make it extremely difficult for herbicides to stick to the leaves. It has been found that herbicides may be effective killing young plants, but when used on adults, the leaves make spraying herbicides ineffective (Reichard). However, since English Ivy does resprout, applying herbicides on the cut branches could be very helpful after hand pulling ivy (Reichard).

Another hindrance for herbicide use is the social opinion of pesticide and herbicide use in Humboldt County. Many people in Humboldt County disapprove of herbicide use. In fact, there was a project where herbicide was going to be the technique for removal of purple loosestrife on the eel river. Although the State said that the project would cause no significant negative impacts, Humboldt County Supreme Court disagreed and stopped the project from continuing (Trees Foundation). There are also groups like Californians for Alternatives to Toxics, which is centered in Eureka, whose sole purpose is to

stop these types of projects. Trying to use herbicides at Luffenholtz may cause interference from the public that may be very difficult to work around. This is especially true since the site is on public land.

A final problem is that the herbicide and the safety protection equipment are going to cost money. Training would also be needed for anyone wanting to use them, so volunteers could not be involved. Even though there would be benefits like less soil erosion and preventing the ivy from resprouting, there are too many problems associated with it, that the use of herbicides isn't a feasible option.

GRAZING

Grazing is a biological technique used by managers to get rid of unwanted species. Many different animals can accomplish this including: cow, geese, and goats. Overall English ivy has a low palatability to livestock (USDA, 2010). For example in an experiment performed in Connecticut found that geese do not eat *H. helix* (Conover 1991). Conversely, a study was conducted in Oregon that found that using high intensity low-frequency grazing with goats was a good technique for removing *H. helix*. However, it was incredibly important that the goats had to be trained to eat the ivy because a plant compound called Herderin in *H. helix* can cause intake suppression. Goats that experienced this compound earlier in life were able to better digest Herderin (Ingham and Borman 2010). These goats could be useful because they can get up and down steep terrain (US Fish and Wildlife 2009).

A negative aspect to using goats is that goats have to be trained to graze *H. helix* (Ingham and Borman 2010). This means that we would have to find a place that has trained goats for us to use. Since there has been very little research done on goat grazing and *H. helix*, there are probably very few herds of goats that can do this. Also if a herd was found it may be from far away, so it would be difficult to transport these goats. This process would also have to involve building a fence and finding someone to watch the goats, since this site is on public land. Another problem is that high intensity low frequency

grazing was suggested and this means that there would be many goats on the landscape. Since erosion is a huge concern, these goats may just make it worse.

Overall this technique would not be best because of the difficulty with accessing a herd that has been trained to graze ivy. Also it could be counterproductive to use goats due to the high potential for erosion. This is not a feasible option.

PRESCRIBED FIRE

Fire has been used as a control method in tidal marshes, grasslands and forests to manage the prevalence of invasive species, to encourage habitat for native biota and to consume and reduce forest fire fuels (Fulé, 2004 et al; McDonald and McPherson, 2011; Owens et al, 2007). Fire is an effective tool that can cover and treat large areas that have been overrun with a target species or fire fuel. However, fire is not always applicable to a project area. Prescribed fires have to be planned according to environmental conditions because they can get out of control and endanger people, wildlife and property (Cantu, 2011). There have been few studies on the response of *H. helix* to fire. However, USDA research shows that the shallow roots and stoloniferous networks, which are found with ivy, are not well protected from surface fires. Though it was believed that the seed coats protect ivy seed from fire, recent studies show that *H. helix* does not have a hardened seed coat resistant to fire (USDA). This emerging information coupled with short longevity of seeds in the seed bank likely cultivates an interest in the use of prescribed fire to combat *H. helix*.

Though fire would likely be useful in the removal of *H. helix* from our project site, the possible expenditures of an out of control fire outweigh the possible benefits of a successful prescribed fire treatment. When using prescribed fire as a management tool, overall safety is more important than the treatment results. The project site is paralleled by a popular scenic drive surrounded by vegetated cliffs

that lead to residential neighborhoods and structures. Fire can also harm non targeted native species which would be counteractive towards our project goals which include an overall increase in native plant species.

SOLARIZATION

Solarization is the process of covering soil seed banks or unwanted species with plastic sheeting to trap the heat and moisture generated by the incoming solar radiation. As an alternative to chemicals or fire, the heat under the plastic decreases the viability of the seeds and plant species under the treatment area (Stapleton, 1986). Studies have shown that solarization is comparable to prescribed fires in small scales. In some cases repeat removal of exotics is not necessary until a year after initial treatments (Marushia et al, 2011).

Since the project site is located in an area of California that is very temperate and coastal. This means that incoming solar energy is limited. This makes the solarization method inadequate due to the amount of time that the plastic would require to smother *H. helix*. Under hotter climatic scenarios solarization can accomplish the job in a matter of days to weeks, whereas at the current project site it is being assumed that solarization may take months. Solarization works across the board, effectively killing or reducing the viability of seeds and plant species of all kinds. This means that native species which have broadcasted their seed may have representatives inside the seed bank that for the purposes of this project need encouragement to germinate and grow. Though solarization is an appropriate method for the size of our project site, time constraints and project goals do not allow for the implementation of this method.

MECHANICAL/MANUAL IVY REMOVAL

The growth habits of *H. helix* promote the use of heavy machinery to cut down on time spent removing the invasive. Barring extreme slopes or compromised soil stability heavy machinery can easily remove *H. helix*. Heavy machinery can achieve the goal of removing deep overlapping ivy mats that contribute to the common re-growth exhibited by *H. helix*. The current project site has extreme slopes and soil stability that would be compromised by the weight and mechanics of heavy machinery. Therefore mechanical methods were not used to remove ivy on our site; however, the volunteers worked on sites that were not as obstructive to mechanical methods. Parts near the project site included areas of asphalt over which *H. helix* had grown. In this area a Bobcat skid steer was employed to remove the ivy completely off of the underlying parking lot asphalt. The Bobcat was a blunt tool for a precise job that needs care and attention to detail. Though the Bobcat can remove the ivy mats, it cannot insure that sprouts will not come back from the surrounding area. In some cases the Bobcat was used to push the ivy back towards the hill slope, though removed and out of the parking lot this ivy was still alive. Though this method was used at other places, for our site use of mechanical equipment like a Bobcat was not feasible.

Manual ivy removal is favored on slopes and areas that do not allow for machinery or other removal methods such as herbicides or fire. Grubbing is the preferred manual method for these ecologically sensitive areas. Grubbing is the manual removal of the invasive from the roots up, removing the entire plant using simple tools and paying due diligence to plant material that could result in new sprouts (NPS, 2010). In the light of a project's budget it could be argued that the manual grubbing method can be costly due to its labor intensity and required training for proper follow through on the methods; all the more reason to gather volunteers and other community members to join the labor force.

The project site will likely benefit the most from the utilization of the grubbing method, in particular due to topography and ecological habitat that is being protected for local endangered species.

EROSION CONTROL

STRAW/HAY

Straw is a common erosion control tool. This technique involves using straw as mulch in order to prevent soil erosion. With the straw covering the ground, there is a barrier from the erodible soil and the falling rain.

The previous project conducted at this site used straw as an erosion technique. However, even though it was supposed to be sterile, the straw had seeds in it (Hawley-Jones et al 2011). This brought non-natives such as velvet grass onto the site. This grass still covers a significant amount of one of the hillsides. It was not only found here, but was located in a quarter of the monitoring plots. Other issues with straw include that use of it is limited to sites below a 3:1 inclination (Norris et al 2008). Straw can be lost to wind, so it needs to be anchored mechanically or chemically to the soil (Metropolitan Council 2001). Also at 80% ground cover by straw, there is a smaller reduction in sediment loss as compared to wood chips or erosion mats (Burroughs and King 1989).

Straw is fairly versatile and depending on how it is applied, it can be temporary to a semi-permanent erosion control technique. Although there are benefits like quickness of application, low cost, and ability to maintain soil moisture (Norris et al 2008), because the previous project experienced trouble with this technique, we did not use it again.

WOOD MULCH

Wood mulch can be used as well. Wood mulch would be placed on the ground over the erodible soil. Like straw, it would create a barrier between the soil and falling rain. There is still a chance that the mulch may wash downslope if it is not adhered to the ground through mating or tackifiers, which are adhesive agents that hold mulch together. At 80% ground cover wood chips reduce sediment loss better than straw but worse than mats (Burroughs and King 1989).

There are many different types of wood that can be used as mulch. It is cheaper to use local types; however, at least 7 inches of mulch is needed to be effective at preventing weeds (Herms et al 2001). A lot of mulch would be needed to be effective. Wood mulch can create the same problem that was seen at the last project if the wood that is acquired contains weeds. Wood chips may also contain chemically treated wood, introducing chemicals in the ecosystem. These factors make it incredibly important to know where the wood came from (Metropolitan Council 2001).

Also some wood mulch can tie up nitrogen in the soil causing a need for fertilizers. Hardwoods tend to cause an unbalance in the C:N ratio. Because softwoods are resistant to being decomposed, there is little effect on the C:N ratio if the mulch is made of softwoods (Herms et al 2001). Because of these issues, using wood mulch by itself would not be a good decision. This is especially true because access to tackifers and the cost of tackifiers would make it expensive to do erosion control.

We used mulch as an aspect for this project because of its ability to suppress weeds and because we were able to acquire some for free. We hoped to use the mulch to prevent the ivy from moving back to our site. Because we would have needed a lot of mulch in order for it to be effective and because the slope is too steep, we did not use mulch by itself. Also, because of other negatives like chance of weeds, and an unbalance C:N ratio, we only used the mulch as a strip along the perimeter of the project to prevent the ivy from getting into the project site. We also created a border out of small logs to prevent

the mulch from washing down slope. Finally, because the purpose of this project is to create habitat for the threatened *O. wolfii*, covering the site with mulch would also prevent regrowth of this primrose.

MATTING OR BLANKETS

Matting or erosion control blankets are materials that can be natural and synthetic. They are usually woven and can be made of materials like straw, coconut fiber, jute or polypropylene. These blankets are placed on erodible soil and prevent erosion by slowing down the water surface (Sutton and Williams). At 80% ground cover, it works best at reducing erosion when compared to straw or wood mulch (Burroughs and King 1989). Blankets can vary from being temporary to semi permanent. Synthetic forms are usually used as a permanent erosion control technique. It would also be unwise to use synthetic matting or blankets since it is so permanent. There is no guarantee that the project will continue, so there also would not be someone to take it off later.

It is incredibly important that the mats are installed properly because they will not work if they are installed incorrectly. Also, they can be very expensive to buy. For example, the coconut jute we bought cost $80 for around 800 square feet. Some of the natural mats found at local stores were improperly stored and contained mixes of straw and other plant matter within the material. Straw had introduced an exotic grass to the site previously, so it was important that straw is not used again on the site.

We used coconut fiber matting because we did not want invasives spread through straw which has already occurred at the site. We also wanted to use coconut matting because it will eventually biodegrade. However the strongly invasive ivy will probably grow in shade under the jute. The mat by itself will probably not keep the ivy out, so we used other erosion control factors as well to prevent ivy from spreading onto the site.

REVEGETATION

HYDROSEEDING

Hydroseeding, also known as hydraulic mulch seeding is the process of revegetating an area using a slurry of seed, fertilizer, and mulch or fiber. Typically the slurry is contained in a truck-mounted tank and can spray the mixture through pressurized large diameter hoses. Because of its efficiency in covering large areas with seed, mulch, and fertilizer, it's often employed for slope stabilization. California's Department of Transportation (DOT) recommends using hydroseeding in areas of 0.5 acres or more, and hand seeding in smaller areas. Its benefits include rapid vegetation growth which leads to slope stability through the grass's root structure as well as by preventing raindrop impact erosion through above ground vegetation (DOT, 2004).

Naturalized alien species are well suited for hydroseeding because of their ability to emerge through the thick layers of substrate applied with the seeds. Many native grasses or forbs are incapable of this ability, and are not suited for hydroseeding (DOT, 2007). Because one of our goals is to increase native plant diversity, using the hydroseeding technique may not be suitable for our goals. Additionally, local hydroseeding companies in Humboldt County generally require a minimum of $250 to hydroseed (S. Trapkus, pers. Comm., 2012). Due to our restoration site's small size, and budget constraints, hydroseeding is not a feasible alternative.

DIRECT/HAND SEEDING

Direct/hand seeding is simply the process of broadcasting seeds over an area and sowing them in the soil by machine or hand. Benefits to this process are as follows:

- Plants are able to "self select" suitable establishment sites within the revegetation area, particularly if a mixture of species is sown
- Direct seeding is much cheaper (10 - 20% or less of the cost of planting tubestock [plugs]), and requires minimal labor
- The plants are usually healthier and have stronger, deeper root systems because they are not transplanted and there is no disturbance to root growth. This enables plants to be more tolerant of stressful conditions such as pest attack and drought
- Final plant cover is random, and looks more natural than planting (DPI, 2011).

The self selection establishment of plants helps ensure genetic suitability to grow under the conditions of a site. Their establishment is dependent on multiple variables such as climate, slope, aspect, and natural disturbances like wind, and salt spray. If careful planning goes into the species spread, and enough seeds are broadcasted, this has a high success potential provided that the substrate contains sufficient nutrients and stability. Additionally, it's important to have healthy growing species that are able to compete against the invasive *H. helix* during reinvasion which is inevitable due to the surrounding population. If seeded plants are given enough time to grow, they will likely be healthier than grass plugs which can be stressed prior or during transplanting.

Possible disadvantages to direct/hand seeding:

- Direct seeding is limited to plants that grow readily from seed.
- A large amount of seed is required. Hence, if only minimal seed is available for a particular species, it may be better to raise seedlings for that species in a nursery.
- Plants germinating under field conditions are extremely vulnerable. Frosts, spring droughts, or flooding of the sowed area can dramatically reduce seedling establishment.
- The initial density of plants is harder to control (DPI, 2011).

Because of our restoration goals to stabilize the slope and create habitat for *O. wolfii,* we planned to seed with local/native grasses which easily grow from seed. However it was difficult to find native seeds and by the time we were ready to seed, it was too late to collect seed. This hindrance made hand seeding of native grasses unfeasible. However, we were able to collect *O. wolfii* seeds from the local genetically pure population for dispersal on our site.

HAND PLANTING

As stated earlier, one of our goals is to create suitable habitat for the expansion of *O. wolfii.* Because of this, only low growing grasses, forbes, and/or shrubs that do not shade out the understory are desired. The budget constraints on this project restrict our options to a select few. Because nurseries need to nurture seedling until they are ready to be transplanted, hand planting is inherently more expensive than just obtaining seeds, thus, if seeding alone leads to our goal, it is the more feasible option.

Transplanting seedlings may often be stressful to the plant, but grown and transplanted correctly in suitable habitat, they are likely to survive and it speeds up the succession of the area planted. Hand planting is a useful technique to speed up successional processes by establishing late seral species, or species of a certain height in order to prevent competition. Oftentimes, this can be due to a dense, low-growing understory where late successional species have a hard time establishing and emerging. Hand planting can also be used to simply control the species that grow in a given area.

The physical process of hand planting can be time consuming, expensive, and exhausting. Generally, hand planting isn't a first choice method for larger areas unless it's critical to the success of the planted species. Because of the small size of our restoration site, hand planting is a feasible technique that will allow establishment of the threatened *O. wolfii*, and other native grasses, forbes and/or shrubs. Because it is more expensive than direct/hand seeding, though, hand planting should only be used to augment

revegetation when cheap or free seedlings can be acquired. We were able to acquire free grass plugs, so this option, though seeming unfeasible became our best option for revegetation.

IMPLEMENTATION METHODS

ENGLISH IVY REMOVAL

Hedera helix grows in numbers through vegetative reproduction but can also spread prolifically by its seed dispersal. This makes the *H. helix* a formidable invasive species to remove and manage. Grubbing is the best way to effectively remove English Ivy, however, probably the most arduous.

By designating an area to be relieved of its invasive tenant, a focused effort can assure the proper and effective removal of the entire plant by doing as follows. Where the project site was on a slope, we started at the top of the slope and began cutting down into the roots and runners/stolons of the ivy. The goal here was to be able to peal the roots, runners and other vegetative material cohesively up and away from the soil and into a log roll, much like a household rug rolled up (No Ivy League, 2012). Continuing downhill from the upper slope we cut free a manageable sized ivy log. Once the Ivy log was free it was piled to be desiccated in a secured area or disposed of properly otherwise. The denuded areas were rechecked for any remaining ivy material that could result in re-sprouts. The matted roots and runners were cut by loppers, a Pulaski, heavy brush axes or by any means necessary while maintaining vigilance over the project goals and objectives. Due to the nature of this species, it is imperative that full and practical removal of plant material be accomplished to reduce the necessity of repeated treatments. (Cal-IPC, 2012).

Hedera helix proliferates by extending fertile shoots vertically, often using nearby walls, bushes or trees as a trellis for optimal extension of its fruit bearing body. The scaling ivy was killed by locating and completely severing the basal roots and runners of the ivy, otherwise known as the girdling method.

Many of these climbing branches may need to be cut using a chainsaw or similar tools while being careful not to damage the host. Trees are a common host for this invasive climber and ivy can grow up into a tree's canopy making it unreachable. However, because the basal vines were severed these canopy branches will die. To discourage further growth and return treatment, the basal vines were severed and peeled away from the tree or host starting at shoulder height (NPS, 2010). Following the girdle treatment, a six foot buffer zone around the tree's base was established where possible and the ivy was removed by grubbing the ivy plants, roots and all.

EROSION CONTROL

In order to prevent higher levels of erosion and sediment deposits to nearby watercourses, relative to pre-project conditions, multiple actions were taken to stabilize on-site soils. These actions comprised of the use of erosion control jute netting, silt fencing, and native grass planting. Coconut fiber netting was laid down over the newly exposed soil in 4.5 ft wide strips from the top of the slope to the bottom perimeter of the removal area. As the jute matting was being laid down, the soil was leveled as best as possible in order to maximize the contact area between the netting and soil. The down-slope ends of the coconut fiber strips were then cut to fit the curvature of the adjacent *H. helix* vegetation as closely as possible. Each strip was laid to overlap the adjacent strips by approximately six inches. Eight inch metal staples were inserted within these six inch overlaps in order to ensure that the adjacent strips were to remain overlapping and in place. Furthermore, staples were inserted through the center of all netting strips to keep them in place. A trench approximately one foot wide and one foot deep was then dug along the perimeter of the top of the action area. The upper portion of the matting was then embedded inside of the trench and buried with the previously removed soil in order to anchor the jute matting at the top of the slope and ultimately prevent the movement and/or loss of the matting down-slope by future weather events and foot traffic.

Silt fencing was then set in place along the down-slope perimeter of the action area where the coconut fiber matting met *H. helix* vegetation. In order to optimize the aesthetic quality and naturalness of material used as fencing, coast redwood (*Sequoia sempervirens*) and Sitka spruce (*Picea sitchensis*) logs were used as fencing material. These logs were selected according to different lengths, diameters, and shapes that would allow for the optimal fitting of the logs to the contours of the slope where they would be laid. A trench was then dug along the base of the logs and stones were placed in gaps in order to maximize the contact area between the logs and soil, thereby minimizing the loss of silts between and underneath the logs. Once the logs were adequately placed along the perimeter in optimal positioning, wooden stakes were driven into the soil on both sides of the logs to anchor them in place. Finally, in order to create a soil anchoring root system, native Pacific reedgrass (*Calamagrostis nutkaensis)* plugs were planted throughout the treatment area. Slits were cut in the coconut fiber mat at the location of each grass planting. Then, grass plugs were planted in the underlying soil to a depth that ensured the entire root systems were buried and photosynthetic portions of the grasses were above the mat.

REVEGETATION

Reestablishment of vegetation was not necessary to prevent soil erosion due to the fact that the soil on site was stabilized with coconut fiber netting. Also, because *O. wolfii* is a ruderal species it is necessary to keep open/safe sites available for its establishment and to reduce competition. To ensure success of our goal to increase native biodiversity, though, *C. nutkaensis* was transplanted from healthy nearby populations. Species adjacent to our site such as *Yarrow spp., Baccharis pilularis, Lolium spp.*, etc., are expected to seed in naturally over time and will establish natural densities. After the first few big storms of the season, we were able to see some of these species plus many more starting to sprout.

Due to the timing of heavy precipitation, matting was laid down after removal of ivy and before any large storms to prevent as much erosion as possible. Collection of *O. wolfii* seeds wasn't complete or able to be worked into the soil until after matting had already been laid. The seeds were collected from the existing population's of *O. wolfii* to ensure genetic integrity. Seeds were collected from living *O. wolfii* as well as from a pile of inflorescences that resulted from a well intentioned local citizen who mistakenly uprooted *O. wolfii* because it looks like a weed. *Oenothera wolfii* seeds (23.57 g) were broadcasted over the top of the jute netting and worked into the soil where possible.

MONITORING

We conducted our monitoring in order to estimate the success of the ivy removal at the site. One year ago a group from ENVS 410 pulled ivy on the north side of the parking lot. We wanted to look at the previous project and see how successful their removal was so that we could make sure that our methods reflected the success of their methods. To do this we attempted to use the same monitoring techniques of the previous group. We placed a transect along the edge of the North side of the parking lot. There were no markers for the exact location of the transect used from the previous group, so we did as best we could to get as close as we could to their transect. This transect was 22 meters long and we started it at the edge of the rock wall that runs along the parking lot. We went along every two meters of the 22 meter transect and created secondary transects that went up the hill at randomly determined distances. We got the distance from a random number chart containing numbers 01-50. If this distance was too great, we simply added the two digits together to form a smaller number. If this new distance was still too large, we subtracted the digits. We placed one square meter quadrats at the end of each secondary transect. We then estimated percent cover of vegetation, bare soil, rock or litter that was located in the quadrat.

Additionally, we performed pre-removal monitoring on our site. For this monitoring we used a 32 meter transect along the south side of the parking lot. The transect started on the southeastern side of the parking lot across from the main sign for the Luffenholtz parking lot and ended at the middle door found behind of the bathroom. We again used secondary transects every two meters along the 32 meter transect. We used a random number table in the same manner as mentioned previously. Using the square meter quadrat, we estimated plant species cover percentages prior to removal of *H. helix*.

We conducted post removal monitoring for our site as well. Because removal occurred during a BLM planned event, we had no control over removal techniques done except for removal directly on our site. However, we did notice what types of removal were done. In hopes that a future group can assess the success of the different types of removal we extended our transect to look at the cover percentages of the different removal technique's. We also extended the transect because we were not the ones who ended up removing ivy on the site we did pre-monitoring for. However, we had looked at the site before and we estimated that our site had close to 100% cover by English Ivy. We conducted post monitoring the same as pre-monitoring except we lengthened the transect to 42 meters instead of 32 meters. The extension started at center of the south wall of the bathroom and continued along the jute. We placed the start of the extension right next to the log we laid down as a border for the project. The transect then wrapped around the 2nd left square pole making a right angle to the transect and continuing along the jute at the western side of our project. Finally, from the south west corner of the bathroom, we measured the azimuth and distance of each bunch pacific reed grass planted. This way a group later can come in a see how successful the bunch grasses were for surviving at the site. The azimuths are described in appendix 2.

MONITORING RESULTS

PAST PROJECT

Because our project is a continuation of a previous project, we monitored the previous work done to estimate its success. Overall the percent cover of ivy was fairly low varying from 0 to 15% cover (Table 1). The average cover of *H. helix* was 7%. When compared to the monitoring data collected from the previous group, the results were interesting (figure 1). *H. helix* average cover decreased to below 1% after the last project. One year after the project, ivy cover increased to an average of 7%. Even though cover did increase, it was nowhere near the starting point of around 47% cover. This was important for our project for several reasons. This emphasized that the removal technique used by the previous group was fairly successful which allowed us to decide on using manual removal as an appropriate removal technique. Monitoring also showed us that *H. helix* does come back. This showed us that creating a good monitoring and implication program after the project is incredibly important as well.

Table 1. Monitoring the project done by last year's class. Results are in percent cover from square meter quadrats.

	Rock	Bare ground	Litter	Ivy (*Helix lantus*)	Forb	Grass	Tree	Shrub
0 meters	0	40	50	3	24	5	0	0
2 meters	0	1	4	5	23	45	0	0
4 meters	0	4	35	2	33	30	0	7
6 meters	0	11	25	10	80	0	0	0
8 meters	0	0	15	0	50	41	0	0
10 meters	70	0	20	0	64	5	0	0
12 meters	2	15	30	16	23	0	10	0
14 meters	0	0	15	3	18	70	0	0
16 meters	0	5	0	10	5	95	10	0
18 meters	0	0	0	0	106	0	0	0
20 meters	0	0	0	3	68	42	0	0
22 meters	0	30	40	0	1	20	0	0
Total	72	106	234	52	495	353	20	7
Average	36	15	26	7	41	29	2	1

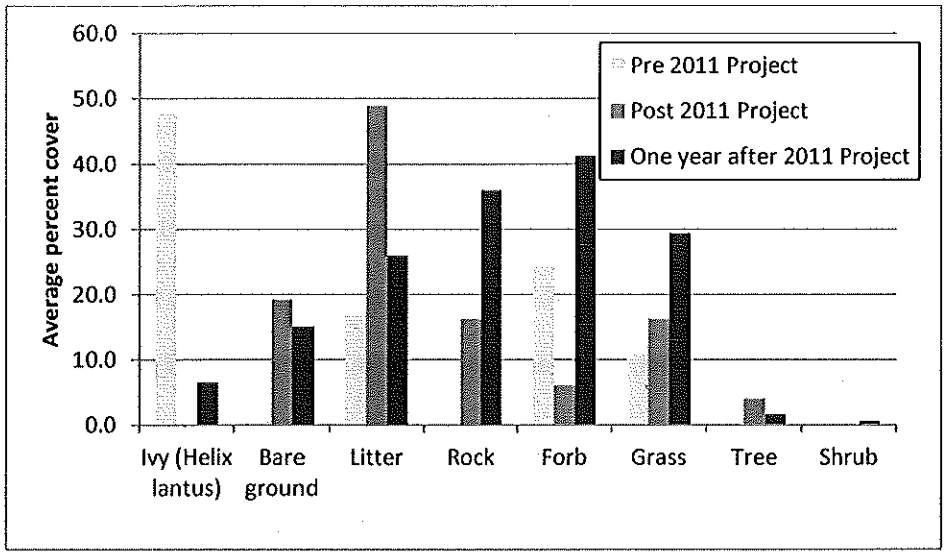

Figure 1. Average percent cover along a 22 meter transect on the project on the northern side of the parking lot. Estimates are from 2011, before and after the project, and in 2012.

OUR PROJECT

We monitored our project as well to estimate success and so that groups from ENVS 410 or ENVS 450 can come back later and monitor the long term success of the project. The pre-project monitoring results showed a high percentage of *H. helix* on the site (table 2). On average 68% of the cover was *H. helix*. Native California Black Berry was next most cover with 31%.

Table 2. Pre project monitoring. Results are in percent cover from square meter transects.

Meter mark on transect	English Ivy (*H. helix)*	Alder (*A. Rubus)*	Black-berry (*R. ursinus)*	Coyote Brush (*B. pilularis)*	Stinging Nettle (*U. dioica)*	Grasses (Poaceae)
0 Meters	80	20	1	0	0	0
2 Meters	100	0	0	0	0	0
4 Meters	100	0	0	0	0	0
6 Meters	100	0	10	0	0	0
8 Meters	100	0	30	2	0	0
10 Meters	100	0	5	0	0	0
12 Meters	0	0	100	0	0	0
14 Meters	5	0	100	0	0	0
16 Meters	25	0	100	0	0	0
18 Meters	100	0	30	0	0	0
20 Meters	100	0	5	0	0	0
22 Meters	40	0	10	60	15	0
24 Meters	90	0	15	0	0	0
26 Meters	0	0	70	0	45	0
28 Meters	95	0	15	0	0	0
30 Meters	80	0	15	0	20	0
32 Meters	40	0	20	0	0	40
Total	1155	20	526	62	80	40
Average	68	1	31	4	5	2

However, the site we did pre-project monitoring on was not the site we ended up pulling. Because of this we extended the transect to 42 meters in order to gather data on the site where we actually worked on. Because our site had looked similar to the site we actually did pre-monitoring for, we are assuming that the averages that we got were good representations of our actual site. Post project monitoring had an average of 15% cover of *H. helix*. This is a significant decrease and could have been even less; however, meter marks 26, 28, and 30 had not been pulled. Overall it would seem that in the short term, our project was fairly successful because of the decrease in *H. helix*.

Table 3. Post project monitoring. Results are in percent cover.
**Stems only include stems that have no vegetation on them

Meter mark on transect	English Ivy (*H. helix*)	English Ivy (*H. helix*) stems**	Black-berry (*R. ursinus*)	Bare Ground	Leaf Litter	Asphalt	Wood chips	Nettle (*U. dioica*)	Jute	Grass Plugs (*C. nutkae-nsis*)	Forb/ grass regen-eration
0 Meters	100	0	0	0	0	0	0	0	0	0	0
2 Meters	0	0	0	0	0	100	0	0	0	0	0
4 Meters	0	0	0	85	15	0	0	0	0	0	0
6 Meters	3	12	5	60	20	0	0	0	0	0	0
8 Meters	0	0	0	45	20	25	0	0	0	0	0
10 Meters	0	0	0	45	30	15	0	0	0	0	0
12 Meters	55	0	45	0	0	0	0	0	0	0	0
14 Meters	7	0	10	48	35	0	0	0	0	0	0
16 Meters	0	0	0	35	40	25	0	0	0	0	0
18 Meters	0	0	0	0	30	70	0	0	0	0	0
20 Meters	0	3	0	42	55	0	0	0	0	0	0
22 Meters	0	5	0	80	15	0	0	0	0	0	0
24 Meters	0	35	10	75	0	0	0	0	0	0	0
26 Meters	0	0	70	0	0	0	0	45	0	0	0
28 Meters	95	0	15	0	0	0	0	0	0	0	0
30 Meters	80	0	15	0	0	0	0	20	0	0	0
32 Meters	0	0	0	0	0	0	100	0	0	0	0
Extended Transect											
34 Meters	0	20	10	20	0	0	0	0	0	0	0
36 Meters	0	0	0	0	0	0	0	0	100	0	0
38 Meters	0	0	0	0	0	0	15	0	80	5	0
40 Meters	0	0	0	0	0	0	0	0	85	10	5
42 Meters	0	0	0	0	0	0	0	0	100	0	0
Total	340	75	180	535	260	235	115	65	365	15	5
Average	15	3	8	22	11	10	5	3	15	1	0

However since removal of *H. helix* is not the only goal of the project, monitoring *O. wolfii* regeneration is important as well. Just looking over the site after the first big rain of the season, we were able to find one *O. wolfii* plant coming up on the site. This was right after we seeded so we are predicting far more to come up as time goes on. Because of this we are considering our project successful.

FUTURE MONITORING

As seen when monitoring the previous project, *H. helix* comes back if it is not kept up on. The *H. helix* went from less than 1% cover to 7% cover in one year. Humboldt County Parks monitors and upkeeps Luffenholtz beach parking lot. Since we placed redwood logs along the border of our project, it will be easy for Humboldt County Parks to see when *H. helix* goes into our project. Humboldt County Parks weed-eats the area and it would be easy for them to weed eat it before coming into the site. We are also going to either talk with the next ENVS 410 class to encourage anther group to continue this project, or talk with the professor of ENVS 450 and try to get this project a part of that class.

The next group who wants to continue this project should monitor a few things. First they should see if *H. helix* has reentered either our project site or the previous project site. This could be done by re-estimating percent cover on the site, or by looking at the redwood log border of the project and seeing if *H. helix* went over the border. Also, since we used eucalyptus mulch to suppress weeds on the border, it would be important to monitor whether or not this mulch generated eucalyptus seedlings.

Also since the removal was done at a BLM work day, we did not control removal methods. We did post monitoring to set up data so that a next group can come in and see how well each technique did in removal of *H. helix*. This description can be visualized in appendix 1. Before the transect, along the scenic drive before getting to the parking lot, there was vegetation removal. Only a top layer of the ivy was removed. This was for about 15 meters south along the road right before the parking lot. Even after removal, this site still had 100% ivy stems and we could not see the ground because the stems were so thick. On transect meter marks 0 through about meter mark 28 there had been bobcat machine removing the ivy. Meter marks 28 through 32 had the vegetation removed (not the stems) and then we covered the site with eucalyptus mulch. For meter marks 34 to 42 the ivy stems and roots were

completely removed, jute was placed and a border of 7 inch mulch was placed around the site to prevent ivy from getting back onto the site.

If ENVS 410 or ENVS 450 students continue this project, the mortality of the Pacific reed grass plugs should be looked at to see if this grass is successful on the site. The site map that we created gives an azimuth and distance of each grass plug from the south eastern corner of the bathroom. Since we scattered primrose seeds over the site, it would be good to monitor the success of primrose on the site as well. Finally, the previous site which is across on the northern side of the parking lot should be monitored as well to ensure that the *H. helix* does not come back.

PROJECT EVALUATION

From start to finish our project has been successful and has gone relatively smoothly. Nothing is ever done perfectly, though; there is always room for improvement. The following is what we did, and a somewhat critical evaluation of our project:

Removal of the invasive *H. helix* was done properly, especially in contrast to the methods used by volunteers who removed it adjacent to our restoration site. Because the ivy is tenacious and has multiple propagules, it was important to remove all leafy vegetation as well as below ground vegetation. Within the boundaries of our site, we attempted to remove 100% of the ivy. In doing so, we severely disturbed the soil, but it was essential to eradicate the plant from the site. Other volunteers simply removed the leafy vegetation and left the stolons and roots which will indefinitely resprout in subsequent years. There is no way to ensure 100% removal due to below ground vegetation; however, our technique was a valiant effort and has so far proved successful.

Preventing erosion of the disturbed soil was also done properly; however, we were a couple of days late laying down the coconut fiber netting. We had to spend a couple of days searching for the cheapest netting and in doing so had a rain storm come in before the netting could be applied. We attempted to correct this by laying down a tarp to prevent erosion during this storm. This did prevent any erosion from occurring, but, had we done everything properly, the netting would have been laid down earlier.

Because we were rushed to lay down the netting, we laid it before we were able to sow *O. wolfii* seeds into the site. This shouldn't be too significant of a problem; however, it would have been more effective to sow the seeds in prior to laying the jute. Instead, we broadcasted the seeds on top of the netting and it's possible that some of them washed down site during heavy rain falls.

One of the first things that we should have done was consult with the *O. wolfii* specialist Dave Imper to determine what plants could be planted onsite, how to plant *O. wolfii* if we could find any seedlings, best way to sow it, *et cetera*. We contacted him after the jute netting was already applied and *O. wolfii* seeds already procured. He was an invaluable source and could have been more useful if we had contacted him earlier.

Other professional contact with Humboldt County Parks (HCP) was done vigilantly and they were always kept up to date with our project. We received permission for anything that needed to be done or performed on site and coordinated everything through HCP.

The wood chips we procured from the end of South G. Street in Arcata could have been contaminated with roadside weed seeds. It was a good idea to use the mix of pine and eucalyptus for allelopathic properties, and it was within our price range (free) where we got if from. However, a more reliable source could have been used to ensure that we didn't contaminate our site with the potential roadside weeds. If done again, another source would be used.

Also within our price range were the redwood and spruce logs we received from Coastal Tree Service. They were important in distinguishing our site's boundary, preventing the mulch from washing down site, and as a silt fence. However, the logs weren't the ideal size. We had originally asked for only redwood and for a minimum diameter of 12 inches but received much smaller diameters and a mix of redwood and spruce. What we received was workable and we were able to use it, however, it wasn't ideal.

RECOMMENDATIONS

In the process of implementing the methods for the removal of *H. helix*, many notes were taken along the way to improve on any future treatments employing our methods or the like. The management of resources, people and time were the main areas to enhance upon reflection of this project.

RESOURCES

The resources were not necessarily difficult to find, but rather locating them in a timely fashion was and could be a challenge. What made it especially difficult was the lag time in between communication with the person or agency in charge of said resource. Our recommendation in regards to this phenomenon would be to start a tools and resources list early and start calling and emailing early in the project's beginnings. Doing so would help secure tools and resources for the day of carrying out the treatment.

Materials that could have been improved include the anchor pins used for the jute netting. These pins would ideally be made of something more environmentally friendly than the metallic ones used, that after some time will oxidize and deteriorate into the soil.

Another material that should be enhanced for the future would be the fencing used to keep any human or animal interference out of the project area. During our work at this site, a make shift fence line was made using simple wooden stakes and yellow rope that proved too enticing for a passer by. For the future a more secure, less appealing and more official fence should protect the area being treated.

At this site we secured logs at the bottom edge of the project site to help keep the mulch in place that was laid down as part of the treatment discouraging encroachment of *H. helix*. For the future we would like to recommend that fewer larger diameter logs be used instead of many smaller diameter logs for the same objectives. Using smaller diameter logs developed issues around securing the logs in place and to each other. While, using one larger diameter log to achieve the same damming effect in an area would do so more simply and elegantly.

The mulch mentioned above was used because of its constituents. Derived from the chipping of Eucalyptus trees that are known to be allelopathic this mulch is believed to discourage the growth and germination of *H. helix*. However, the question remains whether or not any invasive seeds capable of germinating were transported within the mulch to the project site. For the future a quick study of the mulch should be conducted to assess the seed availability and viability within the mulch.

In the search for native seed stock for our coastal site we encountered a discontinuity in the definition and use of the words *native* and *naturalized* plant species for California. The main difference was unfortunately between merchants and academia. For the future we recommend early consultation with local biologists for proper seed stock and consistently reliable information.

While the project did utilize a local coastal bunch grass, we recommend that in the future a mixed variety of sizes and species of local coastal bunch grasses be used for better survivorship, differentiated habitat structure and function.

Always, when working within another agency's jurisdiction proper forms and permits must be signed and doing so during the project's infancy will help insure its smooth development.

PEOPLE

Removing ivy can be both expensive and time consuming, all the more reason to be efficient and effective with the methods of removal. During this project we realized that the proper methods for removing ivy were not shared by all of the volunteers. This disparity translated into a mixed level of ivy removal on the ground. The removal of the invasive ivy is particular due to the plants' growth habits. It's tenacious in its reproduction and its invasion must be equally met with diligent adherence to protocol. We believe that the methods used and described for our site were proper for the goals and objectives of this project and should be followed by everyone who wishes to properly remove *H. helix*. In the future we recommend that the body of volunteers be briefed and or guided in proper methods of *H. helix* removal.

TIME

Inclusive to the time being saved and properly managed by considering the recommendations above we also propose securing longer work days that amount to fewer trips to the project site. We experienced having to make a lot of short trips to the project site instead of having longer work days planned out. We believe that this will make better use of time, gas and morale by seeing bigger changes in shorter time spans. Also properly guided volunteers can help treat a bigger area efficiently and can therefore cut down on the necessity of time consuming return treatments.

CONTACT DETAILS

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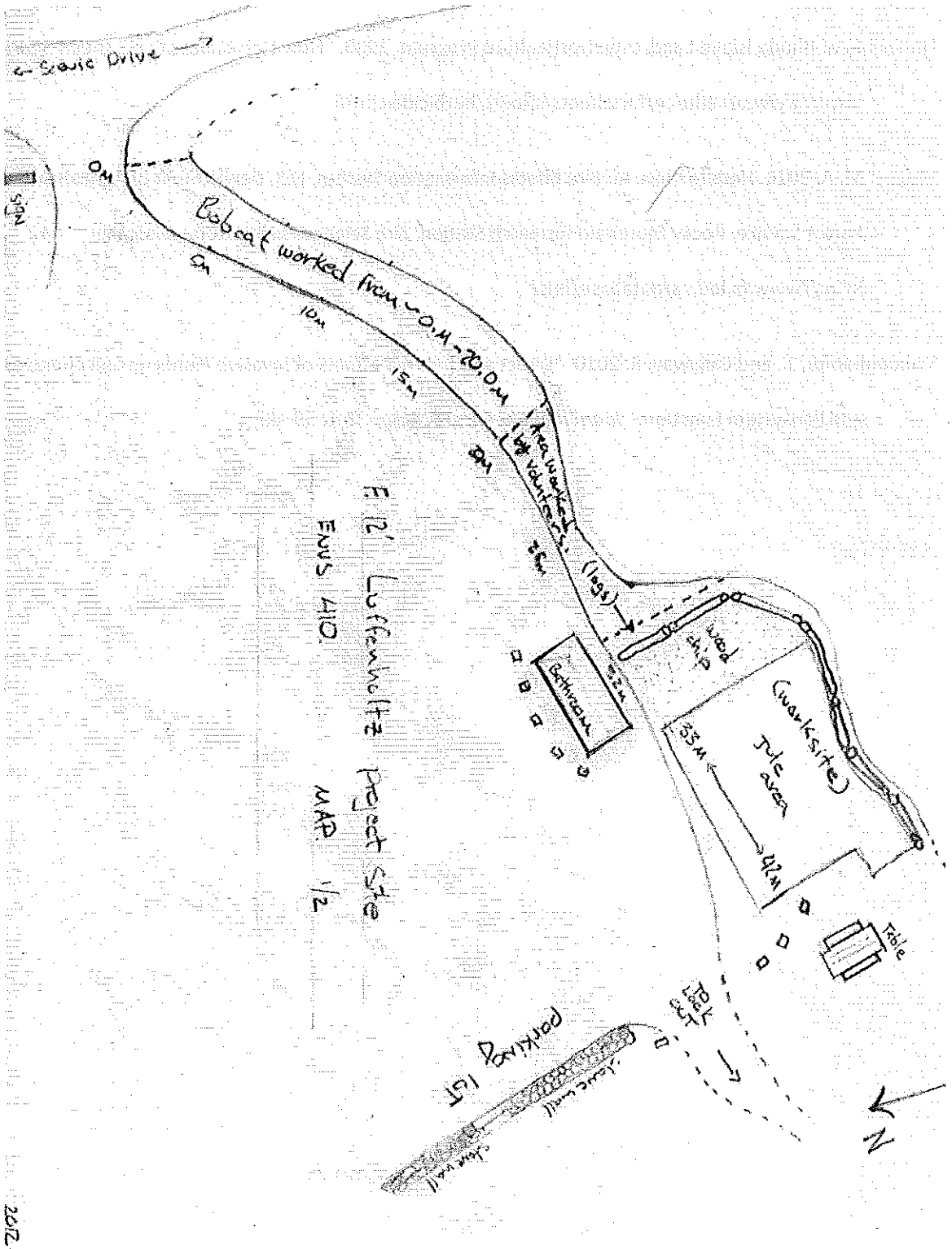
APPENDIX 1 (SITE MAP)



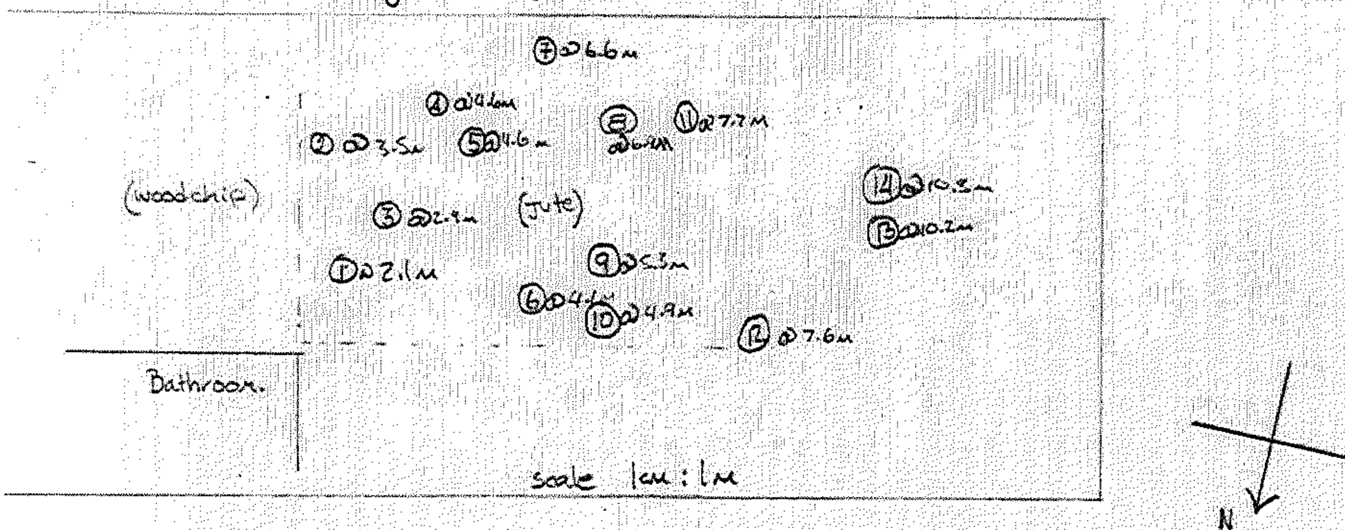
APPENDIX 2 (PACIFIC REEDGRASS PLANTING LOCATIONS)

* Compass bearings & distances to individual grass plugs within the jute. *

* measurements taken from SW corner of the bathroom. *

Grass Plug Number	Compass Bearing	Distance
1	200°	2.1m
2	180°	3.55m
3	200°	2.9m
4	200°	4.6m
5	210°	4.6m
6	250°	4.1m
7	210°	6.6m
8	230°	6.9m
9	245°	5.3m
10	255°	4.9m
11	232°	7.7m
12	260°	7.6m
13	250°	10.2m
14	245°	10.3m

- map to grass plugs - 2/2



7/12

APPENDIX 3

(Matthew Smith)

Date	Time hours	Activity
12-Sep	0.5	Meet with group (class)
17-Sep	1	Meet with group (class)
19-Sep	1	Reading of past project's report
20-Sep	3	follow-up survey of last year's project and baseline vegetation survey of our site
20-Sep	1.33	spreadsheet for monitoring data
24-Sep	2	Writing problem statement and Background
26-Sep	1.5	met w/Brian at luffenholtz to discuss project
26-Sep	0.5	editing Bailey and Anabal's alternative sections
29-Sep	6.17	Work Day number 1. everyone was present
29-Sep	2.33	Seed collecting at the house
1-Oct	1	Meet with group (class)
2-Oct	0.5	Calling around for Jute
3-Oct	2.75	Work day with group, touching up our site/finish pulling ivy
8-Oct	1	Hauling woodchips to site
10-Oct	1.5	Hauling woodchips to site
10-Oct	0.33	editing Background
10-Oct	1.33	Alternatives: hydroseeding, seeding, and planting
15-Oct	0.5	Meet with group (class)
16-Oct	2	Laying Jute
17-Oct	1.5	Trip to cutten to look at Coastal Tree Service's redwood logs.
20-Oct	3.12	Upper trench for jute, lay down logs.
21-Oct	1.25	Redoing Alternatives: hydroseeding, seeding, and planting
24-Oct	1.5	Keep out signs and Interpretive sign
24-Oct	0.5	Emails to Jennifer (BLM Botanist) regarding plant seed sources.
24-Oct	2	Meet with group (class)
26-Oct	1.67	Emails to Jennifer, Dave Imper, Hank Seeman, and Brian. Coordination of permitting. Relaying info to group.
27-Oct	2	print/laminate interpretive signs/Met with Dave Imper at site
29-Oct	0.5	Meet with group (class)
3-Nov	7.25	Procured Reedgrass, planted it, touched up wood chips, pulled ivy from last year's site, broadcasted wolfii seeds
11-Nov	6.25	Finished pulling ivy from last year's site, remonitored our site, touched up our site.
25-Nov	2	Powerpoint
26-Nov	1	Trip to site to check up on signs, wood chips, plants, etc.
26-Nov	0.33	Powerpoint
27-Nov	0.58	Evaluation of project
28-Nov	1	Powerpoint
29-Nov	1	Putting powerpoint slides together/editing
1-Dec	3	Group powerpoint practice/finalization
3-Dec	3.33	Editing final paper
3-Dec	0.75	Practice presentation
5-Dec	1	Finish editing final draft of paper
6-Dec	2	Finish editing final draft of paper
TOTAL	73.77	

(Bailey Hunter)

Date	Task	# of hours
9-Sep	Meet with group, visit site	1.5
12-Sep	Meet with group, visit site	0.5
12-Sep	Found pictures of plants on site	1
17-Sep	Meet with group	1
20-Sep	Meet with stateholders	1.5
22-Sep	Monitor site	3.5
24-Sep	Alternatives-research and wrote	3
26-Sep	Meet with county	1
29-Sep	Pulled Ivy	4.5
1-Oct	Meet with group	1
1-Oct	Reseach Erosion control	1
2-Oct	Meet with group, visited and clean up site	1
5-Oct	Researched Seeds to plant	2
8-Oct	Got mulch	1
8-Oct	Research place to purchase seeds	1
8-Oct	Erosion control alternatives	1
10-Oct	Gather mulch	2
15-Oct	Meet with group	0.5
15-Oct	Put on plastic cover to prevent rain ersoion	1
16-Oct	Put down jute	2
17-Oct	Look at wood	1.5
18-Oct	Pick up wood	1
20-Oct	Place wood/ dig top trenches for jute	3
21-Oct	Put together alternatives	0.5
22-Oct	Put down mulch	2
24-Oct	Met with group	1
24-Oct	Wrote monitoing methods	1
27-Oct	Met with Primerose expert	2
27-Oct	Finished monitoring methods	1
29-Oct	Met with group	0.5
31-Oct	Meet with group	0.5
2-Nov	Got tools and reed grass seedhead	1
3-Nov	Got grass plugs, planted plugs, scattered seed, pulled ivy	7.5
5-Nov	Returned tools	0.5
7-Nov	Meetwith group	0.5
7-Nov	timeline and e-mail Anibal	0.5
10-Nov	Finish up site	6
10-Nov	typed up data, edit paper	1
11-Nov	edit paper	2.5
14-Nov	met with group	0.5
17-Nov	write monitoring	2.5
19-Nov	edit paper	1.5
21-Nov	write monitoring	2
27-Nov	visit site after storm	1.5
30-Nov	made slides for power point	1.5
1-Dec	work on presentation	3
3-Dec	Pratice presentation	1
5-Dec	Finish up paper	3.5
Total		81.5

(Anibal Florez)

DATE	TIME ON (HRS)	DESCRIPTION
9/?/2012	1.5	Initial site visit. Brainstorming
9/9/2012	1.5	Baseline data
9/12/2012	0.5	met with group
9/17/2012	1	met with group
9/24/2012	1	Lobby group mtg, brainstorming+tools
9/25/2012	1.75	Writing alternatives
9/26/2012	2.5	Meeting with Brian From Co. Parks
9/27/2012	1.5	Research:erosion, flora
9/29/2012	6	Natl. Public Lands Day 2012 (Ivy Pull)
10/1/2012	1	met with group
10/3/2012	2.75	2nd work day on site. Grubbing
10/4/2012	5.75	Mining for resources through local Co. Trip out to Blue Lake on a wood chip tip located and shoveled some wood chip
10/8/2012	3	More chip shoveling, brainstorming and trips out to site.
10/10/2012	2.75	Two trips with mulch out to site.
10/15/2012	1	Securing bare soil on site with plastic sheeting.
10/16/2012	3.55	Setting down jute and phone calls to BLM and 6Rvs for permits.
10/20/2012	1	On site wood/rope fencing.
10/22/2012	2	Mulching the site. Meeting with Botanist
10/24/2012	1	met with group
10/25/2012	3	Alternatives and Methods
10/29/2012	0.5	met with group
11/3/2012	7.5	Mulching, Ivy pulling, and grass plugs.
11/10/2012	7.5	more ivy pull+as built monitoring+site map
11/19/2012	3	recommendations section
11/25/2012	1	editing partner's parts
11/26/2012	1	quick site inspection post precipitation event
11/26/2012	1	Sketch of grass plugs
11/26/2012	2	final drafts of site maps
11/28/2012	2	PPT slides and presentation
11/31/2012	2	PPT finals and practice
12/3/2012	1	practice presentation
12/5/2012	2	wrote an Introduction for paper
12/6/2012	0.5	Final editing on paper
Total	75.05	