

# Identifying Priority Invasive Species and Areas within the HSU Campus



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## **Abstract**

Humboldt State University (HSU) is often characterized as having and encouraging an environmentally conscious community. However, these attitudes are not reflected in the campus landscaping which is housing many known invasive plants of California. This is particularly pertinent because of the campus' close proximity to the Arcata Community Forest. The issue of invasive flora on the HSU campus is acknowledged by grounds managers, teaching faculty, and even some students; however, there are still barriers preventing substantial progress to be made regarding the removal of these invasives. The objective of this document is to characterize the invasive flora on campus and identify high risk or priority areas to inform decision making on future management of campus invasive species. A list of criteria was developed, in collaboration with grounds managers and professors, to characterize invaded areas and used to design a prioritization scoring method. This method was applied to establish a baseline characterization of the invasive plants and identify high priority areas on the HSU campus.

## **Problem Statement**

The campus of Humboldt State University currently contains an overabundance of invasive plant species that are detracting from the potential native landscape, causing maintenance and upkeep issues, and posing potential health and safety risks on campus. However, there is currently no formal management plan in place (Doug Kokesh, pers. comm.) that better informs and guides how the issue of invasive species on campus can best be addressed and dealt with.

## **Background**

Since the creation of the continents, terrestrial species have evolved and adapted to survive in their ever changing native environments. With the shifting of the plates, mountains and valleys begin to form, river channels are carved out, and species diversity begins to rise. Many organisms can't overcome the new limitations that may be placed on them and their genetics can get locked into a specific region. When an organism (for the purpose of this paper we will be discussing plants) becomes a part of the balance of nature after developing over hundreds or thousands of years in a particular region or ecosystem, its referred to as a native species. This is

quite different from a plant introduced with human help (intentionally or accidentally) to a new place or new type of habitat where it was not previously found- these plants are known as non-natives. Not all non-natives are bad, many can't continue to grow without the help of humans since they have been removed from their native environments. Plants that are non-native and do not need human help to reproduce and maintain itself over time in an area where it is not native is called a naturalized plant. If a plant is not native to the continent on which it is now found, it is considered an exotic plant (Marler, 2000). When a non-native (or naturalized) plant begins to spread and displace native plants due to a disturbance or just favorable conditions, it becomes invasive. From the Presidential Executive Order 13112: An invasive species is defined as a species that is (1) non-native (or alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Clinton, 1999). If a native plant is able to take advantage of disturbance to the soil or existing vegetation and begins to spread quickly and outcompete the other plants on the disturbed site, it is considered an opportunistic native plant.

Plants in particular are dispersed in many different ways. Some plants spread by rhizomes, others by fruits that are passed through an organism (such as a bird) and deposited in a new location, and also by translocation due to humans. During the colonization of what is now the United States, ships would transport plants from the colonizers' lands and replant them in the new territory to give the comforts of home. Many grasses have been translocated because they tend to be better feed for farm animals and are only able to thrive since natural fire regimes have been ceased. *Spartina densiflora* (cordgrass) was brought over on ships from South America in the ballasts of the ships (Strong & Ayres, 2009). Since the ships needed to be counterbalanced, they would dredge the land for soil to place in the ballasts and when they got to their destination they would dump everything into the ocean (and for *Spartina* it was dumped into the Humboldt Bay). Many other non-native plants have been brought over and found conditions in which they thrive. Human disturbance in the landscape alters the communities which tend to kill off native species which can lead to decreases in health and even the economy. In croplands, weeds can take away from the yield as they compete for resources. In 1994 the economic impact of weeds was estimated at \$20 billion or more annually (Westbrooks, 1998). According to the NRCS a weed is a plant (native or non-native) that is not valued in the place where it is growing. This means while many weeds can be opportunistic native plants, weeds are generally invasive species

because they are taking over natural landscapes and spreading prolifically, such as Ivy around at Humboldt State University.

### Invasive Species and HSU

Invasive plant species are not new to campus. Many exotic and non-indigenous plant species were intentionally planted at the onset of HSU's development. Many of these species were chosen for aesthetic purposes- ornamental shrubs, trees, and herbs. Furthermore, some species such as English and Algerian Ivy were intentionally planted not only for their aesthetic qualities, but for other esteemed qualities such as soil stability, ground cover, low maintenance requirements, and even educational opportunities. However, the campus landscape was originally designed with minimal knowledge of or attention paid to the life history traits and potential threats associated with the plant species chosen (Doug Kokesh, pers. comm.). Some of those original species planted now pose a myriad of threats to HSU's perceived aesthetic quality, public health and safety, surrounding natural ecosystems, and the university's commitment to sustainability (White, 1998). Adding to the negative effects of planted exotic species on campus has been the steady recruitment of new invasive species that have naturally colonized areas of campus.

Being an educational institution with a strong natural sciences department, the level of knowledge concerning the problems associated with exotic and native species, even in non-natural areas, has greatly increased on campus. Furthermore, the life history traits of the invasives on campus are much better understood and many successful strategies to deal with invasives have become available. Due to this greater level of knowledge about invasives and associated management strategies, there have been steps taken over the last few decades to address the issue of invasive plants on campus. The grounds crew, headed by Doug Kokesh, has taken campus landscaping in a new and more progressive direction over the last decade. Although attention has been paid to attempting to control weedy and nuisance plant species on campus for some time now, the campus was always managed in a more natural and passive manner- plants on campus were somewhat left to do their own thing, with many describing the campus as being much more "overgrown" than it is today.

Over the last decade, a new vision and approach has guided campus toward a more manicured and park-like setting. In 2012, HSU was recognized by a panel of National Garden Clubs for excellence in land use and landscape design. The panel was impressed by the fact that the landscape design was also an asset to the community and that continued development over the course of the last several years has been well thought out and easily incorporates itself into the existing campus. Furthermore, also in 2012, a team of HSU faculty and staff completed an extensive overhaul of the university's campus standard plant list. The document included hundreds of plant species and according to Doug Kokesh, "was intended to create a comprehensive guide for future landscaping projects but also to provide students and professors with a hands-on learning resource". However, this document only involved cataloging the plant species found on campus and certain attributes associated with some of them. This is an excellent resource for those involved with the campus landscape management and species composition decisions, but there is a need for an even more comprehensive guide that addresses a more encompassing background of the invasives that are here, prioritizes species and areas in need of invasive removal, and potential strategies to resolve the issue of invasive species management. Given the new direction being taken for campus landscaping and the growing amount of interest and information regarding invasive plants on campus, there couldn't be a better time to develop a comprehensive management plan that provides the information necessary to further the attempt to resolve the issue of invasive plants on campus.

### Grounds Crew view on invasives on campus

The current landscaping policy for Humboldt State University is directed and controlled by a handful of stakeholders. Plant Operations dictates policy and protocol for the majority of the campus while HSU Housing and Dining manages all landscaping tied to the campuses dormitories. The Botany department is a minor stakeholder whose influence is felt through the planting of educational exotic plant species. The major stakeholder with the greatest influence on the schools landscaping policy is Facilities Management, through constant budget cuts and reallocations the schools landscaping departments are forced to do more and more with less and less.

Plant Operations as previously mentioned manages the majority of the campuses landscapes. Their views concerning invasive species are a mixed bag. If funding were not an issue Plant Ops would remove all non-educational invasive species, one notable exception exists and that is the utility of slope stabilization found in the two Ivy species found throughout campus. In situations where erosion is not a factor, two hundred to three hundred square feet of Ivy are removed on a yearly basis; this figure would be much larger, however, budget constraints limit the allocation of work hours towards removal. Most other invasives are removed through regular landscaping upkeep and maintenance when noticed. This practice is ongoing, as birds disperse seeds on campus constantly. Budget constraints, however, overshadow the ability for landscapers to dispatch volunteer invasives, so prioritization of areas where there are possible health concerns or areas with high visual impact take precedence. In the past there has not been and nor is there currently a hard copy document dictating Plant Ops campus policy on landscaping protocols and or pertaining to invasive species.

HSU Housing and Dining also do not have any current written mandate concerning upkeep of campus landscapes and consequently lack any guidelines towards invasives species on campus. Housing and Dining's general outlook on landscaping mirrors Plant Ops for the most part. One key difference should be noted that while Plant Ops sets a fairly low priority towards campus periphery, Housing and Dining have locales of high priority on the campus outskirts. Again it should be mentioned that the greatest restraint to the upkeep of campus landscapes regardless of department is funding.

## Stakeholders

- Stakeholders Involved
  - Funders/Admin
  - Botany Department
  - Plant Operations
  - Housing and Dining'
- Potential Stakeholders
  - Associated Students/Student Groups
  - City of Arcata
  - California Conservation Corps
  - North Coast Native Plant Society

## Invasive Species

### English Ivy (*Hedera spp.*)

English Ivy is often used to refer to the species *Hedera helix*, but is actually a broad term used for a complex of evergreen woody vines that encompasses the genus *Hedera* (Clarke et al., 2006). It is prevalent throughout northern California and the Pacific Northwest (Bossard et al., 2000; Clarke et al., 2006). The most common species found in northern California are English Ivy (*Hedera helix*), Canary Ivy (*Hedera canariensis*), and Algerian Ivy (*Hedera algeriensis*). English Ivy is native to Eurasia and can be found in Mediterranean parts of Eurasia and in North Africa (Bossard et al., 2000; Ackerfield & Wen, 2002; Clarke et al., 2006). Ivy was introduced to North America during the early colonial era as an ornamental ground cover and for slope stabilization (Bossard et al., 2000; Clarke et al., 2006). The evergreen foliage of Ivy has a waxy or leathery appearance, and populations can range from a thin, matted network of vines (Appendix B.8) to a dense, shrub-like thicket of woody stems (Appendix B.6; Bossard et al., 2000). English Ivy produces an umbel of greenish-yellow to white flowers throughout the fall and sets fruit, as dark purple berries, the following spring, typically April and May (Bossard et al., 2000).

The adventitious roots of English Ivy allow it to be very effective at spreading laterally as well as climbing vertically along walls and trees (Appendix B.1, B.2), making it highly competitive for light and nutrients (Bossard et al., 2000; Clarke et al., 2006). English Ivy can completely overtake the native landscape by killing and sometimes even felling trees and other native plants, creating a homogenous stand of Ivy (Bossard et al., 2000; Ackerfield & Wen, 2002; Clarke et al., 2006). Because of its dense network of fibrous roots, English Ivy is very persistent, even after removal (Bossard et al., 2000).

Manual removal of English Ivy, either by hand or with the use of pruners, is likely the most simple and convenient method of management (Bossard et al., 2000). Pruners and other cutting implements are especially helpful for managing climbing shoots, which are the most likely to produce flowers and set seed (Bossard et al., 2000). English Ivy does not respond to pre-emergence herbicides and the thick waxy coating of its foliage makes the use of postemergence herbicides largely ineffective (Bossard et al., 2000).

### Cotoneaster (*Cotoneaster spp.*)

*Cotoneaster* is a genus of 90 species of evergreen shrubs in the rose family, Rosaceae. The historical distribution of the genus was restricted to temperate parts of Europe and North Africa, as well as most of Asia (Zheng et al., 2006a). The entire genus is non-native to North America and many species are invasive (Bossard et al., 2000). Cotoneasters are often sought after as an ornamental for its white or pink rose-like flowers and vibrant orange-red fruits (Appendix B.17). Cotoneasters are propagated primarily by seed, and while their berries can be dispersed by birds, more often they will fall on the ground and germinate on their own (Bossard et al., 2000). Plants begin flowering as early as late-spring, typically lasting throughout the summer, and set fruit in autumn, but can persist through winter (Bossard et al., 2000; Zheng et al., 2006a).

Cotoneasters are fast-growing and can cause many issues for native plants and landscapes. They possess highly aggressive and competitive root systems which will often overtake native plants (Bossard et al., 2000). It is also a very persistent propagator because of the large number of seeds it produces (Bossard et al., 2000). Flowers of Cotoneasters have been known to attract wasps, including yellow jackets (Bossard et al., 2000; Brodmann, 2010).

There are various methods to control Cotoneasters, each with their own disadvantages and benefits. Plants can be physically removed, either manually or mechanically. Hand removal can be labor-intensive because of its aggressive root system. Coppice shoots (new growth from the stump), will emerge from the stored energy in the roots of remaining stumps if not treated with herbicide (Bossard et al., 2000). Stumps can persist up to three years on energy stored in the roots, but cutting plants after fruit set, when stored energy is depleted, can decrease stump persistence (Bossard et al., 2000). Cotoneasters can also be killed with various herbicides. *Invasive Plants of California's Wildlands* suggests a 25 percent solution of triclopyr (Garlon® 4) with 75 percent of an inert, surfactant ingredient, such as cottonseed or light cooking oil).

### English Holly (*Ilex aquifolium*)

English holly (*Ilex aquifolium*) is an evergreen shrub whose distribution historically spanned from North-western, central and southern Europe, North Africa, and Asia Minor (Peterken & Lloyd, 1967). It is often found on mountains and hillsides, with a wide elevational range as high



as 2300 meters (Peterken & Lloyd, 1967). In addition to being shade-tolerant, holly is very hardy and can grow in a wide range of conditions and soils, making it extremely successful understory vegetation (Peterken & Lloyd, 1967; Gray, 2003, Evergreen, n.d.). It can be easily identified by its spined leaves (Appendix B.12). Holly is dioecious, meaning male and female flowers do not occur on the same plant, and is pollinated by insects, primarily various types of bees (Peterken & Lloyd, 1967). Flower buds begin to form in late summer and open the following May or June (Peterken & Lloyd, 1967). Plants develop bright red berries containing up to four seeds and are most commonly dispersed by birds (Peterken & Lloyd, 1967).

Holly is shade-tolerant and can out-compete natives that are more dependent on solar radiation (Peterken & Lloyd, 1967; Gray, 2003). It can also grow in dense clumps and can sometimes be found in pure stands (Peterken & Lloyd, 1967; Evergreen, n.d.). Holly, like many invasives, is a very successful propagator and can spread quickly through suckering or layering (Evergreen, n.d.).

The most common method to remove holly is by physically removing it, either mechanically or manually. However, holly can grow quite large if left for too long, so early removal is recommended (Evergreen, n.d.). The relatively thin bark of holly also makes it susceptible to fire, which can be used to manage larger, dense populations (Peterken & Lloyd, 1967). Another possible method to reduce growth in low temperature areas is to open the canopy and introduce more solar radiation, which induces photoinhibition in holly (Gray, 2003).

#### Himalayan Blackberry (*Rubus armeniacus*)

Not to be confused with the native California Blackberry (*Rubus ursinus*) of the same genus, Himalayan Blackberry (*Rubus armeniacus*) is a very aggressive growing non-native species (Appendix B.10) that can withstand a wide range of soil textures and pH levels (Bossard et al., 2000, Caplan & Yeakley, 2006). This particular species' native distribution ranges from Western Europe, to parts of Asia, to North Africa, and was brought over to the United States as a cultivated crop (Dutson, 1974; Bossard et al., 2000). It is able to produce copious amounts of seed-bearing fruits that are highly attractive to birds and mammals, including humans (Bossard et

al., 2000). Himalayan blackberry flowers from May through July and produces fruit from July to September (Bossard et al., 2000).

Himalayan blackberry is a robust, sprawling, vine-like shrub that possesses heavy, broad-based prickles along its stems (Bossard et al., 2000). Stems can accumulate into dense thickets that can displace native plants as well as serve as a potential nest habitat for ground rodents such as the *Rattus rattus* (Dutson, 1974). Dense thickets of blackberry may also create fire hazards if they are in close proximity to buildings and structures (Bossard et al., 2000).

Herbicides have not been found to be effective on Himalayan blackberry and are often managed manually with the aid of tools such as weed wrenches and loppers (Bossard et al., 2000). When controlling the plant physically, the whole rootstock should be removed to discourage resprouting, which can occur after multiple cuttings before nutrient reserves are depleted (Bossard et al, 2000). Fire can also be an effective means to control Himalayan Blackberry (Bossard et al, 2000).

#### *Pampas Grass (Cortaderia jubata)*

This distinctive perennial grass can be found all throughout the California coast and in disturbed areas. Pampas grass, also called jubata grass, is native to western South America, with a historic range that spans from Ecuador to Chile and northern Argentina, and occurring at elevations from sea level to over 11,000 feet (Bossard et al, 2000). Pampas grass was at one time desired for its ornamental and decorative qualities in Europe and is suspected to have been brought to North America through horticultural trade (Bossard et al, 2000). It can be very easily identified by its voluminous tuft of basal leaves, referred to as a tussock, and a tall stem extending far beyond the tussock (Appendix B.16) with a dense plumed panicle of female flowers, usually one to three feet long (Bossard et al, 2000). Flowers are typically produced between June and September (Bossard et al., 2000). Because of the lack of male flowers, pampas grass set seed without pollen transfer, which leads to reduced genetic diversity in populations (Bossard et al, 2000).

Pampas grass is highly competitive and can quickly exclude native plants, particularly in delicate ecosystems (Bossard et al, 2000). In disturbed or cut-over forested areas, pampas grass can actually suppress reestablishment of seedling conifers (Bossard et al., 2000). Because of the

density of the leaves in its tussocks, the accumulation of plant matter creates a fire hazard (Bossard et al., 2000). An inflorescence can produce up to 100,000 minute seeds that are easily dispersed by wind, making pampas grass extremely resilient and difficult to manage (Bossard et al., 2000).

Manual removal of pampas grass by hand can be highly effective for smaller individuals, but labor intensive (Bossard et al., 2000). For larger, mature plants, the use of tools such as pulaskis or shovels would be needed to aid removal of the entire crown and upper root system and prevent resprouting (Bossard et al., 2000). The application of glyphosate, at a two percent solution, after the emergence of an individual can also be an effective control strategy (Bossard et al., 2000).

#### Scotch Broom (*Cytisus scoparius*)

Scotch broom (*Cytisus scoparius*) is a perennial shrub native to Europe and North Africa that was introduced to the Sierra Nevada foothills in the 1850s as an ornamental, and later used to stabilize slopes and dune hummocks (Bossard et al., 2000). Mature plants can range from six to ten feet tall, with five green longitudinal ridges on young shoots and narrow sessile leaves throughout (Bossard et al., 2000). It produces a raceme of golden-yellow flowers (Appendix B.13) that are morphologically characteristic of other papilionoid subfamily of Fagaceae (Bossard et al., 2000). Individuals are typically not reproductive until reaching two to three feet in height, which is roughly two or three years, and flowers in late March to June (Bossard et al., 2000). Seeds mature in June to July and are long lived, with a potential seed bank of 2,000 seeds per square foot (Bossard et al., 2000).

Scotch broom is very efficient at colonizing open areas and can readily displace native species as well as hindering reforestation because its rapid vertical growth can shade out seedling trees (Bossard et al., 2000). Shoots are unpalatable to many foraging animals, its seeds are poisonous to ungulates, and its foliage causes digestive complications for horses (Bossard et al., 2000). Fire hazards are another concern for scotch broom because of its flammability and its height can spread flames up to the upper canopy (Bossard et al., 2000).

Manual removal of scotch broom would require equipment such as weed wrenches for larger individuals, or can be managed by cutting individuals near the base (Bossard et al., 2000). However, manual removal with weed wrenches is highly intrusive, leading to trampling of natives, and cutting still allows individuals to resprout from the remaining roots (Bossard et al., 2000). Biological control through the use of burrowing and seed-feeding insects have been approved by USDA, but are not effective in California, though other strategies of biological control are being researched (Bossard et al., 2000). Thorough application of two percent glyphosate herbicide has been effective on adults, although can impact non-target species and resprouting is still possible (Bossard et al., 2000).

### *Periwinkle (Vinca major)*

A perennial vine, periwinkle (*Vinca major*) is native to southern Europe and North Africa (Bossard et al., 2000). Like English ivy, periwinkle was introduced to North America for its use as an ornamental ground cover (Bossard et al., 2000). Non-flowering stems are typically prostrate and low to the ground, rooting at nodes, while flowering stems are erect, extending up to two feet (Bossard et al., 2000). A single purple-blue flower per stem develops in the leaf axil of flowering stems (Bossard et al., 2000). Although populations of periwinkle will produce flowers, it has not been found to reproduce sexually in California and only reproduces vegetatively (Bossard et al., 2000).

Left unmanaged, periwinkle can form a dense mat of vegetation (Appendix B.11) that will displace native plants and exclude other plant species from establishing (Bossard et al., 2000). Riparian areas are particularly sensitive to periwinkle because stem fragments can be transported through waterways and resprout downstream (Bossard et al., 2000).

Hand removal of periwinkle can be effective in sparse distributions, but can be labor-intensive in more established stands (Bossard et al., 2000). For hand removal, starting at the perimeter of a population and working inward towards the center has been proven as an efficient strategy, but requires repeated treatments (Bossard et al., 2000). The use of glyphosate herbicide has been tried, with success, when applied immediately after cutting or trimming (Bossard et al., 2000). A

three percent solution resulted in roughly between 70-75 percent control, and a five percent solution was able to achieve 100 percent control (Bossard et al., 2000).

#### Victorian Box (*Pittosporum undulatum*)

Victorian box (*Pittosporum undulatum*) is a broadleaf evergreen tree native to coastal mountain regions in southeast Australia, but has been cultivated all around the world for its attractive, fragrant flowers (IUCN, 2005). It can grow as a shrub or tree, growing as tall as 30 feet, and typically has slender branches with smooth, grey bark (IUCN, 2005). Its leaves can be lanceolate to oblong in shape, with a distinctive wavy margin (Appendix B.14; IUCN, 2005). Individuals are not reproductive until at least five years of age and fruits, in the form of capsules containing 20-40 orange seeds, mature after six months (IUCN, 2005). A single tree has the potential to produce 37,500 seeds (IUCN, 2005).

Victorian box is rapid-growing and can take advantage of open, disturbed areas which allows it to shade out and exclude native plants in native forest areas (IUCN, 2005). The leaves of Victorian box also contain an allelopathic toxin that can inhibit growth of other plant species (IUCN, 2005).

Manual removal of Victorian box seedlings can be effective, but removed shoots and roots cannot be left exposed to the ground because they are able to reestablish (IUCN, 2005). Glyphosate, as well as a mixture of 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) and diesel, has been successfully used in Australia and South Africa, respectively, when applied on stumps after cutting (IUCN, 2005). The injection of glyphosate into holes drilled in plant stems has also been tried in Australia (IUCN, 2005).

#### Spanish Heath (*Erica lusitanica*)

Despite its name, Spanish heath (*Erica lusitanica*) is actually native to southwestern Europe (Cal-IPC, CRC, ODA). It is a woody perennial shrub or subshrub and can grow as tall as ten feet in height (ODA). It possesses needle-like leaves that are light in color and evergreen (ODA). Spanish heath is commonly cultivated as an ornamental for its aesthetic qualities (CRC, ODA). Its inflorescences are very showy, with a high concentration of small, tubular flowers that are

white to pink in color (Appendix B.15) and can produce millions of seeds in a mature individual (CRC, ODA). The flowering season for Spanish heath is relatively long, spanning from December to April (Cal-IPC, ODA).

Areas in Oregon, Australia, and New Zealand have been experiencing invasions of Spanish heath creating dense monocultures, and there have been recent incidents of this in California, specifically Humboldt County (Cal-IPC, CRC, ODA). It is highly competitive and is adapted to moist, acidic or infertile habitats common of northern California (CRC, ODA). These qualities make Spanish heath effective at colonizing disturbed areas and preventing regeneration of natural wildlands (CRC, ODA).

Not many management strategies have been researched in North America, but in Australia and New Zealand, where Spanish heath is prevalent, various methods of control have been implemented. Because of its dense root system, and woody stems, manual removal of mature plants is not practical, but this method could be used for removing seedlings (CRC). Foliar application of herbicide can be effective, but close attention to native vegetation must be made (CRC). Stem injections or post-cutting application of herbicide have also been found to work (CRC).

## **Objectives**

- Identify invasive species on campus with high a need/ prioritization for removal/management
- Identify areas on campus with high a need/ prioritization for invasive plant species removal/management
- Increase the level of awareness about high priority invasive species and areas on campus
- Identify potential strategies to better manage and, in the long term, decrease the abundance of high priority invasive species on campus
- Guide future landscaping development and management endeavors by creating a more empirical methodology for assessing the prioritization of invasive species and invaded areas of campus

## **Constraints**

### **Prioritization**

Prioritizing the level of relative threats posed by invasive plant species on campus and the corresponding levels of need to focus management efforts at removal regarding those species will be considerably difficult given the many stakeholder interests and needs on campus. The grounds crew, housing and dining department, and other stakeholders responsible for the direct management and design of the campus' plant landscape tend to prioritize plants with qualities beneficial to aesthetics, health and safety, and, most notably, maintenance requirements/usefulness. However, there are other interest groups on campus, such as botany professors, that highly value the educational value of certain plant species found on campus to serve as real-life examples of the species and concepts that they need to teach students about. Furthermore, some involved with the wildlife pens have become concerned with threats posed to their wildlife through diseases and predation from pests that certain invasive species promote. Lastly, related to the concerns about aesthetics by those directly responsible for landscape management, many students come to our campus from far-reaching locales and they often appreciate seeing plants that remind them of home. In order to overcome these hurdles, we are actively engaging with all stakeholders to ensure that they have input into the approach used to prioritize the need for managing campus invasives. Both verbal and formal surveys have been carried out which provide the specific criteria on which the invasive species will be evaluated and room for the stakeholders to provide input regarding how they prioritize the criteria, their rationale behind that prioritization, and recommendations for improving the evaluation process. Furthermore, we hope to explore opportunities involving improving the collaboration (campus landscape working group) between different stakeholders in order to ensure that everyone on campus is on the same page and all stakeholder needs can be most optimally met.

### **Implementation**

Once the invasive species on campus have been prioritized in the most optimal manner regarding fulfilling all stakeholder needs and interests, we will need to provide recommendations for dealing with those invasives. The recommendations that we provide will, undoubtedly, face

many hurdles before actual implementation can be carried out and objectives such as decreasing the vices related to invasives on campus can be achieved. The most significant constraint to implementing the strategies provided by our study will be the availability of resources to tackle the issues surrounding the invasives. Budget cuts have severely hampered the ability of those directly responsible for campus landscaping decisions and management. Professional landscapers once employed by the grounds and housing departments have been laid off due to budget limitations. This has led to a diminished ability by those departments to adequately address the many landscaping issues related to invasive species on campus. Furthermore, these groups responsible for landscaping have not always held invasive species management as an important facet of their operations. We will need to provide extensive and persuading background information on the invasive species on campus that sufficiently sudee those in decision making positions within the responsible departments to pay more mind to invasive management and the benefits that it can bring to the campus.

## **Methods**

Due to the limited resources available to the Facility Grounds and the Housing and Dining Grounds, the issue of invasive plants on campus has become increasingly difficult to manage. To more effectively manage the invasive species on campus, problem areas on the Humboldt State University Campus must be prioritized by their level of concern. A list of criteria was developed in collaboration with Doug Kokesh, from Plant Operations; Susan Buckley, from Housing and Dining; and Dr. Michael Mesler, from the HSU Botany Department to methodologically identify high priority areas. Each individual criterion was given a relative weight based on feedback from surveys given to the grounds staff (Appendix D) of the two departments and to Dr. Mesler. After the weights were received (Appendix E), the provided weights were averaged in order to create weights used in our scoring methodology. The campus was then divided into zones that corresponded with the grounds work crews. Each of these zones was evaluated using the prioritization criteria and giving a score. The evaluation of each species, along with the location, was used to determine the level of concern. A description and reasoning for the evaluation criteria will be discussed below.



## Evaluation Criteria

For each criterion, a value of 0-4 was given to each species in each zone. A value of 0 indicates that there is a low priority (no reason to remove a species from its location), while a value of 4 indicates a high priority for the invasive to be removed. Weights (provided by Doug Kokesh, Susan Buckley, and Michael Mesler) were given to each criterion as a multiplier for the values given to each species.

- Landscape Value

The landscape value criterion can be separated into three distinct categories: (1) maintenance, (2) aesthetic, (3) educational. The main landscape concern for the plants on campus is largely for maintenance. Slope, erosion, and drainage are all important concerns regarding maintenance. Plants should also meet a certain aesthetic criteria, as the appearance of the campus is important to creating a pleasurable working environment. Plants in the landscape can also provide an important educational component, so that must be considered as well. Plants that most optimally meet the landscape criteria should have a low priority.

- Escape or Dispersal Potential/Threat

This criterion takes into consideration the likelihood for the invasive to disperse into new areas, particularly wild or extraterritorial areas. Often times animals, wind, or even pedestrians can be a vector of seed dispersal to outside areas, which is an important factor to consider. Areas or plants with greater potential to escape should be considered a higher priority.

- Health/Safety Threat

As Humboldt State University is an open facility with thousands of students and faculty, maintaining a healthy and safe environment is of the highest concern. Rats, which can be a vector for disease, like to nest in ivy and Himalayan blackberry. Wasps are another concern as they can be attracted by the invasive Cotoneaster. These potential health risks are an important issue to consider in the evaluation of campus invasive plants. Plants that pose a higher health and safety risk should have a higher priority.

- Alternative Feasibility

This criterion deals with the issue of how easily an invasive can be replaced without affecting the other criteria. Some invasives are currently providing an important maintenance value that may be sacrificed by replacing it with a less effective native species. A high priority rating should have a greater feasibility for alternatives with minimal effect to the other criteria.

- Removal Cost

This criterion considers the costs associated with the removal process. One important cost consideration is the amount of labor required to remove the invasive. Different areas may cost more depending on the species of invasive plant being removed and techniques required to remove it. The type of equipment required for removal is another prohibitive cost that should be considered. Higher priority tasks in this category should typically have lower costs.

### Zone Delineation

In order to more accurately assess the invasive flora of the HSU campus and for the convenience of the grounds crews, we divided the campus into four zones based on information provided by Dough Kokesh and Susan Buckley about how they delineate work zones for each working grounds crew. Zone 1 is managed by HSU Housing and Dining and is divided into 6 subzones (a-g). Zones 2, 3, and 4 are managed by Plant Operations (Figure 1).

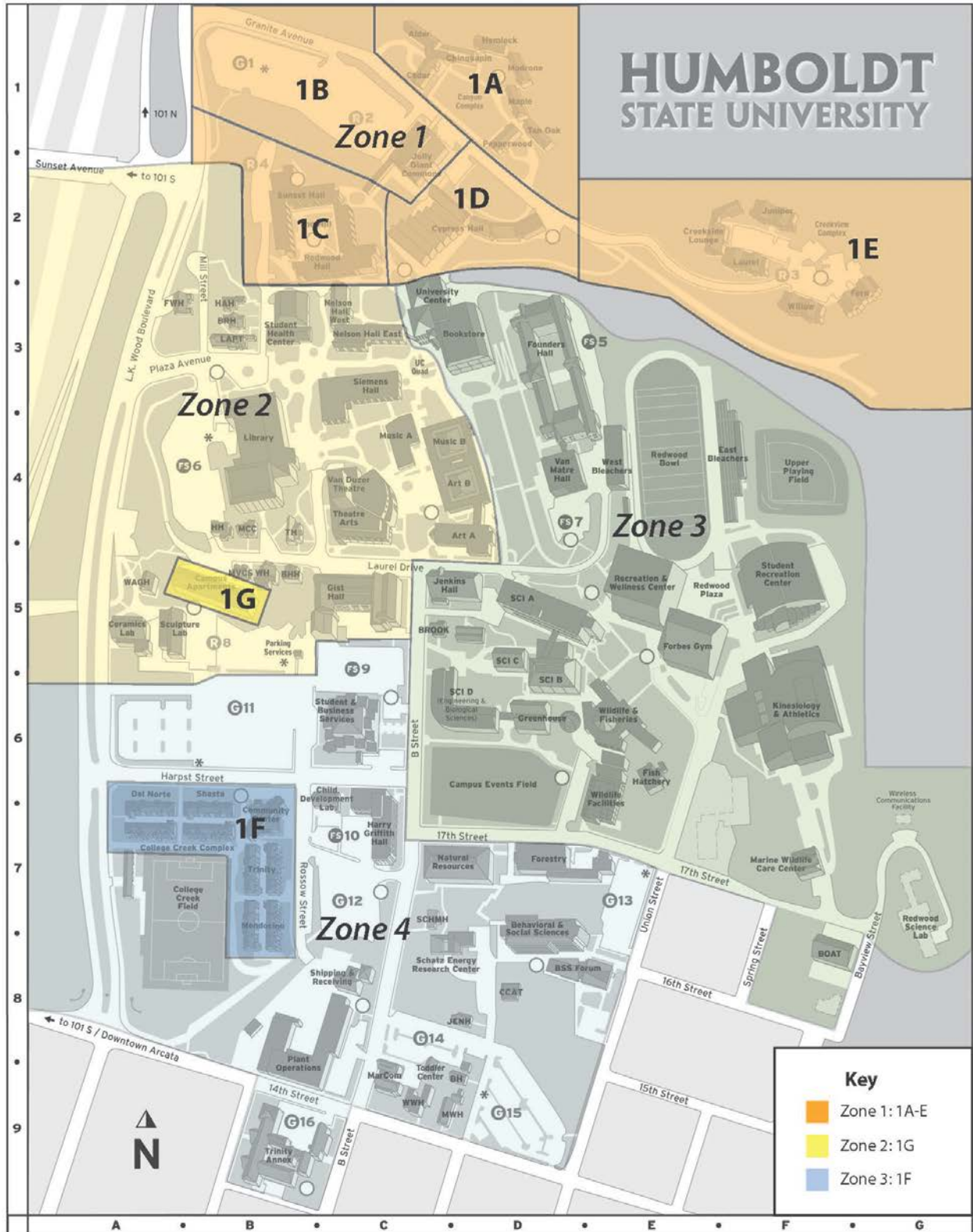


Figure 1: Landscape management zones of Humboldt State University campus

- Zone 1a
  - Location: Canyon Complex. The north boundary is delineated by the retaining wall behind the north buildings. The east boundary is located on the east side of the Tan Oak dormitory. The south boundary is represented by Granite Avenue. The west boundary is delineated by the west side of the Alder dormitory.
  - Management: Housing and Dining (2 part time students)
  
- Zone 1b
  - Location: Jolly Giant Commons and parking lot. The northern boundary is delineated by Granite Avenue consisting of the southern boundary of zone 1a. The east boundary consists of the eastern periphery of Jolly Giant Commons. The southern boundary is delineated by the transition from the steep slope on the southern side of the parking lot to the plateau found behind Sunset Hall. The west boundary extends to L.K. Wood Boulevard.
  - Management: Housing and Dining (1 part time student)
  
- Zone 1c
  - Location: Redwood and Sunset Hall. The northern boundary is delineated by the plateau transition from southern end of zone 1b. The eastern boundary is represented by the pathway between Redwood Hall and Cypress Hall. The southern boundary is delineated by the pathway between Redwood Hall and Nelson Hall West. The western boundary is delineated by the western side of the parking lot on next to Sunset Hall.
  - Management: Housing and Dining (2 part time students)
  
- Zone 1d
  - Location: Cypress Hall. The northern boundary can be delineated by the path between Jolly Giant Commons and Cypress Hall (adjacent to zone 1b). This boundary then continues and extends down Granite Ave. (adjacent to zone 1a), to the eastern periphery of Cypress Hall. The eastern boundary is as short section extending from Granite Ave. south through the eastern periphery of Cypress Hall.

The southern boundary is an ambiguous border on the southern periphery of Cypress Hall. The western boundary is shared with the eastern edge of zone 1c.

- Management: Housing and Dining (1 part time student)
- Zone 1e
  - Location: Creek View Complex. The boundary is an ambiguous border surrounding the periphery of the Creek View Complex. Its western edge is shared by portions of zone 1a and 1d.
  - Management: Housing and Dining (1 part time student)
- Zone 1f
  - Location: College Creek Complex. The northern boundary extends from the corner of L.K. Wood Boulevard and Harps Street to the corner of Harps Street and Rossow Street. The eastern boundary extends from the corner of Harps Street and Rossow Street to south eastern corner of the Mendocino dormitories. The south and western boundaries begin at the corner of L.K. Wood Boulevard and Harps Street to the south western corner of the Del Norte dormitories. This boundary continues east and then south between the College Creek Field and the College Creek Complexes and terminates on the south eastern corner of the Mendocino dormitories. This zone is located within zone 4 of Plant Operations.
  - Management: Housing and Dining (1 part time student/ 1 full time staff)
- Zone 1g
  - Location: Campus Apartments. The boundary tightly surrounds the campus apartments just to the north of the College Creek parking lot.
  - Management: Housing and Dining (1 part time student)
- Zone 2
  - Location: North West Campus. The eastern boundary begins at the east side of the intersection at L.K. Wood Boulevard and Sunset Ave., and extends south to the western exit of the College Creek parking lot. The southern boundary extends from the western exit of the College Creek parking lot to south eastern corner of Gist Hall. The eastern boundary extends from the south eastern corner of Gist

Hall to the corner of B Street and Laurel drive. The boundary then continues from the corner of B Street and Laurel drive around the south eastern corner of Art A. From there continues north along the pathway on the eastern side of Art A to the north western corner of University Center. The northern boundary is adjacent to the southern boundary of 1C and continues to the east side of the intersection at L.K. Wood Boulevard and Sunset Ave. Zone 2 excludes zone 1g.

- Management: Plant Operations (2 garden specialists; 1-full time, 1 seasonal)
- Zone 3
  - Location: North East Campus. The northern boundary extends from the north western corner of University Center east along the northern periphery of Founders Hall, Redwood Bowl and terminates on the north eastern corner of the Upper Playing Field. The eastern boundary extends south from the north eastern corner of the Upper Playing Field along the eastern periphery of the Student Recreation Center and Kinesiology buildings. This boundary then heads east and circles around the periphery of the Redwood Science lab to the corner of Bayview Street and 17th Street. The eastern boundary then terminates at the corner of Bayview Street and 17th Street. The southern boundary begins at the corner of Bayview Street and 17th Street and heads east to the corner of 16th Street and Bayview Street. The boundary then continues north to the corner of 17th Street and Spring street at which point it then heads west and terminates on the corner of 17th Street and B street. The property on the corner of 17th Street and Union Street is private property not included in this zone. The western boundary begins on the corner of 17th Street and B street and continues north until the corner of Laurel Drive and B Street. The western boundary continues adjacent to the eastern boundary of zone 2 until it terminates on the north western corner of University Center.
  - Management: Plant Operations (1 garden specialist; full time)
- Zone 4
  - Location: Southern Campus. The northern boundary begins at the western exit of the College Creek parking lot and continues east adjacent to the southern

boundary of zone 2 until it reaches the south eastern corner of Gist Hall. The boundary then continues south to the corner of 17th street and B street where it heads east, adjacent to the southern boundary of zone 3, terminating at the corner of 17th Street and Union Street. The eastern boundary begins at the corner of 17th Street and Union Street and continues south until it terminates at the corner of 14th Street and Union Street. The southern boundary begins at the corner of 14th Street and Union street and continues east along 14th Street until it terminates at the corner of 14th street and L.K. Wood Boulevard. The eastern boundary begins at western exit of the College Creek parking lot and continues south and terminates the corner of 14th street and L.K. Wood Boulevard.

- Management: Plant Operations (2 garden specialists; 1-full time, 1 seasonal)

## **Results**

### Zone 1a

Zone 1a had a total weighted prioritization score of 12.72 (Appendix A.1), the 4th highest prioritization of the zones. Invasive species present included *Hedera spp.*, *Cotoneaster spp.*, *I. aquifolium.*, *R. armeniicus.*, and *P. undulatum.*. There was an overwhelming amount of matted *Hedera spp.* at the southern section of the Canyon Complex. Furthermore, *Cotoneaster spp.* was forming dense and overgrown shrubs of approximately 10 feet in height behind both the Alder and Madrone dormitories. All species had a relatively high prioritization for removal in the maintenance, educational value, and alternative feasibility criteria categories. All species present were not important in the maintenance of slope stability. The zone is relatively far away from the educational classrooms on campus and therefore, it is unlikely that they would be visited for educational purposes by classes. Furthermore, it would be very easy to utilize alternative native species as there is easy accessibility and the invasives are serving little maintenance benefits. The threat of dispersal also scored relatively high, due to the immediate adjacency to the community forest. This low maintenance value, high threat of dispersal, and areas of dense overgrowth of *Hedera spp.*, *Cotoneaster spp.* and *I. aquifolium* posed by the area on the north side of the zone led to the identification of the specific area (Figure 2) behind the Alder through

Tan Oak dormitories as one of the five highest priority specific areas for invasive species removal on campus.

### Zone 1b

Zone 1b had a total weighted prioritization score of 5.65 (Appendix A.2) with *Hedera spp.* and *R. armeniacus.* being the only two invasive species present. This zone was the third lowest prioritized zone for invasive removal. The criteria that contributed the most to removal prioritization in the zone were, similar to zone 1a, the maintenance, educational value, and alternative feasibility criteria for the same reasons as zone 1a. This zone is located away from the classes, the invasives present are not important for maintenance of slopes, and it would be relatively easy to replace the two species with natives. *Rubus armeniacus* was located on the southern edge of the zone below the Sunset Hall and would be very easily removed from this slope. There was only one instance of *Hedera spp.* climbing up a tree, which was on the south west corner of the zone above the parking lot. This climbing ivy was producing seeds and therefore, represents a target for removal. The low number of different invasive species is greatly influenced by the fact that much of the zone consists of asphalt parking lots. However, this was one of the zones that had a great example of a reference site that was completely comprised of native species with high aesthetic qualities on the Northwest edge of the zone near LK Wood Blvd.

### Zone 1c

Zone 1c had a total weighted prioritization score of 5.16 (Appendix A.3), which represents the second lowest prioritization for invasives removal out of the zones. Invasive species present included only *Hedera spp.* and *Cotoneaster spp.* Both *Hedera spp.* and *Cotoneaster spp.* received high prioritization scores in the educational value and alternative feasibility categories. *Hedera spp.* scored much higher than *Cotoneaster spp.* for removal prioritization due to the fact that it scored high for dispersal potential. This high dispersal potential score was due to numerous *Hedera spp.* that were climbing high into the canopies of redwood trees on the west side of Sunset Hall and producing large quantities of seed. These climbing *Hedera spp.* led to high prioritization scores in the health and safety category due to the adjacency of these redwood



trees to Sunset Hall and the subsequent threat of the *Hedera spp.* infested trees toppling from the effects of the *Hedera spp.* The *Cotoneaster spp.* present within the zone was located on the northwest side of Redwood Hall.

#### Zone 1d

Zone 1d had a total weighted prioritization score of 9.58 (Appendix A.4), the sixth highest prioritization for invasive species removal out of the zones. Invasive species present within the zone included *Hedera spp.*, *Cotoneaster spp.*, *R. armeniacus.*, and *P. undulatum.* The dispersal potential and alternative feasibility categories scored highest for all species present in the zone. All species within the zone, except for *P. undulatum* received low prioritization scores due to the fact that where they were located, on a steep slope adjacent to the walkway behind Cypress Hall, they were serving to stabilize the slope that could otherwise erode down onto Cypress Hall. Dispersal threat was high for all species within the zone due to the immediate adjacency to the Community Forest. Furthermore, all species present were producing seeds and subsequently increasing the risk of spread into the surrounding forest. There were a large number of *Hedera spp.* individuals climbing on top of *R. armeniacus* and going to seed that represent a highly prioritized target for removal.

#### Zone 1e

Zone 1e had a total weighted prioritization score of 11.58 (Appendix A.5), the 5th highest prioritization for invasive species removal out of all the zones. Invasive species present within the zone consisted of *Hedera spp.*, *Cotoneaster spp.*, *I. aquifolium*, and *R. armeniacus.* Similar to the other zones adjacent to the Community Forest, prioritization scores for the dispersal threat category were very high due to the threat of spreading into the surrounding forest. Furthermore, all species present were found to be going to seed, with *Hedera spp.* having multiple individuals climbing into the canopies of trees. Some of these climbers had been previously lopped and were dead. However, there were still multiple climbers on the east side of Fern Hall that were not lopped. Given the relatively easy access to these climbing *Hedera spp.*, individuals in this area represent a target for removal within the zone. Maintenance value prioritization scores were also high across the board, given that none of the invasives present were acting as bank stabilizers or

providing any other such utility value. Related to the high prioritization for removal due to the fact that the invasives weren't serving any utility purpose, there were also high prioritization scores across the board for alternative feasibility. Were invasives within this area to be removed, it would be relatively easy to find native alternatives (especially due to recruitment of native species from the adjacent forest).

### Zone 1f

Zone 1f had a total weighted prioritization score of 2.68 (Appendix A.6), the lowest prioritization for invasive species removal out of all of the zones. This is due to the fact that the only invasive species present in the zone was *V. major*. The highest prioritization scores received were in the removal cost, maintenance value, and alternative feasibility categories. This is because *V. major* was only found creeping among planted ornamental shrubs in a planter along the south side of Shasta Hall adjacent to the College Creek Field. It was serving no maintenance purposes, as it was essentially just overrunning a relatively flat planter. Therefore, it would be very cheap to remove and it would be easy to replace with a native alternative.

### Zone 1g

This zone did not contain any invasive species, as it is entirely comprised of the dorm building. All plants on the periphery are managed by those responsible for Zone 2. This zone therefore received no scoring and is not a priority for invasive removal efforts.

### Zone 2

Zone 2 had a total weighted prioritization score of 15.49 (Appendix A.7), the third highest prioritization for invasive species removal out of all of the zones. Invasives present within the zone consisted of *Hedera spp.*, *Cotoneaster spp.*, *I. aquifolium*, *V. major*, and *P. undulatum*. Prioritization criteria categories that scored high within the zone were educational value, maintenance value, alternative feasibility, and removal cost. Given how many criteria received high prioritization scores for all of the species, this zone represents a high prioritization for invasive removal efforts. The fact that it did not score as high overall as zones 3 and 4 is in part

due to the fact that there weren't as many species present in the zone. Ivy scored far higher than other species in the zone because of the high number of individuals that are climbing into the canopies of trees adjacent to LK Wood Boulevard. All of these climbers were observed going to seed. Similar to zone 1e, some of these vines were lopped at the base and were thus, dead or dying. However, there were still many climbers that need to be lopped in order to reduce the amount of *Hedera spp.* climbing into the canopies and producing seeds for dispersal.

Furthermore, due to these climbers, scores for health and safety were relatively low because were the *Hedera spp.* climbers to harm trees to the point that they toppled, traffic and pedestrians on the immediately adjacent LK Wood Blvd. could be harmed. The highest target area for invasive species removal was located on the south side of the Campus Apartments. This area (Figure 2) was extremely overgrown with *Hedera spp.*, *Cotoneaster spp.*, and even *I. aquifolium*. The plants were serving absolutely no maintenance value and were producing seeds without even climbing. However, there were also climbers adjacent to the campus apartments which pose potential health and safety risks to those living in the Campus Apartments. Furthermore, removal costs would be low for the area due to ease of access, stable terrain, and high feasibility for alternative native species. This area represents one of the five highest priority specific areas due to all of the reasons stated above. Also notable in greater zone was the high concentration of *P. undulatum* relative to other zones. However, the greater majority of *P. undulatum* individuals in the zone were large trees and therefore, had poor scores associated with costs of removal, but the amount of seeds that they were producing posed a very high prioritization for removal due to dispersal potential.

### Zone 3

Zone 3 had a total weighted prioritization score of 24.24 (Appendix A.8), the highest prioritization for invasive species removal out of all of the zones. Invasives present within the zone consisted of *Hedera spp.*, *Cotoneaster spp.*, *I. aquifolium*, *V. major*, *P. undulatum*, *C. jubata*, *R. armeniacus*, and *E. lusitanica*. All prioritization criteria categories, excluding health and safety as well as educational value, scored high relative to other zones. Maintenance value had the highest prioritization score for all species because of the fact that most of the areas containing invasive species within the zone consisted of stable terrain where invasives were not serving any utility value. Educational value scores were a bit lower in this zone due to the fact

that many of the natural science classes taught on campus are found within this zone. Therefore, the high number of invasives in this zone may be utilized for educational purposes at a higher rate than other zones. However, given high overall total weighted score for the zone, invasive removal efforts are greatly needed. One of the five highest priority specific areas identified was located within the zone, in the area (Figure 2) directly behind the Natural Resources and Forestry buildings. This location is one of the most overgrown on campus, and the majority of species are invasives. This was one of only two areas on the entire campus that contained *C. jubata* (Appendix B.16) a species that is a substantial threat to adjacent surrounding wildlands. At least three invasive removal efforts have been undertaken in this area and proved very successful in the past. However, all of these efforts have strictly involved the removal of *Hedera spp.* and replacement with the use of native species. The slightly steeper slopes above the past removal sites is even more overgrown than those previously removed and are therefore, a high priority target for future invasive removal efforts despite the maintenance value that invasives may be serving in the specific area.. Another specific area within the zone that stood out as being in need of invasive removal efforts was located on the slopes behind the south side of the CCAT building. This area wasn't quite as overgrown with invasives as the area behind the Natural Resources and Forestry buildings, but poses less obstacles for removal. The *Hedera spp.* present in the area are only beginning to climb up the trees and are easily accessible for removal. Furthermore, the area contains small *Cotoneaster spp.* shrubs that represent low removal costs. Despite receiving the highest overall prioritization score for invasive removal, this zone did contain one of the reference sites (Appendix B.19, B.21, B.22) that we recognized as a perfect example of what native landscapes on campus should look like. This area was located on the south side of the BSS building and contained strictly native species. This area was replanted when the new BSS building was constructed and therefore, exemplifies the opportunities that new construction and development projects can provide for invasive species removal and native plant enhancement efforts.

#### Zone 4

Zone 4 had a total weighted prioritization score of 22.69 (Appendix A.9), the second highest prioritization for invasive species removal out of all of the zones. Invasives present within the zone consisted of *Hedera spp.*, *Cotoneaster spp.*, *C. scoparius*, *P. undulatum*, *C. jubata*, *R.*

*armeniacus*, and *E. lusitanica*. Maintenance value and dispersal threat were the most influential prioritization criteria categories affecting the scores of for invasives in zone 4. Besides the area directly behind the Wildlife Building, all areas were of minimal slope steepness and therefore, the invasives in the zone are not of high maintenance value. Dispersal potential scores were also relatively high for the zone due to the fact that the entire northern and eastern boundaries of the zone are immediately adjacent to the Community Forest. This zone also contained two of the highest prioritized specific areas on campus. Plant Ops personnel explicitly emphasized that overgrown and rat infested areas are of great concern around the wildlife pens. This area (Figure 2) is located directly behind the fish hatchery and Wildlife pens and was observed to be extremely overgrown with *C. scoparius*, *Hedera spp.*, *Cotoneaster spp.*, and *R. americanus*. The threat to wildlife within the wildlife pens posed by the rats and subsequent diseases that they harbor thrive in such dense overgrowth (Appendix B.18) resulted in very high prioritization scores for the specific area and subsequently, the whole zone. This area would, however, have a high cost of removal. This is due to the fact that the overgrowth is so dense and accessibility is limited. The other highly prioritized specific area identified within the zone was the fence line that is on the edge of the Community Forest on the north and east sides of Founders Hall. This area (Figure 2) was identified as a crucial area for invasive removal efforts due to extensive amounts of *Hedera spp.* climbing up trees (Appendix B.6) and producing seeds that could be easily dispersed into the surrounding forest. Furthermore, these trees posed a potential health and safety risk given the fact that they could topple onto the highly populated Founders Hall. As with other areas on campus containing extensive climbers of *Hedera spp.*, some of the climbers had been previously lopped. However, there were many climbers that had not been lopped and therefore, provide a high priority target for future invasive removal efforts.

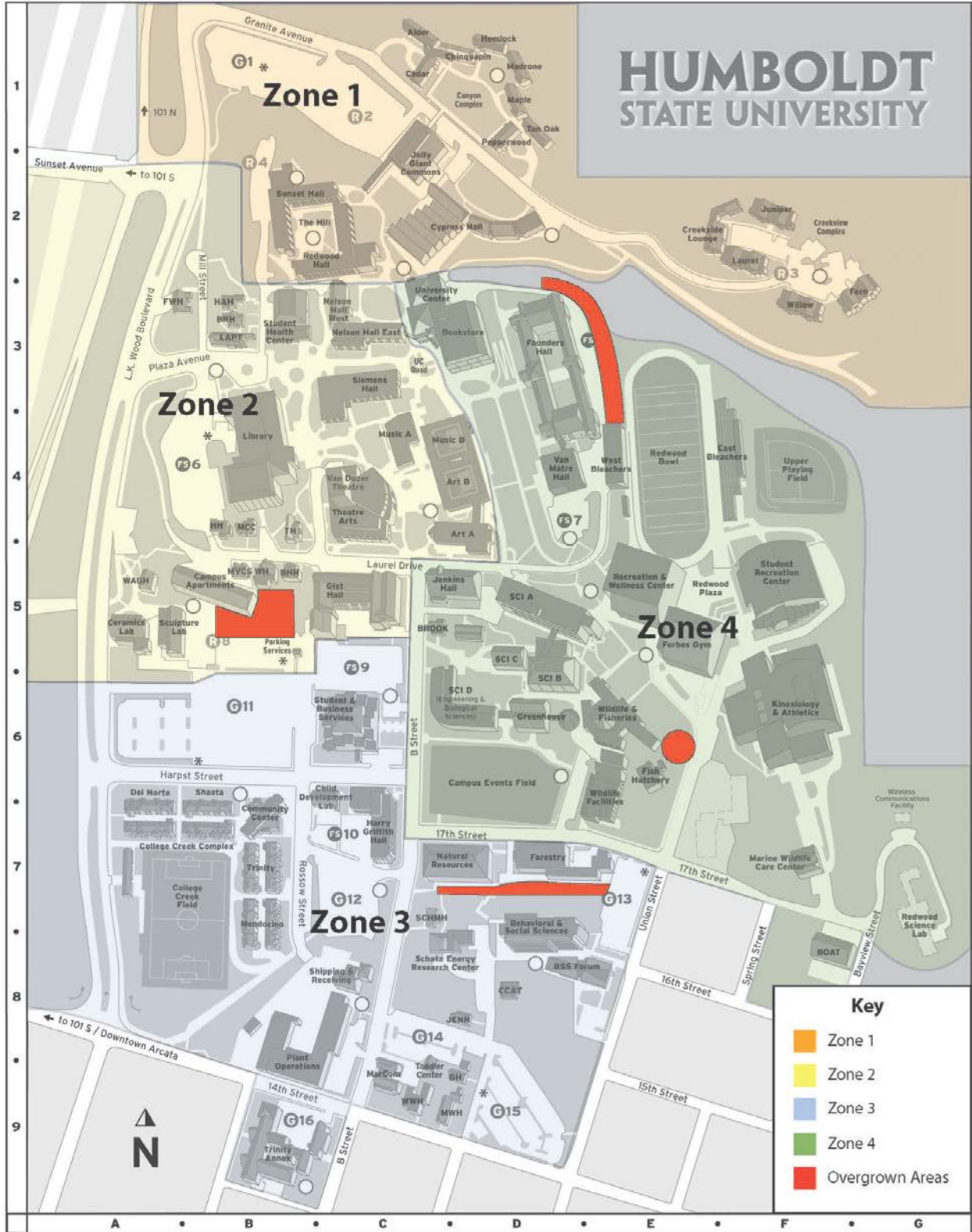


Figure 2: Four specific target areas for invasive species removal

## Monitoring and Evaluation Recommendations

To maintain the vision and integrity of this project, regular monitoring of the campus flora is highly recommended. This monitoring will allow for a qualitative analysis of the efficacy of the implemented management techniques and allow for adaptive management of the campus flora. The main component of this monitoring plan should be the invasive plant prioritization surveys. These should be conducted preceding and immediately following any site-specific action to manage invasive plants. A campus-wide survey should be conducted every six months, as well. These surveys will allow for more concrete observation and tracking of the progress of this management plan. Regular monitoring, with the use of this survey method, will also provide the opportunity to observe possible changes in prioritization that might arise, and allow for the adaptation of management strategies. We suggest that these surveys be performed by a member, or members, of the working group or a third party.

The working group is another large component to this monitoring and evaluation plan. It is our vision that the working group will provide much of the oversight and decision-making with regards to the management of plants on campus as well as the methods outlined in this document. With the expansion of the working group to include more stakeholders, there will be a broader scope of perspectives that will allow for more informed, objective, decision making. Given that outside contractors are generally left in charge of the species composition and planting of new development projects on campus, such as the College Creek dorms, we highly recommend that planting and landscaping plans created by contractors for new campus developments be reviewed by the working group prior to implementation. This will help avoid the surprises and confusion related to the flora used for new projects that has arisen in past development projects on campus.

## Conclusion

By identifying priority invasives species and areas affected by them, our findings should be highly beneficial for the future of invasive species management on the HSU campus. The extensive background information on the life history traits associated with the invasive species identified will better allow those responsible for invasive species management of the campus landscape to make more informed decisions regarding how to approach the difficult endeavor of

significantly reducing the abundance of invasives on campus. The methodology developed for this study can also be used as a guide to prioritizing invasive species and areas in the future. However, the findings of this paper are only the first step in tackling the issue of invasives at HSU.

There has been expressed interest, particularly by students, on the topic of invasive plants and attempts to manage invaded landscapes on campus (Girard et al., 2010; Agler et al., 2012). The results in this document can be used by those interested in similar projects to help direct and focus their efforts to specific high priority invasive species and areas. The findings that resulted from extensive surveying of campus landscape experts, interviews and surveys of those in decision making positions regarding invasive species on campus, and on the ground photographic surveying of the invasive species situation on campus should better enable and therefore, increase the probability of success of future endeavors wishing to resolve the invasive species issue. Not only does this document identify the highest priority invasive species and areas around campus, but begins to illuminate the many possible steps that can be taken to better the success of future projects dealing with invasives on campus. Our findings show the many opportunities to lop highly prioritized *Hedera spp.* that are climbing many trees (Appendix B.4) and structures on campus and therefore, can help to alleviate the issues of health, safety, and dispersal risks created by these climbers on campus. Future projects may want to tackle this undertaking of *Hedera spp.* climbers. Also, by identifying the seven important criteria and their relative weightings of importance for prioritizing invasive species through input from those in decision making positions, our findings can be used by future groups to easily prioritize invasive species and areas using less subjective and more empirical scoring system before any invasive removal implementation is carried out. Most notably, the map of the highest priority specific areas (Figure 2) can help expedite the process of selecting specific locations for invasive species removal efforts and streamline the process of getting straight to on-the-ground implementation. Overall, the future of invasive species management and removal efforts on HSU's campus should continue at an accelerated and more effective rate now that this framework for how to approach the issue of invasive species on campus is in place.



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## Appendix A: Prioritization Datasheets

Appendix A.1: Zone 1a datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	1	4	1	1	3	4	1	15	1.92
<i>Cotoneaster spp.</i>	2	4	4	3	1	4	1	19	2.87
<i>Ilex aquifolium</i>	1	4	4	3	1	4	1	18	2.72
<i>Rubus armeniacus</i>	1	3	4	2	1	4	4	19	2.59
<i>Pittosporum undulatum</i>	2	4	4	2	1	3	1	15	2.62
<b>Total</b>	<b>7</b>	<b>19</b>	<b>17</b>	<b>11</b>	<b>7</b>	<b>19</b>	<b>8</b>	<b>86</b>	<b>12.72</b>
<b>Weighted total</b>	<b>1.1</b>	<b>2.98</b>	<b>3.86</b>	<b>2.12</b>	<b>0.93</b>	<b>1.14</b>	<b>0.58</b>	<b>12.72</b>	

Appendix A.2: Zone 1b datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.060)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	1	4	4	3	1	4	2	19	2.79
<i>Rubus armeniacus</i>	2	3	4	2	3	4	2	20	2.86
<b>Total</b>	<b>3</b>	<b>7</b>	<b>8</b>	<b>5</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>39</b>	<b>5.65</b>
<b>Weighted total</b>	<b>0.47</b>	<b>1.01</b>	<b>1.82</b>	<b>0.96</b>	<b>0.53</b>	<b>0.48</b>	<b>0.29</b>	<b>5.65</b>	

Appendix A.3: Zone 1c datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	4	4	2	4	2	3	3	22	3.15
<i>Cotoneaster spp.</i>	2	4	1	1	2	4	2	16	2.01
<b>Total</b>	<b>6</b>	<b>8</b>	<b>3</b>	<b>5</b>	<b>4</b>	<b>7</b>	<b>5</b>	<b>38</b>	<b>5.16</b>
<b>Weighted total</b>	<b>0.94</b>	<b>1.26</b>	<b>0.68</b>	<b>0.96</b>	<b>0.53</b>	<b>0.42</b>	<b>0.36</b>	<b>5.16</b>	

Appendix A.4: Zone 1d datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	2	4	1	4	2	2	0	15	2.33
<i>Cotoneaster spp.</i>	1	4	1	3	2	3	3	17	2.26
<i>Rubus armeniacus</i>	2	3	3	3	3	3	2	19	2.45
<i>Pittosporum undulatum</i>	1	4	4	2	1	3	2	17	2.54
<b>Total</b>	<b>6</b>	<b>15</b>	<b>9</b>	<b>12</b>	<b>8</b>	<b>11</b>	<b>7</b>	<b>68</b>	<b>9.58</b>
<b>Weighted total</b>	<b>0.94</b>	<b>2.35</b>	<b>2.04</b>	<b>2.32</b>	<b>1.06</b>	<b>0.66</b>	<b>0.51</b>	<b>9.58</b>	

Appendix A.5: Zone 1e datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	1	4	1	4	3	4	1	18	2.49
<i>Cotoneaster spp.</i>	2	4	4	4	1	4	2	21	3.14
<i>Ilex aquifolium</i>	1	4	4	4	1	4	2	20	2.98
<i>Rubus armeniacus</i>	1	3	4	4	1	4	4	21	2.97
<b>Total</b>	<b>5</b>	<b>15</b>	<b>13</b>	<b>16</b>	<b>6</b>	<b>16</b>	<b>9</b>	<b>80</b>	<b>11.58</b>
<b>Weighted total</b>	<b>0.78</b>	<b>2.35</b>	<b>2.95</b>	<b>3.09</b>	<b>0.79</b>	<b>0.96</b>	<b>0.66</b>	<b>11.58</b>	

Appendix A.6: Zone 1f datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Vinca major</i>	0	3	4	2	3	4	4	20	2.68
<b>Total</b>	<b>0</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>20</b>	<b>2.68</b>
<b>Weighted total</b>	<b>0</b>	<b>0.47</b>	<b>0.91</b>	<b>0.38</b>	<b>0.39</b>	<b>0.24</b>	<b>0.29</b>	<b>2.68</b>	

Appendix A.7: Zone 2 datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	4	4	2	4	4	2	3	23	3.35
<i>Cotoneaster spp.</i>	2	4	4	2	2	4	4	22	3.03
<i>Ilex aquifolium</i>	2	4	4	3	2	4	4	23	3.23
<i>Vinca major</i>	1	4	4	3	1	4	4	21	2.94
<i>Pittosporum undulatum</i>	1	4	4	3	1	4	4	21	2.94
<b>Total</b>	<b>10</b>	<b>20</b>	<b>18</b>	<b>15</b>	<b>10</b>	<b>18</b>	<b>19</b>	<b>110</b>	<b>15.49</b>
<b>Weighted total</b>	<b>1.57</b>	<b>3.14</b>	<b>4.09</b>	<b>2.89</b>	<b>1.33</b>	<b>1.08</b>	<b>1.39</b>	<b>15.49</b>	

Appendix A.8: Zone 3 datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	4	4	2	4	4	2	3	23	3.35
<i>Cotoneaster spp.</i>	2	4	4	2	2	4	4	22	3.03
<i>Ilex aquifolium</i>	2	4	4	3	2	4	4	23	3.23
<i>Vinca major</i>	1	4	4	3	1	4	4	21	2.94
<i>Pittosporum undulatum</i>	1	4	4	3	1	4	4	21	2.94
<i>Cortaderia jubata</i>	4	3	4	4	0	4	1	20	3.09
<i>Rubus armeniacus</i>	3	3	4	4	3	4	3	24	3.48
<i>Erica lusitanica</i>	1	2	4	1	1	3	4	16	2.18
<b>Total</b>	<b>18</b>	<b>28</b>	<b>30</b>	<b>24</b>	<b>14</b>	<b>29</b>	<b>27</b>	<b>170</b>	<b>24.24</b>
<b>Weighted total</b>	<b>2.83</b>	<b>4.39</b>	<b>6.81</b>	<b>4.63</b>	<b>1.86</b>	<b>1.74</b>	<b>1.97</b>	<b>24.24</b>	

Appendix A.9: Zone 4 datasheet

	Aesthetic Value (.157)	Educational Value (.157)	Maintenance Value (.227)	Dispersal Potential/Threat (.193)	Health & Safety Threat (.133)	Alternative Feasibility (.06)	Removal Cost (.073)	Total	Weighted total
<i>Hedera spp.</i>	4	4	2	4	4	3	1	22	3.27
<i>Cotoneaster spp.</i>	4	4	3	4	3	4	2	24	3.49
<i>Cytisus scoparius</i>	3	4	4	4	0	4	4	23	3.31
<i>Pittosporum undulatum</i>	1	4	4	3	1	4	4	21	2.94
<i>Cortaderia jubata</i>	3	4	4	4	0	4	1	20	3.09
<i>Rubus armeniacus</i>	3	4	4	4	4	4	2	25	3.69
<i>Erica lusitanica</i>	2	2	4	2	1	4	4	19	2.9
<b>Total</b>	<b>20</b>	<b>26</b>	<b>25</b>	<b>25</b>	<b>13</b>	<b>27</b>	<b>18</b>	<b>154</b>	<b>22.69</b>
<b>Weighted total</b>	<b>3.14</b>	<b>4.08</b>	<b>5.67</b>	<b>4.82</b>	<b>1.73</b>	<b>1.62</b>	<b>1.31</b>	<b>22.69</b>	

**Appendix B: Invasive Species**



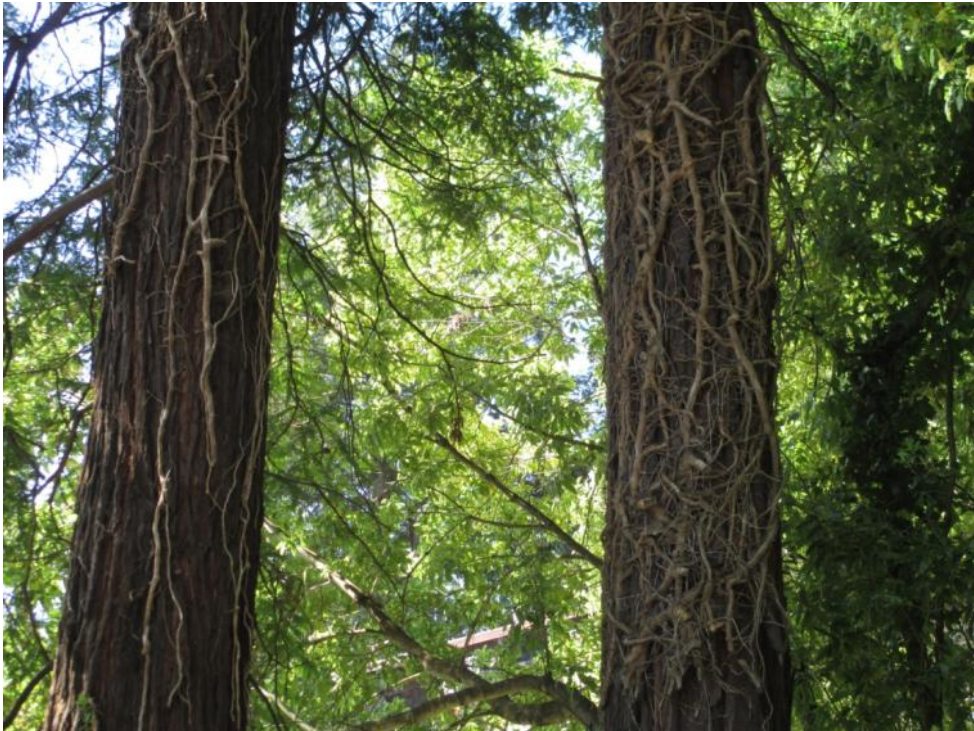
Appendix B.1: *Hedera spp.* climbing up tree in zone 1d above the Cypress dorm complex



Figure B.2: *Hedera spp.* climbing in zone 2 north of the Y.E.S. House



Appendix B.3: *Hedera spp.* aggregate on an old stump in zone 2, below Campus Apartments



Appendix B.4: Remaining *Hedera spp.* shoots after cutting





Appendix B.5: Climbing *Hedera* spp. setting fruit



Appendix B.6: Unmanaged *Hedera* spp. overtaking a landscape behind Founders Hall in zone 4



Appendix B.7: Managed *Hedera spp.* with a buffer around a redwood (*Sequoia sempervirens*)



Appendix B.8: Managed *Hedera spp.* retaining a slope in zone 3



Appendix B.9: *Rubis aremiacus* growing in zone 1a



Appendix B.10: *Rubus armeniacus* overtaking a hillside in zone 1b



Appendix B.11: Homogenous population of *Vinca major* north of Nelson Hall East in zone 2



Appendix B.12: *Ilex aquifolium* growing behind Little Apartments (LAPT) in zone 2



Appendix B.13: *Cytisus scoparius* flowering in zone 4, between Founders Hall and the Redwood Bowl



Appendix B.14: *Pittosporum undulatum* flowering



Appendix B.15: *Erica lusitanica* flowering by Founders Hall in zone 4



Appendix B.16: *Cortaderia jubata* and other invasives on a hillside in zone 3, behind the Forestry building





Appendix B.17: *Cotoneaster* spp. setting seed below Campus Apartments in zone 2



Appendix B.18: An unmanaged thicket of invasive species in zone 4, between the Wildlife and Fisheries building and the Fish Hatchery



Appendix B.19: Strawberry (*Fragaria spp.*) used as groundcover in zone 3, by the Behavior and Social Sciences (BSS) building

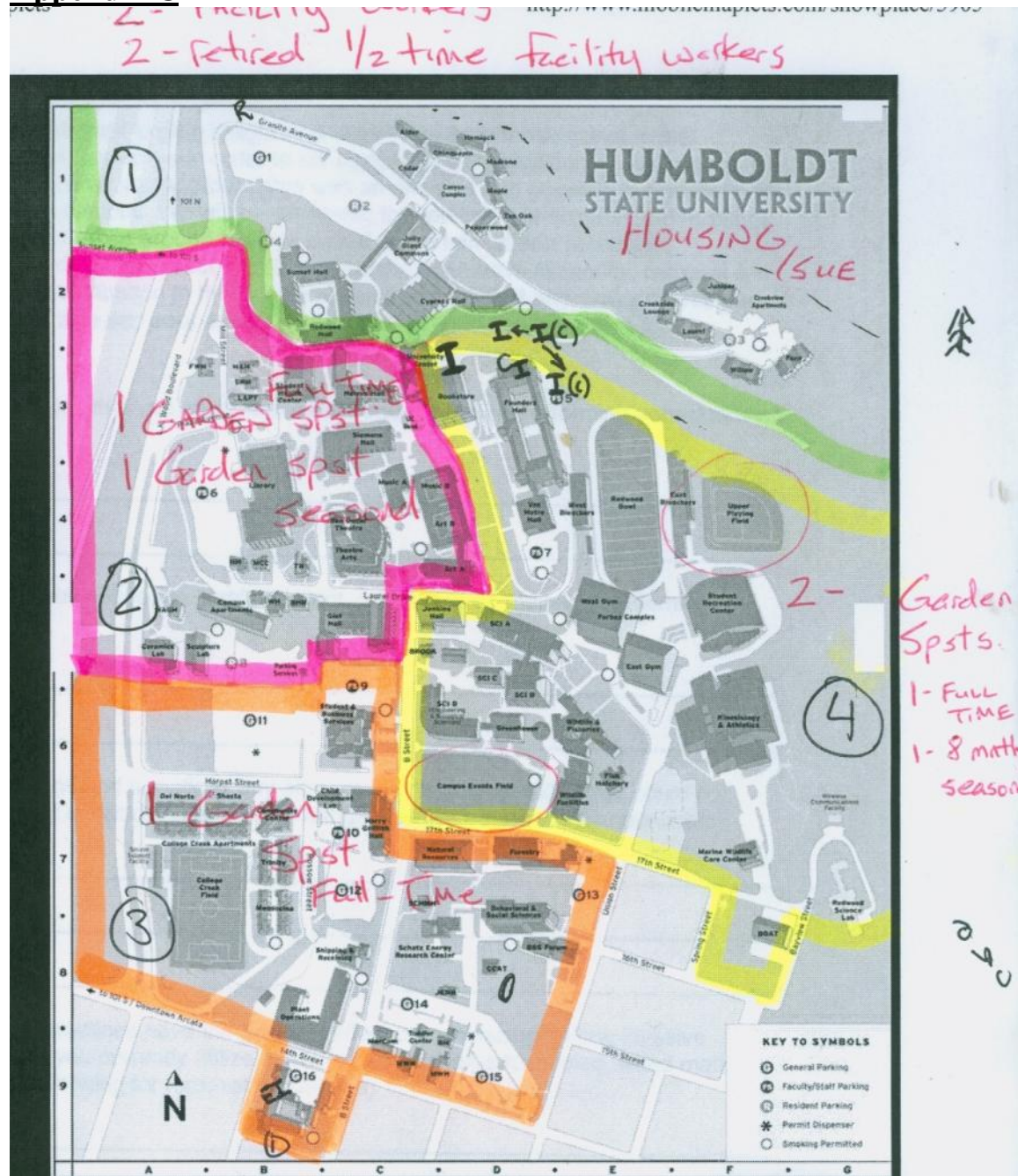


Appendix B.20: Bearberry (*Arctostaphylos uva-ursi*) used as groundcover in zone 3, by the BSS building



Appendix B.21: Entirely native plant landscape in zone 3, by the BSS building

Appendix C



## **Appendix D: Weighted Criteria Responses**

Mesler

Aesthetic value	0.2
Education value	0.2
Maintenance	0.25
Dispersal threat	0.05
Health and safety	0.2
Alternative feasibility	0.05
Removal/management cost	0.05
	1

Maintenance gets the highest score because the campus must be able to afford anything we propose for the landscape.

### **Susan Buckley**

Aesthetic:5

Educational:5

Maintenance:10

Health/Safety:10

Dispersal Threat: 50

Alternative Feasibility:10

Removal & Management Cost:10

Handwritten: *Handwritten*

	Aesthetic Value	Educational Value	Maintenance Value	Dispersal Potential/Threat	Health & Safety Threat	Alternative Feasibility	Removal Cost	Total
Hedera spp.	25	5	80	70	1	50	70	
Cotoneaster spp.	25	75	50	95	1	80	70	
Ilex aquifolium	10	10	90	100	40	80	80	
Vinca major	1	1	100	90	1	90	90	
Cortaderia selloana	1	1	100	100	1	90	100	
Cytisus scoparius <i>ban</i>	1	1	100	100	1	90	100	
Asclepias spp. <i>milkweed</i>	1	1	100	100	1	90	50	
Cirsium spp. <i>Thistle</i>	5	5	100	100	1	90	50	
Rubus discolor	10	10	90	100	40	90	70	
Pittosporum undulatum	40	25	90	75	1	90	90	
Total								

- Aesthetic prioritization score (1-100): 22
- Educational prioritization score (1-100): 22
- Maintenance/ utility prioritization score (1-100): 33
- Dispersal threat prioritization score (1-100): 3
- Health and Safety prioritization score (1-100): 10
- Alternative feasibility prioritization (1-100): 3
- Removal/Management Cost prioritization (1-100): 7

Comments, Thoughts, or Suggestions?: 100

- ~~Add *Thistle* grass to list~~
- ② Add red sorrel (*Rumex acetosella*)
- ① Add Ranunculus (*buttercup*)

7 CRITERIA

## Appendix E: Evaluation Forms

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank you for your time and cooperation. (Please feel free to use back side for responses).

What invasive species do you encounter most frequently while performing your duties on campus?

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What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**?

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Do you have any suggestions and or alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

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What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

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How much time to you spend removing invasive species during an average workweek? Circle one.

0    1-2    2-3    3-4    4-5    5-6    6-7    7-8    8-9    9-10    10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10%    11%-25%    26%-40%    41%-55%    56%-70%    71%-85%    86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

Return by FRIDAY @ 10AM  
(4/12)

CHRIS JOHNSON

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

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What invasive species do you notice are highly resilient, persistent, or, mainly, **problematic**? Why are they problematic?

trifolium, spurge, blackberries, Ranunculus, and chickweed

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Hire more gardeners.

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

Mulching, spraying, planting ground covers

How much time to you spend removing invasive species during an average workweek? Circle one.

0   1-2   2-3   3-4   4-5   5-6   6-7   7-8   8-9   9-10   >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10%   11%-25%   26%-40%   41%-55%   56%-70%   71%-85%   >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.



return by FRIDAY @ 10 AM  
(4/12)

CHUCK HEANEY

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

IVY, Black Berry Vines (himalaya)  
horse tails, Butcher cup in all lawns

What invasive species do you notice are highly resilient, persistent, or, mainly, **problematic**? Why are they problematic?

IVY, grows every where, can't get rid of it.  
horse tails grow in asphalt.

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

dig up or spray

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

lots of mulch, dig out the pest.

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

✓ Aaron - Jgc

4/13

4/13

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank you for your time and cooperation. (Please feel free to use back side for responses).

What invasive species do you encounter most frequently while performing your duties on campus?

grassy weeds in pavement cracks  
crocosmia (seasonal) (site dependent), oxalis, dandelions  
Canada Thistle (seasonal), sheep sorrel, plantain, calla lily, lady fern  
ivy growing on trees

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**?

weeds in paving - persistent  
ranunculus  
morning glory  
sheep sorrel - the worst  
by PSU sign wall - never get rid of it

Do you have any suggestions and or alternative practices or steps, that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Hand pull esp before flowering • spray weeds in paving w/ (organic) citric acid weed killer - needs to be warm + dry for best efficacy, weed eat large areas

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

weed, Pan muck MAT - minimizes + makes pulling easier  
weed fabric currently in place semi-effective but too heavy  
hula hoe  
crack hoe

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

too heavy  
dirty to  
dig/  
plant  
in

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

return by FRIDAY @ 10 A.M.  
(4/12)

STEVE LEE

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

Horse Tails, Bindweed, Sheep Sorrel, Himalaya Blackberries.  
Pampas grass, (Butter cup & Clovers in lawns) Ivy

What invasive species do you notice are highly resilient, persistent, or, mainly, **problematic**? Why are they problematic?

Bindweed, Blackberries,  
Butter cup in lawns.

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Most important thing is persistence, ~~the~~ which  
~~every~~ technique you use, mechanical, chemical  
whatever, - one treatment is ineffective,

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed mat, etc...., however we are not looking for removal techniques)

improving drainage works well for some weed varieties  
(Buttercup) mulching heavily, Removing weeds before  
they go to seed, Trimming old growth Ivy to prevent seed Prod.

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

Return by FRIDAY @ 10 AM  
(4/12)

FRED MILLER

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

English Ivy, Blackberry vines  
horsetails, Buttercup & clover in lawns

What invasive species do you notice are highly resilient, persistent, or, mainly, problematic? Why are they problematic?

horsetails - they are difficult to exterminate & grow thru Asphalt damaging roads and walkways.

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

SPRAY

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

Regular maintenance trimming back etc. to keep in check.

How much time to you spend removing invasive species during an average workweek? Circle one.

- 0  1-2
- 2-3
- 3-4
- 4-5
- 5-6
- 6-7
- 7-8
- 8-9
- 9-10
- >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

- <10%
- 11%-25%
- 26%-40%
- 41%-55%
- 56%-70%
- 71%-85%
- >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

return by FRIDAY @ 10 AM  
(4/12)

Tony Pulver

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

Dandelion, Sheep's sorrel, Bindweed, Horsetail  
Dockweed, Clover, Crabgrass

What invasive species do you notice are highly resilient, persistent, or, mainly, **problematic**? Why are they problematic?

Bindweed, Horsetail and Sheep's sorrel

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Just frequent weeding. Weeding prior to it going to seed. Using a weeding fork to loosen the soil to get the roots

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

Weed matt (good matt) will work for a while. Horsetails can come up through asphalt, raising the pH will reduce Horsetails. Sheep's sorrel thrives in wet soil, water reduction may help.

How much time to you spend removing invasive species during an average workweek? Circle one.

0   1-2   2-3   3-4   4-5   5-6   6-7   7-8   8-9   9-10   >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10%   11%-25%   26%-40%   41%-55%   56%-70%   71%-85%   >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

return by FRIDAY @ 10 AM  
(4/12)

DAWN-ANN RYPKEMA

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENV5 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

IVY, HOLLY, PITTOSPORUM, VARIOUS GRASSES, SHEEPS HEAD SORREL  
TRIFOLIUM, CROLOSMIA, COTONGASTER, <sup>Himalaya</sup> BLACKBERRY, BIND WEED

What invasive species do you notice are highly resilient, persistent, or, mainly, problematic?

Why are they problematic? BECAUSE THEY'RE INVASIVE! THEY HAVE BETTER SELF-PROMOTION SKILLS.

ALL OF THEM! BIRD DROPPINGS FROM BERRY EATING &  
UNDERGROUND RUNNER ROOTS AND CORM PRODUCTION <sup>ARE</sup> HARD TO CONTROL

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

SPECIFIC TARGET ARGAS WITH INTENSIVE FOLLOW-UP MAINTENANCE.

START CLOSE IN ~~AND~~ AND WORK TOWARD THE OUTER AREAS

OF CAMPUS. THE IVY WAS PLANTED FOR EROSION CONTROL OPENING UP LARGE SLOPING AREAS MAY NEVER BE PRACTICAL.

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc....., however we are not looking for removal techniques)

MOST NEEDED! ALL THE TIME TO CONTROL REINFESTATION & OR REGROWTH - THAT NEVER GOES AWAY!

WEED MAT IS ONLY A SHORT TERM FIX. EVENTUALLY YOU HAVE TO REMOVE

IT TO REMOVE ALL THE ROOTS WOVEN INTO IT. LARGE ~~CONSTRUCTION~~ CONSTRUCTION PROJECTS HAVE BEEN OUR BEST OPPORTUNITY TO REMOVE & REPLANT AREAS OF CAMPUS.

How much time to you spend removing invasive species during an average workweek? Circle one.

EACH ONE HAS A SEASONALITY TO ITS MANAGEMENT SO IT VARIES

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% >86%

MANAGEMENT

REMOVAL IS MOSTLY HAND WEEDING IN TENDED BEDS.

IF YOU INCLUDE KEEPING TURF GRASS IN ITS PLACE.

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

MY AREA HAS MOSTLY BEEN PLANTED WITH INVASIVES... (IVY & COTONGASTER)

ALL MY TIME IS SPENT MANAGING THEM! REMOVAL IS IMPOSSIBLE

I TRY TO KEEP IVY & OTHER SEED PRODUCTION MINIMIZED

AND <sup>MY</sup> OUT OF THE TREES IF POSSIBLE.

AT STAFFING LEVELS!

return by FRIDAY <sup>10AM</sup>  
(4/12)

CARLOS JONES

This survey is an informal attempt to gain insight and knowledge from those active in the management of the campus landscape in order to aid our ENVS 411 practicum group project. We hope to create a comprehensive management plan with an analysis and possible suggestions for invasive species control on campus. We will be assessing the relative prioritization and threat of certain invasive species and areas around campus based on certain criteria (aesthetic, educational, maintenance, dispersal threat, health and safety, alternative feasibility, removal & management cost). Your contribution to this survey is much appreciated and highly valuable to our project. Thank for your time and cooperation. (Please feel free to use back side for responses).

What are the invasive species that you encounter most frequently while performing your duties on campus?

Moss weed around the track Redwood Bowl

What invasive species do you notice are highly resilient, persistent, or, mainly, **problematic**? Why are they problematic?

Butter cups in lawn  
do to bad drainage and over water

Do you have any suggestions and or noticed any alternative practices or steps that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Creating a better selection plants and materials  
in the construction installments

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

hand work dig invasive plant out by the root

How much time to you spend removing invasive species during an average workweek? Circle one.

0 (1-2) 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 >10

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% >86%

Please circle on the map, the location(s) which you spend the greatest amount of time removing invasive species and the name of the invasive.

Connor / Cid- Canyon 4/13

(5)

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What invasive specie(s) do you encounter most frequently while performing your duties on campus?

perennial weeds herbicide  
Nipplewort, spotted ~~x~~ catsear, spiny southistle, annual southistle, holly, dandelion, broadleaf plantain, creeping buttercup, non-native blackberry, ~~English~~ Ivy.

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?

Algerian ~~English~~ Ivy is very persistent and also chokes trees and other plants

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Spray perennial weeds w/ citric acid (organic weed plant winter lay sparse to soak up wet soil Kibor) due to drainage from upper Breata hillside

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

If using a weed matt, must keep soil from building up on top of matt

How much time to you spend removing invasive species during an average workweek? Circle one. 2 people combined

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.



X Regina -

Creechview

1/11

14

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What invasive specie(s) do you encounter most frequently while performing your duties on campus?

Sorrel, ~~ambrosia~~ Ranunculus (buttercup) <sup>x = worst</sup>  
fruit of fern - horsetail due to wetlands along creek esp. along creek

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?

morning glory + bowies - "designated wetlands" area.  
by garage

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

keep up on weeding  
weed before they flower  
use of weed mat - But not such heavy duty

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed mat, etc...., however we are not looking for removal techniques)

plant native geranium groundcover material as currently in use at Creechview  
reduce irrigation in shady areas during watering season

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

✓ Audrey - Redwood + Just

4/13

(3)

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What invasive specie(s) do you encounter most frequently while performing your duties on campus?

Blackberry vines/Berry vines; Buttercup; Thistle; dandelions; Oxalis; Spentain; Sorel; black medic

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?

Buttercup, <sup>(sheep)</sup> Sorel because they are most prominent/recurring.  
Dandelions & Thistle because the roots <sup>full</sup> tend to remain in the soil.

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

Herb-thin is a good tool to remove the root of some weeds. <sup>full</sup> <sup>thistle/dandelions</sup> especially

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

get to them before they flower; committing to a schedule/routine <sup>for</sup> of weeding;

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 (6-7) 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% (26%-40%) 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

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What invasive specie(s) do you encounter most frequently while performing your duties on campus?

- 1) Ranunculus repens - creeping Buttercup
- 2) Rumex acetosella - sheeps Sorrel (aka red sorrel)

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?

1+2 both are fast growing on underground runners. The Ranunculus is very invasive in lawns

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

on campus manual removal on an ongoing basis seems the only solution

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

I don't like using weed mat. Chemicals are not an option. Manual removal seems the only answer

How much time to you spend removing invasive species during an average workweek? Circle one.

- 0
- 1-2
- 2-3
- 3-4
- 4-5
- 5-6
- 6-7
- 7-8
- 8-9
- 9-10
- 10+

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

- <10%
- 11%-25%
- 26%-40%
- 41%-55%
- 56%-70%
- 71%-85%
- 86%+

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

All beds bordering buildings

J. Nathan - Cypress

7/13

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What invasive specie(s) do you encounter most frequently while performing your duties on campus?

Ranunculus and dandelions  
black medic - top of cypress x from KBR

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?

Both of the above. Spread aggressively  
and very tough to eradicate

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

taking up more ground area with other  
plants

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed mat, etc...., however we are not looking for removal techniques)

weed mat works pretty well, root removal,  
mulch

How much time <sup>do</sup> you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

Area

~~Area~~

1/13

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What invasive species do you encounter most frequently while performing your duties on campus?

*Cotoneaster willow shoots*  
CC- Sheep Sorrel, Thistle, dandelion, purple oxalis, milkweed, "clover"-like weed - esp. in lawns - ~~black water~~  
Some vicia major at S. side of Del Norte, grasses??

What invasive species do you notice that are highly resilient, persistent, or mainly, problematic?

Sheep sorrel - roots are deep + parasitic

Do you have any suggestions and or alternative practices or steps, that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

get roots out, pull before flowering  
use ~~weed~~ "weed-free topsoil" for new projects; mulch after weeding

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

encourage grass cover + low shrubs by topping to get lateral growth - choke out weeds w/ desirable plants / constant vigilance

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

7/13

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What invasive species do you encounter most frequently while performing your duties on campus?

ivy on tree trunks, growing up structures,  
blackberry, wild onions, dandelions

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**?

blackberry, broadleaf + grassy weeds  
in cracked asphalt on south side

Do you have any suggestions and or alternative practices or steps, that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

citric acid spray used in  
optimum conditions warm + dry for  
best results - otherwise - use weedeater <sup>or</sup>

What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

Fix paving! crack  
hoe  
tool  
mulch beds after seeding  
elim/ reduce irrigation - new plants now established

How much time to you spend removing invasive species during an average workweek? Circle one.

0 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10 10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10% 11%-25% 26%-40% 41%-55% 56%-70% 71%-85% 86%<

Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.

South side of building mostly  
"pavement weeds"

Nic - Redmond + Sweet 4/13

(2)

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What invasive specie(s) do you encounter most frequently while performing your duties on campus? Labrador Violet, Crocasmia, English Daisy  
Dandelions, Buttercup, Ranunculus, Bamboo  
lady ferns, wild onion, strawberry, oxalis

What invasive species do you notice that are highly resilient, persistent, or mainly, **problematic**? Why are they problematic?  
Thimbleberry, Blackberry - its covered  
in thorns!!!

Do you have any suggestions and/or noticed any alternative practices or steps (on the ground or procedural) that could be taken to make the endeavor of removing and eradicating invasives easier or more plausible?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



What specific landscaping practices have the greatest effect on minimizing/halting invasive species proliferation, which you currently utilize, if any? (i.e. replacement species, weed matt, etc...., however we are not looking for removal techniques)

Timely removal - before seed proliferation

\_\_\_\_\_



How much time to you spend removing invasive species during an average workweek? Circle one.

0    1-2    2-3    3-4    4-5    5-6    6-7    7-8    8-9    9-10    10<

What percentage of your time is dedicated to the removal of invasives during an average workweek? Circle one.

<10%    11%-25%    26%-40%    41%-55%    56%-70%    71%-85%    86%<



Please circle on the map, the location which you spend the greatest amount of time removing invasive species and the name of the invasive.