Fig. 1: Completed restoration project with Kalamalka Lake in the background and the reference ecosystem in the foreground. Photo credit: T. Sunstrum (2012).
Abstract

The purpose of this project was to remove invasive Sulphur Cinquefoil (*Potentilla recta*) in different sites across the property belonging to Okanagan College (OC), on the border of Vernon and Coldstream, BC. After removing the invasive species in the chosen sites for restoration, I transplanted four different species, native to the Interior Douglas-fir biogeoclimatic zone to recreate native grassland habitats. The four species chosen for transplanting included Bluebunch Wheatgrass (*Pseudoroegneria spicata*), Smooth Sumac (*Rhus glabra*), Prickly Pear Cactus (*Opuntia fragilis*), and Common Rabbitbrush (*Chrysothamnus viscidiflorus*). These species were chosen for transplanting due to their abundance within the reference sites across the land at the College; they are all native species to the area and some are referenced as possible restoration species for the drier phase of the Interior Douglas-fir biogeoclimatic zone (Meidinger and Pojar, 1991). Two main sites were chosen for restoration, one with transplants and one with only *Potentilla recta* removal. There has been no other studies or projects similar to the one that I have conducted on the chosen sites, therefore all of the information collected and photos taken are my own, with reference to plant guides for the area including Parish, Coupe, and Lloyd (1996), Plants of the Southern Interior, BC.

Most of the initial information gathered regarding the site conditions and the biophysical inventory is used from ER 312A Final Report: Biophysical Inventory at Okanagan College, Vernon BC (Sunstrum, 2012). This inventory was conducted between May and June, 2012. This source will be one of my largest regarding biophysical aspects of the region and can be used for future references for baseline conditions of the restoration sites. Data management should be easy to retrieve for monitoring and reporting for the project to be effective, and myself as well as Laurie Donovan will undertake this task. Monitoring will include determining if the transplanted species are successful, and if the Cinquefoil invasion has subsided in the restored areas.
1.0 Introduction
1.1 Location Maps

Fig. 2 Map of Coldstream. Scale 1:11,111

Fig. 3 Large scale map of Okanagan College and the Forestry Center. Scale 1:5,842
Fig. 4 Sites of Sulphur Cinquefoil removal, source species for transplanting, and the Demonstration Garden Project. Scale 1:2,895.

Legend:
Yellow pin - Bluebunch Wheatgrass
Blue pin - Smooth Sumac
Red pin - Common Rabbitbrush
Green pin - Prickly Pear Cactus

Fig. 5 Site 2 Cinquefoil removal and native grassland habitat recreation. Scale 1:184. Adapted from Google Earth.
1.2 Area Location

For this project, I used multiple sites for restoration/removal of Sulphur Cinquefoil (*Potentilla recta*), vegetation sampling, a reference site, and a few different sites for acquiring species for transplanting. Originally I was going to work to remove Cinquefoil at three different sites, but only ended up working with two. I will explain why this was in the discussion section. The first site where I removed Cinquefoil was in proximity to where I conducted my vegetation sampling for ER 312A. This area is a combination of the Interior Douglas-fir (IDF) biogeoclimatic zone characterized by grassland habitats, sagebrush steppe, and arid, sparsely vegetated areas (Iverson, Curran, Fleming, Haney, 2008; Marcoux, n.a; Ministry of Forests, n.a.). This area is a mixture of the Ponderosa Pine (PP) and Bunchgrass (BG) biogeoclimatic zones as well. The vegetation sampling area is sparsely vegetated, dominated by bunchgrass and small- to medium-sized shrubs. Within the vegetation sampling area was small- to large-sized patches of Sulphur Cinquefoil (*Potentilla recta*).

The second site where I removed Cinquefoil was on a northwest facing slope, closer to College Way (see Fig. 3 and 4 for details). I chose this site due to its level of disturbance. I do not think that there had ever been any invasive species removal on the slope that I chose to restore. The reference site for recreating a native grassland habitat occurred to the right of site 2, if one were looking downslope. Though the aspect was slightly different (more west-facing than northwest-facing), this reference site consisted of all native species with a very low level of disturbance, making for the ideal reference site for the ecosystem I attempted to recreate.

The sites that I chose to acquire native species from for transplanting purposes was the most random process within my whole project. I wanted to acquire species from areas that had an abundance of native species, so as to not decimate the native species cover in those sites. This process will be explained in the methods section of this report. The average elevation above sea level is 466m (measurement acquired from an etrex Garmin handheld GPS unit) (Sunstrum, 2012).
1.3 Legal Issues

There are no current legal issues associated with my project. I had received approval from the Dean of Okanagan College, Jane Lister, before conducting any physical work on the ground, and she allowed me to choose any areas that I wanted to work in. If I was going to be working in the Demonstration Garden Project area, there would have been potential legal and/or organizational issues to sort out.

1.3 Scope, Objectives, and Goals

The ecological goal of conducting this project is to recreate native grassland habitats by removing Sulphur Cinquefoil (*Potentilla recta*) at sites on Okanagan College’s property. By removing the Cinquefoil, I am hoping to re-establish the natural growth and spacing of native plant species by allowing those species to no longer be out-competed by the invasive Cinquefoil. An objective of mine is to utilize the plant resources in proximity to my transplant site in order to minimize stress on the species chosen for transplanting. This objective was also important for minimizing costs. This way, I did not need to buy plant species from nurseries or other places that sold the species I was looking for,
which would have been my greatest cost for the project. The last objective for my
restoration project was to use the sites as educational tools for future Ecology 203
(Ecological Processes) classes taken at Okanagan College. My previous professor,
Laurie Donovan, is the professor of this course offered at OC, and he will use the work
that I have done to help the students study native and invasive species assemblages,
including elements of reference sites and ecological restoration within ecological
processes.

The scope of this project is localized on the property at Okanagan College. With
restoration projects comes time restraints, and for the time allotted for me to finish this
project, anything larger than what I conducted would have been overwhelming. The
main focus of this restoration prescription was to remove as much Cinquefoil as
possible from the chosen sites in hopes of hindering its growth to the point where it will
not grow back and inhibit the natural native vegetation in the area (BC Ministry of
Agriculture and Food, 2002).

Fig. 7 Site of biophysical inventory/site analysis. Photo credit: Sunstrum, 2012.
1.4 History of Disturbance

The landscaping company that was contracted by the College to carry out the landscaping needs was one of the most detrimental sources of disturbance on the property. The employees operating the sit-and-ride lawnmowers were mowing in an area that was inhabited by all native grassland species. This mowing did not need to occur; the land that was continuously being mowed did not possess any aesthetic or functional purpose for the College, it was basically a field of native species. This past summer (2012), the lawnmowers would mow this area every two weeks. After mowing, everything would die. The Sulphur Cinquefoil was the first species to grow back because it thrives on disturbance, like the majority of invasive species. The mowing allowed the species to establish populations quickly after the disturbance, and to spread to larger areas, furthering its success as an invasive species.

Fig. 8 Site of biophysical inventory after mowing. Photo credit: Sunstrum, 2012

Fig. 9 Site of biophysical inventory after mowing the second time over the summer. Photo credit: Sunstrum, 2012
Road disturbance is another issue occurring on the property at OC. Kickwillie Loop (see Fig. 10) is the oldest road in the area. From its initial establishment, it has been altering the landscape and native species adjacent to the road. I worked extensively at site 2 to remove Cinquefoil; a site that was disturbed long ago by the paving of Kickwillie Loop. The seed bank at this site is so immense, I suspect that even though I removed every specimen of Cinquefoil in the plot that I could find, I believe it will exhibit resilient characteristics and some individuals may grow back next season.

There is a new road, College Way, that was established in the area within the last two years and is meant to be a better access road for Coldstream citizens trying to access the highway. This road is used by plenty of drivers because one can now bypass Kalamalka Lake Road, which consists of large speed bumps and a speed limit of 30 km/hour. When this road was being planned, the municipality of Coldstream consulted with Okanagan College regarding the topsoil that was going to be removed and ruined by the establishment of the new road. Where College Way is located now used to be a native grassland habitat, consisting of the species much alike to my site analysis at the College. The College administration agreed to have the topsoil moved onto their property for future use in their Demonstration Garden Project (UTM coordinate 337405 mE, 557181 mN; dark blue marker in Fig. 4). By moving the soil approximately 100m, it completely decimated the characteristics of the soil organisms and structure. The relocated topsoil is so compact today from heavy machinery constantly driving over it that one can barely dig a hole in it. The area where the topsoil was dumped in the delineated area for the Demonstration Garden Project is overgrown with weeds that I could not identify.

Fig. 10 Kickwillie Loop Rd. Photo credit: Sunstrum, 2012
Fig. 11 College Way. Photo credit: Sunstrum, 2012
2.0 Methods

The first steps I conducted were used as my ER 312A biophysical inventory. This is also known as a site analysis; so one knows what is occurring on the ground. One cannot make a restoration plan or prescription without acquiring knowledge of the problems happening on the ground. Within this site analysis, I conducted a vegetation sample of a 10m x 10m plot to determine the native/invasive species existing in site 1 (UTM coordinates 337325 mE, 5567173 mN). Within this plot, I sampled 3 smaller 1m x 1m quadrats to determine species cover, as well as conducting a 20m transect to find out the distribution of native/invasive plant species in that area.

Fig. 12 Chain link fencing off the side of College Way, Great Mullein and Bluebunch Wheatgrass behind the fencing. Photo credit: Sunstrum, 2012
Once I had conducted my vegetation sampling, I determined an area in proximity to the plot that had endured a high level of invasive Cinquefoil disturbance. This species had completely taken over and was forcing the native Bluebunch Wheatgrass out of its natural habitat. I removed as much Cinquefoil as I could from this area, as it was abundant due to the frequent mowing. Removing the invasive species from the root is important, even though the seed bank within the soil is extensive (see Fig. 14 and 15).
For site 2, I chose another area of high Cinquefoil disturbance, though instead of being on flat land, this site was well-drained and occurred on a northeast facing slope closer to College Way (see Fig. 4 for details). I chose this site due to its level of disturbance; I predicted that the Cinquefoil had never been removed or even attempted to be removed. I used the same technique to delineate an area of species removal as I did for the site analysis. I chose a starting point, and measured 10m at a 90° angle, four different times. This allowed me to end up with a 10m x 10m perfect square to remove the Cinquefoil from. I used a compass, wire-nylon fencing material, plastic stakes to
mark the corners, and a 30m tape measure. I chose to work within a 10m x 10m plot to remove the invasive species because anything larger than that would not be feasible for the time I had to conduct my restoration.

Fig. 20 Delineated 10m x 10m quadrat for Cinquefoil removal and transplants. Photo credit: Sunstrum, 2012

If one is looking downslope to the right of site 2 is where the reference site occurs. This site contained all of the native vegetation species that are characteristic of an Interior Douglas-fir or Bunchgrass biogeoclimatic zone, and shows no external signs of disturbance. The significance of a reference site is to have a ecosystem or habitat to strive for and to provide a model for restoration (SER International Primer, 2004).
Fig. 21 and 22 Reference site for the restored native grassland habitat. Photo credit: Sunstrum, 2012

Fig. 23, 24, 25, 26 Sequence of Cinquefoil removal over five days and a large pile of pulled Cinquefoil. Photo credit: Sunstrum, 2012
I transplanted seven Smooth Sumac, three Bluebunch Wheatgrass, two Prickly Pear Cactus, and one Common Rabbitbrush. The reason for choosing these particular amounts of species was guided by the availability of the surrounding plants within in the reference site as well as across the valley closer to site 1. In an attempt to recreate a native grassland habitat with natural spacing, I chose specific spots for transplanting each species. The three Bluebunch Wheatgrass were planted along the bottom of the slope with hopes in maintaining stability as their roots become the most spread out compared to the other species transplanted. As shown in Fig. 5, I transplanted the Smooth Sumac in a circular pattern around the already existing Bluebunch Wheatgrass that was already on site. The spots chosen for the Prickly Pear Cactus were random, and were chosen to fill “holes” of the bare ground on the site, including the one specimen of Common Rabbitbrush.

To transplant each species, I dug a hole as deep as I could in the site chosen for the final planting and filled it with water. Each specimen was dug out of the ground at their original sites with great care, trying to protect as much of the rooting structures as I could. With each species out of the ground, I soaked the roots in buckets of water before planting them back into the ground (Fig. 28). I did this to promote the growth of the species as well as to decrease the amount of stress put on the plants. Once placed in the holes, I planted the specimens in the ground, and watered them again. I used as much water as I saw fit without choking the plants. I did not want the vegetation to be shocked by using too much water because damp conditions are not what the plants are used to in the late summer in the arid Okanagan, but I did not want to speed up their demise by not watering them. The level of watering is subjective, as many actions are in ecological restoration.

Fig. 27 Myself watering down the transplanting areas. Photo credit: J. Sunstrum, 2012

Fig. 28 Bluebunch Wheatgrass specimen getting its roots soaked in water before transplanted. Photo credit: Sunstrum, 2012
2.1 Vegetation and Wildlife: Species List

Silky Lupine (*Lupinus sericeus*)
Arrow-leaved Balsamroot (*Balsamorhiza sagittata*)
Bluebunch Wheatgrass (*Lupinus sericeus*)
Sulphur Cinquefoil (*Potentilla recta*)
Common Rabbit-brush (*Chrysothamnus nauseosus*)
Junegrass (*Koeleria macrantha*)
Great Mullein (*Verbascum thapsus*)
Dalmatian Toadflax (*Linaria genistifolia* spp. *dalmatica*)
Brittle Prickly-Pear Cactus (*Opuntia fragilis*)
Giant Wildrye (*Elymus cinereus*)
Smooth Sumac (*Rhus glabra*)
Parsnip-Flowered Buckwheat (*Eriogonum heracleoides*)
3.0 Results and Interpretation

I found both restoration sites to be highly invaded by Cinquefoil, which is one of the most common invasive species in this region of the province (BC Ministry of Agriculture and Food, 2011). The Cinquefoil removal at site 1 after the last mow occurred (August 13, 2012) proved to work against the invasive species. Throughout my visits after the initial removal, the species did not grow back. In Figures 18 and 19, one can see the native Bluebunch Wheatgrass coming back, with patches of bare ground which are characteristic of this type of habitat.

After transplanting, all of the species were monitored and watered twice a day for over one week. In conducting the watering schedule, the transplants did not die, though they did show signs of stress. This was expected of those species.

Fig. 31 10m x 10m quadrat on a northwest facing slope for Sulphur Cinquefoil (*Potentilla recta*) removal. Estimation of Cinquefoil cover: >50%
3.1 Ground Cover Estimations (Adapted from Sunstrum, 2012).

**Quadrat 1**

Arrow-leaved Balsamroot (*Balsamorhiza sagittata*) - 35%
Silky Lupine (*Lupinus sericeus*) - 20%
Bluebunch Wheatgrass (*Agropyron spicatum*) - 50%
Bare ground/detritus material - 20%

**Quadrat 2**

Bluebunch Wheatgrass (*Lupinus sericeus*) - 10%
Silky Lupine (*Lupinus sericeus*) - 10%
Sulphur Cinquefoil (*Potentilla recta*) - 20%
Bare ground/detritus material - 60%

**Quadrat 3**

Silky Lupine (*Lupinus sericeus*) - 25%
Arrow-leaved Balsamroot (*Balsamorhiza sagittata*) - 20%
Bluebunch Wheatgrass (*Lupinus sericeus*) - 40%
Sulphur Cinquefoil (*Potentilla recta*) - 15%
Common Rabbit-brush (*Chrysothamnus nauseosus*) - 10%
Bare ground/detritus material - 10%

**Table 1:** Waypoints for vegetation sampling quadrats, site 1 (large and small): up to 20m accuracy, zone 11U

<table>
<thead>
<tr>
<th>Description</th>
<th>UTM mE</th>
<th>UTM mN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrat corner</td>
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<td>5567161</td>
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<td>Quadrat corner</td>
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<td>Quadrat corner</td>
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<td>Quadrat corner</td>
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<td>Small quadrat 1</td>
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<tr>
<td>Small quadrat 2</td>
<td>337335</td>
<td>5567150</td>
</tr>
<tr>
<td>Small quadrat 3</td>
<td>337338</td>
<td>5567141</td>
</tr>
</tbody>
</table>

Fig. 32 Arrow-leaved Balsamroot. Photo credit: Sunstrum, 2012
3.2 Transect Observations (Adapted from Sunstrum, 2012).
NOTE: Where there are no measurements, the ground was either bare or detritus material occurred.

<table>
<thead>
<tr>
<th>Meter</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4-0.8</td>
<td>Sulphur Cinquefoil (<em>Potentilla recta</em>)</td>
</tr>
<tr>
<td>1.1-1.45</td>
<td>Sulphur Cinquefoil (<em>Potentilla recta</em>)</td>
</tr>
<tr>
<td>1.0-1.1</td>
<td>Junegrass (<em>Koeleria macrantha</em>)</td>
</tr>
<tr>
<td>2.0-2.5</td>
<td>Bluebunch Wheatgrass (<em>Lupinus sericeus</em>)</td>
</tr>
<tr>
<td>2.6-2.7</td>
<td>Sulphur Cinquefoil (<em>Potentilla recta</em>)</td>
</tr>
<tr>
<td>2.8-3.2</td>
<td>Bluebunch Wheatgrass (<em>Lupinus sericeus</em>)</td>
</tr>
<tr>
<td>3.2-3.3</td>
<td>Junegrass (<em>Koeleria macrantha</em>)</td>
</tr>
<tr>
<td>3.75-4.0</td>
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<tr>
<td>4.3-4.4</td>
<td>Bluebunch Wheatgrass (<em>Lupinus sericeus</em>)</td>
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<tr>
<td>4.8-5.1</td>
<td>Arrow-leaved Balsamroot (<em>Balsamorhiza sagittata</em>)</td>
</tr>
<tr>
<td>5.4-5.9</td>
<td>Arrow-leaved Balsamroot (<em>Balsamorhiza sagittata</em>)</td>
</tr>
<tr>
<td>5.6-7.3</td>
<td>Common Rabbit-brush (<em>Chrysothamnus nauseosus</em>)</td>
</tr>
<tr>
<td>8.3-8.6</td>
<td>Parsnip-Flowered Buckwheat (<em>Eriogonum heracleoides</em>)</td>
</tr>
<tr>
<td>8.7-9.0</td>
<td>Common Rabbit-brush (<em>Chrysothamnus nauseosus</em>)</td>
</tr>
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<td>9.7-10.0</td>
<td>Junegrass (<em>Koeleria macrantha</em>)</td>
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<tr>
<td>11.0-11.2</td>
<td>Junegrass (<em>Koeleria macrantha</em>)</td>
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<td>12.4-12.7</td>
<td>Parsnip-Flowered Buckwheat (<em>Eriogonum heracleoides</em>)</td>
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<td>13.5-14.2</td>
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<td>15.2-16.0</td>
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<td>16.4-16.45</td>
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<td>17.1-17.3</td>
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<tr>
<td>17.8-20.0</td>
<td>Sulphur Cinquefoil (<em>Potentilla recta</em>)</td>
</tr>
</tbody>
</table>

Table 2: Transect Results (Adapted from Sunstrum, 2012)

<table>
<thead>
<tr>
<th>Species</th>
<th>Coverage (m)</th>
<th>Percent Cover Along Transect</th>
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<tbody>
<tr>
<td>Sulphur Cinquefoil (<em>Potentilla recta</em>)</td>
<td>2.3</td>
<td>13.0%</td>
</tr>
<tr>
<td>Junegrass (<em>Koeleria macrantha</em>)</td>
<td>0.7</td>
<td>3.5%</td>
</tr>
<tr>
<td>Bluebunch Wheatgrass (<em>Lupinus sericeus</em>)</td>
<td>2.9</td>
<td>14.5%</td>
</tr>
<tr>
<td>Arrow-leaved Balsamroot (<em>Balsamorhiza sagittata</em>)</td>
<td>0.8</td>
<td>4.0%</td>
</tr>
</tbody>
</table>
From the transect percentage results, one can see that Bluebunch Wheatgrass (*Lupinus sericeus*) and Sulphur Cinquefoil (*Potentilla recta*) are the most frequently occurring species. The Cinquefoil species is an introduced species from Asia and Europe (BC Ministry of Agriculture and Food, 2011; Endress, Parks, Naylor, Radosevich, 2008), which has now become an invasive species. Just by sight, I predicted that the main types of vegetation occurring on the property at the College were going to be Sulphur Cinquefoil and Bluebunch Wheatgrass, and the transect results proved this hypothesis. Individually removing each plant of Sulphur Cinquefoil can control the invasive species, but this approach may not be viable in the long-term. Cinquefoil seeds are viable for up to three years, so this information must be included in the long-term monitoring and management plan (BC Ministry of Agriculture and Food, 2011).

**Table 3:** Waypoints for site 2 of transplanted species - up to 9m accuracy, zone 11U

<table>
<thead>
<tr>
<th>Description</th>
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<th>UTM mN</th>
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<td>Quadrat Corner</td>
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<td>Quadrat Corner</td>
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<tr>
<td>Prickly Pear Cactus</td>
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<td>Prickly Pear Cactus</td>
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<td>Common Rabbitbrush</td>
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<td>Bluebunch Wheatgrass</td>
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<td>Bluebunch Wheatgrass</td>
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<td>Smooth Sumac</td>
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<td>Smooth Sumac</td>
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<td>Smooth Sumac</td>
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Fig. 33 Transplanted Smooth Sumac.  
Photo credit: Sunstrum, 2012

Fig. 34 Transplanted Common Rabbitbrush.  
Photo credit: Sunstrum, 2012
4.0 Discussion

After removing Cinquefoil at site 1, the invasive species did not grow back all summer. This suggests that once removed from the root, one can control the species from spreading into areas of native vegetation. Site 2 is different from site 1 with regards to invasive species removal. Site 2 had considerably more Cinquefoil to remove, and is a perfect 10m x 10m plot of restoration. This provides edge effects of the invasive species to move into the restored plot from outside the delineated boundary, which can have negative impacts on the restored plot (Murcia, 1995). There is now a contrast in habitats with reference to the restoration site; the rest of the slope that was not restored maintains nearly 100% Sulphur Cinquefoil, whereas within the restored plot, there is no Sulphur Cinquefoil. An assumption I have made regarding site 2 is that the seed bank is considerably higher for Cinquefoil than it is in site 1, so re-establishment of the invasive species seems inevitable (Donovan, personal communication, August 20, 2012).

A study conducted on the grazing of Sulphur Cinquefoil (*Potentilla recta*) found that deer, elk, and cattle all graze on the invasive species, but are not classified as a biological control (Parks, Endress, Vavra, Mclnnis, Naylor, 2008). These ungulates do diminish the seed heads and the number of flowers of Sulphur Cinquefoil (*Potentilla recta*), but not enough to decimate the species. This gives hope for the continuous removal of Sulphur Cinquefoil (*Potentilla recta*) in the area because it is known that White-tailed Deer (*Odocoileus virginianus*) are present, and perhaps they are grazing on this species in the fall and spring.

For this project, restoration success can be identified by the amount of Cinquefoil that grows back next season. I am striving that none re-establishes, but without personal consistent monitoring over the spring, it is hard to determine what will happen to site 2. I was successful in recreating a native grassland habitat with natural spacing of specimens, and completed what I set out to originally achieve. If time permitted, I would have removed all of the Cinquefoil from the entire slope, but for this project, that amount of labor needed more volunteers and considerably more hours of work than what I conducted over the days of August 20-27, 2012. For the monitoring program, I monitored site 1 by myself over the summer. As for site 2, one and a half weeks of monitoring was done by myself as I was watering the species twice a day. After that for over two weeks, Laurie Donovan examined the species for me and carried out the monitoring. His personal communication to me suggested that the transplants were not dying, but looked stressed (Donovan, personal communication, August 30, 2012). I assumed that this was because their new roots had not yet established, even when they were previously struggling to find water. All of the species I transplanted were native to the region and are drought resistant, so in the long term all of the specimens will hopefully establish their root systems to the extent that they should be growing, and the native grassland habitat can flourish in the environment that it is meant to.
4.1 Challenges and Recommendations

Water is and always will be a pressing issue in the arid Okanagan basin. Water flows into upland reservoirs have been predicted to slow down with the effects of climate change (Merrit, Alila, Barton, Taylor, Cohen, et al. 2006), so planting and maintaining native, xeriphytic plant species is vital for this arid region (Kruckeberg, 1982). The Interior Douglas-fir biogeoclimatic zone includes climate predictions such as increasing average temperature, and decreasing average precipitation (Hamman and Wang, 2006), which will cause water stress problems to be exacerbated. Since the water pipes were not turned on at the College, I had to transport water from my house in buckets in the back of my car to take care of my restoration plot. This was not ideal, but I did not have any other option. Though the transplanted native species are drought resistant, they had been disturbed in order to be transplanted by myself digging them out of the ground, so even adding an abundance of water may not override the stress from moving them. I recommend that if anyone else tackles a vegetation restoration project in the Okanagan, that they have a good source of water available that is nearby to minimize stress on the plants, as well as themselves.

Other than doing the physical restoration work, I found communication to be the most important aspect of this project. Without communication, all stakeholders included are not on the same page. By simply mentioning that the mowing was causing detrimental harm to the native species in the area where I did my initial site analysis, the Dean ordered the landscaping company to stop mowing there effective immediately. I feel lucky in this respect. I believe it is not frequent when someone mentions a problem to a person that is higher up on an authoritative scale, that that problem is immediately and effectively dealt with.

I would have preferred more communication with the contracting companies that were working in the Demonstration Garden Project area. On one of the last days on my monitoring/watering, the company was installing a 10 foot fence along the boundary of the Project area. This fence met with the chain link fence that is on the eastern side of the College property, ultimately fencing me out of my restoration area. There was a 10 inch space that I could crawl under the fence with my buckets to conduct my monitoring/watering, which was difficult. If there was an open line of communication between me and the contractors, perhaps the Dean could have held back on the fencing for a few days, but their Demonstration Garden Project took precedence over mine, and therefore I was fenced out of my area.

Long-term monitoring is another challenge with my project. Currently, it is winter and has snowed periodically in the Okanagan. One cannot investigate the restoration sites due to the season; winter is not ideal for species identification because everything has died due to the decreasing temperature. A full growing season (one full year in the Okanagan) will have to occur before I can conduct any more monitoring to determine a level of success at the sites. To monitor the project myself is not feasible because I do not know where I will be living in the future. This is why it is ideal to have someone who
lives in the region indefinitely to monitor it for me, for example Laurie Donovan, in order to project success rates of the transplants and species removal.

The Demonstration Garden Project is great in theory, but it provides more challenges than benefits for Okanagan College. Since the topsoil is the soil that was moved from the road area where a field used to exist (now College Way as mentioned earlier), the soil organisms have been greatly disrupted over the last two years. The College immediately planted Giant Wildrye (*Elymus cinereus*) in the area where the designated area of the Demonstration Garden is to stabilize the soil. This soil stabilization method worked until they contracted a company at the beginning of last summer (2012) to mow it. By the end of the summer, weeds that I could not identify grew aggressively in the Garden Project area, leaving the College no future choice but to do extreme roto-tilling or an extensive digging-up of the soil with heavy machinery. These two methods will only disrupt the soil organisms more. Since the heavy machinery drove across the ground numerous times when the relocating of the soil was occurring, it is so compact now that one can barely dig a hole in that area. The Dean originally wanted me to work in the Native Plant Garden, but time restrictions and the soil characteristics did not permit this.

![Fig. 35 and 36 What the Demonstration Garden Project area looked like in August 2012. Photo credit: Sunstrum, 2012](image)

I believe the Demonstration Garden Project has proposed too many uses for the delineated area. In theory, I believe an outdoor classroom, butterfly garden, community gardens, native plant gardens, food forests, and apiary are great ideas, but I believe the proposal of multiple uses in such a small area will prove to be more difficult than the
planners initially thought. I recommend that the College completely rethink their proposal for the Demonstration Garden Project, and try to maintain the area as an active restoration site for interested students and citizens. I believe the ecology of the area and the people residing in Coldstream and Vernon would gain more benefits from working with native species rather than planting an abundance of ornamentals and introducing species to the area that have the potential to become invasive.

One last challenge touches on the importance of electronic devices and field work. My camera broke half way through conducting my restoration project, so there is nearly one full day that no photos were taken. If one is relying on electronics, such as cameras or GPS units, it is always beneficial to charge them or make sure they are in good working condition before heading out in to the field. After my camera broke, I could not access...
some of the photos that were stored on it, so that is why there is only a select few from the transplanting day. After I had no camera, I had to use the camera on my phone, which is also subject to battery life. This is more of a reminder than a challenge - make sure if one is relying on electronics, that they are in good working condition and are fully charged for a full day of work.

If I were to do this project again, I would take on a larger area to restore if time permitted. I believe the property on the College should be an assemblage of native species without any encroachment of invasive species to help teach students and citizens the importance of ecosystem goods and services with reference to biodiversity and native species assemblages (Costanza et al., 1997).
Fig. 38 Final restoration project: recreating a native grassland habitat mimicking natural spacing of native species. Photo credit: A. Mass, 2012
5.0 Acknowledgments

First, I would like to acknowledge Okanagan College and Dean Jane Lister. Without her approval, this project would have never happened. I appreciate that she allowed me to work on the property at the College. Second, I would like to thank Laurie Donovan for being an amazing mentor as well as colleague. He helped me chose sites for restoration, guided me with species identifications, and provided endless support throughout the entire project. He also provided a GPS unit, a tape measure, text books and field guides, a compass, and the material used to delineate the area I sectioned off for my project. I appreciate his continuous input and opinion, as well as his vision to use the native grassland habitat for future ecology/botany classes at the College. I would also like to thank Val Schaefer for approving my project and supporting my ideas from the beginning, as well as providing the basic knowledge to carry out the physical restoration work. Lastly, I would like to thank my father, Jamie Sunstrum, for providing the Super Save Disposal toilet truck to spray water on the site on the transplanting day, as well as helping me fill up my buckets to soak the root systems. I send thanks to Alisha Mass and Tori Reid, as they helped with the project for watering/monitoring.

References


Appendix A - Climate and Weather Information for Vernon, BC, Canada

Average and Record Temperatures in Vernon BC (The Weather Channel, 2012).

Total weekly water extraction from surface sources in the Okanagan Basin (Sears, 2011).