

A photograph of a rocky, mossy ground covered with fallen yellow and brown leaves and small green plants. The scene is a close-up of a natural, somewhat desolate environment. The ground is composed of various sized grey and brown rocks, some of which are covered in bright green moss. Scattered across the rocks and between them are numerous fallen leaves, mostly in shades of yellow and brown, indicating autumn or winter. Interspersed among the leaves and rocks are several small, thin green plants with tiny leaves, some of which appear to be Scotch broom seedlings. The lighting is bright, casting sharp shadows on the rocks and leaves.

Galiano Learning Center Scotch broom control  
project

Ziyi Qi

## Summary

Scotch broom (*Cytisus scoparius*) has been established on Vancouver Island for decades. As a tough competitor to local native species, scotch broom acidifies soil, which creates less favorable conditions for native plants. Fast re-productivity, deep roots, and a hard seed coat makes it impossible to be removed entirely. Two techniques are promising for managing extensive broom populations on the Galiano Learning Center. First, manual control has already been used successfully at the Learning Center. It is especially effective for scattered populations of broom in difficult location. Done properly, it creates relatively small impact on soil and other plants. Second, and not yet tested, is goat grazing, which has been used successfully for removing invasive species on farmlands. It is best used in areas with denser concentrations of broom. The densities of scotch broom in Lot 57 are different at different sites, and these two methods are flexible to different landscapes.

## Introduction

With increasing attention on negative ecological impacts of invasive species, it is essential to tackle invasive species problems specifically based on a local circumstances. The target of this project is to control Scotch broom (*Cytisus scoparius*, in this report also "broom") on District Lot 57, also known as the Galiano Learning Centre, with minimal environmental impact.

The Learning Center is located in the Coastal Douglas-fir ecoregion, which is "the smallest and rarest of the 16 biogeoclimatic zone in British Columbia" with significant conservation value (Biodiversity BC, 2008); it is also a globally endangered ecosystem. However, broom can influence conifer seedlings (ISCBC, 2014) and reduce up to 98% of young trees in a Douglas-Fir forest during dry seasons(Graves *et al*, 2010). In addition, Lot 57 contains roughly "7 ha of contiguous steep southwest facing coastal bluff including red-listed Garry oak communities, moss and herb dominated seepage site"(Galiano Learning Center, 2013), which ecosystem forms broom desired living conditions. Garry oak ecosystem sustains survival of many risky native species, such as , Victoria owl-clover(*Castilleja victoriae*) and prairie lupine(*Lupinus lepidus*)(GOERT, 2010). Brooms can also compete out some native understorey plants which adapt to open condition by forming dense shrubs and shades(GOERT, 2016).

## Background

### History

Scotch broom is a native shrub in "Northern Africa" (Kris, 2005) and "Mediterranean areas of Europe". (Graham). It was invasive and abundant in the neglected areas, the poor pastures and the hillsides within these native ranges (Kris, 2005). It has been introduced to other countries, such as Chile, United States and New Zealand as an ornamental vegetation, but it has become serious weed problems in many countries such as New Zealand, Australia (Kris, 2005). Even though, Scotch broom was first used for roadside erosion in 1850, it has been recognized as a problem since 1930 in California (Kris, 2005).

It was first brought by Captain Walter Grant to Vancouver Island as a gardening vegetation in his farm near Sooke in 1950 (Graham). However, because there is no natural predator nor competitors, the broom soon started its invasion outside of the garden and spread out quickly on Vancouver Island (Lee, 2010). Soon, "it spread over most of Vancouver Island in the last century and a half" (Kris, 2005). In the past 50 years, the British Columbia Ministry of Highway accelerated the invasion of Scotch broom by deliberate planting on the Vancouver Island as ornamental vegetation (Kris, 2005). 10% area of Vancouver Island has been invaded by Scotch broom and common gorse (*Ulex europaeus*) (Kris, 2005).

### Characteristic

Scotch broom is a perennial or evergreen shrub (Kris, 2005) with bright yellow flowers that may have red markings in the middle. Its woody stem is 5-angled that has slender leaves with 3 leaflets in the lower part of stem and un-stalked leaves in the upper part (ISCBC, 2014). More importantly, around 50% of photosynthetic tissues of broom is in its stems, which support the plant in hot summers, and help plant to survive in the hot, high sunlight environment (Kris, 2005). When it reaches the third year, the broom is already mature for reproduction (Graham). Brooms will produce black furry seed pods after flowering, which can contain up to 18,000 seeds in each single plant (Graham). When the seed pods are dry, it will split and expel seeds up to 5 meters to surroundings (Kris, 2005). Besides of this, the seeds can be carried to other environments by passengers, animals and vehicles to farther places (Graham).

Scotch broom can grow both erect (2-4 meters) (ISCBC, 2014) and prostrate depending on the sunshine (Kris, 2005). Broom is a shade-intolerant plant commonly found in roadsides where passengers and vehicles frequently pass by (Graham), post-logging places, and other open and disturbed areas. Quick growth and deep root structure make it a tough competitor to other native plants for nutrient resources, water and

light (Graham). Further more, the photosynthetic stems can maintain the ability of broom to photosynthesize after the defoliation by animals or drought(Kris, 2005). Scotch broom is leguminous which help it survive in poor nutrient soil successfully, and generally acidify the soil(Graves *et al*, 2010). It prefers habitats with warm temperatures and mild summer conditions, such as Mediterranean climates(Aggie Horticulture, 2009 ). BC possesses these Mediterranean characteristics( Wikipedia, 2016) which provides suitable environment for scotch broom survival.

People have used many methods to remove and control scotch broom on their farms and environments. 1) prescribed fire can remove mature brooms, but the environmental condition after burning can promotes the seedling establishment. The barren land also creates opportunities for other undesired weeds and grasses(appendix 7, 2014). 2) chemical using(herbicide) possibly kill non-target plants, and remind residues in soil and plants which can affect health conditions of animals that consume the plants( Graves *et al*, 2010) 3) insect predators, "a twig-boring moth (*Leucoptera spartifoliella*) and a seed weevil (*Exapion fuscirostre*)", was used as the control agent of scotch broom in California( Graves *et al*, 2010), but the influence is limited to scotch broom and it potentially influences other plant species and environment. This paper is focus on grazing and manual management those two methods.

## Methods

### Manual management( cliff and old-grow areas)

Hand-pulling and manual tools are the most successful methods in some cases (BRM<sup>2</sup>). It is a labor-intensive work to remove entire plants, however, it cause subtle or even no damage to the surroundings at all, because it is highly selective. (BRM) More importantly, this methods has been already used for removing scotch broom in conservancy, so we can implement this easily.

### Grazing

Since goats are non-selective eater( Graves *et al*, 2010). In New Zealand, "goats have been used for controlling Blackberry(*Rubus Fruticosus*) since 1906"(Harrington *et al*, 2011). Goats were used to restore bog turtle habitat which reduced the common reed(*Phragmites australis*) on that site by 85% after two seasons(U. S Fish and Wildlife Services, 2009).Compared to sheep, goats had a significant impact when the density of scotch broom was low( 4%), but no influence when the density is high(10%)(Holst,

---

<sup>2</sup> BRM: Abbreviation of Appendix 7: Broom Removal Methods.

2004). Goats can affect and reduce seed productivity by digesting to only 8% of seeds that are capable of germination afterward(Holst, 2004). Moreover, goats are prefer shrub layers, so the remaining pastures in goat paddock was far more abundant than the pasture in the sheep paddocks( Holst, 2004) More importantly, goats can digest some weeds that can cause health problems to other animals. To be specific, the twigs, leaves and seeds of scotch broom contains "quinolizidine alkaloids sparteine and isosparteine"(Graves *et al*, 2010), which can trigger the depression of nervous system of animals (Everest *et al*, 2000), but there is no goat illness having been reported yet(Graves *et al*, 2010).

In New Zealand, study show Continued goat grazing for several seasons can effectively prevent scotch broom invasion(Bellingham and Coomes, 2003) .Moreover, King County Noxious Weed Control Program in Washington states that regular grazing can reduce infestation of scotch broom in some examples(King Country, 2008).

## Goals and Objectives

- To increase people's awareness of scotch broom's impacts on local ecosystems.  
Setting information boards (comparison pictures) in public accessible place;  
Community outreach
- To reduce 95% of scotch broom effectively from the Learning Center by 2021.

## Design

This project focuses on the three general landscapes: cliff area, old-growth area, and the middle grass and shrub ground (grammoid 2.6, 4.7, 7.5, and rural/ agricultural area)(Galiano Learning Center, 2014), which bases on the former research and information.

## Site Describe



the investigation of scotch broom in 2014, done by a group of Germany students.



Grass and Shrub Areas (the middle yellow areas in the map)

The agriculture area is 13.06 hectare (Galiano Learning Center, 2013) which is relatively flat and suitable for applying grazing with few desirable plants. According to the density map of scotch broom in 2014 (Galiano Learning Center, 2014).

These areas are open, dry disturbed with abundant sunlight, at the early successional stage. Weeds and grasses are the main covers with significant amount of invasive species such as scotch broom, Canada thistle, and holly. These areas are partially accessible to passengers and cars. Scotch broom is common found near trail and the

places that contain fewer Canada thistle. The density of scorch broom at this site is lower than 10%(Galiano Learning Center, 2014), which is manageable by grazing.

#### Cliff Areas

Open or semi-open areas with poor nutrient and rocky soil are unsuitable for majority of plants. Scotch broom shrub sparsely grow between rocks and on the flat area near cliffs. According to the previous data, "Six cliff points with few sporadically occurring individuals to several well-spaced patches or clumps Five cliff lines with few patches up to continuous uniform occurrence of well-spaced individuals"(Galiano Learning Center, 2014).



#### Old-growth Area:

It is a semi or shady area with shrub and tree layers, and have the highest ecological value among those three landscapes. Scotch broom intensively grow along path. The scotch broom is continuously occurred with few gaps in this site (Galiano Learning Center, 2014)

#### Manual Method

The scotch broom in cliff area and old growth areas should be done by hand pulling, because cliff areas has vulnerable and rocky soil conditions, and old-growth area has path for accessing.

The appropriate time for pulling the new shoots of young scotch broom is from late winter to early spring (during February and March) (BRM). Using tools , such as weed wrench, to cut the stem of mature scotch broom before seedling (when flowering) when soil is moisture, or after raining.

The scotch broom pulling activities should be held twice a year regularly with different groups. The first period is in the February, with volunteers from center to remove new shoots and cut mature plants. When the soil is moisture, it is easy to remove seedlings by hands because the root is shallow and cause subtle damage to the soil condition.

The second period is in the summer (June or July) with program students as a part of optional outdoor activities for them. In this season, they are mainly tackle with mature plants which contains seed bank and deep root, so using wrenches and other tools instead of hand-pulling.

Before starts each season, there is a scotch broom workshop, which is open to public to train volunteers and inform people who are interested in it as well.

### Goat grazing method

The scotch broom in agriculture land and grassy areas can be done by goat grazing. Grazing is an all-year and long-term method to control scotch broom (BRM, 2014) for at least 5 years. In these areas, the shrubs and grass are mainly weeds and invasive species, so it is possible to graze not only scotch broom but other trouble weeds, such as Canada thistle. It is ideal to apply grazing during March and September(BRM, 2014).



The first step is to choose one spot as experimental place in the first. The ideal experimental site is near the cove, which is around 0.5 - 0.8 acres. This spot includes the conditions that appear in the all other grass areas, such as, three or four clutches of scotch broom, several fenced native plants and other weed species.

Goats graze this area once or twice a year(May and September) , which should take less than one week each time(BRM, 2014). Recording the site condition: the maturity and quantity of scotch broom, and the influence on native plants and other weed species. before and after each grazing periods. If the abundance of scotch broom reduced by 50% to 60% Then this method is effective.

Before transferring goats to a weed-free spot, there should be 4-5 days for goats to digest the weeds and residues in the bodies by feeding them weed-free grasses and hay(Harrington et al, 2011).



There are two optional goat species for grazing choices: Angora and Spanish goat, which have been used in America successfully for managing scotch broom (King County, 2008).

The average fee of grazing is 800 American dollars( 1029.6 Canadian dollars) per acre in America which includes labor fee, fencing, insurance and healthcare of goats(Goats R Us, 2008). If the fee in Canada was around this level, the total fee of grazing all assigned grassy and shrub site could be 33207.7 Canadian dollars . There are two possible methods to collect funds. 1) Center can consult other landowners who also want to reduce the abundance of scotch broom in their lands, and renting goats as a group which can reduce certain amount of cost. 2) Center can hold workshop to introduce and educate people from Galiano Island the benefits of weed grazing for the island and show the results of the experiment for fund raising.

### Monitoring

Since the latest data on density of invasive species around center was done in 2014, the change in scotch broom density among those sites should be updated before starting this project.

#### Step I

A group of students or volunteer do transect among the recorded sites in old-growth, cliff, gramoid and rural/agriculture areas to note the updated densities in those areas before grazing and manual pulling.

#### Step II

Doing annual transect in the same week each year to record the changes and differences as the procedure processing.

### Public information



## Information board

The information board should be located in the red spot shown in picture where visitors can easily access and see. The brief introduction of scotch broom's characteristics should be included with the distribution of scotch broom in the Galiano Learning Center area. Moreover, the information board should inform visitors the spreading methods of scotch broom to increase people's awareness and reduce human impacts on sites. Sample information board(see appendix 2).

## Acknowledgment

First, I would like to thank my professor Dr. Eric Higgs who provide this great opportunity to this project on scotch broom management, where I have learned lots of new knowledge.

Second, I would also thank Keith who supported me with many useful and relative data for this project..

Last but not least, I would like to thank my TA Jemma Green, whose helps were very inspiring and useful

Thanks to all people who helped me.

## Reference

Aggie Horticulture. 2016. *Cytisus scoparius*. Retrieved from <http://aggie-horticulture.tamu.edu/syllabi/308/Lists/Fourth%20Edition/Cytisusscoparius.pdf>

Appendix 7: Broom Removal Methods. ( Can't find the way to cite)

Bellingham, P. J., and Coomes, D. A., 2009., Grazing and Community Structure as Determinants of invasion success by Scotch Broom in New Zealand montane shrubland.

Biodiversity BC. (2008). *Taking nature's pulse: The status of biodiversity in British Columbia: Summary report*. Victoria, B.C: Biodiversity BC.

Everest, J. W., Powe Jr, T. A., and Freeman, J. D. Poisonous Plants of the Southeastern United States. Retrieved from <http://www.aces.edu/pubs/docs/A/ANR-0975/ANR-0975.pdf>

- Galiano Learning Center. 2014. LEARNING CENTER-INVASIVE SPECIES CONTROL PLAN.
- Galiano Learning Center. 2013. Galiano Learning Center Management Plan.
- Galiano Learning Center. 2014. Learning Center - Invasive Alien Species Control Plan.
- Garry Oak Ecosystem Restoration Team. 2016. Invasive Species. Retrieved from [http://www.goert.ca/about/invasive\\_species.php](http://www.goert.ca/about/invasive_species.php)
- Garry Oak Ecosystem Restoration Team. 2010. Rare and Endangered Species. Retrieved from [www.goert.ca/documents/GOERT-SAR-Table-2010-Nov-web.xls](http://www.goert.ca/documents/GOERT-SAR-Table-2010-Nov-web.xls)
- Goat R Us. 2008. Frequent Asked Questions. Retrieved from <http://www.goatsrus.com/faq.htm>
- Graves, M., Mangold, J., Jacobs, J. 2010. Biology, Ecology and Management of Scotch Broom ( *Cytisus scoparius* ). Montana State University.
- Graham, P. A., scotch broom ( *Cytisus scoparius* ). Retrieved from <http://www.shim.bc.ca/invasivespecies/private/scotchbroom.html>
- Harrington, K.C., Beskow, W.B., and Hodgson, J. 2011. Recovery and viability of seeds ingested by goats. Retrieved from <http://www.cabi.org/isc/fulltextpdf/2011/20113406633.pdf>
- Lee, Troy V., 2010. "GLISTENING PATCHES OF GOLD": The environmental History of Scotch Broom(*Cytisus scoparius*).
- Scotch Broom, Scot's Broom. 2008., Retrieved from <http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/Scotch-Broom-Control.pdf>
- Spotting Scotch broom - Invasive Species Week. Retrieved from <http://bcinvasives.ca/invasive-species/identify/invasive-species/invasive-plants/scotch-broom>
- U. S Fish and Wildlife Services. 2009. Retrieved from <https://www.fws.gov/invasives/stafftrainingmodule/methods/grazing/practice.html>
- Wikipedia. 2016. Climate of Vancouver. Retrieved from [https://en.wikipedia.org/wiki/Climate\\_of\\_Vancouver](https://en.wikipedia.org/wiki/Climate_of_Vancouver)

Zouhar, Kris. 2005. *Cytisus scoparius*, *C. striatus*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).