

**Invasive Species Management: Education through Restoration at Camp  
Thunderbird**

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## **Abstract**

Camp Thunderbird is a youth camp and outdoor education centre that operates during the summer months. It is located in Sooke, British Columbia and consists of 1200 acres, including a campground and extensive hiking trails. The goal of this ecological restoration project is to instill values of environmental stewardship and restoration in camp instructors and youth through removal of the two primary invasive species on the grounds: Scotch broom and English holly. The project focuses on management and removal of invasive species in high traffic areas surrounding buildings and Glinz Lake, as well as on three main hiking trails: Forbidden Trail, Thunderbird Trail and Crow's Nest Trail. A long-term monitoring and management plan that can be implemented by the camp program and maintenance staff was created including a logbook to identify and record the extent of invasive species at monitored sites. Actual removal of plants will primarily be incorporated into Camp Thunderbird's outdoor education and summer camp programs, and aid their goal of facilitating positive relationships between youth and the environment. To accomplish this goal, a lesson plan was created to aid camp instructors in instructing youth about invasive species management in an engaging and educational way.

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## 1.0 Introduction

Camp Thunderbird, a youth summer camp and outdoor education centre in Sooke, BC, has invasive species, primarily Scotch broom and English holly, on its property. This document outlines management goals and objectives for restoring the area through the restoration based education at Camp Thunderbird. Invasive plant species have a significant impact on ecosystems of Vancouver Island because they compete with native plant species for moisture, nutrients and light (Sensitive Habitat Inventory and Mapping, 2013). The IUCN describes invasive species as animals, organisms or plants that are introduced into ecosystems outside of their natural habitat, where they become established and disperse, resulting in a negative impact on the local ecosystem (Invasive Species Council of British Columbia, 2013). Moreover, due to ecosystem complexity, it is difficult to predict the outcome of invasive species introduction, however, Invasive species often result in a loss of native species and compromise ecosystem function (Sensitive Habitat Inventory and Mapping, 2013).

The project seeks to use restoration as a tool beyond its ability to create ecological value, as the Camp Thunderbird region already has a well functioning ecosystem due to its remote setting, small-scale human disturbance, and minimal invasive species. The project seeks to capitalize on the educational, recreational and community potential of restoration (Higgs, 2003). The goal is to foster values of respect and environmental stewardship in youth through a camp restoration program. Therefore, our focus is not on the eradication of Scotch broom or English holly, but on the consistent removal for its educational value. The project focuses on achievable goals,

as it is important for youth to experience the product of their labor and its effectiveness (Parks Canada Guidelines and the Canadian Parks Council, 2008). This in turn encourages future commitment and reinforces "optimistic" nature of restoration (Higgs, Lecture).

This report outlines the vision, goals and objectives for the restoration project, before describing the history of Camp Thunderbird property including ethnoecology, physical site description, ecology of the area, and the history of human disturbance. Next, the problem is identified, by evaluating the extent of invasive species present on the property, and stakeholders are identified. Recommendations for the implementation of invasive species management and education are outlined next, followed by a monitoring plan following the principles of adaptive management. A budget and timeline for the project are also included. Finally, challenges and key recommendations are discussed.

## **2.0 Vision Statement**

This project envisions Camp Thunderbird having camp staff and clients who are engaged with and knowledgeable about invasive species and invasive species management, within an ecologically resilient natural environment without the threat posed by invasive species.

## **3.0 Goals and Objectives**

**Goal One:** Engage and educate children and youth in the management of invasive species at Camp Thunderbird.

Objective One: Design a lesson plan that can be used to educate campers on invasive species and have them take part in invasive species management.

Objective Two: Incorporate creative songs, stories, and activities to make invasive species management fun and youth friendly.

Objective Three: Create a total of ten educational signs for Scotch broom and English holly (five signs each) that can be placed in areas of dense patches of invasive species, that can educate the camp members and the public on these invasive species.

**Goal Two:** Reduce the impact of invasive species on Camp Thunderbird's ecosystems.

Objective Four: Create a manual of best practices for management of Scotch broom and English holly including timing of removal and disposal of plants that can also be transferred and used in grant funding applications.

Objective Five: Provide camp management with a method to conduct annual inventory of Scotch broom and English holly, for the high traffic and accessible areas of Camp Thunderbird property and on high traffic trails on the broader property.

Objective Six: Design a long-term monitoring plan that can be revisited and updated after each pulling session using the principles of adaptive management.

## **4.0 Site Background**

### **4.1 Ethnoecology**

Two distinct cultures currently influence the Camp Thunderbird property.

### **4.1.2 First Nations**

The landscape that makes up Camp Thunderbird is on the traditional territory of the T'Souke First Nation. However, currently the T'Souke people are not significantly involved with the management of the portion of their territory where Camp Thunderbird now resides (Gibbs, 2013).

### **4.1.3 Camp Culture**

Being aware that Camp Thunderbird has its own culture will also play a significant role in the way that the landscape is managed. As the camp focuses on involving youth with nature, introducing a management plan that incorporates education and education specifically about invasive species (in an interactive way) will be important; emphasizing the importance of restoration through camp led educational activities will provide the appropriate platform in which this objective can be achieved.

## **4.2 Site Description**

Located just over 30km West of Victoria, British Columbia, Camp Thunderbird consists of 1200 acres of forested Western hemlock ecosystem (Ministry of Forests, Land and Natural Resources, 2012). Due to the extensive size of the camp there are several notable geographic features including three notable peaks in the area: Mount Ragged, Windy Point, and Mount Manuel Quimper. The camp's focal point, Glinz Lake, is a source for Ayum Creek, which flows from the Sooke hills into the Sooke Basin. It serves as a Coho and Chum Salmon spawning area as well as a habitat for more than 107 different native species (The Land Conservancy, n.d.). The salmon in particular, provide ecological and cultural value. Salmon act as keystone species in the Western hemlock ecosystem of Vancouver Island due to their role in transporting nutrients

through the ecosystem. They also hold cultural significance for many First Nations groups (The Land Conservancy, n.d.). There are also several smaller streams that are only active during the wet winter months and serve as hiking paths during summer months. This illustrates a “cultural” ecosystem service as it is used for recreational activities, such as hiking (Higgs, Personal communication, 2013).

Camp Thunderbird is surrounded by the Capital Regional District’s “Sea to Sea Green Blue Belt”, an extensive and protected wild area. Geographically defined by Tod Inlet in the North to the Sooke Basin in the South and from the Sooke Hills to the East and Sooke River to the West. It comprises the largest protected area in the CRD (Sea to Sea Green Blue Belt, 2013). Please refer to map in Appendix A.

#### **4.2.1 Ecological Conditions**

Camp Thunderbird is part of the coastal western hemlock biogeoclimatic zone, which dominates the rest of Vancouver Island and the British Columbia coast (Ministry of Forests, 2012). While temperate forests are found in many parts of the world, temperate rainforests are relatively rare due to the specific climatic and geographic factors necessary for ecosystem function (eg. a coastal and mountainous region). In fact, over half of the world's temperate rain forests are on the West coast of North America (Ministry of Forests, 1999).

Coastal western hemlock ecosystems are known for their large and long-lived tree species such as Western cedars and Sitka spruce. A small number of old growth trees are still present at Camp Thunderbird, including a 500-year-old Douglas fir. These

trees are particularly important as they represent some of the last remaining trees of this size and age (Franklins *et al.*, 1991). Dominant tree species on Camp Thunderbird property include Western hemlock and Western red cedar. Other common tree species are shore pine, Douglas fir, grand fir and bigleaf maple and they vary depending on climatic variances within the system (Ministry of Forests, 1999). Western hemlock ecosystems also have high biodiversity as they harbor a variety of species, which contributes to ecosystem resilience and function (Carey & Curtis, 1996; Thompson & Starzomski, 2007).

#### **4.2.2 History of Human Disturbance**

Prior to the arrival of European settlers, the area now known as Camp Thunderbird was a seasonal hunting ground used by the T-sou'ke First Nation, a Coast Salish group. No permanent structures were constructed and human impact on the area would have been minimal (A. Chipps, Personal Communications, June 28, 2012).

In the early 20th century, the area was settled by two men: Arnold and Leonard Glinz, two brothers from Switzerland. They logged the property and built a small house on the property before selling it to the Victoria Y in 1935. Prior to acquisition by the Y, the land was logged by the Glinz brothers. Subsequent to purchase by the Y, a small area was developed on the East shore of Glinz Lake, with several small buildings constructed. In the 1970s, a road was built from Sooke Rd to Glinz Lake. During the 1980s, a second area of the property was developed, with a septic system, water towers and ten new buildings constructed on the West side of Glinz Lake (YMCA-YWCA of Greater Victoria, 1985). During the winter of 2005/2006, a selective forestry

project was piloted at Camp Thunderbird along Crow's Nest Trail and Vagabond Trail from the Flat's campsite to the Nicola Ridge climbing area. The forestry project was abandoned after one year (Gibbs, 2013).

Currently, there is an extensive trail network spanning the Camp Thunderbird property, which is hiked by camp groups from May to September and members of the public year round. Several campsites throughout the property have camp groups camp at them during July and August. The core camp area around Glinz Lake is occupied by up to 200 people at a time from May to September. Most areas of forest around the core camp area see groups of campers play in them throughout the May to September operating season, extensively trampling the underbrush in some places (Gibbs, 2013).

Currently, the land is informally protected from development due to its use for recreational purposes by Camp Thunderbird. Camp Thunderbird's current practices reduces human disturbance by ensuring that the majority of human construction is built within a 300 metre radius of Glinz Lake and by maintaining a short operating season from May to September (Gibbs, 2013).

## **5.0 Problem Identification**

### **5.1 Site Assessment**

Before beginning the initial project, our group went to Camp Thunderbird in order to assess the invasive species present. The group divided into three groups with each

group was in charge of surveying a specific region of the camp. The two invasive plant species that were being surveyed were Scotch broom and English holly and each sub group used a map of the area to identify “problem areas”. The objective was determining which areas were at the largest risk from these invasive species and to determine which areas would need to be focused on for restoration. Scotch broom was most prominent in disturbed areas due to its proficiency as a pioneer species and its preference for dry and sunny habitats, it was less successful in the mature Douglas Fir ecosystem of the majority of the Camp Thunderbird property, but where the landscape had been previously altered, it was the dominant invasive species. This is supported by the Ministry of Environment, Lands, and Parks assertion that invasive species are most successful in disturbed areas or areas with an abundant source of light (2012). Fortunately, relatively manageable amounts of Scotch broom and English holly were visible, in relation to the scale of the property.

## **5.2 Invasive Species Present**

Camp Thunderbird’s remote wilderness setting and the limited scope of its human use reduce its potential for invasive introduction. Propagule pressure is reduced since invasive species are no longer introduced for ornamental or horticultural purposes. No previous formal evaluation of invasive species at Camp Thunderbird had been conducted. Throughout the rest of this restoration project, invasive species will refer to Scotch broom and English holly. Taking into recognition that invasive species can be plants or animals, this project focuses solely on invasive plant species.

Two invasive plant species were identified on Camp Thunderbird property: Scotch broom and English holly. A site survey of the property was conducted to identify the extent of the presence of the two species. Conducting a survey of the entire 1200-acre was deemed to be too large a task, and so the site survey focused on areas that were easily accessible for camp clients and staff to be both efficient and engaging. These areas may also be the most prone to Scotch broom due to human disturbance of the landscape (J. Volpe, personal communications, November 18, 2013). Human disturbance compromises native ecosystems and facilitates the establishment of Scotch broom (Graves *et al.*, 2010). Scotch broom also occurred in wilder areas with relatively less disturbance.

Taking these two aspects of accessibility, and previous site disturbance into consideration, the areas directly around the camp buildings were surveyed, as well as the most frequented hiking destinations: Windy Point, Crow's Nest, and Nicola Ridge (Appendix A).

### **5.3 Why Invasive Species Matter**

Invasive species are considered to be plants, animals, or microbes that are not native to a region, which establish a species subset outside of its natural range, and often out compete native species because of energy flows (Volpe, 2013). These species are often more successful at cycling energy within a system, and thus result in outcompeting native species that may not be as adaptable. There are a variety of

hypotheses for why invasive species are so successful, one of which includes an “enemy release” where a population is under stress and moves to an area of no stress, thus resulting in change and proliferation (Volpe, 2013). Often it is the economic impacts that end up determining when a species is considered invasive (Higgs, 2013), as they can end up dominating an ecosystem, and can have far reaching and long lasting impacts; some of these include altering fire regimes, and fragmenting the landscape (CRD, 2013). Scotch broom is one such invasive species that is both well known, and also extremely successful in Southern British Columbia, and the western United States (CRD, 2013). Scotch broom can attribute its success to its ability to flourish in nutrient poor soils, where other plants are not as likely to survive (CRD, 2013). Scotch broom can be found throughout previously disturbed areas on the Camp Thunderbird property, and can be categorized as an established species as self-sustaining populations can be found, but it has yet to cause negative economic effects and thus is not yet a pest species (Volpe, 2013).

Even though there was minimal English holly at Camp Thunderbird, it is still important that English holly be addressed, in case habitat expands and poses a risk. English holly was cultivated in northwestern North America and their seeds have spread up the coast from California to British Columbia due to birds distributing the seeds (Zika, 2010). English holly raises many concerns about ecosystems on Vancouver Island. English holly, and other invasive plant species, alters plant communities by displacing the native biota (Zika, 2010). Despite scientists’ inadequate understanding of

biodiversity's effect on ecosystem function, it is understood that it does play a role in both ecosystem function and ecosystem resilience (Thompson and Starzomski, 2007).

#### 5.4 Extent of Invasive Species found at Camp Thunderbird

A simple scale was used to evaluate the extent of invasive species present. The scale was designed so that a survey could be easily replicated by camp staff without any special training in a relatively short period of time. Category 0 corresponds to no invasive species present (ground cover=0%), Category 1 corresponds to minimal invasive species present (0% < ground cover < 15%), Category 2 corresponds to minimal to moderate invasive species present (ground cover 15%-50%) and Category 3 corresponds to a dominating level of invasive species present (greater than 50% ground cover) (Table 1). Appendix B contains photos with site examples of each category of invasive species extent.

**Table 1: A simple scale depicting the ranges of Scotch broom and English holly at Camp Thunderbird.**

Category 0: 0%	No Scotch Broom or English holly
Category 1: 0% – 15%	Minimal presence of Scotch Broom and English holly
Category 2: 15% – 50%	Minimal to moderate presence of Scotch Broom and English holly
Category 3: >50%	Dominating presence of Scotch Broom and English holly

By identifying areas of interest through a simple classification of four stages, which signify the percentage of presence of Scotch broom, the aim was to simplify the surveying process to make the management areas of broom removal more easily identifiable in future when camp leaders and youth take action. Although this approach may not be the most scientifically accurate, or quantifiable, it allows camp staff to perform site surveys on a continuing basis, making it more financially efficient as Camp Thunderbird will not have to hire specialists, and will be more engaging as camp staff can participate directly in ongoing monitoring. Instead, an emphasis is placed on education and engagement, and thus accessibility is of the utmost concern versus designing and maintaining a monitoring system, which maximizes the accuracy of the assessment method.

Scotch broom was to be significantly more prevalent than English holly, which was present as sporadic isolated individuals in closed canopy areas. Scotch broom was found in the highest concentrations in disturbed and open areas where the mature forested ecosystem was not present. Some areas were found to have no invasive species present. The areas surveyed were divided into several sites (Appendix C). Each site area is listed in the invasive species inventory and monitoring plan in Appendix D, with a corresponding category of invasive species presence, and a description of the site and notes. Some sites were made significantly larger than others, depending on the extent of the invasive species in the site. For example, Site 4 includes approximately half of the core area of Camp Thunderbird west of Glinz Lake because there was no invasive species found in that area and therefore does not

require invasive species management at this time and can simply be re-surveyed each year to ensure no invasive species have established. In contrast, Site 11 contains a much larger proportion of invasive species and so has been separated into a smaller, more manageable area.

## **5.5 Scotch Broom Profile**

Binomial Name: *Cytisus scoparius*

Family: *Fabaceae*

Origin: Native to western and central Europe

Current Distribution: Present widespread distribution in South America, North America, India, Australia, Chile, Iran and New Zealand (Peterson and Prasad, 1998).

Characteristics: Broom typically grows 1-3 m tall and has deciduous trifoliolate leaves 5-15mm long (Oregon State University, 2008). It shows yellow flowers in the summer, which attracts bees for pollination, and is a perennial shrub (Graves *et al.*, 2010). Flowering occurs after 50-80 growing degree days and the seed pods mature black in late summer. They burst open with a “crack” sound that catapults the seeds. It reproduces at 3 years and lives 15-20 years (Graves *et al.*, 2010). Each seed pod contains 5-9 seeds and can release up to 30,000 seeds per plant (Graves *et al.*, 2010).

Invasive Implications: Its deep root structure and rapid growth, through sexual and vegetative reproduction, causes it to invade areas easily (Mkhize *et al.*, 2013). People intentionally planted broom along roads to stabilize the bank structure. It competes with

native plant species for moisture, sun, and nutrients and does not have many natural predators. Seeds are spread by wind, animals, water and humans. The seed coat can delay germination for 30 years and can tolerate extreme conditions such as drought with its deep taproot, photosynthetic stem, and thick wax coating to prevent water loss (Peterson and Prasad, 1998). It also acidifies surrounding soil preventing other species from establishing. It is the hardiest species of broom and can tolerate extreme temperatures down to -25 °C, however, it is shade intolerant. Seeds are capable of germinating from a depth of 6 cm (Graves *et al.*, 2010).

Local Habitat: Broom thrives in sunny, dry, open sites, which have been previously disturbed (eg. along road sides or logged areas). It prefers temperate areas with cool winters and warm summers in areas with a wide range of soil moisture conditions (Graves *et al.*, 2010).

History: It was intentionally introduced to B.C. in 1850 by Captain Walter Calhoun Grant, who planted broom on his farm on Vancouver Island as it reminded him of home. (Sensitive Habitat Inventory and Mapping, 2013). In the mid 1800s, broom was used as an ornamental plant as well as a bank stabilizer to control soil erosion (Graves *et al.*, 2010).

Interesting Facts: Since Scotch broom is a legume, it can fix nitrogen in the soil through a symbiotic relationship with a bacteria called Rhizobium (Wheeler *et al.*, 1979). Scotch broom is often confused with Spanish broom as they look similar, however, Spanish

broom can be distinguished by the fragrance of the flowers, the bright green and rounded stems and a later flowering time (King Country, 2012).

Cultivation Methods: It is used as an ornamental plant or a bank stabilizer due to its large root system. The flowers are edible and contain medicinal ingredients. Broom also contains toxic alkaloids that depress the heart and nervous system, which has been used in medicine. The green twigs, before flowering, are used medicinally as a diuretic and cathartic (Khare, 2007).

## **5.6 English Holly Profile**

Binomial Name: *Ilex aquifolium*

Family: *Aquifoliaceae*

Origin: Native to western Europe and the British Isles

Current Distribution: Found in Europe and the British Isles, the West coast of North America from BC to California, Hawaii, Ontario and Virginia (USDA, 2013).

Characteristics: English holly is a broadleaf evergreen tree and grows 5m-18m high. Female trees have small red to orange berries. Its seeds are often spread by birds which eat its berries. English holly is easily identified by its waxy, thick, wavy, dark green, spiky leaves and bright berries. It is sometimes confused with Oregon grape, which has waxy, dark green, spiky but *flat* leaves (Sea to Sky Invasive Species Council, 2009).

Invasive Implications: English holly can form dense thickets that choke out native plants in the shrub layer. It also uses significant amounts of water, which can further suppress native plant growth (Sea to Sky Invasive Species Council, 2009).

Local Habitat: In British Columbia, English holly prefers mesic (moderate amounts of moisture) forest habitat in low lying areas of the province (Klinkenberg, 2013).

Interesting Facts: English holly is sold during Christmas time as an ornamental plant for wreath making and decorations. In some areas it is cultivated in holly farms for this purpose (Klinkenberg, 2013).

## **6.0 History of Invasive Species Management in Area**

In the past, invasive species management occurred in a haphazard manner without coherent management objectives, training for staff or campers, and monitoring of management efforts. A lack of human and financial resources have prevented Camp Thunderbird staff from developing formal invasive species management plans. As a result, Scotch broom was often pulled in haphazard or destructive methods eg: pulling very large plants up by the roots and disturbing significant tracts of soil, which actually encourages the propagation of seeds. No English holly management has been practiced at Camp Thunderbird in recent years (Gibbs, 2013).

## **7.0 Stakeholders**

Successful restoration projects require the engagement of all stakeholders prior to planning and implementation (Parks Canada and the Canadian Parks Council, 2008).

The primary stakeholders are identified as the T'Sou-ke First Nation, camp staff, clients and community members who use the area for recreational activities.

### **7.1 T'Sou-ke First Nation**

Camp Thunderbird staff currently has very limited communication with the T'Sou-ke Nation, whose territory the camp is on. A member of the T'Sou-ke Nation has visited the camp in the past to educate the staff and clients, however this relationship was short-lived and sporadic (Gibbs, 2013). As we are proposing to further alter the landscape through the management of invasive species, including Scotch broom and English holly, future consultation with the T'Sou-ke First Nations could prove to be a beneficial partnership as traditional ecological knowledge serves as an important source of historical knowledge on which to draw upon for restoration practices. (Parks Canada and the Canadian Parks Council, 2008).

Recognizing that Camp Thunderbird is on the traditional territory of the T'Sou-ke is important and is something that should be noted in the educational component of the management plan as it familiarizes youth with the variety of stakeholders that identify with the land which the camp sits on; as well, it provides a platform in which to discuss how the alteration of natural landscapes and restoration techniques have been practiced for millennia. The T'Sou-ke should be consulted prior to the start of the 2014 season for additional input on restoration techniques.

## **7.2 Camp Staff**

Camp Thunderbird staff have all spent extensive amounts of time in the forest at camp, and are likely to have a personal connection to the natural space and therefore a concern for the forest's health and ecological integrity. The camp director was consulted prior to project by group member Peter Gibbs as part of problem identification (L. Ferris, personal communications, October 25, 2013). The camp program coordinator also provided feedback to the project, emphasizing the importance to camp staff of a restoration project that engaged youth. This feedback significantly influenced the goals and objectives of this project (A. MacAdams, personal communications, September 17, 2013). Other staff will be educated about the program in the 2014 season as part of the staff training process (Gibbs, 2013).

## **7.3 Camp Clients**

Camp Thunderbird clients, including campers, parents and teachers, often have a significant connection to the natural spaces at camp. Parents will be informed of their child's involvement in invasive species management through the "Camper Development Form" (CDF), a summary of campers' experiences sent home after the camp session is over. A CDF is often used by parents to spark conversations with their child about their camp experience. As a result, campers and their parents may have the opportunity to continue discussing invasive species after camp is over (Gibbs, 2013).

## **7.4 YMCA-YWCA of Greater Victoria**

The YMCA-YWCA of Greater Victoria ('the Y') owns 800 acres of the Camp Thunderbird property and owns and operates the camp itself. Being a major asset for

the not-for-profit, the health and ecological integrity of the Camp Thunderbird property is likely of concern to the Y as an organization (Gibbs, 2013). The camp director, Luke Ferris, is a Y employee and represents the Y in this capacity and has been consulted.

## **7.5 Community**

Many community members use Camp Thunderbird hiking trails for recreational hikes, mushroom picking and nature viewing (Gibbs, 2013). Some community members may have been using the trails for many years, and as a result may have a significant connection to the forest there and an interest in its ecological integrity. It is difficult to actively engage public users in the planning process due to logistical and financial restrictions, however educational signage will educate community users on Scotch broom and English holly and may be invited to volunteer work parties to participate in removing invasive species.

## **8.0 Invasive Species Management Plan**

### **8.1 Invasive Plant Species Removal**

Invasive plant species can be removed a number of ways, including mechanically, biologically, and chemically. When removing invasive plant species, one must be aware of potentially spreading the seeds further and aiding in germination. There are many options outlined in the literature and these are described in further detail below.

### **8.2 Scotch Broom Removal Best Practices**

Scotch broom is considered “one of the five most destructive alien plants in Canada” (Lee, 2010). Scotch broom must be removed carefully so the seeds are not

further spread. The first strategy for removal is mechanical. Pulling broom before it blooms in the spring months, such as May, is the cheapest way to remove it, however, it can be labor intensive. It involves physically pulling the broom roots out of the ground or clipping it at the roots with loppers or hand clippers. Broom should be cut 3 inches or closer to the soil during the driest time period from late June to early October (Oregon State University, 2008). Broom plants 2" in diameter or smaller can be pulled instead of cut, as they are unlikely to re-sprout (King County, 2008). However, one must be careful not to further spread the seeds once the broom has been pulled and the ground has been disturbed, as this brings seeds close to the surface where they will germinate (Oregon State University, 2008).

The second strategy for removal is prescribed burning, although it is not always the best choice since it will burn the surrounding plants as well, which could be native to the area. However, prescribed burning is the most effective long-term strategy because it is more successful in depleting the seed banks, which can stay dormant for 30 years (Leblanc *et al.*, 1967).

The third method is chemical control. Although this strategy may not always be the first choice due to toxic chemicals, it is quite successful at killing broom. In retrospect, this is not an ideal choice of removal of invasive species for youth, although, camp instructors could apply the chemical control to aid in the eradication.

The fourth method is biological control, such as goats and beetles. For example, Lamancha goats graze on broom and have been successful on Vancouver Island (Sensitive Habitat Inventory and Mapping, 2013). Seed weevils are beetles whose

larvae bore into and feed on the broom seeds, thus, destroying the ability to germinate. An effective species of seed weevil is *Exapion fuscirostre*, which aids in slowing the spread of the plant (Andres *et al.*, 1967). Many of these biological controls have been established in Europe as they are endemic to that area, however, not many biological controls have been introduced in Canada yet.

Overall, a combination of these strategies is required to reduce broom and suppress growth. No single method will effectively control this invasive species and eradicate it forever. When combined, the success rate increases. The site must be revisited each year in order to maintain the success of this ecological restoration project (King County, 2008).

Mechanical control is recommended for Camp Thunderbird. Burning and chemical control bring potential health and safety hazard to an area that is explicitly for use by children, and the use of these methods could cause safety issues and controversy around the project. Biological controls pose a risk of introducing invasive fauna to the area. As a result, it is recommended that broom plants under 2" in diameter are pulled if possible, and plants over 2" in diameter are cut. If a plant smaller than 2" in diameter cannot be pulled, it can be cut but should be flagged with flagging tape and revisited in future years to be re-cut in case it has re-sprouted.

### **8.3 English holly Removal Best Practices**

English holly can be removed mechanically or killed using herbicides. Mechanical control can involve pulling or digging up the plants or cutting them. If pulling or digging, the plant must have their root systems dug up and removed. Small plants can be pulled

or dug up, removing as much of the root system as possible, when soil is moist. When trees are mature, pulling or digging up the tree is challenging and may result in excessive damage to surrounding vegetation. In these cases, the trees should be cut off low to the ground. The tree may re-sprout from the stump, and should be re-visited in subsequent years and be re-cut to ensure the tree dies (Sea to Sky Invasive Species Council, 2009).

Chemical control can also be applied to English holly. Paint-on herbicide can be applied to a cut stem or by frilling: cutting a deep groove all around the base of the tree and then applying copious amounts of herbicide (Sea to Sky Invasive Species Council, 2009).

Mechanical removal of English holly is recommended for Camp Thunderbird; herbicide poses environmental and health and safety concerns, particularly around children.

#### **8.4 Invasive Species Disposal Best Practices**

There are specific methods that must be undertaken to dispose of Scotch broom and English holly in order to limit the spread of the seeds. The first method is to bag the removed plant immediately and transport it to a sanitary landfill or incinerator. Some areas on Northern Vancouver Island actually have a group called “Broom Busters” who pick up broom on certain days and dispose of it, although there is not a group in the Greater Victoria area (Broom Busters, 2013). Secondly, composting may further the distribution of seeds but it is possible if it is in a shady area so broom cannot grow

(Leblanc, 2013). The removed invasive plants at Camp Thunderbird can be manually pulled or clipped and immediately put in a bag and brought to a road or parking lot at camp. Then ReFuse (a local composting company) will pick up the broom and take it to an industrial composting facility. An option to recycle the removed invasive plants is to use it as kindling and burn it in campfires; this will limit the amount of garbage within the camp.

### **8.5 Implementing Invasive Species Removal**

Invasive species removal will be carried out by two methods: by Camp Thunderbird campers as part of an invasive species educational program (Appendix E); and by volunteers on volunteer work days. Camp staff will use the invasive species monitoring package, to be stored in an easily accessible place at Camp Thunderbird, to determine which areas at camp require invasive plant species removal and then record the results of their session.

### **8.6 Implementing Invasive Species Education**

Invasive species education will have two components: educational signage and the educational program run by camp staff. Educational signs have been created providing site users with information on English holly and Scotch broom (Appendix F). These can be printed off, laminated by camp staff and placed in strategic locations around the core Camp Thunderbird site. Engaging youth in restoration in a summer camp setting can be best achieved by having camp counsellors use interactive educational activities concerning invasive species management. Appendix E contains a

lesson plan to this end, intended to be copied into the Camp Thunderbird staff manual or distributed to camp counselors on its own. As a result, it is formatted somewhat differently than the remainder of this document, without numbered headings, to be more easily copied into camp materials.

Through the restoration program, clients (campers) will improve both cultural and ecological value, similar to Higgs' concept of focal restoration (Higgs, 2003). The project will increase the clients (campers) experience at Camp Thunderbird and increase an appreciation of the natural environment through the medium of restoration. By establishing this management plan for Camp Thunderbird, we hope to provide useful information that will allow for Scotch broom and English holly to be successfully removed at Camp Thunderbird through youth involvement.

## **9.0 Monitoring and Adaptive Management for Ecological Restoration**

Restoration and monitoring efforts at Camp Thunderbird will follow the principles of adaptive management (IUCN, 2004). Adaptive management consists of continuous monitoring and necessary altering once the restoration project has been implemented, through an active learning framework. As the restoration project is implemented over the years, monitoring efforts and the results of removal activities will be recorded by camp staff; these data can then be compiled and reviewed annually in order to modify or adjust activities as seen fit. For example, camp staff may conclude after a few years

that they are able to maintain a larger or smaller area free of invasive species than this report has suggested, and choose to scale back or expand their efforts.

The following monitoring components will aid in the adaptive management of invasive species:

1. Ongoing recording: Camp staff will choose which areas to remove invasive species from using the invasive species inventory in Appendix D. After each invasive species removal session, camp staff leading the session will record the state of the invasive species infestation at the end of their session (eg. “all invasives removed” or “approximately half the area cleared”) in the “Results of Session” column.
2. Annual re-evaluation of invasive species: At the beginning of each year, camp staff members will conduct a site survey to evaluate the extent of the presence of invasive species in the area covered in the quadrants in the initial site survey using the Category 0-3 scale outlined above. This annual survey will provide a regular summary of the invasive species management efforts.

These two monitoring activities will give ongoing insight into the state of the invasive species problem at Camp Thunderbird and provide staff with the information needed to evaluate their efforts and adjust the program as necessary.

### **9.1 Adaptive Management for Educational Program**

The educational aspects of the restoration program must also be monitored and adapted as needed. Due to the subjective nature of the education program, it will be

judged primarily by a staff evaluation included in the “Camper Experience” column of the monitoring plan in Appendix D. Camp staff will also consider camper feedback of the restoration program to further tailor the program. As the program matures, camp staff can incorporate client and staff feedback to improve and update the lesson plan in Appendix E.

## **9.2 Human Resources**

Educating and engaging youth on invasive species can be incorporated into existing camp schedules and programs, and as such will not require extra human resources to implement.

As Camp Thunderbird is a not-for-profit organization, financially efficient restoration is of particular importance. Invasive species removal can be incorporated into educational camp programming: while educating youth on the significance of invasive species and how to manage them, youth can also help to remove invasive plants. This offers an engaging restoration and educational experience while also furthering restoration objectives.

Camp Thunderbird holds a semi-annual volunteer work party to help close the site down for the winter and open it up again in the spring (Gibbs, 2013). Camp Thunderbird staff could organize one or more volunteer Scotch broom management parties to engage Camp Thunderbird clients, staff, alumni and community members in invasive species management. A moderate amount of staff time may need to go into organizing and promoting such an event, but it would otherwise be completely free.

## **10.0 Budget and Timeline**

Both budget and timeline are essential elements when implementing a restoration project as they can determine the project's "efficiency" (Parks Canada and the Canadian Parks Council, 2008). Budget represents the fiscal manifestation of the project, and can often determine whether or not specific desires are attainable within the designed restorative framework (Parks Canada and the Canadian Parks Council, 2008). Establishing a timeline for objectives creates responsibilities and expectations for users. By implementing a timeline, it is more likely that goals and objectives are going to be accomplished as there is an expectation that specific tasks are accomplished at specific times throughout the year. When this happens, the success of the management plan is more likely to be attainable, which is important to note when working with youth.

### **10.1 Budget**

When considering the design of any restoration project, it is crucial to consider budget constraints as they can make the proposed project accessible or infeasible. In the case of the management plan proposed for Camp Thunderbird, for the removal of invasive species, the emphasis was placed on keeping the budget as low as possible due to the fact that camp funding is inflexible and restricts them from significantly financing restoration maintenance on site. That being said, there will be certain resources that will need to be purchased including clippers; as the restoration program is aimed at being an educational experience for youth, there will need to be enough clippers on hand for each participant to be able to take part in the removal process. These clippers will be one of the main expenses and can be purchased at Canadian Tire for around twenty-five dollars. For this project, we would need approximately eleven

clippers as there are nine campers and two counsellors in a cabin, which make up one group. Gardening gloves must be purchased in order to achieve safety standards when removing invasive species. These types of gloves can be purchased at Home Depot for approximately five to ten dollars and eleven pairs must be purchased as well. Another consideration that will need to be made will be the cost charged by ReFuse, which is the disposal company that Camp Thunderbird already works with. Additional charges may be applied for picking up additional biomass and removing it from site. The broom and holly can be stored in oversized bags (five feet x five feet x four feet or 2.83 meters cubed), supplied by ReFuse for pick-up, incurring a cost of approximately thirty dollars per bag (ReFuse, personal communications, November 25, 2013). Due to the amount of invasive species noted during our visit to Camp Thunderbird and the amount of available labor, we estimate that roughly one oversized bag per week will be needed during an eight week period. This is based on the assumption that one group of campers per week will participate in invasive species removal. There are available parking lots for use as a transition area for both Scotch broom, and English holly that is pulled before it is hauled away, therefore Camp Thunderbird will not incur costs for storage of the cut biomass.

In total, including the cost of the clippers (\$275.00), the cost of the gloves (\$110.00) and the cost of ReFuse (\$240.00), a net cost of \$625.00 is the approximate budget, as indicated in Table 2 (ReFuse, personal communications, November 25, 2013; Home Depot, 2013; Canadian Tire, 2013).



education at Camp Thunderbird

## **11.0 Challenges**

Throughout the design of this restoration project, we were presented with various challenges. For example, since Camp Thunderbird sits on 1200 acres of land, it was very difficult and impossible to make a detailed inventory of the whole site. The main quadrants that we documented could not be fully detailed, therefore, our scale is a rough estimate with a large range in invasive percentage.

Furthermore, we have no knowledge on whether or not the youth will enjoy this activity or if they will be enthusiastic about learning about invasive species. Without implementing the project, it is hard to gauge the amount of youth involvement and response.

A major challenge presented included what to do once the Scotch broom and English holly were removed from the ground. Since the seeds can be easily dispersed, the invasive species must be strategically moved to a storage site before the composting company, ReFuse, picks it up.

Since Camp Thunderbird only operates during the spring and summer months from May to September, Scotch broom and English holly have already bloomed during most of the operating season. It is best to pull broom before they bloom in June, which leaves May the best month to remove invasive species at Camp Thunderbird. Thus, the risk of spreading seeds during removal is higher during these months. To enable camp

staff and campers to participate in invasive species management, less than ideal timing has been recommended.

## **12.0 Conclusion**

After assessing the extent of the invasive plant species at Camp Thunderbird, goal and objectives were created to prioritizing the education and engagement of youth in removal of invasive species, while simultaneously removing invasive species. The management plan includes a site survey to identify the extent of the problem in the most accessible and high traffic areas of Camp Thunderbird, best practices for the removal of Scotch broom and English holly, a lesson plan to educate youth on invasive species and have them help in removing invasive plants, and a long term monitoring plan to evaluate the progress of educational and restoration objectives.

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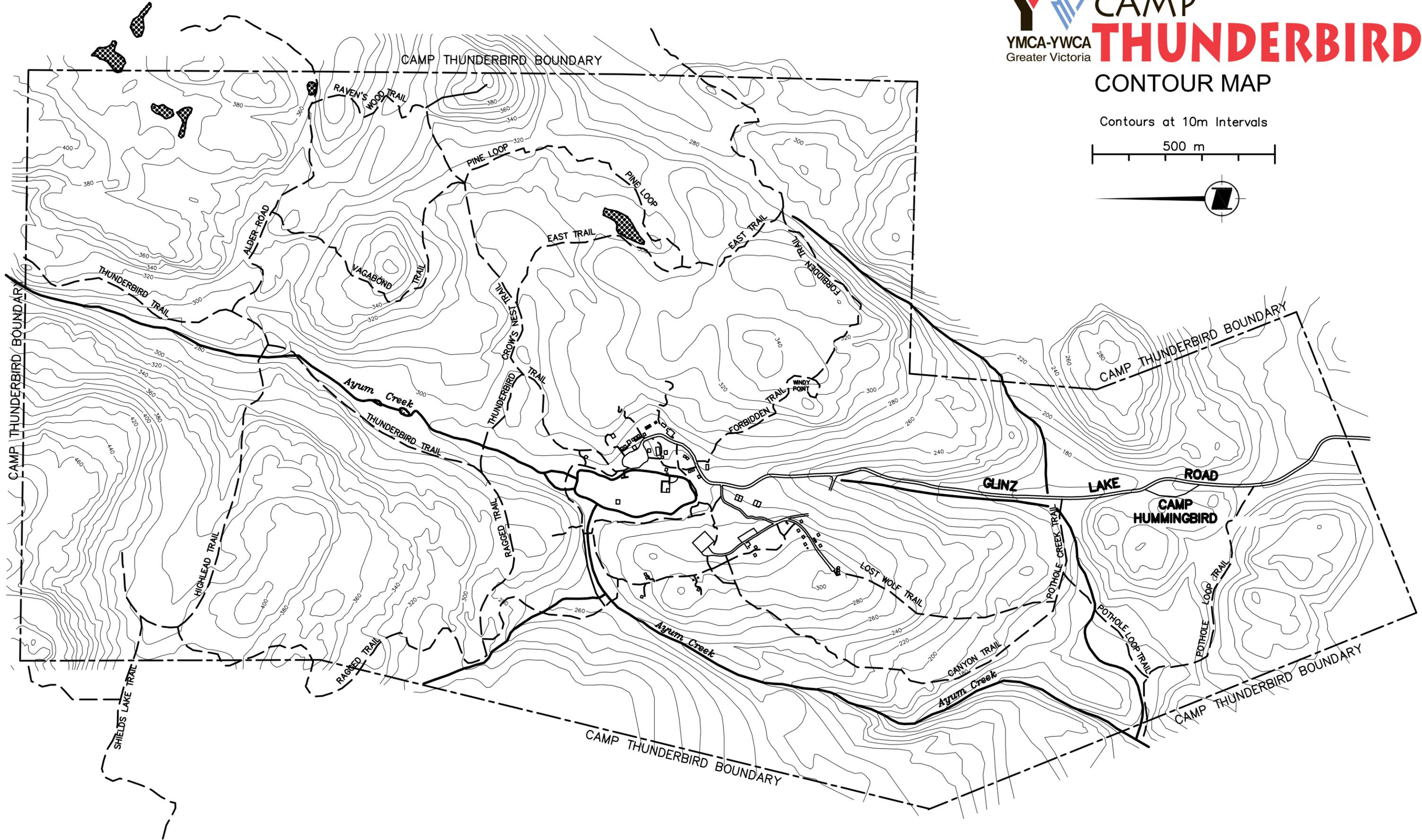
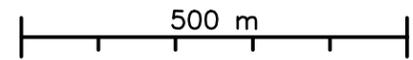
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## Appendix A- Map of Camp Thunderbird

## CONTOUR MAP

Contours at 10m Intervals



**Appendix B- Photographs of examples of Category 1-3 invasive species extent**



**Figure 1.** Example of category 1 invasive species coverage, with less than 15% coverage from invasive species, in this case Scotch broom. Source: *Peter Gibbs*



**Figure 2.** Example of category 2 invasive species coverage, with between 15% and 50%

coverage from invasive species, in this case Scotch broom. Source: *Peter Gibbs*



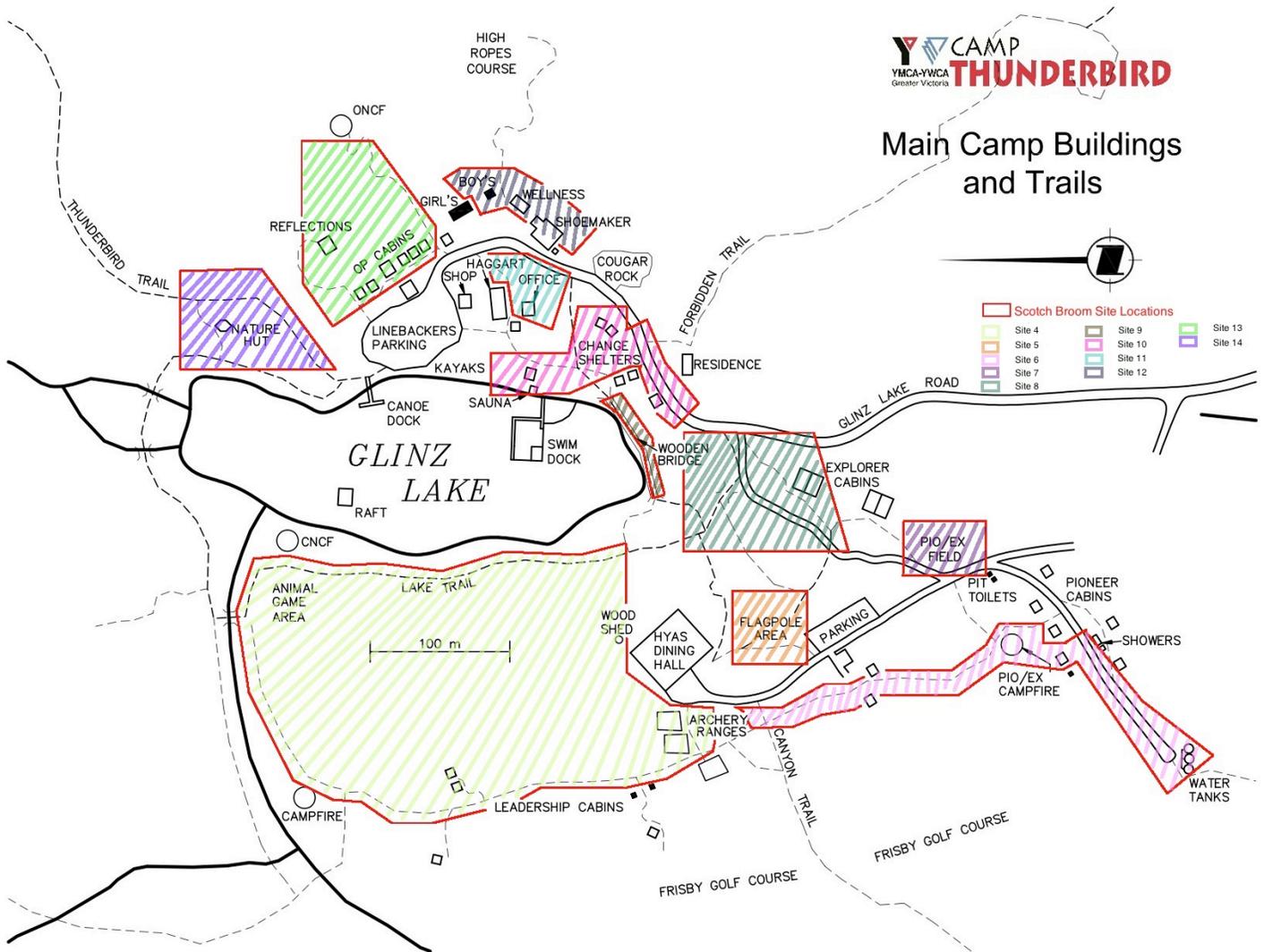
**Figure 3.** Example of category 3 invasive species coverage, with over 50% coverage from invasive species, in this case Scotch broom.

Source: <http://www.terrain.net.nz/friends-of-te-henui-group/weeds/broom.html>

**Appendix C- Maps of Camp Thunderbird with invasive species inventory site areas marked**



## Main Camp Buildings and Trails



## **Appendix D- Invasive Species Inventory and Monitoring Guide**

## HOW TO USE SITE SURVEY GUIDE

The Site Survey is a tool that assists facilitators (Camp Staff) in recording and evaluating each specific restoration effort at Camp Thunderbird. However, it is also designed to be straightforward and easy to use.

- **Site Description** pertains to all “problem areas” (where broom and/or holly is present) on camp and are also identified as sites on the map (**See Appendix C**).
- If possible take a before and after photo as a supplementary site description
- You will choose one site to focus on with a group of campers and take further notes in **Site Description** section to document process.
- Under **Results from Invasive Species Removal**, you can document the success of restoration effort ie. Physical amount of broom or Holly removed. This allows for better direction of future efforts.
- Under **Staff Evaluation of Educational Component and Recommendations** you can answer three questions pertaining to camper’s engagement and the strengths and weaknesses of the program.
- In addition, any notes on camper’s engagement and success can be put under **Staff Evaluation of Educational Component and Recommendations** and will be used in adaptive management .

## HOW TO CONDUCT ANNUAL SURVEY

The Annual Survey is a process designed to help camp staff analyze the distribution and severity of invasive species on camp property. The document is identical to the “Site Survey”, except that it lets the users fill in their own information. It works best with multiple groups working separately and scanning all areas listed in both **Site Description** and in **Appendix C** and compiling their information on to one document.

- In the **Field Notes** section site description (ie geographic features, ecological conditions, weather)
- Then in the **Invasive Species category** you can identify the severity of Invasive Species in terms of percentage of ground cover (broom and holly) in the area on a simple scale from 0 to 3. 0 being no visible presence of invasives. 1 being minimal presence or 0 to 15% coverage, 2 signifies moderate presence from 15 to 50%. Finally severe presence is denoted by a 3 representing 50% coverage and above.

**NOTE: Any area identified as severe regardless of size should be shortlisted as key area for future efforts.**

Thank you for all your help!

Site Description	Site Number	2013 Invasive Species Category	2013 Field Notes	Results from Invasive Species Removal (eg. 'all invasives removed from site'; some broom still left in Western half of site near Thunderbird trail'; etc.)	Staff Evaluation of Educational Component and Recommendations
Forbidden Trail - Windy Point	1	1	Closer to Windy Point, higher densities of scotch broom found		<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Nature Hut- East Trail/Crow's Nest Trail Junction	2	2	Closer along trail to Linebackers parking, will find more scotch broom		<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Crow's Nest Trail/East Trail Junction to Crow's Nest Peak and Nicola Ridge	3	2	Highest densities of broom found along Crows Nest Trail towards Pineloop		<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Lake Trail - Animal Game Area, Campfire, and Leadership Cabins	4	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Flagpole Area	5	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Canyon Trail - PIO/EX Campfire, Showers, and Water Tanks	6	2			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>

Site Description	Site Number	2013 Invasive Species Category	2013 Field Notes	Results from Invasive Species Removal (eg. 'all invasives removed from site'; some broom still left in Western half of site near Thunderbird trail'; etc.)	Staff Evaluation of Educational Component and Recommendations
PIO EX Field	7	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Glinz Lake Road - Explorer Cabins and Lake Trail	8	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Wooden Bridge	9	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Change Shelters - Sauna	10	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Haggart - Office	11	2			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Boys Washroom - Wellness, and Shoemaker	12	0			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>

Site Description	Site Number	2013 Invasive Species Category	2013 Field Notes	Results from Invasive Species Removal (eg. 'all invasives removed from site'; some broom still left in Western half of site near Thunderbird trail'; etc.)	Staff Evaluation of Educational Component and Recommendations
Linebackers Parking - Op Cabins, Reflections, ONCF, and Girls Washroom	13	3	Highest densities of broom found to the right of the trail between Reflections and ONCF		<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): _____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Canoe Dock - Nature Hut, and Thunderbird Trail to Linebackers parking	14	1			<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): _____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>

<p>For Year:</p> <p>_____</p> <p><b>Site Description</b></p>	<p><b>Site Number</b></p>	<p><b>Invasive Species Category</b></p>	<p><b>Field Notes</b></p>	<p><b>Results from Invasive Species Removal</b> (eg. 'all invasives removed from site'; some broom still left in Western half of site near Thunderbird trail'; etc.)</p>	<p><b>Staff Evaluation of Educational Component and Recommendations</b></p>
Forbidden Trail - Windy Point	1				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Nature Hut- East Trail/Crow's Nest Trail Junction	2				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Crow's Nest Trail/East Trail Junction to Crow's Nest Peak and Nicola Ridge	3				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Lake Trail - Animal Game Area, Campfire, and Leadership Cabins	4				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Flagpole Area	5				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
Canyon Trail - PIO/EX Campfire, Showers, and Water Tanks	6				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>
PIO EX Field	7				<p>How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____</p> <p>What was the <u>most</u> successful part of the program? Why?</p> <p>What was the <u>least</u> successful part of the program? Why?</p>

<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">For Year:</div> <div style="border: 1px solid black; width: 100%; height: 15px; margin-bottom: 5px;"></div> <b>Site Description</b>	<b>Site Number</b>	<b>Invasive Species Category</b>	<b>Field Notes</b>	<b>Results from Invasive Species Removal</b> (eg. 'all invasives removed from site'; some broom still left in Western half of site near Thunderbird trail'; etc.)	<b>Staff Evaluation of Educational Component and Recommendations</b>
Glinz Lake Road - Explorer Cabins and Lake Trail	8				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Wooden Bridge	9				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Change Shelters - Sauna	10				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Haggart - Office	11				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Boys Washroom - Wellness, and Shoemaker	12				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Linebackers Parking - Op Cabins, Reflections, ONCF, and Girls Washroom	13				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?
Canoe Dock - Nature Hut, and Thunderbird Trail to Linebackers parking	14				How excited were the campers about pulling invasives? (0-10, 10=Super excited): ____  What was the <u>most</u> successful part of the program? Why?  What was the <u>least</u> successful part of the program? Why?

## **Appendix E- Invasive Species Lesson Plan**

### **Broom and Holly 'Pulling'**

#### **Who**

The project relies on client (camper) labour and camp staff supervision.

#### **What**

Scotch broom and English holly are exotic invasive species. This means that they don't naturally grow in this area and were introduced by humans and that they are able to outcompete other native plants, harming the environment at camp. Broom and holly 'pulling' involves either pulling, digging up or cutting off Scotch broom and English holly. By removing the plants from the forest you are making room again for the native species that they choked out. There is much more broom at camp than holly, so most of the lesson plan will focus on broom pulling.

#### **When and Where**

It is best to pull broom before it starts to bloom and seed. As a result the best time to pull broom is in May before it starts to flower. That said, we would rather involve campers in pulling broom than not, so if you are pulling broom once the seeds have started to grow and spread then try to pick a location closest to camp so that you will be transporting the broom a shorter distance back to camp.

With campers, broom and holly pulling should take place in the main camp area. There is a binder in the phone room marked "Broom and Holly Pulling" that contains a map of

camp broken down into a number of quadrants, and some descriptions of how bad the invasive species infestation is in each quadrant. You'll pick the location for your lesson from that binder.

## **Why**

We want to pull invasive species to help allow the forest at camp and the native species in it to thrive. But we also want to teach campers about invasive species, what they are, and how they can help manage them. In this lesson plan, we have made some compromises. We have simplified how to pull these plants, and in some cases used less than perfect methods, so that campers can participate and learn from the experience.

## **How**

Prepare for your lesson ahead of time by:

1. Booking the Invasive Species Management supplies in the Program Binder.
2. Visiting the 'Broom and Holly Pulling Binder' before the lesson to pick an area to visit and pull in.
3. Collecting the Invasive Species Management supplies from the cabinet on the porch of the office before the lesson.
4. Talking to your campers about what you're going to be doing so they can be excited about it!

5. Thinking about incorporating this into another creative programming or arts and crafts block. There are some suggestions at the end of this section.

Parts of the lesson:

1. Explain what an invasive species is and what a native species is. Ask your campers if they can think of any invasive species. Some examples they might already be familiar other than Scotch broom and English holly are Himalayan blackberry or English ivy (note: invasive species aren't just plants).
2. Explain that invasive species compete with native species for water and sunlight, and that in this way they push out native species.
3. Find an example of Scotch broom and English holly and/or use colour photos in the kit to teach campers how to identify the plants. English holly can be easily confused with Oregon grape so make sure to show them an Oregon grape plant too so they can see the differences.
4. Before you starting pulling and cutting plants, you could tell the Broom origin story or sing a broom song to set the stage and get them excited (below).
- 5a. (Explorer/Pioneer campers; primary school campers) Teach campers that if they find a broom plant smaller than two inches in diameter that's not too hard for them to pull out then they can pull it out, and otherwise they should get a counsellor to come and cut it off with a pair of clippers. Holly plants need to be dug out with all their roots or cut off. If the plant is cut off, it should be marked with flagging tape so that it can be easily found in the future and

re-cut if it re-sprouts.

5b. (Outpost/LD campers; middle school campers and older) Teach campers that if they find a broom plant smaller than two inches in diameter that's not too hard for them to pull out then they can pull it out, and otherwise they should cut it off with a pair of clippers. Holly plants need to be dug out with all their roots or cut off. If the plant is cut off it should be marked with flagging tape so that it can be easily found in the future and re-cut if it re-sprouts.

6. If an area has a very low amount of invasive plant pulled that do not have seeds already, they can be left on site. Otherwise they need to be brought back to camp to be disposed of, as the excessive amounts of drying dead plants provides a forest fire risk. If you aren't sure how much dead plant material is too much, check with the Maintenance Coordinator.

7. Bring the dead plant material back to Linebackers parking lot. Ask the Maintenance Coordinator where they would like it put.

8. If the broom or holly has flowers or seeds on it when you pull it, transport it in garbage bags or wrapped in tarps so the seeds don't disperse as you move them. You can borrow some wheelbarrows from the shop to move the material if there is too much for you and your campers to carry.

9. Put the Invasive Species Kit back, and keep any invasive species material you may need for creative programming or crafts.

## **Invasive species in creative programming! (Peter)**

### Invasive species wreaths

Gather fresh Scotch broom and English holly branches. Take a fairly thick Scotch broom branch and strip away its leaves and wrap it into a circle, twisting and wrapping the branch around itself several times to maintain its shape. You may need to use two or more branches to have it maintain its shape. Once you have a strong circle, attach broom and holly branches with leaves and flowers or berries on them. Tie the branches on with hemp string or fine wire from the Arts and Crafts shack. Once the wreath is filled out, campers can hang them from their bunks or on the door to the cabin. If it has holly branches in it, make sure to hang the wreath in a place where the spikey leaves won't hurt anyone! If the broom has flowers on it and anyone in the cabin has a pollen allergy, you probably shouldn't hang it inside. Make sure the campers don't take the wreaths home (you could spread invasive species back to their yards!) and dispose of the wreath material at the end of the session.

#### Scotch broom fire starter kits

Take some dried broom and fold it into a bundle about the size and shape of your forearm. Take a big handful of dried old man's beard and shape it into a piece the same length as the broom bundle. Using some hemp or other natural string, tie the broom and old man's beard together. You have natural fire starter! When making a fire, place the bundle, broom-side-up, down first, arrange the kindling over top and then light the old man's beard with a match.

Note: old man's beard only works as a fire starter when it is very dry, so if it's raining make sure not to get it wet!

### Make Quidditch Brooms! Or regular brooms!

Take some Scotch broom and tie it to the end of a long stick using rope or hemp string. You now have a broom! You can ride on it like Harry Potter or use it to sweep out the cabin. This could be a good way to tie Scotch broom management into a Harry Potter themed creative program or to get kids excited about cleaning their cabin during Cabin Cleanup Revival. Make sure there aren't any seeds/flowers on the plants you use for this, or you could inadvertently spread invasives all over camp.

### Scotch broom hula skirts

Pull a bunch of Scotch broom, then use tarp ropes to tie it around your waist. You are now wearing a Scotch broom hula skirt! This could be a good way to tie Scotch broom management into a beach themed creative program. Make sure there aren't any seeds/flowers on the plants you use for this, or you could inadvertently spread invasives all over camp.

### **Scotch broom origin story (Peter)**

Many years ago (around 1850) a man named Walter came to Vancouver Island from Scotland. He lived here for a few years, but then got very homesick. He missed Scotland, and especially his favourite plant: Broom! So he ordered some seeds from Hawaii, where he had heard there were some scotch broom plants living. When the seeds came he excitedly planted them and waited for them to grow. To his delight, the

scotch broom did really well on Vancouver Island! The plants quickly grew strong and began flowering and making seeds. But this wasn't enough to cure Walter's homesickness, and he soon moved back home.

But Broom was still here. Broom really liked Vancouver Island: there were lots of sunny and dry spots in the Coastal Douglas Fir ecosystem, and Broom was very happy here for many years. Every year as the flowers came out Broom excitedly called to the bees to come pollinate them. And once that happened and the flowers began to turn into black seed pods, Broom couldn't wait for the seeds to finish growing so they could open up their pods and throw the seeds as far as they could. Broom spread far and wide, making it very happy.

But while Broom was happily taking over Vancouver Island and the rest of Southern BC (and *even* into the United States) the other plants were sad. In some places Broom was so thick that other plants couldn't get enough sunlight or water to grow, and they died. The other plants became very worried that Broom would take over all the forests and there would be no space for the other plants.

So one night the other plants held a meeting. "What should we do?" asked Douglas Fir, "Our seedlings start to grow but can't get enough sunlight under Broom. What will the forest be without us?"

"Let's burn them all!" said Shore Pine, "that'll get them!"

“That’s a terrible idea,” said Oceanspray, “then we’ll all just burn, and the Broom seeds will have an even better chance of taking over once the forest has been disturbed. No, let’s try talking to Broom first.”

The plants agreed to try this first, and Oceanspray went to talk to Broom. When Oceanspray told Broom what all their seeds were doing to the rest of the forest they felt terrible.

“If we could leave we would,” Broom said “ but our roots are holding us in the ground so strong, there’s no way we can pull them out.”

“I know,” said Oceanspray “but maybe we can at least keep the problem from getting worse. Will you stop spreading your seeds?”

“Yes! We will! From now on when the bees pollinate our flowers to turn them into pods we will hold them shut very tight so no seeds get out and there is room in the forest for the rest of the plants.”

When Spring came the next year, and the pods began to form, Broom held them together very tightly. But then, as summer came closer and it became hotter and drier, the pods began to dry out. As the pods dried, the two sides of the pod began to curve, in opposite directions, away from one another. Broom held on very tight, trying to keep

the two sides of its pods together. But after a few days the pressure was too much and the two sides of the first pod split apart and burst open, sending a loud cracking sound into the air and throwing the seeds just as far as when Broom had thrown them on purpose.

One after another each of Broom's pods split open as they dried. Broom felt terrible. It knew that each seed was one more step towards completely taking over the forest floor, but it couldn't do anything to stop it.

Today, if you walk through a patch of broom on a hot and dry day you can sometimes still hear a cracking sound as a broom seed pod bursts open. When you hear this, it's a sign that Broom is still trying its best not to be an invasive plant.

And that's where we come in. It's not Broom's fault that it was brought to BC and that it's really good at growing here. It's just doing what it evolved to do: grow and make seeds! So it's our job to help protect the other plants in the forest, just like Broom was trying to do but couldn't.

### **Broom Song**

Tune: "Can't touch this" by MC Hammer

*"Do the Broom dance!  
Danana Na Na, Na Na  
Can't Pull this!  
Danana Na Na, Na Na  
Can't Pull this!"*

While singing this song, you can do the broom dance:

1. Plant your feet firmly in the ground, like broom roots
2. Put your arms right up in the air above your head, and spread your fingers apart and wiggle them
3. Sway back and forth to the beat of Na Na's.

This could be used as an energizer before going out into the forest to find broom!

## Appendix F- Educational Signage

Name

English holly



What is it?

English holly is a highly invasive species in ecosystems on Vancouver Island. Invasive species is a term used to describe a plant that is not native and has negative effects on the economy and environment. English holly is native to western and southern Europe, northwest Africa and southwest Asia.

How to identify it

English holly can be identified by its broad, dark green leaves that often have a waxy appearance. These leaves are also very pointy and sharp. The fruit of the English holly is bright red in colour. Cutting English holly and digging the root system out of the ground helps to prevent it from growing.

English holly picture retrieved from google images.  
Information on English holly retrieved from Environment Yukon.

Name

Scotch broom

What is it?

Scotch broom is a highly invasive species in ecosystems on Vancouver Island. Invasive species is a term used to describe a plant that is not native and has negative effects on the economy and environment. Scotch broom is native to western and central Europe and was introduced to Vancouver Island in 1850.

How to identify it

Scotch broom can be identified by its bright yellow flowers that bloom in spring and summer. Scotch broom can be pulled by using a weed wrench or manually. Scotch broom may also be cut to avoid it from seeding.



Scotch broom picture retrieved from Google images.  
Scotch broom information retrieved from Environment Yukon.

## Group Member Contributions

Jody contributed to the project in a number of ways, including research, writing, editing, and creating figures. Portions of the report that she wrote include: the budget and timeline (aided by research done by Nikki and Annette), this also includes the timeline table. She also wrote the methods and monitoring sections of the report including the introduction to camp thunderbird, the ecological assessment which consists of all the maps within the report, and tables that relate to the survey done of Camp Thunderbird (both the 2013 version, and for future) and also conducted background research on Scotch Broom. The section on threats posed by invasive species was also written by Jody. In addition she helped with general editing tasks and collaborated with the group in writing and editing the final version of the report, and took the photo found on the title page.

Annette: I contributed to the project by going to Camp Thunderbird and surveying for Scotch broom and English holly. Nikki and I took notes about which areas had been effected by either Scotch broom or English holly. I also helped edit the document, find references for missing sources, made the educational signage that will be used for adults as well as the children at Camp Thunderbird. I collaborated with Izaiah to work on the introduction. I collaborated with Jody and Nikki to help work on the budget. I also collaborated with Jody to help her with invasive species and Appendix 1. I also did site assessment and conclusion. Izaiah helped me with site assessment. I also did the research for the sections I wrote or helped write.

Nikki: I contributed to the following sections: Abstract, Goals and Objectives, Scotch broom profile, Invasive Species Management Plan (8.1, 8.2, & 8.4), Budget, and Challenges. I spent a lot of time editing throughout the semester and formatted the final paper.

I contributed to the project in a number of ways, including going to Camp Thunderbird and doing an inventory of Scotch broom and English holly. I wrote detailed notes and scaled them onto a map from 0-3. I collaborated with the group to come up with goals and objectives. I also did hours (approximately 8+) of research on information on Scotch broom, consisting of history, control measures, and best practices on how to remove it (the Scotch broom profile). I also researched and wrote about the invasive species observed, best practices for removal of broom, and disposal of broom. I wrote all of the information on Scotch broom. Furthermore, I wrote the abstract. I collaborated with Jody and Annette to write the budget, however I called ReFuse for exact costs and researched prices of clippers and gloves. I also wrote the challenges that we were posed with. I collaborated with the group to write and edit the final paper. On the final day I spent 5 hours editing and formatting the final project.

Izaiah: I contributed to the project by researching the ecology of southern Vancouver Island for “ecological conditions”. I took detailed notes during the extensive camp survey with Peter and researched CRD reports to write the “site description” (certain parts of these were moved to other sections because of relevance). I also wrote the “History of Invasive species management”, “Vision statement”, and “Adaptive Management for Educational Program”. I collaborated with Annette to write the “Introduction” and partnered with Peter to “Identifying stakeholders” and “Implementing Invasive Species Education”. Finally I helped edit, source and format many other aspects of the final paper. I also made the “How to use this guide” section of the site survey and monitoring plan.

### Peter

I contributed to the writing of the following sections: Introduction, Vision Statement, Ecological Conditions, Extent of Invasive Species at Camp Thunderbird, Stakeholders and all sub-sections, Invasive Species Present, Invasive Species Plant Removal, History of Invasive Species Management in Area, Adaptive Management for Education Program, Timeline and Conclusion.

I wrote the following sections in their entirety: Ethnoecology, History of Human Disturbance, English holly profile, English Holly Removal Best Practices, Invasive Species Plant Removal, Implementing Invasive Species Removal, Implementing Invasive Species Education (including Appendix E, the lesson plan, games, stories and song), Monitoring and Adaptive Management for Ecological Restoration, and Human Resources.

In addition I participated in the site survey and invasive species inventory visit to Camp Thunderbird, took the photographs on that visit, coordinated all communication with Camp Thunderbird staff, performed all the English holly related research, took part in group brainstorming to develop the goals and objectives, and spent approximately 12 hours revising, editing, formatting and producing the final version of the project in the final 3 days.