# Western Bluebird Nesting Box Project

Shannon Breen, Morag Keegan-Henry, Cortney Fraser, Jessie Bell & Misha Warbanski

University of Victoria

(Klinkenberg, 2011)

A Restoration Project for ES 341
Ecological Restoration
Dr. Eric Higgs

November 26, 2013

# Table of Contents

# Introduction

Garry Oak ecosystems have been devastated by urbanization and other landscape conversions. Interest in restoring this endangered habitat has grown because of its historic importance to First Nation communities, as well as its contribution to west coast biodiversity. Western bluebirds were common in this ecosystem through the 1950, but were extirpated from Vancouver Island by 1995. The University of Victoria (UVic) is making efforts to recover Garry Oak meadows on campus, with ongoing planning for the Alumni Meadow although formal agreements are not yet in place. A large institution with ample green space, the UVic community has a unique opportunity to assist the recovery of the Western bluebird by considering its needs in the context of campus planning, as well as by taking a leading role in informing public policy on urban planning and ecological integrity. The official campus plan expired in 2013 and is currently being revised. This will set the trajectory for institutional priorities into the future. The recovery of a Western bluebird breeding population may seem a distant reality, but, given the nature of planning, it is imperative that future habitat needs of the iconic bird be considered now. This report therefore aims to identify the possibilities for Western bluebird recovery on campus in a user-friendly document that can apply to a range of small-scale habitat improvement projects.

This is an opportunity to reimagine the relationship between human and natural communities and to help to secure the future of an important avian insectivore. Avian insectivore populations have declined by 50 percent since the 1970s (North American Bird Conservation Initative, 2012), which has cascading effects throughout the entire food web. A lack of birds can lead to insect infestations, which can lead to the damage of forests and agricultural crops with severe economic impacts. Therefore, insectivorous birds such as the bluebird improve ecosystem function and ecosystem services. Furthermore, the bluebird is culturally associated with the Garry Oak ecosystem. The restoration of the Western bluebird may contribute to the ongoing restoration of Garry Oak ecosystems in the southern Vancouver Island area. Bluebirds are still irregular visitors to the Greater Victoria area (Klinkenberg, 2012); therefore, we believe that, with continued habitat improvement efforts, bluebirds are likely to return.

**The Challenge:**
Improve habitat quality on the University of Victoria Campus so that it is hospitable to Western bluebirds, and establish a long-term commitment from stakeholders in Victoria to ensure the future success of this initiative.

## Background Information

Western bluebirds live at the edges of woods and in open woodlands, such as those found in a Garry Oak ecosystem. Garry Oak ecosystems are among the rarest ecosystems in Canada, and the areas that they occupy continue to decline (GOERT, 2011). This current status of Garry Oak ecosystems in Canada results from habitat loss, habitat fragmentation, and habitat degradation (GOERT, 2011). Garry Oak Meadows occur in patches within the Coastal Douglas-Fir biogeoclimatic zone as a result of climatic, edaphic, and cultural factors (GOERT, 2011). Significant losses of these ecosystems have occurred because of agricultural and urban development (GOERT, 2011). The understories of these rock outcrop communities now often contain an extensive cover of invasive alien species such as Scotch Broom, agronomic grasses, and other weeds.

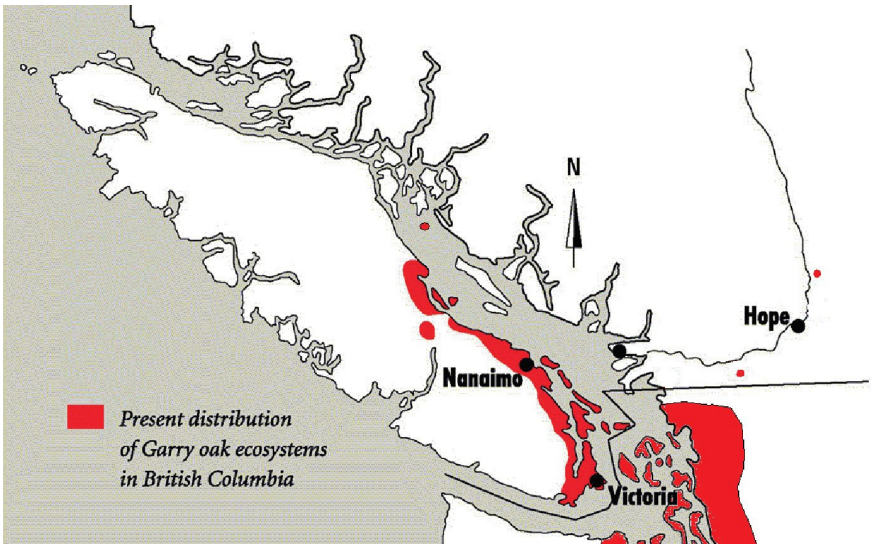



Figure 1: Map of Present Distribution of Gary Oak Ecosystems in British Columbia (GOERT 2011)

### *Site Description*

All sites for this restoration project are located on the UVic campus, on southern Vancouver Island, British Columbia, within the Saanich and Oak Bay municipalities. This area experiences a moderate climate with mild, wet winters and hot, dry summers.

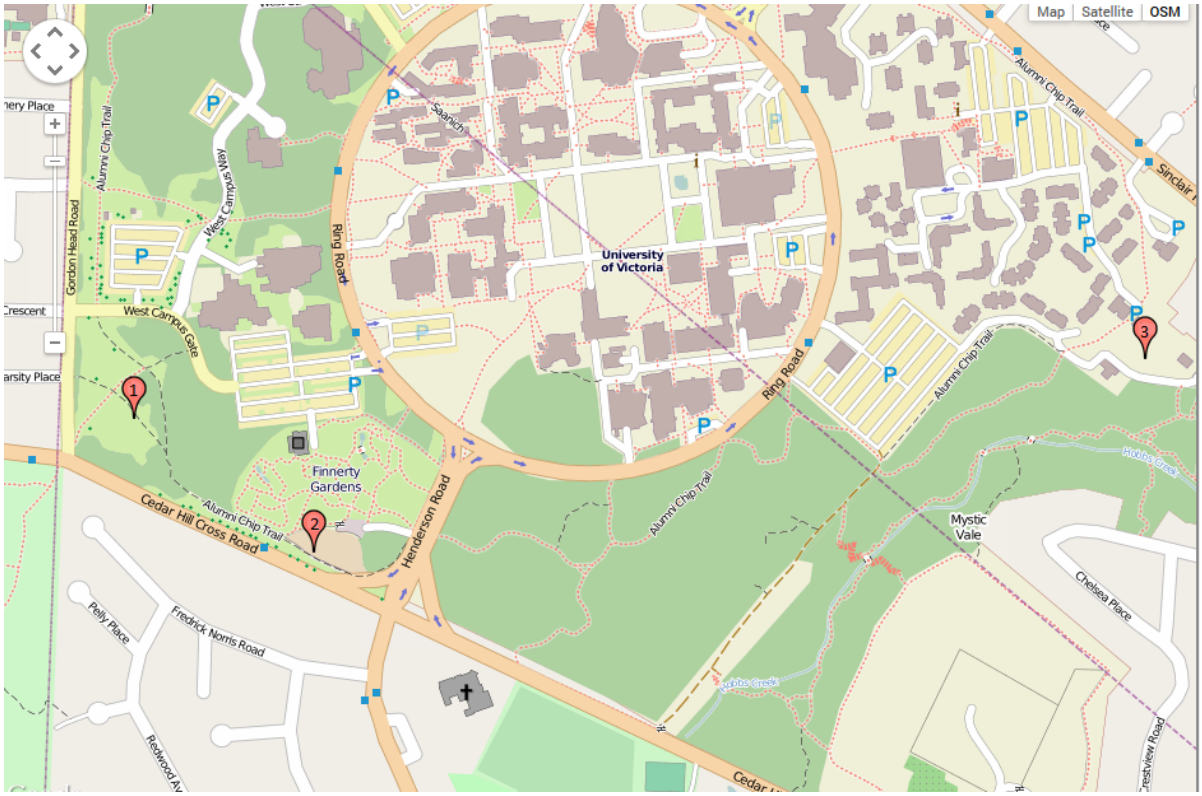



Figure 2: Map of Site locations 1, 2, & 3

**Site Surveys**

*Plants of the Pacific Northwest Coast* was used to identify plants in site survey (Pojar & Mackinnon 2004)

1st Site Survey – SW UVic Garry Oak Meadow

Wednesday October 9, 2013. 10 a.m.

Weather – Sunny ~ 12$^{o}$

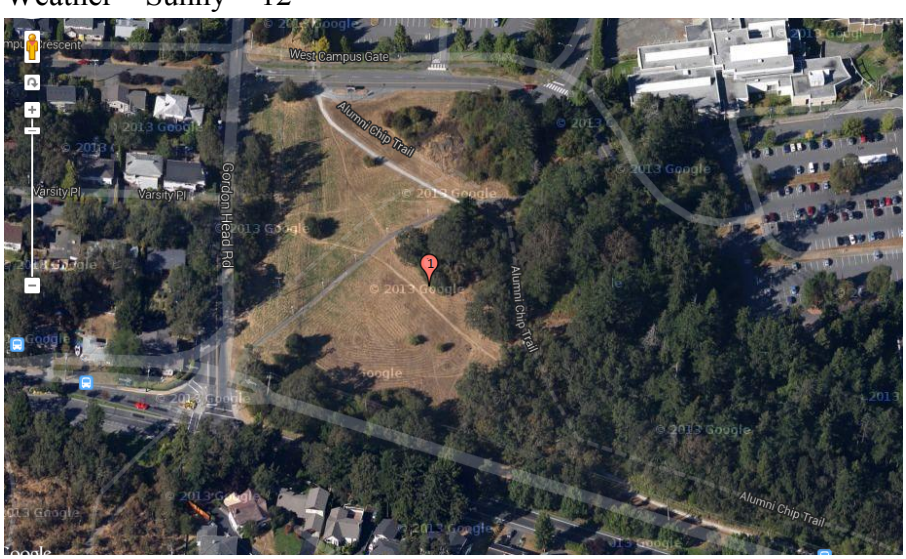



Figure 3: Map of Site 1 - SW UVic Garry Oak Meadow

Table 1: Plant Species List of SW UVic Garry Oak Meadow

| Common Name | Latin Name |
|---|---|
| Bracken Fern | *Pteridium aquilinum* |
| Big Leafed Maple | *Acer macrophyllum* |
| Daphne* | *Daphne laureola* |
| Douglas Fir | *Pseudotsuga menziesii,* |
| English Hawthorn* | *Crataegus laevigata* |
| English Holly* | *Ilex aquifolium* |
| English Ivy* | *Hedera helix* |
| Garry Oak | *Quercus garryana* |
| Himalayan Blackberry* | *Rubus armeniacus* |
| Indian Plum | *Oemleria cerasiformis* |
| Kentucky bluegrass | *Poa pratensis* |
| Nootka Rose | *Rosa nutkana* |
| Orchard grass | *Dactylis glomerata* |
| Red Hawthorn | *Crataegus mollis* |
| Red-osier Dogwood | *Cornus stolonifera* |
| Scotch Broom* | *Cytisus scoparius* |
| Snowberry | *Symphoricarpos albus* |
| Sweet vernal grass | *Anthoxanthum odoratum* |
| Trailing Blackberry | *Rubus ursinus* |

* Introduced or Invasive

Figure 4 : Photo of Site 1 – SW Corner of UVic

2nd Site Survey – UVic Alumi Garry Oak Meadow
Wednesday October 9, 2013. 1 p.m.
Weather – Sunny ~ 15°

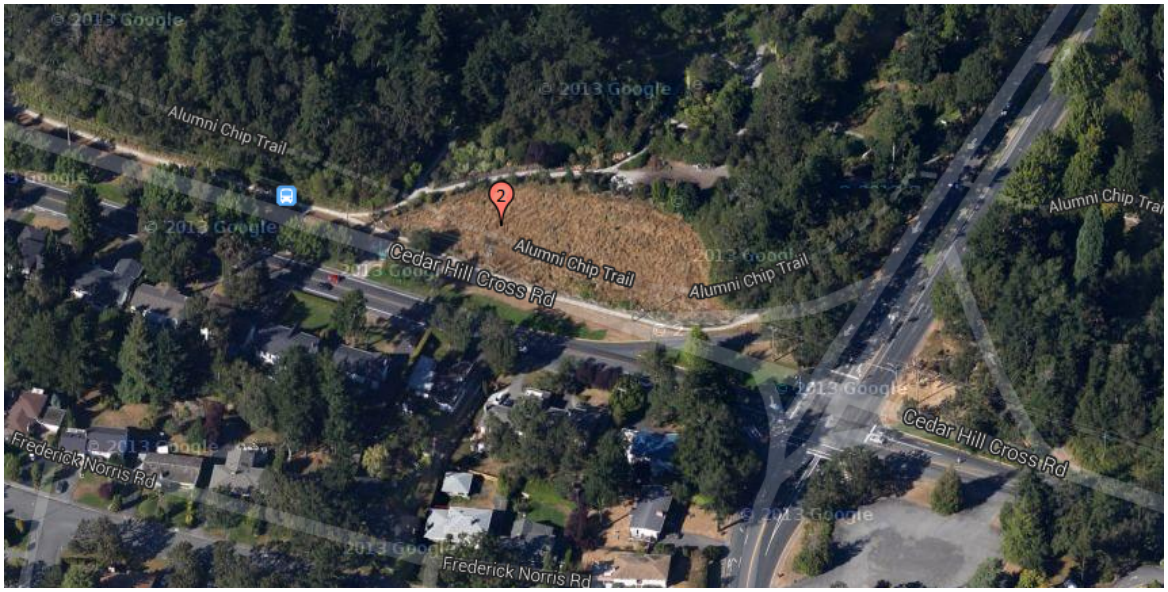



Figure 5 : Map of Site 2 - Alumni Garry Oak Meadow

3rd Site Survey – Space behind Undergrad House 4 (UH4)
Wednesday October 9, 2013. 2 p.m.
Weather – Sunny ~ 15°


Figure 6: Map of Site 3 – Behind UH4

Table 2: Plant Species List of UH4 site

| **Common Name** | **Latin Name** |
|---|---|
| Bracken Fern | *Pteridium aquilinum* |
| Big Leafed Maple | *Acer macrophyllum* |
| Douglas Fir | *Pseudotsuga menziesii,* |
| English Holly* | *Ilex aquifolium* |
| Himalayan Blackberry* | *Rubus armeniacus* |
| Snowberry | *Symphoricarpos albus* |
| Oceanspray | *Holodiscus discolor* |

*Introduced or Invasive

**Reference Ecosystem**

When planning a restoration project it is important to use a reference site. (National Parks Directorate, 2008, p. 59) It is especially important to use a reference site because many invasive alien plant species dominate Garry Oak ecosystems (GOERT, 2011). The Garry Oak Meadow at the Cowichan Garry Oak Preserve (CGOP) is situated 6 km east of Duncan, BC and has been the focus of intensive restoration since the late 1990s (GOERT, 2013). We chose the CGOP as our reference site because it is one of the most intact Garry oak woodland meadows on Vancouver Island (GOERT, 2013).

**Site History and Related Disturbances**

The planned restoration sites are located on the southwest and southeast corners of the UVic campus. The UVic campus lies in the traditional territory of the Lekwungen or Songhees Nation. These peoples played an important role in managing the landscape through traditional land management practices such as burning and the selective harvesting of root vegetables such as camas (Hague, Fehr, Griffin, Chaboyer & Gomes, 2009). In 1858, the campus lands were acquired by the Hudson's Bay Company and traditional land management practices were replaced by more domesticated techniques of farming. Since then this area has been seeded with agronomic grass species and was used for hay (Hague *et al.,* 2009). The greatest impact on Garry Oak Ecosystems has been development, habitat fragmentation, invasive species and the discontinuation of traditional management practices (GOERT, 2011).

In May 2003, UVic's campus plan included a 10-year moratorium on any development in natural areas outside of Ring Road including Sites 1 and 2. However, Site 3 is outside the zone of protection (UVic, 2004, p. 1). Discussions for a new campus plan are set to begin fall of 2014. Students have already started to actively gather new ideas around sustainability and are hoping to ensure the current areas under the moratorium become permanently protected (Theissen, 2013).

Table 3: Common Native Plant Tree and Shrub Species in Garry Oak Ecosystem and Native Species found at Sites 1, 2 and 3.

| Native Plant Species | Site 1 | Site 2 | Site 3 |
|---|---|---|---|
| ***Tree Layer*** | | | |
| Garry Oak | X | X | |
| Douglas Fir | X | X | X |
| ***Shrub Layer*** | | | |
| Common Snowberry | X | | X |
| Indian Plum | X | | |
| Nootka Rose | X | | |
| Oceanspray | | | X |
| Tall Oregon Grape | X | | |
| Western Trumpet | X | | |

**Novel Ecosystems**

Novel Ecosystems are ecosystems that develop from a historical ecosystem due to disturbance. This disturbance causes changes in species composition. As the composition of the ecosystem changes, so does the function of the ecosystem. When the function and/or composition of the ecosystem is no longer the same as the historical and cannot be completely restored, it is now considered a novel ecosystem (Hobbs, Higgs, & Harris, 2009). After human caused disturbances, in particular, the influence of agricultural farming practices combined with the introduction of exotic species have greatly impacted the composition of the Garry Oak ecosystem on UVic campus. This ecosystem has retained characteristics of the historic system but its composition or function now lies outside the historic range (Hobbs *et al.,* 2009). The Garry Oak Meadow located on the UVic campus is considered a novel ecosystem.

**Site Improvements**

Site improvements for the Garry Oak Ecosystems on the UVic campus should include the removal and control of invasive species, planting of native plant species to improve habitat quality, and the assessment and maintenance of wildlife trees on campus. Invasive species of concern are English Ivy, English Hawthorn, Scotch Broom, and Agronomic grasses.

Performing a prescribed burn on the site would remove most unwanted grasses and allow for suitable growing conditions for Common Camas and Great Camas. Due to the surrounding houses of the site location, however, there are concerns of fire safety, and thus this is not permitted by the fire department.

Figure 7 : Invasives at site 1 – Agronomic grasses , English Hawthorn, and Scotch Broom

Figure 8: A Potential Wildlife tree, UVic SW Garry Oak Meadow

Allowing the grasses to grow without mowing would allow for a better habitat for the Western bluebirds. However this may be a point of contention with neighbours due to increased pollen, a common allergen.

In order for UVic to better house Western bluebirds, more nesting spots must become available. With the addition of bluebird boxes, UVic must also keep and maintain Wildlife tree availability for these birds to use. A wildlife tree is any standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife (Wildlife Tree Committee of British Columbia, 2001).

## *Species Profile*

The majestic Western bluebird (*Sialia mexicana)* is a member of the thrush family, known for its one-noted song that can usually be heard at dawn (Alderfe, 2006). The male is an uncommon royal blue with small patches of a rusty red on its chest and back, whereas the female has more greyish tones with a lighter orange chest and a white ring around her eye (GOERT, 2003). The bird is considered to be medium-small, as it measures approximately 6 ½ - 7" in length (GOERT, 2003). After one year they reach maturity and are able to reproduce in the May to July breeding season (Dickinson, Kraaijeveld & Kraaijeveld, 2000). Western bluebirds maintain long-term pair bonds and although some do partake in extrapair breeding, they are co-operative breeders and share equally in bi-parental care of juveniles (Dickinson *et al*., 2000). Western bluebirds tend to nest no closer than 90m apart, with each pair incubating approximately 5-6 eggs (Beauchesne, Chytyk & Cooper, 2002). Juveniles are heavily spotted with white coloring on their back and dark brown on their chest and some slight grey tones on the edges of the tertials (Alderfe, 2006). It can take up to 9 weeks after the eggs are laid for juveniles to be completely independent from their parents (Beauchesne *et al*., 2002).

The Western bluebird's traditional habitat stretched from Southwestern Canada to Northern Mexico (Alderfe, 2006). Including historic breeding sites throughout the Georgia Depression (See Figure 9) (Beauchesne *et al*. 2002). Conservation groups such as GOERT (2011) report the bird was extirpated from Vancouver Island by mid 1990s, and as of 2010 the Georgia Depression population is red-listed by the Ministry of Environment (B.C. Conservation Data Centre, 2013). But, due to recovery efforts through GOERT hopefully the next analysis will result with this sub-population joining other Western bluebird populations as yellow listed; moving status from extirpated, endangered, or threatened to apparently secure (Ministry of Environment, 2013). Depending on the region of residence some will migrate short distances and others may be year round residents. They are second-cavity-nesters and breed in semi-open habitats, such as Garry Oak and Ponderosa Pine Ecosystems, farms, pastures, and burned or logged forests, which include low perches allowing easy access the understory for hunting insects (Kozma & Kroll, 2010, p. 87). These habitats are located within the Georgia Depression, anywhere between 30-600 meters in elevation (GOERT, 2003). Adults consume mostly larvae but when taking care of nestlings their food patterns change and can also include other insects, fruits, and seeds (Herlugson, 1983). When hunting, Western bluebirds mainly hover in a stationary position 1-10

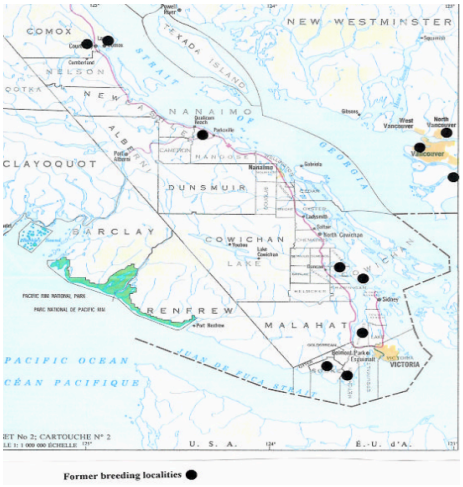



Figure 9: Map of former breeding locations, (Alderfe, 2006)

meters above the ground until prey is spotted, they then fly to the ground to try and capture it. This is a continual sequence called the hover-foraging method (Herlugson, 1983, p. 58). However, other hunting methods have been witnessed, such as gleaning insects from vegetation and the pursuit of prey along the ground (GOERT, 2003).

## *Threats*

Threats to Western bluebirds on the UVic campus include predation, competition (for food and for habitat), a lack of food, cold weather, chemicals, windows, human disturbances, and loud noises.

Predators of the Western bluebird present on Vancouver Island include Cooper's Hawk (*Accipiter cooperii*), cats (*Felis catus*), raccoons (*Procyon lotor*), grey squirrels (*Sciurus carolinensis*) garter snakes (*Thamnophis sirtalis*), Virginia opossums (*Didelphis virginiana*), ermine (*Mustela ermine*), Northwestern crows (*Corvus caurinus*), common ravens (*Corvus corax*) and house sparrows (*Passer domesticus*) (Wightman, 2009, p. 249; Slater & Altman, 2011, p. 228). Predation is a problem for both young and adult birds, but it is the main cause of death for nestlings (Sullivan, 1989, p. 275).

One of the most serious threats to Western bluebirds comes from domesticated and feral cats. In an experiment on San Juan Island, house cats killed at least one breeding female, and many sources emphasize the risk to both adults and young of a significant population of cats (Slater & Altman 2011, p. 28; Beauchesne *et al.*, 2002, p. ii, 13). Beauchesne *et al.* (2002, p.13) suggest implementing an active program to control the population of feral cats in association with the Society for the Prevention of Cruelty to Animals (SPCA). However, this may have significant public opposition, and does not deal with the problem of domestic cats. Our suggested solution is to place the nest boxes on poles that are at least 6 feet in the air, so that domestic cats cannot jump high enough to reach them. If this proves insufficient, we will place predator guards around the poles so that they cannot be climbed (Beauchesne *et al.*, 2002, p. 13; Bluebirds of San Diego County, n.d.; Shaw Creek Bird Supply, 2003). These actions will also help to address the threat from raccoons, snakes, opossums, squirrels, and ermine.

The threats to adult bluebirds from hawks, crows, and ravens are less easily addressed. Short of reducing the population of these species, many of which are valued by the public, there is very little we can do except ensure that there is plenty of scrub in which the bluebirds can hide.

House sparrows are another serious threat, both breaking eggs and killing adult females in the San Juan case (Slater & Altman, 2011, p. 228). One way to minimize house sparrow attacks is to set up sparrow spookers. More active management, such as removal of sparrow nests and trapping of adult sparrows, has also been suggested by a variety of sources, but falls outside of this project's scope (Bluebirds of San Diego County, n.d; Bet, 2013). A third management option is to place nest boxes farther away from houses, where house sparrows are less likely to be a problem (Slater & Altman, 2011, p. 229). Our locations have thus been chosen to, insofar as possible, avoid possible problem areas. Given that English sparrows are a

naturalized alien species, however, resource intensive management efforts are not likely to be successful.

A final management option for predators is to build large aviaries to protect bluebirds from predators until they have started breeding. This approach was undertaken at the start of the San Juan project and in the Vancouver Island project. They later found that attempting to skip this step led to greatly increased losses due to predation (Slater & Altman, 2011, p. 229). Due to budgetary and equipment restraints, this project will focus on improving survivorship by improving habitat quality in order to offset mortality from predators, rather than on measures such as this.

The second major threat to Western bluebirds lies in competition for habitat and for food. "Bluebirds that experience aggressive contests over a nest box may leave an area altogether rather than stay in what they perceive to be a suboptimal location" (Wetzel & Krupa, 2013, p. 405). Bluebirds are secondary cavity nesters, and potentially compete with five other species of birds: house wrens, Bewick's wrens, violet-green swallows, European starlings, and house sparrows. House wrens have not been observed on campus, and have only rarely been observed in the Victoria area; therefore, they are not a serious threat (Harrop-Archibald, 2007, p. 70; Victoria Natural History Society (VNHS), 2008). Bewick's Wren is not aggressive in nesting behavior, and at least one study argues that "the habitat characteristics of bluebirds and Bewick's wrens are different" (Pogue & Carter 1995, p. 172). Violet-Green Swallows are present on campus, and have been observed taking over bluebird nests when acting in large groups (Harrop-Archibald, 2007, p. 70; Brawn, 1990, p. 606). Thus, they pose a measurable threat to bluebirds when there is a lack of habitat. However, with the addition of sufficient nest boxes that the swallows also have habitat, we can avoid the two species being in competition. Violet-green swallows have also been observed cooperating with Western bluebirds to feed bluebird young and defend the nests from other birds in situations where the original swallow nests fail, so they may actually prove to be an asset in protecting Western bluebirds (Eltzroth & Robinson, 1984, p. 259-261). Violet-green swallows may therefore also be an important bird protected and enhanced by our project. European starlings are a major source of competition, and are possibly responsible for the decline of Western bluebirds in central Washington (Kozma & Kroll, 2010). They are present on campus in large numbers (Harrop-Archibald 2007, p. 70). Building our nest boxes with 1 ½ inch entrance holes will help to limit the ability of starlings to take over nests (Prescott Bluebird Recovery Project, 2002). Both house sparrows and European starlings are invasive species, so active management approaches involving trapping and removing nests may be indicated in future stages of this project, despite the possible public relations problem. "Sparrow spookers," a device which involves strips of material (usually mylar) which flutter in the wind and scare away sparrows, could also help to avoid competition and predation from house sparrows, if this becomes a future problem (Bet, 2013). If bluebirds return but do not nest due to competition from these other birds, we may have to move nest boxes at least 60 metres away from the edge of the meadow (GOERT, 2012, p. 1)

Food shortages can arise from competition over scarce resources, but also as a result of limited habitat. This is another major limiting factor in the ability of Western bluebirds to thrive (Yackel Adams, Skagen, & Savidge, 2006). Food competitors present on campus in large numbers include Violet-green swallows, tree swallows, red-breasted nuthatches and chestnut-capped chickadees (Beauchesne *et al.*, 2002, p. 11; Harrop-Archibald, 2007, p. 70). This could be interpreted in two ways. First, the presence of these birds implies that there is a sufficient food supply to sustain the Western bluebirds. On the other hand, established competitor populations may out-compete bluebirds for foraging opportunities. One solution to this problem is to provide mealworms to supplement the diet of the birds (Slater & Altman, 2011). This is particularly crucial when the young are juveniles, as the point when adult birds stop feeding their young is the time when most juveniles starve (Sullivan, 1989, p. 275).

Another major threat to Western bluebirds is cold weather. At least three studies have found that excessively cold weather has been a contributing factor to decreasing populations of songbirds in various areas (Wetzel & Krupa, 2013; Slater & Altman, 2011; Sullivan, 1989). This is partly due to the sensitivity of nestlings to exposure to cold, which can be solved by ensuring that our nest boxes face away from prevailing winds (McLochlin, 2007). However, it is also due to a lack of food. While the young are still nestlings, in cold weather, the adults lose the ability to forage as effectively because insects may become inactive, and this can lead to nestling death (Beauchesne *et al.*, 2002, p.7). Similarly, during storms, juveniles can find themselves unable to forage effectively enough to avoid starvation (Sullivan, 1989, p. 283). Thus, an effective ongoing management plan will include supplying extra food during periods of bad weather in order to reduce mortality rates. This plan includes provisions to supply mealworms during the entirety of the nesting season, in order to maximize bluebird survival.

Pesticide use is problematic for reintroducing bluebirds, as "the use of pesticides may also have contributed to declines [in bluebird populations] in coastal areas" (Beauchesne *et al.*, 2002, p.iii). Grounds management has used Safer Soap, Glyphosate, Resmethrin, Trillium, and Malithion within the last ten years (Office of Campus Planning and Sustainability (OCPS), 2011). While Safer Soap and Glyphosate are both low in toxicity to birds and wildlife, Resmethrin and Malithion are both moderately toxic (College of Agricultural Sciences, 2013; Extension Toxicology Network, 1993).

Table 4: Pesticide use on campus 2006-2010 (OCPS, 2011)

| Pesticide | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| **Safer Soap** | - | 50ml | 225ml | 500ml | 900ml |
| **Glyphosate** | 2.35L | 2.9L | 4.3L | 3.5L | 2.8L |
| **Resmethrin (Bug-be-Gone wasp spray)** | 360gm | 2150gm | 2800gm | 3400gm | 1700gm |
| **Trillium** | - | 0.795L | 2.100L | - | - |
| **Safer Slug bait** | 2Kg | 500gm | - | - | - |
| **Malithion** | - | 750ml | - | - | - |

*Chart3. Pesticides used by grounds staff on campus from 2006 to 2010. The university integrated pest management approach minimizes non-essential use of pesticides.*

However, as this table shows, UVic is making a concerted effort to reduce pesticide use and to ensure that the pesticides that are used are as safe as possible (OCSP, n.d.). The goal in the campus plan is to "Eliminate toxic chemicals from routine landscape management by 2012," (UVic, 2009) and while this has not been achieved, they continue to attempt zero pesticide use (OCSP, n.d.). Therefore, while some minor amounts of toxic chemicals are being used on the grounds, it is unlikely that these quantities will prove any more dangerous to the birds than the amounts used anywhere else.

Another major threat to bird populations is the presence of windows. One source argues that unintentional killings through windows represent "the largest human-associated source of avian mortality except habitat destruction" (Klem, 2009, p. 314). Last February, an undergrad student pointed out the dangers of the large numbers of windows on the University of Victoria campus for a variety of bird species. She proposed that the most strike-heavy windows be covered with a special marker, which looks like rows of dots on the glass and does not impede the view, but does stop birds from flying into the windows. She was met with resistance from Facilities Management, but it is not clear whether or not there has been any movement towards implementing such a project (Wong & Werman, 2013). Including this solution into our restoration project would greatly increase the scope of this project, but it is something to be kept in mind for future iterations of the project. In the mean time, it seems likely that despite the dangers posed by the many windows on campus, the area where nest boxes are to be placed is distanced enough that they will pose merely an acceptable risk.

Placing the bluebird nest boxes in areas of high human traffic poses a risk that the birds will be too disturbed to nest properly. While site 1 is heavily used, site 2 is fenced off and sees little human disturbance, as does site 3. However, at least one survey has found that while human disturbance causes short-term changes to nesting bird behaviour, there are no long term consequences for the success of the nests (Smith-Castro & Rodewald 2010, p. 130-138). Another source argues that Western bluebirds can "tolerate some human disturbance" (Beauchesne *et al.,* 2002). Thus, while less human disturbance is certainly preferable, our hope is that Western bluebirds will be able to nest in these areas anyway.

A final threat to bluebirds is loud noises. Anthropogenic noise may cause more infertile eggs to be lain, those eggs to develop badly, or increased immune infections in both young and adult birds (Kight, Saha, & Swaddle, 2012). The Garry Oak Meadow is located between two fairly well-used roads, and therefore there is a risk of loud noises affecting our population. On the other hand, these effects are relatively minor in a low-density residential neighbourhood, and thus will not be addressed in this project. The noise issue could be at least partially addressed through habitat improvement efforts in future projects, such as planting more trees and shrubs on the meadow edges, but this is again outside the scope of this project.

Thus, while there are many threats on the UVic campus, including predators, competition for habitat, a lack of food, cold weather, pesticides, windows, human activities, and noise, a

coherent adaptive management plan can address all of these issues in meaningful ways, making this a suitable habitat.

## *Restoration Continuity*

Our nest box plan for UVic builds on progress made by two major species restoration plans for Western bluebirds in the Pacific Northwest; one on Vancouver Island in the Nature Conservancy of Canada's Cowichan Preserve and another in Washington's San Juan Islands.

The San Juan Islands Western bluebird reintroduction plan ran for five years, from 2007 to 2011. The San Juan project prioritized habitat preservation (conserving 376 acres), nest box building, and actively reintroducing breeding pairs from Fort Lewis, Washington. In 2012, the San Juan team reported 13 pairs of nesting adults, as well as increasing numbers of young female birds returning to the area; both signs that the population will become self-sustaining. So far the project has yielded 238 fledglings, along with 38 returning adults, (including the 13 breeding pairs). Project volunteers have installed 600 nest boxes across ten islands (San Juan Preservation Trust, 2013).

GOERT led a similar re-introduction program on Vancouver Island in 2011. These intensive efforts are taking place in an already-protected deep soil Garry Oak meadow. They are also encouraging area residents to consider putting nestboxes in their yards. As of October 2013, the Vancouver Island population includes 14 adults and 31 young. A female from the San Juan population was also spotted, an indication that immigration between the two populations is once again possible (GOERT, 2013).

The Southern tip of Vancouver Island is part of an important bird migration corridor. Crossing the Juan de Fuca strait requires intense energy output. In Metchosin, Rocky Point (owned by the Department of National Defense), is the closest point of land to Washington, and is an important stopover site for resting and feeding. Migration between the recovering bluebird populations has been documented (GOERT, 2013) and is a positive sign, but underscores the need to protect and restore suitable coastal habitat in order to support long-term population resilience and gene flow.

## *Landscape Connectivity*

When GOERT was first looking for suitable areas for Western bluebird reintroduction, the Victoria area was omitted because it was deemed too fragmented for success (GOERT, 2013). While the deep-soil Garry Oak preserve in the Cowichan Valley is believed to meet the immediate needs of the birds, an eye on future range must be considered. This nesting box project represents a short-term goal of improving habitat quality for recovering Western bluebird populations on the UVic campus, but it encompasses a longer-term goal of increasing both the number of suitable habitat patches and their connectivity. It is also an opportunity for people in heavily urbanized Southern Vancouver Island to “re-imagine” the place of nature in human-dominated landscapes (Evans, 2007).

Changes to land use through urbanization, agriculture, logging and other human activities has a profound impact on ecosystem function. It has been identified as a major threat to biodiversity in British Columbia (Biodiversity BC, 2007). Conversion impacts system functions from air purification and pollination to soil structure and hydrology (Biodiversity BC, 2007). Development causes the fragmentation of habitat, reducing the effective area available to native organisms. On Vancouver Island, the Garry Oak bioclimatic zone is considered one of the most threatened (Biodiversity BC, 2007). Considerable conservation effort is ongoing to protect and expand remnant Garry Oak habitat by groups including the Habitat Acquisition Trust, the Garry Oak Ecosystems Recovery Team, Parks Canada (Fort Rodd Hill), with many cooperating local governments. Population theory can help us to understand why habitat connectivity across broad spatial scales is important to species health and should be considered as part of this Western bluebird nest box plan.

Island biogeography theory tells us that larger islands (isolated equally by open ocean, or vast swaths of urban concrete) can support larger populations than smaller islands, while islands closer to a source population will have higher immigration rates than islands that are more isolated (MacArthur & Wilson, 1967). Linking disparate habitat patches helps increase the effective area available organisms, as it facilitates dispersal and gene flow between populations. Wilson's species-area relationship further generalizes that 50 percent loss of area results in a 10 percent population decline (Wilson, 1992). But as area shrinks below 10 percent of its original size, populations undergo precipitous decline towards local extinction. With only 5 percent of intact Garry oak habitat remaining, it is critical to remediate this habitat (GOERT, 2013). Indeed, about one hundred denizens of the Garry Oak ecosystem are considered at risk (GOERT, 2013). The ultimate success of Western bluebird reintroduction will depend on increasing the effective area of suitable habitat.

The probability of a local extinction is positively correlated to habitat isolation (far island), and negatively related to size (small island). There are several strategies to decrease the threat of extinction. In order to increase the carrying capacity of a population, either the size of the habitat or the quality of the habitat must be increased (Baguette, Blanchet, Legrand, Stevens, & Turlure, 2012). The ability to disperse is integral to the fitness. Dispersal is essential to avoid density dependent effects (disease, increased aggression, etc.), and to maintain gene flow. Small populations face increased chances of stochastic environmental or demographic events. Population bottlenecks reduce genetic diversity and cause inbreeding depression. Small, inbred populations are more prone to disease and have reduced fitness (Kareiva & Marvier, 2010).

Critics have cited a "dearth of evidence" that habitat corridors work (Baguette, *et al.*, 2012). But a literature review found wildlife corridors are strategic tools for urban planners and ecologists (Evans, 2007). We recognize that uncertainty exists within this field. This underlines the need for robust monitoring efforts, including an evaluation of baseline data on habitat extent and quality.

Avian populations have the advantage of flight to facilitate dispersal between habitat patches. A single migrant from established San Juan was documented this summer in the

Cowichan valley (GOERT, 2013). Providing new habitat patches for nesting, foraging and stopover may increase dispersal success, both now and in the future.

### *Stakeholders*

In the UVic area, two groups of stakeholders should always be consulted before beginning a project. First, we will contact the University itself, to inform the staff of our proposal and to request input on its viability. Second, we will contact the Songhees First Nation, to make sure that our proposal meets with their approval. Further community consultation will follow to a certain degree.

However, our primary goal here is to blend adaptive management and social learning to provide learning opportunities to the UVic community. In this vein, our stakeholders include local restoration groups, with whom we will attempt to build a network of motivated individuals; UVic students, whom we hope to integrate into our monitoring; UVic faculty, whom we hope to work with to ensure continuity of monitoring; and Gordon Head Elementary staff and faculty, who will play a role in constructing the bird boxes. (See Appendix B for a complete list of stakeholders and their suggested roles in this project.)

**Problem Statement:**
The Western bluebird, formerly an important avian insectivore and secondary cavity nester, has been reintroduced to Vancouver Island, but there is insufficient habitat to support the recovering population. Only 5 percent of the Garry Oak Ecosystem remains intact, and the shortage of habitat will significantly reduce the ability of the bird to recover. Western bluebirds have been observed at Rocky Point, where nest boxes have been installed by GOERT, and at least one individual has moved from the San Juans to Cowichan, which implies that individuals may make use of improved habitat in Victoria for foraging, roosting, and nesting.

## Goals and Objectives

### *Vision*

Encourage migrating and breeding Western bluebirds to return to the UVic area.

### *Goals*

**1) ECOLOGICAL**: Strengthen Garry Oak ecosystem structure and function, through restoration and conservation, in such a way as to provide habitat for the Western bluebird.

**2) ENGAGEMENT:** Build community by providing opportunities for both adults and children to engage with this project, and by connecting with existing restorative efforts to create a network of motivated and engaged contributors.

**3) KNOWLEDGE BASE:** Contribute to scientific knowledge about Western bluebirds, including the effects of habitat connectivity and the effectiveness of restoration projects through ongoing monitoring.

## *Objectives*

**1. Ecological**

1.1 Build 5 paired nesting boxes on campus in time for the spring 2015 nesting season to provide habitat for bluebirds

1.2 Support bluebird foraging success by supplying mealworms on an as-needed basis.

1.3 Propose that sites 1, 2, and 3 be included in the updated campus plan as protected area, as of 2014.

2. **Engagement**

2.1 Engage the community through four annual events revolving around bluebird boxes including elementary school field trips, volunteer events, site cleanups, and nest monitoring

2.2 Create a social media campaign both on and offline by writing articles to be contributed to *BC Nature* Magazine, the GOERT newsletter, the VNHS newsletter, the Restoration Network, the Martlet, Essence and creating a Facebook and Twitter presence.

2.3 Establish a working relationship with GOERT to suggest a partnership and to incorporate their successful strategies into the ongoing project.

2.4 Contact at least 5 other organizations on campus (UVic Sustainability Project (UVSP), Ecological Restoration Volunteer Club, etc.) and set up networks so that their members can participate in projects. Involve each group in at least one event by 2017.

2.5 Set up a link with the Victoria Natural History Society (VNHS) Rare Bird line.

**3. Knowledge Base**

3.1 Ensure ongoing monitoring and public records of the project through 2017.

3.2 Set up an online publicly-accessible database which can be used to record results of the project and to act as a repository for related research on campus restoration planning

3.3 Incorporate Western bluebird / Garry Oak ecosystem biology into university curriculum by securing a commitment from UVic departments (Biology, Environmental Studies, and Restoration of Natural Systems (RNS)) to take on monitoring projects in targeted classes, and advise on curriculum development.

# Restoration Plan

## *Implementation Plan*

1. *Establish UVic Bluebird club.* CommonEnergy UVic has an ongoing call for driven members willing to develop and take on projects. By establishing a committee as part of CommonEnergy, we will establish a project presence on campus and ensure that there is institutional backing. As members of a club under the University of Victoria Student Society (UVSS) umbrella, we will also gain access to in-kind resources such as photocopying, email lists, the CommonEnergy website, meeting space, and their volunteer network. If CommonEnergy is unwilling to collaborate, then we will apply to the UVSS for status as a club. During this step, we will contact at least 5 organizations on campus, including the UVSP and the Ecological Restoration Volunteer Club, in order to create a network of volunteers. We will also contact organizations off campus and ask them to be partners in this endeavor. These organizations will include GOERT and the VHNS, which will allow us to link our efforts to GOERT restoration efforts and to the VHNS Rare Bird contact line.

2. *Establish communication strategy.* We will create a publicly accessible website with an infrastructure which will allow us to compile relevant research and our monitoring data, so that in the long term, our observation data will be available to contribute to longer-term understandings of bluebird habitat use and migration patterns, and to be used in directed studies, honours and masters projects. This website will include a list of key contacts, have an embedded Google Calendar to facilitate coordination of events, and contain a collection of useful form documents, such as a form letter to potential funding sources and a brief summary of key project goals and objectives. We will publish monthly updates on this website and simultaneously on our Facebook and Twitter accounts, to keep the public up to date. We will establish an email address, uvicbluebirds@gmail.com (password: uvicbluebird). We will create educational materials to distribute at events. These materials will include short articles which will be submitted at various stages throughout the project to media sources such as *BC Nature* Magazine, the GOERT newsletter, the VNHS newsletter, the Restoration Network, the *Martlet*, and *Essence*. We will also request that researchers who use our information credit our project and email the official email address, so that we can maintain a list of collaborators. This communication strategy will be updated and expanded throughout the project.

**Data Management Plan**

1) *Creation of a website (publically accessible)*

1.1 Interactive mapping of current bird boxes & bluebird sightings.

1.2 Calendar of scheduled events (public consultations, fundraisers, educational seminars).

1.3 Open forum for discussions about Western bluebirds.

1.4 News section for monthly updates on project status and findings.

1.5 Contact information and details on how to get involved.

1.6 List of stakeholders that are involved and key contacts.

1.7 Database of relevant research, published papers, and useful web links.

1.8 Collection of form documents, including project summary and fundraising letter.

1.9 Articles submitted to other media sources.

1.10 Detailed compilation of observational data from project.

2) *Creation and maintenance of Twitter and Facebook account*; to be updated once a month alongside the website. This will be regular enough to update the public, but irregular enough to not overwhelm our resources.

3. *Contact stakeholders.* Since the three parcels of land have passed through competing visions over the years, we need to develop a coherent, common vision for these spaces to ensure that there is a context into which our project will fit. Therefore, a series of public consultations will take place involving the university, the Songhees First Nation, and other interested parties (see Appendix B). These consultations will take place in concert with planning meetings for the official campus plan, coordinated through the Office of Sustainability and Campus Planning. During this process, we will begin informing the public about the importance of preserving this habitat. Furthermore, we will present our recommendation that this area be preserved in the updated campus plan. To consult with individual stakeholders, we will send out a form email which will give a project overview and solicit input on the project. This email can be distributed through stakeholder networks to increase engagement and opportunities for input. We will follow up with phone and in-person meetings as required.

As this project will be located on the UVic campus, it seems advisable to consult specifically with UVic students. Contacting every student through email is impractical and would require significant support from the university. However, by publishing short articles in The *Martlet* and *Essence* with requests for feedback to be sent to uvicbluebirds@gmail.com, we can receive community feedback with maximum efficiency. Representation during UVSS Clubs Days will improve our physical presence on campus. Through tabling we will raise awareness of

the project, provide an opportunity for students to give us feedback, and increase volunteer recruitment.

This project is sufficiently limited in scope that we will not consult with other potential stakeholders, such as the District of Saanich, the District of Oak Bay, or the UVic Alumni Association, without further indication that such a consultation is necessary.

4. *Site Use Permission*. Personal communication suggests that Campus Facilities Management in principle supports installation of nest boxes on campus. The nest box sites are publicly accessible and no permits are currently required. However, installation must be coordinated with Neal Connelly, director of UVic's Office of Campus Planning and Sustainability. We will contact him at nconn@uvic.ca. The UH4 site is managed by the Environmental Studies department. Therefore, we will contact them directly at esadmin@uvic.ca to ask permission to install boxes in that area.

5. *Develop Education Collaboration*. We will work with UVic departments to integrate the bluebird project into lab activities and embed it into various class curriculums. We will liaise with senior lab instructors to establish standard protocols and objectives. The target courses are listed in Table 5.

Table 5: Class collaboration

| Class | Activty |
|---|---|
| BIOL 329, "Biology of the Vertebrates of British Columbia" | Spring bird survey |
| ES 341, "Ecological Restoration" | Invasive species removal |
| GEO 327 "Research Methods in Human Geography" | Assessment of how the community has accepted the bluebird project. |
| RNS diploma program | Annual habitat site assessment |

(See monitoring section for full details).

6. *Raise money and awareness through "Beer for Birds" event.* We will contact *Felicita's* to arrange an evening where some percentage of cover charge is donated to the bluebird project. At the same time, we will apply for grants from the sources listed in Appendix A.

7. *Site Assessment*. Preliminary site assessment has been carried out, but this work has identified data gaps. There is a need for further baseline data on our target sites before the boxes are installed. These data include a census of wildlife trees and a census of bird species composition. We will coordinate a bird census with the Rocky Point Bird Observatory and/or the Victoria Natural History Society, which will provide a training opportunity for interested volunteers.

Further data on the Garry Oak community structure will be collected through an RNS required field study in the spring of 2014. This plan will then be adapted to fit the new information.

8. *Improve Habitat Quality*. We will coordinate a volunteer event with the Ecological Restoration Volunteer Club (coordinator Lexi Fisher), which already organizes ivy pulls around campus. They will continue the process, begun by ES 341, of removing some of the invasive plant species from the area. Since invasive grasses are the main issue, prescribed burning would be the best approach. However, current fire regulations make this unlikely.

9. *Build the boxes*. We will organize a working bee with Gordon Head Elementary School to engage students in building 5 paired nest boxes, and engage volunteers through the restoration network to work with students in order to ensure simultaneous safety and learning. The field trip will include a presentation on bluebirds, a hike to the site, and the building of boxes. This may need to be a multi-day process, with one day involving an introduction to the birds and the site, and a second day involving the building of the boxes. This will also provide an opportunity to address one of the major threats to the boxes by connecting urban children to the wildlife in their city, thus addressing the risk of vandalism.

The nest boxes are easily assembled. The nest boxes will be the same design as a general bird house. The house will have 4 walls, a floor, and a roof. The front wall will have an entrance hole 1.5 inch in diameter, and one of the side walls will be constructed as a door for the monitoring and cleaning of the nest box. This door will have hinges at the top and will be held shut by a galvanized nail at the bottom. (See Appendix C for full assemblage directions)

10. *Install the boxes*. Through the volunteer network, we will organize a working party to install the 5 paired nest boxes. Pizza will be provided to encourage participation, and we will order 4 medium pizzas from *Palagio*. Nesting bluebirds have a large territory and will not likely nest closer than 90 m apart, but we will install boxes at a higher density and in pairs in order to provide options and to decrease nest box competition from species such as violet-green swallows.

After completing the site analysis, we confirmed that the UVic SW Garry Oak Meadow, Alumni Garry Oak Meadow, and a space behind UH4 areas are appropriate habitats for the Western Bluebird. Therefore we have chosen 5 locations around campus. (See Figure 10)

Table 6: UTM Coordinates of Bluebird Boxes on UVic campus

| **Location** | **UTM Coordinate** |
|---|---|
| **A** | 10 U 0476329 5367644 |
| **B** | 10 U 0476321 5367596 |

| | |
|---|---|
| **C** | 10 U 0476358 5367582 |
| **D** | 10 U 0476581 5367414 |
| **E** | 10 U 0477617 5367651 |

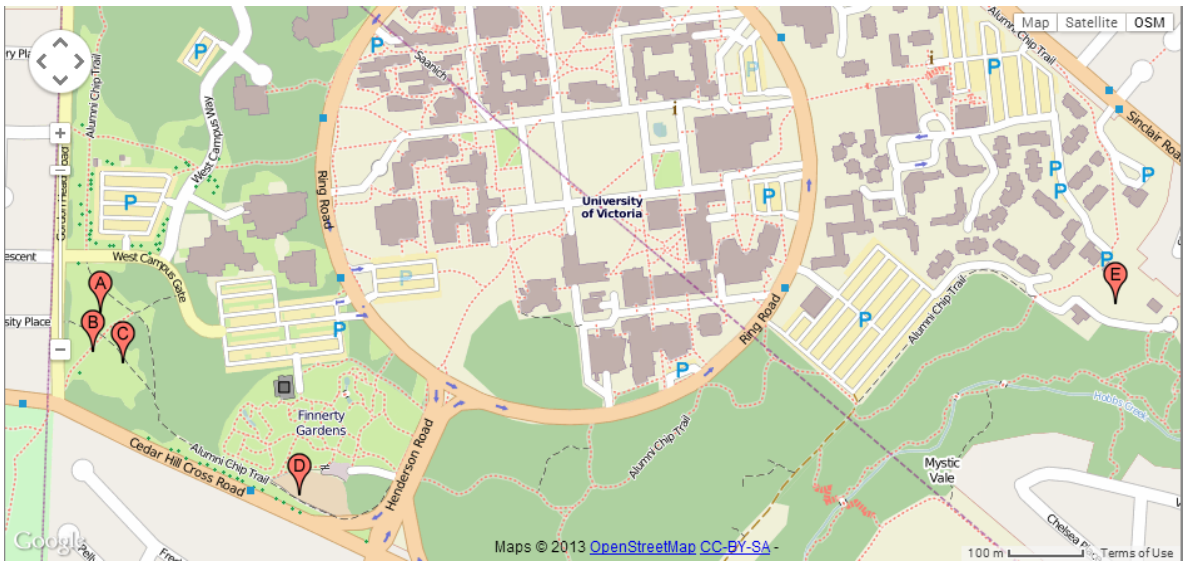



Figure 10: Map of Proposed locations of nest boxes

When attaching the nest box to the tree or pole, it should be placed as low as possible while still excluding cats, raccoons, squirrels, and any other land based predator from the nest box. This will be approximately 5-6 feet (1.5-2 m) above the ground. Prevailing winds and rains must be taken into consideration, so that the nest box is placed facing away from them. It must also be situated in such a way that the monitoring door can easily be opened, and so birds can easily access the front. Ideally a safe perch, in the form of a tree or shrub, will be within 100 feet (30m) of the front of the box for the birds to use.

## *Maintenance Plan*

1. *Before the nesting season:* Volunteers will assess nest boxes for damage and cleanliness, removing debris and making repairs as necessary. They will also remove any inactive nest material from the boxes, but will not interfere with active nesting by any species. This will be facilitated through a single working party organized by the club sometime in February, and volunteers will be encouraged to attend through the provision of Starbucks "Hot Chocolate travellers."

2. *During the nesting season*: Until the first bluebird is sighted, volunteers will make weekly rounds to determine whether bluebirds have arrived. The bluebird diet will need to be

supplemented with daily provision of mealworms once the bluebirds are nesting. Mealworms are to be provided on an as-needed basis every morning during nesting season as well as in the evenings during inclement weather (Slater & Altman, 2011, p. 227). They usually amount to approximately 20 mealworms per individual per day, but the precise amount must be determined by volunteers on the ground so as to avoid leaving excess mealworms for competitors (Slater & Altman, 2011, p. 227). Mealworms should be placed in open areas around the nesting boxes, and then observed to ensure that all are taken. Once bluebirds stop collecting mealworms, the volunteers must collect those remaining. Because of the importance and sensitivity of this task, volunteers will be carefully selected to ensure that they can commit to long term provision of mealworms. This project will continue from the first sighting of nesting bluebirds until 2017.

Medium-sized mealworms will be purchased in bulk from SuperCricket.ca, and stored in volunteers' fridges in order to conserve them between uses. An order is approximately 1,000 worms, and three orders will therefore supply a family of 8 birds for one full nesting season.

## *Ecological Monitoring Plan and Data Collection*

Collection of high quality data can be a challenge for volunteer-driven organizations. We hope to lay down a framework for monitoring with clear goals, easily followed protocols and simple measurements that will minimize training and maximize accuracy of data. We will record this data on our website - see Data Management Plan, above.

**Observational Data Collection**

a) Record presence/absence of individual Western bluebirds and nesting pairs

b) Record clutch size and key development benchmarks (ie: fledging, independent foraging events).

c) Record numbers of mealworms consumed by individuals each day

d) Record weather conditions

e) Record an annual survey of nest box and habitat tree activity, to be carried out by volunteers recruited from Biology Survey of Vertebrates students, or club members each fall. A bird species census will also be conducted at this time.

See Appendix C for the basic data sheet to be carried by volunteers, which will record this information.

**Other Monitoring Recommendations**

a) Bird banding. Banding will require more resources than can reasonably be provided by this project. We will maintain communication with the Rocky Point Bird Observatory (RPBO) and GOERT to update them on sightings. If they are interested in banding, we can help facilitate the project on campus, and volunteers would benefit from training. Banding would allow assessment of bird health and breeding condition, parasite presence/absence, molt patterns and other valuable data.

b) Habitat mapping of natural features ought to be performed every five years to document changes to the community structure over time. However, this is again outside of the scope of this project, although we will provide a database to which to upload the results of this mapping project if any other organization decides to take it on.

**Monitoring Methods**

1) University of Victoria: Classes will, as discussed above, monitor various aspects of this project:

a) RNS diploma program - a habitat site assessment to be carried out annually as one of their mandatory field surveys. The metrics on site conditions will include soil samples, tree diameter at breast height (DBH), and comparison to reference site. Reports will be uploaded to the project database and will be used to assess changes to the habitat/community over time.

b) BIOL 329, "Biology of the Vertebrates of British Columbia" – spring bird survey. We will establish a standardized walking route for point counts. Each laboratory section will complete a point count over the course of the spring semester. Data on species presence/absence will be tabulated and uploaded to the project database.

c) ES 341, "Ecological Restoration" – invasive species removal. Continued effort to maintain control of invasive species, including ivy, hawthorne, and holly.

d) GEO 327 "Research Methods in Human Geography"- Assess how the community accepts the bluebird projects and how engaged the community has become in the project.

2) Volunteer monitoring: After bluebirds nest, daily nest rounds will be carried out by dedicated volunteers. These volunteers will each be assigned a site, and three volunteers will go out each day to each investigate one area, so that a full walking tour of the 3 sites will only take 20 minutes of commitment per person. If birds are present, they will fill out a data sheet on the location and number of bluebirds seen or heard, and status of eggs and/or chicks. (See Appendix D for a sample form) These volunteers will be provided with clipboards, paper protectors for rainy days, and pencils. We will store the sampling clipboard and extra data sheets in one of the public lockers in the Petch building, so that all volunteers can access it as needed. We will buy a combination lock for this locker from the university bookstore.

3) Public monitoring: The project areas are located on and along walking trails, so public reports on the status of the bluebirds will form a background to our committed volunteer data. We will liaise with GOERT's existing program to document and follow up on reports of sightings. We will also use our link with the VNHS Rare Bird reporting line to document sightings of bluebirds in Victoria.

### *Supervision and Safety*

During open community events we will have proper instruction on how to handle and use all tools and other equipment. As well, installation of bird boxes will be in March, to prevent harm or disturbance to breeding birds in the area and allow time to troubleshoot before the breeding season starts in May. Those who will participate in further monitoring will receive instruction in how to conscientiously monitor nesting birds without disturbing them.

## Budget

### *Nest Boxes*

For this project we will budget for 10 bird boxes, as we will try to put as many in place as we can in any given area, using as many paired boxes as we can. Budgeting was done at Home Depot and online at homedepot.ca, although there are many other hardware stores where equipment such as this could be bought. The tools required for construction of the boxes are a hammer ($3.98), a saw ($10.95), and a drill ($24.99). As the boxes will be put into place outside, cedar and galvanized nails should be used to enhance the lifespan of the nest box. A 1” x 6” x 5” cedar board, which will be used to create the walls, floor, and roof, costs $2.25. Each box will need its own cedar board, so ten cedar boards will cost $22.50. To hold the nest box together, 420g of 1 3/4” galvanized nails is $5.29 which will be enough to assemble the ten boxes. The nest box will be attached to a pole, which will be inserted into the ground, using galvanized metal strapping ($4.38). There is enough strapping in one roll to be used for all ten boxes. The pole used will be 2” x 2” x 8” cedar to allow for the box to be high enough off the ground, costing $4.41 per pole for a total of $44.10 for the ten poles. The total budget for ten next boxes will therefore be $132.39, although another ten would only cost $86.95 as the tools to build the box would have already been purchased, as shown in Table 7.

Table 7. Budgeting for a total of ten Bird Boxes.

| Tools/ Supplies | Quantity | Price (for one) | Total costs |
|---|---|---|---|
| Hammer | 1 | $3.98 | $3.98 |
| Saw | 1 | $10.95 | $10.95 |
| Drill | 1 | $24.99 | $24.99 |
| 1’ x 6” x 5” Cedar Board | 6 | $2.25 | $22.50 |
| 420g 1 3/4” Galvanized Nails | 1 box | $5.29 | $5.29 |
| Galvanized Metal Strapping | 1 role | $4.38 | $4.38 |

| | | | |
|---|---|---|---|
| 2” x 2” x 8’ Cedar Pole | 6 poles | $4.41 | $44.10 |
| | **GRAND TOTAL (first ten boxes) AFTER TAX** | **($116.19)(0.14)** | **$132.39** |
| | **GRAND TOTAL (subsequent boxes) AFTER TAX** | **($76.27)(0.14)** | **$86.95** |

## *Monitoring and Volunteer Materials*

Pizzas for the volunteers will the ordered from Palagio (4 medium pizzas, for a total cost of $40.00) during the initial installation of the boxes. Each year, two Starbucks “Hot Chocolate travellers” will be purchased for volunteers during the pre-nesting season birdbox cleanup, which will cost $30.00 for each year, and $150.00 over the 5 year period. These prices can be seen in Table 8.

Monitoring equipment used by the volunteers will be purchased at Staples. A total of 5 clipboards and 20 pencils will be obtained, totalling $15.00 and $2.00 respectively. Monitoring sheets will be printed at Zap using the project’s Zap card which will have a total of $20.00 on it. This equipment will be stored in a free locker in the Petch building, locked with a $5.23 lock from Staples. This data can be viewed in Table 8.

Medium-sized mealworms will be purchased in bulk from SuperCricket.ca, and stored in volunteers’ fridges in order to conserve them between uses. They cost approximately $10 for 1,000 worms. Three orders will therefore supply a family of 8 birds for one full nesting season. Over 5 years, a maximum of 15 orders will be made, totalling $150.00, as shown in Table 8.

Our final project cost is thus approximately $568.13.

Table 8. Monitoring and Volunteer Material Costs for 5 year project plan.

| **Tools/ Supplies** | **Quantity** | **Total price** |
|---|---|---|
| Pizzas | 4 | $40.00 |
| Starbucks Hot Chocolate Traveller | 10 | $150.00 |
| Clip Boards | 5 | $15.00 |
| 10 Pack of Pencils | 2 | $2.00 |
| Zap Printing Card | 1 x $20 | $20.00 |
| Lock | 1 | $5.23 |
| Medium Sized Mealworms | 15 | $150.00 |
| **GRAND TOTAL PLUS TAX** | **($382.23)(0.14)** | **$435.74** |

### *Funding Plan*

As discussed above, we will require a minimum of $568.13. We intend to fund this project in three ways. First, through our status as members of CommonEnergy, we will have access to between $125-150 per semester. However, as CommonEnergy often has other requirements for that money, we will not count on that money being available. If we apply for club status on our own, we will have access to $60-85 per semester. As all of this is uncertain, this money is not a primary source of funding for this project. Second, we will apply to the UVSS special fund, which provides funding of up to $500 for clubs with special projects (UVSS, 2013). Third, we will have a fundraising night at Felicita's. The campus pub reserves Saturday evenings for UVic student groups to hold events, and donates all cover revenue to the group. We will contact them at manager@felicitas.ca (Felicita's, 2013). If these sources of funding prove insufficient, then we will apply for the other grants also listed in Appendix A.

## Evaluating Project Success

### *1. Ecological*

1.1 We will have achieved objective 1.1 if we have built and installed 5 paired nesting boxes by May 2015.

1.2 We will have achieved objective 1.2 if we have supplied mealworms to nesting pairs throughout the nesting season for a full year, depending on when the bluebirds arrive.

1.3 We will have achieved objective 1.3 if the moratorium has been reinstated and expanded to including sites 1, 2, and 3 in the updated campus plan, as of 2014.

### *2: Engagement*

2.1 We will have achieved objective 2.1 if we have held four annual community events in 2014, 2015, 2016 and 2017.

2.2 We will achieved reached objective 2.2 if we reach 100 total followers on Twitter and Facebook within the first year, add 50 new followers each year thereafter, and have published articles in at least four print media sources, or two thirds of our targets, each year. This many followers will ensure the necessary support to implement our project, and new followers will replace those leaving due to graduation or a loss of interest. However, followers on social media are inadequate measures of actual engagement, so we will aim for a conversion of 10 followers to active volunteers each year.

2.3 We will have achieved objective 2.3 if we have established regular communication with GOERT including the exchange of at least 1 status report per year to be presented at their Annual General Meeting, and relevant information from their workshops has been summarized and shared in our document database for consideration annually between 2014 and 2017.

2.4 We will have achieved objective 2.4 if we have contacted at least 5 other organizations and at least 3 organizations have responded favorably, such that we have involved 3 groups in at least one event each by 2017.

2.5 We will have achieved objective 2.5 if we have set up a link with the Victoria Natural History Society (VNHS) Rare Bird line by May 2014. The need for this will hopefully diminish with time as the Western bluebird once again becomes a regular sight in Victoria.

### *3: Knowledge Base*

3.1 We will have achieved objective 3.1 if volunteers have filled out our basic data sheets on at least 6 days of every week for the entirety of the nesting season when birds are present each year between 2014 and 2017. When birds are not present, informal site visits twice a week will be sufficient. Ideally, volunteers would make nest rounds and provide mealworms daily, but due to the nature of volunteer-run programs, we will aim realistically for six days per week, prioritizing days with inclement weather. This will be sufficient to provide detailed information and will ensure that adequate numbers of mealworms are provided, while allowing for human error.

3.2 We will have achieved objective 3.2 if we have, by 2015, created an online database which is publicly accessible which has been updated annually to include all data-sheet information, an update from the GOERT AGM, an updated contact list (private), fundraising letter, data from the Rare Bird line and other public monitoring, and other information deemed relevant.

3.3 We will have achieved objective 3.3 if we have secured commitments from the Biology department, the Environmental Studies department, and/or the RNS department to incorporate our project into at least one laboratory session per targeted course (or equivalent) by the beginning of the 2015 fall semester. While it would be preferable to implement these classes earlier, the nature of curriculum development suggests that it will take a while to create the necessary projects.

## Adaptive Management

Throughout this project, we have discussed possible solutions to various problems as they arise. These discussions form the core of our adaptive management plan, but we will consider some further contingencies below.

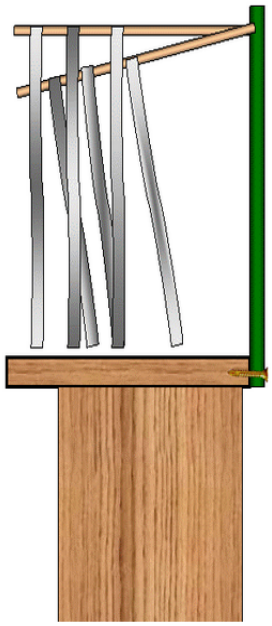
We will consider our vision to have been met if we have observed at least one bluebird on campus by 2017. If no birds have been observed in that time frame, we will consider our plan to have failed. Failure may indicate that the habitat, despite restoration efforts is simply no longer suitable for Western bluebirds, and that restoration efforts would be better directed to other habitats. We will use annual site assessment data to inform our understanding. However, if ecosystem recovery metrics are on track, we will commence a feasibility study into relocating successful breeding pairs to campus. We will follow the San Juan and Cowichan project models to design our adapted plan.

We will evaluate threats to bluebirds through regular monitoring, and presence of nest material of other species during February maintenence. We will then take appropriate action, as follows:

Table 10: Adaptive Management of Threats

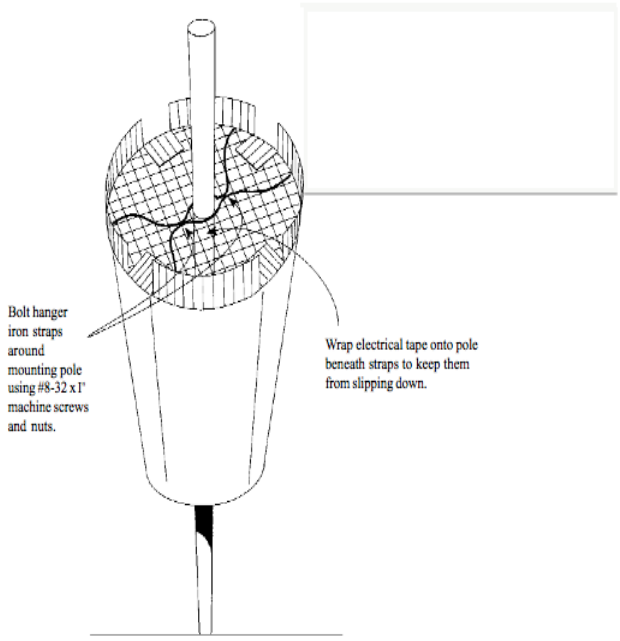
| Threat | Action | Trigger for action |
|---|---|---|
| Ground Predators (Cats, squirrels, etc.) | Predator Baffle<br>Place boxes 6 feet high | Nestling is found dead or there is other evidence of predation |
| Hawks, Crows, Ravens | None | |
| House Sparrows | Sparrow Spookers | Sparrows are observed to be attacking nestlings or nests |
| Violet-Green Swallows and other secondary cavity-nesters | Remove inactive nest materials; extra nesting boxes; moving the boxes at least 60m away from the edge of meadows. | Nest boxes are all or mostly (more than 6/10) taken over by Swallows or other birds |
| European Starlings | 1 ½ inch wide entrances to boxes | Preventative measure, in project plan |
| Food competition | Mealworms | Preventative measure, in project plan |
| Cold Weather | Mealworms, box direction | Preventative measure, in project plan |
| Pesticide Use | None | |
| Windows | Campaign to coat windows in anti-bird stickers | More than one Western bluebird found dead next to windows |

| | | |
|---|---|---|
| Human Disturbance | None | |
| Noise Pollution | Plant shrub screen | Birds observably disturbed by loud noises from the road. |



We chose not to implement active predator deterrents at this stage of the project. However, if, during our regular monitoring, we find evidence that predators are impacting the bluebirds, we will adapt our plan. If we have problems with sparrows, we will install sparrow spookers. Sparrow spookers are mylar strips attached to the top of the boxes (See Figure 11). These should only add $20 to the budget, particularly if we buy mylar banners from the dollar store, and use dowels as the frame.

Figure 11: Sparrow Spooker Design (Sialis, 2013)




If other predators, such as cats and raccoons, are the problem, then we will build Predator baffles on the poles to prevent them from climbing. Predator baffles are installed approximately 6 inches below the bird box, and require a stove pipe, a hardware cloth, bolt hangers, and electrical tape (Kingston, 2001). Six inch stove pipe costs $8.50 from Home Hardware, so it would cost approximately $50 to install them on all project poles (See Figure 12)

Figure 12: Predator Baffle Design (Kingston, 2001)

If multiple birds are injured or killed by windows, we will have to look into coating the windows with protective stickers. This may necessitate an active media campaign to create public interest in the issue and to encourage the university to take action.

Determining the effects of noise pollution on bluebirds is difficult. However, if the bluebirds have observable reactions to the noises of the road, then we will need to investigate the possibility of planting noise screens around the area.

Other possible obstacles to our project may come from the community. If there is no interest shown by UVIC or the surrounding community, and our engagement objectives are not met, then we will have to look into contacting other sources, such as GOERT or the District of Saanich, in order to ensure adequate volunteer power to help with implementation and monitoring. If the University departments decline to participate in our plan, then we will need to investigate other possible options for ongoing monitoring and learning, such as contacting Camosun College or working more closely with the Gordon Head Elementary School. If there is an institutional or community backlash against the boxes for aesthetic reasons, we will consider "hidden" boxes which look like hollow trees. However, this is a more expensive option than our current design.

## References


Alderfe, J. (2006). *Complete Book of Birds.* National Geographic.

B.C. Conservation Data Centre. (2013). *BC Species and Ecosystem Explorer.* Retrieved November 5, 2013, from Ministry of Environment: http://a100.gov.bc.ca/pub/eswp/results.do

Baguette, M., Blanchet, S., Legrand, D., Stevens, VM., & Tulure, C. (2013). Individual dispersal, landscape connectivity and ecological networks. *Biol Rev Camb Philos Soc*, 88(2), 310-326.

Beauchesne, Chytyk, & Cooper. (2002, October). *Garry Oak Ecosystem Recovery Team.* Retrieved November 1, 2013, from WESTERN BLUEBIRD STEWARDSHIP ACCOUNT for the Garry Oak Ecosystems of Southwestern British Columbia: http://www.goert.ca/documents/SA_sialmexi.pdf

Bet. (2013). *Bluebirding Basics*. Retrieved November 5, 2013, from Sialis: http://www.sialis.org

Biodiversity BC. (2007). *Taking Nature's Pulse*. Retrieved on September 29, 2013, from: biodiversitybc.org

Bluebirds of San Diego County. (n.d.). *Predators & Pests of Bluebirds*. Retrieved November 5, 2013, from Bluebirds of San Diego County: http://www.cbrp.org/SDBluebirds/pests.htm

Brawn, J. (1990). Interspecific Competition and Social Behavior in Violet-Green Swallows. *The Auk*, 107(3), 606.

College of Agricultural Sciences. (2013). *Safer Insecticidal Soap*. Retrieved November 5, 2013, from PENN STATE College of Agricultural Sciences: http://extension.psu.edu/plants/gardening/fphg/pests-pesticides/fungicides-herbicides-and-insecticides/pesticide-types/safer-soap

Dickinson, Kraaijeveld, & Kraaijeveld. (2000). Specialized Extrapair Mating Display in Western Bluebirds. *The Auk* , 1078-1080.

Eltzroth, E., & Robinson, S. (1984). Violet-Green Swallows Help Western Bluebirds at the Nest. *Journal of Field Ornithology*, 55(2), 259-261.

Erickson, W. (1998). Garry Oak (Quercus garryana) plant communities and ecosystems in southwestern British Columbia. *BC Ministry of Forests*, Range Section, Victoria, BC.

Evans, J. P. (2007). Wildlife Corridors, an urban political ecology. *Local Environment*. 12(2),129-152.

Extension Toxicology Network. (1993). *Resmethrin*. Retrieved November 5, 2013, from Extension Toxicology Network: http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/resmethrin-ext.html

Garry Oak Ecosystems Recovery Team. (2013). *Bring Back the Bluebird*. Retrieved November 5, 2013, from Garry Oak Ecosystems Recovery Team: http://www.goert.ca/documents/WEBL%20project%20overview-August-2013.pdf

Garry Oak Ecosystems Recovery Team. (2007). Cowichan Garry Oak Preserve. Retrieved November 5, 2013, from Garry Oak Ecosystems Recovery Team: http://www.goert.ca/news/2007/03/cowichan-garry-oak-preserve/

Garry Oak Ecosystems Recovery Team. (2012). *Nestbox Placement and Mounting at Suitable Sites.* Retrieved November 5, 2013, from Garry Oak Ecosystems Recovery Team: http://www.goert.ca/documents/Nestbox-placement-and-mounting.pdf.

Garry Oak Ecosystems Recovery Team. (2011). Restoring British Columbia's Garry Oak Ecosystems Principles and Practices. *Garry Oak Ecosystems Recovery Team*. Victoria, BC Canada.

Garry Oak Ecosystems Recovery Team. (2013). *Sialia mexicana.* Retrieved November 1, 2013, from Garry Oak Ecosystem Recovery Team: http://www.goert.ca/documents/SAR_manual/Sialia_mexicana.pdf

Garry Oak Ecosystems Recovery Team. (2013). *What remains of Garry oak ecosystems*. Retrieved November 1, 2013, from Garry Oak Ecosystems Recovery Team: http://www.goert.ca/about/what_remains.php

Hague, A., Fehr, B., & Griffin, S., Chaboyer, S., & Gomes.T. (2009). Alumni Garry Oak Meadow Restoration Project. *School of Environmental Studies*. University of Victoria , Victoria, BC.

Harrop-Archibald, H. (2007). *University of Victoria Natural Features Study: Bowker Creek, Cunningham Woods, Upper Hobbs Creek/Mystic Vale.* Victoria: University of Victoria.

Herlugson, C. (1982). Food of Adult and Nestling Western and Mountain Bluebirds. *The Murrelet*, 59-65.

Herlugson, C. (1983). Hover-Foraging by Western Bluebirds. *The Murrelet*, 58-60.

Hobbs, R.J., E. Higgs & J.A. Harris. (2009). Novel ecosystems: implications for conservation and restoration. *Trends in Ecology and Evolution*, 24, 11, 599-605.

Kareiva, P. & Marvier, M. (2010). *Conservation Science: Balancing the Needs of People and Nature.* California: Roberts and Company Publishers.

Klem, D. (2009). Preventing bird-window collisions. *The Wilson Journal of Ornithology,* 121(2), 314-321.

Kight, C., Saha, M., & Swaddle, J. (2012). Anthropogenic Noise is associated with reductions in the productivity of breeding Eastern Bluebirds. *Ecological Applications,* 22(7).

Kingston, R. (2001). *A Plan for a Stovepipe Predator Baffle.* Retrieved November 1, 2013, from Nest Box Builder: http://nestboxbuilder.com/pdf/stovepipebaffle.pdf

Klinkenberg, B. (2012). *Sialia mexicana*. Retrieved November 1, 2013, from E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia: http://linnet.geog.ubc.ca/efauna/Atlas/Atlas.aspx?sciname=Sialia%20mexicana

Kozma, J, & Kroll, A.(2010). Nest Survival of Western Bluebirds Using Tree Cavities in Managed Ponderosa Pine Forests of Central Washington. *The Condor*, 87-95.

MacArthur, R. H. & Wilson, E. O. (1967). The Theory of Island Biogeography. Princeton, N.J.*Princeton University Press*.

McLochlin, J. (2007). *The Bluebird-box*. Retrieved November 1, 2013, from Audubon Society of Omaha: http://audubon-omaha.org/bbbox/bbfaq.htm

Ministry of Environment. (2013). *FAQs: Red, Blue and Yellow Lists*. Retrieved November 5, 2013, from Ministry of Environment: http://www.elp.gov.bc.ca/atrisk/faq3.html

National Parks Directorate. (2008). *Principles and Guidelines for ECOLOGICAL RESTORATION in Canada's Protected Natural Areas.* Parks Canada.

North American Bird Conservation Initiative Canada. (2012). The State of Canada's Birds 2012. *Environment Canada*, Ottawa, Canada.

North American Bluebird Society, Inc. (2006, December 29). *Western Bluebird Nestbox Plans.* Retrieved November 5, 2013, from http://www.goert.ca/documents/plans-Western-Bluebird-Nestbox.pdf

Office of Campus Planning and Sustainability. (2011). *2009-2011 Progress Report on the Sustainability Action Plan.* Victoria: Campus Operations.

Office of Campus Planning and Sustainability. (n.d.). *Grounds*. Retrieved November 5, 2013, from University of Victoria: http://www.uvic.ca/sustainability/operations/grounds/index.php

Pogue, D., & Carter, W. (1995). Breeding Biology of Secondary Cavity-nesting birds in Oklahoma. *The Southwestern Naturalis*t, 40(2), 172.

Pojar, J. & MacKinnon, A. (1994). Plants of the Pacific Northwest Coast. British Columbia. *Lonepine Publ*., Vancouver, BC.

Prescott Bluebird Recovery Project. (2002). *Western Bluebird: The comeback bird*. Retrieved November 5, 2013, from Prescott Bluebird: http://www.prescottbluebird.com/BB_Article98.htm

San Juan Preservation Trust. (2013). *Western Bluebird Reintroduction*. Retrieved November 5, 2013, from The San Juan Preservation Trust: http://sjpt.org/places-projects/stewardship-projects/western-bluebird-project/

Shaw Creek Bird Supply. (2003). *Bluebird House Predator Control*. Retrieved November 1, 2013, from Shaw Creek Bird Supply: http://www.shawcreekbirdsupply.com/bluebird_predator_control.htm

Slater, G., & Altman, B. (2011). Avian Restoration in the Prairie-Oak Ecosystem: A Reintroduction Case Study of Western Bluebirds to San Juan Island, Washington. *Northwest Science,* 85(2), 228.

Smith-Castro, J., & Rodewald, A. (2010). Behavioral responses of nesting birds to human disturbance along recreational trails. *Journal of Field Ornithology,* 81(2), 130-138.

Sullivan, Kimberley. (1989). Predation and Starvation: Age-Specific Mortality in Juvenile Juncos (junco phaenotus). *Journal of Animal ecology*, 58(1), 275.

Super Cricket Cricket Farm Inc. (2013). *Live Mealworms.* Retrieved November 5, 2013, from Super Cricket: http://supercricket.ca/live_mealworms.html

Theissen, E. (2013, October 3). *10-year moratorium on campus deforestation to expire*. Retrieved November 1, 2013, from Martlet: http://www.martlet.ca/news/10-year-moratorium-on-campus-deforestation-to-expire/.

University of Victoria. (2009). *Sustainability Action Plan 2009-2014.* Victoria: Campus Operations.

UVic. (2004, February 19). *POLICY HIGHLIGHTS - UVIC CAMPUS PLAN MAY 2003.* Retrieved November 1, 2013, from University of Victoria: http://communications.uvic.ca/releases/makepdf.php?type=backgrounder&id=27

Victoria Natural History Society. (2008). *Victoria Christmas Bird Count*. Retrieved November 1, 2013, from Victoria Natural History Society: http://www.cbrp.org/SDBluebirds/pests.htm

Wetzel, D., & Krupa, J. (2013). Where are the Bluebirds of the Bluegrass? Eastern Bluebird Decline in Central Kentucky. *American Midland Naturalist*, 405.

Wightman, C. S. (2009). Survival and Movements of Fledgling Western Bluebirds. *The Southwestern Naturalist,* 54(3), 249.

Wildlife Tree Committee of British Columbia. (2001). Wildlife/Danger Tree Assessor's Course Workbook: Forest Harvesting and Silviculture Module. *N/A.*

Wilson, E.O. (1992). The Diversity of Life. *W.W. Norton and Co*. New York.

Wong, R. & Werman, D. (February 14, 2013). *Is UVic Feather Friendly Enough?* The Martlet.

Yackel A. A., Skagen, S., & Savigge, J. (2006). Modeling Post-Fledging Survival of Lark Buntings in Reponse to Ecological and Biological Factors. *The Ecological Society of America*.

# Appendices

## *A. Funding Sources*

Table 11: Funding Sources

| Funding source | Amount offered | Contact information |
|---|---|---|
| **UVSS special fund** | **Up to $500** | **http://uvss.ca/student-groups/clubs/running-your-club/** |
| **Fundraising night at *Felicita's*** | **Unknown** | **manager@felicitas.ca.** |
| **UVSP grant** | **Up to $500** | **http://uvsp.uvic.ca/uvsp-sustainable-grants-program** |
| **Habitat Conservation Trust Foundation, PCAF Grants,** | **Up to $2500** | **http://www.hctf.ca/apply-for-funding/pcaf-grants** |
| **Canadian Wildlife Federation** | **$2000-15000** | **http://cwf-fcf.org/en/explore-our-work/funding-awards/foundation/** |
| **EcoAction Community funding program** | **Up to $100 000** | **http://www.ec.gc.ca/ecoaction/default.asp?lang=En&n=FA475FEB-1** |
| **Vancity** | **Unknown** | **https://www.vancity.com/AboutVancity/InvestingInCommunities/Grants/enviroFund/** |
| **TD Friends of the Environment Foundation** | **$2000** | **http://fef.td.com/funding/** |

## *B. Stakeholders and Contacts*

A) GOERT: Kathryn Martell, Conservation Specialist/Bluebird Project Coordinator; 250-383-3427; kathryn.martell@goert.ca

> *GOERT has lots of resources for the conservation of Garry Oak Ecosystems and will be able to provide us with inside information on their bluebird project in Cowichan.*

B) Victoria Natural History Society: Darren Copley, President; 250-479-6622; dccopley@telus.net

> *The Victoria Natural History Society (VNHS) runs the Rare Bird Alert line, which we hope to be able to tie into in order to allow the public to report sightings of bluebirds. They may also be interested in contributing to the project.*

C) Gordon Head Elementary: Brent Kelly, Principal; 250-477-1855; bkelly@sd61.bc.ca

> *Getting the school involved in the project could offer opportunities for the students to learn about restoration, as well as provide a method of ongoing monitoring.*

D) UVic: Neil Connelly, Director of the Office of Campus Planning and Sustainability,: 250-472-5433, nconn@uvic.ca

> *Personal communication informs us that UVic does not require that permission be asked, but they do require us to inform Neil Connelly of our proposal and let him know where the boxes will be. He may also have suggestions as to where the boxes should go and it is also possible that he and Rita would be willing to include some kind of monitoring in future sustainability events.*

E) UVic Environmental Studies Department: Lori Erb, School Administrator, 250-472-4568; esadmin@uvic.ca

> *The UH4 house and grounds is managed by the School of Environmental Studies, so we will have to get permission from the ES department before we put nest boxes there.*

F) RNS program: Val Schaefer, Faculty Coordinator; 250-472-4387, schaefer@uvic.ca

*The RNS program does a lot of restoration on and around campus, so they may be good people to consult with to make sure that we can integrate Garry Oak restoration into our work.*

G) On pre-existing meadow restoration: Brenda Beckwith, sessional faculty and undergraduate advisor, beckwith@uvic.ca

*Brenda Beckwith has been central to major restoration efforts in the Garry Oak meadows on campus. Therefore, she may be able to inform on the future plans for these meadows, as well as suggest how the nest boxes may influence the ecosystems.*

H) Ecological Restoration Volunteer Network: nature@uvic.ca

*Their website promises that any organization needing restoration volunteers can email them at this address and it will be circulated to their mailing list.*

I) Biology Department: Tanya Threlfall, Department Secretary, 250-721-7091
biology@uvic.ca

*We hope that the biology department might be willing to integrate monitoring the nest boxes into one of their classes. The Department Secretary seems like a good first point of contact to ask whether they might be interested.*

J) Songhees First Nation: Chief Sam Robert, 250-386-1043

*Although there is no evidence that the Western bluebird was a particularly important species for First Nations in this area, the University of Victoria does lie on unceded Coast Salish territory. Furthermore, the Songhees nation may possess detailed ecological knowledge about the habits and needs of bluebirds in this area. For that reason, it is important to include the local first nations in our decision making processes, and to ask them for advice.*

K) UVIC Students: The Martlet and Essence

*As this project will be located on the UVic campus, it seems advisable to consult with UVic students. Contacting every student through email is impractical and would require significant support from the university. However, by publishing short articles in The Martlet and Essence with requests for feedback to be sent to uvicbluebirds@gmail.com (password: uvicbluebird), we can receive community feedback with maximum efficiency.*

We also considered consulting with the District of Saanich, the District of Oak Bay, and the UVic Alumni Association. However, this project is sufficiently limited in scope that it seems unnecessary to bother any of those groups without further indications that such a consultation is necessary.

## *C. Bird Box Plans*

First, the 1 x 6 x 5 cedar board will need to be cut into the 6 different pieces required using a saw. The cuts will be made perpendicular to the long side. The first piece will be 4 inches along the 4 foot side. The next piece will be 19.5 inches long, and will then be cut in half diagonally into 2 pieces, ensuring the edges are beveled to have a snug fit to the roof piece later in construction. The 4th will be 9 3/8th inches long and the 5th piece will be 10.5 inches long. The rest of the board (approximately 15-17 inches) will be used for the back. This cutting pattern of the first 4 pieces is depicted in Figure 13.

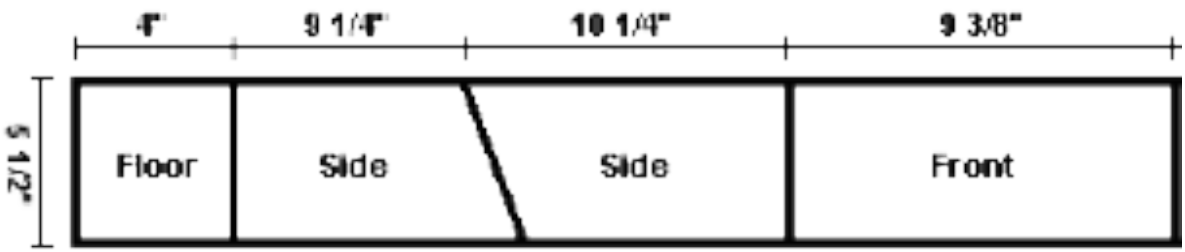



Figure 13. The cutting pattern required to create the walls, floor, and front of the birdbox.

Once the pieces are cut to size, the detail cutting will occur. The floor piece will be cut at the corners to allow for draining of the box. The entrance will be cut into the front piece, 6.5 inches up from the bottom, as a 1.5 inch diameter circle, allowing just enough room for the birds to get in and out while also being small enough to exclude predators and competing species (Purcell *et al.,* 1997).

The walls will then be attached together with galvanized nails. First, we will attach the 3 walls to each other and to the floor first, then we will add the roof, then the "door" wall on the side. The "door" will be installed 1/2 inch below the roof to allow ventilation and room for pivoting when opening.

The "door" wall will be installed with pivot nails (also galvanized) driven through the front and back pieces, and into the sides of the door piece at the same height. These pivot nails act as the pivot point to open the door for monitoring the nest. A hole (larger in diameter than the diameter of the nail, to ensure it fits) will then be drilled at the bottom, from the front piece down at an angle through the side piece so that a nail can be inserted to act as a lock. It is drilled at an angle to ensure it does not fall out. The orientation of the pivot nails is pictured in Figure 14.

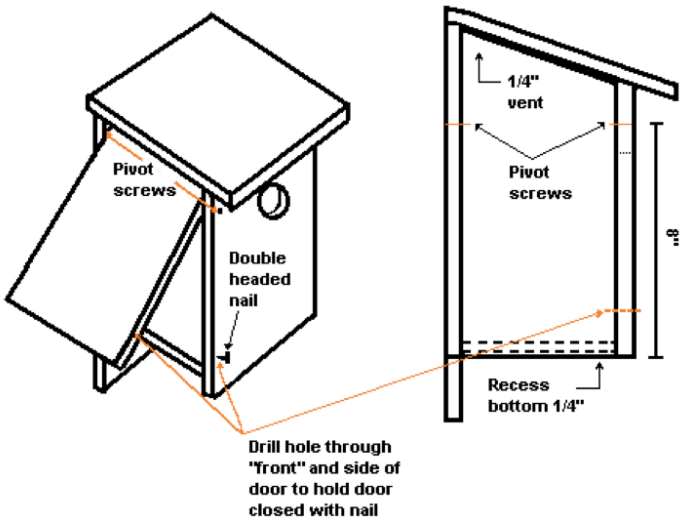



Figure 14. The location of the pivot nails at the top of the “door” wall of the birdbox and the location of the lock nail at the bottom of the door.

A piece of galvanized metal will be attached to the next box with galvanized nails and then used to attach the nest box to the intended habitat (in this case, a pole).

Plan adapted from North American Bluebird Society, 2006.

## *D. Monitoring Data Sheets*

UVic Bluebird Club
Nesting Season Monitoring Info Sheet

Date: _____Observer Names: _____

Weather Conditions: _____

Site Observed (please circle one) Site 1 Site 2 Site 3

Bluebirds (please circle one) PRESENT / ABSENT

| Bird # | Location relative to box | Behavior (Feeding, nest building, etc.) | Band Number (if present) |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |

Notes on nesting activity: (Nesting material in box? Eggs? Chicks?): _____
_____
_____
_____

Meal worms provided? (Please circle one) YES / NO

If yes, how many? _____

Feeding observed? YES / NO

Competitor species in vicinity (Using nest boxes, interacting with bluebirds)?: _____
_____
_____
_____

Other (please report vandalism, other observations of interest): _____
_____
_____

## ***Acknowledgements***

*This project was developed for the Environmental Studies Ecological Restoration course, University of Victoria, 2013. We would like to acknowledge the support from Tanya Taggart-Hodge, Dr. Eric Higgs and UVic Facilities Management personnel.*

## Division of Labour

Morag:

| | |
|---|---|
| Main author: | Threats and Considerations<br>Adaptive Management<br>Stakeholders (paragraph and Appendix B)<br>Funding sources and funding plan (Paragraphs and Appendix A) |
| Cowriter: | Goals and Objectives<br>Implementation Plan<br>Monitoring Plan<br>Evaluating Project Success<br>Basic Data Collection Sheet |
| Other Contributions: | Creation and maintenance of To-Do list<br>Detailed proofread<br>Final compilation<br>Formatting<br>Editing |

Misha:

| | |
|---|---|
| Main author: | Introduction<br>Restoration Continuity<br>Landscape Connectivity |
| Cowriter: | Goals and Objectives<br>Implementation Plan<br>Monitoring Plan<br>Evaluating Project Success<br>Basic Data Collection Sheet |

Other Contributions: Editing
Detailed proofread

Cortney:

Main author: Species Profile
Moratorium
Safety

Cowriter: Goals and Objectives
Monitoring Plan
Evaluating Project Success

Other Contributions: Checking references and putting everything into APA
Editing
Detailed proofread

Jessie:

Main Author: Budget
Materials
Design of Boxes (Paragraph and Appendix C)

Cowriter: Goals and Objectives
Basic Data Collection Sheet

Other Contributions: Detailed proofread

Shannon:

Main Author: Site Description
Site Introduction
Maps and Tables of site and site description, and site photos
Proposed locations of nest boxes
Reference Ecosystem, Novel Ecosystems
Site history and related disturbances
Site considerations

Cowriter: Goals and Objectives

Other Contributions: Contacted K. Martell, R. Hebda, E. Higgs, B. Beckwith, N. Turner, V. Shafer, R. Rose and D. Eastman via email
Attended GOERT symposium and asked questions about our project

Detailed proofread

We also all participated in a Site Visit with the group to take GPS coordinates, find suitable locations, etc., and in group editing / planning sessions.