Restoration of Native Bee Populations in Victoria, BC, through Public Education work with LifeCycles

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Abstract

With the decline in managed honeybee populations due to the effects of introduced parasites, a decrease in pollination activity resulting in reduced fruit yields has been cause for alarm. Solitary native bees have become a recent focus for counteracting this ‘Pollination Crisis’. LifeCycles, a Victoria based environmental and community minded organization, has been working to educate the public on these issues through the development of a new project: ‘Maintaining a Bee Average’. This project aims to educate the Victoria community on the importance of native pollinators, and to encourage enhancement of native bee habitat within the urban environment. This report outlines the research and activities undertaken through LifeCycles as a Final Project, required for completion of the Restoration of Natural Systems diploma program through the University of Victoria, Victoria, BC. Research and activities involved: experimentation with the construction of several bee box designs, fabrication of a mural for outreach initiatives, development of a pamphlet for the LifeCycles’ bee box design, and public education at Seedy Saturday.
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Introduction

Bees are responsible for the pollination of approximately one third of food crops worldwide. (LifeCycles, 2000; Buchmann et al., 1996) Generally, when one thinks of bees, honey producing bees come to mind, when in fact, of the estimated 20,000 to 30,000 bee species worldwide, less than 1% can be classified as honeybees. (Torchio, 1987) These non-honey bees (otherwise known as solitary or wild bees) vary greatly, but their contribution as pollinators to all types of ecosystems worldwide is phenomenal. In fact, of the $3 trillion value derived from agriculture around the globe, bees in general are directly responsible for one third of the total. (Buchmann et al., 1996) The importance of bees and other pollinators to our continued survival is best expressed by Edward O. Wilson in the forward to The Forgotten Pollinators (Buchmann et al., 1996): “There is a welded chain of causal events that leads directly to our species: if plants, including many food and forage crops, as well as natural floras, must have insects to exist, then human beings must have insects to exist.”

Honeybees have been important pollinators in agricultural setting throughout North America ever since their introduction from Europe by early European colonists. (Watanabe, 1994) Unfortunately, the introduction of two species of parasitic mites, the tracheal mite and the varroa mite, in the 1980’s has had a huge impact on the health of honeybee hives, resulting in the deterioration in the quality of hives and a huge drop in the numbers of honeybees. (Watanabe, 1994) In a recent study by Gingras et al. (1999) it was found that “the presence of honey bees together with the number and cumulative duration of their visits to the flowers are important to pollination and influence both the quality and the quantity of cucumber production.”(p. 435) The decline in pollination activity, and its effects of decreased fruit yields and destabization of healthy ecosystems, has led to fear and concern of an inevitable ‘Pollination Crisis’. (LifeCycles, 2000; Buchmann et al., 1996; Kevan, 1999) In The Forgotten Pollinators, (Buchmann et al., 1996) this decrease and its effects are identified: “It now appears that the majority of plants studied to date show evidence of natural pollinator limitation. That is to say, under natural conditions, 62 percent of some 258 kinds of plants studied in detail suffer limited fruit set from too few visits by effective pollinators.”(p. 24)
The rising concern of a ‘Pollination Crisis’ has led to the increasing attention toward native bees as pollinators. (LifeCycles, 2000; Kevan, 1999; Watanabe, 1994) In North America alone, the estimated number of native bee species is between 3,500 and 4,000. (LifeCycles, 2000) (It is uncertain how many are found on Vancouver Island.) The majority of native bees are solitary, which means they do not live in hives, and each female has her own nest where she lays her eggs. (Proctor et al., 1996) These solitary bees can be divided into two groups, soil-dwellers, who make their nests in the ground, and wood-dwellers, who make their nests in wood. (Proctor et al., 1996) Solitary bees, while they do not produce economically valuable amounts of honey or wax like hive dwelling honeybees, do an exceptional job of pollinating surrounding plant species. (LifeCycles, 2000) One such species, the blue orchard mason bee (*Osmia lignaria*), can pollinate over 2000 apple blossoms in a day; a number that would take the average honeybee 30 days! (BC Fruit Testers Association, nd) Habitat requirements for solitary bees include nesting sites, flowers that produce adequate amounts of nectar and pollen, and a water source. (LifeCycles, 2000; Proctor et al., 1996)

While native bees have the potential to counteract the effects of decreasing numbers of honeybees, there is still a lot of work that needs to be done to increase their numbers. (LifeCycles, 2000) The two main threats affecting native bees today are habitat loss and pesticide use. (LifeCycles, 2000; Kevan, 1999; Buchmann et al., 1996) It is critical that these effects be reduced to ensure healthy habitat for native pollinators, as “pollinators are key to global sustainable terrestrial productivity.” (Kevan, 1999, p. 386) Public awareness of the role local pollinators play in the areas of ecosystem sustainability and food security needs to increase.

LifeCycles is a local organization working to educate the public about the importance of native pollinators, and what can be done to improve their situation. As stated on their website (www.coastnet.com/~lifecycles): “LifeCycles is an environmental non-profit, non-governmental organization dedicated to cultivating awareness of and initiating action around food, health, and urban sustainability in the Greater Victoria
community.” Through its numerous projects, LifeCycles works to increase environmental awareness on many levels.

Early in 2000, LifeCycles, with the support of the EcoAction 2000 Community Funding Program, the BC Ministry of Environment, Lands and Parks, and the City of Victoria, launched a new project called ‘Maintaining a Bee Average’ to address concerns of food security with decreases in pollination. The ‘Maintaining a Bee Average’ project has two main components: 1. educating the public on the importance of native bees as pollinators, and 2. providing and enhancing habitat for native bees in the urban environment. As part of this program, over 250 ‘Pollination Station’ seed packages were made containing seeds from a variety of plants that attract bees, and 100 bee boxes were constructed, for distribution in 2001. As a main component, public education is planned on many different levels including community events and through the incorporation of the project information into other LifeCycles projects.

This research and work was done as part of the Restoration of Natural Systems diploma program final project requirements, through the University of Victoria, Victoria, BC. The restoration and protection of native pollinator population is integral to the restoration of healthy ecosystems; the key to the success of native plant reintroductions is the success of native pollinators. (Buchmann et al., 1996) Through urban enhancement of native bee habitat, and thereby the enhancement of natural areas within an urban setting, the creation of ecologically valuable areas will lead to healthier human communities. Public education on pollination and the connection between our food and environment can lead to increased environmental awareness and respect. As part of this project several ventures were undertaken: experimentation with the construction of several bee box designs, fabrication of a mural for outreach initiatives, development of a pamphlet for the LifeCycles’ bee box design, and public education at Seedy Saturday.
**Bee box research and construction**

Bee boxes, also known as bee condos, are a unique way to provide nesting habitat to numerous wood-dwelling solitary bees. (LifeCycles, 2000 (3); Greer, 1999; BC Fruit Testers Association, nd) In the Victoria area, these boxes can provide homes for three main types of bees, who will nest in pre-existing holes in wood: *Osmia lignaria* (the blue orchard mason bee), *Osmia texana* (the berry bee), and *Megachile* spp. (the leafcutter bee). (LifeCycles, 2000 (2)) There are several different types of bee box designs made with a variety of materials, which will be discussed in greater detail below.

For all types of bee boxes, certain parameters should be met in their construction to attract bees. For attracting *Osmia lignaria*, ideal hole size has been identified as six inches in length, and 5/16 of an inch in diameter. (Torchio, 1998) This length provides an appropriate amount of room to house the number of eggs one female blue orchard mason bee will lay in a season, and therefore give a high number of female offspring, as the first few egg cells closest to the entrance of the nest are males.

**Cardboard tube bee box**

The cardboard tube bee box is a simple design that can be constructed by all age groups. It consists of cardboard tubes or milkshake straws secured into a pop bottle cut open at one end. (LifeCycles, 2000 (3); Anon., nd) Tubes can also be made by rolling newspaper. Figure 1 shows one such box made as part of this project.

**Wooden block bee box**

Wooden block bee boxes are made by drilling holes of appropriate size into a block of wood. They can be drilled most of the way through the block (Buchmann, nd; LifeCycles, 2000 (3)), or right through the block (BC Fruit Testers Association, nd). When holes are drilled through the entire block, a backing must be attached to the back to close one end of the holes. An experimental box was made by drilling holes into a piece of driftwood (Figure 1). It is unsure if this box would be adequate to house bees, as the inside of the holes are not very smooth. This factor might deter solitary wood-dwelling bees from using the box. (Metcalf, 2001)
Figure 1. Photograph of two types of bee boxes. The box on the left is an example of a simple cardboard tube box; the box on the right was made using driftwood and is a wooden block design.
The LifeCycles bee box design (Figure 2) is an example of a block box. As part of LifeCycles' ‘Maintaining a Bee Average’ project, one hundred of these bee boxes were constructed by Bill Metcalfe, a local machinist. Flanks left on either side of the front help protect the overwintering bees inside from predation by woodpeckers and a variety of parasitic wasps. (Metcalf, 2001) Another important feature of this design is a mounting block on the back to allow for easy mounting and dismounting from the side of an outdoor wall, when it is time to clean the box, or store it inside for the winter. (Metcalf, 2001)

**Slotted tray bee box**

Another wooden design of bee boxes is the slotted tray bee box. This variety uses stacks of several thin trays of wood that have routed strips through nearly the entire length of the blocks, on one side. When stacked on top of each other, these strips provide holes that can be used as nesting sites of solitary bees. Two types of routed strips can be made. One using a Dato machine will produce continuous straight square bottomed strips, while the other type uses a Router will produce rounded bottoms and can also make curves in the strip. (Metcalf, 2001) Figure 3 shows three Routed trays of a slotted bee box. Overwintering bee casings and earwigs, as well as other unidentifiable material were found in these trays.

**Observational bee box for educational use**

A website on solitary bee boxes (Anon., nd) gave instructions for the construction of a bee box made with clear tubes, to allow observation of the nesting bees. A variation of this observational bee box (Figure 4) was constructed by inserting 8 acrylic tubes with an inside diameter of 3/8 of an inch into a wooden box. The tubes were blocked from one end using earplugs, and kept from slipping down by gluing in plastic slots at the back of the box. The tubes were also glued into the front of the box around the holes made for their insertion. This type of box can be used in educational initiatives on the lifecycle and overwintering stages of solitary bees.
Figure 2. The LifeCycles’ bee box.

Figure 3. Photograph of three slotted trays from a bee box in use by nesting native bees. Bill Metcalfe constructed the trays using a Router. The trays contained overwintering bee casings, earwigs and other material (possibly mites).
Figure 4. An observational bee box.
Bee box installation and maintenance

Bee boxes should be set up on an east-facing wall approximately three to six feet above the ground. (LifeCycles, 2000 (3); BC Fruit Testers Association, nd.) Ideally, the area should be dry and sunny. Empty boxes should be put up by mid-March, when the blue orchard mason bees begin to emerge from their nests. The females will begin making their nests almost immediately. It is important that the boxes are not disturbed or moved until after July 1st, as movement can cause damage to the eggs. (LifeCycles, 2000 (3); BC Fruit Testers Association, nd) When the boxes are filled, they can be stored in a cool dry place until the next spring, or left outside for the winter, as long as temperatures do not fall below -18°C. (BC Fruit Testers Association, nd.) Mud walls at the entrances can identify filled holes.

In the spring, filled boxes should be covered with fabric or cardboard with a hole at one end to allow emerging bees to find their way out, but not back in. When all bees have emerged, it is necessary to clean wooden block bee boxes to kill off molds and parasitic mites. This can be done by soaking the box in a light bleach solution, or by placing the box in the oven at 65°C (150°F) for an hour. (LifeCycles, 2000 (3); BC Fruit Testers Association, nd.) Once the box is clean, it can be reinstalled outdoors.

Slotted trays can be cleaned while the bees are overwintering. Trays can be unstacked, and the contents of the routered strips can be put into a 5% bleach solution. (Greer, 1999; Welland, 2000) Blue orchard mason bee casings are waterproof, so a short soak will not harm them. After soaking for several minutes in the bleach water, the bee casings can be placed in water for a couple minutes. Bleach/water soaks should be done twice to remove and kill parasitic mites. (Welland, 2000) Casings can then be placed on paper towel to dry and stored in a box in a cool place until spring. In spring the box should be placed outside, and a small hole cut into the box for the bees to emerge.

For cardboard tube boxes, the tubes should be destroyed and new tubes made for the next season. Observation boxes can be cleaned by taking out acrylic tubes and washing them in a light bleach solution.
Backyard enhancement

Besides providing nesting habitat for native solitary bees, it is also important that other aspects of their habitat requirements be addressed. As many of the bees that would inhabit the bee boxes have a small foraging range (100m circumference for blue orchard mason bees), attracting them means providing resources that they need. (LifeCycles, 2000 (3); BC Fruit Testers Association, nd.) Buchmann (nd) suggests “the most important consideration is how to use a maximum of native annual and perennial wildflowers which naturally grow in your region.” A diverse array of following plants is ideal, with as few invasive species as possible. (Xerces Society, 2000) For orchard pollination, it is important that flowering plants are present before and after orchard trees are blooming. (Strickler, 2000) Trees and shrubs of the genera Prunus, Ribes, Rubus and Salix are great for attracting blue orchard mason bees; while great herbs include Brassica (mustards), Raphanus sativus (radishes), Salvia carduacea (sage), Senecio (dusty miller), Taraxacum vulgare (dandelions), Trifolium repens (white clover), Vicia californicum (vetch), and many members of the Asteraceae family, as these plants provide large amounts of nectar and pollen for visiting bees. (Strickler, 2000)

A nearby water source is also important. This can be done simply, with a birdbath, pond, or dripping faucet. (Buchmann, nd.) A pesticide and herbicide free yard is also key to maintaining a healthy bee population. (LifeCycles, 2000 (3)) By providing bee habitat, a gardener can improve the health and production of their garden.

Outreach material

A major part of this project involved the development of outreach material for the public education component of LifeCycles’ ‘Maintaining a Bee Average’ program. This involved making a fabric mural and designing a pamphlet to accompany the LifeCycles’ bee box.
Bee habitat mural

The mural (Figure 5) was constructed for use as an educational tool for young children. It is designed to initiate discussion on the topic of native bees, their habitat requirement and threats to their survival. The mural contains a variety of positive and negative factors affecting the health of native bees in an urban environment. Three-dimensional fabric bees were made, with velcro on their abdomens, to be stuck on the various components of the mural by children, to encourage discussion on these topics.

The components represented in the mural are as follows:

- Garden flowers and wildflowers (this does not include the daffodil, which is discussed below) - *positive* - The flowers represent the food sources, nectar and pollen, of bees. This component can lead to discussions on pollination and its role in our gardens and food production in general. It can also be used to discuss the lifecycles of bees, as the female bees lay their eggs next to pollen balls for the larvae to eat when they hatch from the eggs.

- Stream - *positive* - The stream represents a water source, important to bees for drinking, as well as for making the mud they use to separate the cells in their nests, and to close-in the nest hole from the outside. Other sources of water, such as bird baths, can also be discussed.

- Dirt from the garden - *positive* - As with the stream, this can be used to educate children on the nesting techniques of wood-dwelling solitary bees.

- Bee Box - *positive* - The bee box represents a way that humans can provide habitat for native bees. The threat of increasing urbanization on bee habitat can be addressed here, as well as the positive things humans can do to maintain native bee populations.

- Mites - *negative* - As a natural predator of native bees, the mites can initiate discussion on food webs, as well as the importance of regularly cleaning bee boxes to minimize the impact of mites on nesting bees.

- Daffodils - *negative* - The daffodil represents highly hybridized flower species of high commercial value (including tulips) which, although are beautiful and showy, provide very little pollen and nectar for bees. This
can also be used to talk about energy expenditure and habitat range of bees.

- Pesticides - *negative* - As one of the main threats to bees and other pollinators in urban areas, the pesticide component of the mural can be used to look at human impact on the health of bees, and to discuss alternatives.

The use of the mural as an educational tool can be very positive as an fun and interactive way to encourage interest in the topic of native bees, pollination and habitat needs. Though discussion, children can learn how to help native bees by providing habitat right in their own backyards.

![Mural Image](image)

**Figure 5.** *The native bee mural constructed as an educational tool for LifeCycles.*
Bee box pamphlet

The LifeCycles bee box pamphlet (Insert 1) was designed to accompany bee boxes sold at Seedy Saturday, the event attended as part of this project (which will be discussed later in this report). The pamphlet provides general information on wood-dwelling native solitary bees, their importance in the urban environment as pollinators, and the role of bee boxes in providing habitat for these bees. The stewardship tips section of the pamphlet covers bee box installation and maintenance, as well as information on other ways to encourage bees to take up residence in a bee box owners yard, through providing other habitat needs, such as water and flowers. The unique features of the LifeCycles bee box are also discussed. Information in the handout on bee boxes is specific to the LifeCycles bee box design, but the information is also relevant to other types of bee boxes. Thus the information in this pamphlet can be useful to people with other types of bee boxes in their yards, or for people interested in designing and building their own boxes.

Public Education

The event attended as the public education component of this project was Seedy Saturday, held at the James Bay Community Centre on February 17, 2001. This venue, organized by the James Bay Market Society, provided a space for local urban farmers and the general public to buy and sell seeds and produce and other organic garden-variety products. The event was well attended, with an estimated crowd of over 200 members of the public.

LifeCycles attended the event in a public education capacity. The booth provided general information on LifeCycles and their numerous projects, as well as a special focus on the ‘Maintaining a Bee Average’ project. The LifeCycles bee box pamphlet, as well as two other pamphlets with general information on native bees and pollination, was also on display. LifeCycles’ bee boxes and ‘Pollination Station’ bee garden seed packages were for sale at the booth.
Preparation for the LifeCycles display at Seedy Saturday had many components. Appropriate pricing for the bee boxes and seed packages was researched, and price signs were made up. Two prices were assigned per item, a regular price and a reduced price for customers willing to sign up for a follow-up telephone interview to find out how they liked the products and how successful they were in attracting bees. The seed packages were assigned a regular price of $1.50, and a reduced price of $0.50, and the bee boxes were given a regular price of $25.00 and a reduced price of $15.00. The prices (especially those of the bee boxes) were chosen to encourage people to sign-up for the follow-up interviews, but, also, to not compete with local sellers of similar products (as LifeCycles had received outside funding for these projects). Prices were also assigned to better ensure that the seeds and boxes were purchased by people who would likely follow through with making them available to the bees. Both sign-up sheets and telephone interview questionnaires were also developed prior to the event, as was the organization of the display board, with general information on LifeCycles, as well as more in-depth information on native bees.

During the event, a record was kept of the numbers of people who saw the LifeCycles display, the number of people who were educated on LifeCycles and native bees, and the number of seed packages and bee boxes sold. Sales goals were loosely set prior to the event, at 5 bee boxes and 20 seed packages. Over the course of the day, 24 seed packages were sold, but only 1 bee box. Fortunately though, many positive contacts were made. Approximately 150 people saw LifeCycles at the event and, of those, approximately 70 bee box educational contacts and 60 general native bee educational contacts were made.

Although few sold, many people were interested in the bee boxes. The pricing of the bee boxes may have been discouraging, as many people in attendance were there to buy seeds, and not larger, more expensive items. The sold bee box did provide LifeCycles with a follow-up contact, and of the 24 seed packages sold, 15 people signed up for follow-up interviews.
A post-event write up was done on Seedy Saturday, to provide LifeCycles with information on what did and did not work, as well as provide recommendations for next year's event.

Conclusion

The role of public education in the restoration of native bee populations in the Victoria area is vital. LifeCycles' 'Maintaining a Bee Average' project is working hard at providing this education to all age groups. With the possible incorporation of native bee information into its other active projects, such as the Growing Schools project, LifeCycles will be successful in educating many Victoria residents. Follow-up on habitat enhancement initiatives is key to measuring this success. Through monitoring bee boxes and gardens, it will be possible to determine the focus and direction of the 'Maintaining a Bee Average' project in the future. The importance of native pollinators to food security and ecosystem health, and thereby the health of human communities is immense: "The message is clear: the fields and orchards that sustain our food supply should never become too far removed from wildlands and the animals that inhabit them, [who] are playing an increasingly important role in maintaining the stability of the world's food, fiber, and beverage supply. We cannot let wildness become too remote from the lives of pollinators, or from our own lives. The risk is too high..." (Buchmann et al., 1996, p.223)
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