Towards a more Ecological Version of FireSmart for Galiano Island

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Abstract

FireSmart is an important program in Canada that works towards helping communities protect themselves from wildfires. We ask: is FireSmart taking account of ecological considerations in its program, and could ecological measures be aligned at least partly with ecological restoration practices in forested ecosystems? Presently, many of the recommendations are focused on extensive thinning, removing any potential fine and coarse fuels in the forest and near structures, and keeping simplified grass lawns. Many of the drought-resistant plant suggestions for landscaping are non-native and potentially invasive. We propose a way to combine FireSmart principles with those of ecological restoration. Techniques such as thinning the forest canopy and promoting the understory can improve both essential ecological services of the forest as well as its resilience against the spread of wildfire. Recommendations for gardens can also be communicated to better address native plant use, pollinator health, and human benefits. Disseminating this information to the public is essential in ensuring that homeowners have options to protect their property while still protecting and even restoring surrounding ecosystems.

Acknowledgments

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Introduction and Background

As climate change makes many parts of the world face hotter and drier summers, we are seeing an increased risk of major wildfires in many communities in forested areas throughout B.C (Wang et al., 2015; Pinna Sustainability, 2020). One such community is the island of Galiano in the Salish sea (Pinna Sustainability, 2020), which is home to about 1,400 permanent residents. Galiano comprises 78% forest dispersed evenly across the island (Emmings & Erickson, 2004). Aside from increased risks from drought and heat, Galiano also faces the issue that most of their forested area has been commercially logged within the last 15-80 years (Emmings & Erickson, 2004). Due to harvesting practices and a lack of restoration, the forests that have grown in commercially logged areas often lack the structural characteristics which make old growth Coastal Douglas Fir (CDF) ecosystems resistant to catastrophic fire events (Brown et al., 2004).

One program that aims to mitigate the risks of wildfire for communities and for homeowners is FireSmart BC, an offshoot of FireSmart Canada. Part of FireSmart's aim is to provide guidance to homeowners who live within the Wildland Urban Interface (WUI) on how to lower their risk in the event of a nearby fire (FireSmart BC (1), 2022). Guidance involves home maintenance tips and measures for the landscape to reduce fire risk, as well as methods for reducing fire risk in the forested areas surrounding people's homes (FireSmart BC (1), 2022). Although their recommendations are effective in terms of mitigating risk, they are quite broad and do not appear to take into account local ecosystems needs (e.g., the coastal Douglas fir ecosystems of Galiano Island) or goals of ecological restoration. While their guidelines can technically accommodate ecological wellbeing and restoration goals, the way those guidelines are communicated prioritize methods which can instead lead to greatly simplified landscapes

which do not address issues of biodiversity or ecosystem services (FireSmart BC (1), 2022). In response to this, we are working with the Galiano Conservancy Association (GCA) to design a brochure that will communicate FireSmart practices to Galiano residents in a way that is more consistent with ecological restoration and attentive to local conditions.

Our project has two key goals. The first is to understand how current FireSmart guidance relates to common goals of ecological restoration. Our objectives within this goal are; to compare FireSmart forest treatments to restoration treatments; to review the restoration literature on CDF ecosystems; and to compare FireSmart gardening advice with the literature on both pollinator health and ecological gardening. The other key goal is to provide Galiano and the GCA with a resource that can connect residents with the information they need to build resilience in the face of increasing wildfire risk. Our objectives within this goal are; to distill the information from our analysis into what is essential and actionable; to package that information in an intuitive and appealing way within the brochure; to provide resources for further reading; and to build a localised native plant list and organize it within a FireSmart framework.

In this report we first detail the reasons for taking on this project and the goals and objectives we aim to achieve. We then discuss the methods we used to understand the role of FireSmart on Galiano, and its relationship to environmental restoration. Following this we will provide an analysis of what we learned about FireSmart, its potentials and constraints, and its relationship to ecological restoration. We will then discuss our recommendations for adapting FireSmart to ecological restoration on Galiano, and provide a description of our brochure design.

Goals and Objectives

This project was proposed by Adam Huggins, the restoration coordinator for the GCA. The GCA have worked with FireSmart Galiano in the past to provide education on forest stewardship and fire risk mitigation (GCA, 2022). They have also worked to incorporate FireSmart guidance into their demonstration garden at the GCA main office. This project was thus proposed from the understanding that there is a lot of promise in incorporating FireSmart guidance and ecological restoration, but that there is work needed to better align these two frameworks. From this project the GCA intends to produce a brochure that can be used to communicate a more ecological version of FireSmart practices to Galiano residents.

The first goal of this project is to understand what opportunities and constraints are present when combining the FireSmart program with ecological restoration. To achieve this we have three objectives. The first is to review the restoration literature on CDF ecosystems and to compare it to the recommendations available through FireSmart BC. The second is to compare two different CDF forest stands on Galiano, one which has been treated by FireSmart Galiano, and one which was the focus of a GCA forest restoration project. Lastly we will look at the FireSmart gardening guidance and see how it aligns with the literature on ecological gardening practices and pollinator health.

The other goal of this project is to use what we have learned and design a brochure for the GCA that will communicate FireSmart practices to Galiano residents in a way that promotes the health of natural systems, including increasing biodiversity, building resilience/adaptability, and restoring ecosystem services. For this goal we have four objectives. The first is to refine the information from our analysis down to simple recommendations which are essential and actionable. Our second objective is to present that information in a visually appealing and easily

understandable form within the brochure. Our last two objectives are to provide resources for gardeners on Galiano. The first is to provide a brief list of local resources on ecologically sound gardening; the second is to build a localised native plant list and organize it within a FireSmart framework.

Through meeting these goals and objectives we hope for this project to promote ecologically-minded FireSmart practices in a way that encourages community members to engage in restoration-adjacent practices themselves, and to do so in ways that directly benefit the community through building resilience to fire, drought, and environmental degradation (Fox & Cundill, 2018). In areas such as Galiano, with a high percentage of forested private property, the opportunity present in community-engaged ecosystem care is high (Emmings & Erickson, 2004). For this engagement to be effective it is necessary that our recommendations are relevant and accessible to Galiano residents (Fox & Cundill, 2018). Beyond the specifics there is also the need to raise awareness of FireSmart generally, given that in a recent study only 33% of respondents had heard of the program (Erigibi & Hesseln, 2020). A brochure for the GCA to distribute is a valuable resource for what we hope to achieve, as printed media is one of the most effective forms of outreach available to the conservancy after social media, which is less permanent and requires more upkeep (Erigibi & Hesseln, 2020).

Methods

To understand the ecological constraints and opportunities within FireSmart and to build our recommendations, brochure, and resource lists we used a variety of methods. These included reviewing FireSmart BC's material as well as the relevant scientific literature, meeting with local experts, direct observation of different forest treatments, attending an online meeting for a fire

and drought mitigation research project on Salt Spring Island, and comparing plant lists from regional ecological-gardening resources.

We started out by working through the available videos and webpages on the FireSmart B.C. website to familiarize ourselves with their recommendations. We then looked through the scientific literature on the restoration of CDF ecosystems, and the literature on ecological gardening so that we could see whether or not FireSmart recommendations aligned with best practices for restoration. For this we tried to focus on locally or regionally based research as much as possible given that we are designing a localised resource.

While we were still working through the restoration literature, we met with Adam Huggins of the GCA to discuss how FireSmart and ecological restoration relate to one another and to discuss the that they had chosen to engage with FireSmart on their property. This included an explanation of the FireSmart measures taken in their demonstration Garden as well as the gardens water retention methods. We also met with Keith Erickson (R.P. Bio.), who was the previous FireSmart Galiano coordinator, and a previous restoration ecologist with the GCA. Keith showed us a CDF stand that he had been involved in restoring and explained the restoration process (Scholz et al., 2004). He also described some work he was involved in for FireSmart Galiano, treating a forest with FireSmart practices for use as a FireSmart demonstration site. Keith was very helpful in describing the differences and similarities between these two treatments, and provided valuable insight on the way that FireSmart has treated forests elsewhere in the province.

We also had the opportunity to sit in on a presentation by Transition Salt Spring (TSS) on the preliminary findings of their recent research in the Mount Maxwell watershed. TSS are

researching and designing restoration options for the watershed and are doing so with a focus towards drought resilience, and fire mitigation (TSS, 2022). This was a valuable opportunity and it highlighted the importance of promoting water retention in the landscape as a key method for reducing risks of fire, by keeping landscapes from reaching hazardously low moisture levels.

Finally, we compared plant selection resources from Pollinator Partnerships (n.d), FireSmart BC ((2) 2021), the Habitat Acquisition Trust (n.d), and the B.C. invasives council (ISCBC (2) 2021), as well as information on select plants from *Plants of the Pacific Northwest* (Pojar et al. 1994). We used these sources to narrow down a list of plants that are fire resistant, drought resistant, pollinator friendly, and native to Galiano. We also used the information from these various sources to divide our plant recommendations into zones that are consistent with FireSmart guidelines, and to provide additional gardening suggestions. Once we had a draft of our list ready Adam Huggins provided additional plant suggestions, formatting suggestions, and editing to ensure that the plants on our list were appropriate for Galiano specifically.

Analysis of Current FireSmart Guidance

From our research into FireSmart, CDF restoration, and ecological gardening we found a few issues with the current FireSmart guidance and practices but also a lot of opportunity to achieve restoration goals within a FireSmart framework.

For forest ecosystems we found that FireSmart prioritises the removal of any possible fire fuels and over thinning of the trees. This often leaves forests with unhealthy understories and little forest structure (Fig 1). However, from our discussion with Keith and our observations of the FireSmart demonstration forest a lot of this came down to interpretation of guidelines. The demonstration forest on Galiano was not as different from the restored stand as we had expected,

Figure 1: FireSmart treated forest in Williams Lake B.C. (picture by City of Williams Lake)

and differed greatly from the FireSmart forest we found in the scientific literature (Fig 2). This showed that there is a lot of opportunity simply in highlighting the restoration opportunities within FireSmart. Practices which need to be highlighted are the promotion of understory plants, the benefits of leaving large diameter debris in treated forests, and the creation of light diversity through opening up the canopy. One key aspect that is missing from FireSmart is the need for greater water retention in landscapes. This was highlighted by TSS in their Mount Maxwell presentation as a key method of reducing fire risk while also addressing the regionally salient issue of drought tolerance. Greater water retention can be achieved by the above methods of promoting the understory and keeping large diameter debris in the forest. The promotion of the understory also has direct benefits to the proliferation of native plant species and the health of local pollinator populations.

Figure 2: FireSmart Galiano demonstration forest (picture by C. Riccitelli)

We found that FireSmart guidance for gardens can also be adjusted in a few key ways to better accommodate common restoration goals. Firstly, when we reviewed FireSmart's landscaping guide we found that their list of recommended plants could be better adapted to the

needs of Galiano. FireSmart B.C. does provide some useful suggestions for fire resistant plants, listed by hardiness zone (FireSmart BC (2), 2022). However these lists are generalized for all of B.C. and include potentially invasive horticultural varietals (such as varietals of Laurel), and plants which are known invaders in similar ecosystems (such as dead nettles, common heather (Effah et al., 2020), and hawthorns including common hawthorn) (ISCBC (1), 2021; FireSmart BC (2), 2022). The plant list also includes potentially problematic native species such as snowberry, which have been known to crowd out the understory in relatively open forests, and meadows (Shackleford et al., 2019). This leaves a lot of room to adjust FireSmart recommendations to promote plant species native specifically to Galiano, and to prevent the promotion of invasive species. The plant list can also be adjusted to be more attentive to the drought conditions that Galiano faces each summer. This ties into another opportunity to enhance FireSmart's advice, which is to address water retention in Garden landscapes. Similar to forest ecosystems, water retention in the landscape can increase the fire resiliency by preventing arid conditions (Barkeley et al., 2004). areas that are able to retain higher moisture may even be able to act as green fire breaks, providing security to adjacent ecosystems (Cui et al., 2019;). This gap also misses an opportunity to make FireSmart more appealing to residents of drought prone communities who may benefit from finding methods of addressing these issues concurrently (McCann et al., 2018). Many water retention methods such as swales and rain gardens also create microclimates and greater habitat diversity for pollinators (HAT, n.d.).

Pollinator health is another concern that can be better addressed by some adjustments to the current FireSmart guidance. Part of FireSmart's advice is to regularly mow lawns regularly to keep them below ten centimetres, and their infographics all feature landscapes dominated by grass lawns (Fig. 3). Although their guidance on this does not exclude other types of

landscaping, the material does give the strong impression that a FireSmart landscape is a neatly mown monoculture. The other plants that feature in these infographics are few and are widely spaced. The recommendation of frequent mowing and the predominance of lawns, does not align well with the need to promote local native species, and it might turn away gardeners who prioritize diverse and productive landscapes over FireSmart. It also does not align with the needs of local pollinators, as it reduces key habitat and food resources (Del Toro & Ribbons, 2020; Lerman et al., 2018; Pollinator Partnerships, n.d). This presents an opportunity to promote other forms of FireSmart compatible landscapes, thus addressing most of these issues. The recommendation for frequent mowing can also be adjusted to address these issues while remaining effective by specifically recommending mowing in peak fire season while allowing for wildflower meadows at times of low risk (Del Toro & Ribbons, 2020).

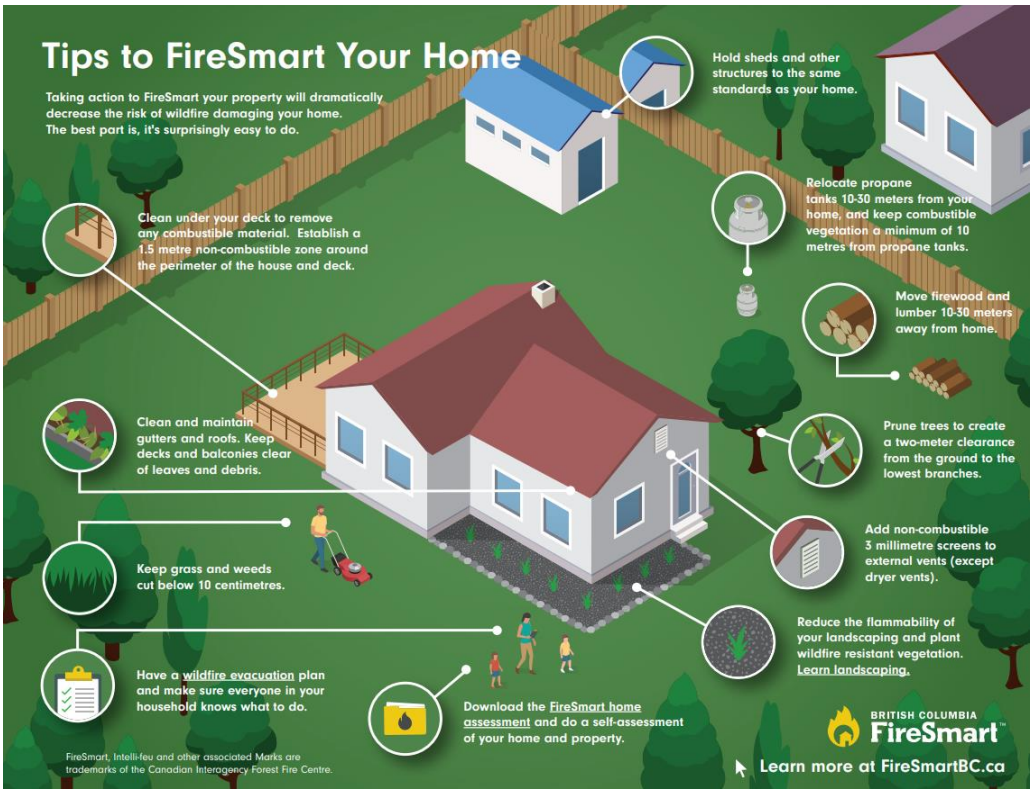

Figure 3: FireSmart home maintenance poster

The potential for combining community-engaged restoration with FireSmart on Galiano is high (Fox & Cundill, 2018). However, while FireSmart guidance is technically inclusive of goals related to restoration of forest ecosystems, their primary focus is on reducing risks of fire damage to property (FireSmart BC (1), 2022). Although FireSmart recommendations may not align exactly with standard definitions and principles of ecological restoration, any program with the potential to promote widespread ecosystem and landscape changes while involving private stakeholders on a local, provincial, and federal level, has a massive potential to effect positive ecosystem changes (Fox & Cundill, 2018). FireSmart is an attempt to limit the risk of catastrophic fire and does not aim for total fire suppression (Hirsch et al., 2001). They acknowledge that citizen interventions will be based around different levels of risk acceptance (Hirsch et al., 2001). With this in mind we hope that our recommendations will offer flexible, locally adapted, solutions which residents can apply creatively to attain their desired level of fire safety (Hirsch et al., 2001).

Discussion and Recommendations

Forested Areas

Mature coastal Douglas-Fir forests are naturally more resistant to fire and assisting the succession of these forests by combining ecological restoration with FireSmart practices could help Galiano Island work towards a long-term safety net against wildfires (Flynn 1999). One of the first suggestions we present that could satisfy both restoration and FireSmart is opening up the forest canopy. Open forest ecosystems have several ecological benefits including increasing the biodiversity by creating a “formation of a diverse, forb- and grass-dominated understory” (Hanberry et al., 2020, p. 3). This can promote the growth of young trees which have the potential to become a fire risk if left unchecked. In order to reduce that risk, it is best to ensure

that the young trees are kept widely spaced and have no fire ladders or fine fuels attached to them. Additionally, open forest canopies increase soil moisture as more rainfall is able to reach the understory, allowing the plants there to take up more water and prevent them from drying out and becoming more susceptible to the spread of wildfire, especially during seasonal droughts (Hanberry et al., 2020). An open forest ecosystem also increases the diversity in the availability of light which in turn promotes plant diversity and structural complexity of the understory (Hanberry et a., 2020). Opening the forest and creating more space between trees also reduces the amount of fuel and bridges a wildfire has to catch on to, thus decreasing the likelihood of the fire spreading (K. Erickson, personal communication, June 15, 2022).

Creating an open forest ecosystem can occur by limbing trees up to 2 metres, which also reduces fire ladders which fire can use to climb up into the forest canopy. Thinning trees where it seems appropriate, such as with dead or suppressed trees, also helps to create spaces in the canopy and open up the forest. To incorporate restoration principles, while still being FireSmart, people can leave larger trees and logs dispersed across the forest floor and that organic material will provide habitat for native plants and wildlife, creates desirable soil conditions for the growth of beneficial fungi and functions as a moisture sink during periods of heavy drought, which further encourages resilience against the spread of wildfire, and overall helps to creates a diverse, healthy forest structure that usually takes centuries to form (Scholz et al., 2004).

Thinning trees and opening the forest canopy leads to a more substantial understory, which can improve various ecosystem functions. This includes increasing the amount of native flowers and plants, which in turn will be beneficial for native pollinators and other insects, food for a variety of native wildlife, more stable soil that is less susceptible to erosion, and improved water retention of the soil (Anr, M. and Taylor, L., n.d.).

FireSmart Galiano representative Keith Erickson (personal communication, June 15, 2022) explained to us that promoting the understory can be both ecologically beneficial and FireSmart compliant and informed us on some techniques that can be used to achieve this. People should also remove fine fuels (wood less than 7cm in diameter) such as smaller sticks and logs which tend to catch fire quicker and easier than larger woods. Additionally, the removal of flammable invasive species, such as scotch broom and gorse both decreases fire risk and improves the native ecology of the forest. According to Erickson, this kind of forest management would only need to occur every 10-15 years, meaning it is relatively low-commitment for Galiano residents.

Garden Areas

The other major landscape category that FireSmart provides recommendations for is the garden areas directly surrounding people's homes (FireSmart BC (1), 2022). We identified a number of opportunities within these areas which align with FireSmart guidelines, the needs of Galiano, and principles of ecological restoration. These were; the promotion of drought tolerant and fire-resistant native species, the promotion of more diverse and abundant gardens for pollinator health (Del Toro & Ribbons, 2020; Ebeling et al., 2008), fire prevention and drought mitigation through on-site water retention systems (Barkeley et al., 2004), and the continuation/integration of the aesthetic and provisioning needs of Galiano residents. Similar to forest ecosystems, FireSmart leaves room for ecologically minded practices in garden design and maintenance, but the way that their guidelines are communicated privileges simplified landscapes and downplays or ignores related ecological issues (FireSmart BC (1), 2022).

This section of our advice is inspired by the work of the Galiano Conservancy Association in their demonstration garden at their main office. Their garden incorporates

ecological design techniques with FireSmart guidelines, while addressing native plant promotion and on-site water retention. While designed ecosystems such as these do not necessarily fit within an orthodox ecological restoration framework, they can contribute significantly to biodiversity goals, especially when looking at a landscape scale (Jason, 2022). One of these goals is the protection and proliferation of locally adapted native species. Because the coastal Douglas fir ecosystems and Garry oak ecosystems which cover much of Galiano are fire adapted, there are many fire-adapted native plants for home landscapers to choose from. By promoting the use of a diversity of native species, home gardens can aid in pollination of wild populations in adjacent ecosystems, and provide a seed reserve in the event of threats to wild populations (Ebeling et al., 2008). To address the incompatibility of FireSmarts plant list with the needs of Galiano's ecosystems, we have developed a localised native plant list (Appendix A) as well as a list of more general ecological gardening resources for residents to reference. These resources include the B.C. invasives council planting recommendations, as well as a localised guide for native plants for pollinator health (ISCBC (2), 2021; Pollinator Partnerships, n.d). These resources were also used along with Firesmart's plant recommendations, the Habitat Acquisition Trusts local guidance (HAT, n.d.), and *Plants of the Pacific Northwest* (Pojar et al. 1994) to generate our plant list (FireSmart BC (2), 2022).

While the promotion of native plant species - and more plant diversity in gardens - is central to the goal of increasing pollinator diversity and abundance (Ebeling et al., 2008), we will also be including recommendations for gardeners seeking lower maintenance options. FireSmart's communication of near home fire safety falls short. One key issue is the prominence of neatly mown grass lawns in their visual aids, along with their recommendation of always keeping grasses below 10cm. Our recommendation of region appropriate native plant species is

aimed to address the issue of lawns generally, but we also want to provide advice to accommodate residents who do not have the time or resources to maintain full gardens, or who may wish to maintain a lawn for mobility reasons. For those who wish to keep a lawn we are recommending a reduction in the frequency of mowing, which has been shown to provide long term benefits to pollinators (Del Toro & Ribbons, 2020; Lerman et al., 2018). The recommendation to keep grasses short can be adhered to more closely in peak fire season. We also recommend the inclusion of wildflowers in lawns, which can be a low maintenance way of increasing pollinator resources and assisting native species (Del Toro & Ribbons, 2020). Many wildflower options - such as blue flax *(Linum lewis)* and common camas *(Camassia quamash)* - have flowering seasons which end before peak fire season and can be included in maintenance plans which require regular mowing in July and August. This recommendation is based on the need to provide guidance which aligns with the needs of Galiano residents in order to increase engagement. Another aspect of FireSmart guidance which doesn't adequately integrate ecological needs and residents' needs is the recommendation of spacing out ornamental and food plants, and prioritising sparse landscapes in their visual aids. This not only limits pollinator resources but limits residents' abilities to achieve their aesthetic and food provisioning needs from their gardens. To address this, we can look at the work of the GCA on integrating ecological design with FireSmart principles in the design of their demonstration Garden.

FireSmart divides the home landscape into four key zones (Fig 4). The first is the non-combustible zone or zone 0, which extends 1.5 metres out from any buildings, and which should be kept clear of any flammable material. The FireSmart guidance on zone 0 is sound, comprehensive, and well communicated and we have no issue with directing people directly to their recommendations. The zones we are concerned with are zones 1-3, in which the above

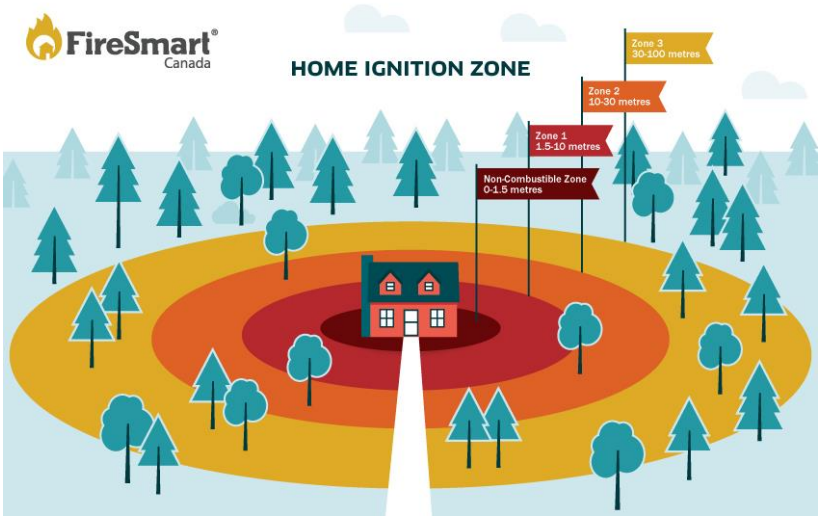

Figure 4: FireSmart infographic depicting the Home Ignition Zone

issues of landscape simplification are present. Zone 1 is 1.5-10 metres from the home and advice for this zone includes keeping a low density of plants, and avoiding woody debris. Zone 2 is 10 – 30 metres and advice is also focused on thinning, pruning, and general fuel reduction. Zone 3, if it applies, extends 30-100 metres from the home and advice for this zone is similar to advice for forest ecosystems, meaning thinning and fuel reduction. Our advice follows the lead of the GCA demonstration garden and incorporates higher densities of local native plants that still keep the FireSmart guidance around fire breaks, fire ladders, and fire resistance in mind. We have organized our recommended native plant list into these zones to make the communication of this guidance more intuitive. For zone 1 we only recommend low-lying fire-resistant plants that don't produce woody debris. The recommendations of plants in this high-use zone will include plants with high aesthetic value as well as frequently used food plants such as non-volatile herbs, or fun snacks like wild strawberry. This zone can include rock gardens, and dirt or gravel paths which can act as fire breaks between densely planted beds. Mulch should be avoided in this zone and if more water retention is needed, we recommend lasagna gardening instead, as it can achieve similar water retention without contributing to exposed, dry woody debris (El-Ahmed, 2020; Bloom & Boehnlein, 2015, p. 143). Zone 2 allows for more flexibility in planting. This zone can include fire resistant shrubs, and deciduous trees and can be used to create food forests which can

increase on site water retention, while providing for pollinator and food provisioning needs. Zone 3 can include more trees, which can provide shade and allows for a wetter ecosystem. Plant recommendations for this zone include some more shade tolerant species. Plants for this zone are also more suited to slightly wetter soils, while still being able to handle drought. By increasing water retention in this part of the landscape Zone 3 can potentially act as a green firebreak if properly managed (Cui et al., 2019).

The final part of this advice is focused on ways in which residents can increase water retention in their gardens. By keeping more water in the landscape, residents can reduce the risks of high intensity fires that would occur in a drier environment (Barkeley et al., 2004). Increasing on site water retention makes gardens more drought resistant, which also allows for more productive gardens without straining limited public water sources (McCann et al., 2018). By fostering greater plant productivity throughout the summer these recommendations align with our objective of promoting native plant species and associated resources for pollinators. Pollinators are also supported by landscape modifications for water retention through the creation of greater habitat diversity (HAT, n.d.). Water use is an important issue on Galiano and other drought prone Gulf Islands, so water retention recommendations are also intended as a way of increasing engagement. Most of the landscaping methods we recommend have been implemented throughout the GCA's property and are originally derived from the traditional methods of ecosystem management by indigenous peoples from all parts of the world (Akpinar & Cecunjanin, 2014; Bloom & Boehnlein, 2015). The goal of these water retention systems is to slow, sink, and spread water as it moves through a site (Bloom & Boehnlein, 2015, p. 148). Examples of water retention strategies that can be viewed at the GCA's demonstration garden, including swales both on and off contour, as well as rain barrels to collect water from built

structures through the winter. Both of these options are a great low maintenance way to increase water on site and to keep gardens well watered in times of water scarcity (Akpinar & Cecunjanin, 2014; Bloom & Boehnlein, 2015, pp. 146-171). Another method that the conservancy uses, but which is a greater investment, is a greywater system with flow splitters to divert the offices' greywater use directly to the garden (Bloom & Boehnlein, 2015, pp. 177-179). Alternatively, a much cheaper method is to spread woody debris where appropriate, meaning on bare soil, and outside of zone 1. While FireSmart prioritises advice on the removal of coarse woody debris in most situations, this use is still consistent with their guidelines and can provide residents with a cheap method of building the soil sponge and increasing the drought tolerance of their landscape (Bloom & Boehnlein, 2015, p. 142). This also provides a use for woody debris removed from other parts of the landscape. Aside from these methods drought mitigation will largely be achieved by selecting plants which are adapted to local conditions as discussed above.

Brochure description / layout

Appendix A shows a mock-up of our brochure in what we think would be an effective way to deliver this information to the community on Galiano Island. We tried to design it in a way that the content flowed nicely and it is easy to read and understand for all members of the community.

We suggest a 6-panel brochure that folds out to reveal a larger picture on the inside (see Appendix C for reference). Panel 1 will have native, fire-resistant, drought-resistant plant suggestions and examples of native plant guilds that are resilient to wildfires as well as links to more information on native plants. Panel 2 will have links to further resources, the GCA, FireSmart Galiano, and acknowledgements to those who assisted in this project. Panel 3 will be an introduction/title page. Panel 4 will explain what FireSmart is, why programs like it are

important, but also how it is lacking in terms of considering ecology. Panel 5 will explain why it is important to use FireSmart techniques in an ecologically minded way and its benefits. Panel 6 will provide some brief suggestions on actual home maintenance as well as links to further information. The inside will be the main focus, which will have the suggestions for both forested areas and meadows, clearings, and gardens that may be closer to people's homes. We will also share an editable link to the brochure so the GCA may alter it as they see fit.

Conclusion

We hope that our project provides the residents of Galiano with a resource that allows them to safeguard themselves and their community from wildfires in a way that still benefits the environment they love and live in. It is important that people have access to information such as this in a way that is accessible and easy to understand. Should the project be successful on Galiano Island, similar techniques and resources could be applied to the other Gulf Islands.

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Appendix A

Plant Suggestions by Zone

Our plant recommendations are arranged into three FireSmart zones. Zone 1 includes plants which are low to the ground, produce minimal or no woody debris, and which are adapted to high sunlight and low moisture. This zone also includes recommendations for wildflowers which would be suitable for low maintenance lawns which will be mown at times of high fire risk. Zone 2 plants are also drought tolerant and considered fire resistant, but zone 2 allows for more flexibility in plant choice. Plants in zone 2 include small trees (pruned to 2 metres, select shrubs, and wildflowers. This zone allows for the incorporation of plants with higher shade tolerance due to the inclusion of trees and even low shrubs. Zone 3 is likely either forested or forest adjacent, and allows for a higher presence of conifers. This zone is more suitable for plants which have higher shade and moisture needs, but suggestions are still attentive to drought tolerance. The zone column of our plant lists includes the zone or zones we think are appropriate for each plant according to these parameters. When multiple zones are suggested the ideal zone according to fire resistance, water use, sun exposure and associated plants (i.e. presence/absence of shrubs and/or trees), is bolded.

*(M) next to common name indicates plants that flower early and can be mown down in peak fire season

** Ideal zone is bolded (includes water use, sun exposure, and FireSmart considerations)

Wildflowers and Groundcovers

Scientific name	Common name	Water use	Sun (s) / Shade(sh) Partial (p) / Full (f)	Zones**
Achillea millefolium	Yarrow	very low	fs	1-2
Allium acuminatum	Hookers' onion	low	**fs**-psh	**2**
Allium cernuum	Nodding onion	low	**fs**-psh	**2**
Aquilegia canadensis	Red columbine	medium	fs-psh	2-**3**
Brodiaea elegans	Harvest brodiaea	low	fs-psh	**1**
Calandrinia ciliata	Red maids (m)	low-med	fs	1-2
Camassia leichtlinii	Great camas (M)*	low-med	fs	**1**
Chamaenerion angustifolium	Fireweed	low	fs-psh	**2**-3
Clarkia amoena	Farewell to spring	low	fs	**1**-2
Claytonia perfoliata	Miners' lettuce	med-high	psh	2-**3**
Coreopsis sp.	Coreopsis	low	fs-psh	1-2

Delphinium menziesii	Menzies larkspur (M)	low-med	fs-psh	1-**2**
Eriogonum umbellatum	Sulphur buckwheat	very low	fs	1-2
Erythranthe guttatus	Seep monkey flower	med-high	fs/psh	2
Erythronium spp. (E. oregonum or E. revolutum)	Fawn lily	low-med	fs/psh	**1**-2
Fragaria Vesca	Woodland strawberry	med	fs/psh	1-**2**-3
Fritillaria affinis	Chocolate lily	med	fs	**1**-2
Heuchera micrantha	Crevice alumroot	low-med	fs-psh	**2**
Lomatium utriculatum	Spring gold	very low - low	fs	**1**-2
Lonicera ciliosa	Western trumpet honeysuckle	low	fs-psh	1-**2**-3
Lupinus polyphyllus	Large leafed lupin	med	fs-psh	**2**
Monarda fistulosa	Beebalm	low	fs-psh	1-2
Plectritis congesta	Seablush	low-medium	fs-psh	**2**

Primula hendersonii	Broad leafed shootingstar (M)	low-med	fs-psh	**1**
Primula pauciflora	Dark throated shootingstar (M)	low-med	fs-psh-fsh	**1**
Sedum spathulifolium	Broadleaf stonecrop	very low	fs-psh	**1**-2
Solidago altissima subsp. gilvocanescens	Canada goldenrod	low	fs	1-2
Tellima grandiflora	Fringe cups	medium-high	psh-fsh	2-**3**
Triteleia hyacinthina	Fools onion	low	fs	**1**-2
Viola adunca	Early blue violet (M)	med	fs-psh	**1**-2

Shrubs:

Scientific name	**Common name**	**Water use**	**Sun (s) / Shade(sh) Partial (p) / Full (f)**	**Zones**
Amelanchier alnifolia	Saskatoon berry	low	fsh-psh	**2**

Gaultheria shallon	Salal	high	fs-psh	**3**
Holodiscus discolor	Oceanspray	med	fs-psh	2-3
Mahonia aquifolium	Tall Oregon grape	low	fs-psh	**2**-3
Mahonia nervosa	Dull Oregon grape	low-med	fs-psh	2-**3**
Oemleria cerasiformis	Osoberry	low-med	fs-psh	**2**
Physocarpus capitatus	Pacific ninebark	low-med	fs-psh	2-**3**
Ribes sanguineum	Red flowering currant	med	fs-psh	**2**
Shepherdia canadensis	Soapberry	very low	fs	**2**
Spiraea douglasii	Hardhack	medium	fs-psh	2-3
Vaccinium parvifolium	Red huckleberry	medium	fs-psh	2-3

Trees:

Scientific name	Common name	Water use	Sun (s) / Shade(sh) Partial (p) / Full (f)	Zone
Acer macrophyllum	Big leaf maple	med	fs-psh	**3**
Alnus rubra	Red alder	med	fs-psh	**3**
Arbutus menziesii	Arbutus	low	fs	**3**
Malus fusca	Pacific crab-apple	low-med	fs-psh	**2**
Populus trichocarpa	Black cottonwood	med-high	psh-fs	**3**
Prunus emarginata	Bitter cherry	med	fs-psh	**2**
Quercus garryana	Garry oak	low-med	fs	2-3

Non-native plant tips

- Well watered garden beds of regularly used food crops can be planted in zone 1 provided you avoid plants with volatile oils such as rosemary or mint)
- Zone 2 can also include planter beds, and can be used to grow volatile herbs provided they are well spaced. This zone is a good place for small fruit trees. FireSmart fruit trees without excessive watering needs include pear or black cherry.
- If your property extends to zone 3 consider using this space for your larger fruit trees.

Appendix B

Resource Recommendations for Brochure

- https://www.getprepared.gc.ca/cnt/hzd/wldfrs-bfr-en.aspx
- https://www.getprepared.gc.ca/cnt/hzd/wldfrs-drng-en.aspx
- https://bcinvasives.ca/play-your-part/plantwise/grow-me-instead/
- https://www.pollinator.org/guides
- http://hat.bc.ca/gardeningwithnature

Appendix C: Brochure Images*

*The GCA is free to alter this brochure design however they see fit.

WHAT IS FIRESMART?

- A program aimed at helping Canadians protect their homes and communities from wildfires.
- Programs like this are important as climate change has worsened wildfires for many fire-prone regions, such as here on Galiano.

HOWEVER...

- Many of the FireSmart techniques do little to consider the ecological impact of the program
- Even though much of the potential fuel for a fire is removed, many forests are left with little to no understory

Pictured here is an area treated using standard FireSmart techniques in the Williams Lake Community Forest (picture by the City of Williams Lake)

WHY IS IT IMPORTANT TO KEEP ECOLOGY IN MIND?

MAKING FIRESMART MORE ECOLOGICALLY MINDED CAN...

- provide resources for pollinators
- Provide habitat for a variety of native wildlife
- revitalize ecosystem services like retaining and filtering water, and preventing erosion
- provide a seed bank for local native plant species
- Helps build resilience in local ecosystems
- Supports community wellbeing

HOUSE MAINTENANCE

One of the first things homeowners can do is maintain a FireSmart home

STRATEGIES

- Keep all firewood away from the house
- Use fire-resistant roofing and side paneling
- Clean debris from roofs and rain gutters
- Maintain exterior of home by clearing away any woody debris and fine fuels on yards, decks, window sills, etc.

(Picture by FireSmart BC)

MEADOWS, CLEARINGS, AND GARDENS

Strategies:

- prioritize native drought-adapted fire- resistant plants. Native wildflowers can keep a garden FireSmart and help local pollinators.
- For low maintenance lawns plant wildflowers that bloom early and which can be mowed in fire season. Mow less frequently outside of peak fire season

- Use water conservation strategies such as swales and rain barrels to keep thirstier plants watered through times of increased fire risk
- Lasagna gardening instead of mulching can increase water retention while keeping woody debris off of the surface
- Plant your garden around Firesmart zones to ensure a productive fire resistant garden. Visit the GCA program center garden to see this, and many other strategies in action. See the GCA plant list for zone appropriate plant choices.

FORESTED AREAS

Strategies:

- Limb trees up to 2m to reduce fire ladders
- Remove fine fuels less than 7cm in diameter (i.e. sticks and small logs)
- Remove flammable invasives (i.e. scotch broom and gorse)
- Thin dead or suppressed trees to create space in the forest
- Leave behind larger felled trees and logs to support the understory

Here is an area of forest near the Galiano Library treated by FireSmart Galiano using these types of strategies (picture by C. Riccitelli)