Invasive Species in the Capital Regional District
Best Practices

Major Project

Royal Environmental Consulting

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Executive Summary

This report was commissioned by the Capital Regional District Roundtable on the Environment (RTE) to determine the best practices that can be implemented in the Capital Regional District (CRD) to control the spread invasive species (IS). The overall goals of this report were to: identify the social, economic, and environmental implications of IS; provide recommendations for improved disposal along with a governance model that will improve the management and control of IS; and communicate effective strategies that will modify the behaviours of residents and the private sector in the CRD.

Invasive species were brought into the CRD over a century ago; today, many of these plants cause negative impacts on society, the economy, and the environment. Disposal of invasive species is a major barrier in the CRD, which is likely due to the limited disposal methodologies leading to decreased participation by local residents. There are also discrepancies in the governance model due to a lack of uniformity between municipalities, making it difficult to deal with this region-wide issue. By-laws also appear to be lacking in all areas except Saanich and there seems to be a disconnect between the government and the community. Further investigation was done to determine ways for the CRD to effectively communicate to the public and increase community participation to improve this disconnect.

A disposal methodology has been outlined to improve the current method, which includes bagging, labeling, and disposing of the invasive species at the Hartland Landfill. This new method will be done by creating awareness and introducing yellow bin stickers. A potential pilot project has also been suggested to determine the effectiveness of such a disposal project. In order to resolve the governance quandary, a tier system has been proposed with increasing levels of effectiveness based on researched methodologies. In order to improve communication between the CRD and the public, various methods have been suggested including increasing social norms, emphasizing the impacts of invasive species, community events, suggesting alternative plants, and utilizing social media to campaign against invasive species.

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Acknowledgements

Jonathan Moran (RRU - Faculty Advisor)

Nancy Wilkin (CRD Roundtable on the Environment)

Stephen Brydon (CRD Roundtable on the Environment)

Carolyn Richman (District of Saanich, Capital Region Invasive Species Partnership)

Members of the CRD Roundtable on the Environment

Acronyms and Abbreviations

The following are a list of acronyms or abbreviations that may be used within the report:

CBSM	Community-Based Social Marketing
CISC	Coastal Invasive Species Committee
CRD	Capital Regional District
CRISP	Capital Region Invasive Species Partnership
IAPP	Invasive Alien Plant Program
IS	Invasive Species
LEED	Leadership in Energy & Environmental Design
REC	Royal Environmental Consultants
RRU	Royal Roads University
RTE	Roundtable on the Environment

Glossary of Terms

The following is a list of key terms that will be used within the report:

Allelopathy: The chemical interaction between plants in a given area.

Biodiversity: The variation of organisms occupying an area.

Canopy Cover: The vegetative growth that covers an area.

Carcinogenic: A substance that has the ability to cause cancer.

Community-Based Social Marketing: The delivery of products and services that are used as tools for individuals to overcome barriers of a desired behaviour.

Control: The management of invasive species in a way that prevents the further spread of current invasive species populations in an area.

Deleterious: A negative impact that causes damage.

Dominant Nature: The ability to thrive in the environment and out-compete native species.

Ecosystem: Living and non-living components interacting in an area.

Eradication: The full removal of invasive species from an area.

Erosion: The transfer of soil from an area by air and water.

Established: Temporal and spatial persistence of a given invasive species in an area.

Governance: All the processes that involve the government.

Humic: The organic horizon found in a soil profile.

Invasive Species: Any plant or animal that is non-native to an area and has the potential to negatively affect local ecosystems.

Impact: The positive or negative effects on something/someone due to the presence of invasive species.

Mitigation: The implementation of measures that will lessen the impact of invasive species.

Native Species: Living organisms that are indigenous to an area.

Non-Invasive Introductions: Non-native species that are not invasive.

Social Diffusion: A message that is relayed socially by individuals within a community.

Social Norm: An activity that becomes normal practice accepted by society.

Xenobiotic: A substance created by humans that is not commonly found in nature; therefore, natural attenuation is retarded.

Understory: Plants that can be found under the overlying canopy in an area.

Introduction

Invasive species are introduced organisms with no local competition from native species. Due to the lack of natural control, invasive plants are able to outcompete and overtake native species, causing a decline in biodiversity. This can have many negative effects on the environment as well as on the social and economic aspects of society. They can be dispersed by humans intentionally via the buying and selling of seeds, or unintentionally via wind, water, and other physical means; therefore, it is important to determine effective, standardized methodologies for controlling future spread of invasive species. The purpose of this report was to provide the Capital Regional District Roundtable on the Environment with best practices for governance, management, and communication of invasive species within the Capital Region.

Background & Scope of Project

Invasive species are alien species that were introduced by humans and animals into an ecosystem where they were not previously present. For example, the long range transport of seeds via birds. The nomenclature, invasive species, is derived from the knowledge that these alien species act in a particular way (CISC, n.d.). When species do not spread to adjacent properties or cause detrimental impacts to the native species, they are classified as non-invasive introductions (Muth & Pigliucci, 2006). Only when the species acts in a manner that negatively impacts the surrounding environment, by outcompeting native species, are they considered invasive. Most invasive species are introduced accidentally by humans and sometimes intentionally without realizing the damage it might cause to the ecosystem. Invasive species originate from an ecosystem that possesses a similar climate to the ecosystem it is invading, which makes them very difficult and costly to control and eradicate (CISC, n.d.).

The introduction of invasive species in the CRD can be traced to over a century ago. A classic case would be the introduction of Scotch broom (*Cytisus scoparius*) by gardeners in the 1850s. The plants eventually breached the boundaries of their gardens and spread to the local ecosystems. The understanding of the significance at that time was not realized, which led to the spread of Scotch broom throughout Vancouver Island (CRISP, n.d). To this day, broom remains on both the CRISP and CRD invasive species lists under species to "control" (CRISP, n.d.). Because of the destructive nature of this species, it is surmised that the invasive committees of BC are hesitant to change the classification to "established".

The CRD, established in 1966, now encompasses thirteen municipalities and three electoral areas. The primary purpose of forming this governmental organization was to coordinate local government (municipal) on topics of regional issues. One of the objectives was to ensure that essential services were provided to all regions that fell within its boundaries (CRD, n.d.). The Capital Region Invasive Species Partnership (CRISP) was formed in order to help combat the invasive species issue within the CRD region. CRISP is a branch of the Coastal Invasive Species Committee that is made up of volunteers from CISC, local governments, Capital Regional District, First Nations, provincial representatives, and local land managers (CRISP, n.d.).

Community-Based Social Marketing (CBSM) was used as an approach in this report to prompt changes in human behaviours by drawing on social psychology to develop tools for a desired behaviour (McKenzie-Mohr, 2010). This approach can be conducted in a five step process: selecting behaviors, identifying barriers & benefits, developing strategies, conducting a pilot, and broad-scale implementation. Some of the major strategies used to induce change involve social norms, commitment, social diffusion, prompts, effective communication, incentives, and increasing convenience (McKenzie-Mohr, 2010).

The purpose of the major project was to develop a comprehensive program for the communication, management, and disposal of invasive species that are currently found in the Capital Regional District (CRD). There are currently a few non-profit organizations established on Vancouver Island that are working with the CRD for the mitigation and control of invasive species. The invasive species that are found within the Capital Region have been categorized as species that should be prevented, eradicated, contained, or controlled. Some of the species have been listed as a toxic risk to humans and animals (CRISP, 2013). One of the main problems identified with the current program, or lack thereof, is the disposal methodology that is being used for invasive species. In order to provide recommendations to the CRD Roundtable for consideration, research had to be performed in order to look at:

1. The social, economic, and environmental implications of invasive species.
2. The disposal methods that are currently being used and recommendations for improvements.
3. Providing a governance model that could be easily implemented in order to improve the management and control of invasive species within the CRD.
4. Effective and easy to implement communication strategies that would modify the behaviours of residents and the private sector. This would influence the establishment of partnerships and networks between entities.

The project was divided into four main components: impacts, disposal, governance, and communication. The scope was to provide a platform in which the CRD could implement the program based on the magnitude of implementation. The goal was to provide a broad range of selections, ranging from easy to difficult, with the hopes that the easier ones would be accepted

and implemented immediately by the CRD. If adopted, it would require that the CRD transcend the proposal to higher levels of government (provincial) in order for it to become an essential service provided by this entity (CRD). This would allow for better standardization for the disposal and control of invasive species across each jurisdictional border. The arrangement of the proposal would ensure that individual municipalities had an opportunity to adopt a simplified version of the program if the CRD decided to opt-out.

Background Information on the Sponsor

Nancy Wilkin is currently the Director for the Office of Sustainability at Royal Roads University. Her past experiences include Chief Negotiator for the Province of British Columbia in the Ministry of Aboriginal Relations and Assistant Deputy Minister for Environmental Stewardship Division in the Ministry of Environment for the Province of British Columbia. Stephen Brydon is currently the Manager of Environment and Climate at BC Transit Corporation. Nancy and Stephen are currently members of the CRD Roundtable on the Environment (RTE) whose objectives are to lend support to the CRD through another branch called the Environment Sustainability Committee.

The current members of the RTE include Lynn Bailey (Vice-Chair), Stephen Brydon, Stephanie Cairns, Jill Doucette, Neville Grigg, Gene Miller, David Moffatt (Chair), Dale Wall, and Nancy Wilkin. The primary interest for the RTE pertains to protecting the environment as well as developing ideas for climate change action. Their objectives are to include long-term strategies for issues pertaining to environmental sustainability and forwarding these strategies to decision-makers. In addition, bringing current issues to light with new plans that can be implemented to reach the CRD's goals and strategies for sustainability. The RTE functions as a separate advisory entity formed by residents of the CRD that have in-depth expertise in environmental management; they typically report through the Environmental Sustainability Committee. In turn, the Environmental Sustainability Committee may forward their findings to the CRD or other committees (CRD, 2011).

Methods

i) Background Research - Determining what the current management practices are within the thirteen municipalities and their effectiveness in controlling invasive species. Also, determining what similar regions are doing to control invasive species to see if a comparable approach can be used in the CRD.

ii) Interviews - Consulting with professionals such as members of the CRD or municipality members for their current understandings, professional opinions, etc. Also, conducting interviews with the public to determine knowledge and opinions on the subject.

iii) Site Visits - Potential walkthrough visits to locations such as the Hartland Landfill, Knockan Hill Park, RRU campus etc. to gain further insight to current or potential management practices.

iv) Report Writing - Compiling information gained from research and interviews into a detailed report pertaining to the objectives of the project detailed above.

v) Presentations - Presenting current and final research, findings, and ideas to the faculty advisor, CRD Roundtable on the Environment and guests.

Impacts

When creating a plan for the management and control of invasive species, it is important to consider all of the social, economic, and environmental impacts associated with said species. These impacts help determine the severity of invasive species on society, the economy, as well as the environment, and help determine the feasibility of management and control.

Social

One of the major social impacts associated with invasive species is the adverse effect they can have on human health. Other social impacts of invasive species include the reduction of recreational opportunities, reduction of freshwater and groundwater quality, and aesthetic issues.

Human Health

Some of the human health effects associated with invasive species includes skin irritation and asthma, and they can also be carcinogenic. Giant hogweed (*Heracleum mantegazzianum*) is known to contain sap that causes skin inflammation; if the hogweed is touched, it can result in burns and blisters, as well as scarring of the skin (Invasive Species Council of BC, 2013). Orange hawkweed (*Hieracium aurantiacum*) is another invasive species that can cause impacts to human health because it produces a hay fever response (Invasive Species Council of BC, 2009).

Recreational and Aesthetic Issues

Invasive species can reduce recreational opportunities for numerous reasons; these include park closures for the control of invasive species, the physical impacts to humans, and because they can be aesthetically displeasing. Carpet burweed (*Soliva sessilis*) has spiny seeds that can cause physical discomfort if stepped on, which results in reduced enjoyment of parks, beaches, and fields. Burweed is also known to reduce aesthetic values of parks and golf courses because it forms brown patches during the summer. Some invasive plant species, such as the Eurasian watermilfoil (*Myriophyllum spicatum*), are also known to provide breeding space for mosquitoes (Canadian Food Inspection Agency, 2008).

Water Quality

Invasive species generally reduce the quality of water through erosion and sedimentation (Invasive Species Council Of BC, 2013). Invasive species cause erosion by reducing soil stability, which leads to the transportation of loose soil by agents such as wind or water. The sediments transported by the wind or water will eventually find their way to groundwater and freshwater sources.

Environmental

Invasive species can have detrimental effects on the environment. Not only do they outcompete native plant species, they also have negative impacts on industries such as agriculture and forestry. The physical, chemical, and biological controls used to eliminate invasive plant species can also have negative impacts on the environment.

Native species and Ecological Diversity

Invasive species compete and thrive against native species for the available sunlight, nutrients, and water. A prime example is Scotch broom that was introduced to Vancouver Island in the 1850s. This alien plant was once used as an anti-erosion measure on highways and for decorative landscapes; however, it has since become the second most destructive plant that impacts the biodiversity of native species. The mechanism that this plant has in order to become successful is the ability to grow fast and spread rapidly (ISC BC, 2013).

Invasive species have different levels of effect on the biodiversity of native species. They have the potential to out-compete native species, reduce populations, and cause extinction (local, regional, or global). They can also reduce the native populations to a state where they no longer play an ecological role in the ecosystem (Mooney and Cleland, 2001).

Controls: Physical, Chemical, and Biological

There are different methods used for the control of invasive species that can lead to negative impacts on the environment. These methods may include physical, chemical, and biological, all of which have varying degrees of impact on the surrounding environment.

Physical controls include pulling, uprooting, prescribed burning, or the use of heavy machinery, such as bulldozers, if an area is mainly dominated by invasive species (Shaben &

Myers, 2010). Hand held mechanical tools such as saws and axes, as well as power tools such as chainsaws and brush cutters can also be used for physical removal (Van Wilgen *et al.*, 2000). An example of an invasive species that requires physical methods of control is Scotch broom. In order to control the spread of Scotch broom, the plant can be pulled before the seeds have set or burned, both of which can have negative impacts on the environment. Pulling broom can cause soil disturbance as well as the spread of seeds if they are not pulled at the right time of year. Burning broom creates smoke pollution and causes harm to other plant species in the area (Shaben & Myers, 2010).

Chemical control is another option for the handling of invasive species, which involves the application of poisonous substances. If the chemicals are used properly, they should have little to no effect on native plant species or the surrounding environment (Ontario Ministry of Natural Resources, 2012). An example of a herbicide that can be used for the control of invasive species, such as Scotch broom, are 2,4-dichlorophenoxyacetic acid, a combination of 2,4-dichlorophenoxyacetic acid and triclopyr, picloram, hexazinone or atrazine (Shaben & Myers, 2010).

Lastly, biological controls can be used to decrease the spread of invasive species through the use of living organisms (Ontario Ministry of Natural Resources, 2012). LaMancha goats were once used as an effective biological tool for grazing small areas invaded with Scotch broom. The use of biological controls for the eradication of invasive species generally causes little to no harm to the natural environment.

Agriculture and Forestry

It is important to implement a management strategy for the control and spread of invasive species found on Vancouver Island that may have economic implications and threaten the health of livestock. One such species found in the southern regions of the island is the Common tansy (*Tanacetum vulgare*). This plant has multiple spreading mechanisms (from root to root and by seed) that allow them to spread from plant to plant or by the use of a vessel, such as a bird. The viability of the seeds is approximately 25 years, meaning that management and eradication could become difficult if not managed properly. These are sun loving plants that prefer dried, well-drained soils making pasture lands a prime habitat. The biggest reason of concern regarding this particular species is that they are toxic to wildlife and livestock (ISC BC, 2013).

Invasive species such as English ivy (*Hedera helix*) have the ability to infiltrate forests. Once they are established, they are capable of choking out the native species by allelopathy and suffocation (Zevit, 2012). This, in turn, has negative impacts on native forests.

Land Fertility

The impacts that invasive species can have on the fertility and viability of soil can be overwhelming. Some of the major issues associated with certain invasive species are their ability to bring about plant disease, deteriorate soil fertility and productivity by altering the chemistry, and reduce biodiversity of the soil (Zevit, 2012). Invasive species can also alter canopy cover, which brings rise to changes of ecosystems found in the humic regions of the soil. Alterations to this region can modify the fertility of the soil and affect biodiversity of microorganisms, which can be beneficial or deleterious (ISC, 2013).

Erosion

Erosion is a major concern when considering the damages that specific invasive species can have on riverbanks and other areas that are sensitive to erosion (Gov't of British Columbia, 2013). One species that is of particular concern is knotweed (*Polygonum* spp.). This invasive species is currently the only alien plant that seems to have a management strategy for its eradication and disposal. The reason that the disposal methodology works in this situation is that the root system is destroyed by stem injection. According to the CRD, this methodology for the management and removal of this species seems to have been adopted across jurisdictional borders (municipality to municipality). A cause for concern is the fact that this species prefers moist soils that are commonly found alongside riverbanks (CRD, n.d.).

Economic

Invasive species have significant impacts on the economy through management and handling costs, effects on local parks and recreation, decrease in property values, and impacts on agriculture and forestry. On a global scale, the cost of invasive species to society, the environment, and the economy is estimated to be $1.4 trillion, which is approximately five percent of the global economy (Ministry of Natural Resources, 2014).

Management and Handling Costs

The costs associated with the management, control, and disposal of invasive species are astronomical, and can have detrimental effects on the economy. According to the Invasive Species Council of British Columbia, between $13 and $35 billion of revenue is lost annually. This is the result of only sixteen invasive species out of the eighty plus found within the CRD boundaries (ISC, 2013).

Parks, Recreation, and Tourism

There are numerous impacts associated with parks, recreation, and tourism in regards to invasive species. For example, park closures are often required in order to control certain invasive species. There are also some plant species that are a nuisance, such as Carpet burweed, deterring people form certain areas, which again depreciates local tourism and recreational values.

As mentioned above, Carpet burweed is an example of a bothersome invasive species and can be found at Thetis Lake as well as Ruckle Park on Saltspring Island due to its ability to grow well in sunny areas with moist soil. Their seeds have stiff hairs and spines that can easily attach to skin, hair, shoes, and clothes for transportation to other areas. Carpet burweed also grows in the same areas as many at risk species, such as Macoun's meadowfoam (*Limnanthes macounii*), and outcompetes the native species for space. Due to its dominant nature, it often causes areas of the parks to be fenced off from the public to avoid the spread of seeds.

Property Values: Private Land

Property values can also be impacted by the invasion of non-native plant species due to their ability to out-compete native plants as well as their resistance to eradication. An example found in aquatic ecosystems that is known to decrease the value of lake front private properties is Eurasian watermilfoil. A study was completed in 2008 that showed an average decrease of 13% on property values after being invaded by this species (Horsch & Lewis, 2009).

Agriculture and Forestry

Estimated crop losses to British Columbia agriculture due to invasive species are over $50 million annually. Species such as knapweed infest rangelands and reduce forage quality.

Many other species out-compete desired species in cultivated fields (BC Ministry of Agriculture, n.d.). This leads to a reduction in crop yields by 10 to 15% on average, as well as crop quality by tainting food products with off flavours, toxic berries, spines, etc. They also provide refuge for insects and diseases that attack adjacent crops and beneficial plants (BC Ministry of Agriculture, 1998).

Invasive species also have negative impacts on the forestry industry. They tend to disrupt natural ecosystem processes, increase soil erosion, increase the risk of wildfires, interfere with forest regeneration, and alter soil chemistry, which can prevent the regrowth of native plants (BC Ministry of Forests and Range, 2012). Historic logging, increased fragmentation, human encroachment, and fire control increases the vulnerability of forests to invasive species. This is because forests are losing necessary buffering, which is required to maintain their interior integrity. Canopy and understory are affected by species such as English ivy, Silver nettle (*Lamiastrum galeobdolon*), hops (*Humulus lupulus*), and knotweed. Negative effects occur via direct strangulation as well as allelopathy as these species smother forests and their diverse shrub understory. Streams and riparian areas can become choked as increased vegetation encroaches and blocks sunlight infiltration necessary for benthic invertebrates and freshwater food chains (Zevit, 2012).

Management & Disposal

It has been identified that three different methodologies have been successfully used for the management of invasive species found in British Columbia. The methodology used would depend on the invasive species of interest. The three methods used are physical, biological, and chemical.

Physical Methods

Physical methods are the most common form of disposal practice used. There are two different types of physical management practices, manual and mechanical. The manual removal of invasive species can involve physically pulling the plant from the soil, cutting the plant at the base, or removing it with a shovel. Manual removal was determined to be the most effective and cost effective approach as it is selective to the invasive species of interest and does not require machinery. Another benefit to manual removal is that isolated areas can be accessed relatively easily. The second method used is mechanical. This involves the use of machinery to remove the invasive species. This is an effective method of removal; however, it requires the use of machinery, at times heavy, to remove the invasive species present. The larger the machinery, the less selective the removal program becomes. In addition, as the machinery increases in size, the need to have trained operators to operate the machinery increases as well. The costs associated with the machinery are higher; however, larger parcels of land can be treated in a shorter time frame. Usually included in the mechanical removal is the landscaping of the modified property. There are a few serious setbacks when considering the use of heavy machinery, such as an excavator, which would include the damage that they can have on ecologically sensitive areas (Community Mapping Network, 2003). Prescribed burning can be used if the situation calls for it; however, prudency has to be practiced since fires can quickly grow out of control. Also, the rich soil left behind after the fire has to be re-seeded with native plants before re-infestation occurs (DiTomaso et al., 2009).

Chemical Methods

The chemical method of controlling invasive species involves the use of herbicides and other chemicals geared at limiting growth and reproduction, or the downright destruction of the plant. There are many different forms of chemicals on the market. The efficacy of the chemical is

based on the mode of interaction it has with the plant species. There are many problems involved with the use of chemicals as a mode of controlling invasive species. For example, the persistence and toxicity of the chemical may be hazardous to other forms of life, including humans and animals. The problems seem to amplify in some situations when chemicals reach a body of water, slowly attenuate, and persist due to their xenobiotic nature. Some of the chemical compounds used are not selective and are capable of causing some degree of harm to native species. The method of application can be a cause for concern. Air spraying or vehicular (tractor) applications can cause the chemicals to migrate with the wind to other areas downstream of the infected site; however, there are advantages of using chemicals in a controlled manner. Chemicals with a high efficacy eliminate the need of removing the plant from the site resulting in reduced costs of disposal. This would only be applicable to plants that degrade rapidly as slowly decomposing plants may become aesthetically unpleasing. Other shortcomings of using chemicals are the relatively high costs and the damages caused by repetitive use on the same area (Community Mapping Network, 2003). Some examples of the widely used herbicides include aminopyralid, glyphosate, triclopyr, imazapyr, and metsulfuron. The mode of action and target areas of each of the herbicides are described below (UF, 2014).

Aminopyralid is a hormone balance disrupter. It targets auxins causing plants to grow uncontrollably. It can be applied to foliage where it is absorbed by the leaves. This herbicide persists in the soil; therefore, it can be absorbed through the root systems of plants. Due to these attributes, it is very effective in controlling seedlings in germinating states. It is generally effective on specific broadleaf species and does not affect grasses (UF, 2014).

Glyphosate is one of the most extensively used herbicide for invasive species. It denies the formation of essential amino acids that are needed for protein and enzyme synthesis. Numerous woody-type invasive species are not susceptible to glyphosate and are able to regrow after the herbicide has been applied. Glyphosate does not persist in the soil and has no residual effects (UF, 2014). Another method of administering glyphosate, practiced by CRISP in their early detection rapid response (EDRR) program, is the injection of glyphosate into the stem of various species of knotweed.

Triclopyr is used primarily on woody-type invasive species. It has minimal to no effect on grassy weeds. Similarly to aminopyralid, it causes uncontrolled growth by disrupting normal

hormone balance by targeting auxins in plants; however, unlike aminopyralid it does not have any soil activity (UF, 2014).

Imazapyr is an effective herbicide to use on grasses. The mode of action is blocking the essential amino acid production that is required for protein and enzyme synthesis. The types of amino acids that are affected by imazapyr and glyphosate differ. This herbicide can be absorbed through the foliage of plants; however, it also has residual activity within soil and therefore can be absorbed through root systems of plants, allowing continual control (UF, 2014).

Metsulfuron is a herbicide that has a similar mechanism to imazapyr by blocking essential amino acid production, in turn, affecting protein and enzyme synthesis. It is applied to foliage and has some soil activity, but to a lesser magnitude than imazapyr (UF, 2014).

Biological Methods

Biological methods involve the use of other species, whether indigenous or invasive, introduced that will outcompete the targeted invasive species. This could involve either flora or fauna that are capable of choking off the species of interest or use them as a source of food. Providing that the selection of the competitors is carefully selected, the results can be successful and long lasting. Careful consideration should be taken when determining what species to use as the introduction of other invasive species that are capable of destroying adjacent ecosystems may be counterproductive. The advantages of using this approach are that machinery and chemicals are not required. In addition, this method is not as labour intensive and the invasive plants do not need to be manually removed, contained, and disposed of properly. For these reasons, biological controls can have the highest success rate at the lowest cost (Community Mapping Network, 2003). For example, the LaMancha goat (*Capra aegagrus*) grazes on Scotch broom and has been used on areas in southern Vancouver Island. Another example is the use of fungi, such as *Fasarium tumidum*, which causes stem lesions on young and old Scotch broom, ultimately causing death (Shaben & Myers, 2010). Insects have also been used as an effective method of weed control. Biological consuming organisms are usually classified in guilds that are represented by the part of the weed they affect (roots, stems, leaves, flowers, fruit or seeds) and by the method they consume the plants (sucking, chewing, galling or mining). A combination of at least one of each guild assures a higher success rate in the control of the weed. For example, to control Purple loosestrife (*Lythrum salicaria*) a total of five organisms can be used. These

include *Nano-phyes marmoratus* and *N. brevis*, which feed on the flowers, *Galerucella pusilla* and *G. calmariensis*, which are beetles that feed on the leaves, and lastly a root-effecting weevil, *Hylobius transversovittatus* (McEvoy and Coombs, 1999). The online "Biocontrol Agent on Invasive Plant Matrix" specifies biological agents that are specific for a variety of invasive species in BC, including Vancouver Island (Government of BC, 2014).

Current Disposal

Some of the disposal methodologies that are used in the CRD are:

CRD Region

1. Hartland landfill is owned and operated by the CRD.
    a. Accepts invasive species for disposal.
2. There is currently an agreement within most jurisdictions for a standardized method of disposal for knotweed.
    a. The service for the disposal of knotweed is provided or directed by CRISP.

(Capital Regional District, 2014)

Saanich

1. Invasive species have been excluded from the Yard & Garden Waste bylaw.
2. Uses the Hartland landfill for disposal of some of their invasive species.
3. Disposes of some invasive species (broom, holly, blackberry, etc.) at the Saanich Public Works yard (Saanich, 2014).

Provincial and Federal Government

1. The province has a noxious weed regulation for "some" jurisdictions in British Columbia.
    a. Problems with the regulation:
        i. It does not describe acceptable disposal practices.
        ii. It does not include, or limits, the description of enforcement.
        iii. It is assumed that it is not a current database.

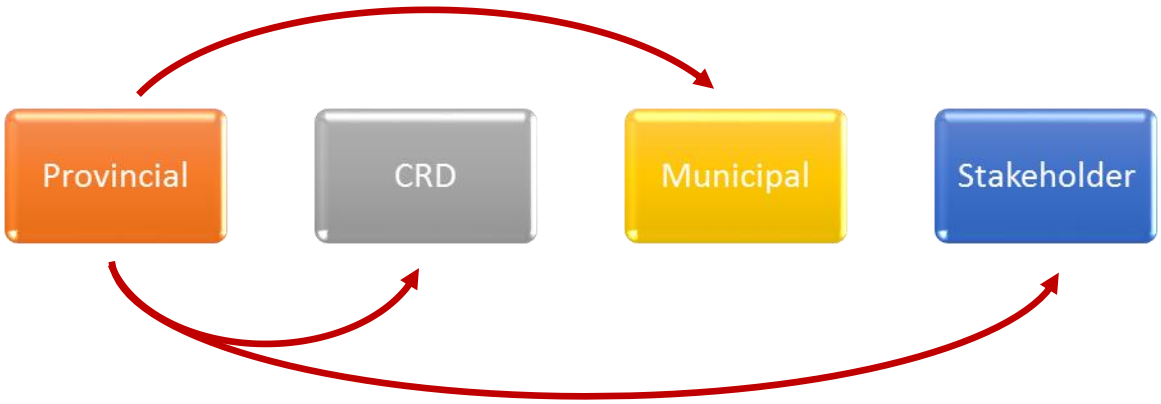
    (BC Forests, Lands and Natural Resources Operations, n.d.)
2. The federal government has little information with regards to dealing with invasive species, including disposal methodologies.

Recommendations

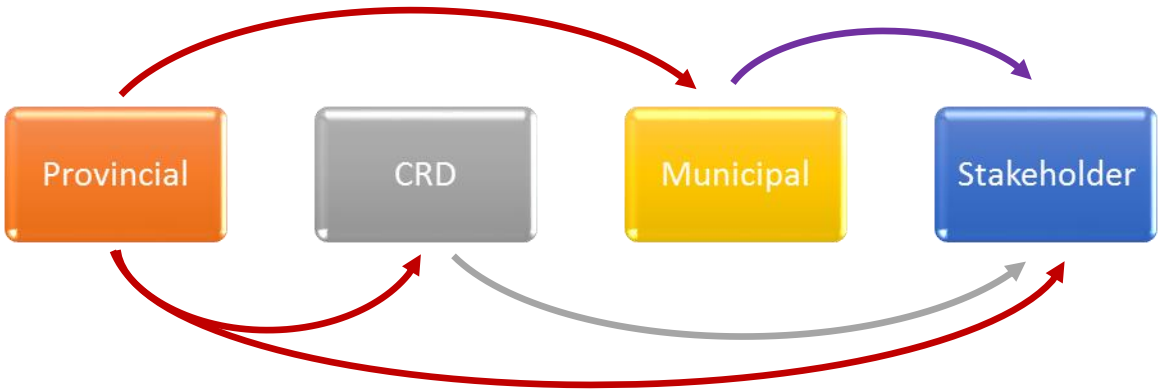
Governance

It was decided that the audience of focus for the report would consist strictly of the CRD. Since the CRD is formed by constituents of local municipalities, the opportunity of the report being adopted and implemented on a smaller scale is a real possibility. It should be noted that the intent of this report was to focus on providing a governance model that could be used by either jurisdictional government (CRD or Municipality).

It has been identified that a provincial regulation exists mandating the control of noxious weeds in the province of British Columbia; however, it seems to be a regulation that is seldom acted upon or enforced. The current governance model for the management of invasive species:



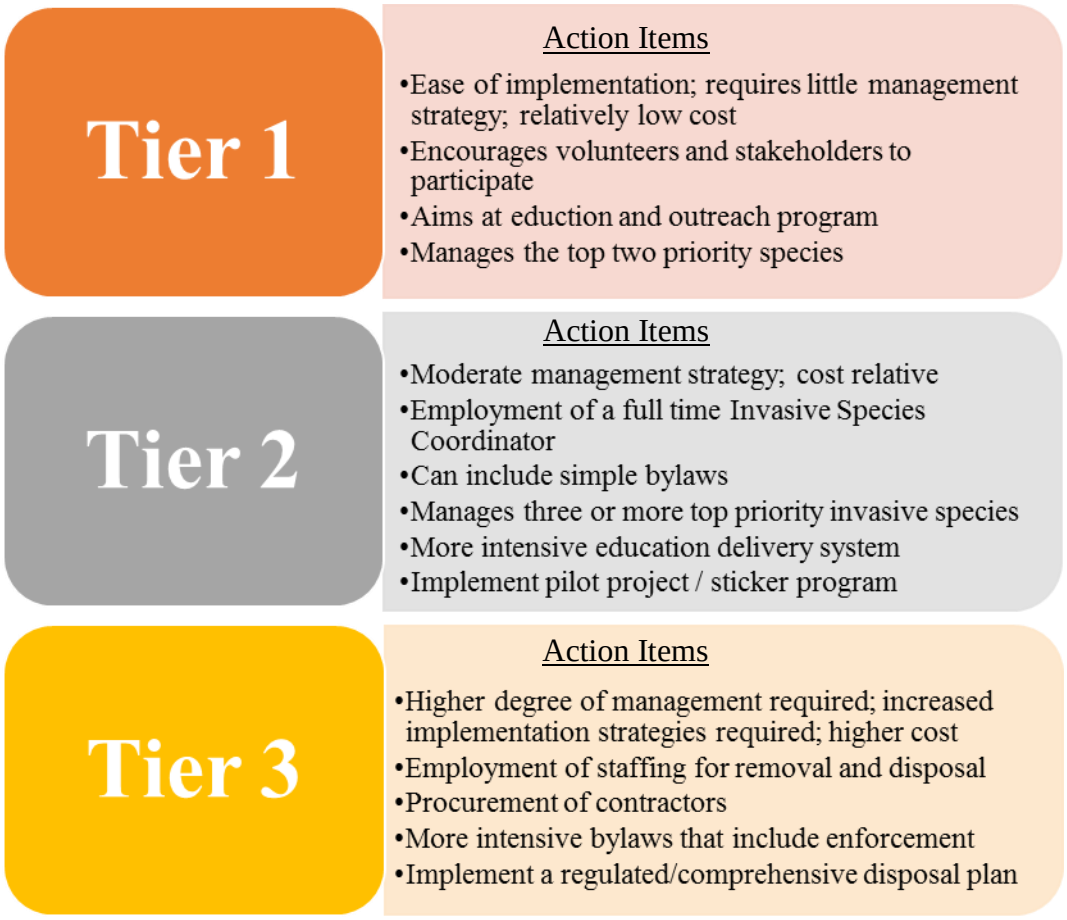
The proposed governance model for the management of invasive species:



It has been identified that certain municipalities within the CRD region lack the workforce and/or the capacity to deal with invasive species on a financial level. With the damages that the invasive species can cause on the region on a holistic level, it would be suggested that the CRD act as stewards by implementing a management plan that can be used across each jurisdictional border.

It was determined that a multiple tiered system would be the best approach in developing a plan that could be implemented. This is a simple approach that categorized the "action items" based on complexity. Due to the intricate nature of the action items, the complexity shifts as management requirements increase. The tiers that were used to categorize each program are:

- Tier 1: This program could be easily implemented and uniformly enforced throughout the CRD region. This would require that the program be adopted as an essential service to the CRD region with the option of certain jurisdictions having the opportunity of opting out if they provide their own services.
- Tier 2: This program could entail some components of simple concepts as described in Tier 1, in addition to the enrollment of a simple bylaw system, education program, employment of a coordinator, or other venues that require more extensive planning and funding.
- Tier 3: This program could entail an elaborate management strategy that involves extensive bylaws, the creation of a new department, or other. This has been determined to be out of the scope of this report and will not be discussed in greater detail.



It would be suggested that the CRD adopt and implement, at minimum, a Tier 1 plan as a proactive approach on dealing with invasive species in the CRD region. An example of a Tier 1 plan would encompass a cost effective approach that would be easy to implement. As a plan becomes multi-faceted, the complexity of implementation would be expected to increase; therefore, the tier system should be adjusted accordingly.

Examples of "action items" determined relevant when developing a comprehensive strategy plan that would deal with invasive species are listed below followed by a short description:

1. Seed Sales – The placement of seed sales on the tier system would be based on:

a. Communicating with nurseries via registered letter or direct contact aimed at encouraging a voluntary removal of invasive species seeds from their stock; or

b. Development of bylaws that would include the banning of seed sales of species that are classified “invasive”; and

c. Enforcement of the bylaws resulting in fines and levies to individuals who do not comply.

2. Public Participation – This would be based on getting the community involved (both private and commercial) in participating in the proper removal of invasive species. The placement of “public participation” on the tier system could range from a Tier 1 or Tier 2 based on:

a. Encouraging the local residents to remove invasive species from their property; and/or

b. Developing local programs that focus on student education and participation; and/or

c. Motivating stakeholders and volunteers to participate in a partnership program; and/or

d. Implementing local or regional invasive eradication programs that would be supervised by local authorities.

3. Bylaws – Bylaws are enforceable regulations stipulated by a governing body that can be imposed on the residents of the CRD. The placement of bylaws on the tier system can range from a Tier 2 or Tier 3 depending on complexity:

a. The ease of implementation for simple bylaws that could be used to effectively reduce the spread of invasive species.

b. The generation of bylaws that would enforce the ban on seed sales and plant species that are deemed high risk of spreading.

c. The generation and enforcement of bylaws to impose on private and commercial land owners to deal with invasive species for:

   i. Proper disposal practices.

   ii. Proper removal practices.

4. Coordinator – The employment of a full/part time coordinator to deal with invasive species would be categorized as a Tier 2 based on:

a. Funding requirements for the position.

b. A new position can either be a branch of an existing division (i.e.: Parks & Recreation) or the inception of a new division which usually leads to the requirement of a budget.

5. Communication/Education/Outreach – A communication program implemented within the region can lead to better education and outreach between governments, residents, and business owners. Depending on the campaign, the program can range from a Tier 1 to a Tier 3 based on:

a. The development of the outreach component to educate the public in the region.

b. The inception of an "invasive species day" that would invoke participation between residents, business owners, land managers, and children.

c. Develop an educational program to train professionals on proper removal techniques.

6. Target – The placement of "target" on the tier system could range from a Tier 1 to a Tier 3 based on:

a. Impacts (toxicity) they have on society, the economy, and the environment.

b. Factors used to base the hierarchy would be on:

   i. Impacts on humans, animals, and the natural environment.

   ii. Preserving the integrity of local ecosystems.

   iii. The degree of spread.

   iv. The ease of removal.

   v. Removal methodologies.

   vi. Disposal methodologies.

c. An example of a Tier 1 would consist of one to three top priority species that:

   i. Facilitates the development of a management plan.

   ii. Facilitates the control, mitigation, and disposal methodologies.

   iii. The inception of a standard that can be used for the removal and disposal of invasive species that have similar characteristics.

d. For example, a Tier 1 species that could be easily implemented and managed for disposal would be Japanese knotweed (*Fallopia japonica*).

7. Pilot Program – The placement of public participation on the tier system would be based on:

a. The complexity of implementing a pilot project; this would be considered a Tier 3 program.

b. For more information, refer to the Pilot Project on page 31.

8. Disposal – A disposal program can range from simple to complex depending on the program. The recommendations are that a simple disposal program, similar to the one described in this report, should be implemented in order to standardize a methodology. If implemented correctly, this would fall under a Tier 1 system. The minimum suggestion for this action item would be to implement:

a. A sticker program for residential waste containers (see Pilot Project on page 31).

9. Volunteering – Depending on the circumstances surrounding the invasive species and topography, the implementation of a volunteer program could be difficult; therefore, it can range from 1 to 3 on the Tier system based on complexity.

a. Care and consideration must be taken into account when developing a program that relies heavily on volunteers. The reason is that untrained person(s) can either become injured or may increase damages to the local ecosystem when removing the invasive species. Increasing damages means deployment of improper removal and disposal techniques used on targeted invasive species.

b. It would be strongly suggested that larger voluntary removal programs be supervised by a professional when dealing with invasive species.

c. Prior to deployment, a questionnaire should be filled out by the volunteers. This would be a good tool to identify the volunteers understanding:

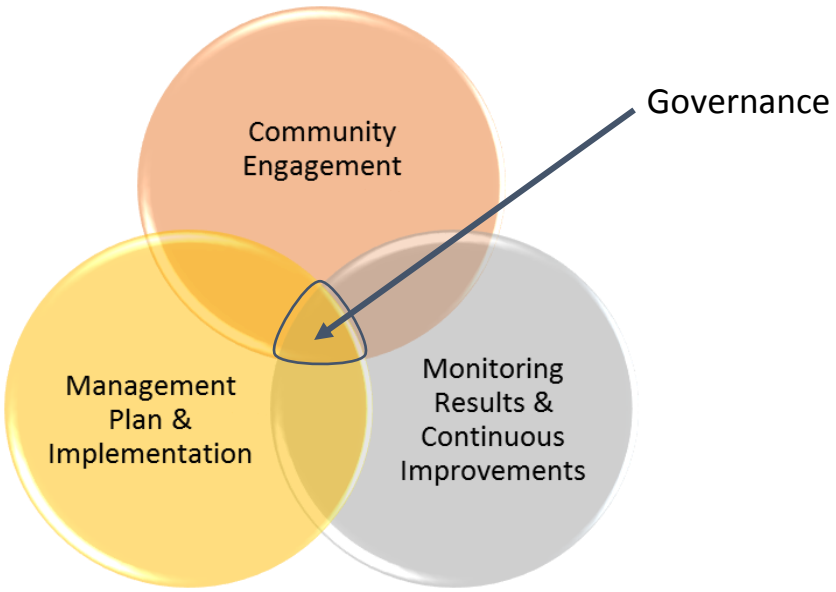
    i. The personal risks.

    ii. Risks to the ecosystem if the invasive species are removed and disposed improperly.

In order for an effective governance program to be implemented, the criteria below must be incorporated into the model. It was anticipated that for a governance model to be effective, multiple facets need to overlap resulting in a central focal point that would incorporate all aspects. The above criteria would be a baseline in the creation and development of an "invasive species management plan" that can be implemented for the region.

The model illustrated below demonstrates the importance of:

1. Community Engagement - This would include networking and participation aimed at standardizing the implementation, mitigation, and disposal strategy used for the invasive species program. It needs to be pointed out that the program needs to encompass a comprehensive program that falls under one umbrella of governance (RTMT, n.d.). The "governance" in this case will be the jurisdictional boundaries that separate one community from another.
2. Management Plan and Implementation – This would consist of a comprehensive plan created by the government and stakeholders. The plan would incorporate input from residents, business owners, and other stakeholders from the community (RTMT, n.d.).
3. Monitoring Results & Continuous Improvements – The implementation of a tracking program would be key in measuring the success and shortcomings of the governance model (RTMT, n.d.).



Communicating to the Public

It is essential to be able to effectively communicate to the public, business owners, and governing bodies about the importance of invasive species management. Little to no action is likely to be done if people are unaware of the impacts of the problem, how these impacts affect them, and how they can help to prevent or improve the situation; therefore, communication is a very important tool to begin mitigating invasive species issues within the Capital Regional District. The following section will identify target audiences as well as provide optional methods for informing the public about invasive species.

Target Audiences

There is an abundance of information on invasive species available. The issue is targeting the information at the right audiences in order to see optimal response. By narrowing down the target audiences and their associated values, one is able to better communicate why this issue is of importance to that particular person or organization. One is also able to attempt to remove some of the barriers preventing them from taking action. The following are some of the main target audiences and their associated values within the CRD:

1. Privates Residents
    a. Cost
    b. Time
    c. Family
    d. Health

2. Local Gardeners
    a. Medicinal
    b. Aesthetics
    c. Hobby

3. Recreational Users
    a. Park Limitations
    b. Boating Restrictions

4. Municipalities
    a. Cost
    b. Environmental and Economic Impacts

5. Garden Centres/Nurseries
    a. Profit
    b. Customer Demand

Methods

There are various ways to inform people and organizations about invasive species as well as identify ways they can help. The list below outlines some of the methods that could be used to target specific audiences.

1. Privates Residents
    a. Pamphlets to areas that are infested with invasive species
    b. Newsletter adds
    c. Websites
    d. Specific coloured bag/bin/sticker for invasive species
    e. Branding
    f. Social media
    g. Smartphone apps

2. Local Gardeners
    a. Information booths at food markets and garden centers

3. Recreational Users
    a. Interpretative signs
    b. Information packages (at regional parks with park attendants)

4. Municipalities
    a. Bylaws
    b. Community events

5. Garden Centres/Nurseries
    a. Invasive species garden sign
    b. Information on alternatives to invasive species
    c. Letters from the CRD about invasive species

Method Descriptions

1. Branding

An important aspect in CBSM is social diffusion, which allows social cues brought about by neighbors, friends, family, businesses etc. to cause a change in behaviour (McKenzie-Mohr, 2010). One natural trait that humans have is the desire to be a part of a group; something bigger than themselves. For instance, when someone buys organic food, labelled by the Organic brand, they are making a statement that they eat healthy as well as support local organic farms. Another example is when a building is constructed to Leadership in Energy & Environmental Design (LEED) standards. This LEED label defines the building and the organization as being a leader in the environmental movement by promoting sustainable practices. In both cases, people can choose to go the cheaper or easier route; however, because they recognize the importance of the environment, they make the choice to commit to the more difficult task. In the case of invasive species, it is simpler to not take action, however once people catch on to these "trends," the issue becomes more apparent and solutions more attainable because people are working together.

The issue with social diffusion is that it can become hindered when the behaviour is invisible. When people choose to pull invasive species in their backyard, others are unlikely to know about this action; unlike curbside composting or recycling where these behaviours are obvious due to the green and blue bins (McKenzie-Mohr, 2010).

By creating a brand, the CRD would be creating something that people recognize and could be a part of. It could be used on things such as brochures, information packages, stickers, lawn signs, neighborhood signs, a symbol for community events, shop signs, etc. It could also be used as a sticker to be placed on garbage bins to identify that a household is disposing of invasive species (see Pilot Project on page 31).

Examples

- Sticker contest for a brand - Encourage community involvement and catch the attention of a wider target audience (youth, artists, etc.) by creating a friendly competition for the creation of this brand. This sparks interest on the topic of invasive species as well as gives the community a sense of ownership to the ideas which may encourage further action. Prizes could also be given to further encourage participation. A current example

of this has already been done by Wildsight Invasive Weed Program in Golden, BC who is giving away trail rides and bragging rights to the contest winner (CSISS, 2013).

- Entire neighborhoods or communities who decide to clear their area of invasive species could have this brand on a sign. This shows to all visitors that these residents are taking action to resolve the issue of invasive species which may encourage other communities/neighborhoods to want to do the same. This is a similar idea to Neighborhood Watch signs.

2. Brochures

Brochures or pamphlets are a good way of packing important information into one convenient source. They can include:

a. Impacts of invasive species;
b. Local invasive plant examples;
c. Control and disposal tips;
d. Medicinal/aesthetic replacements;
e. Additional contact information (Website, CRD staff).

A good example that was created by the Invasive Species Council of BC is their "Grow Me Instead" brochure which provides users with native alternatives to invasive species. A similar brochure could also be used for alternative medicinal plants. Once created, it is necessary to get the brochures into the hands of the people who are most likely to value its contents. This would likely include gardeners, farmers, local residents, parents (due to health concerns such as asthma in children) and more. Therefore, determining where these people are most likely to get their hands on one of these documents is key. By providing them at farmers markets, gardening centers, nurseries, recreational areas, education facilities, and residential mail boxes, the CRD is more likely to reach its target audience.

Examples

- Select a neighborhood that is infested with a particular invasive species. Then go door to door dropping off brochures about that particular invasive species with information

mentioned above. This method ensures that people are likely to recognize the plant, know its implications, and how to deal with it. This also establishes social pressure because residents know that the rest of their neighborhood also knows about the problem. If they see other residents doing their part to clean up the neighborhood and prevent the spread, they may feel inclined to participate.

- Provide "Buy Me Instead" brochures at the source of the purchase (garden centers, nurseries, farmers markets). First, this informs people about the negative effects of certain species. Second, it allows them to choose good alternatives to their first plant or seed choice. This, in turn, will decrease the demand for the invasive, which may cause the seller to stop carrying this species altogether. In the future, the shop owner may want to even brand itself as being "invasive species free," which may draw in more environmentally conscious customers.

3. Community Events

Active involvement from community members is a good way to boost local knowledge and build relationships around invasive species. It is likely an incentive to many people because it may be a fun, social opportunity for them to become involved. These events may be in the form of a group plant pulling, contests, invasive species days and more. There are currently broom and ivy pulls that occur throughout the Capital Region, which consist of coordinated plant removal by groups of volunteers. The timing of the event and type of species would have to be considered to ensure proper removal, disposal, and limited seed spread.

Examples

- An "Invasive Species Week" could be promoted in a similar way as "Bike to Work Week". This would be a good way to raise initial awareness about invasive species and catch the attention of those who are less willing to make a full commitment to dealing with invasive species because it is over a short period of time.
- Friendly competitions within or between neighborhoods, businesses, schools, etc. with prizes available to whoever can pull the most bags of invasive species provides incentives while promoting education and awareness. This may also encourage people to pull more than their own share in order to win, which offsets the people who were not willing to participate.

4. Information Booths

Information booths are good for targeting certain audiences that would likely have an interest in invasive species, the environment, gardening, or other similar topics. They could be located at markets, community events, garden centers etc. This provides a good opportunity for people to receive more information than they would get from a brochure and also allows them to become engaged and able to ask questions. Here, one could also use the CBSM approach by asking people to commit to small requests, which has been shown to increase the likelihood of larger commitments (McKenzie-Mohr, 2010). In this case, asking people to participate in surveys, register their emails for newsletters, signing a petition etc. may cause them to feel more inclined to deal with invasive species.

5. Social Media

Social media has become a part of many people's everyday lives. Facebook and Twitter are simple and effective tools for providing information about invasive species to desktops and mobile phones. The Peace River Regional District uses Facebook and Twitter to increase awareness of invasive species through "Weed Wednesdays" (PRRD, 2013). This weekly reminder could provide tips and interesting information to increase education on a comfortable platform as well as share information instantly to others. This aids in social diffusion, an important CBSM tool, because when information is spread by friends and family, people are more likely to pay attention and trust the information.

6. Smartphone Apps

A "Report a Weed" iPhone and Android smartphone apps can already be downloaded by users for an easy method of reporting weeds and uploading photos anywhere in BC. To ensure this tool is used to its full potential, it could be promoted by the CRD on all other invasive species documents and websites to make the public aware of these apps.

7. School Groups

Programs, such as the Nature Kindergarten, allow children to learn in and about nature. By integrating invasive species into their curriculum, these children would be learning about the impacts and importance of removing invasive species at a young age, which will encourage desired behaviours as they grow up, developing social norms. They are also likely to tell their

parents and other children what they have learned, further extending the reach of this information.

8. Rewards and Recognition

Providing rewards and recognition to those who are already participating in invasive species removal acts as an incentive to continue this desired behaviour. This could come in many forms such as contests, fun events, and recognition through the media. For example, the Peace River Regional District recognizes those who perform the most and second most manual treatments in their Invasive Plant Annual Report (PRRD, 2013).

Pilot Project - Disposal of Invasive Species

By incorporating the current disposal methodologies of invasive species in the CRD as well as the communication recommendations outlined in this report, a pilot project could be conducted in order to determine the feasibility and success of such a project in the CRD as a whole. The following outlines the steps that should be taken for designing an invasive species disposal pilot project, as well as an example template for a project in the Panama Flats area.

The first item that was decided upon for the pilot project was a colour to represent the disposal of invasive species; blue is recycling, green is compost, and black is garbage. In order to incorporate CBSM, the colour yellow was chosen for invasive species to enhance visibility and to catch the attention of the public (McKenzie-Mohr, 2010). This was followed by a brainstorming session of possible delivery methods that would enhance community engagement and would also be economically feasible; these ideas included a bin program, a bag program, as well as a sticker program. The bin program was rejected due to its high cost and the fact that the bins would only be used a few times a year and not every week like a recycling or compost bin. The bag program was also decided against because of its high cost and the difficulty of delivering the bags to the public. A sticker program was chosen because of its relatively low cost in comparison to a bin or bag program, and also because it will catch the attention of the public in order to enhance community engagement. Residents will continue to use the current disposal methodology of bagging their invasive species and disposing of them in their garbage bins; however, the sticker below could be placed on their garbage bins to communicate to their neighbourhood that they are actively eradicating invasive species on their property, and ultimately increasing awareness and creating a social norm. According to McKenzie-Mohr, in order for a sticker program to be successful, they must be laminated and durable, have permission to place the stickers on the public's garbage bins, and be visible (McKenzie-Mohr, 2010). The following sticker was designed by REC to be used for the invasive species sticker pilot project:

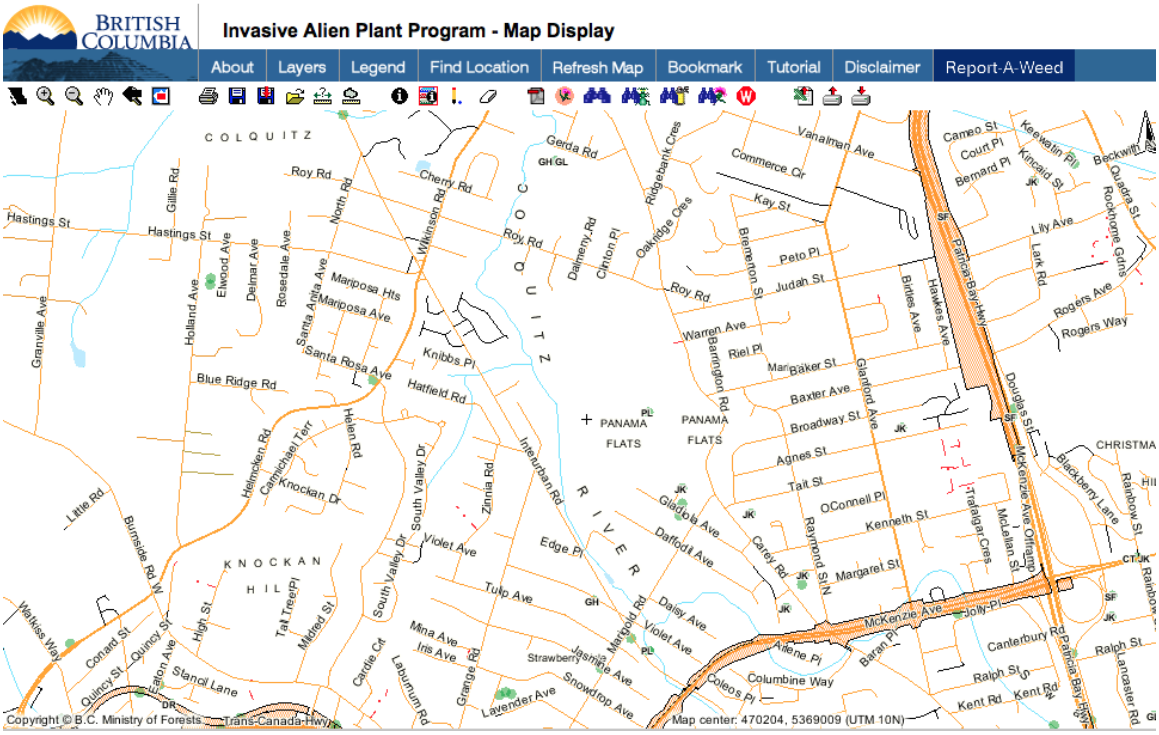
The main purpose of the invasive species sticker pilot project is to create awareness as well as begin the eradication and proper disposal of two or three invasive species in an area. In order for the pilot project to be successful, the following actions must be completed:

1. Choose an area;
2. Choose 2 or 3 invasive species that have been identified within this area to eradicate as a starting point;
3. Contact each home in the area;
    a. Ask if they are actively controlling invasive species on their property;
        i. If YES, ask if the CRD can place an "Invasive Species Sticker" on their garbage can;
        ii. If NO, inform them of the pilot project (sticker program) as well as the invasive species of concern in their area.
4. Contact local nurseries and greenhouses in the area;
    a. Ask if they are currently controlling invasive species on their property;
        i. If YES, ask if the CRD can place an "Invasive Species Sticker" on the door of their business;
        ii. If NO, inform them of the pilot project (sticker program) as well as the invasive species of concern in their area.
5. Create a pamphlet/website that includes;
    a. Background information (impacts/hazards), pictures, how to identify, growth cycles as well as how to eradicate and dispose of each invasive species of concern in the area;

b. Tips for controlling the spread of invasive species.

Example

An example pilot project has been designed for the area of Panama Flats in Saanich, BC. This area was chosen because of the large amount of Japanese knotweed and Purple loosestrife that has been reported in the area through the Invasive Alien Plant Program (IAPP) website as well as their community engagement in actively protecting the environment (IAPP, 2014). The above steps for the disposal pilot project must be completed.



(IAPP, 2014)

Conclusion

The major objective of this project was to generate a comprehensive report for the CRD Roundtable on the Environment that provides the following topics:

1. The social, economic, and environmental implications of invasive species;
2. The disposal methods that are currently being used and recommendations for improvements;
3. Providing a governance model that could be easily implemented in order to improve the management and control of invasive species within the CRD;
4. Effective and easy to implement communication strategies that would modify the behaviours of the residents and private sector. This would influence the establishment of partnerships and networks between entities.

The objectives remained clear throughout the generation of the comprehensive report and each aspect was covered appropriately. The recommendations outlined throughout the report will hopefully help alleviate the spread of invasive species within the CRD if they are implemented. The associated impacts of invasive species on society, the economy, and the environment have been included and will allow the CRD Roundtable on the Environment to quickly access pertinent information in regards to this subject.

In regards to the governance model, it was quickly identified that there is little reinforcement of the provincial regulations on noxious weeds, as well as a lack of uniformity among the thirteen municipalities that make up the CRD. There are many differences among the municipalities that cannot be changed, which include the amount of funds and/or the available workforce that is required to eradicate and control invasive species. The proposed governance model will help with these shortcomings by allowing the CRD to act as a steward that can implement management plans for each jurisdictional area. It exhibits a tiered system that can be developed or customized from one municipality to another. The most simple, low-cost methods will be placed in the first tier, which can be generally applied across the CRD region. The proposal includes two additional tiers; the methods and recommendations increases in cost and difficulty of implementation as the tiers move up. The examples included in the report are merely suggestions; the inclination of the tier system is its flexibility and adaptability to different situations within the CRD region.

The handling and management of invasive species varies drastically among different species and the inclusion of each specific method in the report for each invasive species found in the CRD was not a plausible task. However, general methods of management were identified including physical, chemical, and biological means of control. There is also referenced material that is readily available from credible sources online, as well as specific examples included in the report for completion. It was brought to our attention that disposal of invasive species was a major issue in the CRD. Rather than suggesting the implementation of an additional pickup service of invasive species, it was concluded that creating awareness of the current disposal methods and utilizing CBSM strategies would best promote action upon the control of invasive species. This method also coincides with the communication aspects of the project.

Lastly, the communication section of the report includes numerous suggestions on how to communicate effectively to the public in regards to invasive species. Part of the spread can be alleviated if the CRD communicates to nurseries the importance of selling non-invasive plants and educates the public to not purchase invasive species. The CRD can also generate pamphlets that include relevant information for quick and convenient access about invasive species targeted for specific areas. Social media, which is now a large part of our daily lives, can also be used to transfer or display information. The recommended action for the disposal methods, as previously mentioned, is the use of the current "bag and tag" method with some minor changes that can have positive impacts in controlling invasive species. The CBSM method could be a yellow sticker that is placed on the stakeholders' garbage bin, who is aware of the current disposal method and is actively controlling invasive species on their property. The residents will promote awareness by allowing neighbouring stakeholders to view the sticker, and even stimulate the active control of invasive species. This will also prompt people to continue disposing of invasive species in their garbage containers and promote a new social norm, similar to the successful blue bin approach that is used for recycling. Finally, in order to improve on the growing number of invasive species within the CRD, it is suggested that they consider the recommendations provided within this report.

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Appendix A

Project Agreement

Introduction

The problem of invasive species began long ago when European settlers first came to North America. They imported numerous plants for medicinal, crop and ornamental use. They also imported livestock, which directly or indirectly brought more invasive species attached to the animals themselves or in their carriers. Although invasive species were introduced as early as the 17th century, there are records of more recently introduced invasive species that has occurred even in this century (Invasive Species Council of BC, 2014).

The purpose of the project is to provide the Capital Regional District (CRD) Roundtable on the environment with a comprehensive report on invasive species. This includes social, environmental and economic impacts, recommendations for the best governance model for management, handling and disposal, and recommendations for communicating effectively to the public about invasive species. The problem will be approached on a broad scale manner; however, specific examples will be included in order to give the diverse population specific handling and disposal methods. The geographical area of concern for the invasive species problem is the thirteen municipalities that encompass the CRD: Central Saanich, North Saanich, Saanich, Colwood, Oak Bay, Esquimalt, Highlands, Sidney, Sooke, Langford, Victoria, Metchosin, and View Royal.

Given the nature of the project, the general approach will be heavily research based. Determining best practices for each objective will be done using the internet, through interviews with the CRD roundtable, other professionals, and the public. The following agreement provides an outline of the project to ensure all needs are met by all parties involved.

Identification

i) Team Name: Royal Environmental Consultants (Team 3)

ii) Members Involved and Project Scope:

- Sponsors: Nancy Wilkin on behalf of Capital Regional District Round Table on the Environment and Stephen Brydon
- Faculty Advisor: Jonathan Moran
- Team Members: Jillian Campbell (Principal Investigator), François Messervier (co-investigator), James McNeill (co-investigator), Kirsten Johnson (co-investigator), and Ridwan Aroworamimo (co-investigator),
- Capital Regional District Boundary: It encompasses thirteen municipalities, which include: Central Saanich, North Saanich, Saanich, Colwood, Oak Bay, Esquimalt, Highlands, Sidney, Sooke, Langford, Victoria, Metchosin, and View Royal.
- Invasive Species: two criteria have to be met to classify an organism as an invasive species. An invasive species has to be organisms that are not native to the region, and have negative impacts on the environment, economy, or health. Therefore introduced species may not necessarily be an invasive species.

Research Questions

i) What are the social, environmental and economic impacts of invasive species in the CRD?

ii) What governance model could provide the best practices for managing and handling of invasive species in the CRD?

iii) What are the best practices for communicating to the public on how to deal with invasive species?

Underlying Objectives

i) To provide the CRD Roundtable on the environment with a comprehensive report of invasive species that includes social, environmental and economic impacts;

ii) To provide recommendations for the best governance model for the management, handling and disposal of invasive species;

iii) To provide recommendations to communicate effectively to the public about invasive species.

General Approach

Since the priorities of this project are to determine best practices for managing invasive species in the CRD, the general approach to carrying out our goals will be through research. This is likely to be done via the internet or other e-sources and through interviews with the CRD roundtable, other professionals and the public.

Ethical Review

Interviews/surveys will be conducted with the CRD Roundtable, other professionals and the public; therefore, it is necessary to complete an ethical review. This is to be completed as soon as possible to ensure its approval in order to allow commencement of interviews/surveys.

Proposed Methodology

vi) Background research- Determining what the current management practices are within the 13 municipalities and their effectiveness in controlling invasive species. Also, determine what other similar regions are doing to control invasives to see if a similar approach can be used in the CRD;

vii) Interviews- Consulting with professionals such as members of the CRD or municipality members for their current understandings, professional opinions,

etc. Also, conducting interviews with the public to determine knowledge and opinions on the subject;

viii) Site visits- Potential walkthrough visits to locations such as the Hartland Landfill, Knockan Hill Park, RRU campus tour etc. to gain further insight to current or potential management practices;

ix) Report writing- Compiling information gained from research and interviews into a detailed report pertaining to the objectives of the project, detailed above; and

x) Presentations- Presenting current and final research, findings, and ideas to the Faculty Advisor, CRD Roundtable and guests.

Analysis Methods

Due to the nature of this project, analytical tools will not be required.

Timeline

February/March: Complete background research on invasive species in the CRD in regards to current management, handling, disposal and communication methods.

March 21: Presentation of progress.

April/May: Investigate methods of improving management, handling, disposal and communication methods in the CRD.

June 13: Presentation of progress.

June/July: Compilation of research and recommendations into a comprehensive report.

Mid-August: Completion of final report.

August 28/29: Presentation of final report.

Communication Plan

Francois Messervier will be the contact person between the team and the faculty advisor and sponsor. All team members will be cc'd on every e-mail between Francois and the faculty advisor and/or sponsor so that everyone is aware of what is being discussed. If any group questions or issues arise, all team members will discuss them as a group and Francois will contact the sponsor directly. Any team member may contact the faculty advisor directly with questions or concerns.

Deliverables to the Department

Quarter 2:

- February 9, 2014: Draft Project Agreement
- March 7, 2014: Project Agreement and Budget Signed off by Sponsor
- March 9, 2014: Annotated Table of Contents
- March 21, 2014: Second Quarter Presentation
- April 4, 2014: Self & Peer Evaluations

Quarter 3:

- June 3, 2014: Interim Report Including Progress Report & Financial Statement/Budget Sheet with billable hours
- June 13, 2014: Third Quarter Presentation
- June 27, 2014: Self & Peer Evaluations

Quarter 4:

- July 15, 2014: Draft of Final Report
- August 12, 2014: Corrected Final Report
- August 22, 2014: Project Financial Statements
- August 28/29, 2014: Final Presentation
- August 29, 2014: Self & Peer Evaluations

Deliverables to the Sponsor

March 7, 2014: Project Agreement and Budget Signed off by Sponsor

March 21, 2014: Second Quarter Presentation

June 13, 2014: Third Quarter Presentation

August 12, 2014: Corrected Final Report

August 28/29, 2014: Final Presentation

Team's Expectations of Sponsor

Royal Environmental Consultants (REC) will respond to the sponsor's e-mails within 24 hours on weekdays and within 48 hours on weekends/holidays and will expect the same response time from the sponsor. Any provisions of necessary information will be e-mailed to Francois by the sponsor and all team members will be cc'd.

Lab Requirements

There are no laboratory requirements for this project.

Project Budget

(Please see next page)

Royal Environmental Consultants (Team 3)

Major Project Budget Proposal

Date	Description				Expenses	Funding
01-Dec-13	Admin Fee (billed at start of project)			CRD Roundtable		$500.00
07-Mar-14	Total Project Funding			CRD Roundtable		$793.10
Expenses:		**Mileage**	**0.45/km**	**Projected Quantity**		
	Project Expenses					**$793.10**
Jan-Aug	Mileage to the CRD (downtown)	168	0.45	Six trips to the downtown core of Victoria at 24 km/trip	$75.60	$717.50
Jan-Aug	Mileage - Site Inspections	250	0.45	Five site inspections at 50 km/trip	$112.50	$605.00
Jan-Aug	Miscellaneous			Photos, maps, and materials	$50.00	$555.00
Jan-Aug	Printing of Final Report			1 copy @ $50.00 each (+ HST)	$55.00	$500.00
						$500.00
						#REF!
				Total Expenses:	$293.10	
Estimated Billable Hours						
Date	**Description**	**Hours**	**Qty**	**Notes**	**Amount**	
21-Mar-14	2nd Quarter Billable Hours	325	48		15600.00	
13-Jun-14	3rd Quarter Billable Hours	605	48		29040.00	
28-Aug-14	4th Quarter Billable Hours	610	48		29280.00	
				Total Estimated Billable Hours:	**73920.00**	

Royal Environmental Consultants - Signatures

Francois Messervier Date

Kirsten Johnson Date

Jillian Campbell Date

Ridwan Aroworamimo Date

James McNeill Date

RRU Major Project Advisor:

Jonathan Moran Date

Major Project Sponsors:

Nancy Wilkin Date

Stephen Brydon Date

2005 Sooke Road, Victoria, BC V9B 5Y2