

Monsters in the Marsh! Project Report  
Removing Glossy Buckthorn (*Rhamnus frangula*) from the Annapolis Royal Marsh



Prepared by Megan Tardif-Woolgar  
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Clean Annapolis River Project



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Cover Photo: Volunteer group removing glossy buckthorn (*Rhamnus frangula*) from the Annapolis Royal Marsh.



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## Executive Summary

Glossy buckthorn (*Rhamnus frangula*) is an invasive alien plant from Europe. Invasive species are considered the second greatest threat to biodiversity on the planet (Godwin, 2007). In 2007, glossy buckthorn was identified as being one of the most threatening alien invasive plants in Nova Scotia, and has been identified in various locations throughout the Annapolis Valley. Glossy buckthorn is present and thriving in the Annapolis Royal Marsh, a constructed freshwater wetland surrounded by the popular recreational French Basin Trail. Because it out-competes native species of the area which many other species rely upon for survival, glossy buckthorn has become a major problem. The Clean Annapolis River Project (CARP) and partners, the Wal-Mart Evergreen Fund, the Shell Environmental Fund, the Nova Scotia Department of Natural Resources Habitat Conservation Fund, and the Town of Annapolis Royal have all expressed a keen interest in working towards the long-term management of glossy buckthorn.

This document outlines the steps CARP has taken towards removing glossy buckthorn from the Annapolis Royal Marsh. Included in this report is a Best Management Practices (BMP) guide for Nova Scotia communities dealing with glossy buckthorn infestations (Appendix A).

The management goals identified for glossy buckthorn include:

- Raising awareness in the community through active engagement, information sessions and volunteer opportunities;
- Removing glossy buckthorn from the Annapolis Royal Marsh and planting native species in its place;
- Creating a Friends of the Marsh group for long-term stewardship and monitoring of the Annapolis Royal Marsh and its species;
- Creating a best management practices (BMP) document applied to managing populations of glossy buckthorn in Nova Scotia (Appendix A).

Management actions were implemented in the summers of 2008 and 2009, and wherever possible, notes and recommendations for improvements and/or changes to the plan have been included, by section, based on experience. In addition, further management considerations are detailed for three topics, as described below.

### **1-Active Partner Participation**

It is recommended that partners remain involved, as the management initiatives for glossy buckthorn removal require long-term commitments. This multi-year initiative recommends actions to be taken by the Town of Annapolis Royal when performing maintenance of the French Basin Trail.

### **2-Community Engagement**

It is important that community members actively participate in management endeavors through a 'Friends of the Annapolis Royal Marsh' group. This is not only important for invasive species management, but also for the long-term stewardship of the marsh. A leader of this group should be identified and the continuation of this group should engage the community in more invasive species removal events.

### **3-Seedling Survival Rate Monitoring**

It is recommended that seedling survival rate be quantified prior to seed source removal until the seed bank is completely removed. This would give a better overall perception of the removal resource requirement and would result in a more accurate long-term management plan.



## Introduction

The Annapolis Royal Marsh is a 15 hectare constructed wetland completed in 2002. The town of Annapolis Royal, in partnership with Ducks Unlimited and the Clean Annapolis River Project (CARP), restored the Annapolis Royal Marsh and created the French Basin Trail. The wetland was constructed for several reasons. Firstly, restoring the wetland was a means of increasing the overall quantity of marshes in Nova Scotia and the Annapolis Royal Marsh was identified as a restoration site by CARP in 2005. Secondly, the constructed freshwater wetland serves as tertiary sewage treatment for the town of Annapolis Royal; it improves the quality of the Annapolis River by retaining and breaking down sediments, nutrients, and water-borne diseases. The marsh also creates a nourishing habitat for a wide variety of wetland species, and serves as an important breeding ground for waterfowl. The French Basin Trail is a very popular recreational site within the town of Annapolis Royal with a 2 km hiking path that encircles the freshwater marsh.

The Annapolis Royal Marsh serves as habitat for many different species, but unfortunately, the presence of the alien invasive *Rhamnus frangula*, or glossy buckthorn, has decreased the ability for native plant establishment by out competing the dominant woody vegetation of the marsh. The presence of this alien invasive threatens the future integrity of plants and animals alike in the Annapolis Royal Marsh, as it causes habitat biodiversity to decrease.

In the early 1980's, the alien invasive species *Rhamnus frangula* (glossy buckthorn) was identified in Nova Scotia. In 2008, the full extent of the infestation was discovered to cover the entirety of the marsh and beyond, with different densities throughout the marsh. The smaller individual populations of glossy buckthorn are widely spaced, but the woodlot area of the trail was identified as the densest area of buckthorn. This is why the woodlot area was selected as the highest priority site for eradication, as it was the site with the greatest potential for spreading. The other infested areas occur not in wooded areas, but in open areas with a dense grass mat below. The grass out competes the glossy buckthorn in these areas, making it less likely to spread from seed.

In October 2007, Marika Godwin of the Clean Annapolis River Project produced a report entitled *Invasive Alien Plants and You*. This report outlined the types of alien invasive species invading Nova Scotia. In this report, the invasive species were ranked to display the appropriate prioritization in regards to removal. Glossy buckthorn was identified as one of the top priorities for Nova Scotia due to its highly invasive nature and the threat it poses to native species. It was noted that several years are required to deplete the seed bank fully so long-term management is crucial for successful removal of glossy buckthorn. In partnership with the Wal-Mart Evergreen Fund, the Shell Environmental Fund, and the Nova Scotia Habitat Conservation Fund, CARP created a long-term management plan to eradicate glossy buckthorn from the Annapolis Royal Marsh.

## Mapping of Glossy Buckthorn Populations in the Marsh

Although the actual extent and density of glossy buckthorn within Nova Scotia is unknown, sources indicate that the problem is widespread (Wendy Courtice, and Gini Proulx, personal communication 2009). Glossy buckthorn is especially prominent in Annapolis Royal, and is concentrated in and around the Annapolis Royal Marsh. It is unknown how extensive the infestation is beyond the marshland owned by the Town of Annapolis Royal because the buckthorn has spread beyond the boundaries of the marsh onto private properties. Individual populations have been discovered slightly north of Annapolis Royal in areas of Granville Ferry and some have also been identified in Bridgetown, about 20 km to the east of Annapolis Royal. The distribution of glossy buckthorn in the Annapolis Royal Marsh was surveyed and mapped during the summer of 2008.

To gain insight into the full extent of the glossy buckthorn infestation in the Annapolis Royal Marsh, the marsh was subdivided into five different areas: the woodlot, the dense salt marsh, the less dense salt marsh, the dyke land, and the skate park. Each of the five sites had a series of 5m<sup>2</sup> and 1m<sup>2</sup> randomized test plots. The number of glossy buckthorn trees, diameter and canopy information were recorded for the 5m<sup>2</sup> test plots, and the amount of regeneration present were recorded for the 1m<sup>2</sup> test plots. The averages of the different densities divided by the area of land in each specific area gave an indication of the overall density of the glossy buckthorn infestation in the different marsh locations. The average densities of the different marsh areas were calculated as follows:

Area of Annapolis Royal Marsh	Average Glossy Buckthorn Density/m <sup>2</sup>
Woodlot	3.430 trees/m <sup>2</sup>
Dense Salt Marsh	0.516 trees/m <sup>2</sup>
Dyke Land	0.270 trees/m <sup>2</sup>
Less-Dense Salt Marsh	0.003 trees/m <sup>2</sup>
Skate Park	0.002 trees/m <sup>2</sup>

See Figure 1 for locations of specific marsh areas. The woodlot had the highest glossy buckthorn density out of all the areas tested. See Figure 2 for photo of woodlot before management actions were taken.



Figure 1- An aerial photograph of the French Basin Trail and sub-areas of Annapolis Royal Marsh. Sub-areas include glossy buckthorn densities.

Although the infestation is apparent around many areas of the marsh, the majority of the areas are not capable of rapid seed spreading due to a dense grass mat below the trees. Most of the plants existed in non-forested areas of the marsh, where the risk of affecting indigenous tree species is lower. The priority area of eradication was identified as the woodlot area of the marsh. This area was chosen because it had the densest population of buckthorn within, and the greatest potential of the buckthorn spreading beyond the woodlot. The woodlot is home to many native plant species growing in a natural forest succession and is therefore suffering the greatest from the buckthorn infestation. Also, most of the other areas of infestation are bordered by water. It is possible for seeds to survive or disperse via water, but the plants cannot reproduce by rhizomes through water.



Figure 2-Photograph of French Basin Trail in the Woodlot area of the Annapolis Royal Marsh. The woodlot contained the greatest density of glossy buckthorn trees and seedlings. Aside from the large coniferous trees, nearly all other plants in this photo are glossy buckthorn.

## Control Methods Used

When removing any type of persistent alien invasive, it is important to establish a long-term commitment to ensure the depletion of the seed bank. With help from committed partners and carefully following recommendations suggested throughout this report, glossy buckthorn should be eradicated from the Annapolis Royal Marsh in 5-7 years. The Clean Annapolis River Project's goal was to clear a total of 200m<sup>2</sup> or to pull at least 400 stems from priority areas of the Annapolis Royal Marsh. Along with invasive species removal, it is important to plant native species where the invasive species have been cleared. It was CARP's intention to plant 250 tree, shrub, or plant species in an effort to suppress the glossy buckthorn and reintroduce native species into the area to provide habitat and reduce sedimentation and erosion.

## Materials

Puller-Bear™  
Extractigator™  
Tree Girdler  
Camera  
GPS Unit  
Buckets  
Mulch  
Shovel  
Native tree and plant species  
Soil

## Glossy Buckthorn Removal

Many removal methods were considered for this project. Scientific literature suggests that either burning the infestation or applying the herbicide glyphosate directly to the stumps after chainsaw removals of the trees are the most effective methods of eradication. Burning the glossy buckthorn as a means of eradication was considered, however burning permits are not administered within the Town of Annapolis Royal. The plants would have to be taken out of town prior to burning, thus increasing the potential of spreading the infestation elsewhere during transportation. Applying herbicide to the cut stumps with a paintbrush was considered together with leaving the cut trees on-site. Although the chances of plant survival would have been slim, the herbicide has the potential to affect the re-establishment of native species, thus hindering future aesthetics. CARP did not want to apply an herbicide so close to a waterway in a marsh habitat in fear of the herbicide damaging sensitive ecosystems. The method of choice was to pull the smaller plants by hand, to use a weed wrench for the bigger plants, and to girdle the trees, which are too large to pull out with a weed wrench.

The smaller plants were easily pulled out by hand. Two weed wrenches were used for the trees too large to be pulled by hand (usually trunks up to 2 inches in diameter). The two weed wrenches (the Puller-Bear™ and the Extractigator™) use leverage and body weight to rip the trees out of the soil (See Figure 3). Any roots broken off in the process would have to be excavated and removed to avoid re-sprouting. Any trees greater than two inches in diameter and thus too large to remove with a tool were girdled.

**Outcomes for Year 1:** The total cleared area of the woodlot (both tree-girdled area and smaller regeneration removal) was 2,592m<sup>2</sup> of the densest woodlot area (see Figure 4). The larger trees of the same area were girdled, and the suckers pulled from below the incision. Areas in which the buckthorn had been pulled earlier in the spring and summer had to be re-pulled as new seedlings emerged continuously.

**Planned changes for Year 2:** Glossy buckthorn takes a long time to die after it has been girdled. The trees may still produce viable fruit if they are girdled later in the summer. To ensure the trees inability to produce viable fruit, trees should be girdled at the beginning of summer or spring. Also, removal work should cease once the trees have gone to seed (during the presence of ripe purple berries). There is a much greater risk of seed dispersal when removing the seeding trees in the late summer or the fall. Although the use of herbicide is avoided whenever possible, it may be useful to incorporate the use of a 30% glyphosate solution on the stumps. In past years, the town has worked towards widening the path in the woodlot. The trees bordering the path have been cut, making it very difficult or impossible to remove the entire stump. Some of the root systems remain intact



Figure 3- Weed Wrench (Extractigator™) removing a glossy buckthorn stem that was too large to pull by hand.

below the gravel path. If glyphosate were painted on the stumps of these trees then they would no longer re-sprout. Extreme caution should be exercised when using this method to ensure that none of the herbicide is spread into the surrounding environment.

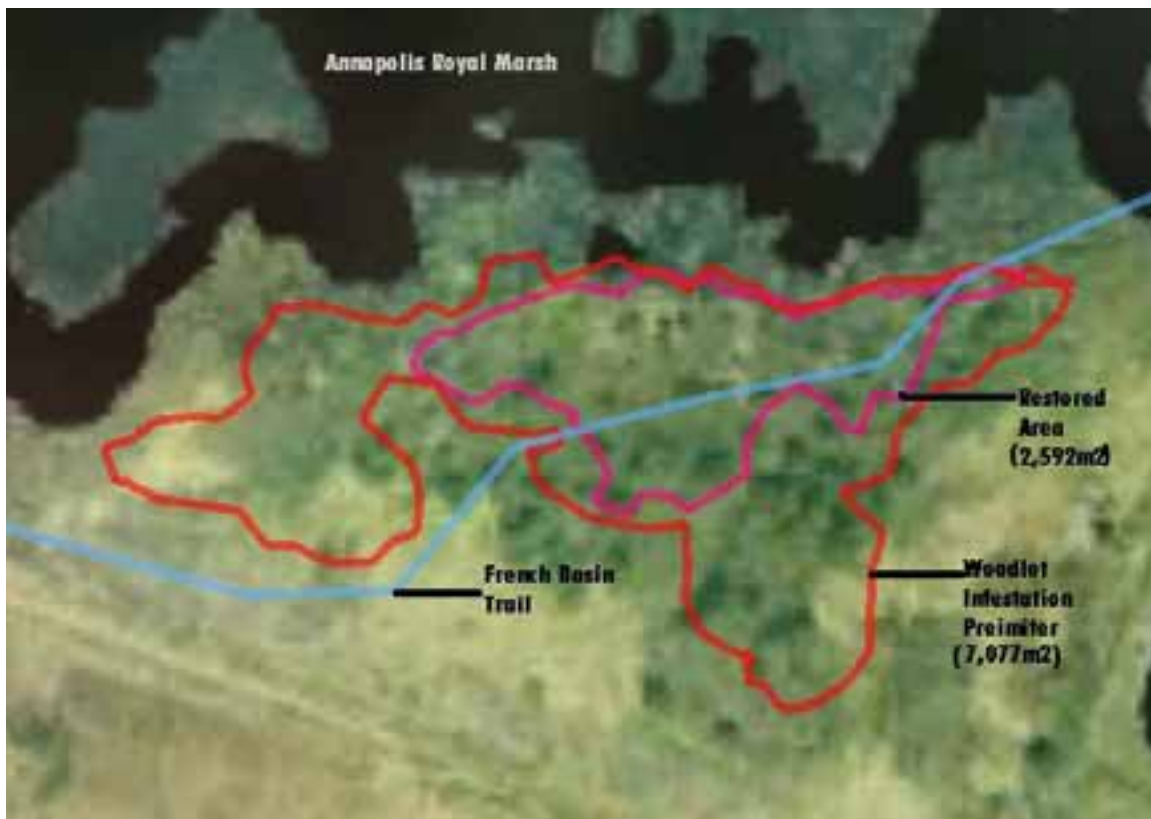


Figure 4-Woodlot infestation area (red), restored area (pink), and corresponding area.

## Reforestation with Native Species

**Outcomes for Year 1:** A total of 168 native trees and shrubs were planted in an effort to out compete the viable seeds present in the soil (See Figure 5). All the species planted in the marsh are recognized for their endurance and ability to thrive in riparian zones. Some of these tree and shrub species include elderberry, dogwood, hemlock, red oak, and cranberry. To suppress glossy buckthorn seedlings, a small amount of mulch was placed around the bases of the newly planted native trees until they have a chance to become established. A total of 2592m<sup>2</sup> of area was naturalized; however further monitoring and seedling removal will be required to ensure the area's natural integrity.

Bunchberry was planted as a ground cover to increase the aesthetic value of the trail and out compete the glossy buckthorn seed bank. Thirty bunchberry plants were planted in the cleared areas. It was noted that the areas containing a thick grass or fern mat were not colonized by the glossy buckthorn. CARP decided to experiment with different methods of ground cover to see which ones are most effective at suppressing the glossy buckthorn seedlings. With the help of local botanist Ginny Proulx, CARP was able to identify and transplant different native ferns (2 species) and sedges (2 species) from outside and inside the Annapolis Royal Marsh. The ground covers were transplanted in the cleared woodlot area in September and October 2009. They were specifically selected for their shade and moisture tolerance, and their ability to propagate through rhizomes. The sedges and ferns (approximately 10 of each species, 40 in total) were placed at randomized distances from the water with the exact location noted for easy identification in years to come.

**Planned changes for Year 2:** CARP may want to incorporate more sedges and ferns into future management endeavors if they prove to keep glossy buckthorn seedlings suppressed in the spring of 2010. The bunchberry planted, although very aesthetically pleasing, is not aggressive enough to out compete the glossy buckthorn seedlings. It is recommended that bunchberry not be introduced until all danger of glossy buckthorn re-sprouting has passed (approximately 5-7 years).



Figure 5- Examples of tree species planted within the Woodlot area of the Annapolis Royal Marsh maple (left) and pine (right).

## Disposal Methods Used

The French Basin Trail is a popular recreational area, used by both tourists and the general population of Annapolis Royal. Any disposal practices that negatively change the aesthetics of the area would be unacceptable. Many methods of glossy buckthorn disposal methods were identified and considered, however it was difficult to identify a method that was both the least harmful environmentally and did not negatively change the aesthetics of the woodlot.

**Outcomes for Year 1:** CARP decided that the safest method to dispose of the pulled plant material was to leave it on-site, but not visible to the general public. The pulled plant material was stacked in small piles not visible from the trail. The material dried out in a couple of days with no apparent indicators of re-sprouting. There was some concern that the pulled plants touching the ground on the bottoms of the piles would re-sprout, but the piles were large enough to block sufficient sunlight from getting through. The trees that were girdled earlier in the summer lost their leaves and failed to bear any fruit but will later fall and contribute to the litter layer of the forest floor.

**Planned changes for Year 2:** Removing the seedlings solely by hand can be tedious and time consuming. Controlled burnings of the seedlings with the use of a blowtorch could be more efficient. This would decrease the amount of plant waste generated and may speed up the seedling removal. Extreme care would have to be exercised to ensure this practice was only implemented at times of low spreading hazard (such as when there is low seasonal drought).

## Community Engagement Activities

### Raise Awareness Through Community Involvement

The Clean Annapolis River Project has encouraged community involvement in this project by holding three volunteer days: one on May 22<sup>nd</sup>, one on May 31<sup>st</sup>, and a third on the 25<sup>th</sup> of July 2009. These volunteer days (approximately 4 hours each) brought out six community members. Short information sessions were held and approximately 10m<sup>2</sup> of buckthorn in total were pulled in the woodlot of the marsh, where pamphlets and information sheets were distributed. Four Grade 7 classes (approximately 75 students) were given both presentations and pamphlets (see Appendix B) outlining the glossy buckthorn infestation, the threats it poses to native biodiversity, and plant identification characteristics. Each class then participated in a field session in the marsh, where they received hands-on identification experience and a chance to remove some of the plants. The classes pulled 20m<sup>2</sup> in total from the woodlot of the marsh.

To spark interest within the community and solicit for volunteers, signage was created and placed at different locations throughout the French Basin Trail in the Marsh (see Appendix C). The signs successfully explained the transforming landscape within the marsh, promoted the project, and encouraged volunteers to help with the removal. When performing fieldwork along the Annapolis Royal Marsh, brochures were often handed out to community members curious about the glossy buckthorn project.

### Friends of the Annapolis Royal Marsh

To help ensure the long-term stewardship of the Annapolis Royal Marsh, a 'Friends of the Annapolis Royal Marsh' group has been initiated. Through online promotion and marsh signage, community members are encouraged to sign an online 'Friends of the Marsh' Guest book. The guest book allows participants to record different marsh species they have encountered along the French Basin Trail. The species could be common, rare, or invasive, but all entries are capable of giving an indication of the

marsh's health and integrity. Participants have the option to post photos and comment on their encounters, and also view other group members' entries. (See appendix D, <http://www.annapolisriver.ca/frenchbasinrail.php>).

## Proposed Schedule for 2010

- May- conduct surveys to monitor 2009 control effectiveness and search for new occurrences
- May- plan management activities and community/volunteer training
- Early June- implement volunteer training and management activities
- Early June- implement all management activities
- Late June- Quality Assessment/Quality Control (QA/QC) surveys
- July, August, September- monitoring activities
- September and beyond- evaluate and revise management plan

## Evaluation

Both short and long term monitoring are required for this project. Monitoring of restored areas must be undertaken to determine whether the management actions have been successful. This will include monitoring of girdled trees and the density of the new seedlings, as well as looking for new infestations or the occurrence of further spreading. Long-term monitoring is also required to determine the success of the management program, for example whether the girdled trees remain dead, or whether the sedges and ferns were successful. The management effectiveness monitoring is required for assessment of overall success balanced with costs.

## Resource Requirements

### Glossy Buckthorn Removal

The person-days required to remove glossy buckthorn vary with certain conditions. The size of the plants varies drastically, as does the energy required to pull them. The larger trees can be girdled relatively quickly, however the smaller trees removed with the weed wrench are far more energy intensive, as additional digging may be required for full root system removal. The medium sized plants are much easier to pull and an area of approximately 15m<sup>2</sup> can be cleared in one person-day. This number can vary depending on soil type and moisture and the density of the plants. The plants tended to be easier to pull closer to the marsh where the ground was wet or anywhere following precipitation. The smaller seedlings can be removed at a slightly slower rate, as there tend to be more seedlings in a smaller area. Area cleared was calculated rather than number of stems removed, as the removal would have been greatly slowed if all the plants were being individually accounted for.

**Note:** 15m<sup>2</sup> indicates the area cleared initially containing high-density medium sized plants. The same area would have to be pulled a second and sometimes third time during the remainder of the season as the new seedlings emerged due to the persistent seed bank. This does not include the girdling of older trees to stop the replenishing of the seed bank. It takes approximately 15-35 minutes to properly girdle a mature tree, depending on the number of stalks the root system has (each one requires a separate girdle incision). The girdled trees also require maintenance, as new suckers will emerge below the incision. These new suckers should be pulled approximately 2 weeks after the tree has been girdled, but the trees will die off after the suckers are removed. The actual amount cleared in one person-day is closer to 8m<sup>2</sup> when pulling new seedlings from the same initially cleared area more times than once and removing suckers from the previously girdled trees.



It will take 7 or more years to fully remove glossy buckthorn from the Annapolis Royal Marsh, followed by careful monitoring. Outlined below are the appropriate actions required for successful and efficient removal. It should be noted that the other marsh infestation locations, such as the Dense Salt Marsh, are much less dense than the Woodlot area. The controlling of the other populations will be significantly less energy intensive in the other areas and will require fewer resources.

**Outcomes for Year 1:** Little resource planning was conducted prior to implementing management actions in 2009. The density plots gave an estimation of the extent of the infestation in 2008, however 2009 should be viewed as a trial year. In the summer of 2009, the majority of the seed-producing plants were girdled in the woodlot. The rest of the woodlot can be cleared of the seed bank; however timelines are very important and the recommendations within this report should be followed to ensure maximum future efficiency.

**Planned changes for Year 2:** Since the majority of the seed producing trees within the woodlot have been successfully girdled, it is important to keep the seed bank suppressed. The woodlot should be continually cleared of all seedlings in 2010, and each sequential year until the seed bank is depleted. It should take approximately 90 person days to remove the remainder of the seedlings from the Woodlot in 2010, and girdle any trees that may have been missed in 2009. Fortunately, this will become easier with each progressing year. The cleared areas of the woodlot should be monitored for successful mortality rates of trees girdled later in the summer. In conjunction with seedling and seed bank depletion, once all the seed producing plants have died off, other areas of the marsh should be considered for removal. It is suggested that the majority of the removal occur early in the spring. CARP recommends that the next area to receive invasive removal is the Dense Salt Marsh area. The trees should be girdled in the spring of 2010, and the suckers should be pulled throughout the summer of 2010.

**Planned changes for Year 3:** The Woodlot should still be closely monitored for seedling growth, and new seedlings must be removed as they emerge. The girdled trees of the Dense Salt Marsh area should be monitored, and new seedlings removed from the surrounding area (however few since a dense grass mat exists). Other areas of the marsh should be girdled and possibly assessed for new occurrences.

## Reforestation with Native Species

The person days required for planting native species depended on many different factors, however the time is easier quantified than glossy buckthorn removal in terms of person-days. Approximately 20 trees (1L pots) can be planted by one person in one day. The smaller plants could all be planted in one day.

**Outcomes for Year 1:** Planting trees in the remainder of the woodlot are important for glossy buckthorn removal endeavors in 2010.

**Planned changes for Year 2:** The outcomes of the fern and sedge transplants should be carefully observed, and if one thrives more than the others, that successful species should be incorporated into future eradication endeavors within the woodlot. In the other areas of the Annapolis Royal Marsh, except for the Skate Park area, there are very few tree and shrub species other than the glossy buckthorn itself. It is suggested that no other trees or shrubs be planted in place of the glossy buckthorn in these areas, as the dominant species comprise of marsh and wetland grass and sedge species. It is recommended that native full sun and high moisture grass or sedge species should be planted in the marsh areas instead of native trees.

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**Planned changes for Year 3 and beyond:** When glossy buckthorn removal occurs in the Skate Park area of the marsh, more trees and shrubs should be planted depending on how much area has been cleared, and how much natural regeneration exists. Other groundcover should be incorporated based on the pre-existing conditions of the site and the soil exposed upon glossy buckthorn removal.

## Further Recommendations

### 1-Active Partner Participation

It is recommended that partners remain involved, as the management initiatives for glossy buckthorn removal require long-term commitments. This multi-year initiative includes recommended actions to be taken by the Town of Annapolis Royal when performing maintenance of the French Basin Trail. Seasonal cutting occurs along the French Basin Trail to increase public safety. Some of the glossy buckthorn plants get cut off in the process, encouraging the extended root growth and making it very difficult to dig the roots out in the future. It is recommended that the cut root masses be excavated.

### 2-Community Engagement

It is important that community members actively participate in management endeavors through the Friends of the Annapolis Royal Marsh group. This is not only important for invasive species management, but also for the long-term stewardship of the marsh. A leader of this group should be appointed and the continuation of this group should engage the community in more invasive species removal events.

### 3-Seedling Survival Rate Monitoring

It is hard to quantify the amount of time it will take to establish full seed bank depletion. There is little literature present on the subject, and what exists is not specific to the conditions in Nova Scotia. It is recommended that seedling survival rate be quantified proceeding seed source removal until the seed bank is completely removed. This would give a better overall perception of removal resource requirement and would result in a more accurate long-term management plan.

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Appendix A – Beneficial Management Practices (BMP) Document created by the Clean Annapolis River Project  
October 2009.

Better Management Practices (BMP) and Control Methods for Glossy Buckthorn (*Rhamnus frangula*) in the  
Annapolis Valley



Clean Annapolis River Project

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## Executive Summary

Invasive alien plants threaten the biodiversity of our native ecosystems. Areas that are valued for their natural qualities, such as parks, trails, waterways, and campgrounds, may be at risk of being forever changed. We can all play a key role in reducing new introductions, and preventing the spread of invasive plants.

An **alien species** is any species (plant, animal, microbe) introduced by human action outside its natural range. They may originate on another continent, in another country, or in another part of Canada. These species introductions may be intentional or accidental, and include a number of pathways.

An **invasive alien species** (IAS) is an alien whose introduction and/or spread may threaten the environment, the economy, or society (including human health). Plants are just one type of alien invader wreaking havoc on Canadian ecosystems. Some of our most notorious invasive aliens include the zebra mussel (*Dreissena polymorpha*), the purple loosestrife (*Lythrum salicaria*) plant, and the brown spruce longhorn beetle (*Tetropium fuscum*). High productivity, good dispersal, long growth periods, and lack of natural controls contribute to their success in new environments. Due to increases in global trade, travel, and resource extraction, species introductions are on the rise. Access to formerly pristine areas for recreation and resource extraction is of particular concern. Invasive species are considered the second greatest threat to biodiversity on the planet (Godwin, 2007).

Glossy buckthorn (*Rhamnus frangula*) is an invasive alien from Europe. In 2007, glossy buckthorn was identified as being one of the most threatening alien invasive species in Nova Scotia, and has been identified in various locations throughout the Annapolis Valley. Glossy buckthorn has become a major problem by out-competing other plants for nutrients and sunlight, decreasing the overall abundance of native plant species. The Clean Annapolis River Project (CARP) and partners: the Wal-Mart Evergreen Fund, the Shell Environmental Fund, the Nova Scotia Department of Natural Resources Habitat Conservation Fund, and the Town of Annapolis Royal have all expressed a keen interest in working towards the long-term management of glossy buckthorn, and have developed this Best Management Practices document.

This document compiles management information on dealing with infestations of *Rhamnus frangula*, or glossy buckthorn, and offers communities a practical guide to eradication procedures based on literature and experience. The main management goals identified for glossy buckthorn include:

- Raising awareness in the community through active engagement, information sessions and volunteer opportunities;
- Removing glossy buckthorn infestations from communities and planting native species in its place;
- Promoting the monitoring of current invasive populations

In October 2007, Marika Godwin of the Clean Annapolis River Project produced a report entitled *Invasive Alien Plants and You*. This report outlined the types of alien invasive plants of concern in Nova Scotia. In this report, the species were ranked to display the appropriate prioritization in regards to invasive species removal. Glossy buckthorn was identified as one of the top priority species for Nova Scotia due to its highly invasive nature and threat to native species. It was noted that several years are required to deplete the seed bank fully; so long-term management is crucial for successful removal of glossy buckthorn. In partnership with the Wal-Mart Evergreen Fund, the Shell Environmental Fund, and the Nova Scotia Habitat Conservation Fund, CARP created a long-term management plan to eradicate glossy buckthorn from the Annapolis Royal Marsh.

## Glossy Buckthorn: Biology and Identification

### Species Description

The Global Invasive Species Database (GISD) describes glossy buckthorn as a small tree or shrub reaching approximately 7 meters high with alternate shiny-topped un-toothed leaves with a slightly hairy underside. The leaves have up curved veins, and stay green well into the fall. The plant produces a tiny bell-shaped flower in spring. The immature berry will appear light red in August, maturing to a black colour before falling to the ground in the fall. Each berry can produce four seeds (Godwin, 2007). The plants can grow rapidly in one season. They can reach a maximum height of 7 meters once they reach maturity (GISD, 2005). Frequently mistaken for an alder, the younger stems of *Rhamnus frangula* can be easily identified by their deep purple stems with white flecks. The bark remains smooth upon maturity (See Figure 1).

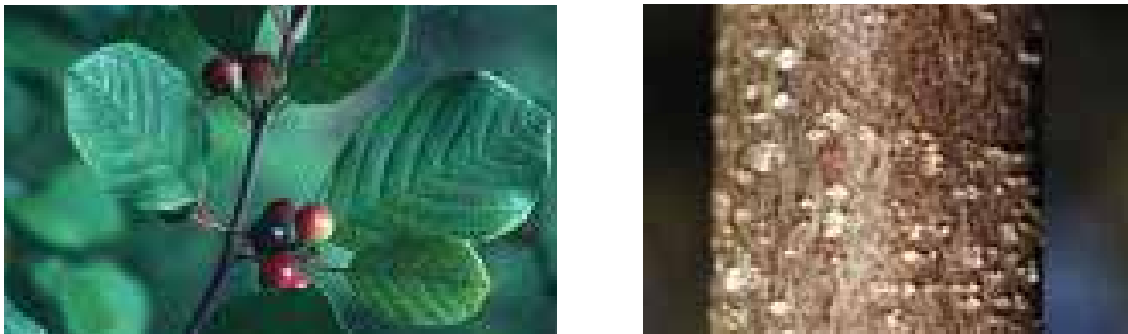


Figure 1- Glossy buckthorn leaves with maturing berries (left) and trunk (right).

### Current Distribution

Glossy buckthorn, native to Europe and Africa, was brought to Canada in the late 1800's and has now spread all across North America. The plant was brought by early European settlers as a hedgerow and an ornamental because of its adaptability and ability to thrive in various soil types with a lack of insect predators (Natural Resources Canada, 2002). The United States Department of Agriculture's Natural Resources Conservation Service Plant Database has created a distribution map depicting the presence of the species across North America:

USDA Plant Database, <http://plants.usda.gov/java/nameSearch?keywordquery=Frangula+alnus&mode=sciname>.

The Plant Database shows infestations from Newfoundland to as far west as the state of Illinois in the USA and the province of Manitoba in Canada. The densest infestation areas in Canada occur in the southernmost parts of Ontario and Quebec in the mixed wood Plains Ecozone (Natural Resources Canada, 2002).

### Reproduction and Dispersal

Glossy buckthorn reproduces mainly by seed dispersal by female plants, but can also spread laterally through rhizomes. The seed bank in the soil is very persistent, with seeds remaining viable for a number of years (Godwin, 2007). When the trunk is cut, the stump will re-sprout. Re-sprouting may occur when a small root is left behind after the majority of the plant has been up-rooted or even from cut logs with no visible root system.



The most effective method of dispersal comes from ingestion by birds. The Global Invasive Species Database states that blackbirds, starlings, and cedar waxwings are the main seed dispersers. The European Starling (another invasive) has also been noted to spread the seeds (Natural Resources Canada, 2002). The berries have been known to cause diarrhea, which in turn intensifies the area of seed distribution. The seeds may also be spread by water, as the ripe berries can stay buoyant for about nineteen days and the dry berries stay buoyant for about a week (GISD, 2005). Depending on stream velocity, the berries could be spread a significant distance in that amount of time.

Inadvertent dispersal may also occur by individuals through improper invasive species removal. The removal of glossy buckthorn from an infested site may cause further spread of the infestation by introducing viable seeds into an area. Also, greenhouses and nurseries unaware of potential invasive qualities may not resist sale of these invasive threats to biodiversity.

## Habitat

Glossy buckthorn has a range of habitat types and a very long growing season. Its aggressive growing behavior allows it to out-compete native species for resources such as water, sunlight, and nutrients through the rapid formation of a dense population. Although glossy buckthorn prefers slightly acidic riparian habitats, this plant's aggressive behavior can be partly attributed to its ability to tolerate a wide range of habitats (Godwin, 2007). It can withstand both dry and wet environments, and is especially drought resistant within North American climates. Once it has invaded an area, it will thrive and become the dominant species, choking out less aggressive plants by blocking out available sunlight and nutrients. Disturbances, such as woodland grazing and cutting, provide ideal habitat for seedling establishment (Maine Invasive Plants, 2001).

## Damage and Threats

Glossy buckthorn will invade an area very rapidly, with plants that can grow up to two meters in one growing season. The plants grow uniformly and very close together, creating a shaded environment below, and leave no opportunities for natural forest succession of native species (Godwin, 2007). This is not only a threat to native plant species, but also to those insects and animals that rely on these native species for survival. Once a plant has been established and has produced seeds, the seeds may remain viable in the soil for up to seven years. The roots are extensive, choking out any potential for native plant establishment. (IPSAWG, 2006).

## Delineation and Mapping of Target Populations

When dealing with populations of invasive species, it is important to grasp the scope of the problem by both identifying the boundaries of the infestation, and calculating the densities of the populations within the set boundary. The Clean Annapolis River Project found it effective to take a series of 1m<sup>2</sup> and 5m<sup>2</sup> test plots to quantify the severity of the infestation. First, the scope of the problem was identified, and then the area in question was broken down into smaller sub-areas. In the series of 1m<sup>2</sup> test plots, the numbers of glossy buckthorn regeneration plants were recorded. This was repeated several times in randomly selected plots within an area. An average density was calculated to give an overall indication of regeneration in the area. In the 5m<sup>2</sup> plots, the canopy width, tree height, trunk diameter, and number of stems were recorded on the larger trees (not the smaller regeneration trees) were recorded. This process is important in identifying priority areas for management.

## Control and Eradication

### Glossy Buckthorn Removal

Given that glossy buckthorn reproduces both by seed and by root mass propagation, several methods of removal were investigated and considered to eradicate *Rhamnus frangula* from communities. Literature suggests that using herbicide on the localized tree-stump area after cutting has proven the most successful method of removal when used in conjunction with pulling or burning of the seedlings (Godwin, 2007). Roundup (glyphosate) is the herbicide of choice for most *Rhamnus frangula* eradication endeavors; however it is non-species specific and may pose a threat to any native species present or may hinder the establishment of new natives in the future. Herbicide should never be applied before a rain event and only after carefully reading and complying with the manufacturer's directions.

The Clean Annapolis River Project believes that manual pulling of the plants along with the incorporation of a weed-wrench or tree-girdler for the larger trees is the most effective method of invasive removal (Godwin, 2007). Two weed wrenches were tested for removing large glossy buckthorn plants (trunks up to 2 inches in diameter). The two weed wrenches (the Puller-Bear™ and the Extractigator™) use leverage and body weight to rip the trees out of the soil by clamping around the tree trunk and pulling the tree down (See Figure 2). Both tools are similar in form and function, however CARP found that the Extractigator™ was better at gripping the trunk of the trees. The Extractigator™ has a larger metal base that prevents it from sinking into wet soils, where the Puller-Bear™ fell short with a small wooden base. Any roots broken off in the process would have to be excavated and removed to avoid re-sprouting. This method decreases the chances of damaging natives (established and potential), and ensures the death of the root system without interfering with the integrity of the surrounding ecosystem. Manual pulling of the plants is the most successful when the roots are removed, because any root masses left in the soil will re-sprout.



Figure 2- The Extractigator™ weed-wrench (left), and the Puller-Bear™ weed-wrench (right).

Tree girdling is an effective method for killing larger trees, causing the tree to “bleed out.” One type of tree-girdling tool consists of a chainsaw blade with handles attached on either end of the chain (See Figure 3). The chain is wrapped around the base of the tree trunk and crossed over at the front with the teeth of the chain touching the trunk. Pulling on the handles will destroy the phloem (nutrient transport) and the cambium (regenerative layer) of the tree. The tree is starved of nutrients reaching the roots, and unable to repair the damage (See Figure 4). It is important that the trees are girdled early in the spring and summer before they begin to produce fruit. Any handling of the trees must be done before the berries have matured to avoid introducing more seeds to the already excessive soil seed bank. The girdled trees will produce new suckers below the incision as a last chance at

survival. These suckers must also be removed, as they will bring sufficient nutrients to the roots if ignored. Once the trees have died, they will eventually fall to the ground, decomposing and adding to the forest litter layer. They may also serve as food and habitat for other forest species. The best time for tree girdling is spring and summer, after the tree has depleted energy reserves from its initial spring growth (Sound Native Plants, 2009).



Figure 3- Tree girdling tool (chainsaw blade with handles attached).



Figure 4- Base of girdled glossy buckthorn tree trunk in the Woodlot of the Annapolis Royal Marsh.

#### Notes on Herbicide Use

Non-selective herbicides (such as Roundup) will harm or kill any growing plant. As such, they are often recommended for control of unwanted plant species, including invasive alien plants.

-Always read and follow directions on any pesticide label.

- Be sure that the pesticide you are using is registered for your intended use (eg. to use a herbicide in a riparian area, it must be registered specifically for that use). **It is illegal to use a pesticide in any way that is not specified on the product label.**
- There are no pesticides currently licensed for use in riparian areas in Canada.
- Most herbicides will have a maximum application rate per unit area. Do not exceed these maximum rates when applying large quantities of herbicide.
- CARP does not endorse the use of herbicides, but is aware that under certain circumstances they may be the only realistic control option for some invasive alien plants.

## Reforestation with Native Species

Apart from pulling glossy buckthorn, it is important to plant native species (trees, shrubs, and ground cover) in the cleared areas. Native plant species will provide important food and habitat for other species, and in time will contribute to natural forest succession. The ground cover will help suppress the viable seeds still present in the soil, keeping the glossy buckthorn from out-competing the planted native trees for valuable resources. If the cleared land is left exposed, the soil may lose nutrients through erosion, or cause sedimentation if the area is located close to waterways.

## Disposal of Glossy Buckthorn Plant Material

A common question is “How do I dispose of my invasive alien plant material once I have removed it from my property?” Ideally, all plant material could be composted. Composting recycles nutrients, and reduces waste in landfills. However, in the case of invasive plants, the answer is not that simple. Most backyard composters do not reach high enough temperatures to completely decompose all plant material. As such, persistent seeds, pieces of roots, and other plant parts may remain viable throughout the composting process. Because complete decomposition does not occur, using this compost may then actually contribute to the spread of alien invaders.

Results from a British study (Ward 2003) suggest that in order to prevent regeneration of Japanese knotweed (*Polygonum cuspidatum*), another persistent invasive, plant material must be composted at a temperature greater than 55°C for a minimum of 1 week. Even after high-temperature commercial composting, Ward (2003) suggests that there would be a small risk of spread. Northridge Farms in Aylesford, NS, who are contracted to compost all green-cart material for Valley Waste Resource Management (VWRM), in the Annapolis Valley, have a 3-fold composting process (Dwight Horsnell, personal communication 2006). The first cycle involves heating the compost to 140°F (just over 60°C) for 1 day, during which the compost is also exposed to air. The second cycle includes 7 days at a temperature of 130°F (approximately 55°C). The final cycle is a lengthy process during which the organic material is left outdoors and turned regularly. The complete composting process takes 3 months, from start to finish.

Although it is likely that the Northridge Farms composting process is hot enough and lengthy enough to kill plant material, there can be no guarantee. Glossy buckthorn can be especially persistent. Therefore, it is recommended that highly invasive plants such as glossy buckthorn and other highly invasive plant material not be composted.

There is also always a risk of spread associated with transporting invasive plant material. By disposing of plant material on the property from which it was removed, risk of spread is minimized. In cases where this is not possible (eg. too much plant material, fire ban, etc), green invasive material should be double-bagged in a regular garbage bag for transportation to an alternate disposal site.

The first step to responsible disposal of invasive plants is drying them out. Some plants, such as glossy buckthorn, can take root from any part of the plant stem or root coming in contact with bare mineral soil. Drying should be done on a tarp, or other inorganic material (eg. concrete, wood, etc) to prevent rooting or sprouting from seed. Removing plants before they produce seed is a good way to minimize the risk of spread. Once the plant material is completely dry, it can then be burned, or put in a garbage bag for disposal in a landfill. It is possible to try composting after the invasive plant material has been dried, but it is imperative that no living parts remain after composting. Even then, it is recommended that use of the compost be tracked to see if any invasive alien plants spring up where it has been spread. Never move the compost off the property from which it originated.

## Community Engagement

When disposing of any alien invasive, it is important to educate the community so that they can become involved in removing any invasive species from their own property, or become involved in volunteer endeavors to remove invasive species within the community. Increasing the community's understanding of the importance of native species for wildlife habitat will promote the long-term stewardship of natural wildlife habitat areas. This can be accomplished by holding information sessions to educate on the dangers of invasive species.

## The Need for Long-Term Commitments

Most invasive species cannot be removed in one year. Most (including glossy buckthorn) require several years to ensure complete removal. The majority of the seed producing plants can be removed in the first season to stop the addition of further seeds to the seed bank. Unfortunately, the glossy buckthorn seed bank will not be depleted for 5-7 years. Therefore, as with other persistent alien invasive, it is important to establish a long-term commitment to ensure the eradication of the species. Short and long term monitoring are required to test the effectiveness of management endeavors.

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- United States Department of Agriculture. Natural Resources Conservation Service. Plants Database: *Frangula alnus* Mill. glossy buckthorn. Accessed online at: <http://plants.usda.gov/java/nameSearch?keywordquery=Frangula+alnus&mode=sciname>

Appendix B – Pamphlet and information sheets handed out to students, community members, and volunteers.


**MAKE A DIFFERENCE!**

- Learn to identify invasive species in your area
- Remove invasive species and dispose of them properly
- Clean off clothing, gear, vehicles and pets before and after exploring a new area
- Spread the word, not the weeds!

This Project is Thanks to Funding by:



And Support from





**GLOSSY BUCKTHORN  
IN THE  
ANNAPOLIS ROYAL MARSH**

For more information on this and other invasive species, please visit:


[www.annapolisriver.ca/projects/irs\\_main.htm](http://www.annapolisriver.ca/projects/irs_main.htm)  
[www.projectufa.ca](http://www.projectufa.ca)

**VOLUNTEERS ARE NEEDED!  
TO HELP COMBAT INVASIVE SPECIES  
PLEASE CONTACT  
KATHERINE**


  
**CLEAN ANNAPOLIS RIVER PROJECT**  
 532-7533 [corp@annapolisriver.ca](mailto:corp@annapolisriver.ca)



**Clean Annapolis River Project**  
 21 St. Anthony Street  
 PO Box 395 Annapolis Royal, NS  
 B0S 1A0  
 Phone: 902-532-7533  
 Fax: 902-532-3038




**WHY IS GLOSSY BUCKTHORN A PROBLEM?**




Spreads Easily

- Birds consume the berries and "drop" them off elsewhere, spreading seeds near and far.




Out-Competes Native Species


- Glossy Buckthorn was introduced from Europe to North America for landscaping.




Threatens Biodiversity

- Glossy Buckthorn is fast-growing and takes advantage of open and disturbed spaces








**WHAT ARE WE DOING ABOUT IT?**

**REMOVAL**

Smaller trees and seedlings can be removed physically by hand or using the Estrogenator™. These can be composted (unless they are fruit bearing).




**GIRDLING**

Larger trees must be girdled. This means that a strip of bark and underlying tissue is removed in order to interrupt the flow of nutrients between the crown and roots.



**PLANTING**

In the Spring of 2009 we will plant at least 100 trees and shrubs to replace the Glossy Buckthorn. Exposed soil often is colonized by invasive species.







## LEAVE NO TRACE PRINCIPLES

### Leave What You Find

- Avoid introducing or transporting non-native species

### Travel or Camp on Durable Surfaces

- Concentrate use on existing trails and campsites

### Respect Wildlife

- Observe wildlife from a distance

### Be Considerate of Other Visitors

- Respect other visitors and protect the quality of their experience
- Let nature's sounds prevail. Avoid loud voices and noises

### Dispose of Waste Properly

## IDENTIFICATION



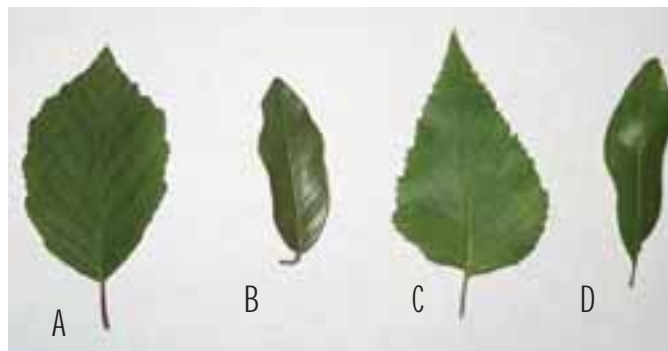
Alder



Bayberry



Birch




Can you tell which is which?

A couple hints:






Appendix C – Signage and promotion material to spark community interest and recruit volunteers.



## GLOSSY BUCKTHORN IN THE ANNAPOLIS ROYAL MARSH


*Volunteers needed to help control this  
**ALIEN INVASIVE***

If you are interested in taking part please contact  
Katherine at the Clean Annapolis River Project  
Drop in, phone or e-mail:  
Phone: 532-7533  
E-mail: [carp@annapolisriver.ca](mailto:carp@annapolisriver.ca)



Clean Annapolis River Project  
Community Action on Invasive Alien Plants  
151 Victoria Street  
Annapolis Royal, N.S

In cooperation with:



Project Supported by:

- NS Habitat Conservation Fund (DNR)
- Shell Environmental Fund
- Wal-Mart—Evergreen Green Grant





Clean Annapolis River Project  
151 Victoria Street  
Annapolis Royal, NS

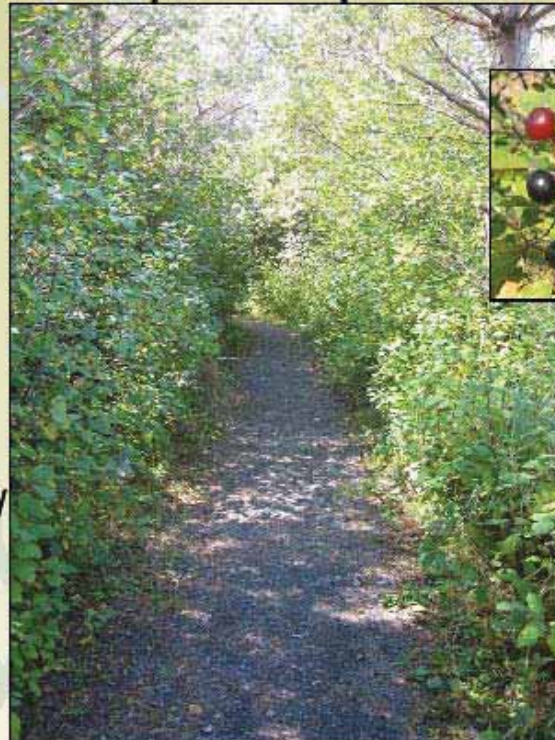
# GLOSSY BUCKTHORN IN THE ANNAPOLIS ROYAL MARSH

## Why is this a problem?



Out-competes  
native species

Compromises safety  
by narrowing the  
trail and reducing  
visibility



Spreads easily



Threatens  
biodiversity

## VOLUNTEERS ARE NEEDED!

For more info on how you can help contact Clean Annapolis River Project  
[CARP@annapolisriver.ca](mailto:CARP@annapolisriver.ca) or 532-7533

Schedule:  
Fall 2008—Removal of Buckthorn  
Spring 2009—Replanting with Native Species

Project Supported by:  
Town of Annapolis Royal  
NS Habitat Conservation Fund (DNR)  
Shell Environmental Fund  
Wal-Mart—Evergreen Green Grant



Appendix D – Friends of the Annapolis Royal Marsh website featuring Marsh Guest book.

Location: Home > Projects Search:

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## Clean Annapolis River Project

Questions? Email: [carp@annapolisr.ca](mailto:carp@annapolisr.ca)

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**CARP Program Areas**

**Programs by Category**

**Current Programs**

**Past Programs**

**Friends of the Annapolis Royal Marsh**

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**Become Involved**

CARP is always looking for volunteers. Please let us know your area of interest and we will try to get you involved!

Learn More >

### Friends of the Annapolis Royal Marsh

The Annapolis Royal Marsh is a constructed wetland surrounded by The French Basin Trail. The marsh serves as habitat for many different species, including the painted turtle and the redwing blackbird.



Since the French Basin Trail is widely used by both local residents and visitors to the Town of Annapolis Royal, it is important that the integrity of the Annapolis Royal Marsh be sustained for many years to come.

Help us promote long-term marsh stewardship through community involvement. The Clean Annapolis River Project and partners have created an online Guest Book, where marsh-goers can record the species they have seen.



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What exciting species have you encountered today? Record the different species you observe, leave a comment, or post a photo on our [Friends of the Annapolis Royal Marsh Guest Book](#).

Are you interested to see what others have posted? [View the French Basin Trail Guest Book now.](#)

ENTER TO WIN! - [Sign the French Basin Trail Guest Book](#)

By submitting your Annapolis Royal Marsh photograph, you are automatically entered for a chance to win a copy of *Restoring the Acadian Forest* by Janice Simpson!

Winning photo will be framed and mounted at the Clean Annapolis River Project office at 151 Victoria St., Annapolis Royal, Nova Scotia. Competition closes December 25th, 2009.



Help ensure the long-term stewardship of the Annapolis Royal Marsh!

[Sign the French Basin Trail Guest Book](#) == [View the French Basin Trail Guest Book](#)

November 2009

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