

# Invasive *Phragmites* – Best Management Practices

2011



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Front cover photo courtesy of Ontario Federation of Anglers and Hunters.

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Photo courtesy of Dave Featherstone.



Photo courtesy of Janice Gilbert, MNR.

These Best Management Practices (BMPs) are designed to help control the invasive plant *Phragmites australis* subsp. *australis* (common reed) and are based on the most effective and environmentally safe *Phragmites* control practices known from recent research findings, field trials, and experience. These BMPs are subject to change as new research findings emerge.

## Introduction

*Phragmites australis* subsp. *australis* (Common reed) is an invasive perennial grass that was transported from Eurasia and is causing severe damage to coastal wetlands and beaches in North America. In 2005, Agriculture and Agri-food Canada identified it as the nation's "worst" invasive plant species. Invasive *Phragmites* was first introduced along the eastern seaboard but have since been identified and located farther west and north of the original point of introduction. In Ontario, invasive *Phragmites* has been identified across the southern part of the province, with scattered occurrences as far north as Georgian Bay and Lake Superior. Invasive *Phragmites* is currently sold through the horticultural trade as an ornamental plant and spreads through various methods, including by wind and

water. Stands of invasive *Phragmites* decrease biodiversity and destroys habitat for other species, including Species at Risk. The Ontario Ministry of Natural Resources works with several partners towards controlling and managing invasive *Phragmites australis*.

The name *Phragmites* is derived from the Greek term *phragma*, meaning fence, hedge, or screen. Invasive *Phragmites* is a subspecies known as *Phragmites australis* subsp. *australis*, and is closely related to the native subspecies *americanus*. Much of the biomass of invasive *Phragmites* is found underground, in an intricate system of roots and rhizomes. This aggressive plant grows and spreads easily, quickly out-competing native species for water and nutrients. Invasive *Phragmites* releases toxins from its roots into the surrounding soil which impedes the growth of and even kills off neighbouring plants. It thrives in disturbed habitats and is often among the first species to colonize a new area. This plant prefers areas of standing water but the roots can grow to extreme lengths allowing the plant to survive in low water areas. Invasive *Phragmites* is sensitive to high levels of salinity, low oxygen conditions, and drought, all of which can limit the viability of seeds or rhizome fragments.

## Life Cycle of Invasive *Phragmites*

In general, growth of invasive *Phragmites* follows these timelines however exact timing will be site-dependent:

- Dormant: November–March
- Germination: April–May
- Primary vegetative growth: June–July
- Flowering: August–September
- Translocation of nutrients: September–October

## Reproduction

Invasive *Phragmites* reproduces by dispersing seeds, by roots via rhizomes, or by stolon fragments. Dispersal can be natural through water, air, or animal movement, as well as through human actions and equipment such as horticultural trade, boats, trailers, or ATVs. Invasive *Phragmites* rhizomes can grow horizontally several metres per year and this is the most common method of reproduction. Vertical plant growth can reach 4 cm per day and plants can produce thousands of seeds annually.



**Figure 1:** A native *Phragmites* stand (left) and an invasive *Phragmites* stand (right). Note the varied vegetation and lower density of native *Phragmites* stalks on the left and the taller, higher density invasive *Phragmites* stalks on the right.

Native stand photo courtesy of Erin Sanders, MNR. Invasive stand photo courtesy of Janice Gilbert, MNR.

## Invasive vs. Native *Phragmites*

The invasive subspecies (*australis*) of *Phragmites* is similar to a native species (subspecies *americanus*), and it is imperative that a stand be identified before implementing a management plan. When large-scale control is planned any stands of native *Phragmites* should be protected because unlike the invasive strain, native *Phragmites* rarely develops into monoculture stands, does not alter habitat, has limited impact on biodiversity, and does not deter wildlife.

It can be difficult to tell native and invasive *Phragmites* apart, and genetic analysis may be necessary. Some identifying characteristics that may help tell the species apart are:

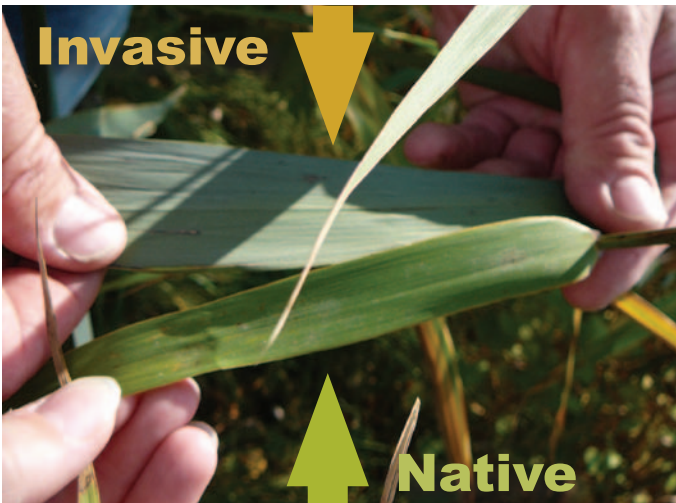
- Stand height
- Stand density
- Stem colour
- Leaf colour
- Seedhead density

	Native <i>Phragmites</i>	Invasive <i>Phragmites</i>
<b>Stand height</b>	No taller than 2 metres	Up to 5 metres (15 feet)
<b>Stand density</b>	Sparse, interspersed with native vegetation	Dense monoculture, up to 100% invasive <i>Phragmites</i>
<b>Stem colour</b>	Reddish-brown	Beige, tan
<b>Stem texture</b>	Smooth and shiny	Rough and dull
<b>Stem flexibility</b>	High flexibility	Rigid
<b>Leaf colour</b>	Yellow-green	Blue-green
<b>Leaf sheaths</b>	Fall off in fall, easily removed	Remain attached, difficult to remove
<b>Lower glume</b>	3.7–7 mm	2.6–4.2 mm
<b>Flower timing</b>	Early (July–August)	Intermediate (August–September)
<b>Seedhead density</b>	Sparse, small	Dense, large



**Figure 2:** A native *Phragmites* stem (left) and an invasive *Phragmites* stem (right). Note the reddish brown native stem on the left, and the tan/beige invasive stem on the right.

Native stand photo courtesy of Erin Sanders, MNR. Invasive stand photo courtesy of Janice Gilbert, MNR.



**Figure 3:** A native *Phragmites* leaf (bottom) and an invasive *Phragmites* leaf (top). Note the yellow-green native *Phragmites* leaf, and blue-green invasive *Phragmites* leaf above.

Photo courtesy of Erin Sanders, MNR.

Invasive *Phragmites* stands can grow up to 5 metres tall (15 feet) in very dense stands with up to 200 stems per square metre. These near-monoculture stands can consist of 100% invasive *Phragmites*. In comparison, native *Phragmites* does not grow as tall, and does not out-compete other native species, so there is more diversity within a stand (Figure 1).

Invasive *Phragmites* stems are generally tan or beige in colour with blue-green leaves and large, dense seedheads, in contrast to the reddish-brown stems, yellow-green leaves, and smaller, sparser seedheads of native *Phragmites* (Figure 2, 3, and 4). Cross-breeding between invasive and native *Phragmites* plants has not been confirmed in the field, but has been produced in laboratory studies. Where the plant is found in certain environmental conditions such as those that occur along sandy coastal shorelines and deep water systems, the morphological differences described above are not definitive. If it is not clear whether a *Phragmites* plant is invasive or native, it is recommended that a *Phragmites* expert be consulted.



**Figure 4:** A native *Phragmites* seedhead (top) and an invasive *Phragmites* seedhead (bottom). Note that the native *Phragmites* seedhead is smaller and sparser compared to that of the invasive *Phragmites*.

Photo courtesy of Erin Sanders, MNR.

## Control Measures

Controlling invasive *Phragmites* before it becomes well-established will reduce the environmental impacts, time, and costs. The effectiveness of early detection and reporting is greatly increased through public education. Proper identification of the plant is critical. Once invasive *Phragmites* is confirmed, a control plan should be developed and implemented taking into consideration any site specific conditions such as native plant diversity, wildlife usage, and water table fluctuations. A detailed inventory of each site is strongly recommended prior to initiating control efforts to help ensure the proper control methods and timing are selected to minimize negative impacts to the system. The inventory should identify the flora present and wildlife usage so there is minimal impact to them resulting from the control measures. Recreational usage and the presence of people and domestic animals around control sites should be minimized when herbicides are being used.

The presence of Species at Risk flora or fauna at the site is a key consideration in control planning. There are a number of mitigation efforts that can be used to reduce potential harm to plant Species at Risk, including timing. Further information is available from a local Species at Risk Biologist in the MNR district office.

Due to the extensive underground rhizome system created by invasive *Phragmites*, the use of a single control measure is not always effective, and disturbance to an area may actually increase the density and spread of an invasive *Phragmites* stand. The Ontario Ministry of Natural Resources recommends using an integrated pest management (IPM) plan, which combines two or more methods into a long-term plan that follows up initial treatments with frequent monitoring and re-assessment, and subsequent treatments if necessary. Case-by-case assessments will help determine which combination of control measures will be most effective in a given area.

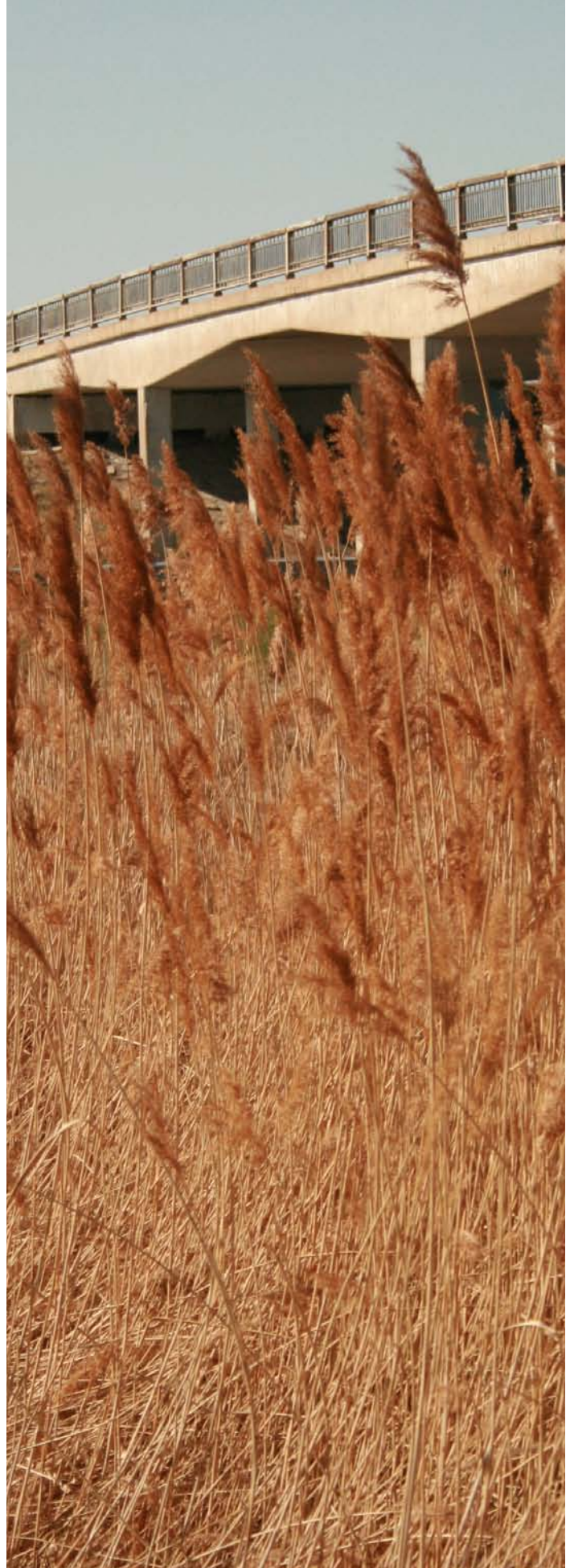


Photo courtesy of Francine MacDonald, OFAH.



**Figure 5:** A study site at MacLean’s Marsh, using 5% glyphosate. Before: Pre-treatment, 2007. After: Post-treatment, 2008. Note: There was no standing water in this area at the time of treatment.

Photos courtesy of Janice Gilbert, MNR.

Management options for control include mechanical excavation, flooding, herbicide application, and prescribed burning. The most effective approach for most situations is a combination of herbicide application, cutting/rolling and prescribed burning. Herbicide label restrictions may prohibit the use of the herbicide in or over water and sites that are flooded for the entire growing season cannot be controlled using the available herbicides.

The success of any control project is dependent upon a number of factors including stand density, accessibility, and the control options employed. Complete eradication of invasive *Phragmites*, particularly in well-established stands, is rarely achieved after one treatment. Depending upon the site, annual visits and touch up control work will be required for several years. Post-treatment assessments are recommended to track control efficacy and guide future management.

Regeneration of native plants from the residual seed bank should be seen in the growing seasons following control measures, but some sites may require seeding or planting particularly if plant diversity historically was low.

## Herbicide Application

While using herbicides is not always an ideal solution, in some situations the detrimental effects of allowing invasive *Phragmites* to flourish can far outweigh the negative effects of pesticide use.

Ensure all necessary permits are obtained and regulations followed when using herbicides. In Ontario, herbicide storage, use, transport, and sale is regulated under the Pesticides Act and Regulation 63/09 (information available at [www.e-laws.gov.on.ca/html/source/regs/english/2009/elaws\\_src\\_regs\\_r09063\\_e.htm#BK37](http://www.e-laws.gov.on.ca/html/source/regs/english/2009/elaws_src_regs_r09063_e.htm#BK37))

Section 33 under Regulation 63/09 provides an exception for Class 9 pesticides (i.e., pesticides that are prohibited for cosmetic use purposes) to be used for natural resource management purposes.

Class 9 pesticides can be used by the following persons, if they hold the appropriate exterminator license:

- an employee of MNR;
- an employee of a Conservation Authority;
- an employee of a body having a written agreement with MNR to manage natural resource features; or



- a licensed exterminator providing a service to MNR, a Conservation Authority, or a body responsible for managing a natural resource management project under a written agreement with MNR.

If the extermination is done by a body not mentioned above, a written Letter of Opinion is required from the Branch or Regional Director of the Ministry of Natural Resources. Depending on the site, other agency approvals may also be necessary. Proper public notification signage as prescribed in Regulation 63/09 is required to be posted at all treated areas.

### *Herbicide type:*

When selecting an herbicide, it is best to choose one specifically designed for use on grass species. Herbicides with high animal LD50 values indicate low acute toxicity levels for wildlife. Herbicides that are broken down microbially into harmless compounds have a short half-life, and are preferred. Herbicides used for *Phragmites* control should be able to translocate from the application site (usually the leaves or stems) down to the roots, effectively killing the entire plant.

In North America, there are two herbicide active ingredients shown to be effective in *Phragmites* control: glyphosate and imazapyr. Both are formulated into products under a range of common or brand names. Imazapyr is a more effective herbicide, but is also more expensive than glyphosate.

Management plans that combine the two herbicides can decrease costs while maintaining high levels of efficacy. Alternating herbicide active ingredients can decrease the chances of *Phragmites* developing resistance to one or the other herbicide.

Information and regulations regarding the use of herbicides, including precautions, storage, disposal, solution concentrations, and buffer zones can be found at: <http://pr-rp.pmra-arla.gc.ca>.



Photo courtesy of Janice Gilbert, MNR.

### *Methods of application:*

Herbicides can be applied to a stand of invasive *Phragmites* through a variety of methods, including spraying and wicking. Choosing an appropriate method will depend on the characteristics of the site, as well as the logistics of the overall management plan for the area. Because the herbicides are broad spectrum, it is important to target monocultures or stands that are composed of a large fraction of invasive *Phragmites* and limit application to the upper canopy, avoiding native vegetation growing in the understory. Even in lower-density stands, the use of herbicides can be effective, since less chemical is needed to control a stand and native species often respond well once the invasive *Phragmites* is removed.

Spraying herbicides is effective for dense monoculture stands and spraying directly onto the leaves using high pressure is common, but a small backpack sprayer or a larger boom sprayer attached to an all-terrain vehicle (ATV) or similar vehicle will work. Backpack spraying allows for targeted spraying and is effective in areas where a boom sprayer cannot easily gain access, and in mixed vegetation or previously treated stands.

Larger sprayers effectively target dense stands in larger areas. When spraying, take into consideration weather and wind conditions and limit any non-target drift to plants or wildlife present in the area.



Photo courtesy of Janice Gilbert, MNR.

Wicking or daubing is effective for small stands, and allows herbicide application to specific plants, while avoiding native vegetation. Hand-wicking involves direct contact with each individual stalk using an absorbent glove soaked in herbicide, while daubing uses an applicator to directly apply the herbicide to the plants. Hand-wicking is labour-intensive and difficult on tall stands, but can be done where wind and weather conditions do not allow for spraying.

### Concentration:

The concentration of the herbicide in a spray or wicking treatment will affect the ability of the pesticide to enter and control the plant. Following the label directions is required by federal legislation, the Pesticides Act and Regulation 63/09.

### Timing:

The optimum window for *Phragmites* control using an herbicide occurs between early spring, when plants begin to emerge, until late fall, when the first heavy frost causes significant die off. Take into account surface water and habitat usage when planning herbicide applications. Wildlife is rarely observed in the centre of large *Phragmites* stands, but is commonly observed in smaller, narrower stands, or at the edge of stands. Depending upon the type and density of wildlife usage, controlling *Phragmites* may be best left for late summer or fall when young animals are mobile and wildlife usage is generally far less.



Photo courtesy of Darren Jacobs.

By postponing spray events until late summer/early fall, most native plants will have become dormant or died for the season and/or their seeds will have matured. At this time, invasive *Phragmites* will still be translocating nutrients into the root system, and is capable of transporting the herbicide into the roots. The invasive *Phragmites* remains active much later into the fall and is one of the last herbaceous plant species observed to mature and for stalks to die off naturally.

## Mowing

Mowing of an invasive *Phragmites* stand using tools or by hand-cutting stems and seedheads will not affect the root system and if used as a standalone control method, cutting may stimulate growth and increase the density of a stand. Consider soil moisture and other conditions that allow the soil to support heavy mowing equipment, as these can impede the ease and efficacy of mowing, and may be unsafe. Mowing should be conducted in late July/early August, when most of the carbohydrate reserves are in the upper portion of the plant (i.e., during seed production or flowering). Mowing is relatively low-cost, and can be easily performed with minimal training. All clothing, boots, and equipment should be cleaned on-site to avoid the transportation and dispersal of invasive *Phragmites*.

**As part of an IPM plan:** Mowing or cutting an invasive *Phragmites* stand is an important component of an IPM plan. Mowing compacts the dead biomass, allows for a more effective and efficient prescribed burn to follow,



Photo courtesy of Janice Gilbert, MNR.

removes dead biomass, and allows for spot treatment of new invasive *Phragmites* growth, and for new native plants to grow. Herbicide treatment prior to mowing can help in reducing the moisture content of stalks and leaves. When combining mowing with herbicide application, mowing should occur at least two weeks after herbicide treatment, to allow for translocation of the herbicide to the roots.

**As a standalone control method:** This is not an advisable method as it has shown to be ineffective in controlling invasive *Phragmites*. However, if cutting is necessary, herbicides can still be applied to a mowed stand at the appropriate time of year. In low-nutrient sites it may be possible to stress the plants enough to dampen re-growth under a repeated cutting regime. If the seedheads of a plant are removed before nutrients can be provided to the root system, it may be possible to effectively exhaust the root reserves, causing the plant to die. Cutting must occur several times throughout the entire growing season and over a course of several consecutive years for any improvements to occur.

When considering mowing as a standalone control method, it should be limited to areas that contain predominantly invasive *Phragmites*, to avoid broadscale mowing of other native vegetation. Invasive *Phragmites* stalks should be cut to a maximum height of 10 centimetres. Avoid soil disturbance and the distribution of seeds or rhizomes which may increase growth and spread of the stand. Remove cut debris and leftover dead biomass to allow native vegetation to grow, and dispose of in the proper manner.

## Compressing or Rolling

Compressing or rolling dead stalks using a roller acts in a similar manner to mowing or cutting and is not effective as a standalone control method. Compressing compacts the dead biomass, allows for a more effective and efficient prescribed burn to follow, and makes plants easier to see and spot treat new growth. Compression or rolling may occur at any time after the plant is dead, once the herbicides have had an opportunity to translocate throughout the plants, killing the rhizomes and root system, and after any wildlife using the stand as habitat have vacated the area.

## Prescribed Burning

Prescribed burning is the planned and deliberate use of fire by authorized personnel, and it can be used as part of an integrated management plan, following herbicide application. Ensure all necessary permits are obtained and regulations followed. Burning can be extremely dangerous and should only be undertaken by trained and authorised personnel. The role of fire is to remove biomass that prevents establishment of native vegetation and to provide a source of material for vegetative reproduction. The maximum benefit from fire is obtained when it is done a minimum of two weeks after herbicide treatment, following mowing or rolling of the dead stalks. Prescribed burning without the prior use of herbicides is not an effective control method, and may encourage rhizome growth, leading to the spread or increased growth of a stand. It is strongly



Photo courtesy of Ric McArthur.

recommended that burning does not occur on standing dead *Phragmites* stands because fire containment is difficult and may risk personal safety. Prescribed burning should be used as a way to remove excess above-ground biomass and seeds, promoting native plant growth, and allowing for easier spot treatments of residual plants the following season.

## Hand-pulling or Mechanical Excavation

Hand-pulling or mechanical excavation is not an advisable method, as it is very labour-intensive, and is ineffective in controlling invasive *Phragmites*. Mechanical removal is only advisable when it can be assured that no plant material remains on-site. When hand-pulling is the only option, it is most effective on plants that are less than two years old and found in dry, sandy soils. Ensure all portions of the rhizomes are removed from the ground and all parts of the plant are disposed of properly (see section on "Disposal").

## Flooding

Flooding stands has varied results and is difficult. For an effective flood, the stand must be in an area in which water levels can be easily controlled and the stand should be cut to as low a height as possible. Flooding should occur in late summer to maintain and promote native vegetation, while avoiding the reestablishment of invasive *Phragmites*. Water levels must be maintained at a minimum of 1.5 metres taller than the entire stand, and levels must be kept at this height for a period lasting at least 6 weeks, over the course of the growing season. In wet sites where this is not feasible, it may be possible to drown newly emerging plants in the spring with shallower water levels. In order for drowning to be effective, all standing dead biomass from previous years must first be removed either by cutting, rolling or burning. Removing all the remaining dead stalks, which normally extend above the water surface, reduces oxygen diffusion to the root system.



Photo courtesy of Michigan Sea Grant.

## Tarping

Tarping or solarization of invasive *Phragmites* stands has shown varied results, and is not recommended because it is non-selective and will affect all native vegetation and damage soil biota populations. Tarping works best in *Phragmites* stands that are found in areas of direct sunlight. Before tarping, cut plants to less than 10 cm, and remove or flatten dead biomass. Black plastic tarp or geotextile sheets are then anchored over the area using stakes or weights; the tarps should cover a large buffer area beyond the perimeter of the *Phragmites* stand. Sunlight will cause high temperatures to develop under the plastic, which will eventually kill the plants. While this method is not labour-intensive, continual and frequent monitoring of the *Phragmites* plants along the perimeter is necessary, as there may be runners that grow out from beneath the tarp. The plastic tarp must stay in place for a minimum of six months, in order to ensure complete suppression of the invasive *Phragmites* stand.

## Biological Controls

Invasive species that are new to an area do not generally have the same predation pressure that they would in their native habitat. There are no biological controls available for invasive *Phragmites* but researchers at Cornell University in New York are investigating several insects for feasibility in future as biological controls.

## Disposal

Care is needed when transporting and disposing of trimmings from mowing or cutting of invasive *Phragmites* stands because stands can establish from the dispersal of seeds or stolon fragments from the rhizome. Invasive *Phragmites* clippings should not be composted; cut plants should be bagged in thick plastic bags, and allowed to dry out or decay in the sun to kill all viable seeds and rhizomes. Dried and dead *Phragmites* plants can be burned or the bags must be disposed of at an appropriate municipal staging or disposal location. Contact local municipalities prior to disposal. All clothing, boots, and equipment should be cleaned on-site to avoid the transportation and dispersal of invasive *Phragmites*.

## Effects of Invasive *Phragmites*

- **Loss of biodiversity and species richness:** Invasive *Phragmites* causes a decrease in biodiversity by creating monoculture stands. *Phragmites* stands crowd out native vegetation and hinder native wildlife from using the area, resulting in a decrease in both plant and animal biodiversity.
- **Loss of habitat:** Monoculture *Phragmites* stands result in a decrease in available natural habitat and food supply for various wildlife species, which may include Species at Risk. Invasive *Phragmites* stalks are rigid and tough, and do not allow for wildlife to easily navigate through or nest in a stand.
- **Changes in hydrology:** Invasive *Phragmites* displays very high metabolic rates, which can lead to changes in the water cycles of a system. Monoculture stands of invasive *Phragmites* have the ability to lower water levels, as water is transpired at a faster rate than it would be in an area of native vegetation.
- **Changes in nutrient cycling:** Invasive *Phragmites* stalks are made of a very inflexible structural material which breaks down very slowly. This slows the release of nutrients and leaves a high proportion of recalcitrant biomass (carbon) in the standing dead stalks.
- **Increased fire hazards:** A stand of invasive *Phragmites* is composed of a high percentage of dead stalks, with a lower percentage of live growth. Dead stalks are dry and combustible, increasing the risk of fires.
- **Economic and social impacts:** Invasive species such as *Phragmites* can have many negative effects on economic and social issues. Effects on agriculture and crops can lead to economic losses, while monoculture stands can affect property values, and raise aesthetic concerns.



Photo courtesy of Janice Gilbert, MNR.

## How to Prevent the Spread of Invasive *Phragmites*

- **Do not purposely plant it:** Invasive *Phragmites* is available for purchase at garden and horticultural centres, but gardeners should consider using only native plants in their water gardens. By choosing to not plant invasive *Phragmites* in a garden, the risk of spread is limited.
- **Avoid transportation via equipment:** When leaving an area containing *Phragmites*, be sure to brush off clothing and clean off equipment on-site to avoid the transfer of seeds to new sites.
- **Do not attempt to compost invasive *Phragmites*:** Seeds and rhizomes can survive and grow in a compost heap, creating a new stand or dispersing to other areas. In order to dispose of invasive *Phragmites*, plants should be dried and burned or disposed of in the garbage or at a landfill.

Control Method	Pros	Cons	Timing	Notes/Cautions
<b>Herbicide Application</b>	<ul style="list-style-type: none"> <li>Most effective method</li> <li>Can be cost-effective</li> </ul>	<ul style="list-style-type: none"> <li>Must be used in conjunction with other methods</li> <li>Can only be used in dry areas</li> <li>Non-specific</li> </ul>	<ul style="list-style-type: none"> <li>Spring to late fall (pre-senescence)</li> </ul>	
<b>Mowing/Cutting</b>	<ul style="list-style-type: none"> <li>Low cost</li> </ul>	<ul style="list-style-type: none"> <li>Can be labour-intensive</li> <li>Not effective when used as a standalone method</li> <li>Non-specific</li> </ul>	<ul style="list-style-type: none"> <li>If using as part of an IPM: At least 2 weeks after herbicide application</li> <li>If using alone: when the plant is flowering/producing seeds</li> </ul>	
<b>Compression/Rolling</b>	<ul style="list-style-type: none"> <li>Low cost</li> </ul>	<ul style="list-style-type: none"> <li>Non-specific</li> </ul>	<ul style="list-style-type: none"> <li>If using as part of an IPM: At least 2 weeks after herbicide application</li> <li>If using alone: when the plant is dead and dried</li> </ul>	
<b>Prescribed Burning</b>		<ul style="list-style-type: none"> <li>Not effective when used as a standalone method</li> <li>Non-specific</li> </ul>	<ul style="list-style-type: none"> <li>If using as part of an IPM: At least 2 weeks after herbicide application</li> <li>Should be conducted when conditions are as dry as possible</li> </ul>	<ul style="list-style-type: none"> <li>Should always be performed by authorized personnel, following federal and provincial guidelines and regulations as necessary.</li> </ul>
<b>Hand-pulling / Mechanical Excavation</b>	<ul style="list-style-type: none"> <li>Can easily target specific <i>Phragmites</i> plants</li> <li>More effective on small, isolated stands of plants less than 2 years old</li> <li>Good for dry, sandy soils</li> </ul>	<ul style="list-style-type: none"> <li>Very labour-intensive</li> <li>Not effective for large stands</li> </ul>		<ul style="list-style-type: none"> <li>Caution regarding soil disturbance</li> <li>Must ensure all portions of the rhizomes are removed from the ground</li> </ul>
<b>Flooding</b>	<ul style="list-style-type: none"> <li>Minimal effects on wildlife</li> </ul>	<ul style="list-style-type: none"> <li>Can be used in areas where water levels can be controlled or are naturally prone to floods</li> <li>Non-specific</li> </ul>		
<b>Tarping</b>	<ul style="list-style-type: none"> <li>Minimal effects on wildlife</li> </ul>	<ul style="list-style-type: none"> <li>Not always effective</li> <li>Large impact on soil flora</li> <li>Non-specific</li> </ul>		
<b>Biological controls</b>	<ul style="list-style-type: none"> <li>Target specific plants</li> </ul>	<ul style="list-style-type: none"> <li>Very long timelines</li> <li>Not yet available</li> </ul>		<ul style="list-style-type: none"> <li>More research needed</li> </ul>

**Table 1: Summary of Control Methods.**

## Best Management Practices for Invasive *Phragmites* Control in Ontario

### In *Phragmites* stands where there is standing water present:

- Herbicides CANNOT be applied.
- Cut/mow the stalks as low as possible.
- Tarping/solarization is another option, but may not be as effective in standing water.

### In *Phragmites* stands where the water level can be controlled:

- Cut/mow the stalks as low a height as possible.
- Maintain the water level so that it remains a minimum of 1.5 m taller than the entire stand for a period of at least 6 weeks.

### In *Phragmites* stands where there is no standing water present:

- Perform wildlife assessments.
- Time herbicide application appropriately.
- If necessary, mow or roll the stand to compact the dead biomass.
- If appropriate, perform a prescribed burn in the area.
- Monitor and perform follow-up treatments as necessary.

## Partners and Resources

- Ontario Ministry of Natural Resources  
[www.mnr.gov.on.ca](http://www.mnr.gov.on.ca)
- Ontario Ministry of the Environment  
[www.ene.gov.on.ca](http://www.ene.gov.on.ca)
- Environment Canada  
[www.ec.gc.ca](http://www.ec.gc.ca)
- Government of Canada Invasive Species  
[www.invasivespecies.gc.ca](http://www.invasivespecies.gc.ca)
- Ontario Federation of Anglers and Hunters  
[www.invadingspecies.com](http://www.invadingspecies.com)
- Ontario Invasive Plant Council  
[www.stewardshipcentre.on.ca/index.php/oipc\\_pages](http://www.stewardshipcentre.on.ca/index.php/oipc_pages)
- Ontario Parks  
[www.ontarioparks.com](http://www.ontarioparks.com)
- Turkey Point Provincial Park  
[www.ontarioparks.com/english/turk.html](http://www.ontarioparks.com/english/turk.html)
- Wasaga Beach Provincial Park  
[www.wasagabeachpark.com](http://www.wasagabeachpark.com)
- Rondeau Provincial Park  
[www.rondeauprovincialpark.ca](http://www.rondeauprovincialpark.ca)
- Parks Canada  
[www.pc.gc.ca](http://www.pc.gc.ca)
- Ontario Stewardship  
[www.ontariostewardship.org](http://www.ontariostewardship.org)
- Conservation Ontario  
[www.conservation-ontario.on.ca](http://www.conservation-ontario.on.ca)
- Canadian Wildlife Service  
[www.cws-scf.ec.gc.ca](http://www.cws-scf.ec.gc.ca)
- Lake Huron Centre for Coastal Conservation  
<http://lakehuron.ca>

