

Simcoe County Forest Operations Guidelines for Integrated Pest Management of Invasive and Competing Plants

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Table of Contents

- Simcoe County Forest Operations Guidelines for..... 1
- Integrated Pest Management of..... 1
- Invasive and Competing Plants..... 1
 - 3
- Introduction to Integrated Control Programs 3
 - Simcoe County Forestry Issues 3
- Definitions and Characteristics of IPM Program..... 2
 - Goals of IPM..... 2
 - Goal for Forestry Sites..... 2
- Response and Control of Invasive Species..... 3
 - Rapid Response..... 3
 - Control Programs 3
 - Application of IPM Control Program..... 7
- Undesirable Vegetation Issues 8
 - Undesirable Plants of High Concern 8
 - Undesirable Plant Biology Relative to Control..... 9
 - Weed Impacts on Forestry Planting..... 15
- Weed Surveys/ Monitoring..... 16
 - Invasive Weed Management Monitoring Cycle 16
 - Weed Monitoring for Forestry Replanting Cycle 18
- Options/Tools for Control..... 19
 - Action thresholds for weed control actions 19
 - Methods of Control..... 19
 - Stale Seed Bed Control..... 22
 - Manual Control 22
 - Mechanical Control..... 22
 - Chemical Control..... 23
 - Combination Control Methods..... 23
 - Biological Control 23

Physical control methods.....	24
Legislation Relevant to Forestry and Public Area Weed Control Programs	24
Federal Pest Control Products Act	25
Timing legislation	25
Buffer requirements	25
Noxious weed legislation	25
Outreach	25
Regular Sharing of Information.....	25
Trail Management.....	26
Examples of Record Sheets.....	26

Introduction to Integrated Control Programs

Simcoe County Forestry Issues

Within the County of Simcoe, there are areas of invasive weed species that are in the process of being controlled. Despite the on-going work, several species continue to invade many of the 136 Simcoe County Forest (SCF) tracts. New incursions also occur due to spread of weeds from neighbouring properties and from areas of dumping.

An Integrated Pest Management (IPM) program is being used to incorporate as many methods as possible for control of invasive weeds. This is important with the challenges of having such a large area requiring management. The management of invasive plants within the SCF began with preliminary mapping and limited manual control of primarily garlic mustard in 2005. The program has evolved since that time. Control work has increased to deal with the impacts of an ever-expanding list of problem species. This includes ongoing efforts to modify approaches based on best available science, knowledge and experience.

The Simcoe County Forest has been certified to Forest Stewardship Council (FSC) standards since 2010. A new FSC pesticide policy precipitated renewed scrutiny and a more rigorous approach to existing methodologies.

Definitions and Characteristics of IPM Program

Goals of IPM

- Integrated pest management of weeds relies on a combination of control methods best suited to each species. These best practices of control incorporate methods to reduce, prevent and control the weeds in a multi-year program. This is a program of monitoring, multiple/combined methods of control, quality control monitoring, follow-up control and program adaptation

Goal for Forestry Sites

The vegetation goals for Simcoe County Forests are to establish and maintain native plant communities of productive forest trees with a vigorous understory that supports tree growth and the related biological community.

IPM Methods

- Determine goals for forestry operations and plant species on site
- Monitor locations and species of weeds of concern
 - o Early detection/pre-treatment
 - o Quality control monitoring
 - o Follow-up monitoring at appropriate intervals to confirm success of corrective measures and if re-treatment required
- Maintain documentation of invasive plant locations, related activities, and details of all control methods
- Integrated control program incorporating multiple methods of all suitable options
- Alternation of control methods for improved control
 - o Include alternation of herbicides to avoid resistance and optimum control
- Adaptation and adjustments to integrated control programs
 - o Follow-up based on records and quality control or follow-up monitoring
 - o Re-treatment if indicated
 - o Continuing education to improve knowledge and control methods
 - o Improvement of control programs for future cycles or sites

Continuing Education Program of Meeting Attendance and Research Review

There are many benefits of sharing control methods with other practitioners

- These include other forestry workers and specialists involved in invasive and competitive weed management
 - o SFC is part of the Invasive Species Centre Municipal Community of Practice group
 - o SFC members regularly attends meetings and tours put on by the Ontario Invasive Plant Council (OIPC)
- Interactions with other landowners and land managers dealing with these weeds

- This also includes practitioners in the weed management industry dealing with the same invasive weeds
 - Understanding invasive weed developments and challenges
 - Application of successful management information
 - Incorporation of on-going research
- It is critical to have membership with relevant organizations to receive mailings and to interact with other specialists at meetings to expand knowledge of these plants
 - Invasive plant introductions
 - Neighbouring locations of invasive plants
 - Current and developing control methods
 - Regular internet communications from organizations
 - Sources of up-to-date management information, especially for new species

Importance of Early Detection and Response

- Control of several small, young patches of invasive weeds is easier and less expensive
- Early detection of new incursions is critical to allow for rapid response and control
- Once a stand of invasive weeds spreads and covers a whole area, the work required for control and the associated costs become prohibitive
- It is most cost effective to respond proactively to new incursions of invasive weeds.
- Figure 1 demonstrates this concept
 - Eradication of the weed or weed sites is possible when there are only scattered locations (Proactive stage)
 - Once there are multiple locations a more intensive program is required to achieve control with higher costs of control (Active)
 - If left too long, then the option is a continuing, more expensive program to manage and control all the infestations (Reactive)

Response and Control of Invasive Species

Rapid Response

- Areas of concern
 - Public safety including plants that pose a health hazard
 - Invasive species that spread by wind-blown seed

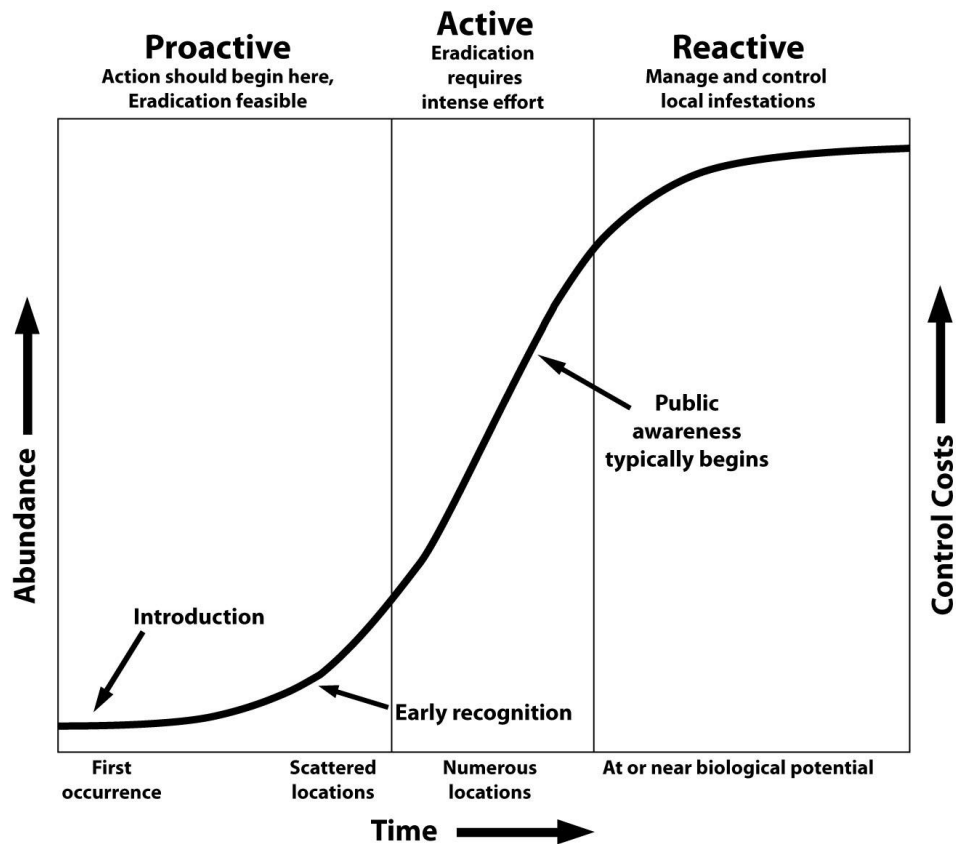
Control Programs

Decision process for planning control of invasive weeds

Use of all records to locate and prioritize work

- Prioritize work, based on species and density
 - Regardless of species, control small patches that are easy to deal with
 - easier control
 - less herbicide used

- fewer propagules (seed, rhizomes, etc.)
- less spread in future
- Where tree harvesting will occur shortly, control infestations that may be impacted by harvest operation that could result in further spread. Invasive plants should be managed prior to harvesting or harvesting should be delayed or restricted so as to not spread the plants.



Phases of Invasive Species Invasion and Control

Figure 1. This chart represents the stages of invasive species invasion. The chart demonstrates the increase in abundance of a new species to a region over time. Control effort and cost increases with increasing populations. Chart from eddmmaps.org

- Prioritize invasive weed species
 - That are known to cause the most negative ecological impact
 - That compete with tree growth
 - That could impact harvest access

- Species that will spread without control
 - Make sure control is carried out within 2-3 years on every invasive weed site once found
 - Uncontrolled sites of invasive will expand without control
- For each species and location decide on all options for control and develop a program for control
 - Incorporate as many methods as possible at once
 - Include natural methods that will be operating at all times
 - These can be promoted in public outreach as part of the IPM program
 - Use records of density thresholds for decisions on methods of control
 - Update density data base yearly after all work

Development of Control Programs

Visit all 136 forest sites (1959 compartments) regularly (see Monitoring section)

For control sites

- Maintain a digital list of new issues and developing issues
- Linked to GIS base maps

Record on-going issues by site

- Chart for each location
- Classify as stable, increasing or out-of-control
- Organize in order to prioritize increasing or out-of-control sites
- For in-house work prioritize the top 60 sites or issues for one to two weeks of control work per year including winter cutting/herbicide control
- Incorporate contract work to provide control in challenging areas and to augment in-house program
- Work closely with County Weed inspector to accomplish control on neighbouring properties and rights-of-way
 - This is important for invasive, provincially noxious weeds that have seed that blows into new sites or is carried in by wildlife such as birds
 - These are buckthorn, poison-ivy and dog-strangling vine species
 - This involves two-way communication
 - Identification of potentially new invasions before they become an issue in SCF forest tracts

- To reduce continuing invasions of SCF tracts from neighbouring properties
- Potential sharing of control expertise with owners of neighbouring forested sites

Application of IPM Control Program

- Develop programs of control for each invasive species
 - Integrated multi-year program
- Adapt and adjust program as necessary
 - Importance of records
 - Incorporation of quality control audit results
 - On-going research and attendance of meetings to incorporate new, updated methods
- Preparation of adjusted program for next control cycle or season

Control Program Integrated with Forestry Harvesting Cycle

Management of invasive species prior to harvest operations

- Prioritize management of any introductions or increases in spread of invasive plants that could be created by or intensified by harvesting
- Eliminate or reduce spread by equipment

Modification of silvicultural objectives/practices

- To mitigate invasive plant impacts
- Exclude specific areas from harvest due to significant invasive plant infestations
 - Dangerous, difficult access
 - Delay until invasive plants are dead and removed
- Alternative is to required removal of plants plus cut-surface treatment as part of forestry removal contract (all trees)
- Exclude specific areas from harvest due to harvest impacts on invasive plants
 - Delayed until weeds have been controlled
- Seasonal restrictions on harvest operations to eliminate introduction or spread of invasive plants

Control Program Integrated with Forestry Planting Cycle

- Weed control needs will be based on the stage/progress of control carried out pre-harvest
- Ideally use an initial program of two post-emergence control cycles for perennial weeds (2 to 3 months total time)
- Use pre-emergence herbicide control programs at planting and in the second year
 - Full season control for the initial planting years will enhance crop growth resulting in long-term gains
 - These gains will continue to compound over the life of the trees
- Spot post-emergence herbicide control late summer and early summer following year

Control Programs Integrated with Forestry Growth/Production Cycle

- Monitoring of invasive weeds and maintain weed documentation on all sites
- Organization of operations to minimize invasive weed spread

- Post-emergence herbicide control program to remove competing and invasive species on site (Tables 1 and 2)
- Application of preventive measures, especially Clean Equipment (and Worker) Protocols
- Development and enhancement of competitive understory to reduce seed establishment of invasive weeds

Undesirable Vegetation Issues

Undesirable Plants of High Concern

The weeds of environmental, agricultural and safety concern to Simcoe County include:

- Poisonous and thorny weeds that could impact harvest
- Invasive plants that seriously impact forest and native plant communities and neighbouring sites
- Noxious weeds of concern to the public in high-traffic areas and using trails and to workers such as poisonous and thorny plants
- Noxious weeds of concern for forestry and agricultural (including horticultural) production (Table 1)
- Many of these noxious or invasive weeds are non-native and have been introduced from other regions of the world.
- Desirable native plants can be determined by publications and lists and/or check lists of local native plants which are often available through local conservation authorities as in-house lists or as published documents.

Simcoe County has the following invasive weed issues:

- European and glossy buckthorn are a severe issue with multiple sites and areas of heavy infestation
- Giant hogweed, wild parsnip, Himalayan balsam and dog-strangling vine are problems in specific sites and require follow-up control and annual monitoring.
- Purple loosestrife, common reed grass (phragmites) and Japanese knotweed are present in areas and present habitat issues for wetlands and shorelines.
- There may be new establishing areas of garlic mustard, yellow archangel and periwinkle within forest stands.
- Poison-ivy and wild parsnip are public access issues along forest trails.

In addition, there are common weeds that can seriously impact the survival and/or growth of reforestation plantings for years. Examples of these weeds are listed in Table 2, but every site has its own characteristic weeds

- The goal is to eliminate/minimize weed threat to the survival and health of the plantings
- Any weeds that grow in rapidly and compete with the planting
 - Common seed propagated weeds

Table 1. Noxious and invasive weeds of concern.

Scientific name	Common name	Status		Life Cycle Annual - A Biennial - B Perennial - P
		Native - Na Introduced - In	Noxious - N Invasive - I	
Noxious and Invasive Weeds in Ontario				
Poisonous and thorny weeds				
<i>Gleditsia triacanthos</i>	honey-locust	Na		P
<i>Heracleum mantegazzianum</i>	giant hogweed	In	NI	P
<i>Pastinaca sativa</i>	wild parsnip	In	NI	P
<i>Rhamnus</i> spp.	buckthorn species	In	NI	P
<i>Rhus radicans</i>	poison ivy	Na	N	P
<i>Robinia pseudoacacia</i>	black locust	Na		P
Other noxious and invasive weeds				
<i>Alliaria petiolata</i>	garlic mustard	In	N	B/wA
<i>Impatiens glandulifera</i>	Himalayan balsam	In	I	A
<i>Lamium galeobdolon</i>	yellow archangel	In	I	P
<i>Lythrum salicaria</i>	purple loosestrife	In	I	P
<i>Phalaris arundinacea</i>	reed canary grass	In	I	P
<i>Phragmites australis</i>	common reed grass	In	I	P
<i>Polygonum cuspidatum</i>	Japanese knotweed	In	I	P
<i>Vincetoxicum rossicum</i>	dog-strangling vine (swallowwort)	In	NI	P
<i>Vinca minor</i>	periwinkle	In	I	P-woody

- Competitive noxious weeds (Table 1)
- Perennial weeds that would compete with the planting
- Perennial species that impact forestry and recreational operations such as trails
 - Weeds impacting access for maintenance and for forest harvesting operations
 - Weeds creating **trip and fall hazard for workers and the public**
 - Weeds obscuring and limiting access to forest sites and trails

Undesirable Plant Biology Relative to Control

This section focuses on species of high concern (Table 1).

Giant hogweed

Biology relating to control and spread

- Short-live perennial, dies the year that it flowers
- Has a crown and a deep taproot
- Spreads only by seed, but 98% of seed germinates in the first year
- Giant hogweed seed is wind dispersed a short distance of about 10 m but will float longer distances in water

Source of infestations to be aware of as related to control

- Due to water dispersal of seed, look for local locations along water bodies
- Soil movement of seed

- o Movement of seed by maintenance equipment, vehicles, recreational vehicles, and workers or visitors to site and is a worse issue in wet or dewy conditions

Table 2. Competitive weeds in forest plantings

Scientific name	Common name	Status		Life Cycle Annual - A Biennial - B Perennial - P
		Native - Na Introduced - In	Noxious - N Invasive - I	
Dryland Weeds				
Broad-leaved weeds				
<i>Amaranthus</i> spp.	pigweed species	Na		A
<i>Ambrosia artemisiifolia</i>	ragweed	Na	N	A
<i>Artemisia</i> spp.	absinth species	Na		A
<i>Barbarea vulgaris</i>	yellow rocket	Na		B
<i>Brassica kaper</i>	wild mustard	Na		A
<i>Carduus nutans</i>	nodding thistle	Na		B
<i>Chenopodium album</i>	lamb's-quarters	Na		A
<i>Cirsium arvense</i>	Canada thistle	Na	N	P
<i>Cirsium</i> spp.	biennial thistle species	Na	N	B
<i>Conyza canadensis</i> (<i>Erigeron canadensis</i>)	horseweed, Canada fleabane	Na		A
<i>Daucus carota</i>	wild carrot	Na		B
<i>Galium aparine</i>	smooth bedstraw	In	N	P
<i>Galium mollugo</i>	white bedstraw	Na		A
<i>Melilotus</i> spp.	sweet-clover species	Na		B/ short-lived P
<i>Pastinaca sativa</i>	wild parsnip	In	NI	P
<i>Populus</i> spp.	poplars	Na/In		P - woody
<i>Salix</i> spp.	willows	Na/In		P - woody
<i>Sonchus</i> spp.	sow thistle spp.	Na	N	A
<i>Tussilago farfara</i>	sweet coltsfoot	In	N	P
<i>Cynanchum (Vincetoxicum) rossicum</i>	dog-strangling vine (swallowwort)	In	NI	P
Grass weeds				
<i>Digitaria</i> spp.	crabgrass species	Na		A
<i>Echinochloa crus-galli</i>	barnyard grass	Na		A
<i>Panicum capillare</i>	witchgrass	Na		A
<i>Setaria</i> spp.	foxtail species	Na		A
Wet area weeds				
Broad-leaved weeds				
<i>Heracleum mantegazzianum</i>	giant hogweed	In	NI	P
<i>Lythrum salicaria</i>	purple loosestrife	In	I	P
<i>Polygonum cuspidatum</i>	Japanese knotweed	In	I	P
Grass/grass-like weeds				
<i>Festuca arundinacea</i>	tall fescue			P
<i>Glyceria maxima</i>	rough manna grass	In		P
<i>Phalaris arundinacea</i>	reed canary grass	In	I	P

Wild parsnip

Biology relating to control and spread

- Short-lived perennial, dies the year that it flowers
- Has a crown and a taproot
- Propagates by seed only, and seed lasts 2 to 3 years with 65% to 100% of the seed germinating by the year after dispersal (2nd year)
- Seed wind dispersed by wind up to 5 m or a maximum of 13 m.
- Spreads further by water
- Produces a low rosette until the year of flowering with plants lasting up to 6 years in poor and crowded conditions
- Susceptible to disturbance or cutting of taproot

Source of infestations to be aware of as related to control

- Local infestations on nearby properties up to 10 m away
- Movement of seed by maintenance equipment, vehicles, recreational vehicles, and workers or visitors to site, especially in wet or dewy conditions

Buckthorn species

Biology relating to control and spread

- Several introduced species are wide spread
 - There is one native species in Ontario, *Rhamnus alnifolia*, alder-leaved buckthorn
 - All species are considered invasive and are noxious in Ontario
- Small tree up to 6 m with dense wood and thorns at tips of short shoots
- Wide range of growing conditions including shaded and open sites
- Create dense stands that are difficult for control or cutting due to thorns
- Propagates by seed fall from female trees or spread by birds. Seeds also fall into adjacent water and spread downstream

Source of infestations to be aware of as related to control

- Local and nearby infestations become source of seed spread over great distances by birds
- Movement of seed by soil movement and by water

Poison ivy

Biology relating to control and spread

- Perennial woody species with different forms – low or tree climbing
- Forms large patches by rhizomes and/or viny stems
- Horizontal spread of stems is minor, reportedly less than 10 cm per year (Mulligan and Jenkins 1977)
- Grows in shade of forests, forest edges and in meadows and non-crop areas

Source of infestations to be aware of as related to control

- Main spread is by birds dispersing seeds

- o Movement of seed and rhizomes by maintenance equipment, vehicles, and recreational vehicles

Garlic mustard

Biology relating to control and spread

- o Biennial weed only reproducing by seed
- o Sections of root will regrow if only damaged and damaged plants will re-flower
- o Grows in unvegetated understories of open forest areas
- o Allelopathic so leaves chemicals in the soil that interfere with growth of seedlings and other plants

Source of infestations to be aware of as related to control

- o Seeds remain viable for up to 7 years, so follow-up control and replanting of perennial vegetation may be necessary to provide long-term control
- o Plants must be completely removed or treated before flowering to break cycle of reproduction

Himalayan balsam

Biology relating to control and spread

- o Annual weed only reproducing by seed
- o Tall form from 1 to 3 m tall
- o Aggressively invades areas out-competing established perennial cover

Source of infestations to be aware of as related to control

- o Prolific seed production with seedpods that pop open to throw seed
- o Plants must be completely removed or treated before flowering to break cycle of reproduction

Yellow archangel

Biology relating to control and spread

- o Perennial groundcover plant
- o Grows well in dry shady areas
- o Aggressively invades shady areas, out-competing established perennial cover
- o Propagates by pieces of the plants and stem pieces

Source of infestations to be aware of as related to control

- o Ornamental plant that may be in garden waste
- o Effective control all plants present is required to eradicate a stand
- o Repeat applications to control escapes

Invasive reed canary grass

Biology relating to control and spread

- o Perennial, grass species of wet sites that is very difficult to remove once established

- o Quickly out-competes native species for space, moisture and nutrients
- o Large infestations are difficult to control due to dense growth that limits access
- o Requires several years of control treatments with follow-up monitoring

Source of infestations to be aware of as related to control

- o Bringing in or movement of contaminated soil
- o Movement of crowns and seed by maintenance equipment and vehicles that drive through plants

Common reed grass (phragmites)

Biology relating to control and spread

- o Perennial, grass species with aggressive rhizomes
- o Prefers wet sites, but grows in many conditions including along dry concrete barriers
- o Herbicide uptake at time of flowering or later, from September on.
- o All foliage required for optimum herbicide uptake

Source of infestations to be aware of as related to control

- o Bringing in or movement of seeds and rhizomes/stolons in contaminated soil
- o Movement of seed or rhizomes/stolons by maintenance equipment, vehicles, recreational vehicles, and workers or visitors to site and along paths
- o Seed movement in water and over short distances by wind

Purple loosestrife

Biology relating to control and spread

- o Perennial plant which forms dense stands with a thick mat of roots over vast areas
- o Important to remove isolated plants or groups of plants first which are easiest to control and will limit spread to new areas
- o Invasive nature takes over wetland areas

Source of infestations to be aware of as related to control

- o Fine seed is spread by water spread downstream, by animals and short distances by wind
- o Importation or movement of contaminated soil
- o Seed is spread by wildlife and by humans (clothes or vehicles)
Movement of seed by maintenance equipment, vehicles, recreational vehicles, and workers or visitors to site, especially in wet or dewy conditions

Japanese knotweed or Mexican bamboo

Biology relating to control and spread

- o The knotweeds (*Reynoutria* spp.) are among the world's top 100 invasive species by the Global Invasive Species Database

- Restricted invasive species in Ontario since 2016, meaning it is illegal to import, deposit, release or grow these plants
- Perennial that regrows the stems each year to full height by July
- Persistent due to the persistent rhizome
- Rhizome forms 2/3 of plant mass and grows aggressively (can grow through and damage concrete)
- Can extend more than 2 m deep and up to 14 to 18 m in length
- Rhizome pieces just 1 cm long will form new plant even buried up to 1 m
- Grows in deep shade, along woodland edges and in full sun

Source of infestations to be aware of as related to control

- Introduced in ornamental plantings due to bamboo-like stems
- Light seeds can be spread by wind and by water
- Seed reproduction is possible with the presence of other knotweed plants for pollination
- Waterways are common zone of seed spread
- Found along roadways and utility ROW's which are common areas of spread due to vehicle, animal, and human movement of seed
- Movement with soil and construction soil movement
- May have a forestry exception of control for forest management

Dog-strangling vine

Biology relating to control and spread

- Perennial plant propagated *only by seed*. One older publication indicates that dog-strangling vine has rhizomes, but this is *not true*. The plants only form crowns that do not send out rhizomes and which get larger with time.
- Plant crowns produces multiple, viny stems each season
- Fine seed is wind dispersed
- Invasive nature takes over naturalized areas

Source of infestations to be aware of as related to control

- Local infestations especially on windward side due to wind dispersal of seed
- Movement of seed by maintenance equipment, vehicles, recreational vehicles, and workers or visitors to site, especially in wet or dewy conditions

Periwinkle

Biology relating to control and spread

- Perennial woody vine that is a broad-leaved evergreen plant

- o Forms a dense, invasive groundcover that competes with herbaceous plants
- o Propagated easily by division of plants and can be propagated by seed
- o Grows best in full to partial shade, but will survive in full sun

Source of infestations to be aware of as related to control

- o Escaped from cultivation in many areas
- o Introduced from ornamental plantings or as ornamental waste due its use as a ground cover in shaded areas

Weed Impacts on Forestry Planting

This section deals with common weeds that could affect the survival, development and growth of forestry plantings. These include annual and biennial weeds that germinate in plantings and perennial weeds that are already established or grow into planting areas.

Table 2 provides examples of annual weeds that could germinate after site preparation and flower in the same season, regardless of the time of site preparation and planting. Effective weed control will provide residual control throughout the growing season.

- o Annuals such as horseweed will germinate at all times of the year. When horseweed germinates in the fall it will produce a rosette and flower the next spring.
- o Other winter annuals, such as shepherd's purse (mustard species), germinate producing a rosette in the late summer or fall and seed the following season.
- o Many annual species such as ragweed will germinate from spring right through to late summer and produce seed by the end of the season.
- Biennial weeds and short-live perennials will geminate any time during the season, overwinter and then seed in the following years.
- Perennial weeds may seed the year of planting or any year after establishment.
 - o The best time for control of all weeds is before flowering to prevent new seed from developing. Flowering occurs from spring right through to fall, depending on the species.
 - o Post-emergence control of all perennial and woody weeds must be delayed until the majority of the leaves fully mature.
 - Once the leaves are fully mature the herbicides will move down to the roots with the translocation of food in the plant.
 - At this stage of development post-emergence herbicides will translocate from the leaves to the root system of the plants.
 - Application from late June until frost will prevent storage of reserves by the target weeds for survival over winter.
 - The optimum time for control depends on the species. The time of first flowering or when the plant is in a rosette stage may be the best time to

control certain species. For example, the best time to apply foliar herbicides to phragmites and milkweed is when the plants begin to flower in late summer.

- Refer to herbicide labels for detailed information.
- Sources of current information and illustrations of Ontario noxious and invasive weeds
 - Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) site:
http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm
 - Ontario weed gallery (OMAFRA)
<http://www.omafra.gov.on.ca/english/crops/facts/ontweeds/weedgal1.htm>
 - Resources are available through the Ontario Invasive Plant Council at
www.ontarioinvasiveplants.ca
 - Ontario Ministry of Natural Resources and Forestry at
www.ontario.ca/page/invasive-species-ontario
 - The local conservation authorities.

Weed Surveys/ Monitoring

Invasive Weed Management Monitoring Cycle

Pre-control Survey

Carry out a **regular survey** on a three-year cycle of all forests for early invasive weed detection, existing invasive weed spread and weed development

To carry out a monitoring program of a half day to full day of invasive weed monitoring per compartment, it would take one full-time staff or a small crew to complete the work in 3 seasons (doing this work half of the time).

- Adding monitoring work by contractors and other relevant Simcoe County personnel whenever they were on site doing identification-related work would reduce this staff requirement.

A pre-treatment thorough evaluation of all sites should be carried out before control programs are initiated to plan work, to have a basis to go on for quality control monitoring and long-term control monitoring to track progress.

Invasive weed survey

- Regular survey and identification
- Density mapping to record specific weed issues
- Recording species information

Early Detection of Invasive Weeds

- **Benefits of control on first detection**
 - easier control
 - less herbicide and few applications required for control
 - fewer propagules (seed, rhizomes, etc.)
 - less spread in future
- Implementing early detection surveys of invasive weed species presence within all forestry management programs and whenever on site for other activities
 - Ongoing invasive weeds surveys whenever on site with reporting procedures
 - **Defined as completed by completion of a digital record for all visits by staff/contractors**
 - Part of any identification related work since these personnel have plant identification skills
 - Crop auditing, tree marking and grading
 - Thinning
 - Competition removal
 - New planting establishment and survival counts (see next section)
 - During contractor/in-house forestry operations
 - Add invasive plant monitoring as part of contracts/programs work
 - Provide a list of species of concern
 - Provide monitoring sheets/digital link
 - During Simcoe County roadside/trail herbicide and control work (contractor/in-house)
 - Add invasive plant monitoring as part of contracts/programs work
 - Provide a list of species of concern
 - Provide monitoring sheets/digital link
- Other operations that could incorporate early detection with critical same season follow-up visits for complete monitoring of site
 - Monitoring by staff during inspections of infrastructure
 - Monitoring by roads staff for roadsides for problem vegetation and weed inspector for off-site noxious weed locations
 - Provide a list of species of concern
 - Provide monitoring sheets/digital link
 - Public Reporting
 - Universal use of EddmapS (current version) for all weed locations and successful control
 - Promote EddmapS use with public in every way
 - Use of Simcoe County website for possible public reporting
 - Download reports on a monthly basis from EddmapS and other online sites regularly by County Staff

Quality control monitoring

Quality control monitoring must be carried out following any weed control measures.

- Effectiveness of control
- Determine any requirement for follow-up control

Long term control monitoring (audit)

- Maintain records of successful previous control methods
- Effectiveness of program being used
 - Early detection for any follow-up control of escapes and new plants
- Changes required to any new programs including herbicide, herbicide rate, timing or rotation/change of method
- Tracking progress of long-term control programs at various sites

Weed Monitoring for Forestry Replanting Cycle

Two surveys per season of new plantings for competing weed development

- Carried out first two full growing seasons
- Quality control monitoring
- Mid-late summer evaluation to determine any required control for late summer/fall
 - Late summer/fall residual control will last until the second season
- Repeat monitoring cycle for second season

Data Collection and Recording

- Types of data to be collected
 - Information relating to actual weed and pest control activities
 - See sample forms for Contractor Check List (Appendix 2).
 - Application Reports required to be recorded daily for all pesticide applications, in-house or contractor (Appendix 3) with required information as per provincial standards (OMEE site) and provided on regular basis to Simcoe County
 - All copies filed in-house over season or in online data base
 - Invasive weed location and weed quality data
 - Minimum would be name, location coordinates of stand, size of infestation (S, M, L), and stage of growth (seedling or mature (S or M), indication of flowering (F)
 - Effective or non-effective control (C/NC)
 - This is important to confirm that control programs are working
 - Weed cover at replanting sites over first three seasons
 - Minimum would be predominant or problem species and stage of growth
 - Coverage of competing weeds within planting(s)

- Recommendations for control
- Take photos throughout the year to use for reports or presentations

Program/system of weed reporting and control data entry

- Regular system to ensure that weed location data gets entered on appropriate layers with tagging of information
 - Important due to the numerous people that are contributing to weed reporting and data collection
- In desired/organized locations to allow access and desired use
- Type of data include word, numbers, photos
- Use of GIS and/or other databases for location data with tagged information
- Use of Eddmaps
 - Two-way integration with Simcoe GIS, contractors or public (where required)
 - Reporting of invasive weed locations and control information
 - Provide appropriate tools/programs/links for contractor and others
 - Sharing of data
 - Review of other useful parameters to collect

Options/Tools for Control

Action thresholds for weed control actions

Timing for control methods will be based on monitoring information

Control options will be determined by propagation characteristics of weed species and timing of optimal control windows based on seasonal timing of weed occurrence

Methods of Control

Control Through Prevention

Prevention is **one of the most important methods of control** that is regularly overlooked. It is usually very low cost or no cost at all to the County, compared to the cost of dealing with established invasive and noxious weeds.

Required Equipment Cleaning to Reduce Human Weed Spread

Equipment cleaning should be required for all mechanical operations coming in contact with weedy vegetation, *including mowing and ditching on roads around the forestry compartments, ATV and truck travel within the forestry compartments.* As well, workers should be required to wash off boots before leaving these sites and forest sites. See notes relating to cleaning stations for recreational use of the forest tracts (Page 23-24).

Research has characterized the movement of plant propagules by workers and equipment including seeds and plant parts that can regenerate into new plants.

- Various studies have found that worker as vectors can collect up to 400 seeds per 100 m on their boots. It is important to realize how effectively boots collect seeds – in one situation they found 63 viable purple loosestrife seeds on a pair of boots.
- ATV equipment collects up to 1,100 to 3,100 seeds per km.
- Tracked equipment contributes about 10 times the number of seeds compared to ATV's due to plants parts being captured by the inside and outside of the tracks.

Research on a powerline ROW in New York State found that ROWs were more invaded near areas with early successional vegetation and near residential areas where ATV and other recreational use occurred. Movement was worse in wet conditions with dew or following rain.

The New Your study found invasive plants made up about 7% of the plants moved. Any movement of pieces of one invasive plant can start a new infestation.

The study also evaluated cleaning techniques. Scaping/brushing alone of equipment missed at least 30-50% of the plant propagules collected. Power washing was required to get an effective cleaning.

The Ontario Invasive Plant Council (OIPC) has developed a clean equipment protocol for use by industry for all potential of equipment and vehicles. This procedure must be required for all contracts on Simcoe Forest sites and without fail for all Simcoe staff work. This is critical for Simcoe staff since these workers are on Simcoe County Forest sites regularly throughout the year, day-in and day-out.

Compact 100 L (25 gal) pressure washer units can be easily set-up on any piece of equipment so that seeds and propagules can be removed before leaving sites or moving between sites. Any alternative is to have mobile wash units move from site to site to power wash equipment.

Equipment/boot cleaning should be required:

- for all mechanical operations and staff coming in contact with weedy vegetation, including mowing and ditching
- before equipment and staff leave a site to return to home base for the day,
- or before equipment and staff move to a completely new area

It is highly recommend that equipment cleaning be compulsory for all County staff and a contract requirement for all contract staff using the “Clean Equipment Protocol for Industry” prepared the Ontario Invasive Plant Council (Appendix 1) Full protocol:

https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf

One page summary (shown below in Appendix 1): https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/CEP-One-Page-Summary_FINAL.pdf

- Clean equipment procedures in contracts
 - All forestry, plant control and road access work
 - Written into RFP's, contracts, and in-house procedures
 - Return bids without this to have it added
 - Equipment cleaning equipment on vehicle/cleaning stations/mobile cleaning equipment
 - Start-up equipment cleaning for contractors before first being brought on-site
 - Recreation cleaning stations at the beginning and end of trails with signage and other weed related promotion
 - Regular inspections as part of quality control inspections.

Organization of Operations to Reduce Human Weed Spread

Organization of operations along with equipment cleaning are essential for wild parsnip and common reed grass (Phragmites) control and will assist in poison-ivy control. Both these approaches minimize personnel and equipment movement of seeds and other plants parts of invasive plants to new areas.

Annual basis

Ideally control work and mechanical operations such as mowing, ditching and construction-related operations should occur at the time of the season when there are no seed or flower heads present on the weeds of concerns

With wild parsnip, for example, this period would be late fall to late spring when only rosettes are present and new seed heads have not formed.

Project basis

Mechanical operations such as mowing, and ditching must be done during the appropriate times *from* least infested sites *to* more heavily infested sites where any invasive weed species are located.

- This will minimize equipment and people movement of seed and rhizomes of invasive and poisonous plants such as wild parsnip, common reed grass (phragmites) and poison ivy.

Use county map of weeds audits to determine operations priority on an annual basis including future harvest plans and priority of invasive weeds (Appendix 4).

In general, work will proceed from the northwest of the County to the southwest due to general wind direction movement of wind-blown seeds.

Area Source Control to Reduce Natural Weed Spread

Control on neighbouring lands will reduce wind, water and animal dispersion of invasive and weedy plant propagules.

- Assistance programs as well as required use of weed inspection notices/enforcement on neighbouring infested areas
- Public works control on roadsides and around recreational facilities that they are responsible for
- During yearly work in a farm block of a local farming operation, expansion of wild parsnip was observed from the roadside location by a field entrance from the road to a non-crop field site across a farm lane to the grower's field. Movement of seed by vehicles and humans is already occurring in the Simcoe County area.

Stale Seed Bed Control

Stale seed bed methods can be used following fall or spring preparation of a new planting site

- After 1-2 months, any weeds that have emerged will be controlled prior to planting by mechanical or herbicide control
- This is a useful technique to provide control of problem perennial weeds and to reduce the seed bank of a site

Manual Control

- Cutting using hand implements, pruners or handsaws
 - Clipping plant stems
- Spade cutting of roots just below the crown
- Cutting woody stems with brush saws or chain saws
- A negative of manual control is that cut stems will re-sprout after cutting

Mechanical Control

- Mowing
- Flail mowing for brush
- Feller-bunchers for larger tree removal

- A negative of mechanical control is that cut stems will re-sprout after cutting

Chemical Control

Daily pesticide application reporting should be done regularly to meet requirements required by OMEE

Herbicide product knowledge is necessary to choose appropriate products and make application prescriptions (Appendices 5 and 6)

- Appropriate timing provides optimum results.
- Herbicide resistance that may prevent effectiveness
- Rotation of herbicides or control methods will improve long-term control
 - This can be done every 3 years or so

Herbicide types and application methods

- Pre-emergence (residual) herbicide application
- Foliar herbicide application for escapes of preemergence program and perennial weed/brush control
- Stem/basal bark applications to target trees
- Combination products and programs to integrate these methods
 - An example would be glyphosate plus simazine mixture to provide foliar control of existing weeds and residual control of germinating seedlings

Combination Control Methods

- Cut-surface treatments should be applied to all cut woody plants at the time of cutting
 - Provides the best and least expensive control using cutting (compared to return visits to control escapes or application of herbicide to plant regrowth)
 - Saves time and reduces the need for return visits to site
- Stem/basal bark or foliar applications of herbicide on woody plant regrowth after cutting

Biological Control

Biological insect or disease control

Purple loosestrife biological control

- Biocontrol of purple loosestrife in Ontario has been successful using 4 insect species including two beetle species and two weevil species.

- These insects reduce the invasiveness of purple loosestrife stands rather than providing total control.
- Once established the insects self-perpetuate and can be swept (collected) with nets and spread to additional sites.

Establishment and/or Improvement of Competitive Understory Vegetation

- A competitive understory will reduce the establishment of invasive weed species by seed
 - Species such as asters, goldenrods, bracken fern, brambles, bunchberry and others form low, dense, competitive canopies and certain species are allelopathic in that they leave chemical residues that reduce other plant growth
 - These natural allelopathic compounds are left in the soil due to exudations from the roots and rhizomes and breakdown residues from leaves and stems
- Surveying understory areas of these plants that are well-established
- Protecting established areas that have suitable plants
- Understory plants can be encouraged naturally and preserved with combination methods by no disturbance to or by minimizing disturbance of competitive understory using targeted maintenance and control methods
 - Long-term program
- Seeding could be used to promote development of new areas
 - Time-consuming and expensive
 - Purchased seed, collected seed or straw from cut plants to establish cover
- Promotion of the goals of program to other staff involved in maintenance operations
 - Beneficial role of these understory plants
 - Avoiding disturbance due to the cost of replacement

Physical control methods

Physical removal of plants

- Effective for certain species if root can successfully be removed
- Use for small stands

Ballast maintenance

- Trails, facilities parking areas
- Ballast maintenance regularly with new material when required

Legislation Relevant to Forestry and Public Area Weed Control Programs

- Relevant Provincial legislation
- Requirements prior to vegetation control work

- Requirements for notification
- Required contractor herbicide application records

Federal Pest Control Products Act

- Deals with sale, storage, use, transportation and disposal of pesticides
- Registered pesticides have specific weeds listed
- Health Canada/ PMRA has a label search site (<https://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>)

Timing legislation

- The Migratory Birds Convention Act limits herbicide application or maintenance work including cutting or mowing in areas frequented by migratory birds during nesting.
 - These areas should be treated as environmentally sensitive areas.

Buffer requirements

- Specific buffers are specified on each herbicide label
 - Product and site specific
 - Relates to specific conditions such as location of water bodies, soil type or sensitive vegetation
- Use this information to provide adequate protection of these areas

Noxious weed legislation

- Control of Ontario designated noxious weeds required in areas affecting agricultural (including horticultural) operations
- Example weeds are wild parsnip, buckthorn species, poison ivy, giant hogweed and dog-strangling vine species.
 - Listed on OMAFRA Noxious Weed site

Outreach

Regular Sharing of Information

It is beneficial to educate other staff working for the County of Simcoe about the complicated work involved in IPM control of invasive weeds within the Simcoe Country forests. Promotion and education of the program should be carried out with staff, contractors and the public on an on-going basis. This will develop acceptance of and participation in this program and the work involved. This will help involve more people as a resource for the proposed reporting, identification and control work.

- In-house and public
- Any County of Simcoe staff and contractors on site
- Neighbouring property owners, for example adjacent to the buckthorn site

- Work with local Conservation staff could provide support in this area
- Trail users

An example of this co-operative work is identification and reporting of invasive species locations

- Neighbouring property owners
- Trail users
- Forest users, visitors
- Public reporting opportunities
 - Availability and usefulness of Eddmaps
 - Other online options

Sharing control methods provides another benefit to the County

- Provide information on and/or share control methods to public if requested
- Demonstration days, tours
- The benefit will be reducing invasive weed load in the county and reducing spread by seed (wind, birds)

Trail Management

- Provide cleaning stations at end and beginning of each trail or at major entrances at parking areas
 - Signage to explain the reason for implementation of clean equipment policy
 - Explain proper use of stations
- Signage with joint message of education on invasive weeds and promotion of cleaning of ATV's, bikes and footwear
- Promotion of reporting using EddmapS (current version) and other in-house digital methods that have public portal

Examples of Record Sheets

At the beginning of all contract work it is necessary to ensure that contractors have a procedure for collecting all the necessary information during the work and that they have the equipment and proper procedures for quality work. There are two parts to this aspect of quality control.

Start-up Meeting audit (Appendix 2) to ensure that contractors have the proper equipment and procedures required to successfully complete the work

- Current and applicable license
- Equipment set-up and suitability
- Rate and mixing procedure
- Review if they have a daily work report method

- Other information required

Daily herbicide and other pesticide recording sheets (Appendix 3) for Simcoe County forestry staff

- Suitable for hand-held devices
- Integrated with the GIS systems
- Confirm sheets similar sheets in use by contractors

Appendix 1. The Ontario Invasive Plant Council (OIPC) provides a clean equipment protocol for industry. This procedure must be required for all contracts on Simcoe Forest sites and all Simcoe staff work. Full protocol: https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf One page summary (shown below): https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/CEP-One-Page-Summary_FINAL.pdf

Clean Equipment Protocol for Industry – Summary

Invasive species are plants, animals and microorganisms that have been accidentally or deliberately introduced into areas beyond their normal range, that out compete native species. Invasive species are a major threat to Ontario's natural areas, and are very costly to deal with once established.

Invasive species can be spread to new areas by contaminated mud, gravel, soil and plant materials on vehicles and machinery.

The best practice is to prevent the spread of invasive species. By inspecting and cleaning equipment and following some simple guidelines, the risk of spreading invasive plants is greatly reduced.

- Identify invasive plants and plan activities accordingly (i.e. schedule work in areas without invasive plants first, leaving infested areas til the end, to reduce the risk of unintentionally moving plants into a new area).
- Record & report sightings of invasive plants (Invading Species hotline at 1-800-563-7711 or online www.invadingspecies.com/report/ or www.eddmaps.org/Ontario)
- Inspect vehicles and machinery before and after entering sites or conducting work along roadways & waterways.

How to Inspect

Before leaving the site, inspect the vehicle thoroughly inside and out for where dirt, plant material and seeds may be lodged or stuck to interior and exterior surfaces. Remove and clean any guards, covers or plates that are easy to remove.

Pay attention to the underside of the vehicle, radiators, spare tires, foot wells and bumper bars. If clods of dirt, seed or other plant material are found, remove immediately and discard where the contamination occurred or in the garbage.

When Cleaning is required

- Safely locate the vehicle and equipment away from any hazards, ensure engine is off and the vehicle or equipment is immobilized.
- Clean the vehicle/equipment in an appropriate area where contamination and seed spread is not possible (or limited).

The site should be:

- » Mud free, gravel covered hard surface, or, if this is not available, a well maintained grassy area.
- » Gently sloping to assist in draining water and material away from the vehicle or equipment. Care should be taken to ensure that localized erosion will not be created.
- » At least 30m away from any watercourse, water body and natural vegetation.
- » Large enough to allow for adequate movement of larger vehicles and equipment.

Continued...

Equipment Required

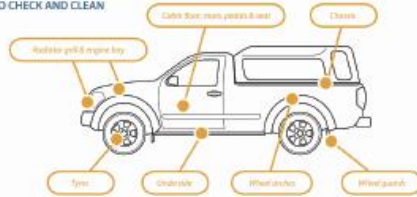
- A pump and high pressure hose OR High pressure water unit
- Air compressor and blower OR Vacuum
- Shovel
- Pry bar
- Stiff brush or broom

Final Inspection Checklist

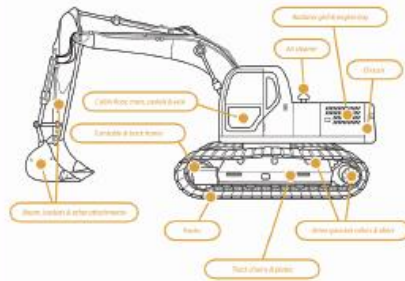
- No clods of dirt should be visible after cleaning.
- Radiators, grills and the interiors of vehicles should be free of accumulations of seed, soil, mud and plant material parts including seeds, roots, flowers, fruit and or stems.

2WD and 4WD Vehicles Excavator

4WD VEHICLE WITH KEY SPOTS TO CHECK AND CLEAN



EXCAVATOR WITH KEY SPOTS TO CHECK AND CLEAN



Backhoe Bulldozer

BACKHOE WITH KEY SPOTS TO CHECK AND CLEAN



BULLDOZER WITH KEY SPOTS TO CHECK AND CLEAN



Appendix 2. Example of a sheet for pre-work Check and Audit of Contractors .

SIMCOE PESTICIDE CONTRACTOR CHECK LIST & FIELD AUDIT RECORD

CONTRACTOR NAME			
Ontario Operating License#			
Insurance policy #			
Years of experience			
Types of equipment			
References (3 minimum)			
APPLICATOR(S) NAME(S)		APPLICATOR(S) LICENSE #	
DATE OF FIELD AUDIT			
LOCATION (S)			
AUDIT START AND FINISH TIME			
EQUIPMENT CONDITION PRE-CHECK			
EQUIPMENT & APPLICATION CHECK LIST			
CALIBRATION CHECK OF SPRAY EQUIPMENT			
CHECK APPLICATORS TECHNIQUES			
ADDITIONAL INFORMATION			

Appendix 3. Example of a sheet for Daily Herbicide Application Record.

SIMCOE PESTICIDE CONTRACTOR CHECK LIST & FIELD AUDIT RECORD

CONTRACTOR NAME			
Ontario Operating License#			
Insurance policy #			
Years of experience			
Types of equipment			
References (3 minimum)			
APPLICATOR(S) NAME(S)		APPLICATOR(S) LICENSE #	
DATE OF FIELD AUDIT			
LOCATION (S)			
AUDIT START AND FINISH TIME			
EQUIPMENT CONDITION PRE-CHECK			
EQUIPMENT & APPLICATION CHECK LIST			
CALIBRATION CHECK OF SPRAY EQUIPMENT			
CHECK APPLICATORS TECHNIQUES			
ADDITIONAL INFORMATION			