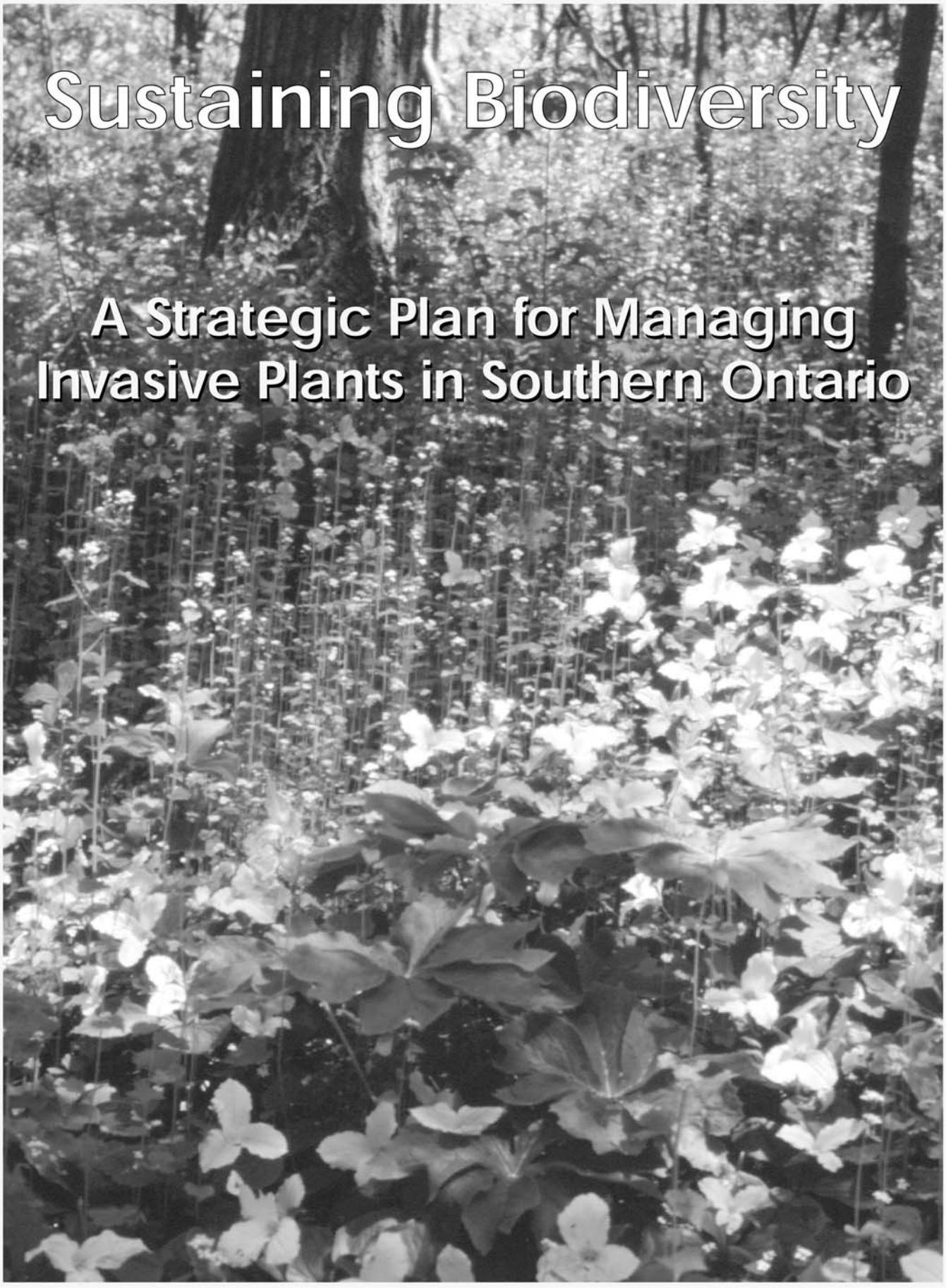

Sustaining Biodiversity

A Strategic Plan for Managing Invasive Plants in Southern Ontario

Prepared by Donna Havinga and the Ontario Invasive Plants Working Group

City of Toronto, 2000

The Office of the City Forester is responsible for the overall coordination and management of the forestry program for the City of Toronto. This involves: the coordination of major forestry initiatives; forestry policies, practices and systems; Integrated Pest Management program; implementation and enforcement of forestry related by-laws; and the coordination of forestry research, performance measures and best practice development.

Society for Ecological Restoration, Ontario

The Society for Ecological Restoration (SER), Ontario Chapter is committed to promoting greater understanding and good practice in all aspects of habitat and ecosystem repair and management. SER Ontario provides educational opportunities and materials for members and others, including the Native Plant Resource Guide for Ontario, semi-annual field days, and occasional major conferences. For more information and membership rates, visit SER Ontario's website http://www.trentu.ca/ser or phone 905-641-2252 x 6494.

Ecological OutLook

Ecological OutLook offers a variety of landscape and environmental services including ecological restoration, ecological landscape design-build, environmental education, facilitation and conflict mediation. They have authored several studies and educational resources including the widely acclaimed "Restoring Nature's Place" and a recent CMHC study on the maintenance of naturalized home landscapes.

A limited number of additional copies are available from the Office of the City Forester, City of Toronto, Parks and Recreation, 21st Fl. E. Tower, City Hall M5H 2N2 or accessto@city.toronto.on.ca

Sustaining Biodiversity

A Strategic Plan for Managing Invasive Plants in Southern Ontario

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Ontario Invasive Plants Working Group

Mission Statement

The aim of the Invasive Plants Working Group is to develop and support the implementation of a strategic plan for managing invasive plants in southern Ontario.The plan is a call for action to prevent the broad-scale loss of native biodiversity resulting from the spread of invasive plants and to aid in the restoration of ecosystem health.

Acknowledgments

Development of this strategic plan was coordinated by Beth McEwen, Urban Forestry Coordinator, City of Toronto Parks and Recreation Division, with assistance from Tove Christensen, City of Toronto Parks and Recreation Division, Silvia Strobl, Ontario Ministry of Natural Resources, and Donna Havinga, Ecological OutLook. Donna Havinga also facilitated and participated in the workshops and prepared the reports.

We extend our appreciation to the Invasive Plants Working Group and to those who provided written comments. Special thanks to:

- Silvia Strobl and Tove Christensen for reviewing in detail final draft reports, contributing to the list of resources, and developing the control methods table (Appendix Four);
- Stephen Smith, Urban Forest Associates, for permission to adapt the list of invasive plants (Appendix Three);
- Metro Toronto Zoo and the City of Toronto for hosting the workshops;
- Ken Towle for providing the cover photograph. The photo depicts garlic mustard (background) invading a southern Ontario forest.

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The rapid spread of invasive plants has become a major concern among ecologists, naturalists, biologists and land managers worldwide. Invasive plants are now considered one of the most serious threats to global biodiversity. They also contribute, either directly or indirectly, to increased erosion, spread of disease, flooding, and other ecological ailments. Further, invasive plants present major challenges and lead to significant costs for the agricultural, fishing and forestry industries. In the U.S., the costs of control and mitigation of only two invasive plants, Purple Loosestrife (Lythrum salicaria) and Melaleuca (*Melaleuca quinquenervia*), have been estimated at $48 million (Pimental, 1999).

Yet managing invasive plants is complex and will require long-term multi-faceted efforts. Prevention of on-going introductions will require improved land use and land care practices, as well effective ways to minimize transport. Where direct, immediate control is necessary, the scope of the problem is often far greater than available resources. Land management agencies need to establish clear priorities for control and adopt the most effective methods. Agencies must also be prepared to respond to controversy over some control methods, such as cutting mature trees and the use of herbicides.

This strategic plan is intended to provide support for the many organizations, agencies and individuals involved in land management and conservation across southern Ontario that face these challenges. It is also meant to act as a catalyst for action and discussion, commitment of resources, and development of on-going partnerships. The strategic plan was developed by a Working Group through two facilitated workshops, a literature search and a review process. Eight key strategies are recommended:

1. Prevent further introductions.
2. Develop guidelines for managing priority species.
3. Identify priority geographic areas for management.
4. Conduct research and disseminate results.
5. Educate and communicate widely.
6. Develop or revise policies and laws.
7. Develop action programs.
8. Promote partnerships.

Several specific actions have been identified under each strategy, some of which are regional (i.e. across southern Ontario) and others local in scope. Some of the high priority actions identified include:

- Utilize appropriately sourced native plants and develop native plant policies.
- Work with the nursery industry to phase out priority invasive species.
- Adopt preventative land care and land use practices (for example, minimize disturbance in natural areas) and restore areas that are already damaged.
- Liaise with provincial Weed Inspectors, the Canadian Food Inspection Agency and other relevant federal and provincial regulatory agencies.
- Circulate user-friendly guidelines for managing priority species of concern (Appendix Four).
- Create an annotated bibliography/database of research and resources relevant to southern Ontario.
- Post the strategic plan and other materials on a website and link to other sites.

Development of the strategic plan was funded and coordinated by City of Toronto Forestry Services. The Society for Ecological Restoration (SER) Ontario will be responsible for future coordination and monitoring of implementation over time. It is hoped that the strategic plan will be widely endorsed, supported and implemented, and that many partners will come forward to participate in this endeavour.

[Some] introduced plants, animals, and pathogens often pose an initially hidden but eventually monumental problem….Their harmful effects are often subtle and surreptitious, but the eventual impacts on the economy or natural environment are no less real, and [are] often disastrous and even irreversible.

Daniel Simberloff, 1996

The rapid spread of invasive plants has become a major concern among ecologists, naturalists, biologists and land managers worldwide.[1] From an ecological perspective, the concern centres on the displacement of diverse native species, the impacts on interrelated species (those that rely on native plants for food or other values), and reduced genetic diversity. In fact, invasive plants are now considered one of the most serious threats to global biodiversity. Further, invasive plants can, either directly or indirectly, contribute to increased erosion, spread of disease, flooding, and other ecological ailments. Invasive plants present major challenges and lead to significant costs for the agricultural, fishing and forestry industries. In the U.S., the costs of control and mitigation of only two invasive plants, Purple Loosestrife (*Lythrum salicaria*) and Melaleuca (*Melaleuca quinquenervia*), have been estimated at $48 million (Pimental, 1999). On a more personal level, seeing a remnant forest, a rare prairie, a lake or a wetland being overtaken by one or two species can be quite alarming.

Yet the issues involved in managing invasive plants are complex. The past century of human activity has resulted in increased environmental degradation and species migration, both of which have created ideal conditions for invasions. Clearly, managing invasive species necessitates improved land care and environmental practices, as well as effective strategies to minimize introductions through transport. Some invasive plants have become culturally valued and widely planted, pointing to the need for a shift in thinking and industry practices. All of these changes will require long-term, multi-faceted efforts.

Even where direct, immediate control is necessary, there are many challenges. The scope of the problem is often far greater than available resources. Staff and budgets within many agencies are already strained and volunteers cannot carry the full responsibility. There is a need for clear priorities and knowledge about the most effective approaches to managing plant invasions. Further, agencies must be prepared to respond to considerable controversy over various techniques, such as cutting mature trees and the use of herbicides.

The *Invasive Plants of Southern Ontario* initiative was undertaken in order to explore and address these and other issues. This *Strategic Plan for Managing Invasive Plants* is intended to provide support for the many organizations, agencies and individuals involved in land management and conservation across southern Ontario. It is also meant to act as a catalyst for action, the commitment of resources, and the development of on-going partnerships. Some of the recommended strategies and actions can be applied at the local level, while others are best undertaken on a regional level with the support of many organizations.

The process of developing the strategic plan involved two intensive facilitated workshops attended by the Invasive Plants Working Group, a literature search, and an extensive review process. The initial stages were sponsored and coordinated by the City of Toronto. The Society for Ecological Restoration (SER) Ontario will be responsible for on-going coordination and monitoring of implementation. It is hoped that the strategic plan will be widely endorsed and implemented.

[1] Invasive plants are defined here as species that "move into a habitat and…displace some or most of the original components of the vegetative community." (White et al, 1993). Although the concern encompasses both flora and fauna, the focus of this strategic plan is invasive plants; insects and other fauna will be considered only in their role as bio-control agents.

The overall goals of an invasive plant management strategy for southern Ontario are:

- ☑ To maintain healthy ecosystems and native biodiversity.
- ☑ To reduce the ecological and economic impacts of invasive plants.
- ☑ To advance knowledge and societal attitudes about invasive plants.
- ☑ To provide support and resources for land management and conservation agencies and landowners.

Specific objectives include (not necessarily in order of priority):

1. To prevent further introductions of invasive plants.
2. To determine the most effective methods for managing specific invasive plants.
3. To identify priority geographic areas for invasive plant management.
4. To support and disseminate research about the ecology of and most effective methods of controlling southern Ontario's most problematic invasive plants.
5. To create tools for advocacy and education about managing invasive plants.
6. To influence planning and other public policy to prevent the spread of invasive plants and facilitate their management.
7. To support and encourage direct action towards managing invasive species.
8. To contribute to improved land management practices in general.
9. To encourage discussion and address unresolved issues and challenges regarding invasive plants.
10. To promote partnerships that allow for information sharing and pooling of resources for more effective management of invasive plants.

3.0 Strategies and Actions

Eight strategies for meeting the objectives have been identified:

1. Prevent further introductions.
2. Develop guidelines for managing priority species.
3. Identify priority geographic areas for management.
4. Conduct research and disseminate results.
5. Educate and communicate widely.
6. Develop or revise policies and laws.
7. Develop action programs.
8. Promote partnerships.

Specific actions, related to each of the strategies and identified as regional or local in scope, are outlined below. In cases where there were many possible actions listed under a particular strategy, actions were assigned priority status in order to better focus efforts.[2] It is hoped that agencies and individuals will commit to supporting or undertaking specific actions (i.e. provide staff time, funding and/or other resources). As they are implemented, various initiatives and participating agencies will be noted on the web page and other presentation tools. Where actions are known to be already underway, the responsible agency or individual is noted in brackets in this document. Progress on the strategic plan will be monitored and the strategies will be refined and revised as needed over time.

[2] "Medium" or "other" priority status should not prevent someone with an interest from pursuing any given action. Further, priorities may differ in various jurisdictions; local agencies are encouraged to revise priorities accordingly.

Strategy 1:

Prevent further introductions.

As is the case when addressing many problems, prevention is the most effective long-term solution. Invasive plants are typically hardy species that thrive in degraded environments. They are often introduced through horticultural or agricultural trade or accidental transport. Prevention should therefore focus on minimizing introductions, and adopting sustainable land care and environmental practices to support overall ecosystem health.

Regional Actions

- Liaise with provincial Weed Inspectors and the Canadian Food Inspection Agency (in progress by H. Martin).
- Provide information to and liaise with all other relevant federal and provincial regulatory agencies.
- Develop an early warning system that identifies plants with invasive potential to prevent new introductions.
- Produce and distribute educational materials (see Strategy 5).
- Work with the nursery industry to phase out priority invasive species (over three years for herbaceous plants and ten years for woody plants).
- Promote the growing and use of locally sourced native plants in place of invasive species (in process by the Forest Gene Conservation Association, SER Ontario and others).
- Adopt ecologically sound land use and environmental policies.

Local Actions

- Utilize appropriately sourced native plants (refer to the Native Plant Resource Guide for Ontario by SER Ontario)
- Watch for and eradicate invasive species when they first appear; train staff and volunteers in species identification and the most effective control methods.
- Adopt ecologically sound land care and environmental practices. For example, minimize disturbance in natural areas.
- Ameliorate damage where it has already occurred.
- Adopt ecologically sound land use and environmental policies.

Strategy 2:

Develop guidelines for managing priority species.

There is a need for information on effective methods of controlling the species of greatest concern across southern Ontario. Some information, based on existing literature and other resources, is provided in Appendices Three and Four. These guidelines will be updated and expanded as new information and resources become available.

Regional Actions

- Circulate a list of priority invasive species in southern Ontario (Appendix Three).
- Prepare and circulate succinct, user-friendly guidelines for managing priority species (Appendix Four).
- Promote Integrated Pest Management and the limited use of low-impact herbicides only where needed; include cautions regarding the use of pesticides, the potential damaging effects of some bio-controls, and the impacts of control methods on faunal species.

Local Actions

- Circulate and adopt guidelines for managing invasive plant species (Appendix Four).
- Identify additional priority species of local concern beyond those noted in the guidelines.
- Prepare and circulate succinct, user-friendly information on managing priority species of concern locally.

Strategy 3:

Identify priority geographic areas for management.

Given the scope of the problem, it is recommended that landowners and local agencies identify priority areas for management within their jurisdictions. Criteria to assist with this task were developed by the Working Group and have been attached as Appendix Two. Although managing invasive plants in all of the high priority areas listed may not be within the immediate means of all landowners or managers, taking a systematic approach can at least begin to focus efforts where they are most needed.

Strategy 4:

Conduct research and disseminate results.

Although there has been considerable research and practice in managing invasive plants in various parts of the world, there are few documented projects that specifically address species of concern in southern Ontario. Further, there are many unanswered questions and areas in need of exploration. The research agenda developed by the Working Group is therefore quite extensive and has been prioritized to better focus efforts.

Regional Actions

***High Priority*:**

- Create an annotated bibliography/database of current research about invasive plants, control methods, and volunteer or staff programs relevant to southern Ontario.
- Develop standardized protocols for formal and informal research; use the Ontario Ministry of Natural Resources Ecological Land Classification system as the site classification model (Lee et. al., 1998).
- Establish research plots and/or document existing efforts to develop and test control methods (see Appendix One for a partial list of current research; additional research is encouraged).

- Post bibliography, protocols and research results on a website (to be hosted by SER Ontario and linked with other sites).
- Create and distribute an atlas or sub-atlas of base-line data (similar to tree, bird and mammal atlases) and determine the best monitoring techniques.

Medium Priority:

- Publish research results in journals and newsletters.

Local Actions

- Inform the Invasive Plants Working Group about local resources, research and programs for inclusion in the bibliography/database.
- Establish research plots and/or document existing efforts to develop and test control methods for local species of concern.
- Post research results on the website.

Research Topics

High Priority:

- existing research, resources and programs;
- control methods for the top priority species, including natural controls;
- species information: autecology and possible ancillary effects such as allelopathy;
- base-line data on species distribution and densities;
- best monitoring techniques.

Medium Priority:

- rate of displacement of native species;
- long-term impacts if left unchecked;
- pre-invasion conditions for various species, for example, healthy or disturbed ecosystems;
- effects of introduced bio-controls (both beneficial and harmful);
- species information: history in southern Ontario, transport mechanisms, medicinal and other benefits (harvesting potential), ecology in their home habitats;
- implications of global climate change, for example, how to manage invasive species and retain needed biomass, how to determine best replacement species for future conditions;
- cost-benefits analysis of managing vs. not managing invasive plants (in terms of damage to ecosystems or landscapes, losses and costs of re-introducing native species, etc.) and of various control methods.

Other:

- screen for potential invasiveness of plants;
- species currently sold in nurseries and how they are labeled;
- impacts of a phase out on the nursery industry; the potential of other uses, such as paper, remedies or lumber, to offset losses;
- identification of organizations or individuals that may be opposed to management, or specific techniques, and why.

Strategy 5:

Educate and communicate widely.

Although there is widespread concern about invasive plants, many people are still unfamiliar with the issue or have little information to guide them. The Working Group identified and prioritized target groups, topics and tools for education. Some of the target groups may also be key stakeholders in the further development and implementation of the strategic plan.

Regional Actions

High Priority:

- Circulate the strategic plan and support documents produced by the Working Group (future circulation to be coordinated by *SER Ontario*).
- Post the strategic plan and other materials on a website and link it to other sites (in process by *SER Ontario*).
- Host focus groups to garner support for/input into the strategic plan.
- Design and/or research examples of signs suitable for public spaces (in process by *B. McEwen* and *E. Furgiuele*).
- Design a field training session for staff and lead volunteers that can be adapted to local situations.
- Incorporate invasive plants management guidelines into existing land and resource management guidelines, as in the recent Silvicultural Guide produced by the Ontario Ministry of Natural Resources.
- Liaise with regional media. For example, circulate a press release about the strategic plan, host a press conference, and invite the media to site tours and other events.

Other:

- Write articles for newspapers, journals and newsletters.
- Conduct tours of sites where management is underway.
- Create a poster for circulation at conferences (is available for loan from *ROM* herbarium, 416-586-5610; to be updated in future).
- Host a wider forum and/or symposia at existing conferences, such as FON, Latornell, SER and Landscape Ontario.
- Produce other user-friendly documents, such as an information package, brochures and fact sheets.
- Create an internet discussion group.
- Create audio-visual media, such as CDs and videos.

Local Actions

High Priority:

- Advocate for the adoption of the strategic plan by local agencies.
- Place signs describing the issue and species to watch for in highly visible public spaces.

- Conduct field training sessions for staff and volunteers.
- Conduct public tours of sites where management is underway.
- Incorporate invasive plants management guidelines into existing land management guidelines.
- Distribute existing educational materials.
- Liaise with local media. For example, invite media to local events and write articles.

Other:

- Produce and distribute user-friendly materials based on invasive plants of concern locally.

Target Groups for Education

High Priority:

- managers of public lands, including municipalities, CAs, land trusts, and provincial and federal agencies;
- general public, including homeowners and other private landowners;
- landscape industry, including LO, OALA and horticultural associations;
- politicians, decision-makers;
- recreation groups, such as hikers, bikers, dog-walkers and golfers.

Other :

- students and teachers (secondary and post-secondary);
- anti-pesticide groups;
- development industry;
- foresters, farmers;
- scientific community (to further raise awareness).

Topics

- priority species and control methods (Appendices Three and Four);
- species identification;
- the issue in general, including:
  - why it is a concern and the controversies;
  - why protecting natural areas and biodiversity are important;
  - examples of high quality natural areas so that people can see the difference;
  - why herbicides may be needed in some situations, noting cautions.
- focus on prevention:
  - recommend native alternatives that can replace invasive plants;
  - the need for improved land care and ways to reduce or ameliorate damage to ecosystems.
- successes and challenges (case studies);
- be aware that some language generates controversy (for example "aliens" and even "invasives").

Strategy 6:

Develop or revise policies and laws.

Policies and laws at all levels can facilitate both the prevention of plant invasions and direct action towards managing invasive species. Conversely, some policies and laws may inadvertently enable continued invasions. Current policies and laws need to be assessed and revised, and new policies and laws developed where gaps exist.

Regional Actions

High Priority:

- Determine which provincial and federal policies and laws are related to this issue.
- Liaise with provincial Weed Inspectors and the Canadian Food Inspection Agency (in progress by H. Martin).
- Implement a phased-in ban on the importation of high priority invasive plants.
- Add high priority invasive species to the noxious weeds list (phase-in).
- Inform/liaise with other relevant federal and provincial agencies.
- Develop or revise other laws and policies as needed.
- Focus on prevention as well as control. For example, establish wide corridors and development setbacks to protect natural areas, and develop native plant policies.
- Research and document precedents in other jurisdictions, such as Noxious Weeds Acts in the U.S. (tie-in with bibliography).

Other:

- Review inter-provincial, national and international issues.

Local Actions

- Inform/liaise with relevant municipal and regional agencies.
- Determine which local and regional policies and by-laws are related to this issue.
- Develop or revise by-laws and policies as needed. For example, require the removal of invasives as part of permitting approvals.
- Focus on prevention as well as control. For example, establish wide corridors and setbacks, control recreational use in some natural areas, and develop native plant policies.
- Look at precedents in other jurisdictions.

Strategy 7:

Develop action programs.

The hands-on management of invasive plants is undertaken by maintenance staff, volunteers and landowners. In many places across the province the scope of the problem is greater than available personnel. Action campaigns can encourage increased hands-on involvement and partnerships while raising awareness of the issue.

Regional Actions

- Review and document existing staff and volunteer action programs (tie-in with bibliography).
- Develop a regional campaign to encourage local action.

Local Actions

- Develop local staff and volunteer action programs.
- Exchange information through the Invasive Plants Working Group.

Strategy 8:

Promote partnerships.

The scope of the problem and complexity of the issues will require input and the pooling of resources from many organizations and individuals. The Working Group is itself a partnership of several organizations that welcomes the involvement of many others in implementing and developing the strategic plan. SER Ontario will act as a clearinghouse and coordinating body for future endeavours.

Regional Actions

High Priority:

- Circulate the strategic plan for sign-on (initial circulation by City of Toronto).
- Seek partners to assist with wider circulation of the strategic plan (in process by City of Toronto and SER Ontario).
- Post the strategic plan and other material on a website with links to other sites (in process by SER Ontario).
- Maintain the Invasive Plants Working Group; invite participation from all key stakeholders (will be coordinated by SER Ontario).
- Review and update the strategic plan periodically; include the landscape industry, anti-pesticide groups and other key stakeholders in the process (will be coordinated by SER Ontario).
- Circulate the management guidelines and other resource documents (see Appendices).
- Host focus groups to garner support for and input into the strategic plan.

Other:

- Identify potential partners for an atlas and monitoring program.
- Identify potential partners for other activities, such as the production and distribution of educational materials, and hosting invasive plants symposia.
- Explore the potential for harvesting invasive plants, such as paper out of Purple Loosestrife or wood products from Norway Maple (Acer platanoides).
- Liaise with groups that are focusing on invasive fauna.

Local Actions

High Priority:

- Maintain communication with the Invasive Plants Working Group.
- Establish local groups involving key stakeholders.
- Discuss the strategic plan with local anti-pesticide groups to gain support for the limited use of herbicides and/or suggestions for workable alternatives.
- Identify potential local partners for specific activities, such as distributing educational materials and participating in local action days.

Other:

- Explore the potential for harvesting invasive plants.

Appendices

One:
References and Select Resources

Two:
Criteria for Determining Priority Geographic Areas

Three:
Priority Invasive Plants in Southern Ontario

Four:
Control Methods for Some Priority Species in Southern Ontario

One:
References and Select Resources

This is a preliminary list of resources relevant to southern Ontario. Strategy Four identifies the development of a full bibliography as one key future action item.

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Other Canadian:

http://cciw.ca/eman-temp/research
(Ecological Monitoring and Assessment Network)

http://www.cws-scf.ec.gc.ca/habitat/inv/index_e.html
(Environment Canada)

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International:

http://www.icsu.org/DIVERSITAS/Plan/gisp.html
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http://www.nbii.gov/invasive
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Two:
Criteria for Determining Priority Geographic Areas

Strategy Three focuses on identifying and mapping priority geographic areas for invasive control efforts. The following criteria for determining high, medium and lower priority areas were developed by the Working Group to assist with this task. To identify high and medium priority species, refer to the list provided in Appendix Three.

High Priority (areas fulfilling one or more of the following):

- established public parks, ESAs, ANSIs and other protected areas;
- undesignated areas of high natural heritage value, for example, areas that provide habitat for rare species (nationally, provincially or regionally rare), represent rare habitat, and/or are still considered relatively pristine;
- all areas in early stages of invasion (i.e. while control is still relatively easy);
- sites in which there is a high level of volunteer, landowner and/or agency interest so that resources for long-term management are available; potential to become a model site;
- areas in which invasive species are creating high-risk conditions, for example, ravines at risk of slope collapse or clogged storm drains.

Medium Priority (areas fulfilling one or more of the following):

- sites adjacent to protected or undesignated areas of high natural heritage value;
- connecting corridors;
- sites with a large proportion of high priority species that are far from remnant natural areas or corridors;
- sites presenting an opportunity due to land use changes and funding availability, for example, a site slated for development on which there is an infested natural area (i.e. make invasives management a condition of development).

Lower Priority[1]:

- potential connecting corridors;
- sites with a large proportion of medium priority species that are far from remnant natural areas or corridors.

[1] Lower priority areas are still considered important but do not require the urgency of higher priority areas.

Three:
Priority Invasive Plants in Southern Ontario

Adapted from *Invasive Exotic Species Ranking for Southern Ontario*, Urban Forest Associates Inc., 2000

The invasive plants listed here are considered priority species for management in southern Ontario. The Working Group recognizes that not all landowners and agencies have the resources to manage for all of these species. The species rankings are intended to assist in establishing management priorities. Further, this list is best used along with the priority geographic areas criteria noted in Appendix Three.

It should be noted that species and rankings differ from region to region, as species of concern in one place may be native and desirable in another. Further, site conditions, and hence experience of various species, may vary even on a micro-scale. The Working Group believes that this list provides up-to-date accurate information relevant across southern Ontario, with the understanding that there may be some local variation. Managers and landowners are invited to provide input into this list on an on-going basis.

"Invades" as used here means that a species displaces many other species and becomes a significant component in a given habitat. "Dominates" refers to species that exclude most or all other species. "Invasive species" as used throughout the strategic plan encompasses both of these. "Native" is treated as synonymous with indigenous.

Category 1 — Species that exclude all other species and dominate sites indefinitely. They are the top priority for control but control may be difficult. Plants in this category are a threat to natural areas wherever they occur because they tend to disperse widely (for example, through transport by birds or water).

Scientific Name	Common Name	Effect on Natural Area
Acer negundo*	Manitoba maple	invades all habitat types
Aegopodium podagraria	Goutweed	dominates forest understorey
Alliaria petiolata	Garlic mustard	dominates forest herb layer
Alnus glutinosa	Black alder	dominates wetlands
Butomus umbellatus	Flowering rush	dominates open marshes
Cirsium arvense	Canada thistle	dominates meadows, prairies and forest edges
Coronilla varia	Crown vetch	dominates meadows
Cynanchum nigrum	Black swallow-wort	dominates meadows and forest edges
Cynanchum rossicum	Pale swallow-wort	dominates meadows and forest edges
Elaeagnus umbellata	Autumn olive	dominates forest edges
Glyceria maxima	Rough manna grass	dominates wet meadows
Hesperis matronalis	Dames rocket	dominates open forest understorey and meadows
Hydrocharis morsus-ranae	European frog-bit	dominates open water habitats
Impatiens glandulifera	Himalayan balsam	dominates forests and wet meadows
Lonicera japonica	Japanese honeysuckle	dominates forest understorey
Lonicera maackii	Amur honeysuckle	invades meadows and forest edges
Lonicera morrowi	Morrow's honeysuckle	invades meadows and forest edges
Lonicera tatarica	Tartarian honeysuckle	invades meadows and forest edges
Lonicera xylosteum	Euro. fly honeysuckle	invades meadows and forest edges
Lythrum salicaria	Purple loosestrife	dominates wetlands
Morus alba	White mulberry	hybridizes with rare M. rubra

Scientific Name	Common Name	Effect on Natural Area
Myriophyllum spicatum	Eurasian watermilfoil	dominates open water habitats
Nymphoides peltatum	Floating heart	dominates open water habitats
Phragmites australis*	Common reed	dominates wetlands and wet meadows
Potamogeton crispus	Curly pondweed	dominates open water habitats in SW Ontario
Rhamnus cathartica	Common buckthorn	dominates forest understorey, meadows and prairies
Rhamnus frangula	Glossy buckthorn	dominates wetlands
Rosa multiflora	Multiflora rose	dominates forest edges

* hardy native species that can become invasive given certain conditions

Category 2 — Species that are highly invasive but tend to dominate only certain niches or do not spread rapidly from major concentrations. Many spread by vegetative means or seeds that drop close to the parent plant. Most persist in dense populations for long periods. Control where necessary and limit their spread into other areas.

Scientific Name	Common Name	Effect on Natural Area
Acer platanoides	Norway maple	dominates forest canopy
Acer pseudoplatanus	Sycamore maple	dominates forest canopy
Ailanthus altissima	Tree of Heaven	dominates early successional forest
Betula pendula	European birch	dominates open wetlands
Celastrus orbiculatus	Oriental bittersweet	now more common than native C. scandens
Galium mollugo	White bedstraw	invades meadows
Lotus corniculatus	Bird-foot trefoil	dominates meadows and prairies
Lysimachia nummularia	Moneywort	dominates wet forest understorey
Melilotus alba	White sweet clover	dominates meadows and prairies
Melilotus officinalis	Yellow sweet clover	dominates meadows and prairies
Pinus sylvestris	Scots pine	invades meadows
Poa pratensis	Kentucky bluegrass	dominates prairies
Polygonum cuspidatum	Japanese knotweed	dominates wet meadows and moist forests
Populus alba	White poplar	invades meadows
Robinia pseudo-acacia	Black locust	invades meadows
Scilla siberica	Scilla	dominates forest understorey
Syringa vulgaris	Lilac	dominates shallow limestone areas
Ulmus pumila	Siberian elm	invades prairies
Vicia cracca	Cow vetch	dominates meadows and prairies
Vinca minor	Periwinkle	dominates forest understorey

Category 3 — Species that are moderately invasive but can become locally dominant given certain conditions. Control where necessary and limit their spread into other areas.

Scientific Name	Common Name	Effect on Natural Area
Abutilon theophrasti	Velvet-leaf	invades meadows[1]
Acinos arvensis	Mother-of-thyme	invades alvars

[1] The Working Group understands that managing large areas of meadow for all invasive herbaceous species is difficult for most landowners and agencies. Categories three and four note meadow species to watch for and manage to the extent possible.

Scientific Name	Common Name	Effect on Natural Area
Aesculus hippocastanum	Horse-chestnut	invades forests
Artemisia absinthum	Absinth sage	invades meadows
Barbarea vulgaris	Yellow rocket	invades meadows
Berberis vulgaris	Common barberry	invades forests
Berberis thunbergii	Japanese barberry	invades forests
Berteroa incana	Hoary-alyssum	invades prairies
Carduus nutans	Nodding thistle	invades meadows and prairies
Centaurea maculosa	Spotted knapweed	invades meadows and prairies
Convallaria majalis	Lily-of-the-valley	invades forest understorey
Convolvulus arvensis	Field bindweed	dominates meadows
Crataegus monogyna	Singleseed hawthorn	dominates shrub communities, meadows and prairies
Dactylis glomerata	Orchard grass	invades meadows and prairies
Dipsacus sylvestris	Teasel	dominates meadows and prairies
Elaeagnus angustifolia	Russian olive	invades meadows and shrub communities
Elymus repens	Quack grass	dominates meadows and prairies
Euonymus alata	Winged euonymus	invades forest understorey shrub layer
Euonymus europaeus	Spindle-tree	invades forest understorey and edges
Euphorbia cyparissias	Cypress spurge	invades meadows
Festuca arundinacea	Tall fescue	dominates moist meadows and prairies
Galium verum	Yellow bedstraw	invades meadows and prairies
Hedera helix	English ivy	invades forest understorey
Hieraceum aurantiacum	Orange hawkweed	invades meadows
Hieraceum caespitosum	Yellow hawkweed	invades meadows
Hieraceum vulgatum	Common hawkweed	invades meadows
Hieraceum x floribundum	Pale hawkweed	invades meadows
Humulus japonicus	Japanese hop	invades wet meadows
Kochia scoparia	Summer cypress	invades meadows
Lycopus europeaus	Bugleweed	invades wetlands, displaces native Lycopus spp.
Miscanthus sinensis	Eulalia	dominates wet meadows
Pastinaca sativa	Wild parsnip	invades meadows
Ranunculus repens	Creeping buttercup	invades meadows
Rorippa amphibia	Marsh cress	invades wetlands (known in SE Ontario)
Salix alba	White willow	invades wetlands, displaces native Salix spp.
Salix fragilis	Crack willow	invades wetlands, displaces native Salix spp.
Salix x rubens	Hybrid willow	invades wetlands, displaces native Salix spp.
Saponaria officinalis	Bouncing-bet	invades meadows
Solanum dulcamara	Bittersweet nightshade	invades forests and wetlands
Sorbaria sorbifolia	False spiraea	invades meadows and forest understorey
Tanacetum vulgare	Tansy	invades meadows
Thymus praecox	Creeping thyme	invades meadows
Urtica dioica sp. dioica	European stinging-nettle	dominates forest understorey
Vicia sativa	Common vetch	invades meadows
Vicia tetrasperma	Slender vetch	invades meadows

[2] Is native to northwestern Ontario; *var albus* is more appropriate for southern Ontario.

Appendix 3

Category 4 — Species that do not pose an immediate threat to natural areas but do compete with more desirable native species. Once established, many can reproduce aggressively and become difficult to eradicate. Some are similar to native species and are often substituted by nurseries. Control where necessary and limit their spread to other areas.

Scientific Name	Common Name	Effect on Natural Area
Acer ginnala	Amur maple	competes with early successional forest species
Ajuga reptans	Creeping bugleweed	persists in forest understorey and edges
Bromus inermis	Smooth brome	resists conversion to native meadow and prairie
Campanula rapunculoides	Creeping bellflower	invades forest edges and meadows
Euphorbia esula	Leafy spurge	can dominate prairies
Glechoma hederacea	Ground ivy	competes with meadow and prairie species
Hemerocallis fulva	Orange day lily	dominates meadows
Hypericum perforatum	St. John's-wort	can dominate meadows
Inula helenium	Elecampane	invades meadows
Iris pseudoacorus	Yellow flag	invades wetlands
Ligustrum vulgare	Privet	invades forest edges
Linaria vulgaris	Butter-and-eggs	invades meadows
Lolium perenne	Perennial rye grass	competes with prairie species
Malva moschata	Musk mallow	invades meadows
Medicago lupulina	Black medick	invades meadows
Medicago sativa	Alfalfa	invades meadows and prairies
Myosotis scorpioides	True forget-me-not	dominates shaded seepage areas
Mentha x piperita	Pepper mint	invades meadows
Nepeta cataria	Catnip	invades meadows
Origanum vulgare	Wild marjoram	invades disturbed meadows
Pachysandra terminalis	Japanese spurge	persists in forest understorey and edges
Populus x canadensis	Carolina poplar	often misidentified/substituted for P. deltoides
Rumex acetosella	Sheep sorrel	invades meadows
Salix caprea	Goat willow	often misidentified/substituted for S. discolor
Salix purpurea	Purple willow	invades wetlands, displaces native Salix spp.
Senecio jacobaea	Tansy groundsel	invades meadows
Setaria spp.	Foxtail grasses	invade meadows
Sorbus aucuparia	European mountain ash	invades forests
Symphoricarpus albus var laevigatus[2]	Western snowberry	often misidentified/substituted for S. albus var albus
Trifolium arvense	Rabbit-foot clover	invades meadows
Trifolium pratense	Red clover	invades meadows
Trifolium repens	White clover	invades meadows
Tussilago farfara	Sweet coltsfoot	invades wet meadows and riverbanks
Ulmus glabra	Scotch elm	invades forests
Viburnum opulus sp. opulus	Guelder rose	often misidentified/substituted for V. opulus sp. trilobum; has replaced V. trilobum across most of Southern Ontario

Potentially Invasive Species to Monitor — Some of these species have the potential to become invasive in Ontario. They can reproduce aggressively on occasion but have not yet been shown to be a serious threat to natural areas in Ontario. Some are very similar to indigenous species and may therefore be difficult to identify.

Scientific Name	Common Name	Effect on Natural Area
Alnus incana sp. incana	European white alder	often misidentified/substituted for A. incana sp. rugosa
Ampelopsis brevipedunculata	Porcelain-berry	invasive in northeast U.S.A.
Artemisia vulgaris	Common mugwort	invasive in New York City natural areas
Cabomba caroliniana	Fanwort	invasive in New England lakes
Cornus sericea	Red osier dogwood	often misidentified/substituted for C. stolonifera
Daphne mezereum	Mezer's Daphne	has invaded moist forests in S. Ontario
Egeria densa	Waterweed	invasive in Massachusetts wetlands
Fraxinus excelsior	European ash	often misidentified/substituted for F. nigra
Isoetes tinctoria	Quillwort	a new invader to the Bruce Peninsula
Lapsana communis	Nipplewort	
Najas minor	Minor naiad	invasive in New York and New England waterways
Humulus lupulus	Common hop	locally invasive in some Ontario locations
Hydrilla verticillata	Hydrilla	invasive in mid-Atlantic states, U.S.A.
Phalaris arundinacea*	Reed canary grass	dominates wet meadows; status as native or exotic strain uncertain
Populus tremula	European aspen	often misidentified/substituted for P. tremuloides
Prunus avium	Bird cherry	
Prunus mahaleb	Perfumed cherry	
Sambucus racemosa	European red elder	often misidentified/substituted for S. pubens
Tilia cordata	European linden	
Trapa natans	Water-chestnut	invasive in New York and New England waterways
Typha spp.	Exotic cattail species	being sold by nurseries in northeast U.S.
Viola odorata	Sweet violet	very aggressive garden plant, many Viola spp. are difficult to identify accurately, leading to misidentification.

* hardy native species that can become invasive given certain conditions

Four:
Control Methods for Some Priority Species in Southern Ontario

Compiled by Tove Christensen and Silvia Strobl

Species	Habitat	Reproduction and Dispersal	Recommended Method of Control
Buckthorns, Common and Glossy (Rhamnus cathartica, R. frangula)	• Open areas, disturbed forest edges, ravines, forests, wetlands • Will germinate in full sun or shade • Shade tolerant under forest canopy • Needs light to be released into canopy	• Prolific seed production, seed dispersed by birds • Produces seed at very young age • Root suckers, resprouts vigorously from cut stumps • Able to form persistent seed bank	• Best achieved by cutting after peak flowering (May-July) followed by selective glyphosate treatment (30% solution) to either cut stumps (immediately after cutting) or resprouts (approx. 6 weeks after cutting) with a wick applicator • Basal bark application with 8% triclopyr
Canada Thistle (Cirsium arvense)	• Cultivated fields, pastures, roadsides, disturbed sites, forest openings, shorelines, savannahs, prairies • Grows best in open, disturbed sunny sites on well-drained, deep moist loamy clay soils	• Reproduces primarily by vegetative growth of root system • Vertical roots can grow as deep as 6.8 m, horizontal roots can spread as much as 6 m in one season, patches can spread 1-2 m/year. Readily propagates from stem and root fragments. • Produces seed, almost exclusively insect pollinated	• Should be targeted at killing established clones, prevention of seed set is a secondary consideration • Often necessary to use two or more methods of control at a given site • Late spring burning can be highly effective, although it may be necessary to continue for several years • Repeated mowing, continued over several years can be effective • Can be difficult to eradicate with glyphosate because of deep root system
Dog-strangling Vines (or Swallow-worts) (Cynanchum rossicum, C. nigrum)	• Fields, hydro corridors, disturbed forest edges, ravines • Not tolerant of heavy shade	• Prolific seed production, seed wind-dispersed over long-distances • Able to regenerate from root crown pieces	• Light infestations can be controlled by removing plants, including root systems • Larger infestations can be controlled by applying glyphosate twice during the growing season, at the onset of flowering and 2 to 3 weeks later; re-treatments will be required for 2-3 years to eliminate surviving plants and new seedlings • Mowing/cutting and burning are ineffective

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– Plant Conservation Alliance (Washington, D.C.) - www.nps.gov/plants/alien
– U.S. Nature Conservancy – tncweeds.ucdavis.edu/tncweeds

Species	Habitat	Reproduction and Dispersal	Recommended Method of Control
Garlic Mustard (Alliaria petiolata)	• River floodplains, forests, roadsides, wooded edges and forest openings • Tolerates full sun to full shade, prefers partial canopy • One of a few exotic herbs that dominates the understoreys of forested areas	• Biennial, a rosette of leaves formed during first half of a two-year cycle • In second spring, rosettes develop rapidly into mature plants that flower, produce seed and die by late June • A single plant can produce thousands of seeds that scatter as much as several meters from the parent plant • Long-distance dispersal is most likely aided by humans and wildlife (e.g., deer) • Spreads rapidly, can displace native plants within 10 years of becoming established	• Should be targeted at preventing seed production • 2-5 years of treatments will be necessary to deplete seed banks • Small, young infestations and/or isolated populations can be controlled by cutting flowering stems at ground level to prevent seed production • Glyphosate provides effective control of heavy infestations when applied in mid-spring; in the fall and early spring glyphosate can be applied to rosettes, provided temperature is above 10° C • Burning stimulates germination of stored seeds and seedling growth, and must be conducted annually for 3 to 5 years to achieve effective control • Four beetles are currently being investigated as biocontrols, may be available within 5 or 6 years
Himalayan Balsam (Impatiens glandulifera)	• Moist riverbanks, damp woods	• Annual, single plant can produce up to 800 seeds, which are explosively released several metres from adult plant • Seeds can survive long periods in water, and can float downstream to invade new areas	• Can be controlled by removing plants or cutting stems before seed dispersal, or by treating foliage with 2-3% glyphosate
Honeysuckles (Exotic) (Lonicera tartarica, L. mackii, L. morrowii, L. bella)	• Disturbed successional communities, wetlands, woodland edges, woodlands • Moderately shade tolerant, canopy gaps	• Prolific seed production, berries highly attractive to birds, which disseminate seeds widely across the landscape • Sprouting occurs in established populations	• In less shaded forest habitat, where plants are less resilient, repeated cutting to ground level (at least once annually) may result in high mortality • Well-established stands can be treated by cutting stems to ground level and applying a 25% solution of glyphosate

Species	Habitat	Reproduction and Dispersal	Recommended Method of Control
Japanese Knotweed (Polygonum cuspidatum)	• Damp to dry soils, along streams and rivers, in low-lying areas, waste places, old homesteads • Found primarily in moist, unshaded habitats • Does not appear to invade forest understories	• In North America, seeds do not appear to be a significant mode of reproduction • Mainly reproduce through extensive rhizomes that reach 15-20 m in length • Rhizome fragments are washed downstream or transported in fill • Rhizomes can regenerate from small fragments and when buried up to 1 m deep	• Digging is not recommended because it tends to spread rhizome fragments • Most effective method of treatment is cutting stems 2-3 times/season, followed by foliar applications of 2% glyphosate in the fall and following spring • Repeated stem cutting may be effective
Kentucky Bluegrass (Poa pratensis)	• Meadows, open woodlands, disturbed sites • Favours moist conditions, avoids acid soils and heavy shade	• Reproduces by seed and rhizomes • Germination primarily occurs in early spring, but can also occur in early autumn if soil moisture is adequate • Readily expands population base vegetatively and aggressively; sod-forming	• Spring burning is the most widely used tool to control cool season grasses, however, it may be necessary to burn annually for several years • Burning most likely to be effective at "boot" stage, when flowering head still enclosed in sheath • Glyphosate has been effectively used to shift dominance from exotic to native grasses
Purple Loosestrife (Lythrum salicaria)	• Wetlands, stream and river banks, lakeshores, ditches and other disturbed wet areas	• Perennial, single plant can produce hundreds of thousands of seeds, seeds have high viability; rapid buildup of seedlings possible • Dispersal mainly by wind, but seeds also transported on feet of waterfowl and other wetland animals, also dispersed by water currents • Can spread vegetatively by resprouting from cut stems and regeneration from pieces of root stock	• Small populations and isolated stems can be removed by hand; entire rootstock must be pulled out • Most commonly controlled with glyphosate, (check re: brand approval for use over water); treatment should occur after peak blooming period (July-August) • University of Guelph, Ontario is investigating the potential of three European beetles as control agents; results have been impressive to date
Siberian Elm (Ulmus pumila)	• Disturbed woods, roadsides, pastures, alongside streams • Tolerant of poor soils and low moisture	• Produces 1-seeded samaras that are wind dispersed • Seeds germinate readily and seedlings grow rapidly, forms thickets of hundreds of seedlings in bare ground	• Small trees can be removed with a grub hoe or weed wrench • Can be killed by girdling in late spring to mid-summer when bark peels away easily from sapwood • Can also be controlled using cut stem applications of 20% glyphosate in the fall

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