# TRCA's Invasive Species Management Strategy and Prioritization Framework

Presented by: Karen McDonald, Senior Manager, Ecosystem Management
Namrata Shrestha, Senior Research Scientist, Ecosystem and Climate Science

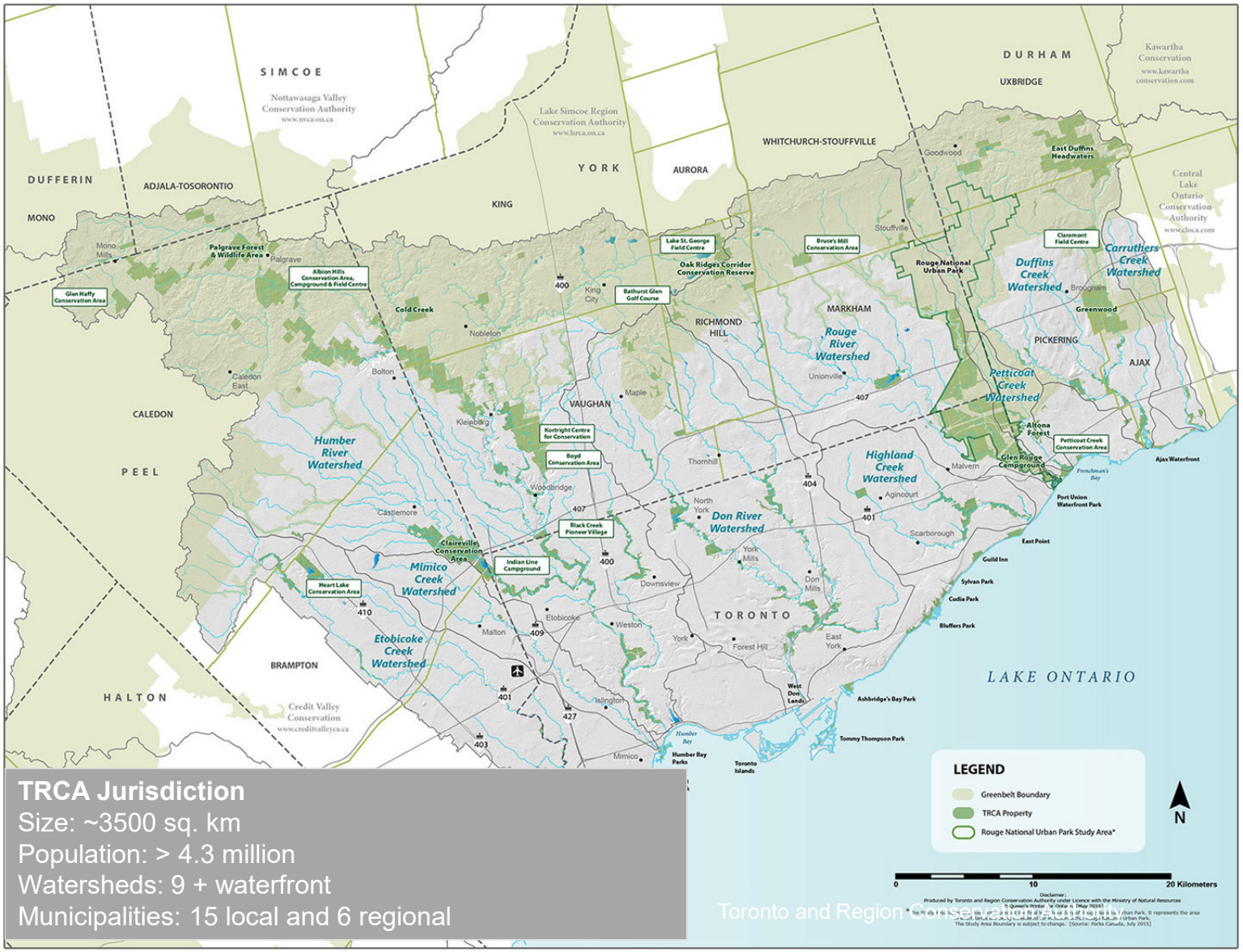
January 12, 2021

Toronto and Region Conservation Authority

# Presentation Outline

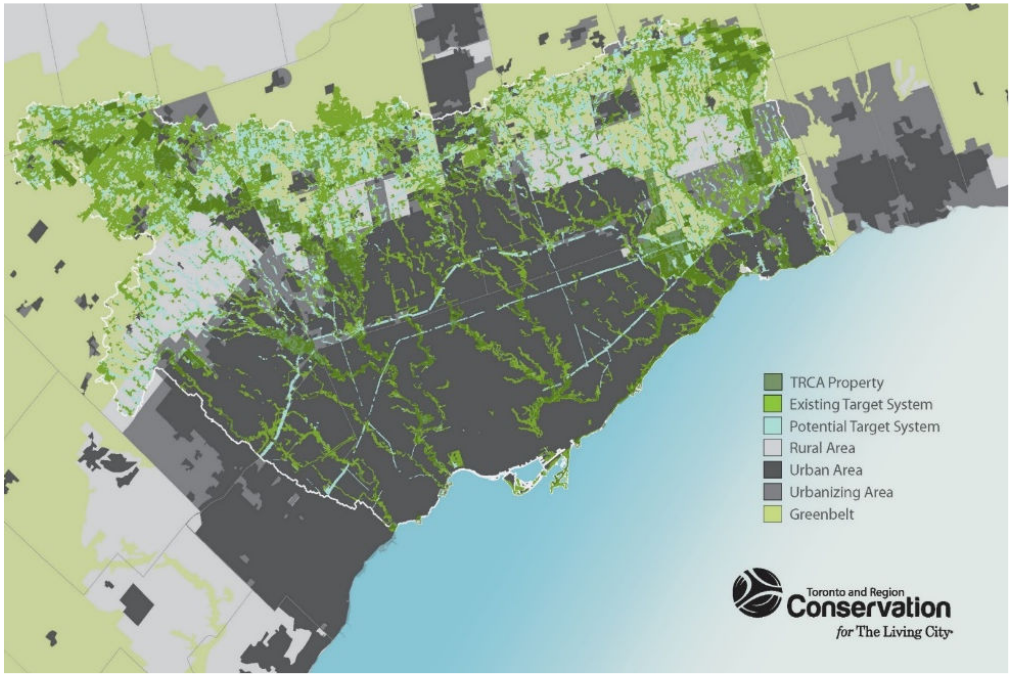
1. A bit about TRCA…
2. The urban context
3. ISMS Goal and Objectives
4. Actions and Success Criteria
5. Prioritization Framework
6. Wrap-up

*The information contained in this presentation is copyright © Toronto and Region Conservation Authority*




**TRCA Jurisdiction**
Size: ~3500 sq. km
Population: > 4.3 million
Watersheds: 9 + waterfront
Municipalities: 15 local and 6 regional

# Invasives Species & the Urban Context



# Invasives Species & the Urban Context

# Goal

To **protect** and, where possible, **enhance** terrestrial and aquatic **ecosystem function and services** on TRCA-owned lands and other public lands to ensure **ecosystem health and community well-being**.

# Objectives

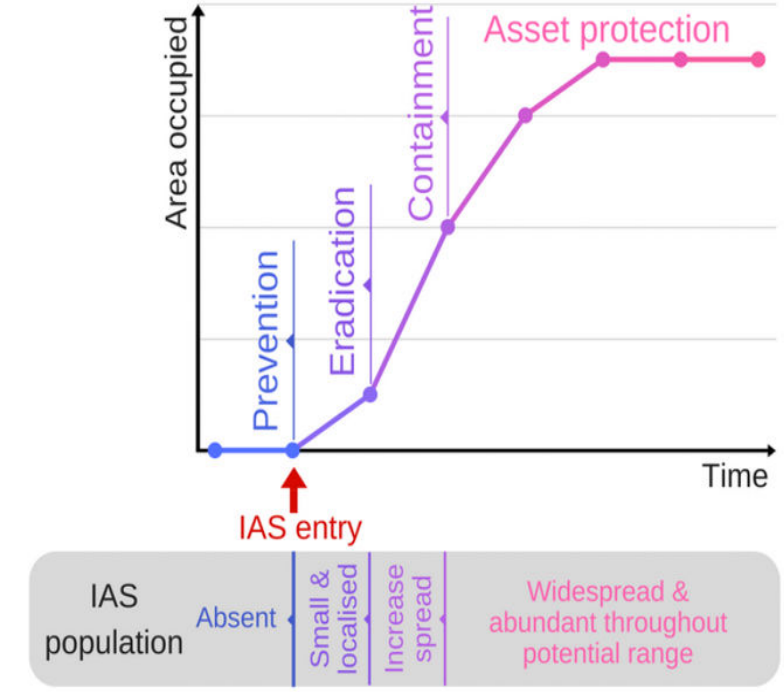
1. **Prevention, early detection, and rapid response**
2. **Eradication, containment, and control**
3. **Protection of high priority areas**
4. **Coordination, knowledge transfer and building awareness**

| Objective | Action | Success Criteria |
| --- | --- | --- |
| Eradication, Containment, and Control | *Action 5*: Undertake strategic and targeted management of established *high priority invasive species* with other agencies and partners to eradicate, contain, and/or control in natural areas owned and/or managed by TRCA, as appropriate. | c) Decrease in IAS richness and extent within the properties owned and/or managed by TRCA. |

# IAS MANAGEMENT PRIORITIZATION

# Why Prioritization?

- IAS impact biodiversity, ecosystem services and human well-bein
- Urban and near urban areas have high levels of IAS
  - Disturbance
  - Dispersal pathways and vectors
  - Foci for IAS introductions
  - High rates of propagule pressure
  - Micro-climatic conditions
- Management is challenging
  - Widespread IAS
  - Limited resources, competing priorities etc
  - Need to be strategic



# Approach

in partnership with Mitacs Inc. and U of T Scarborough (Prof. Marc Cadotte and Dr. Luke Potgieter)

- Literature review
- Two-pronged approach
  1. Species based
  2. Area based
- Analysis
- Stakeholder input

# Literature Review

## A conceptual framework for prioritization of invasive alien species for management according to their impact

Sabrina Kumschick[1], Sven Bacher[2], Wayne Dawson[3], Jaakko Heikkilä[4], Agnieszka Sendek[5], Therese Pluess[2], Tamara B. Robinson[1], Ingolf Kühn[5]

*Invasive Plant Science and Management* 2013 6:339–351

## Prioritizing Invasive Plant Management with Multi-Criteria Decision Analysis

Matthew G. Hohmann, Michael G. Just, Peter J. Frank, Wade A. Wall, and Janet B. Gray*

**Working for Water** South African Journal of Science **100**, January/February 2004 53

## A proposed classification of invasive alien plant species in South Africa: towards prioritizing species and areas for management action

J.L. Nel[a,*], D.M. Richardson[b], M. Rouget[b], T.N. Mgidi[a], N. Mdzeke[a], D.C. Le Maitre[a], B.W. van Wilgen[a], L.Schonegevel[a], L. Henderson[c] and S. Neser[b]

## A proposed prioritization system for the management of invasive alien plants in South Africa

**M.P. Robertson[a,b*], M.H. Villet[b], D.H.K. Fairbanks[c], L. Henderson[d], S.I. Higgins[e], J.H. Hoffmann[f], D.C. Le Maitre[g], A.R. Palmer[a], I. Riggs[h], C.M. Shackleton[i] and H.G. Zimmermann[j]**

## Prioritizing Invasive Species Management by Optimizing Production of Ecosystem Service Benefits

Contractor and Cooperator Report No. 44
July 2008

By Lisa A. Wainger, Dennis M. King, Richard N. Mack, Elizabeth W. Price, and Thomas Maslin

## The EPPO prioritization process for invasive alien plants

S. Brunel[1], E. Branquart[2], G. Fried[3], J. van Valkenburg[4], G. Brundu[5], U. Starfinger[6], S. Buholzer[7], A. Uludag[8], M. Joseffson[9] and R. Baker[10]

[1]*OEPP/EPPO, 21 Bld Richard Lenoir, 75011 Paris, France; e-mail: brunel@eppo.fr*

[2]*Belgian Biodiversity Platform, Centre de recherche de la Nature, des Fôrets et du Bois, Avenue Marechal Juin 23, B-5030 Gembloux, Belgium*

# Literature Review Findings

- Most frameworks designed for use in natural areas and criteria may not be applicable
- Most frameworks exclusively focus on negative impacts
- There are differences in spatial scale of assessments (e.g. many at national scale)
- Recognition that there is more complexity in IAS management in urban areas including incorporation of stakeholder interests and ecosystem services that IAS may be providing

Provided guidance to developing

TRCA IAS Management Prioritization Framework

# ANALYSIS AND RESULTS

# Analysis and Results

**Two-pronged approach**

1. Species based approach focuses on identifying priority IAS based on best available information from science and practice
2. Area based approach focus on identifying strategic areas for IAS management, mainly to protect valued “assets”

**Data driven and expert input**

# Species Based Approach

***1. Develop Prioritization Framework (Plants)***

- Based on Robertson et al. (2003) framework that have been used globally
- Objectively assess 46 criteria, grouped into 8 broad modules reflecting
    1. Assess invasion status
    2. Habitat requirements,
    3. Biological characteristics
    4. Dispersal ability
    5. Distribution
    6. Negative impacts
    7. Positive impacts, and
    8. Potential for control for each IAS
- Score each criteria with a criteria score and a confidence score based on literature
- Product of the criteria score and confidence score determines priority score for each IAS

# Species Based Approach

***2. Develop Candidate IAS List***

- Based on IAS occurrence information from TRCA biological inventory data and other available plant lists (e.g. ROM, Rouge Park, Cadotte Lab research etc.)
- Additional IAS of concern provided by stakeholders through a technical workshop
- Candidate IAS List included highest occurring plant IAS + stakeholder identified IAS (Tot. = 50)

***3. Score and Rank***

- Criterion score and confidence score was assigned to candidate IAS
- Criterion Score x Confidence Score = Priority Score

4. ***Stakeholder Consultation***

- Targeted stakeholder consultation with 20+ experts provided guidance to refine the method
- Identified as next steps as TRCA refines the list

| Modules | Criteria | Weighting | Criterion Scores | Confidence Scores |
|---|---|---|---|---|
| **Invasion Status (2)** | • Invasive elsewhere (Yes or No)<br>• Closely related to invasive taxon (Yes or No) | 1 – 0<br>1 – 0 | 1<br>0 | 0,5<br>1 |
| **Habitat Requirements (3)** | • Germination requirements<br>• Seedling/propagule establishment requirements<br>• How much disturbance is required for seedling establishment to occur? | | | |

| | A | B | C | D |
|---|---|---|---|---|
| 1 | **Modules and criteria** | | **Criterion scores** | **Confidence scores** |
| 2 | **MODULE A: INVASION STATUS** | | | |
| 3 | **Invasive elsewhere** | | | |
| 4 | The species is invasive elsewhere, outside of Canada? | | | |
| 5 | Yes | [1] | 1 | 1,0 |
| 6 | No | [0] | | |
| 7 | **Closely related to invasive taxon** | | | |
| 8 | The species is closely related to an invasive taxon: | | | |
| 9 | Yes | [1] | 1 | 1,0 |
| 10 | No | [0] | | |
| 11 | **MODULE B: HABITAT REQUIREMENTS** | | | |
| 12 | **Germination requirements** | | | |
| 13 | Requires specific environmental factors that are not part of an annual cycle to germinate (e.g. specific temperatures or human-mediated disturbance) | [0] | | |
| 14 | Requires unseasonal or uncommon natural events for germination (e.g. flooding) | [1] | | |
| 15 | Requires natural seasonal disturbances such as seasonal rainfall, spring/summer temperatures for germination | [2] | | |
| 16 | Opportunistic germinator, can germinate or strike/set root at any time whenever water is available | [3] | 3 | 1,0 |
| 17 | **Seedling/propagule establishment requirements (i.e. light, water, nutrients)?** | | | |
| 249 | | | | |
| 250 | INVASION STATUS | | 1,0000 | 1,0000 |
| 251 | HABITAT REQUIREMENTS | | 3,0000 | 1,0000 |
| 252 | BIOLOGICAL CHARACTERISTICS | | 2,5000 | 1,0000 |
| 253 | DISPERSAL ABILITY | | 3,0000 | 1,0000 |
| 254 | DISTRIBUTION | | 3,0000 | 1,0000 |
| 255 | NEGATIVE IMPACTS | | 0,8571 | 0,7857 |
| 256 | POSITIVE IMPACTS | | 2,2105 | 0,6579 |
| 257 | POTENTIAL FOR CONTROL | | 1,5000 | 1,0000 |
| 258 | **Total** | | **17,1** | **7,4** |

| Rank | Species | Common name | Total Criteria Score (Max = 21) | Total Confidence Score (Max = 8) | Final Score (Crit x Conf) |
|---|---|---|---|---|---|
| 1 | Vincetoxicum rossicum | Dog Strangling Vine | 6,51 | 7,44 | 48,48 |
| 2 | Convolvulus arvensis | Field Bindweed | 6,06 | 7,30 | 44,21 |
| 3 | Taraxacum officinale | Common Dandelion | 6,15 | 7,18 | 44,16 |
| 4 | Lonicera tatarica | Tatarian Honeysuckle | 5,85 | 7,42 | 43,47 |
| 5 | Solanum dulcamara | Bittersweet Nightshade | 5,96 | 7,22 | 43,03 |
| 6 | Ligustrum vulgare | European Privet | 5,89 | 7,24 | 42,68 |
| 7 | Rhamnus cathartica | Common Buckthorn | 6,03 | 6,97 | 42,01 |
| 8 | Echium vulgare | Common Viper's Bugloss | 5,39 | 7,60 | 40,98 |
| 9 | Celastrus orbiculatus | Oriental Bittersweet | 5,70 | 7,18 | 40,96 |
| 10 | Rosa multiflora | Multiflora Rose | 5,86 | 6,96 | 40,74 |
| 11 | Impatiens glandulifera | Himalayan balsam | 5,33 | 7,46 | 39,75 |
| 12 | Phragmites australis | Phragmites | 5,37 | 7,39 | 39,66 |
| 13 | Cirsium arvense | Creeping Thistle | 5,99 | 6,55 | 39,24 |
| 14 | Vinca minor | Periwinkle | 5,32 | 7,34 | 39,06 |
| 15 | Elaeagnus angustifolia | Russian Olive | 5,32 | 7,27 | 38,67 |
| 16 | Reynoutria japonica | Japanese Knotweed | 5,73 | 6,74 | 38,65 |
| 17 | Acer platanoides | Norway Maple | 5,63 | 6,76 | 38,07 |
| 18 | Elaeagnus umbellata | Autumn olive | 5,44 | 6,99 | 38,02 |
| 19 | Barbarea vulgaris | Bitter Wintercress | 5,04 | 7,50 | 37,80 |
| 20 | Rumex crispus | Curly Dock | 5,58 | 6,75 | 37,66 |
| 21 | Alliaria petiolata | Garlic Mustard | 5,54 | 6,79 | 37,61 |
| 22 | Potentilla recta | Sulphur Cinquefoil | 5,61 | 6,67 | 37,44 |
| 23 | Phleum pratense | Common Timothy | 4,91 | 7,61 | 37,36 |
| 27 | Tussilago farfara | Colt's-foot | 5,15 | 7,11 | 36,60 |
| 28 | Torilis japonica | Erect Hedge-parsley | 4,97 | 7,34 | 36,47 |
| 29 | Elymus repens | Creeping Wildrye | 5,32 | 6,72 | 35,78 |
| 30 | Lythrum salicaria | Purple Loosestrife | 5,43 | 6,56 | 35,59 |
| 31 | Vicia cracca | Tufted Vetch | 5,35 | 6,61 | 35,38 |
| 32 | Dactylis glomerata | Orchard Grass | 4,64 | 7,61 | 35,29 |
| 33 | Pastinaca sativa | Wild Parsnip | 4,80 | 7,33 | 35,16 |
| 34 | Trifolium repens | White Clover | 5,13 | 6,68 | 34,30 |
| 35 | Linaria vulgaris | Butter-and-eggs | 5,08 | 6,69 | 34,01 |
| 36 | Campanula rapunculoides | Creeping Bellflower | 4,71 | 7,18 | 33,80 |
| 37 | Convallaria majalis | European Lily-of-the-valley | 4,51 | 7,46 | 33,66 |
| 38 | Daucus carota | Wild Carrot | 4,76 | 6,97 | 33,15 |
| 39 | Trifolium pratense | Red Clover | 5,38 | 6,12 | 32,92 |
| 40 | Cichorium intybus | Chicory | 5,65 | 5,63 | 31,85 |
| 41 | Ranunculus acris | Tall Buttercup | 4,81 | 6,54 | 31,46 |
| 42 | Verbascum thapsus | Common Mullein | 4,54 | 6,91 | 31,35 |
| 43 | Robinia pseudoacacia | Black Locust | 4,50 | 6,86 | 30,89 |
| 44 | Hesperis matronalis | Dame's Rocket | 4,38 | 6,98 | 30,61 |
| 45 | Epipactis helleborine | Eastern Helleborine | 4,97 | 6,01 | 29,87 |
| 46 | Glechoma hederacea | Ground Ivy | 4,20 | 7,07 | 29,69 |
| 47 | Cirsium vulgare | Bull Thistle | 4,63 | 6,26 | 29,01 |
| 48 | Aegopodium podagraria | Goutweed | 4,21 | 6,69 | 28,15 |
| 49 | Chelidonium majus | Celandine | 4,58 | 5,96 | 27,29 |
| 50 | Leonurus cardiaca | Common Motherwort | 4,56 | 4,78 | 21,82 |

Further refinement in-progress with input from experts and stakeholders

**Table 2.** Other priority and emerging invasive alien plant species identified through expert assessments.
Native species perceived as important potential replacement species were also provided by expert stakeholders.

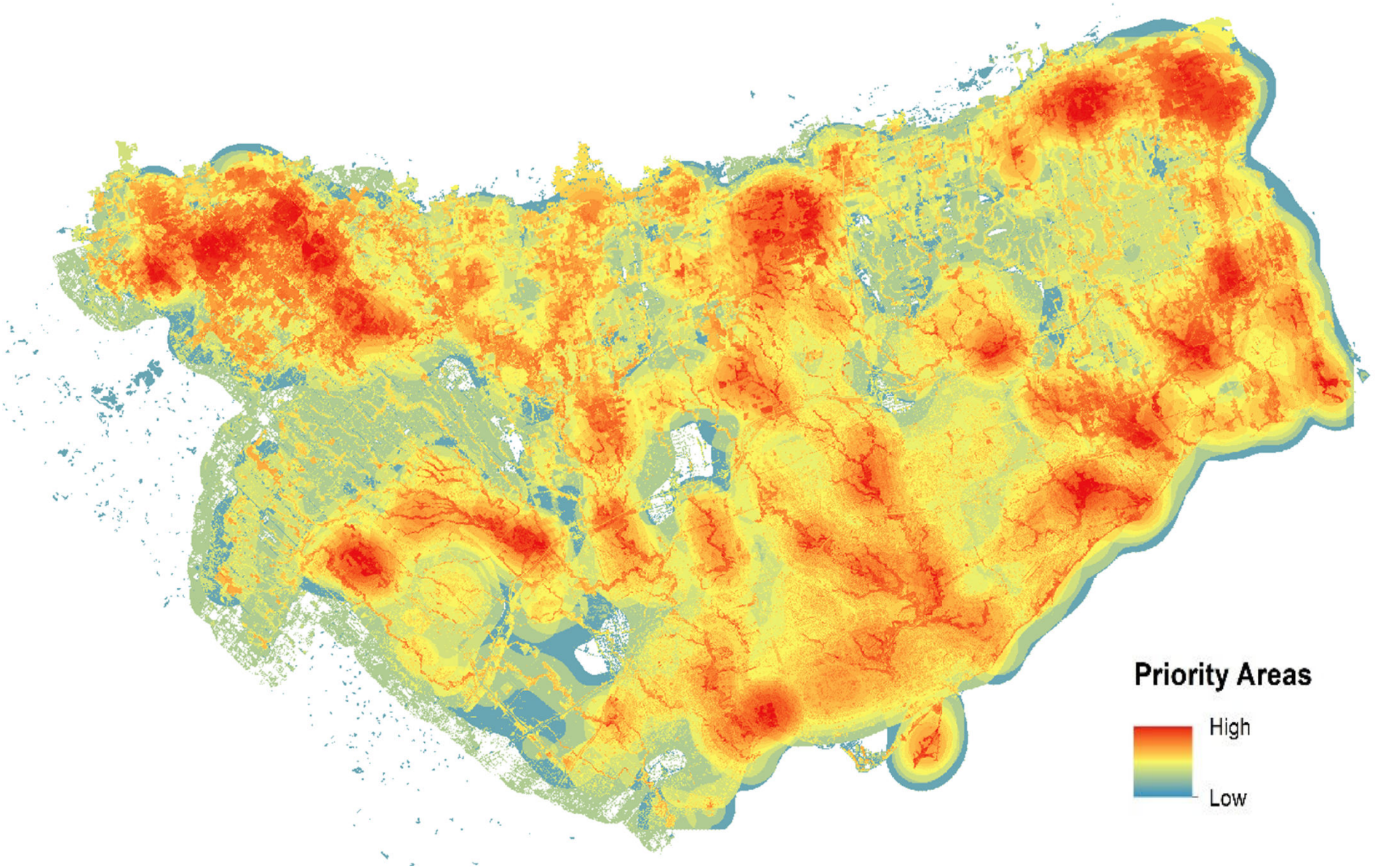
| Scientific Name | Common Name |
|---|---|
| **Other Priority Species** | |
| **Ailanthus altissima** | Tree of Heaven |
| **Alnus glutinosa** | Black Alder |
| **Betula pendula** | Silver Birch |
| **Euphorbia esula** | Leafy Spurge |
| **Frangula alnus** | Alder Buckthorn |
| **Hedera helix** | English Ivy |
| **Heracleum mantegazzianum** | Giant Hogweed |
| **Morus alba** | White Mulberry |
| **Salix alba** | White Willow |
| **Securigera varia** | Crownvetch |
| **Ulmus pumila** | Siberian Elm |
| **Emerging Species** | |
| **Achyranthes japonica** | Japanese Chaf Flower |
| **Berberis thunbergii** | Japanese Barberry |
| **Euonymus alatus** | Burning Bush |
| **Hippophae rhamnoides** | Seaberry |
| **Houttuynia cordata** | Chameleon Plant |
| **Melilotus officinalis** | Yellow Sweet Clover |
| **Microstegium vimineum** | Japanese Stilt Grass |
| **Miscanthus sinensis** | Miscanthus |
| **Pyrus calleryana** | Callery Pear |
| **Native Species** | |
| **Cornus alternifolia** | Alternate-leaved Dogwood |
| **Cornus sp.** | Dogwood |
| **Hamamelis virginiana** | Witch Hazel |
| **Maianthemum canadense** | Canada Mayflower |
| **Maianthemum stellatum** | Starry Solomon's Seal |
| **Rhus aromatica** | Fragrant Sumac |
| **Rosa carolina** | Carolina Rose |
| **Rosa setigera** | Climbing Prairie Rose |
| **Tiarella cordifolia** | Foam Flower |
| **Typha sp.** | Cattail |
| **Viburnum lentago** | Nannyberry |

# Area Based Approach

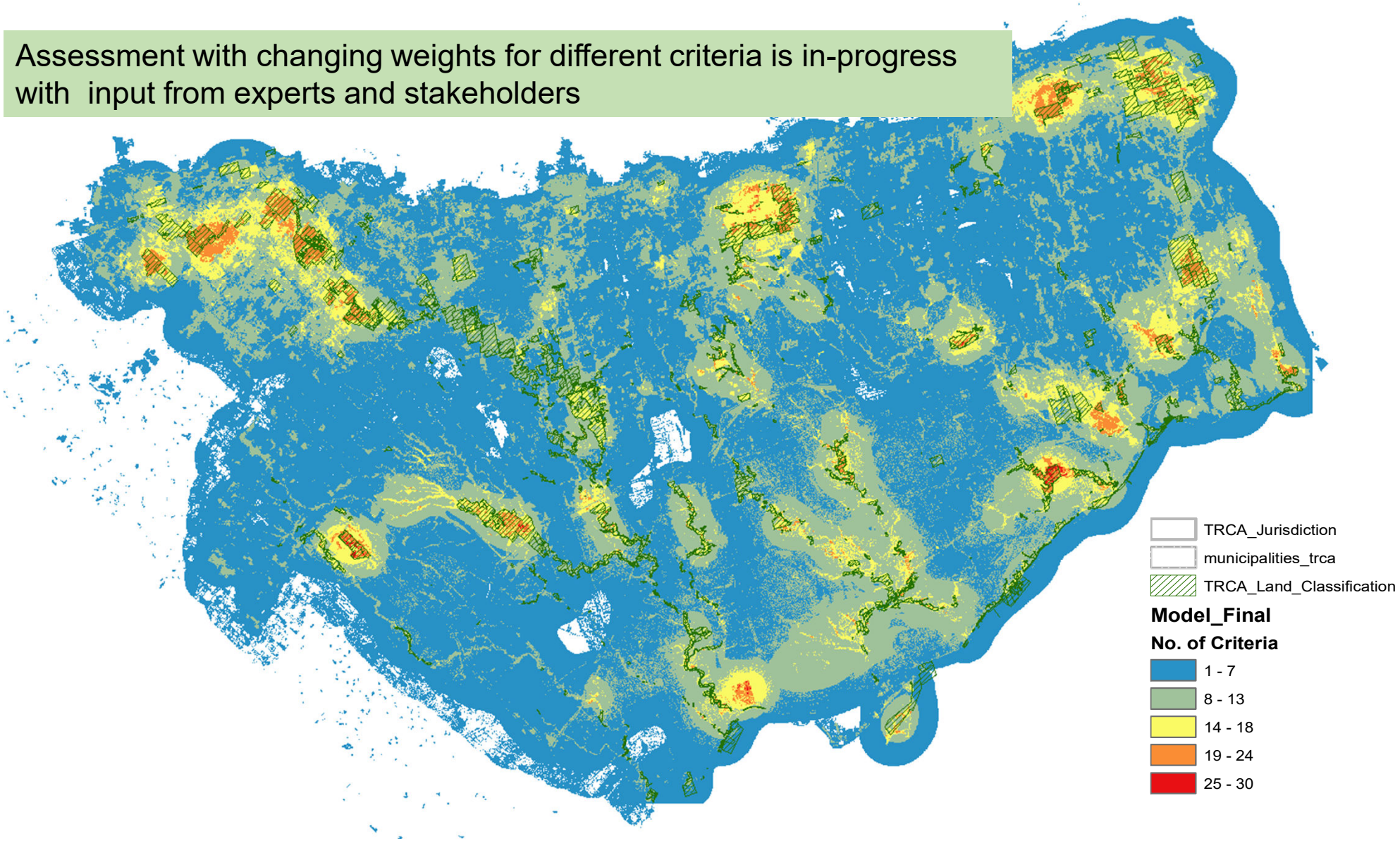
- Focus on protecting ecosystem functions and services from impacts of IAS
- Objectively assessed 2 broad groups of criteria representing
    - Biodiversity and ecosystem functions and
    - Other ecosystem services (MEA 2005)
- Multi-criteria analysis of the total of 30 sub-criteria classified into 5 classes within the 2 groups
- Overlay of all criteria in a raster analysis (equal weighted)

| Level 1 Criteria | Level 2 Criteria | Level 3 Criteria |
|---|---|---|
| **Biodiversity and Ecosystem Function** | Habitat | High quality habitat patch |
| | | Interior habitat |
| | | Natural Heritage System |
| | | Ecologically Significant Areas |
| | | Provincially Significant Wetlands |
| | | Areas of Natural and Scientific Interest |
| | | Restored habitat or planned restoration sites |
| | | Plantations |
| | Biodiversity | Fauna Species of Concern |
| | | Flora Species of Concern |
| | | ELC Vegetation Communities of Concern |
| **Ecosystem services** | Cultural | Education |
| | | Recreation |
| | | Heritage |
| | Provisioning | Food/timber |
| | | Water |
| | Regulating | Pollination |
| | | Carbon sequestration and storage |
| | | Local climate and air quality |

| Goal: To protect natural ecosystems and the services they deliver through the reduction and containment of priority invasive alien plant species. | | | | |
|---|---|---|---|---|
| **Level 1 Criteria** | **Level 2 Criteria** | **Level 3 Criteria** | **Spatial Data** | **Data source** |
| **Biodiversity and ecosystem functioning** | Habitat | High quality habitat patch | *TRCA habitat patch; *LAM scores and ranks | TRCA |
| | | Interior habitat | TRCA natural cover | TRCA |
| | | Natural Heritage System | TRCA Target Natural Heritage System; Natural Heritage System | TRCA, municipal |
| | | Ecologically Significant Areas | Environmentally Significant Areas; York and Durham regional forests | Municipal |
| | | Provincially Significant Wetlands | Provincially Significant Wetlands | Ontario GeoHub |
| | | Areas of Natural and Scientific Interest | Areas of Natural and Scientific Interest | Ontario GeoHub |
| | | Restored habitat or planned restoration sites | | TRCA |
| | | Plantations | | TRCA |
| | Biodiversity | Fauna Species of Concern | TRCA field data | TRCA |
| | | Flora Species of Concern | TRCA field data | TRCA |
| | | *ELC Vegetation Communities of Concern | TRCA field data | TRCA |
| **Ecosystem services** | Cultural | Education | Schools; other education/support centres | Toronto Open Data Portal |
| | | Recreation | Parks, trails, municipal recreation shapefile | Toronto Open Data Portal; TRCA |
| | | Heritage | Public art and monuments, municipal heritage register | Toronto Open Data Portal; Durham open data portal; York open data portal |
| | Provisioning | Food/timber | Agriculture (Forest and Landcover); community farms | Toronto Open Data Portal; TRCA |
| | | Water | Watercourses, waterbodies | Toronto Open Data |


Priority Areas
High
Low

Assessment with changing weights for different criteria is in-progress with input from experts and stakeholders



# MOVING FORWARD…

# Next Steps

**TRCA Invasive Species Management Strategy**

- Facilitate implementation of ISM Strategy
- Build partnerships and collaborations for effective implementation

**Prioritization Framework**

- Complete broader consultation with internal and external stakeholder and partners
- Finalize TRCA's IAS Management Prioritization Framework
- Refine and finalize TRCA priority plant IAS list and priority areas for plant IAS management
- Expand assessment to incorporate climate lens to IAS management
    - Identification of emerging priority plant IAS
    - Identification of climate vulnerable areas for IAS management
- Expand the prioritization framework to include other IAS groups of concern (e.g. aquatic)

# Acknowledgement


- Region of Peel
- Durham Region
- York Region
- City of Toronto
- Mitacs Inc.
- University of Toronto
- Other partners who provided input

**Contact**:

Karen McDonald
Senior Manager, Ecosystem Management
Restoration and Resource Management | Restoration and Infrastructure
E: karen.mcdonald@trca.ca

Namrata Shrestha, Ph.D.
Senior Research Scientist, Ecosystem and Climate Science
Watershed Planning and Ecosystem Science | Development and Engineering Services
E: namrata.shrestha@trca.ca



Toronto and Region Conservation Authority