Distribution & Abundance of Non-Native Plants in Alberta

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INTRODUCTION

Non-native plants — plants that did not occur historically in Alberta — can damage Alberta's native ecosystems[1]. With their rapid growth and reproduction, some non-native plants may outcompete and displace native plants[2]. Although there are differences among ecosystems, invasive alien species — non-native species that have a tendency to spread — are often cited as one of the top three causes for biodiversity loss[3].

Non-native plants have been highlighted for management in Alberta[4], with particular attention placed on noxious weeds that are actively controlled[5]. However, the distribution and abundance of non-native plants are poorly understood. We describe how the richness (number of species detected per ha) of non-native plants varies throughout Alberta, and identify habitats where non-native plants are common. These results will help managers identify areas and habitats where special management of non-native plants may be required.

METHODS

We used data collected by the Alberta Biodiversity Monitoring Institute (ABMI) between 2003 and 2013 at 1,018 sites throughout Alberta (Figure 1). At each site, a 1-ha survey area was sub-divided into four 50x50m quadrants (0.25 ha). Trained observers searched each quadrant systematically and recorded the vascular plant species detected; searches were restricted to 20 minutes/quadrant, for a total of 80 minutes/site. Surveys were conducted between June 25 and August 3. Specimens that could not be identified by the field observer were collected and identified by plant experts at the Royal Alberta Museum. Survey sites included those from the ABMI province-wide sampling grid (ABMI sampled sites) and others chosen to obtain information about poorly sampled habitats (off-grid sampled sites) (Figure 1).

Within the 1-ha survey area at each site, the area of each native vegetation and human footprint type was quantified using remotely sensed information[6]. Landscape information was combined with field survey information to determine how richness of non-native plants varied among habitats and throughout Alberta. The analysis first determined how vegetation, soil, and human footprint types affected species richness, and then estimated additional effects of geographic location, climate and amount of human footprint within the surrounding quarter section area . Modeling was done separately for two regions, the forest (Boreal, Shield and Foothills) and prairies (Grassland, Parkland and Dry Mixedwood).

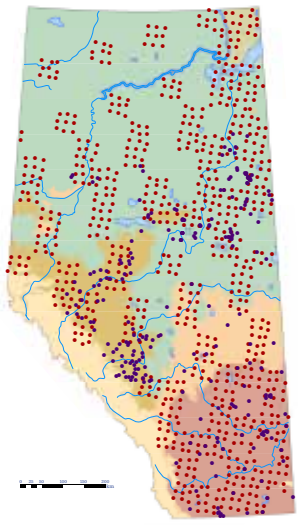


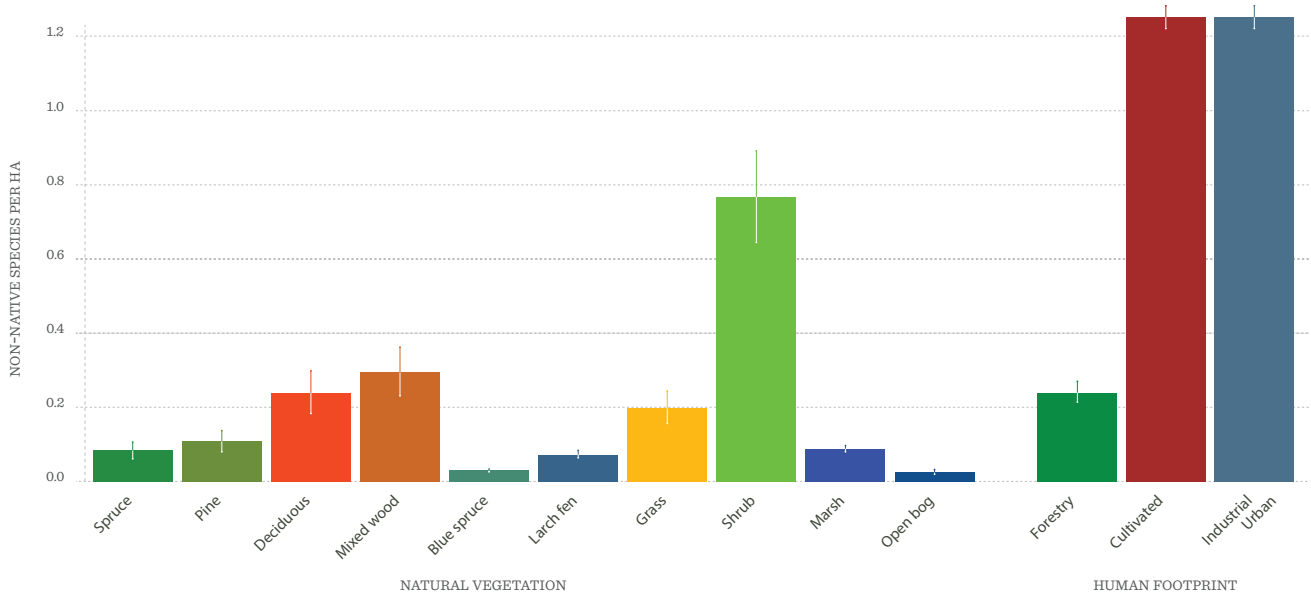
FIGURE 1.
Sites surveyed by ABMI for non-native plants.

1 Rangeland health assessment for grassland, forest and tame pasture. 2009. Alberta Sustainable Resource Development, Publication T044.
2 Dillemuth, P., E.A. Rietschier, J.T. Cronin. 2009. Patch dynamics of a native grass in relation to the spread of invasive smooth brome (*Bromus inermis*). Biological Invasions 11:1381-1391.
3 Clavero, M., L. Brotons, P. Pons, D. Sol. 2005. Prominent role of invasive species in avian biodiversity loss. Biological Conservation 142: 2043–2049.
4 Province of Alberta Weed Control Act, 2010, Alberta Queen's Printer.
5 Alberta Invasive Identification Guide, 2013, Wheatland County Alberta.
6 Unpublished GIS layer created by the Alberta Biodiversity Monitoring Institute by amalgamating information created by Government of Alberta, ABMI plus a variety of other organizations.
7 Alberta Biodiversity Monitoring Institute. 2014. Manual for species modeling and intactness. http://www.abmi.ca, publications page

RESULTS

55 non-native plant species were detected at more than 5% of the ABMI's sampling sites in one or both of the prairie and forest regions (Appendix 1). An additional 89 non-native plant species were detected less commonly. Only a few species were widespread in the forest, while many species were common in the prairies. Common Dandelion and Creeping Thistle were the two most common non-native plants detected.

FIGURE 2.
In the forest regions of Alberta, richness of non-native plants (number of species per ha with 90% confidence intervals) was highest in cultivated and industrial/urban areas. Areas with recent forest harvesting had more non-native species than did native upland spruce or pine stands, but similar levels as native deciduous and mixedwood stands. Among native vegetation, there were more non-native species in deciduous and mixedwood forest than in upland coniferous forests (spruce and pine), fewer in lowland forest (black spruce and larch fen) and wetlands, and much higher levels in shrub habitats.



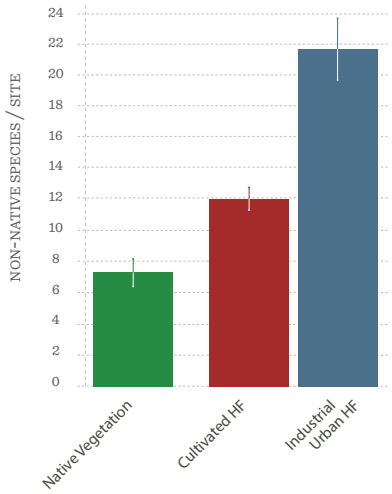


FIGURE 3.
In the Alberta prairies, richness of non-native plants (with 90% confidence intervals) was similar in native vegetation from all soil types (thus soil types were combined into the "native vegetation" category). There were more non-native plants in cultivated areas (which included tame pasture), and substantially more in areas with industrial or urban footprint than found in native habitats.

FIGURE 4.
Sites that have 10% soft linear footprint (road margins, pipelines, powerlines, seismic lines) had considerably more non-native plant species than sites with only native vegetation. The effect of adding soft linear features was greater in the forest (left) than in the prairies (right), possibly because more non-native species were already present in native prairies. Hard linear features (roads, railways) caused less of an increase in number of non-native species than did soft linear features.

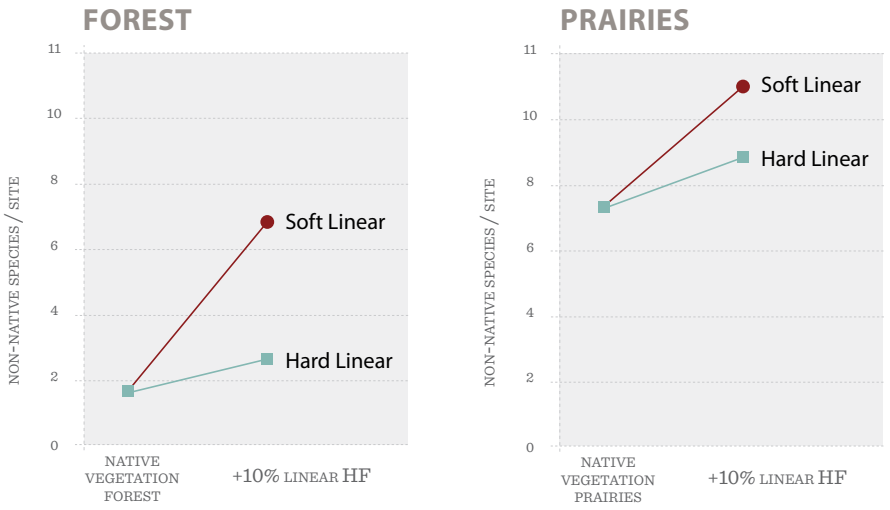
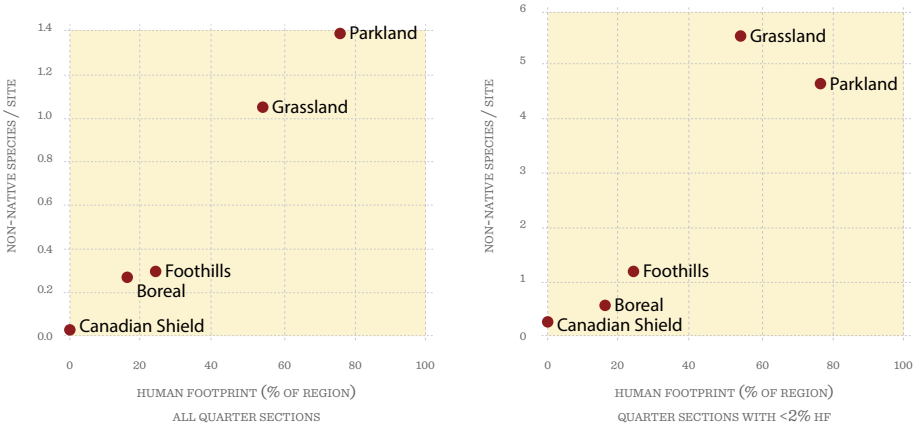


FIGURE 5.
Mean richness (number of species per ha) of non-native plants was highly correlated with the percentage of the natural region covered by human footprint (left figure). This result was not surprising given that most non-native plants occurred in human footprint. However, the correlation remained even when we looked at quarter-sections with low human footprint (right figure). This indicated that non-native plants have spread beyond areas directly affected by human footprint, especially in the highly developed prairie regions. Disturbance by grazing, which was not measured by ABMI, may have accounted for some of the higher richness of non-native plants in prairie regions with low amounts of mapped human footprint.



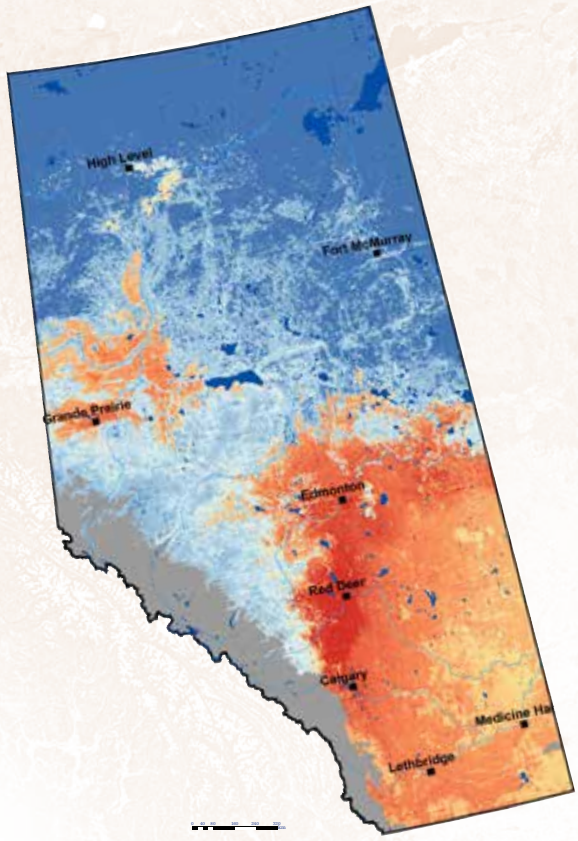


FIGURE 6.
By applying our analytical models of non-native plants to province-wide maps of vegetation and human footprint, we obtained the estimated richness of non-native plants throughout Alberta (blue=no non-native plants predicted through yellow to red=maximum predicted richness of non-native plants). Note that the models also evaluated spatial and climate gradients in richness of non-native plants. Although there was a gradient of increasing richness of non-native plants in the south of both the forested and prairie regions, that effect was small compared to the large effects of human footprint and the substantial differences among vegetation types.

CONCLUSIONS & INTERPRETATIONS

- Non-native plant species exist virtually everywhere throughout Alberta.
- Urban/industrial features, cultivated areas and vegetated linear features supported many different species of non-native plants and had relatively high richness of non-native plants.
- Non-native plants were more likely to be found in the prairie than in the forest regions—this was especially true for noxious weeds.
  - The higher occurrence of non-native plants in the prairies was probably due to abundant agriculture and other human footprints being present there for more than a century and non-native plants spreading beyond these human disturbances.
  - Non-native plants also may have been more prevalent in native vegetation in the prairies than in native forests due to cattle grazing on the prairies.
- Given the wide distribution for many non-native plant species, and their close association with human development, it will be difficult to slow their spread in areas with abundant human development.
- Environmental management, especially on the prairies, needs to acknowledge that all ecosystems contain many non-native plants—eradication of these is not feasible.
- It will be more effective to focus management activities of non-native plants within large tracts of undisturbed vegetation because small areas will be continually "invaded" from the perimeter.

		Occurrence (%)	
Common Name	**Scientific Name**	**Prairies**	**Forest**
Common Dandelion	*Taraxacum officinale*	85.0	35.8
Creeping Thistle	***Cirsium arvense***	62.5	10.9
Kentucky Bluegrass	*Poa pratensis*	45.5	21.1
Awnless Brome	*Bromus inermis*	46.6	11.3
Lamb's Quarters	*Chenopodium album*	46.6	4.0
Common Goat's Beard	*Tragopogon dubius*	47.4	0.3
Black Bindweed	*Fallopia convolvulus*	43.1	2.2
Stinkweed	*Thlaspi arvense*	39.5	5.0
Alfalfa	*Medicago sativa*	39.5	5.0
Flixweed	*Descurainia sophia*	41.9	2.2
Annual Hawk's Beard	*Crepis tectorum*	34.4	5.3
Timothy	*Phleum pratense*	17.8	15.0
Common Wheat	*Triticum aestivum*	29.6	1.1
Crested Wheat	*Agropyron cristatum*	30.4	0.2
Common Plantain	*Plantago major*	20.6	9.1
Quack Grass	*Elymus repens*	23.3	6.4
Alsike Clover	*Trifolium hybridum*	13.0	16.3
Wild Oat	*Avena fatua*	26.9	1.2
Argentine Canola	*Brassica napus*	24.9	1.7
Shepherd's Purse	*Capsella bursapastoris*	22.5	2.6
Common Pepperweed	*Lepidium densiflorum*	23.3	1.6
Yellow Sweet Clover	*Melilotus officinalis*	20.6	3.6
Perennial Sow Thistle	***Sonchus arvensis***	19.4	4.2
White Clover	*Trifolium repens*	11.5	9.9
Hemp Nettle	*Galeopsis tetrahit*	15.4	5.7
Summer Cypress	*Kochia scoparia*	20.9	
Common Knotweed	*Polygonum aviculare*	18.6	1.4
Curled Dock	*Rumex crispus*	18.2	0.8
Cultivated Barley	*Hordeum vulgare*	17.8	0.5
Prickly Lettuce	*Lactuca serriola*	17.8	
Red Root Pigweed	*Amaranthus retroflexus*	17.4	0.3
White Sweet-Clover	*Melilotus alba*	15.0	1.9
Wormseed Mustard	*Erysimum cheiranthoides*	12.3	2.5
Cleavers	*Galium aparine*	12.3	2.2
Hedge-nettle	*Stachys palustris*	10.7	3.6
Red Clover	*Trifolium pratense*	4.7	9.1
Pale Persicaria	*Persicaria lapathifolia*	11.9	0.5
Bluebur	*Lappula squarrosa*	10.7	1.1
Common Chickweed	*Stellaria media*	8.7	2.0
Prickly Russian Thistle	*Salsola tragus*	9.9	
Downy Chess	***Bromus tectorum***	9.5	0.3
Black Medick	*Medicago lupulina*	8.7	0.6
Reed Canary Grass	*Phalaris arundinacea*	7.5	1.7
Prickly Annual Sow Thistle	*Sonchus asper*	8.3	0.6
Green Buckwheat	*Fagopyrum tataricum*	8.3	0.6
Pineappleweed	*Matricaria discoidea*	5.9	2.3
Russian Pigweed	*Axyris amaranthoides*	7.5	0.5
Canola	*Brassica rapa*	7.1	0.8
Bladder Campion	***Silene latifolia***	6.3	1.2
Tall Buttercup	***Ranunculus acris***	3.2	4.2
Small Nightshade	*Solanum triflorum*	6.3	0.2
Field Dock	*Rumex pseudonatronatus*	6.3	0.2
Biennial Sagewort	*Artemisia biennis*	5.1	0.9
Eastern beebalm	*Monarda bradburniana*	5.5	0.5
Barnyard Grass	*Echinochloa crusgalli*	5.5	0.2

APPENDIX 1.

Percentage of systematic sites in the prairies and forest[a] at which each non-native plant species was detected. Only species that occurred at at least 5% of sites in one or both regions are shown. Noxious weeds (as classified by the Alberta Weed Control Act) are identified in bold. An additional 18 noxious species were detected at <5% of sites: scentless camomile(4.3% of prairie sites, 0.5% of forest), field bindweed (4.7% prairie), butter-and-eggs (3.6% prairie, 0.5% forest), common tansy (2.4% prairie, 0.6% forest), ox-eye daisy (1.2% prairie, 0.5% forest), creeping bellflower (1.6% prairie), leafy spurge (1.2% prairie), hound's tongue (1.2% prairie), Japanese brome (1.2% prairie), common burdock (1.2% prairie), common baby's breath (0.8% prairie, 0.2% forest), Dalmatian toadflax (0.4% prairie, 0.2% forest), downy burdock (0.4% prairie), purple loosestrife (0.4% prairie), sweet rocket (0.4% prairie), orange hawkweed (0.3% forest), yellow hawkweed (0.2% forest).

[a] Foothills, Shield, and Boreal natural regions were classified as forested; Grassland, Parkland, and Boreal Dry Mixedwood were classified as prairies.

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