Report on the 2016 Survey of Exotic Plants along Northwest Territories Highways

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March 2017

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1.0 Introduction

In August 2016 a survey of exotic vascular plants was conducted along Northwest Territories (NWT) highways. The results of this project provide a 10-year update on the status of vascular plants along NWT highways, following up on a similar 2006 survey (Oldham 2006). In 2016, 185 10 kilometer (km) long driving surveys were conducted along NWT territorial highways. A total of 5,319 km was driven in NWT in August 2016 surveying almost the entire distance of all of NWT's eight territorial highways for exotic plant species. In addition, 37 formal walking surveys were conducted, mainly at highway pull-offs. Exotic vascular plants were also documented in a variety of disturbed habitats at human settlements, territorial parks, railways, and areas adjacent to highways.

Exotic plants (also known as non-native, alien, or invasive) have spread into NWT through deliberate or accidental human assistance. Most exotic plant species are native to Eurasia though some have spread from other parts of North America. These plant species have entered and spread in NWT through a variety of means including vehicle traffic (e.g. seeds or plant parts on tires or elsewhere on vehicles), construction equipment, highway seeding, camping equipment, boats, though the horticultural trade, agriculture (e.g. as contaminants in seeds), and other means. Highways are excellent conduits for plant movement and species are dispersed along highway corridors by vehicle traffic, mowers, and snow plows. Exotic plants are of concern from a variety of perspectives such as economic (e.g. weeds of agricultural crops), aesthetic (e.g. changing the appearance of roadside vistas), biodiversity conservation (e.g. competition for native plants), and human safety (e.g. large mammals can be attracted to roadsides which can increase vehicle – animal collisions; some exotic plants are toxic to humans). Many exotic plant populations are small and localized in highly disturbed habitats and do not cause significant problems, other exotic plant species however can rapidly spread, reach high population densities and cause a variety of problems; this latter group of plants are often called invasive species.

The "NWT Species 2016-2020" report (Working Group on General Status of NWT Species 2016) identifies 134 vascular plant species which are considered "alien" in NWT (these species are generally referred to as "exotic" in this report). An alien species is defined as one that has been introduced to NWT as a result of human activities. Most exotic vascular plant species occurring in NWT have been introduced to North America from Eurasia but some are native to North America and have spread into NWT as a result of human activities. Table 1 lists the 134 alien NWT vascular plant species (Working Group on General Status of NWT Species 2016) plus six additional species that were either newly discovered in NWT in 2016 (n=4) or were not included in the "NWT Species 2016-2020" report but fit the definition of an alien species in NWT (n=2).

Of the 140 exotic (alien) plant species listed in Table 1, 73 were encountered during 2006 surveys and 73 were documented during 2016 surveys. Combining both years 88 exotic species, 63% of those known from NWT, were encountered. Thirteen exotic plant species not previously reported from NWT were found in 2006 and four were

found in 2016. This report focuses on the 88 exotic plant species which were encountered during the 2006 and 2016 NWT exotic plant surveys.

Table 1. Number of records for exotic plants documented during 2006 and 2016 NWT surveys (NWT rank is from Working Group on General Status of NWT Species 2016; origin is either North American (NA) or Eurasian (EA); * indicates a species not previously reported from NWT; species in yellow shading were only encountered in 2006, those in blue shading were only encountered in 2016, and those in green shading were encountered in both years).

scientific name	English name	NWT rank	origin	2006	2016
Acer negundo	Manitoba Maple	Alien	NA	0	1
Achillea ptarmica	Pearl Yarrow	Alien	EA	0	0
Agropyron cristatum	Crested Wheat Grass	Alien	EA	9	4
Agropyron fragile	Siberian Wheat Grass	Alien	EA	0	0
Agrostis gigantea	Black Bentgrass	Alien	NA	11	8
Agrostis stolonifera	Spreading Bentgrass	Alien	EA	1	0
Allium fistulosum	Welsh Onion	Alien	EA	0	0
Alopecurus arundinaceus	Creeping Meadow-foxtail	Alien	EA	2	4
Alopecurus pratensis	Field Meadow-foxtail	Alien	EA	12	23
Amaranthus retroflexus	Green Amaranth	Alien	NA	0	0
Ambrosia artemisiifolia	Annual Ragweed	Alien	NA	0	0
Arctium tomentosum	Wooly Burdock	not included	EA	0	1*
Artemisia biennis	Biennial Sagebrush	Alien	NA	48	80
Atriplex hortensis	Garden Orache	Alien	EA	0	0
Atriplex patula	Spreading Orache	Alien	EA	0	0
Avena fatua	Wild Oats	Alien	EA	0	1
Avena sativa	Cultivated Oats	Alien	EA	0	0
Axyris amaranthoides	Russian Pigweed	Alien	NA	0	0
Bassia scoparia	Mexican Summer-cypress	Alien	NA	1*	0
Bellis perennis	English Daisy	Alien	EA	1*	1
Berteroa incana	Hoary False-alyssum	Alien	EA	1*	0
Brassica juncea	Chinese Mustard	Alien	EA	0	0
Brassica napus	Turnip	Alien	EA	0	1
Brassica rapa	Bird Rape	Alien	EA	4	0
Bromus commutatus	Meadow Brome	Alien	EA	0	0
Bromus hordeaceus	Soft Brome	Alien	EA	0	0
Bromus inermis	Awnless Brome	Alien	EA	56	144
Bromus squarrosus	Corn Brome	Alien	EA	0	0
Bromus tectorum	Downy Brome	Alien	EA	0	0
Camelina sativa	Large-seeded False Flax	Alien	EA	0	0
Capsella bursa-pastoris	Shepherd's Purse	Alien	EA	23	8
Caragana arborescens	Siberian Pea-tree	Alien	EA	1	4

scientific name	English name	NWT rank	origin	2006	2016
Carum carvi	Wild Caraway	Alien	EA	0	0
Cerastium fontanum	Common Chickweed	Alien	EA	2	1
Cerastium nutans	Nodding Chickweed	Alien	NA	1	0
Chaenorhinum minus	Dwarf Snapdragon	Alien	EA	0	3
Chenopodiastrum simplex	Maple-leaved Goosefoot	Alien	NA	1	0
Chenopodium album	Lamb's Quarters	Alien	EA	49	59
Cirsium arvense	Creeping Thistle	Alien	EA	6	7
Clematis tangutica	Golden Clematis	not included	EA	0	1*
Collomia linearis	Narrow-leaved Collomia	Alien	NA	7	5
Corispermum villosum	Hairy Bugseed	Alien	NA	0	0
Crepis tectorum	Narrow-leaf Hawksbeard	Alien	EA	134	149
Dactylis glomerata	Orchard Grass	not included	EA	0	1*
Delphinium elatum	Dwarf Delphinium	Alien	EA	0	0
Descurainia incisa	Cut-leaved Tansy Mustard	Alien	NA	0	0
Descurainia sophia	Herb Sophia	Alien	EA	1	4
Dracocephalum thymiflorum	Thyme-leaf Dragonhead	Alien	EA	1	6
Elymus repens	Creeping Wild Rye	Alien	EA	17	51
Elymus sibiricus	Siberian Wild Rye	Alien	EA?	1	4
Erigeron canadensis	Canada Horseweed	Alien	NA	1	0
Erucastrum gallicum	Common Dog Mustard	Alien	EA	45	35
Erysimum cheiranthoides	Worm-seed Wallflower	Alien	NA?	2	2
Fallopia convolvulus	Black Bindweed	Alien	EA	2	4
Festuca trachyphylla	Hard Fescue	Alien	EA	0	1
Festuca valesiaca	Steppe Fescue	Alien	EA	0	0
Gaillardia aristata	Great Blanket-flower	Alien	NA	0	0
Galeopsis tetrahit (including *G. bifida*)	Brittle-stemmed Hemp-nettle	Alien	EA	3	4
Galium aparine	Catchweed Bedstraw (Cleavers)	Alien	NA	0	0
Geranium robertianum	Herb-Robert	Alien	NA	1*	0
Gnaphalium uliginosum	Low Cudweed	Alien	EA	3	0
Grindelia squarrosa	Curly-cup Gumweed	Alien	NA	2	0
Gypsophila muralis	Low Baby's-breath	Alien	EA	1*	0
Gypsophila paniculata	Tall Baby's-breath	Alien	EA	0	1
Helianthus annuus	Common Sunflower	Alien	EA	0	0
Hesperis matronalis	Dame's Rocket	Alien	EA	0	0
Hordeum vulgare	Barley	Alien	EA	0	0
Lactuca serriola	Prickly Lettuce	Alien	EA	1*	3
Lamium amplexicaule	Common Dead Nettle	Alien	EA	0	0
Lappula squarrosa	European Stickseed	Alien	EA	21	23

scientific name	English name	NWT rank	origin	2006	2016
Lepidium densiflorum	Dense-flower Pepperwort	Alien	NA	49	57
Lepidium sativum	Garden Pepperwort	Alien	EA	0	0
Lepidium virginicum	Poor-man's Peppergrass	Alien	EA	2*	9
Leucanthemum vulgare	Ox-eye Daisy	Alien	EA	1	2
Leymus cinereus	Great Basin Lymegrass	not included	NA	0	1*
Linaria vulgaris	Butter-and-Eggs	Alien	EA	1	5
Linum usitatissimum	Common Yellow Flax	Alien	EA	0	0
Lolium arundinaceum	Tall Rye Grass	Alien	EA	1*	0
Lolium multiflorum	Annual Rye Grass	Alien	EA	0	0
Lolium perenne	Perennial Rye Grass	Alien	EA	1	6
Lonicera tatarica	Tatarian Honeysuckle	Alien	EA	0	0
Lotus corniculatus	Bird's-foot Trefoil	Alien	EA	1*	1
Malva neglecta	Dwarf Mallow	Alien	EA	0	0
Matricaria discoidea	Pineapple Weed	Alien	EA	57	70
Medicago falcata	Yellow Alfalfa	Alien	EA	28	65
Medicago lupulina	Black Medick	Alien	EA	3	8
Medicago sativa	Alfalfa	Alien	EA	46	74
Melilotus albus	White Sweet-clover	Alien	EA	319	227
Melilotus officinalis	Yellow Sweet-clover	Alien	EA	113	91
Neslia paniculata	Yellow Ball Mustard	Alien	EA	0	0
Onobrychis viciifolia	Sainfoin	Alien	EA	1*	0
Pastinaca sativa	Wild Parsnip	Alien	EA	0	0
Persicaria lapathifolia	Pale Smartweed	Alien	NA	5	4
Phalaris canariensis	Common Canary Grass	Alien	EA	0	0
Phedimus spurius	Two-row Stonecrop	Alien	EA	0	0
Phleum pratense	Common Timothy	Alien	EA	19	43
Plantago major	Common Plantain	Alien	EA?	51	151
Poa annua	Annual Bluegrass	Alien	EA	19	17
Poa compressa	Flat-stem Bluegrass	Alien	EA	4	7
Polygonum achoreum	Striate Knotweed	Alien	EA	32	20
Polygonum aviculare	Prostrate Knotweed	Alien	NA?	60	47
Puccinellia distans	Speading Alkali Grass	Alien	EA	27	40
Ranunculus acris	Common Buttercup	Alien	EA	0	0
Raphanus raphanistrum	Wild Radish	not included	EA	0	0
Raphanus sativus	Garden Radish	not included	EA	0	0
Rheum rhabarbarum	Rhubarb	Alien	EA	0	1
Rumex crispus	Curly Dock	Alien	EA	0	1
Sagina procumbens	Procumbent Pearlwort	Alien	NA	0	0
Scorzoneroides autumnalis	Autumn Hawkbit	Alien	EA	0	0

scientific name	English name	NWT rank	origin	2006	2016
Secale cereale	Cultivated Rye	Alien	EA	0	0
Senecio vulgaris	Common Ragwort	Alien	EA	4	3
Setaria verticillata	Rough Bristlegrass	Alien	EA	0	0
Setaria viridis	Green Bristlegrass	Alien	EA	0	1
Silene csereii	Balkan Catchfly	Alien	EA	0	5
Sinapis arvensis	Corn Mustard	Alien	EA	0	0
Sisymbrium altissimum	Tall Hedge Mustard	Alien	EA	0	0
Sisymbrium loeselii	False London Rocket	Alien	EA	2*	2
Sonchus arvensis	Field Sow-thistle	Alien	EA	172	184
Sonchus asper	Prickly Sow-thistle	Alien	EA	0	4
Sonchus oleraceus	Common Sow-thistle	Alien	EA	0	0
Sorbaria sorbifolia	False Spiraea	Alien	EA	0	0
Spergula arvensis	Corn Spurrey	Alien	EA	0	0
Spinacia oleracea	Garden Spinach	Alien	EA	0	0
Stachys hispida	Hispid Hedge-nettle	Alien	NA	1*	0
Stellaria media	Common Starwort	Alien	EA	6	5
Tanacetum vulgare	Common Tansy	Alien	EA	8	12
Taraxacum erythrospermum	Red-seeded Dandelion	Alien	EA	9	0
Taraxacum officinale	Common Dandelion	Alien	EA	99	193
Thinopyrum intermedium	Intermediate Quackgrass	Alien	EA	1*	2
Thlaspi arvense	Field Pennycress	Alien	EA	8	5
Tragopogon dubius	Yellow Goatsbeard	Alien	EA	0	0
Trifolium hybridum	Alsike Clover	Alien	EA	94	97
Trifolium pratense	Red Clover	Alien	EA	61	133
Trifolium repens	White Clover	Alien	EA	3	8
Tripleurospermum inodorum	Scentless Chamomile	Alien	EA	20	12
Triticum aestivum	Bread Wheat	Alien	EA	0	0
Veronica longifolia	Long-leaf Speedwell	Alien	EA	2	1
Vicia cracca	Tufted Vetch	Alien	EA	4	7
Viola tricolor	Johnny-jump-up	Alien	EA	0	0
Vulpia bromoides	Brome Six-weeks Grass	Alien	EA	0	0
TOTAL				1791	2261

2.0 Methodology

Two formal survey types were conducted (highway and walking) and three informal survey types were also used (territorial park, railway, town). Survey protocols used were designed to be compatible with those used during similar highway exotic plant surveys being conducted in the Yukon Territory. More detailed information on the survey protocols used can be found in Bennett *et al*. (2016) and Oldham (2016).

2.1 Highway Survey Methodology

Highway surveys involved driving territorial highways at moderate speed (40-50 km/h) watching for roadside populations of exotic plant species. Many of the more serious invasive plants can form dense and extensive roadside patches which can be readily detected and identified from a moving vehicle. A suite of 14 priority plant species (Table 2) were the primary focus of the highway surveys, but other exotic species and some native weedy species which were observed and identified were also be recorded. The priority plant species were chosen because: most are relatively common exotics along NWT highways, they are generally tall and robust species which are typically in flower during the survey period (August), they can usually be confidently identified from a moving vehicle without needing to stop for close inspection, some are problematic invasive plants, and they are the same suite of species being targeted during the 2016 Yukon roadside invasive plant survey (Bennett *et al*. 2016). Highways within NWT targeted during the 2016 are shown in Table 3.

Table 2. Priority invasive plant species for the 2016 NWT Exotic Plant Highways Survey.

scientific name	English name
Bromus inermis	Smooth Brome
Crepis tectorum	Narrow-leaf Hawk's-beard
Hieracium umbellatum	Umbellate Hawkweed
Leucanthemum vulgare	Oxeye Daisy
Medicago falcata	Yellow Lucerne
Medicago sativa	Alfalfa
Melilotus alba	White Sweet-clover
Melilotus officinalis	Yellow Sweet-clover
Phalaris arundinacea	Reed Canary Grass
Sonchus arvensis	Field Sow-thistle
Tanacetum vulgare	Common Tansy
Trifolium hybridum	Alsike Clover
Trifolium pratense	Red Clover
Tripleurospermum inodorum	Scentless Chamomile

Table 3. Territorial highways covered during 2016 exotic plant surveys.

highway name	highway number	total length
Mackenzie Highway	Hwy. 1	690.0 km
Hay River Highway	Hwy. 2	48.6 km
Yellowknife (or Great Slave) Highway	Hwy. 3	338.8 km
Ingraham Trail	Hwy. 4	69.2 km
Fort Smith Highway	Hwy. 5	267.0 km
Fort Resolution Highway	Hwy. 6	90.0 km
Liard Highway	Hwy. 7	254.1 km
Dempster Highway	Hwy. 8	272.5 km

In addition to the above highways, the Inuvik to Tuktoyaktuk (ITH) Highway was surveyed by helicopter with landings for targeted ground surveys.

Two surveyors are involved in highways surveys, one driving and watching for exotic plants the other taking global positioning system (GPS) waypoints and recording data. Observations were or written on to hard copy the "*NWT 2016 Highway Survey Exotic Plant Data Entry Form*" (Appendix A) and later entered into a computer database.

Using a dashboard-mounted GPS unit, surveyors recorded a waypoint as well as a vehicle odometer reading at the start of highway travel each day and at the commencement of each highway survey (Figure 1). At the beginning of each 10 km survey any information relevant to the survey, particularly factors which might affect detectability of roadside exotic plants was recorded, e.g. direction of travel, weather conditions (wind, rain, and bright sun can all affect plant detectability), road conditions (gravel, paved), traffic conditions, roadside conditions (e.g. recent mowing, recent fire, etc.). For the next 10 km each exotic plant species observed was recorded. After 10 km have been travelled a new GPS waypoint and odometer reading was taken and the process repeated. In addition to recording each exotic (and some weedy native) species observed, the following information was recorded for each species over each 10 km stretch of highway: whether the species was flowering or fruiting; which side(s) of the road it was on (only for rarities); whether identification was certain or tentative; and an estimate of abundance over the 10 km distance using the abundance categories in Table 4. Additional instructions for completing the "*NWT 2016 Highway Survey Exotic Plant Data Entry Form*" can be found in Appendix B.

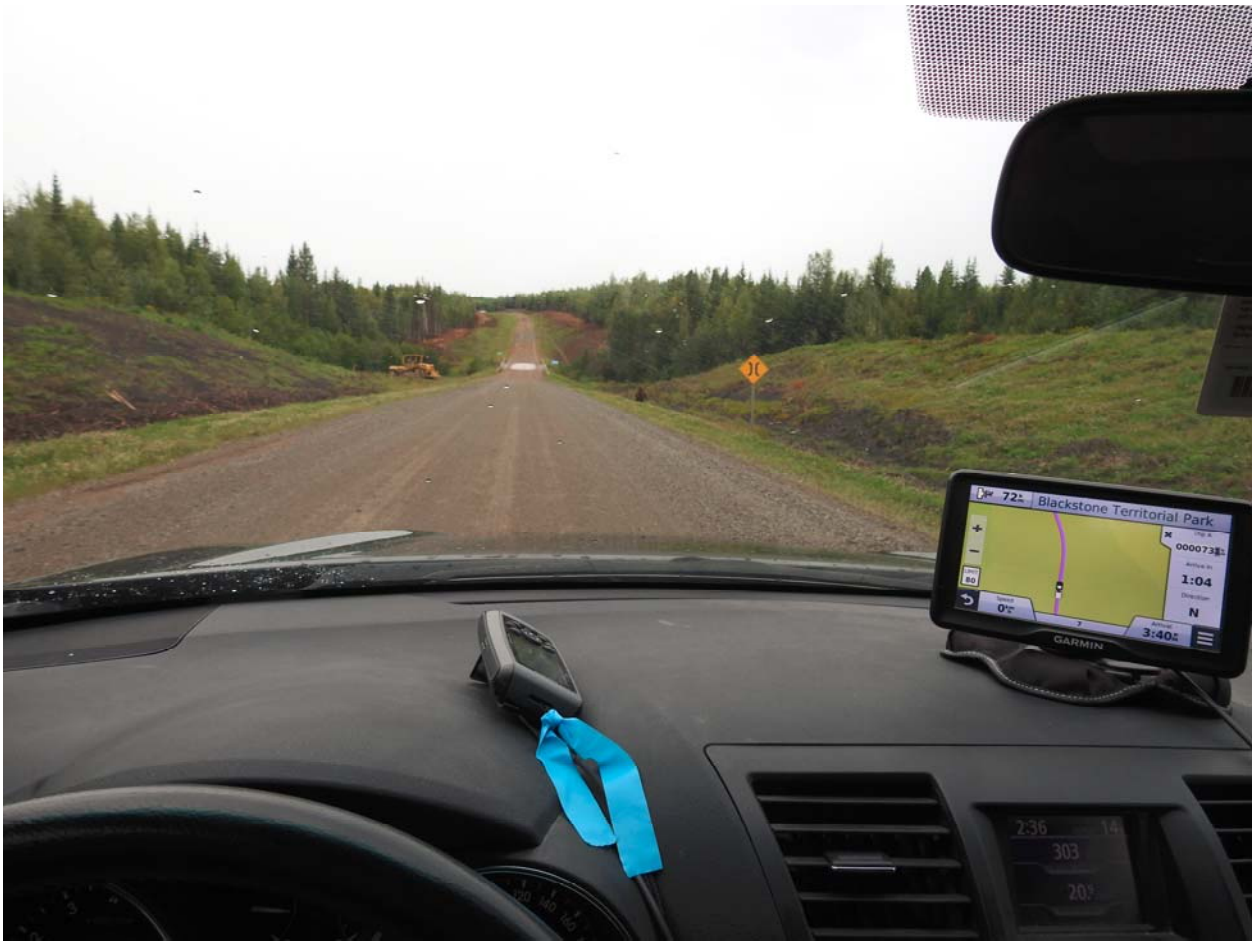


Figure 1. Using dashboard GPS units to record exotic plants on NWT highway exotic plant surveys.

Table 4. Abundance categories for the 2016 NWT Exotic Plant Survey.

Category	Sub-Category	Description
Continuous	--	Plants form one or more dense and continuous patches greater than 100 m long along one or both sides of the highway. Density distribution class of 7 or 8[1].
Sporadic	• High scattered abundance	Plants form occasional patches less than 100 m long which are broken by large sections (i.e., several hundred metres) of scattered or no growth. Patches of high scattered abundance have a density distribution class of 5 or 6[1].

Category	Sub-Category	Description
	• Low scattered abundance	Plants form occasional patches less than 100 m long which are broken by large sections (i.e., several hundred metres) of scattered or no growth. Patches of low scattered abundance have a density distribution class of 3 or 4[1].
Rare	--	Very few plants observed (i.e., small isolated patch). Density distribution class of 1 or 2[1]. Mark a single waypoint where possible.
Absent	--	No plants observed.

[1] See Luttmerding *et al*. (1990).

2.2 Walking Survey Methodology

Highway pull-outs and rest stops which were sampled by walking surveys as part of the 2006 NWT survey (Oldham 2007) were re-surveyed in 2016 as part of long-term exotic plant monitoring objectives. Additional highway pull-out walking surveys were conducted in 2016 (e.g. at new pull-out or rest stop locations not present or not surveyed in 2006).

NWT territorial highway pull-outs and rest stops have a clearly defined parking area, and generally a garbage container. A toilet, interpretive display panel, shelter, and/or picnic table may also be present at some walking survey sites (Figure 2). These areas were selected because they are considered permanent and provide a safe location to park and conduct a walking survey. These sites also experience frequent use by vehicles and are often associated with higher disturbance from initial construction activities making the establishment and spread of exotic species more likely. Formal walking survey sites were selected as long-term monitoring sites because they can be easily relocated for repeated sampling to detect changes in exotic plant populations over time.

Figure 2. Conducting a walking survey site at a highway pull-out.

Formal walking surveys are conducted by one or two surveyors on foot. A complete list of all exotic (and some weedy native) plant species observed at the pull-out or rest stop is recorded, as well as the abundance category (using the codes in Table 4) and phenology stage (e.g. flowering or fruiting) for each species seen. Information is recorded using the "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" (Appendix F). Photographs are taken at each walking survey site showing the general location and habitat conditions.

Voucher plant specimens are collected to document range extensions and new records of exotic plant species in NWT, as well as for species with potential identification problems. Specimens collected will be deposited in the herbarium of Agriculture and Agri-Food Canada (DAO) in Ottawa and sometimes in other herbaria.

2.3 Territorial Park, Railway and Town Survey Methodology

Informal walking surveys were conducted at territorial park campgrounds, along railways, in towns, and sometimes in other disturbed habitats (e.g. construction areas, intersections, roadside borrow pits, ditches, or other areas where high concentrations of exotic plants are visible from the vehicle) following the same general methodology

outlined above (2.2). Areas with high concentrations of exotic plants were opportunistically surveyed with information recorded in a field notebook and later entered into a computer database. Similar information was recorded as for more formal walking surveys (2.2 above).

3.0 Results

2016 surveys documented 73 exotic vascular plant species which are not native to NWT as well as at least a dozen other species native to North America where were likely either not present or much less common in NWT prior to European settlement. An additional 15 exotic species were documented in 2006 but not seen in 2016. Table 1 compares the number of records of each exotic plant species documented in 2006 and 2016.

Differences in number of records between 2006 and 2016 (Table 1) may be in part due to methodological differences and areas surveyed. Most exotic species detections were as a result of highway surveys which are biased towards large and showy species. Fifteen exotic plant species not previously reported from NWT were documented, eleven in 2006 and four in 2016 (asterisked in Table 1); six of these were observed in both survey years.

3.1 Highway Surveys

In 2016, 185 10 kilometer (km) long driving surveys were conducted along NWT territorial highways. The number of surveys conducted on each territorial highway is shown in Table 5 and the locations of highway surveys conducted in southern NWT are shown in Figure 1.

Table 5. 2016 highways surveys on each NWT territorial highway.

highway name (number)	# 10 km surveys	2016 dates	hwy. length surveyed (km + %)	total hwy. length (km)
Mackenzie Highway (Hwy. 1)	57	3, 4, 5, 6, 7 Aug.	570 (83%)	690
Hay River Highway (Hwy. 2)	3	7 Aug.	30 (62%)	48.6
Yellowknife (or Great Slave) Highway (Hwy. 3)	34	6, 12 Aug.	339 (100%)	338.8
Ingraham Trail (Hwy. 4)	7	14 Aug.	69 (100%)	69.2
Fort Smith Highway (Hwy. 5)	24	8, 9 Aug.	240 (90%)	267
Fort Resolution Highway (Hwy. 6)	10	8 Aug.	90 (100%)	90

highway name (number)	# 10 km surveys	2016 dates	hwy. length surveyed (km + %)	total hwy. length (km)
Liard Highway (Hwy. 7)	30	1, 2, 3 Aug.	254 (100%)	254.1
Dempster Highway (Hwy. 8)	20	20 Aug.	200 (73%)	272.5
TOTAL	185		1792 (88%)	2030.2

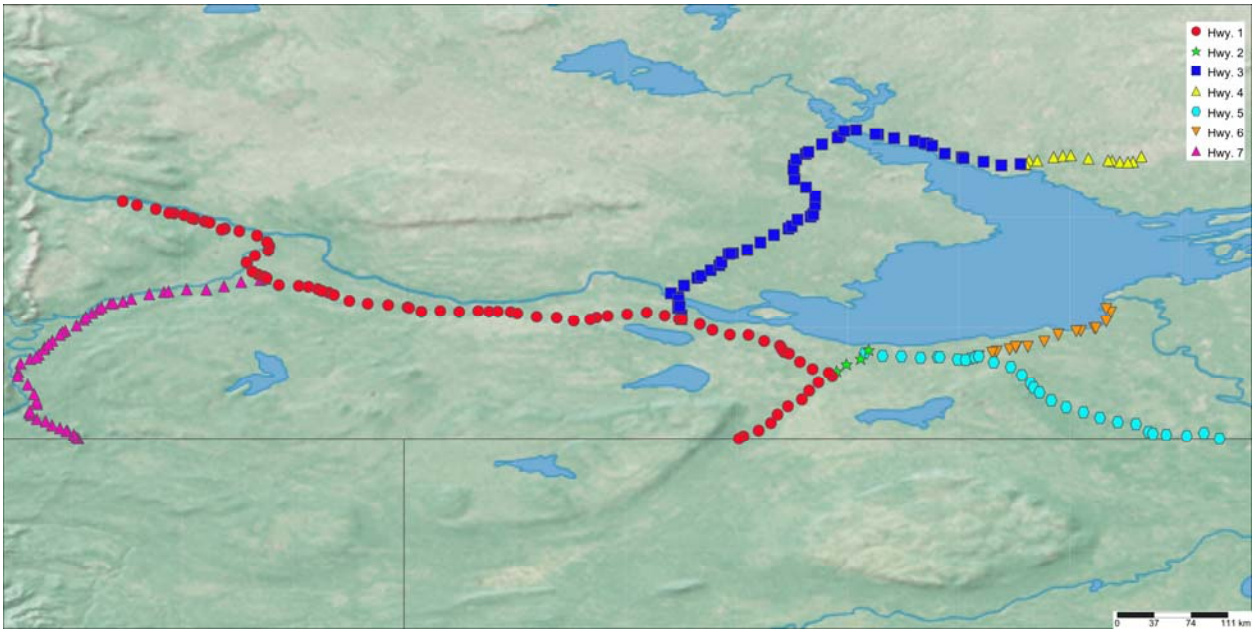


Figure 3. Locations of 2016 highway surveys conducted in southern NWT (20 highway surveys were also conducted along the Dempster Highway in northern NWT)**.**

1,293 populations of 37 exotic plant species were detected on 185 NWT highway surveys in 2016 (Table 6). Note that not all highway detections (4th column in Table 6) were as a result of highway surveys (e.g. some detections were on walking surveys).

Table 6. Exotic plant species detected on 2016 NWT highway surveys.

scientific name	English name	# (%) of 2016 hwy. surveys (of 185) detected on	highways detected on in 2016
Melilotus albus	**White Sweet-clover**	**160 (86%)**	**1, 2, 3, 4, 5, 6, 7, 8**
Sonchus arvensis	**Corn Spurrey**	**147 (79%)**	**1, 2, 3, 4, 5, 6, 7**
Taraxacum officinale	**Common Dandelion**	**123 (66%)**	**1, 2, 3, 4, 5, 6, 7, 8**
Trifolium pratense	**Red Clover**	**106 (57%)**	**1, 2, 3, 5, 6, 7**

scientific name	English name	# (%) of 2016 hwy. surveys (of 185) detected on	highways detected on in 2016
Bromus inermis	**Awnless Brome**	**105 (57%)**	**1, 2, 3, 4, 5, 6, 7, 8**
Crepis tectorum	**Narrow-leaf Hawksbeard**	**88 (48%)**	**1, 2, 3, 4, 5, 6, 7, 8**
Plantago major	**Common Plantain**	**85 (46%)**	**1, 3, 4, 5, 6, 7**
Melilotus officinalis	**Yellow Sweet-clover**	**62 (34%)**	**1, 2, 3, 4, 5, 6, 7**
Trifolium hybridum	**Alsike Clover**	**56 (30%)**	**1, 2, 3, 4, 5, 6, 7**
Medicago falcata	**Yellow Alfalfa**	**53 (29%)**	**1, 2, 3, 5, 6, 7**
Artemisia biennis	**Biennial Sagebrush**	**51 (28%)**	**1, 2, 3, 4, 5, 6, 7**
Medicago sativa	**Alfalfa**	**46 (25%)**	**1, 2, 3, 5, 6, 7, 8**
Elymus repens	**Creeping Wild Rye**	**34 (18%)**	**1, 3, 5, 6, 7, 8**
Phleum pratense	**Common Timothy**	**30 (16%)**	**1, 3, 5, 6, 7**
Chenopodium album	**Lamb's Quarters**	**27 (15%)**	**1, 2, 3, 4, 5, 6, 7**
Alopecurus pratensis	**Field Meadow Foxtail**	**20 (11%)**	**1, 3, 6, 7**
Erucastrum gallicum	**Common Dog Mustard**	**20 (11%)**	**1, 3, 5, 6, 7**
Lepidium densiflorum	**Dense-flowered Pepperwort**	**20 (11%)**	**1, 3, 4, 5, 6, 8**
Matricaria discoidea	**Pineapple Weed**	**14 (8%)**	**1, 2, 3, 4, 5, 6, 7, 8**
Polygonum aviculare	**Prostrate Knotweed**	**9 (5%)**	**1, 3, 4**
Tanacetum vulgare	**Common Tansy**	**7 (4%)**	**1, 3, 5, 7**
Agrostis gigantea	**Black Bentgrass**	**5 (3%)**	**7**
Puccinellia distans	**Spreading Alkali Grass**	**3 (2%)**	**1, 3, 4, 5, 6, 7**
Vicia cracca	**Tufted Vetch**	**3 (2%)**	**1, 5, 6**
Elymus sibiricus	**Siberian Wild Rye**	**3 (2%)**	**7**
Cirsium arvense	**Creeping Thistle**	**2 (1%)**	**1, 3, 6**
Lappula squarrosa	**European Stickseed**	**2 (1%)**	**1, 3, 4, 7**
Silene cserei	**Balkan Catchfly**	**2 (1%)**	**3**
Clematis tangutica	**Golden Clematis**	**1 (<1%)**	**3**
Descurainia sophia	**Herb Sophia**	**1 (<1%)**	**3**
Festuca trachyphylla	**Hard Fescue**	**1 (<1%)**	**1**
Leucanthemum vulgare	**Ox-eye Daisy**	**1 (<1%)**	**6**
Leymus cinereus	**Great Basin Lymegrass**	**1 (<1%)**	**5**
Rheum rhubarbum	**Rhubarb**	**1 (<1%)**	**6**
Thinopyrum intermedium	**Intermediate Quackgrass**	**1 (<1%)**	**1**

scientific name	English name	# (%) of 2016 hwy. surveys (of 185) detected on	highways detected on in 2016
Trifolium repens	**White Clover**	**1 (<1%)**	**4, 6**
Tripleurospermum inodorum	**Scentless Chamomile**	**1 (<1%)**	**1, 3, 4, 5, 6, 7**

3.2 Walking Surveys

328 populations of 39 exotic plant species were documented on 37 walking surveys conducted in 2016, mostly at highway pull-offs. Fifteen walking surveys were conducted in 2006. At ten locations walking surveys were conducted in both years (Figure 2).

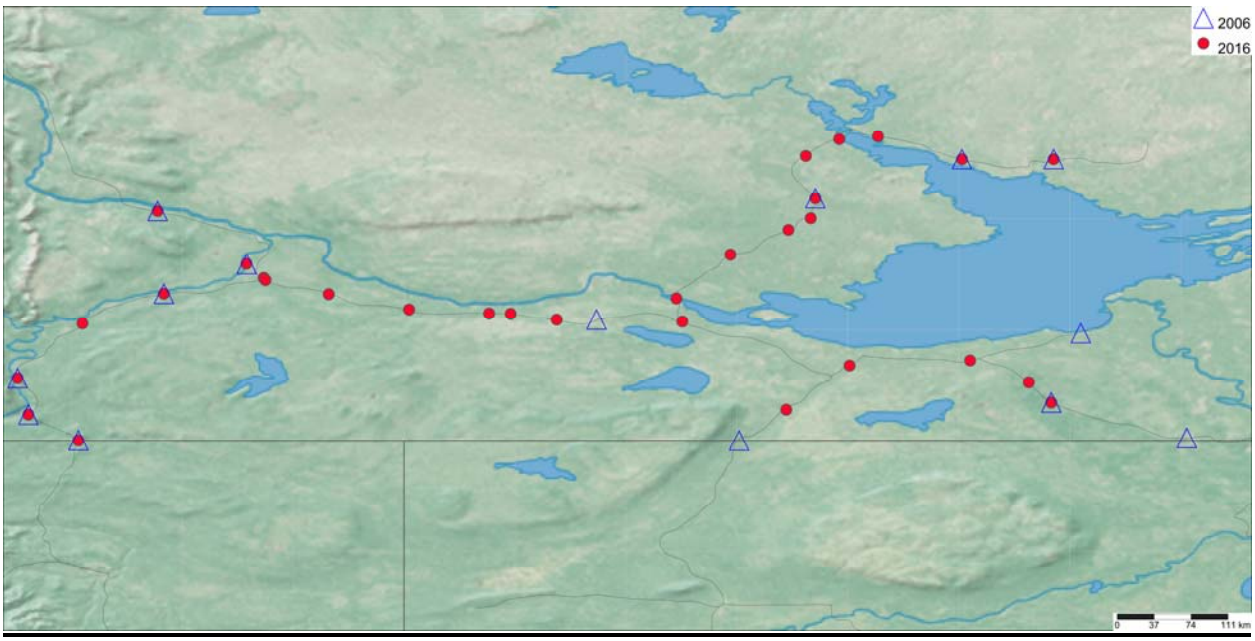


Figure 4. Locations of 2006 and 2016 walking surveys in southern NWT (not shown are 7 walking surveys conducted along the Dempster Highway)**.**

Walking surveys detected a different suite of exotic species than highway surveys (Table 7). Smaller species and species requiring closer inspection for reliable identification were primarily detected on walking surveys. In combination the two survey methods detected 50 exotic plant species, with 37 species detected on highway surveys and 39 species detected on walking surveys. 26 species were detected on both types of surveys, while 13 species were detected only on walking surveys and 11 species only on highway surveys.

Table 7. Exotic plant species detected on 2016 NWT walking and highway surveys.

scientific name	English name	# (%) walking surveys (of 37)	# (%) of highway surveys (of 185)
Plantago major	Common Plantain	30 (81%)	85 (46%)
Melilotus albus	White Sweet-clover	28 (76%)	160 (86%)
Matricaria discoidea	Pineapple Weed	26 (70%)	14 (8%)
Taraxacum officinale	Common Dandelion	26 (70%)	123 (66%)
Crepis tectorum	Narrow-leaf Hawksbeard	25 (68%)	88 (48%)
Puccinellia distans	Spreading Alkali Grass	17 (46%)	3 (2%)
Bromus inermis	Awnless Brome	16 (43%)	105 (57%)
Lepidium densiflorum	Dense-flowered Pepperwort	14 (38%)	20 (11%)
Trifolium hybridum	Alsike Clover	13 (35%)	56 (30%)
Chenopodium album	Lamb's Quarters	12 (32%)	27 (15%)
Polygonum aviculare	Prostrate Knotweed	12 (32%)	9 (5%)
Sonchus arvensis	Field Sow Thistle	11 (30%)	147 (79%)
Artemisia biennis	Biennial Sagebrush	10 (27%)	51 (28%)
Trifolium pratense	Red Clover	10 (27%)	106 (57%)
Lappula squarrosa	European Stickseed	9 (24%)	2 (1%)
Melilotus officinalis	Yellow Sweet-clover	7 (19%)	62 (34%)
Polygonum achoreum	Striate Knotweed	7 (19%)	
Medicago sativa	Alfalfa	6 (16%)	46 (25%)
Poa annua	Annual Bluegrass	6 (16%)	
Phleum pratense	Common Timothy	5 (14%)	30 (16%)
Poa compressa	Flat-stem Bluegrass	5 (14%)	
Erucastrum gallicum	Common Dog Mustard	4 (11%)	20 (11%)
Medicago lupulina	Black Medick	4 (11%)	
Agrostis gigantea	Black Bentgrass	3 (8%)	5 (3%)
Alopecurus arundinaceus	Creeping Meadow-foxtail	3 (8%)	
Elymus repens	Creeping Wild Rye	3 (8%)	34 (18%)
Alopecurus pratensis	Field Meadow-foxtail	2 (5%)	20 (11%)
Lepidium virginicum	Poor-man's Peppergrass	2 (5%)	
Medicago falcata	Yellow Alfalfa	2 (5%)	53 (29%)
Agropyron cristatum	Crested Wheat Grass	1 (3%)	
Dactylis glomerata	Orchard Grass	1 (3%)	
Descurainia sophia	Herb Sophia	1 (3%)	1 (<1%)
Elymus sibiricus	Siberian Wild Rye	1 (3%)	3 (2%)

scientific name	English name	# (%) walking surveys (of 37)	# (%) of highway surveys (of 185)
Fallopia convolvulus	**Black Bindweed**	**1 (3%)**	
Lolium perenne	**Perennial Rye Grass**	**1 (3%)**	
Persicaria lapathifolia	**Pale Smartweed**	**1 (3%)**	
Rumex crispus	**Curly Dock**	**1 (3%)**	
Stellaria media	**Common Starwort**	**1 (3%)**	
Tripleurospermum inodorum	**Scentless Chamomile**	**1 (3%)**	**1 (<1%)**
Cirsium arvense	**Creeping Thistle**		**2 (1%)**
Clematis tangutica	**Golden Clematis**		**1 (<1%)**
Festuca trachyphylla	**Hard Fescue**		**1 (<1%)**
Leucanthemum vulgare	**Ox-eye Daisy**		**1 (<1%)**
Leymus cinereus	**Great Basin Lymegrass**		**1 (<1%)**
Rheum rhubarbum	**Rhubarb**		**1 (<1%)**
Silene cserei	**Balkan Catchfly**		**2 (1%)**
Tanacetum vulgare	**Common Tansy**		**7 (4%)**
Thinopyrum intermedium	**Intermediate Quackgrass**		**1 (<1%)**
Trifolium repens	**White Clover**		**1 (<1%)**
Vicia cracca	**Tufted Vetch**		**3 (2%)**

3.3 Territorial Park Surveys

17 territorial parks (TP) were visited and surveyed for exotic plants in 2016 (Figure 3, 4). 174 records of 40 exotic plant species were documented during territorial park surveys in 2016. In 2006, 153 exotic plant records of 42 species were noted from 16 territorial parks. A total of 20 territorial parks was surveyed (13 in both years) resulting in 327 records of 50 exotic plant species (Table 8). The most common exotic plants in NWT territorial parks were Common Dandelion (*Taraxacum officinale*; 85% of parks), Common Plantain (*Plantago major*; 70% of parks), Alsike Clover (*Trifolium hybridum*; 70% of parks), Annual Bluegrass (*Poa annua*, 65% of parks), Narrow-leaf Hawksbeard (*Crepis tectorum*, 60% of parks), Pineapple Weed (*Matricaria discoidea*, 60% of parks), and White Sweet-clover (*Melilotus albus*, 60% of parks). Table 9 shows the number of exotic plants in each of 20 NWT territorial parks.

Figure 5. Territorial park survey site at Jak Territorial Park, Inuvik.

Camping equipment is known to be a vector for the transport of some exotic plant species including one exotic plant known in NWT only from Blackstone Territorial Park campground. English Lawn Daisy (*Bellis perennis*) was first documented in NWT in 2006 from a single campsite in Blackstone TP. In 2016 it was again documented from only one site in NWT, a single campsite in Blackstone TP, where it has persisted for at least a decade although hasn't spread even to adjacent campsites.

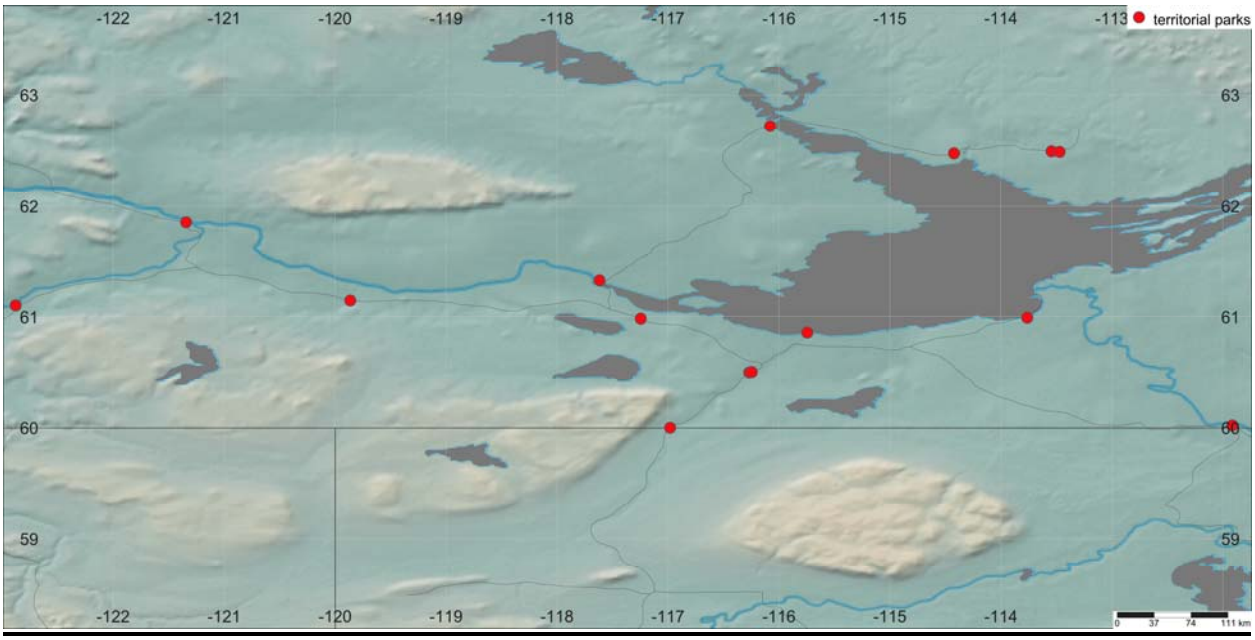


Figure 6. Locations of southern NWT territorial park surveys (locations of 3 parks surveyed in northern NWT not included)**.**

Table 8. Exotic plant species documented in 20 NWT territorial parks.

scientific name	English name	# (%) terr. parks (of 20)	survey year(s)	territorial parks
Taraxacum officinale	**Common Dandelion**	**17 (85%)**	**2006, 2016**	**Blackstone, Cameron River Crossing, Fort Providence, Fort Simpson, Fred Henne, Happy Valley, Hay River, Jak, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, Madaline Lake, Nitainlaii, North Arm, Queen Elizabeth, Sambaa Deh Falls, Twin Falls Gorge**
Plantago major	**Common Plantain**	**14 (70%)**	**2006, 2016**	**60th Parallel, Blackstone, Fort Providence, Fort Simpson, Hay River, Jak, Kakisa River, Little Buffalo River Crossing, Madeline Lake, Pontoon Lake, Queen Elizabeth, Reid Lake, Sambaa Deh Falls, Twin Falls Gorge**
Trifolium hybridum	**Alsike Clover**	**14 (70%)**	**2006, 2016**	**60th Parallel, Blackstone, Cameron River Crossing, Fort Providence, Fort Simpson, Hay River, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, Madeline Lake, North Arm, Pontoon Lake, Queen Elizabeth, Twin Falls Gorge**

scientific name	English name	# (%) terr. parks (of 20)	survey year(s)	territorial parks
Poa annua	**Annual Bluegrass**	**13 (65%)**	**2006, 2016**	**60th Parallel, Blackstone, Fort Providence, Fort Simpson, Hay River, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, North Arm, Pontoon Lake, Queen Elizabeth, Sambaa Deh Falls, Twin Falls Gorge**
Crepis tectorum	**Narrow-leaf Hawksbeard**	**12 (60%)**	**2006, 2016**	**Blackstone, Cameron River Crossing, Fort Providence, Fort Simpson, Hay River, Lady Evelyn Falls, Little Buffalo River Crossing, North Arm, Pontoon Lake, Queen Elizabeth, Sambaa Deh Falls, Twin Falls Gorge**
Matricaria discoidea	**Pineapple Weed**	**12 (60%)**	**2006, 2016**	**60th Parallel, Blackstone, Fort Providence, Fort Simpson, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, North Arm, Queen Elizabeth, Reid Lake, Sambaa Deh Falls, Twin Falls Gorge**
Melilotus albus	**White Sweet-clover**	**12 (60%)**	**2006, 2016**	**60th Parallel, Blackstone, Fort Providence, Fort Simpson, Happy Valley, Hay River, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, North Arm, Sambaa Deh Falls, Twin Falls Gorge**
Sonchus arvensis	**Field Sow Thistle**	**9 (45%)**	**2006, 2016**	**60th Parallel, Fort Providence, Fort Simpson, Hay River, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, North Arm, Twin Falls Gorge**
Trifolium pratense	**Red Clover**	**9 (45%)**	**2006, 2016**	**60th Parallel, Blackstone, Fort Providence, Hay River, Little Buffalo River Crossing, North Arm, Queen Elizabeth, Sambaa Deh, Twin Falls Gorge**
Lepidium densiflorum	**Dense-flower Peperwort**	**8 (40%)**	**2006, 2016**	**Cameron River Crossing, Fort Providence, Fort Simpson, Little Buffalo River Crossing, North Arm, Pontoon Lake, Queen Elizabeth, Reid Lake**
Polygonum aviculare	**Prostrate Knotweed**	**8 (40%)**	**2006, 2016**	**Fort Providence, Fort Simpson, Kakisa River, Lady Evelyn Falls, Little Buffalo River Crossing, Madeline Lake, Pontoon Lake, Queen Elizabeth**
Bromus inermis	**Awnless Brome**	**7 (35%)**	**2006, 2016**	**Cameron River Crossing, Fort Providence, Fort Simpson, Hay River, Jak, Madeline Lake, Twin Falls Gorge**

scientific name	English name	# (%) terr. parks (of 20)	survey year(s)	territorial parks
Chenopodium album	**Lamb's Quarters**	**7 (35%)**	**2006, 2016**	**Fort Providence, Fort Simpson, Hay River, Kakisa River, Lady Evelyn Falls, Sambaa Deh Falls, Twin Falls Gorge**
Capsella bursa-pastoris	**Shepherd's Purse**	**6 (30%)**	**2006, 2016**	**Blackstone, Fort Providence, Fort Simpson, Pontoon Lake, Queen Elizabeth, Sambaa Deh Falls**
Melilotus officinalis	**Yellow Sweet-clover**	**6 (30%)**	**2006, 2016**	**60th Parallel, Fort Providence, Hay River, Kakisa River, Sambaa Deh Falls, Twin Falls Gorge**
Polygonum achoreum	**Striate Knotweed**	**6 (30%)**	**2006, 2016**	**60th Parallel, Fort Providence, Fort Simpson, Kakisa River, Madeline Lake, Twin Falls Gorge**
Medicago sativa	**Alfalfa**	**5 (25%)**	**2006, 2016**	**Fort Providence, Fort Simpson, Kakisa River, Little Buffalo River Crossing, Twin Falls Gorge**
Trifolium repens	**White Clover**	**5 (25%)**	**2006, 2016**	**Blackstone, Hay River, Little Buffalo River Crossing, Queen Elizabeth, Twin Falls Gorge**
Artemisia biennis	**Biennial Sagebrush**	**4 (20%)**	**2006, 2016**	**Blackstone, Fort Providence, Fort Simpson, Sambaa Deh Falls**
Elymus repens	**Creeping Wild Rye**	**4 (20%)**	**2006, 2016**	**Fort Simpson, Happy Valley, Jak, Twin Falls Gorge**
Erucastrum gallicum	**Common Dog Mustard**	**4 (20%)**	**2006, 2016**	**Hay River, Kakisa River, Lady Evelyn Falls, Twin Falls Gorge**
Puccinellia distans	**Speading Alkali Grass**	**4 (20%)**	**2006, 2016**	**60th Parallel, Fort Providence, Little Buffalo River Crossing, Twin Falls Gorge**
Lappula squarrosa	**European Stickseed**	**3 (15%)**	**2006, 2016**	**Cameron River Crossing, Fort Providence, Jak**
Lepidium virginicum	**Poor-man's Peppergrass**	**3 (15%)**	**2006, 2016**	**Blackstone, Fort Providence, Jak**
Phleum pratense	**Common Timothy**	**3 (15%)**	**2006, 2016**	**Fort Providence, Hay River, Little Buffalo River Crossing**
Agropyron cristatum	**Crested Wheatgrass**	**2 (10%)**	**2006**	**Cameron River Crossing, Jak**
Cirsium arvense	**Creeping Thistle**	**2 (10%)**	**2006, 2016**	**Fort Simpson, Little Buffalo River Crossing**
Descurainia sophia	**Herb Sophia**	**2 (10%)**	**2006, 2016**	**Fort Providence, Fred Henne**
Erysimum cheiranthoides	**Worm-seed Wallflower**	**2 (10%)**	**2006, 2016**	**Fort Simpson, Little Buffalo River Crossing**
Galeopsis tetrahit **(including *G. bifida*)**	**Brittle-stemmed Hemp-nettle**	**2 (10%)**	**2006, 2016**	**Blackstone, Fort Simpson**
Taraxacum erythrospermum	**Red-seeded Dandelion**	**2 (10%)**	**2006**	**Blackstone, Cameron River Crossing**

scientific name	English name	# (%) terr. parks (of 20)	survey year(s)	territorial parks
Thlaspi arvense	Field Pennycress	2 (10%)	2006, 2016	Fort Providence, Fort Simpson
Agrostis gigantea	Black Bentgrass	1 (5%)	2006	Hay River
Alopecurus arundinaceus	Creeping Meadow-foxtail	1 (5%)	2016	Twin Falls Gorge
Alopecurus pratensis	Field Meadow-foxtail	1 (5%)	2006	Hay River
Bellis perennis	English Daisy	1 (5%)	2006, 2016	Blackstone
Brassica napus	Turnip	1 (5%)	2016	Little Buffalo River Crossing
Cerastium fontanum	Common Chickweed	1 (5%)	2006, 2016	Blackstone
Cerastium nutans	Nodding Chickweed	1 (5%)	2006	Blackstone
Chenopodiastrum simplex	Maple-leaved Goosefoot	1 (5%)	2006	Fort Simpson
Collomia linearis	Narrow-leaved Collomia	1 (5%)	2006	Fort Providence
Lactuca serriola	Prickly Lettuce	1 (5%)	2006	Fort Simpson
Lolium perenne	Perennial Rye Grass	1 (5%)	2016	Fort Simpson
Medicago falcata	Yellow Alfalfa	1 (5%)	2016	Fort Simpson
Medicago lupulina	Black Medick	1 (5%)	2016	Blackstone
Poa compressa	Flat-stem Bluegrass	1 (5%)	2016	Jak
Senecio vulgaris	Common Ragwort	1 (5%)	2006	Fort Simpson
Sisymbrium loeselii	False London Rocket	1 (5%)	2016	Fort Simpson
Stellaria media	Common Starwort	1 (5%)	2006	Fort Simpson
Tripleurospermum inodorum	Scentless Chamomile	1 (5%)	2016	Fort Providence

Table 9. Number of exotic plants (of 40) in each of 20 NWT territorial parks.

territorial park	# (%) exotics (of 40)
Fort Simpson	28 (70%)
Fort Providence	26 (65%)
Twin Falls Gorge	19 (48%)

territorial park	# (%) exotics (of 40)
Blackstone	18 (45%)
Little Buffalo River Crossing	18 (45%)
Hay River	16 (40%)
Kakisa River	13 (33%)
Queen Elizabeth	11 (28%)
Sambaa Deh Falls	11 (28%)
60th Parallel	10 (25%)
Lady Evelyn Falls	10 (25%)
North Arm	9 (23%)
Cameron River Crossing	8 (20%)
Jak	8 (20%)
Pontoon Lake	7 (18%)
Madeline Lake	6 (15%)
Happy Valley	3 (8%)
Reid Lake	3 (8%)
Fred Henne	2 (5%)
Nitainlaii	1 (3%)

3.4 Railway Surveys

Railways are known vectors for the spread of exotic plant species and at least a couple of NWT exotic species probably arrived in this manner since they have only been found in NWT along or adjacent to railways, e.g. Dwarf Snapdragon (*Chaenorrhinum minus*), Thyme-leaf Dragonhead (*Dracocephalum thymiflorum*). There is only a limited extent of railway in NWT, from the Alberta border to Hay River on the south shore of Great Slave Lake (Figures 7, 8). Railway surveys were conducted at six locations between the Alberta border and Hay River in 2016 and at three locations in 2006, resulting in 82 observations of 30 different exotic plant species (Table 10).

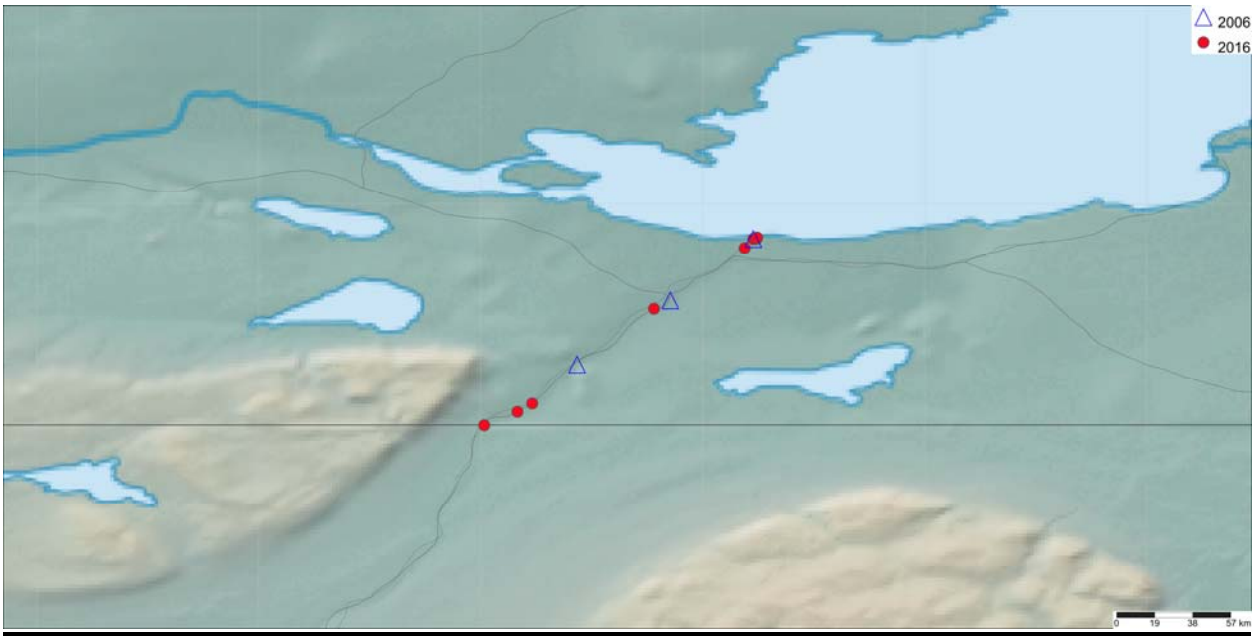


Figure 7. Locations of NWT railway surveys.

Figure 8. Railway survey site at Hay River.

Table 10. Exotic plant species detected on 2006 and 2016 NWT railway surveys.

scientific name	English name	# (%) railway surveys (of 9)
Crepis tectorum	Narrow-leaf Hawksbeard	5 (56%)
Melilotus albus	White Sweet-clover	5 (56%)
Melilotus officinalis	Yellow Sweet-clover	5 (56%)
Chenopodium album	Lamb's Quarters	4 (44%)
Dracocephalum thymiflorum	Thyme-leaf Dragonhead	4 (44%)
Sonchus arvensis	Corn Spurrey	4 (44%)
Bromus inermis	Awnless Brome	3 (33%)
Lepidium densiflorum	Dense-flower Pepperwort	3 (33%)
Matricaria discoidea	Pineapple Weed	3 (33%)
Artemisia biennis	Biennial Sagebrush	2 (22%)
Chaenorrhinum minus	Dwarf Snapdragon	2 (22%)
Collomia linearis	Narrow-leaved Collomia	2 (22%)
Erucastrum gallicum	Common Dog Mustard	2 (22%)
Medicago sativa	Alfalfa	2 (22%)
Polygonum achoreum	Striate Knotweed	2 (22%)
Puccinellia distans	Spreading Alkali Grass	2 (22%)
Silene cserei	Balkan Catchfly	2 (22%)
Trifolium hybridum	Alsike Clover	2 (22%)
Vicia cracca	Tufted Vetch	2 (22%)
Agropyron cristatum	Crested Wheat Grass	1 (11%)
Cirsium arvense	Creeping Thistle	1 (11%)
Elymus repens	Creeping Wild Rye	1 (11%)
Fallopia convolvulus	Black Bindweed	1 (11%)
Lappula squarrosa	European Stickseed	1 (11%)
Lepidium virginicum	Poor-man's Peppergrass	1 (11%)
Phleum pratense	Common Timothy	1 (11%)
Plantago major	Common Plantain	1 (11%)
Sisymbrium loeselii	False London Rocket	1 (11%)
Taraxacum officinale	Common Dandelion	1 (11%)
Trifolium pratense	Red Clover	1 (11%)

3.5 Town Surveys

Urban areas, due to greater levels of disturbance and human traffic, typically have more and sometimes different exotic species than are found in more natural habitats. Town surveys consisted of walking streets and other disturbed habitats and recording the

presence of exotic plants. The following 15 towns were surveyed for exotic plants in 2016 (those with an * were also surveyed in 2006): Behchoko (Rae), Dettah, Enterprise, Fort Liard*, Fort McPherson (airport only), Fort Providence*, Fort Resolution*, Fort Simpson*, Fort Smith*, Hay River*, Inuvik*, Kakisa, Norman Wells, Pine Point (abandoned), and Yellowknife* (Figures 9, 10). Aklavik was surveyed in 2006 but not in 2016. 478 records of 41 exotic plant species were detected during town surveys (Table 10) with the number of exotic species per town varying from 37 (Hay River) to 2 (Kakisa) (Table 11). Note that survey effort varied considerably between towns and more intensive surveys would undoubtedly boost the exotic species totals for several towns. For example, a relatively small amount of time was spent surveying for exotics in Yellowknife, since the non-native flora of Yellowknife is already fairly well-known.

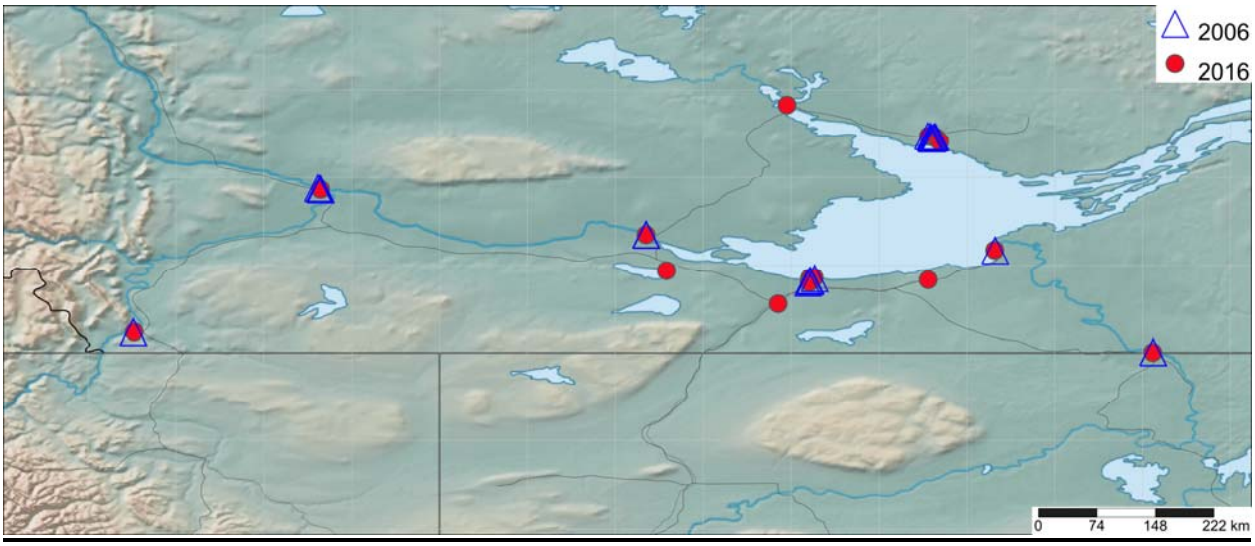


Figure 9. Locations of town surveys in southern NWT (Aklavik, Fort McPherson, Inuvik, and Norman Wells not included on the map)**.**

Figure 10. Town survey site in Inuvik.

Table 11. Number of NWT towns each exotic plant species was detected in during 2006 and 2016 surveys.

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
Crepis tectorum	Narrow-leaf Hawksbeard	29	13 (81%)	Behchoko, Dettah, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Inuvik, Norman Wells, Pine Point, Yellowknife
Melilotus albus	White Sweet-clover	24	13 (81%)	Behchoko, Enterprise, Fort Liard, Fort McPherson, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River,

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
				Inuvik, Norman Wells, Pine Point, Yellowknife
Bromus inermis	Awnless Brome	22	12 (75%)	Aklavik, Behchoko, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Norman Wells, Pine Point, Yellowknife
Taraxacum officinale	Common Dandelion	27	12 (75%)	Behchoko, Dettah, Enterprise, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Inuvik, Norman Wells, Pine Point, Yellowknife
Lepidium densiflorum	Dense-flower Pepperwort	18	11 (69%)	Behchoko, Dettah, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Norman Wells, Yellowknife
Matricaria discoidea	Pineapple Weed	17	10 (63%)	Dettah, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Inuvik, Yellowknife
Polygonum aviculare	Prostrate Knotweed	18	10 (63%)	Aklavik, Behchoko, Dettah, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Hay River, Inuvik, Yellowknife
Sonchus arvensis	Field Sow Thistle	14	10 (63%)	Behchoko, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Hay River, Inuvik, Pine Point, Yellowknife
Chenopodium album	Lamb's Quarters	21	9 (56%)	Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Inuvik, Yellowknife

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
Melilotus officinalis	Yellow Sweet-clover	17	9 (56%)	Behchoko, Enterprise, Fort Liard, Fort McPherson, Fort Providence, Fort Resolution, Fort Smith, Hay River, Yellowknife
Plantago major	Common Plantain	18	9 (56%)	Dettah, Enterprise, Fort Liard, Fort Providence, Fort Simpson, Hay River, Inuvik, Pine Point, Yellowknife
Puccinellia distans	Speading Alkali Grass	15	9 (56%)	Dettah, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Hay River, Inuvik, Yellowknife
Trifolium hybridum	Alsike Clover	21	9 (56%)	Dettah, Enterprise, Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Hay River, Norman Wells, Yellowknife
Medicago sativa	Alfalfa	13	8 (50%)	Enterprise, Fort Liard, Fort McPherson, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Pine Point
Artemisia biennis	Biennial Sagebrush	17	7 (44%)	Behchoko, Fort Liard, Fort Providence, Fort Simpson, Fort Smith, Inuvik, Yellowknife
Elymus repens	Creeping Wild Rye	12	7 (44%)	Fort Liard, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Inuvik, Yellowknife
Polygonum achoreum	Striate Knotweed	14	7 (44%)	Fort Liard, Fort Providence, Fort Resolution, Fort Simpson, Fort Smith, Hay River, Yellowknife
Trifolium pratense	Red Clover	10	7 (44%)	Enterprise, Fort Liard, Fort Resolution, Fort Smith, Hay River, Pine Point, Yellowknife
Capsella bursa-pastoris	Shepherd's Purse	12	6 (33%)	Fort Liard, Fort Providence, Fort Simpson, Fort Smith, Hay River, Yellowknife

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
Caragana arborescens	Siberian Pea-tree	5	5 (31%)	Fort Liard, Fort Providence, Hay River, Inuvik, Yellowknife
Erucastrum gallicum	Common Dog Mustard	11	5 (31%)	Enterprise, Fort Liard, Fort Providence, Fort Simpson, Hay River
Lappula squarrosa	European Stickseed	11	5 (31%)	Enterprise, Fort Providence, Fort Simpson, Hay River, Yellowknife
Linaria vulgaris	Butter-and-Eggs	5	5 (31%)	Enterprise, Fort Simpson, Pine Point, Fort Smith, Yellowknife
Lolium perenne	Perennial Rye Grass	5	5 (31%)	Behchoko, Fort Providence, Fort Simpson, Hay River, Inuvik
Stellaria media	Common Starwort	8	5 (31%)	Fort Liard, Fort Smith, Hay River, Inuvik, Yellowknife
Tripleurospermum inodorum	Scentless Chamomile	9	5 (31%)	Fort Liard, Fort Resolution, Fort Simpson, Hay River, Inuvik
Senecio vulgaris	Common Ragwort	6	4 (25%)	Fort Smith, Hay River, Kakisa, Yellowknife
Thlaspi arvense	Field Pennycress	7	4 (25%)	Fort Liard, Fort Providence, Fort Simpson, Hay River
Trifolium repens	White Clover	4	4 (25%)	Fort Liard, Fort Providence, Fort Simpson, Yellowknife
Vicia cracca	Tufted Vetch	5	4 (25%)	Behchoko, Fort Providence, Fort Resolution, Yellowknife
Agropyron cristatum	Crested Wheat Grass	4	3 (19%)	Fort Providence, Hay River, Yellowknife
Fallopia convolvulus	Black Bindweed	3	3 (19%)	Fort Liard, Fort Simpson, Hay River
Galeopsis tetrahit (including *G. bifida*)	Brittle-stemmed Hemp-nettle	3	3 (19%)	Fort Liard, Inuvik, Yellowknife
Medicago falcata	Yellow Alfalfa	7	3 (19%)	Fort Liard, Fort Simpson, Hay River
Alopecurus pratensis	Field Meadow-foxtail	2	2 (13%)	Fort Simpson, Hay River
Cirsium arvense	Creeping Thistle	3	2 (13%)	Hay River, Yellowknife

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
Collomia linearis	Narrow-leaved Collomia	2	2 (13%)	Fort Smith, Hay River
Descurainia sophia	Herb Sophia	2	2 (13%)	Kakisa, Yellowknife
Dracocephalum thymiflorum	Thyme-leaf Dragonhead	2	2 (13%)	Enterprise, Hay River
Erysimum cheiranthoides	Worm-seed Wallflower	2	2 (13%)	Hay River, Inuvik
Lepidium virginicum	Poor-man's Peppergrass	2	2 (13%)	Enterprise, Fort Liard
Medicago lupulina	Black Medick	2	2 (13%)	Fort Simpson, Hay River
Persicaria lapathifolia	Pale Smartweed	4	2 (13%)	Hay River, Yellowknife
Tanacetum vulgare	Common Tansy	2	2 (13%)	Inuvik, Yellowknife
Acer negundo	Manitoba Maple	1	1 (6%)	Fort Liard
Agrostis gigantea	Black Bentgrass	1	1 (6%)	Fort Liard
Arctium tomentosum	Wooly Burdock	1	1 (6%)	Fort Providence
Brassica rapa	Bird Rape	1	1 (6%)	Inuvik
Cerastium fontanum	Common Chickweed	1	1 (6%)	Yellowknife
Chaenorrhinum minus	Dwarf Snapdragon	1	1 (6%)	Enterprise
Erigeron canadensis	Canada Horseweed	1	1 (6%)	Fort Smith
Gnaphalium uliginosum	Low Cudweed	1	1 (6%)	Hay River
Gypsophila paniculata	Tall Baby's-breath	1	1 (6%)	Fort Smith
Leucanthemum vulgare	Ox-eye Daisy	1	1 (6%)	Pine Point
Lotus corniculatus	Bird's-foot Trefoil	1	1 (6%)	Fort Simpson
Phleum pratense	Common Timothy	1	1 (6%)	Fort Liard
Poa annua	Annual Bluegrass	1	1 (6%)	Yellowknife
Setaria viridis	Green Bristlegrass	1	1 (6%)	Fort Simpson

scientific name	English name	# records (of 478)	# (%) towns (of 16)	towns
Silene cserei	Balkan Catchfly	1	1 (6%)	Hay River
Sisymbrium loeselii	False London Rocket	1	1 (6%)	Yellowknife
Sonchus asper	Prickly Sow Thistle	1	1 (6%)	Fort Providence
Stachys hispida	Hispid Hedge-nettle	1	1 (6%)	Hay River
Taraxacum erythrospermum	Red-seeded Dandelion	1	1 (6%)	Fort Liard
Veronica longifolia	Long-leaf Speedwell	3	1 (6%)	Fort Smith

Table 12. Number of exotic plant species found in each NWT town during 2006 and 2016 surveys.

town	# (%) exotic species (of 41)
Hay River	**37 (90%)**
Yellowknife	**33 (80%)**
Fort Liard	**31 (76%)**
Fort Simpson	**30 (73%)**
Fort Providence	**28 (68%)**
Fort Smith	**21 (51%)**
Enterprise	**20 (49%)**
Inuvik	**19 (46%)**
Fort Resolution	**18 (44%)**
Behchoko	**11 (27%)**
Pine Point	**10 (24%)**
Dettah	**8 (20%)**
Norman Wells	**6 (15%)**
Fort McPherson	**3 (7%)**
Aklavik	**2 (5%)**
Kakisa	**2 (5%)**

3.6 Inuvik to Tuktoyaktuk Highway (ITH) Survey

On 18 August 2016 with support from the NWT Department of Transportation the under-construction Inuvik to Tuktoyaktuk Highway (ITH) was flown by helicopter with seven landings made along the route (Figure 11). Landings were at borrow pits, bridge crossings (Figure 12), and other disturbed sites and informal walking surveys were

conducted at each to detect the presence of exotic and invasive plant species. No exotic plants were detected along the ITH route, though at least 19 species are known from nearby Inuvik (Table 11) at the south end of the ITH.

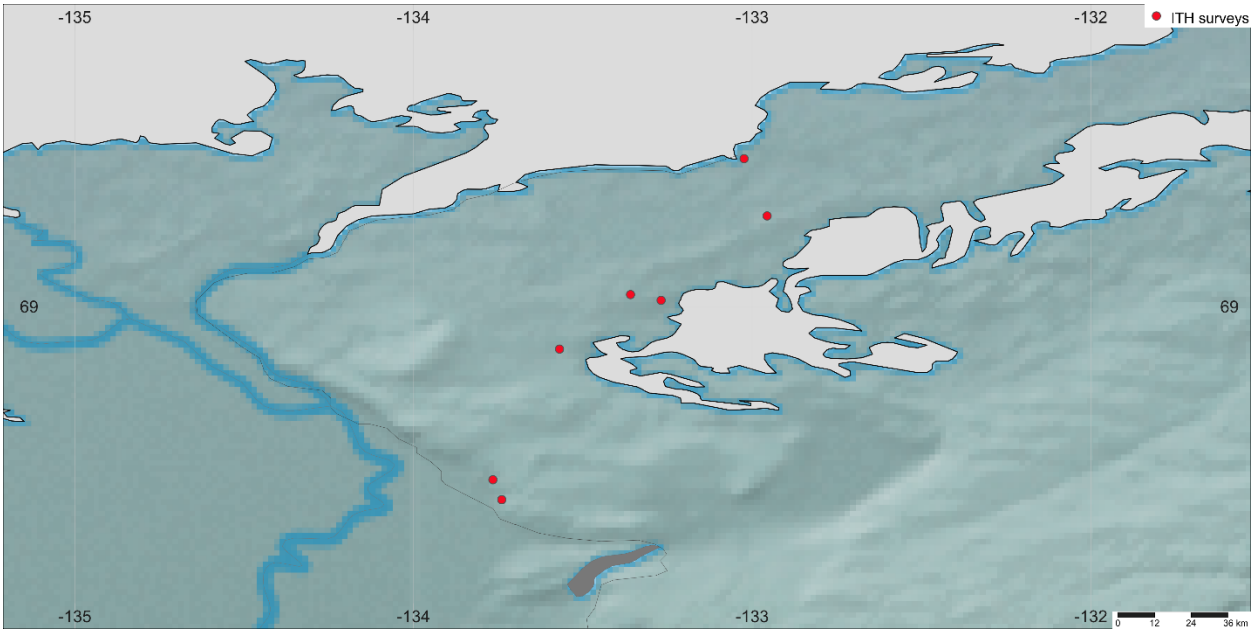


Figure 11. Survey sites along the Inuvik to Tuktoyaktuk Highway route.

Figure 12. Survey site at bridge crossing along the Inuvik to Tuktoyaktuk Highway route.

4.0 Acknowledgements

The Department of Environment and Natural Resources (ENR), Government of the Northwest Territories (GNWT), and Natural Heritage Information Centre (NHIC), Science and Research Branch, Ontario Ministry of Natural Resources and Forestry were the main sponsors of this survey. We would like to sincerely thank Suzanne Carriere and the Department of Environment and Natural Resources, GNWT, for making this survey possible. Suzanne provided funding and logistical support, advice, and enthusiasm to the project. She assisted with obtaining funding and permits to conduct the work. Without Suzanne this project would never have happened.

The Ontario Ministry of Natural Resources and Forestry provided funding to allow Mike's participation in this project and Jim Mackenzie, NHIC coordinator, is thanked for his support and assistance.

The Aurora Research Institute (ARI) provided a Research Licence to permit us to conduct scientific research in NWT. Annika Trimble of the ARI spent a day touring the Inuvik area with Mike in search of exotic plants and also provided access to the ARI herbarium.

The GNWT Department of Transportation provided helicopter support for a survey of the under-construction Inuvik to Tuktoyaktuk Highway (ITH) and a government truck for use during a one-day survey of the Dempster Highway. Mohammad Hossain and Patrice Ngu Ndiangang of the GNWT Department of Transportation accompanied Mike on exotic plant surveys along the ITH and the Dempster Highway.

Bruce Bennett of the Yukon Department of Environment assisted with the project methodology and was a significant source of advice and information concerning exotic plants in NWT and the Yukon.

Most of the 470 plant specimens collected during the NWT surveys are deposited in the Agriculture and Agri-Food Canada Herbarium (DAO) in Ottawa and Dr. Paul Catling and Gisele Mitrow are thanked for facilitating this. Dr. Peter W. Ball, Dr. Nuri Benet-Pierce, Curtis Bjork, Dr. Jacques Cayouette, and Dr. Jeff Saarela are thanked for their assistance with plant specimen identification.

The many NWT residents we met during our travels were universally helpful and interested in our surveys, in particular the staff at the NWT territorial parks where we camped often went out of their way to ensure that experiences were pleasant and productive.

5.0 Literature Cited and Bibliography of Floristic Literature on Southern NWT

Bennett, B. A. Undated. The Distribution of Siberian Wild Rye (*Elymus sibiricus* L.) in Western Canada. Unpublished report, Canadian Wildlife Service, Whitehorse, YT.

Bennett, B., B. Pagecz, A. Suarez-Esteban, and M.J. Oldham. 2016. 2016 Invasive Plant Roadside Survey Methodology, Yukon Territory. Yukon Invasive Species Council.

Bowden, W. M., and W. J. Cody. 1961. Recognition of *Elymus sibiricus* L. from Alaska and the District of Mackenzie. Bulletin of the Torrey Botanical Club 88: 153-155.

Catling, P. M. 2005a. Additions to the Flora of the Continental Northwest Territories from the Great Slave Lake Area. Canadian Field-Naturalist 119(3): 437-440.

Catling, P. M. 2005b. Identification and distribution of the small white water-lilies, *Nymphaea tetragona* and *N. leibergii*, in NT. Botanical Electronic News (BEN) 348: 1-2. http://www.ou.edu/cas/botanymicro/ben/ben348.html

Catling, P. M. 2007. Additional notes on the identification of alien *Phragmites* in Canada. Botanical Electronic News (BEN) 370: 1-3. http://www.ou.edu/cas/botany-micro/ben/ben370.html

Catling, P. M. 2009. Composition, phytogeography, and relict status of the vascular flora of alvars and cliff tops southwest of Great Slave Lake, NWT, Canada. Rhodora 111(946): 189–208.

Catling, P. M., and B. J. Kostiuk. 2012. Notes on the vascular plants of the dunes at White Beach, Great Slave Lake, Northwest Territories. Report to the Government of the Northwest Territories. 16 pp.

Catling, P. M., W. J. Cody, and G. Mitrow. 2005. A compilation of additions to the flora of the continental portions of Northwest Territories and Nunavut. Botanical Electronic News (BEN) 353: 1-2.

Catling, P. M., G. Mitrow, and B. A. Bennett. 2008. A compilation of additions to the flora of the continental portions of Northwest Territories and Nunavut - No. 2. Botanical Electronic News (BEN) 400: 1-13.

Cody, W. J. 1956. New plant records for Northern Alberta and Southern Mackenzie District. Canadian Field-Naturalist 70(3): 101-130.

Cody, W. J. 1960. Plants of the vicinity of Norman Wells, Mackenzie District, Northwest Territories. Canadian Field-Naturalist 74: 71-100.

Cody, W. J. 1961. New plant records from Upper Mackenzie River Valley, Mackenzie District, Northwest Territories. Canadian Field-Naturalist 75: 55-69.

Cody, W. J. 1963. A contribution to the knowledge of the flora of southwestern Mackenzie District, N.W.T. Canadian Field-Naturalist 77(2): 108-123.

Cody, W. J. 1971. A phytogeographical study of the floras of the Continental NWT and Yukon. Naturaliste Canadien 98: 145-158.

Cody, W. J. 1978. Range extensions and comments on the vascular flora of the Continental Northwest Territories. Canadian Field-Naturalist 92(2): 144-150.

Cody, W. J. 1979. Vascular plants of restricted range in the Continental Northwest Territories Canada. Syllogeus (National Museum of Natural Sciences) 23: 57 pp.

Cody, W. J. 1996. Additions and range extensions to the vascular flora of the Northwest Territories, Canada. Canadian Field-Naturalist 110(2): 260-270.

Cody, W. J. 1998. Horned Pondweed, *Zannichellia palustris* (Zannichelliaceae), new to the vascular plant flora of the continental Northwest Territories, Canada, and deleted from the flora of the Yukon Territory. Canadian Field-Naturalist 112(4): 711-712.

Cody, W. J., and V. Johnston. 2003. *Malaxis monophyllos* var*. brachypoda*, One-sided Malaxis, new to the Northwest Territories, Canada. Canadian Field-Naturalist 117(2): 302-303.

Cody, W. J., and K. L. MacInnes. 2000. Head smut, *Ustilago bullata* on slender wheat grass *Elymus trachycaulus*, introduced along the Norman Wells Pipeline, District of Mackenzie, Northwest Territories. Canadian Field-Naturalist 114(1): 138-141.

Cody, W. J., K. L. MacInnes, J. Cayouette, and S. Darbyshire. 2000. Alien and Invasive Native Plants along the Norman Wells Pipeline, District of Mackenzie, Northwest Territories, Canadian Field-Naturalist 114: 126-137.

Cody, W.J., and A.E. Porsild. 1967. *Potamogeton illinoensis*, new to Mackenzie District. Blue Jay 25: 28-29.

Cody, W. J., and A. E. Porsild. 1968. Additions to the flora of the Continental Northwest Territories, Canada. Canadian Field-Naturalist 82: 263-275.

Cody, W. J., and K. L. Reading. 2005. Additions and range extensions to the vascular plant flora of the continental Northwest Territories and Nunavut, Canada III. Canadian Field-Naturalist 119(2): 276-290.

Cody, W. J., K. L. Reading, and J. M. Line. 2003. Additions and Range Extensions to the Vascular Plant Flora of the Continental Northwest Territories and Nunavut, Canada II. Canadian Field-Naturalist 117: 448-465.

Cody, W. J., G. W. Scotter, and S. C. Zoltai. 1992. Vascular Plant Flora of the Melville Hills Region, Northwest Territories. Canadian Field-Naturalist 106: 87-99.

Cody, W. J., and S. S. Talbot. 1978. Vascular Plant Range Extensions to the Heart Lake Area, District of Mackenzie, Northwest Territories. Canadian Field-Naturalist 92: 137-143.

Elven, R., and D. F. Murray. 2008a. The *Potentilla nivea* group in northwestern North America. Botanical Electronic News (BEN) 389: 1-6. http://www.ou.edu/cas/botany-micro/ben/ben389.html

Elven, R., and D. F. Murray. 2008b**.** The *Potentilla villosa-uniflora* group in northwestern North America. Botanical Electronic News (BEN) 390: 1-5. http://www.ou.edu/cas/botany-micro/ben/ben390.html

Garon-Labrecque, M., É. Léveillé-Bourret, K. Higgins, and O. Sonnentag. 2015. Additions to the boreal flora of the Northwest Territories with a preliminary vascular flora of Scotty Creek. Canadian Field-Naturalist 129(4): 349–367.

Gill, D. 1974. Influence of waterfowl on the distribution of *Beckmannia syzigachne* in the Mackenzie River Delta, Northwest Territories. Journal of Biogeography 1(1): 63-69.

Government of Northwest Territories. 2014. Alien or introduced plants in the Northwest Territories, with notes on invasiveness. Received from Suzanne Carriere, Government of NWT. Excel spreadsheet, updated May 2014.

Griffiths, G. C. D. 2007. Some recently discovered vascular plants in NE Alberta [*Cardamine dentata, Euphrasia hudsoniana, Utricularia stygia*]. Botanical Electronic News (BEN) 369: 1-5. http://www.ou.edu/cas/botany-micro/ben/ben369.html

Groh, H. 1949. Plants of clearing and trail between Peace River and Fort Vermilion, Alberta. Canadian Field-Naturalist 63: 119-134.

Gussow, W. C. 1933. Contribution to the knowledge of the Flora of Northern Manitoba and the North-Western Territories, Dominion of Canada. Canadian Field-Naturalist 47: 116-119.

Harper, F. 1931. Some plants of the Athabaska and Great Slave Lakes region. Canadian Field-Naturalist 45: 97-107.

Hernandez, H. 1973. Natural plant recolonization of surficial disturbances, Tuktoyaktuk Peninsula Region, Northwest Territories. Canadian Journal of Botany 51: 2177-2196.

Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press, Stanford, California. 1008 pp.

Jasieniuk, M. A., and E. A. Johnson. 1979. A vascular flora of the Caribou Range, Northwest Territories, Canada. Rhodora 81: 249-274.

Jeffrey, W. W. 1961. Notes on plant occurrence along Lower Liard River, Northwest Territories. National Museum of Canada Bulletin 171: 32-115.

Larsen, J. L. 1969. Vegetation of Fort Reliance, Northwest Territories. Canadian Field-Naturalist 85: 147-178.

Line, J., G. Brunner, R. Rosie, and K. Russell. 2008. Results of the 2007 Invasive Plant Roadside Inventory in Yukon. Available at: http://www.env.gov.yk.ca/publications-maps/documents/invasive_plants_roadside_inventory2008.pdf. Accessed May, 2016.

Luttmerding, H.A., D.A. Demarchi, E.C. Lea, D.V. Meidinger, and T. Vold (editors). 1990. Describing Ecosystems in the Field. 2nd Edition. B.C. Ministry of Environment, Lands and Parks and B.C. Ministry of Forestry. Ministry of the Environment (MOE) Manual 11. Victoria, B.C.

McJannet, C. L., G. W. Argus, and W. J. Cody. 1995. Rare Vascular Plants in the Northwest Territories. Syllogeus 73, Canadian Museum of Nature, Ottawa. 104 pages.

Moss, E. H. 1983. Flora of Alberta. Second Edition, revised by J.G. Packer. University of Toronto Press, Toronto. 687 pages.

Mulligan, G. A., and W. J. Cody. 1968. *Draba norvegica*, disjunct to the Mackenzie District, Northwest Territories, Canada. Canadian Journal of Botany 46: 1334-1335.

Mulligan, G. A., and W. J. Cody. 1995. New information on the problem of Asiatic Cress, *Rorippa crystallina* Rollins (Brassicaceae). Canadian Field-Naturalist 109(1): 111-112.

Oldham, M. J. 2007. 2006 Survey of Exotic Plants along Northwest Territories Highways. Report to Department of Energy and Natural Resources, Government of Northwest Territories. Available at: http://www.enr.gov.nt.ca/sites/default/files/reports/exotic_plants_survey.pdf. Accessed May, 2016.

Porsild, A. E. 1943. Materials for a flora of the continental Northwest Territories of Canada. Sargentia 4: 1-79.

Porsild, A. E. 1945. The alpine flora of the east slope of Mackenzie Mountains, Northwest Territories. National Museum of Canada Bulletin 101: 1-35.

Porsild, A. E. 1950. The genus *Antennaria* in Northwestern Canada. Canadian Field-Naturalist 64: 1-25.

Porsild, A. E. 1951. Botany of southeastern Yukon adjacent to the Canol Road. National Museum of Canada Bulletin 121.

Porsild, A. E. 1961. The Vascular Flora of an Alpine Valley in the Mackenzie Mountains, N.W.T. National Museum of Canada Bulletin 171: 116-130.

Porsild, A. E., and W, J. Cody. 1968. Checklist of the vascular plants of continental Northwest Territories, Canada. Plant Research Institute, Canada Department of Agriculture, Ottawa. 102 pages plus map.

Porsild, A. E., and W. J. Cody**.** 1980. Vascular Plants of Continental Northwest Territories, Canada. National Museum of Natural Sciences, Ottawa. 667 pages.

Porsild, A. E., and H. Crum. 1961. The vascular flora of Liard Hotsprings, B.C., with notes on some bryophytes. National Museum of Canada Bulletin 171: 131-197.

Preble, E. A. 1908. A biological investigation of the Athabaska—Mackenzie region. North American Fauna 27.

Rabeler, R. K., and J. W. Thieret. 1997. *Sagina* (Caryophyllaceae) range extensions in Canada: *S. japonica* new to Newfoundland; *S. procumbens* new to the Northwest Territories. Canadian Field-Naturalist 111(2): 309-310.

Raup, H. M. 1930a. A new species of Salix from the Mackenzie Basin [*S. athabascensis*]. Rhodora 32: 111-112.

Raup, H. M. 1930b. The distribution and affinities of the vegetation of the Athabasca-Great Slave Lake region. Rhodora 32(332): 187-208.

Raup, H. M. 1931a. The genus *Geum* in the Athabasca-Great Slave Lake region [*G. macrophyllum*]. Rhodora 33(391): 172-176.

Raup, H. M. 1931b. *Salix glauca* L. and its allies in the Athabasca-Great Slave Lake region. Rhodora 33: 241-244.

Raup, H. M. 1934. Phytogeographic studies in the Peace and Upper Liard River regions, Canada. Contribution from the Arnold Arboretum of Harvard University 6: 1-230.

Raup, H. M. 1934. A new species of *Euphrasia* from northwestern Canada [*E. subarctica*]. Rhodora 36: 87-88.

Raup, H. M. 1935. Botanical investigations in Wood Buffalo Park. National Museum of Canada Bulletin 74: 1-174.

Raup, H. M. 1936. Phytogeographic studies in the Athabasca - Great Slave Lake region. I. Catalogue of the vascular plants. Journal of the Arnold Arboretum 17: 180-315.

Raup, H. M. 1946. Phytogeographic studies in the Athabasca - Great Slave Lake Region. II. Journal of the Arnold Arboretum 27: 1-85.

Raup, H. M. 1941. Botanical problems in boreal America. II. Botanical Review 7: 209-248.

Raup, H. M. 1947. The botany of southwestern Mackenzie. Sargentia VI: 1-275.

Raup, H. M. 1959. The willows of boreal western America. Contr. Gray Herb. Harvard Univ. 185: 3-95.

Rollins, R. C. 1962. A new crucifer from the Great Slave Lake area of Canada. Rhodora 64: 324-327. [*Rorippa crystallina*]

Scotter, G. W. 1966. A contribution to the flora of the eastern arm of Great Slave Lake, Northwest Territories. Canadian Field-Naturalist 80: 1-18.

Scotter, G. W., and W. J. Cody. 1974. Vascular Plants of Nahanni National Park and Vicinity, Northwest Territories. Naturaliste Canadien 101: 861-891.

Snyder, E., and Anions, M. 2008. Pathways Analysis of Invasive Plants and Insects in the Northwest Territories. Report for the Department of Environment and Natural Resources, Wildlife Division, Government of the Northwest Territories. Project No: PM 005529. 28 pages, 5 appendices.

Straley, G. B. 1986. Wild Bergamot, *Monarda fistulosa* (Lamiaceae), new to the Northwest Territories. Canadian Field-Naturalist 100(3): 380-381.

Thieret, J. W. 1959. Grassland vegetation near Fort Providence, Northwest Territories. Canadian Field-Naturalist 73: 161-167.

Thieret, J. W. 1961a. A collection of plants from the Horn Plateau, District of Mackenzie. Canadian Field-Naturalist 75: 77-83.

Thieret, J. W. 1961b. New Plant Records for Southwestern District of Mackenzie. Canadian Field-Naturalist 75: 111-121.

Thieret, J. W. 1962. New plant records from District of Mackenzie, Northwest Territories. Canadian Field-Naturalist 76: 206-208.

Thieret, J. W. 1963a. Botanical survey along the Yellowknife Highway, Northwest Territories, Canada. I. Catalogue of the flora. Sida 1: 117-170.

Thieret, J. W. 1963b. Additions to the flora of the Northwest Territories. Canadian Field-Naturalist 77: 126.

Thieret, J. W. 1963c. Life-forms in the plains flora of southern Mackenzie, Northwest Territories. Rhodora 65: 149-157.

Thieret, J. W. 1964. Botanical survey along the Yellowknife Highway, Northwest Territories, Canada. II. Vegetation. Sida 1(4): 187-239.

Upadhyaya, M. K., R. Turkington, and D. Mclvride. 1986. The biology of Canadian weeds. 75. *Bromus tectorum* L. Canadian Journal of Plant Science 66: 689-709.

Wein, R. W., G. Wein, S. Bahret, and W. J. Cody. 1992. Northward invading non-native vascular plant species in and adjacent to Wood Buffalo National Park, Canada. Canadian Field-Naturalist 106 (2): 216-224.

Working Group on General Status of NWT Species. 2016. NWT Species 2016-2020 – General Status Ranks of Wild Species in the Northwest Territories, Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 304 pp.

6.0 Appendices

Appendix A - NWT 2016 Highway Survey Exotic Plant Data Entry Form

Appendix B. Instructions for completing the "*NWT 2016 Highway Survey Exotic Plant Data Entry Form*" and database.

Appendix C. NWT 2016 Walking Survey Exotic Plant Data Entry Form.

Appendix D. Instructions for completing "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" and database.

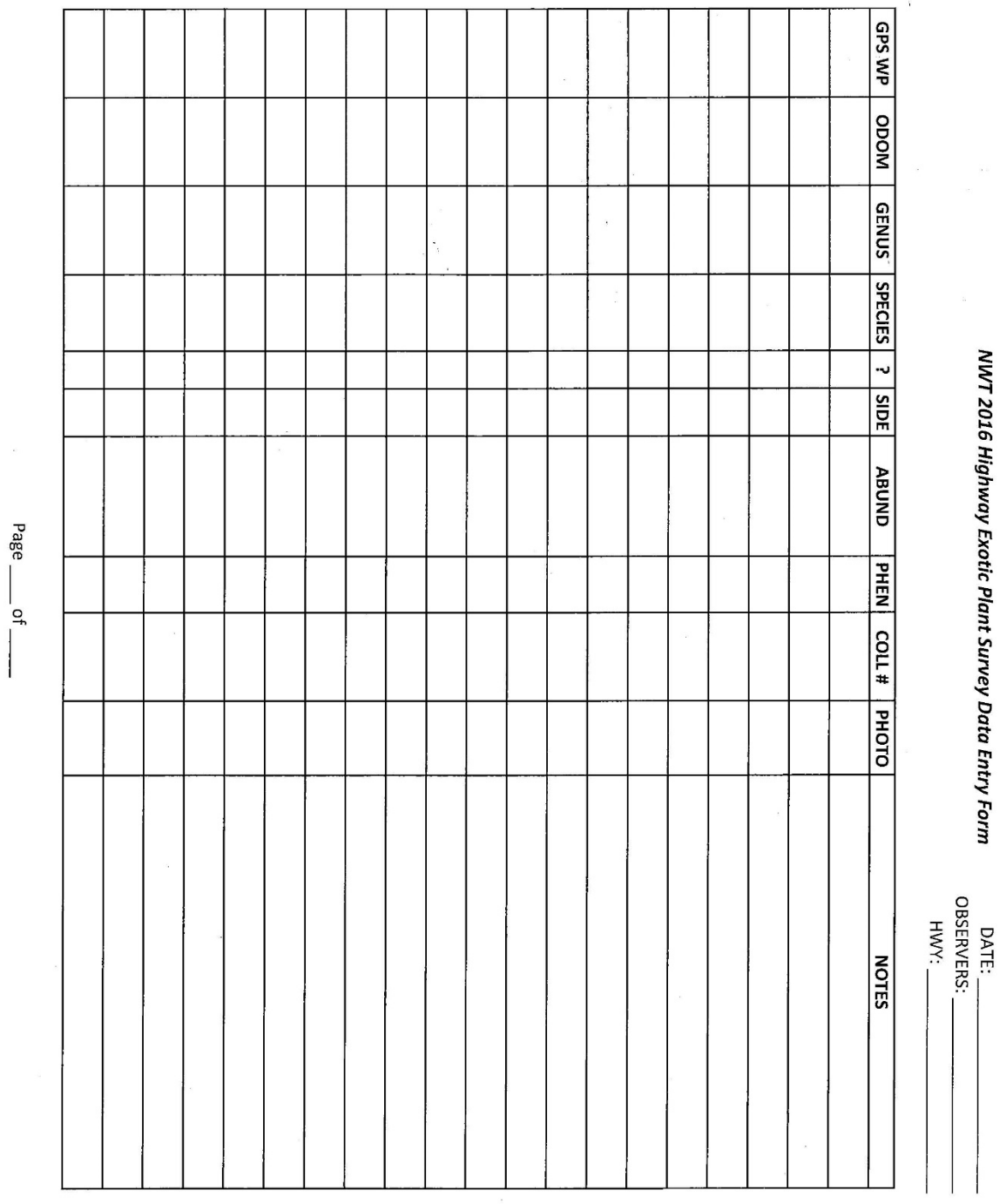
Appendix E. Database of all records gathered during the 2016 NWT exotic plant survey (n = 3492). [NOTE – external file; not included in this report document.]

Appendix F. NWT exotic plant species summary spreadsheet. [NOTE – external file; not included in this report document.]

Appendix G. NWT 2016 exotic plant survey digital photos (n =348). [NOTE – external file; not included in this report document.]

Appendix H. NWT 2016 exotic plant survey digital photo catalogue. [NOTE – external file; not included in this report document.]

Appendix A. NWT 2016 Highway Survey Exotic Plant Data Entry Form



NWT 2016 Highway Exotic Plant Survey Data Entry Form

DATE: _____
OBSERVERS: _____
HWY: _____

GPS WP	ODOM	GENUS	SPECIES	?	SIDE	ABUND	PHEN	COLL #	PHOTO	NOTES

Page ____ of ____

Appendix B. Instructions for completing "*NWT 2016 Highway Survey Exotic Plant Data Entry Form*" and database.

- At the beginning of each highway survey day enter the Date, Observers (full names on first page, initials on subsequent pages), and Highway (number) on the top right of the survey form.
- Take a GPS waypoint at the start of the survey, enter the waypoint number in Column 1 (GPS WP).
- Zero the odometer/trip timer and enter "0.0" in Column 2 (ODOM).
- Enter in Column 11 (NOTES) a description of survey start location and direction of travel (e.g. "Hwy. 7 at entrance to Blackstone TP, driving north"), weather, and other relevant details (e.g. highway conditions).
- When an exotic plant species is observed on the highway shoulder during the first 10 km driven, record:
    - The first 4 letters of the genus in Column 3 (GENUS) and the first 4 letters of the species in Column 4 (SPECIES). If only the genus is known, enter SP in Column 4.
    - If identification of the plant species is not certain, enter a "?" in Column 5 (?). If desired, notes can be added in Column 11 to explain.
    - Which side of the road the species was observed on using L (left), R (right) or both in Column 6 (SIDE); if a species is initially observed on one side of the road, then later within the same 5 km stretch, on the other side of the road, enter both sides, e.g. R, L. [Note that in general this information was not recorded in 2016.]
    - The abundance of the species within the 5 km survey stretch in Column 7 (ABUND) using the following codes: CONT (continuous); SPOR HIGH (sporadic – high abundance); SPOR LOW (sporadic – low abundance); RARE (rare). See the methodology document, Table 2, for detailed descriptions of the abundance categories. Since abundance may change over a 5 km stretch, it may work best to fill in this column at the end of each 5 km survey stretch.
    - Whether the plant species was non-flowering (NON), in bud (BUD), flowering (FL), fruiting (FR), dehiscent (DE; fruits opened, seeds dispersed), or unknown (UNK) in Column 8 (PHEN).
    - If a specimen was collected, enter the collection number in Column 9 (COLL #). Additional information for specimens collected will be recorded in a field notebook (e.g. associated species, habitat description).
    - If a photo was taken, enter YES or photo #(s) in Column 10 (PHOTO). Photo numbers can potentially be added later (e.g. when photos are downloaded later in the day).
    - Notes related to a particular exotic plant species or to other observations (e.g. fauna, landmarks, etc.) can be recorded in Column 11 (NOTES). Use additional rows if more space is needed for Notes.
- After 10 km have been driven, take a new GPS waypoint and odometer reading and repeat the process described above.

- If unusual species are observed, a precise GPS waypoint can be taken and information entered.
- If a brief stop is made during a 10 km stretch (e.g. to take a photo or collect a specimen), take a GPS waypoint and enter relevant information.
- If a stop also involves a walking survey (e.g. for a roadside pull-off, riparian area, gravel pit), then a separate "Walking Survey Data Entry Form" will be completed. Take a GPS waypoint, record the Odometer reading, and enter in NOTES that a Walking Survey was undertaken.
- When a new data sheet(s) is started, the date, observers (initials), and highway number will be entered and page numbers (page x of y) recorded at the bottom of each page.
- For post-survey data entry, use an Excel spreadsheet with the same fields as the columns in the "Highway Survey Data Entry Form", except that additional columns will be added for Date, Observers, and Highway (and potentially other columns as needed).

Appendix C. NWT 2016 Walking Survey Exotic Plant Data Entry Form.

NWT 2016 Walking Survey Exotic Plant Data Entry Form

DATE: _____

START/FINISH TIME: _____

OBSERVERS: _____

TYPE/LOCATION: _____

GPS WP	ODOM	GENUS	SPECIES	?	ABUND	PHEN	COLL #	PHOTO	NOTES

Page ____ of ____

Appendix D. Instructions for completing "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" and database.

- The "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" is to be used for all exotic plant survey types except for highway surveys. This includes **P** (pull-outs and rest stops), **G** (gravel pits), **R** (riparian systems), **C** (campgrounds), **U** (urban areas), and **O** (other).
- At the beginning of each walking survey enter the Date and Time (start/finish), Observers (full names on first page, initials on subsequent pages), and Survey Type (1-letter code indicated above) and Location on the top right of the survey form.
- Take a GPS waypoint at the start of the walking survey, enter the waypoint number in Column 1 (GPS WP).
- If the walking survey is adjacent to a highway (e.g. for P, G, R surveys) record the odometer reading in Column 2 (ODOM).
- Enter in Column 10 (NOTES) a description of survey start location, direction of travel, and any other relevant details (e.g. weather conditions, recent mowing or other disturbance). If the walking survey involves a significant change in direction (e.g. pull-out survey involving walking in one direction for 100 metres then crossing the road and walking back), then another GPS waypoint should be taken at the point where the travel direction changes and the new direction indicted in Notes.
- For each exotic plant species observed on the walking survey, record:
    - The first 4 letters of the genus in Column 3 (GENUS) and the first 4 letters of the species in Column 4 (SPECIES). If only the genus is known, enter SP in Column 4.
    - If identification of the plant species is not certain, enter a "?" in Column 5 (?). If desired, notes can be added in Column 11 to explain.
    - The abundance of the species along the walking survey route in Column 6 (ABUND) using the following codes: CONT (continuous); SPOR HIGH (sporadic – high abundance); SPOR LOW (sporadic – low abundance); RARE (rare). See the methodology document, Table 2 and Appendix C, for detailed descriptions of the abundance categories.
    - Whether the plant species was non-flowering (NON), in bud (BUD), flowering (FL), fruiting (FR), dehiscent (DE; fruits opened, seeds dispersed), or unknown (UNK) in Column 7 (PHEN).
    - If a specimen was collected, enter the collection number in Column 8 (COLL #). Additional information for specimens collected will be recorded in a field notebook (e.g. associated species, habitat description).
    - If a photo was taken, enter YES or photo #(s) in Column 9 (PHOTO). Photo numbers can potentially be added later (e.g. when photos are downloaded later in the day).

  - Notes related to a particular exotic plant species or to other observations (e.g. fauna, landmarks, etc.) can be recorded in Column 10 (NOTES). Use additional rows if more space is needed for Notes.
- If unusual species are observed, collected, or photographed during a walking survey, a precise GPS waypoint should be taken and relevant information recorded.
- When a new data sheet(s) is started for the same walking survey, the information at the top right of the form should be repeated and page numbers (page x of y) recorded at the bottom of each page.
- For post-survey data entry, use an Excel spreadsheet with the same fields as the columns in the "Walking Survey Data Entry Form", except that additional columns will be added for Date, Start Time, Finish Time, Observers, Survey Type and Survey Location (and potentially other columns as needed).

Appendix D. Instructions for completing "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" and database.

- The "*NWT 2016 Walking Survey Exotic Plant Data Entry Form*" is to be used for all exotic plant survey types except for highway surveys. This includes **P** (pull-outs and rest stops), **G** (gravel pits), **R** (riparian systems), **C** (campgrounds), **U** (urban areas), and **O** (other).
- At the beginning of each walking survey enter the Date and Time (start/finish), Observers (full names on first page, initials on subsequent pages), and Survey Type (1-letter code indicated above) and Location on the top right of the survey form.
- Take a GPS waypoint at the start of the walking survey, enter the waypoint number in Column 1 (GPS WP).
- If the walking survey is adjacent to a highway (e.g. for P, G, R surveys) record the odometer reading in Column 2 (ODOM).
- Enter in Column 10 (NOTES) a description of survey start location, direction of travel, and any other relevant details (e.g. weather conditions, recent mowing or other disturbance). If the walking survey involves a significant change in direction (e.g. pull-out survey involving walking in one direction for 100 metres then crossing the road and walking back), then another GPS waypoint should be taken at the point where the travel direction changes and the new direction indicted in Notes.
- For each exotic plant species observed on the walking survey, record:
    - The first 4 letters of the genus in Column 3 (GENUS) and the first 4 letters of the species in Column 4 (SPECIES). If only the genus is known, enter SP in Column 4.
    - If identification of the plant species is not certain, enter a "?" in Column 5 (?). If desired, notes can be added in Column 11 to explain.
    - The abundance of the species along the walking survey route in Column 6 (ABUND) using the following codes: CONT (continuous); SPOR HIGH (sporadic – high abundance); SPOR LOW (sporadic – low abundance); RARE (rare). See the methodology document, Table 2 and Appendix C, for detailed descriptions of the abundance categories.
    - Whether the plant species was non-flowering (NON), in bud (BUD), flowering (FL), fruiting (FR), dehiscent (DE; fruits opened, seeds dispersed), or unknown (UNK) in Column 7 (PHEN).
    - If a specimen was collected, enter the collection number in Column 8 (COLL #). Additional information for specimens collected will be recorded in a field notebook (e.g. associated species, habitat description).
    - If a photo was taken, enter YES or photo #(s) in Column 9 (PHOTO). Photo numbers can potentially be added later (e.g. when photos are downloaded later in the day).

  - Notes related to a particular exotic plant species or to other observations (e.g. fauna, landmarks, etc.) can be recorded in Column 10 (NOTES). Use additional rows if more space is needed for Notes.
- If unusual species are observed, collected, or photographed during a walking survey, a precise GPS waypoint should be taken and relevant information recorded.
- When a new data sheet(s) is started for the same walking survey, the information at the top right of the form should be repeated and page numbers (page x of y) recorded at the bottom of each page.
- For post-survey data entry, use an Excel spreadsheet with the same fields as the columns in the "Walking Survey Data Entry Form", except that additional columns will be added for Date, Start Time, Finish Time, Observers, Survey Type and Survey Location (and potentially other columns as needed).