Results of the 2007 Invasive Plants Roadside Inventory in Yukon

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Photo credit: M. Brunner

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Executive Summary

Over the last decade non-native plants have been observed expanding their ranges in Yukon and a number of new non-native plants have been discovered. There is concern that with climate change invasive plants could cause ecological and economic damage like that seen in southern jurisdictions and in Alaska. In order to develop a strategy for combating invasive plants, we required a baseline inventory. Along major Yukon highways, we mapped the distribution of Sweetclover, a plant that threatens native habitats along rivers. The patterns of distribution of Sweetclover show that invasion is most pronounced in areas that have received recent highway construction and maintenance. Furthermore, populations around bridges and culverts pose a risk to river ecosystems. We also recorded the presence and abundance of non-native and invasive species at rest stops, campgrounds, gravel pits and other disturbed areas along major Yukon highways. Pullouts and rest stops which receive the most vehicle traffic had the highest diversity of non-native plants. This work provided baseline data for monitoring the spread of invasive plants along highways and offers suggestions for a long-term monitoring methodology. Location information for invasive plants presented in this report can be used in an Early Detection and Rapid Response strategy.

Title page image: A highway rest stop that contained a diversity of non-native plants: Smooth Brome, Alfalfa, Sweetclover and Crested Wheat Grass are visible.

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Introduction

Invasive plants are defined in this report as plants that are **not native** and have **negative effects** on our environment, our health and our economy. Around the globe "there is an increasing realization of the ecological costs of biological invasion in terms of irretrievable loss of native biodiversity" (ISSG 2008). Invasive plants can displace native plants, destroy wildlife habitat and modify ecosystems. They facilitate introduction of insect pests, invasive animals and diseases. Furthermore, invasive plants can affect our health and economy. They reduce agricultural production. They create safety issues along highways by obstructing sightlines and attracting wildlife. In a report drafted in 2002, it was determined that the 'cumulative annual costs in Canada of dealing with 16 invasive plants alone was estimated to be between $13.3 and $34.5 billion'; these estimates were known to be incomplete (Canada 2004).

Invasive species have been receiving more attention north of 60° in recent years. Alaska has experienced an exponential increase in invasive plants in the last 40 years (Carlson and Shephard 2007) and has a sizable budget earmarked for research and management. In Yukon we are observing the effects of invasive plants on native ecosystems, highway maintenance and agricultural activity. The Invasive Alien Species Strategy for Canada (Canada 2004) stresses that **prevention** is the key: the best way to avoid the high costs of control is to develop an **Early Detection and Rapid Response strategy (EDRR)**.

Up until recently we believed that introduced plants that have major impacts in the south have little or no impact on Yukon landscapes simply because of the harsher environmental conditions we experience. However, since climate change may ameliorate some of these conditions, it is important to study all non-native species to monitor their long-term impacts in the territory.

Based on incidental observations made in Yukon over the last decade, it appears that non-native plants that have existed in small populations for the last 60 years have started expanding their ranges. Furthermore, newly discovered plant species that are considered invasive in other jurisdictions have been surviving winters and becoming established (B.A. Bennett, pers. comm. 2007). It is believed that with a warmer and wetter climate in Yukon, more invasive plants will establish, over-winter and spread across our landscape.

In order to develop a strategy for combating invasive plants, we required a baseline inventory. Since roadways are thought be the most important vector for dispersing invasive plants in Yukon we surveyed disturbed areas along major Yukon highways (Figure 1). Prior to this survey, no Yukon-wide inventories specific to invasive plants had been conducted.

The **objectives** for this inventory work were threefold. The first objective was to document in detail the distribution of Sweetclover along major Yukon highways. This work is discussed in Part 1 of this report. The second objective was to record presence and abundance of invasive species at rest stops, campgrounds, gravel pits and other disturbed areas along major Yukon highways. This work is discussed in Part 2 of this report. Finally, we wanted to develop a suitable methodology for long-term monitoring of invasive plants along highways in Yukon.

With a small inventory budget we wanted to ensure that major highways were surveyed in 2007 to get a broad picture of the status of roadside non-native and invasive plants in Yukon. Between July 18 and August 9, Greg Brunner and Marlen Brunner conducted surveys along the following highways: Alaska Highway west of Teslin to the Alaska border; Robert Campbell west of Ross River, Klondike, Tagish, Haines, South Canol, Silver Trail and Top of the World highways. Between August 12 & 19, Rhonda Rosie surveyed the Robert Campbell Highway between Ross River and Watson Lake, and the Alaska Highway between the British Columbia-Yukon border near Watson Lake to the town of Teslin. Twenty-four days of travel were used to complete this survey and over 3000 kilometers of Yukon highways were surveyed.

Figure 1. A 2007 survey site: a rest stop infested with Narrow-leaved Hawk's beard. Photo credit: M. Brunner 2007

Part I: The Distribution of White and Yellow Sweetclover along Yukon Highways in 2007

Introduction

One non-native species that has been spreading rapidly along roadsides and has captured the attention of many Yukoners is Sweetclover (Figure 2). Plant taxonomists have recently lumped the white-flowered White Sweetclover (*Melilotus albus*) and the yellow-flowered Yellow Sweetclover (*Melilotus officinalis*) into a single species, *Melilotus officinalis.*

Sweetclovers are in the legume family (Fabaceae) and are prized for their ability to fix nitrogen in nutrient-poor soils; consequently, they continue to be used by a small number of Yukon farmers to improve crop yields. Sweetclover has become a problem along Yukon roadways, however, as it threatens native ecosystems and poses risks to highway users.

Figure 2a. Wading through shoulder-high Sweetclover. Photo credit: G. Brunner

Figure 2b. Sweetclover is a very robust plant, as illustrated by these stems.
Photo credit: G. Brunner

Along the LaBiche River in southeast Yukon, Sweetclover has invaded and inundated gravel bars (Figure 3). Gravel bars of this region would normally contain sparse native vegetation and open cobble shoreline, suitable for some nesting shorebirds like Spotted Sandpipers. Sweetclover has also been found on gravel bars in Yukon River north of Whitehorse. The dried stalks from previous years may affect fire regimes. Use of gravel bars covered in Sweetclover for camping becomes impossible, or at least less attractive.

Figure 3. Sweetclover carpets a gravel bar along the LaBiche River in 2004.
Photo credit: Environment Yukon (B. Bennett)

River corridors and wetlands in northwestern BC and in Alaska (Conn et al. 2008) have also become overgrown with Sweetclover and significant management efforts are underway.

Because it can grow over a metre in height, Sweetclover can obstruct signage (Figure 4) and generally reduce visibility for drivers. It can also become a food source for wildlife such as mule deer (Figure 5) and thus increase the risk of vehicle accidents with wildlife.

Figure 4. Flowering Sweetclover plants along the Alaska Highway near Mendenhall obstruct signage in 2005. Photo credit: L. Freese

Figure 5. Mule deer feeding on Sweetclover along the edge of the Alaska Highway in 2006.
Photo credit: Environment Yukon (N. Leenders).

Highway maintenance crews with Yukon Highways and Public Works have been mowing Sweetclover patches along the edges of highways in Yukon for over a decade. Their efforts to control Sweetclover have been increasing steadily with significant efforts made in the last 3-4 years. Staff are working on improving strategies to control Sweetclover (Omtzigt 2008).

The purpose of this portion of the survey was to digitally record and map the distribution of Sweetclover along major Yukon highways.

This information will prioritize areas upon which highway maintenance staff can focus their management efforts. It will also highlight native ecosystems that are vulnerable to invasion, such as road-accessible watersheds with gravel bars and wetlands.

Methods

Surveys

A GPS waypoint was recorded at the beginning of highway travel. While driving slowly (~30-40 km/hr), surveyors recorded the abundance of Sweetclover based on **three predefined classes: continuous** where plants formed a continuous mat along the side of the highway; **sporadic** where plants formed occasional mats less than 100 metres long that were broken by large sections (several hundred metres) of scattered or no growth; or **absent/rare** where there were no plants or very few plants seen. When a change in abundance was noted over approximately 200 metres, a waypoint was taken and a new abundance class assigned.

Data Preparation and Map Building

Point data from the survey (GPS waypoints) were imported into a GIS (ESRI Arc View 3.3). The point data were overlain on the 1:250 000 NTDB highways layer for the Yukon Territory. These waypoints were then used to split the highway layer into segments. Each segment was assigned the appropriate abundance class: Continuous, Sporadic or Absent/ rare. These segments were joined to create a single shapefile used in the final map.

Results and Discussion

Figure 6 is a map of the distribution of Sweetclover on Yukon highways in 2007, based on the recorded abundance classes: continuous, sporadic or absent/ rare. Note that for presentation purposes the data were simplified for ease of interpretation. Digital data are accurate to +/- 200 m and are available upon request at NatureServe Yukon.

Patches of continuous Sweetclover were predominantly recorded along the highways near the major communities of: Watson Lake, Teslin, Whitehorse, Haines Junction, Carmacks, Faro, Mayo and Dawson. The most extensive 'continuous' patches were recorded east and north of Carmacks and east and west of Teslin (Figure 6).

Sporadic Sweetclover was observed along much of the length of the Alaska Highway southeast of Whitehorse, with a few exceptions (most evidently between Jake's Corner and Johnson's Crossing; between Haines Junction and the White River crossing; and in sections between Whitehorse and Haines Junction). Sporadic Sweetclover was also recorded on the Klondike Highway between Whitehorse and Dawson and along the Robert Campbell Highway between Watson Lake and Frances Lake (Figure 6).

Roads along which Sweetclover was more or less absent included: the Haines Highway south of Haines Junction; the Alaska Highway between Haines Junction and Burwash Landing; the South Canol; and the Robert Campbell Highway between Faro and Frances Lake. Between Ross River and Money Creek (at Frances Lake), Sweetclover was observed in small patches only where recent roadwork or other disturbance has occurred, and as small patches or isolated individuals elsewhere. It was absent from most of the gravel pits and other disturbed sites visited in this region (Figure 6).

Infested areas containing continuous or sporadic Sweetclover that have direct access to major river systems are visible on the map (Figure 6). The Yukon River and its tributaries are vulnerable to an abundant source of Sweetclover seed in the Whitehorse, Carmacks, Stewart Crossing and Dawson areas. Other areas of concern include: the Frances River northwest of Watson Lake; the Teslin River at Teslin and northwest of Teslin along the Alaska Highway; the Dezadeash and Alsek Rivers at Haines Junction. As seen in Alaska (Conn et al 2008), these rivers are at risk from an invasion of Sweetclover in the near future if attempts are not made to remove the seed source around bridges and culverts.

Sweetclover is predominantly a biennial plant, meaning it has a two year life cycle. The first year the plant produces no flowers or seeds and is focused on growing a solid root system. The plant has a smaller stature in this first year. The second year the plant produces conspicuous flowers and grows to approximately 2 metres tall. With this in mind, some observer bias is likely to exist towards detecting flowering plants and overlooking first-year plants.

The map is only accurate for the 2007 growing season.

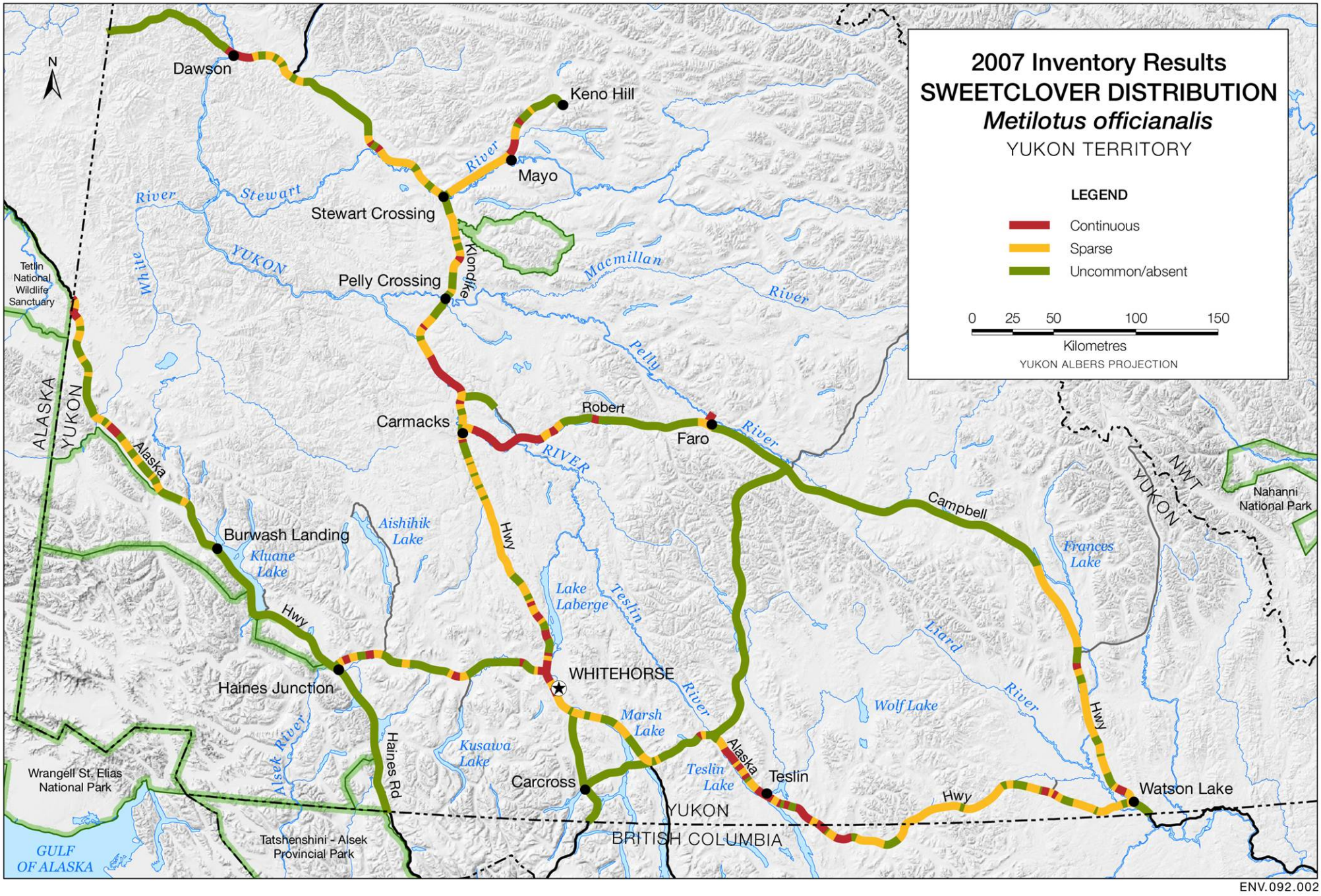

Figure 6. The distribution of Sweetclover along major Yukon Highways, as recorded in 2007.

Sweetclover Management along roadsides: considerations

Less 'disturbed' roadways have fewer Sweetclover problems

Surveyors observed that some roads, undisturbed by upgrading or major road reconstruction for more than 20 years, had few or no patches of Sweetclover. This may indicate that at the time of disturbance a bank of seeds had yet to establish in the soil. With no recent disturbance, there have been no opportunities for the plants to establish.
For example, Sweetclover and other invasive species were limited in distribution along most of the Robert Campbell Highway. The exception was the southern end of the highway, from Watson Lake north for approximately 113 km along which Sweetclover was recorded as continuous or sporadic. Recent road construction has taken place on this portion of the highway (K. Jeffery, pers. comm. 2008). Similarly, the South Canol Road #6 had received comparatively little road maintenance, no recent road improvements and no Sweetclover was observed in 2007.

Potential modes of dispersal of Sweetclover along highways

Based on surveyors' observations, a number of potential sources for Sweetclover dispersal were noted. First, road construction and maintenance work disturb soils, making perfect habitat for Sweetclover. Frequent soil disturbance eliminates competition from other plants and prepares the soil for rapidly-growing Sweetclover. Larger infestations of Sweetclover along the highways appeared to correspond with recent highway maintenance (but Sweetclover was also present in very small amounts where no recent roadwork activity was apparent). Sweetclover was found in abundance along the highway shoulders, in cleared right-of-ways and in the gravel pits used for highway maintenance.

Second, Sweetclover-infested gravel pits may act as seed nurseries, producing seeds that can then be dispersed widely to construction sites. Two actively used gravel pits along the Klondike and Robert Campbell highways (sites RC9 and KH29 in the inventory database), had very large infestations. The west end of the Robert Campbell Highway #4 had an extensive infestation of Sweetclover. Gravel pit RC9 is located in this area and may have contributed to the dispersal of Sweetclover seed along adjacent roadways.

Third, wider shoulders that are frequently graded or plowed for snow removal and large cleared right-of-ways that are frequently mowed are prime sites for Sweetclover infestations.

Fourth, brush-cutting and mowing equipment (Figure 7) that is not cleaned frequently can act as a seed-dispersal mechanism. Two brush cutting projects, one near MacGregor Creek and one near Dawson, were observed in progress on the Klondike Highway #2 North in early August 2007. Sweetclover was of robust continuous distribution and had gone to seed. It appeared likely that the mechanical cutters would not only act to cast the seed in the immediate area in which they were working, but could also carry the seed in the machinery to new areas.

Finally, vehicle tires, people and their pets can all play a role in dispersing Sweetclover seed along roadways.

Figure 7a. Mowing equipment near Whitehorse. Photo credit: Environment Yukon (J.Line)

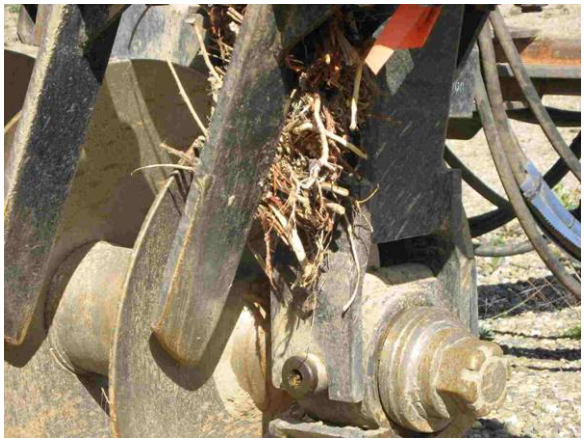

Figure 7b. Vegetation trapped in brush-cutting equipment. Seeds could easily be transported in this manner. Photo credit: M. Brunner

Controlling Sweetclover poses great challenges for highway maintenance staff. If the plants are cut during seed set (late July to freeze-up), the machinery will help disperse the seed. If the plants are cut too early in the season (~prior to mid-July), the plants will regenerate flowers and set seed before the growing season is over (Figure 8). This means there is a limited time period to curb the growth of the plants. Ideally, the plants should be cut two times per year, once early in the growing season and again before the regenerated plants finish flowering and set seed. It is important to kill the Sweetclover plants before they produce seed as each plant can produce up to 350,000 seeds and these seed can survive in the soil for up to 81 years (Klemow and Raynal 1981 as cited in Alaska Natural Heritage Program 2006).

The biennial nature of the plant also means that seed production takes place over a two year cycle. This needs to be considered when scheduling mowing or other management regimes; areas that were heavily infested with flowering plants the year before may not be of highest priority for mowing in the subsequent year. A Department of Highways and Public Works draft report describes the challenges encountered when attempting to manage roadside Sweetclover and suggests new strategies to consider (Omtzigt 2008). A multi-disciplinary approach may be most effective. Reducing the size of cleared right-of-ways and allowing native vegetation to compete with the Sweetclover may be the most effective means for control.

Figure 8. This Yukon roadside was mowed early in the season. Weeks later the stunted plants have regenerated flowers. Photo credit: G.Brunner

Suggested Modifications to the 2007 Sweetclover Inventory Methodology

Special efforts should be made to survey stream and river crossings (i.e. bridges and culverts) during future Sweetclover inventories along roadways. Furthermore, inventories should include Yukon river systems to detect spread along gravel bars, sand dunes and other riparian areas that appear to be suitable Sweetclover habitat.

The “sporadic” class may not be as informative as it could be. It may be more descriptive to split this class into, e.g. “Sporadic of high abundance” or “Sporadic of low scattered abundance”, to show that Sweetclover was consistently present but of varying growth density. Next time the definitions of classes could be more refined.

This work is more efficiently done with two people, a driver and a surveyor. Working alone while attempting to observe and record Sweetclover distribution presents some difficulties since the GPS waypoint and class must be recorded while driving on the highway. This could pose a safety issue for surveyors.

Because Sweetclover is a biennial, using a two-consecutive-year inventory program would give better distribution information. On several occasions, especially in the Mayo area, it was difficult to record Sweetclover abundance due to the very low growth of first year plants. Visiting some or all of the sites that were classified as ‘continuous’ or ‘sporadic’ in several years will help to follow the vegetation changes that are occurring on partially vegetated sites. These visitations should correspond to predicted flowering (i.e. second year growth) years.

It would also be valuable to collaborate with Highways and Public Works staff prior to future surveys. Using information about HPW mowing and construction schedules as well as historical information on construction and reclamation efforts would improve the survey strategy and provide important context for interpreting the data.

Part 2: The 2007 Invasive Plant Inventory at roadside rest-stops, pullouts, gravel pits and campgrounds along major Yukon Highways

Introduction

How many invasive plant species grow along Yukon highways and where are they growing? Hultén (1968) and Cody (1996) provided our first glimpses into the distribution of non-native plants in Yukon. The dot distribution maps in these two publications are compilations of herbarium records. These maps are now out of date and need updating. Bennett and Mulder (In press) have compiled a history of the introduction and spread of invasive plants in the Yukon. A list of known non-native plants in Yukon is frequently updated (Bennett 2008).

Prior to this inventory, few invasive plant surveys were conducted. While working in the Yukon Government Agriculture Branch between 1993-1995, Randy Lamb conducted surveys of Yellow Toadflax, Oxeye Daisy, Scentless False Mayweed and Knapweed. (R. Lamb, pers. comm. 2008). In 1999, Bruce Bennett conducted surveys of Sweetclover, Alfalfa and Sow-thistle. In 2000, Phil Caswell compiled a list of non-native plants growing around the borders of Kluane National Park (Caswell 2000).

This inventory provides baseline data for monitoring the introduction and spread of invasive species along highway corridors in Yukon.

Methods

With limited time and resources for such a large study area, preliminary inventory efforts focused on those areas where humans have congregated or had the greatest impacts. To maximize efficiency, plant inventories were focused on areas that were visible from the roadside.

As the surveyors did not know what types of roadside disturbance to expect prior to the survey, disturbance types were described spontaneously during field work. Table 1 provides a description of the disturbance types used in the data analysis. A total of 191 sites were surveyed in 2007.

Table 1. Description of disturbance types assigned to the sites surveyed during the 2007 inventory.

Disturbance Type	# Surveyed	Definition
Gravel Pit	55	An area that was a source of aggregate for building roads (HPW).
Pull out	49	Areas that may or may not have been used as aggregate sources in the past (i.e. widenings in the roadway) which don't qualify as gravel pits but where a vehicle could pull in.
Recreation site	37	Defined by YTG signage: campgrounds, day-use areas, boat launches
Rest stop	34	Official YTG restops with outhouses and garbage cans.
Roadside	5	Unofficial pull outs/ widened road shoulders where the disturbance has attracted invasive plants
Other	11	Eleven other disturbed sites were surveyed e.g. communication towers, airstrip, construction areas, spoil pile, etc.

A modified datasheet based on the standardized datasheet used in Alaska (Alaska Natural Heritage Program, 2006b) was developed (Appendix I). All non-native plant species (and conspicuous native species that behave like weeds) were recorded, along with estimates of percent cover, stem counts

and notes on flowering phenology. Photographs were taken at each site. If sites were large, a GPS track was created to delineate the site surveyed and to calculate area.

Collections were made when the surveyor was unable to quickly identify a plant or when the presence of a plant represented a significant range extension.

While the main focus of the survey was to record invasive plant distributions along highways, invasive species were recorded in some Yukon communities based on brief walking tours. Comparative abundance was noted using the terms: Common, Scarce, Trace.

Results and Discussion

General

Twenty-eight non-native species were recorded at the 191 survey sites (Table 2). Of these non-native species, 17 are considered “invasive”, i.e. causing harm to native ecosystems and/ or causing economic losses in Yukon’s agricultural sector. To put this into context, 143 non-native species have been recorded in Yukon (Bennett 2008). This discrepancy may reflect the fact that other non-native plants may be restricted to agricultural and horticultural areas, not highway corridors. Others may be concentrated within communities and have not yet spread beyond them. The number of non-native species per site surveyed ranged from 0-11 with the average number of species being 2.35.

Although recorded in the field, the following non-native taxa were removed from the analysis due to field identification problems or taxonomic problems within these groups: Pepper-grasses (*Lepidium* spp.), Dandelions (*Taraxacum* spp.), Knotweeds (*Polygonum* spp.), Plantains (*Plantago* spp.), Stickseeds (*Lappula* spp.), and Tansy-mustards (*Descurainia* spp.) (Table 2). Future study of these groups is needed in Yukon.

We know that not all invasive species growing along the highways were detected at the surveyed sites. Incidental observations were made of Spotted Knapweed (Figure 9) near Teslin. Knapweeds are aggressive invasives and are designated as noxious in many jurisdictions to the south. Other known populations of invasive plants that were missed include Common Tansy (Figure 10) found in and near several communities as well as scattered along highways. Altai Rye Grass (*Leymus angustus)* is an aggressive grass found in Carcross. Thus, it should be noted that these study sites represent a sub-sample of the non-native flora of Yukon and merely provide a means for quantitative monitoring of future spread.

Figure 9. Spotted Knapweed (*Centaurea biebersteinii*) growing in Alaska. Photo credit: I. Lapina.

Figure 10. Tansy (*Tanacetum vulgare*) growing in a cleared right-of-way along the Alaska Highway. Photo credit: G. Brunner

Table 2. Non-native species recorded during the 2007 surveys. The first 17 species on the list are considered “Invasive”.

Scientific Name	Common Name	Origin	Status	Impacts
Agropyron pectiniforme	Crested Wheat Grass	A	C	E
Bromus inermis	Smooth Brome	A	C	E
Capsella bursa-pastoris	Shepherd's Purse	O	C	$
Chenopodium album	Lamb's-Quarters	O	C	$
Crepis tectorum	Narrow-leaf Hawk's beard	O	C	$ (E?)
Elymus repens	Creeping Wild Rye	A	C	E
Leucanthemum vulgare	Ox-eye daisy	H	C	E
Linaria vulgaris	Yellow Toadflax	H	C	E
Matricaria discoidea	Pineapple weed	O	C	$
Medicago falcata	Yellow Alfalfa/ Lucerne	A	C	E
Melilotus albus	White Sweetclover	A	C	E
Melilotus officinalis	Yellow Sweetclover	A	C	E
*Phalaris arundinacea**	Reed Canary Grass*	A?/R?	C	E
Sonchus arvensis ssp. uliginosus	Field Sow-thistle	O	C	E
Stellaria media	Common Chickweed	O	C	$
Thlaspi arvense	Field Pennycress	O	C	$
Vicia cracca	Tufted Vetch	O	C	E
Festuca rubra	Red Fescue	A?/R?	C	U
Lotus corniculatus	Garden Bird's-foot Trefoil	A	C	U
Medicago sativa	Alfalfa	A	C	U
Onobrychis viciifolia	Sainfoin	A	R	U
Phleum pratense	Common Timothy	A	C	U
Poa annua	Annual Blue Grass	A	C	U
Silene vulgaris	Common Catchfly	O	C	U
Trifolium hybridum	Alsike Clover	A	C	U
Trifolium pratense	Red Clover	A	C	U
Trifolium repens	White Clover	A	C	U
Tripleurospermum perforata	Scentless False Mayweed	O	R	U
Species recorded but excluded from the 2007 analysis:				
Descurainia sophia	Herb-Sophia	May be confused with a native relative, *D. sophioides*		
Hordeum jubatum	Foxtail Barley	Though aggressive and opportunistic, this is a native Yukon species		
Lappula squarrosa	Stickseed	May be confused with a closely related native species, *L. occidentalis*		
Polygonum achoreum	Leathery Knotweed	} taxonomic problems		
Polygonum aviculare	Yard Knotweed			
Polygonum buxiforme	Prairie Knotweed			
Plantago major	Great Plantain	native and introduced populations exist in Yukon		
Taraxacum officinale	Common Dandelion	non-flowering plants can be confused with native species		
Legend:				
Origin: A= Agronomics- planted for agricultural purposes; H= planted in horticultural situations; R= seeded in reclamation/ revegetation projects; O= Opportunistic alien invader				
Status: C= common, widespread; R= rare, found in few locations				
Impacts: E= impacts native ecosystems in Yukon and/or in Alaska or BC; $= causes economic impacts on Yukon agriculture; U= unknown in Yukon				

Non-native and invasive plants by Highway

Table 3 summarizes the presence of non-native and invasive plant species at surveyed sites along nine Yukon highways. The greatest diversity of both non-native and invasive plants were recorded along the Alaska and North Klondike Highways, Yukon's most traveled roads. Furthermore, these two highways not only had the greatest species diversity, but in general they also had the highest proportion of sites containing any particular species. For example, 52 of the 75 sites in which Narrow-leaved Hawk's beard was recorded were found along these two highways. The Tagish, Silver Trail, South Canol and Top of the World highways had the fewest number of non-native species.

Table 3 also provides a breakdown of the number of sites per highway in which a particular species was recorded. Narrow-leaved Hawk's beard was the most frequently recorded species, found at 75 sites (39.3%). Smooth Brome, Pineapple weed and White Sweetclover were also found at 30% or more of the sites. Alsike Clover, Timothy Grass and Alfalfa were found at more than 10% of sites surveyed. These three species, which are not native and have historically been seeded in reclamation projects, are currently not considered invasive in Yukon. Twelve of the 17 invasive plants recorded were found in 5% or fewer of the surveyed sites. It was noted, however, that known populations of Oxeye Daisy, Yellow Toadflax, Field Sow-thistle and Tufted Vetch were missed during the survey. This again emphasizes an important point: these data can not be used to create distribution maps for species, but simply provide a baseline for monitoring future spread of invasive plants in the territory. With this caveat in mind, Appendix III provides 20 species distribution maps based on the results of this inventory.

As noted in the Sweetclover survey in Part 1, busier roads that receive more road maintenance appeared to be the most at risk for the introduction of non-native plants. General observations made by surveyors of conditions along less frequented highways (South Canol, Top of the World, Silver Trail) offer some clues about the nature of the spread of non-native plants in Yukon. Gravel pits and other disturbed sites along these highways tended to support sparse vegetation and very few non-native plants, except where recent roadwork or other disturbance had occurred. Common colonizers in the relatively undisturbed sites were native shrubs and young trees, grasses, and a few forbs. Recently-disturbed sites sometimes supported patches of Sweetclover and other non-native plants, as well as native species; however, along many of these highways, xeric conditions existed and vegetation was sparse. On sections of the highways above treeline, conditions were too harsh for non-native plants. Some gravel pits had moist depressions, which tend to be dominated by native shrubs, grasses, and forbs. Surveyors also noted that highway sections that have been widened or upgraded and seeded in more recent years supported a relatively lush growth of native and introduced grasses and forbs between the highway and forest edges. This was most evident in moist areas.

Table 3. Invasive plants detected at survey sites along nine Yukon highways.

Non-native species	Highway	Alaska	S Klondike	Tagish	Haines	N Klondike	R Campbell	Silver Trail	S Canol	Top of World	Species presence: total # sites in which found
	Number of sites surveyed:	**51**	**11**	**2**	**9**	**34**	**55**	**10**	**6**	**9**	
	Total # of non-native species:	**23**	**10**	**2**	**11**	**18**	**12**	**5**	**6**	**6**	
	Avg. # n-n. species per site:	**3.4**	**2.1**	**1.0**	**2.6**	**3.2**	**1.0**	**2.2**	**2.0**	**2.3**	
	Total # of Invasive species:	**14**	**5**	**2**	**7**	**12**	**7**	**4**	**3**	**2**	
Agropyron pectiniforme	Crested Wheat Grass	3/51	0/11	0/2	1/9	1/34	0/55	0/10	0/6	0/9	**5**
Bromus inermis	Smooth Brome	27	7	1	4	10	6	0	1	4	**60**
Capsella bursa-pastoris	Shepherd's Purse	4	0	0	0	1	0	0	0	0	**5**
Chenopodium album	Lamb's-Quarters	5	1	0	0	14	0	3	0	0	**23**
Crepis tectorum	Narrow-leaf Hawk's beard	33	4	1	2	19	11	3	2	0	**75**
Elymus repens	Creeping Wild Rye	1	0	0	1	1	0	0	0	0	**3**
Leucanthemum vulgare	Ox-eye daisy	1	0	0	0	0	0	0	0	0	**1**
Linaria vulgaris	Yellow Toadflax	2	0	0	0	0	0	0	0	0	**2**
Matricaria discoidea	Pineapple weed	20	2	0	1	17	4	5	3	6	**58**
Medicago falcata	Yellow Alfalfa/ Lucerne	5	0	0	2	1	2	0	0	0	**10**
Melilotus albus	White Sweetclover	26	1	0	1	18	10	8	0	0	**64**
Melilotus officinalis	Yellow Sweetclover	2	0	0	0	2	0	0	0	0	**4**
*Phalaris arundinacea**	Reed Canary Grass*	2	0	0	0	0	0	0	0	0	**2**
Sonchus arvensis	Field Sow-thistle	2	0	0	0	0	0	0	0	0	**2**
Stellaria media	Common Chickweed	0	0	0	0	1	0	0	0	0	**1**
Thlaspi arvense	Field Pennycress	0	0	0	0	0	1	0	0	0	**1**
Vicia cracca	Tufted Vetch	0	0	0	0	1	1	0	0	0	**2**
Festuca rubra	Red Fescue	2	0	0	0	0	0	0	0	0	**2**
Lotus corniculatus	Garden Bird's-foot Trefoil	1	0	0	0	0	0	0	0	0	**1**
Medicago sativa	Alfalfa	10	2	0	1	4	3	0	0	0	**20**
Onobrychis viciifolia	Sainfoin	2	0	0	0	0	0	0	0	0	**2**
Phleum pratense	Common Timothy	11	1	0	4	2	2	0	0	3	**23**
Poa annua	Annual Blue Grass	2	0	0	0	3	0	3	0	2	**10**
Silene vulgaris	Common Catchfly	0	0	0	0	2	0	0	0	0	**2**
Trifolium hybridum	Alsike Clover	12	3	0	5	10	2	0	4	5	**41**
Trifolium pratense	Red Clover	5	1	0	1	1	2	0	1	0	**11**
Trifolium repens	White Clover	8	1	0	0	0	8	0	0	1	**18**
Tripleurospermum perforata	Scentless False Mayweed	0	0	0	0	0	0	0	1	0	**1**
	Total # n-n. species observations:	**186**	**23**	**2**	**23**	**108**	**52**	**22**	**12**	**21**	

Non-native and Invasive plants by Disturbance Type

Table 4 lists non-native plants by disturbance type. Pullouts and rest stops had the highest diversity of non-native and invasive plants across all surveyed sites. These sites have the greatest frequency of vehicle traffic and were observed to have frequently-disturbed ground. A lower diversity of non-native plants was recorded at gravel pits, recreation sites and roadsides. The average number of species per site ranged from 1.7 to 3.7 species across disturbance types.

Table 4 also provides a breakdown of the number of sites per disturbance type in which a particular species was recorded. Narrow-leaf Hawk's beard and White Sweetclover were recorded most frequently at gravel pits, rest stops and pullouts. Pineapple weed was recorded most frequently at recreation sites, rest stops and pull outs. Reed Canary Grass was recorded twice during the survey and in both instances the sites were rest stops. Overall, however, there were few trends linking non-native plants with the disturbance types recorded during this survey. This is further demonstrated in Figure 11 which depicts numbers of plants by disturbance type at all 191 sites. The map does reveal that the sites with the highest numbers of non-native plants tended to be near communities.

Table 4. Non-native plants recorded at sites of various disturbance types.

Non-native species	Disturbance type:	Gravel Pit	Pull out	Recreation site	Rest stop	Roadside	Other
	# of sites surveyed	**55**	**49**	**37**	**34**	**5**	**11**
	Total # non-native spp.	**16**	**20**	**13**	**21**	**8**	**13**
	Average # spp. per site	**2.0**	**2.1**	**1.7**	**3.7**	**2.0**	**3.1**
	Total # invasive spp.	**9**	**12**	**8**	**13**	**6**	**8**
Agropyron pectiniforme	Crested Wheat Grass	0	1	0	4	0	0
Bromus inermis	Smooth Brome	9	16	7	20	1	7
Capsella bursa-pastoris	Shepherd's Purse	0	1	2	2	0	0
Chenopodium album	Lamb's-Quarters	5	9	1	6	1	1
Crepis tectorum	Narrow-leaf Hawk's beard	24	15	7	22	1	6
Elymus repens	Creeping Wild Rye	0	1	0	1	0	1
Leucanthemum vulgare	Ox-eye daisy	1	0	0	0	0	0
Linaria vulgaris	Yellow Toadflax	0	1	0	1	0	0
Matricaria discoidea	Pineapple weed	6	12	21	16	2	1
Medicago falcata	Yellow Alfalfa/ Lucerne	2	2	1	3	0	2
Melilotus albus	White Sweetclover	22	13	8	16	1	4
Melilotus officinalis	Yellow Sweetclover	0	2	0	1	1	0
*Phalaris arundinacea**	Reed Canary Grass*	0	0	0	2	0	0
Sonchus arvensis	Field Sow-thistle	0	1	0	0	0	1
Stellaria media	Common Chickweed	0	0	0	1	0	0
Thlaspi arvense	Field Pennycress	1	0	0	0	0	0
Vicia cracca	Tufted Vetch	1	0	1	0	0	0
Festuca rubra	Red Fescue	1	0	0	1	0	0
Lotus corniculatus	Garden Bird's-foot Trefoil	0	0	0	1	0	0
Medicago sativa	Alfalfa	7	1	0	9	0	3
Onobrychis viciifolia	Sainfoin	0	2	0	0	0	0
Phleum pratense	Common Timothy	7	6	2	7	0	1
Poa annua	Annual Blue Grass	0	1	8	1	0	0
Silene vulgaris	Common Catchfly	1	0	0	0	1	0
Trifolium hybridum	Alsike Clover	10	13	5	7	2	4
Trifolium pratense	Red Clover	3	5	1	1	0	1
Trifolium repens	White Clover	11	1	1	3	0	2
Tripleurospermum perforata	Scentless False Mayweed	0	1	0	0	0	0

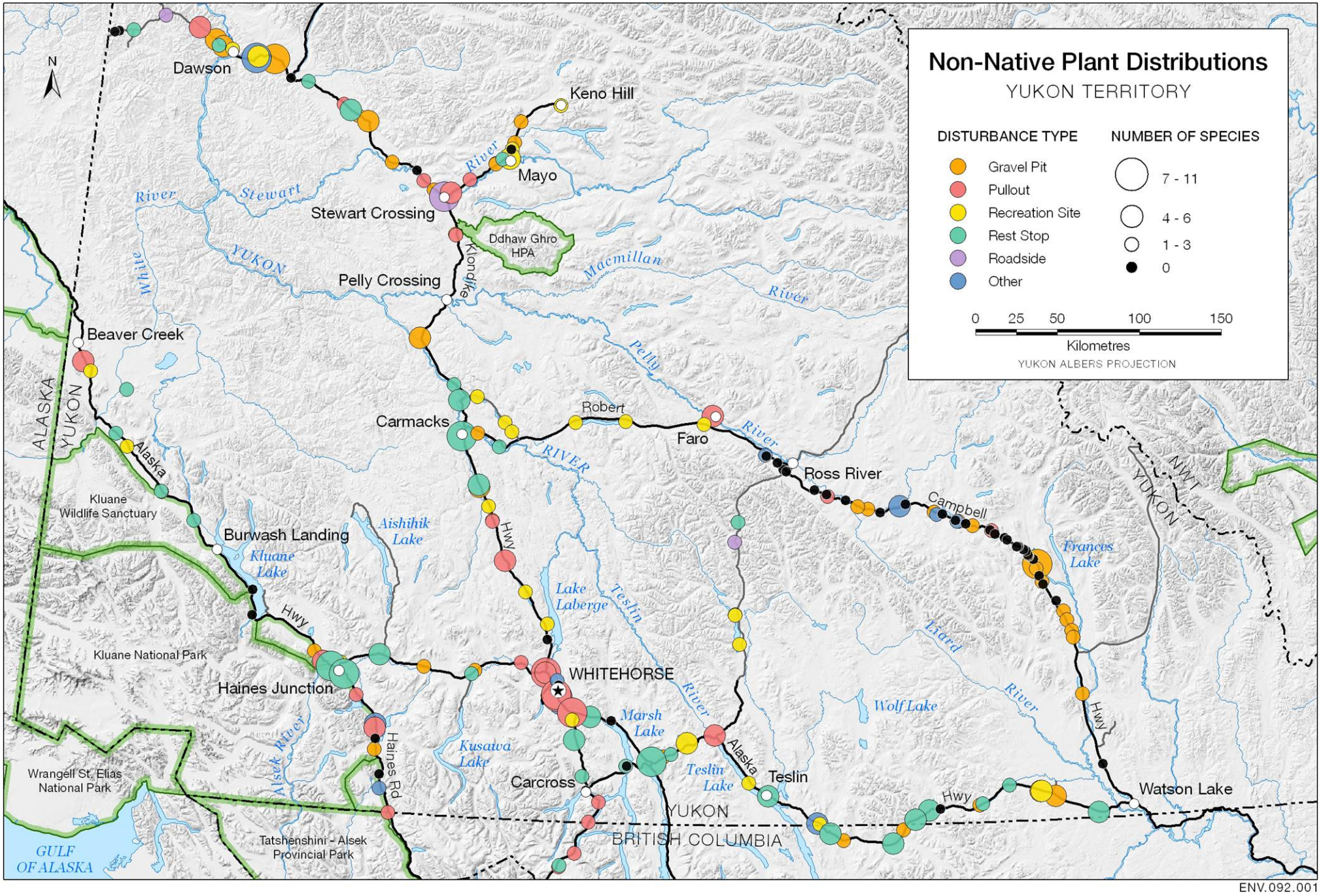

Figure 11. The number of non-native plants recorded at six different disturbance types across all 191 surveyed sites.

Non-native plants on Traditional Territories of Yukon First Nations

As there have already been requests for invasive species information on First Nations lands, a list of invasive plants recorded at survey sites in each traditional territory is provided in Appendix II.

Figure 12. A Kluane National Park rest stop supports a healthy population of Lucerne.
Photo credit: M. Brunner

Suggestions for improvements to methodology

Visiting known populations of Invasive plants

As mentioned previously, previously known populations of aggressive invasive plants such as Spotted Knapweed, Altai Rye Grass and Tansy were missed during the survey. In future surveys, known populations of invasive plants should be visited to assess their status.

Species missed along highway corridors

It would be valuable to document all incidental observations of new non-native species growing along the highway right-of-ways. Some invasive species may only be found along these sections. This would add to the time involved for the survey, but would provide a more complete picture of invasive species presence and dynamics along the highways.

Improving definitions of disturbance types

In order to detect meaningful patterns in invasive plant distributions based on the effects of different types of disturbance, the “disturbance types” should be better quantified and defined. The following criteria could be used to develop these definitions: 1) how and when was the area originally disturbed?; 2) what ongoing disturbances might affect the establishment and/or perpetuation of non-native plants?; and 3) what vectors exist that might introduce non-native seed to a particular area of disturbance? Cooperation with Highways & Public Works to gather information would be valuable.

Compiling known data sources

The Yukon Government's Forest Management Branch has also collected plot data on non-native plants on secondary and tertiary roads that could be incorporated into our existing maps. As well, data from Highways and Public Works about historical highway restoration and reseeding programs could also be superimposed on the maps. This would also help determine the rate of spread of non-native plants like Red Fescue, Alfalfa and Alsike Clover. Ultimately, however, the first priority should be controlling invasive plants; studying the autecology of the plants is an important second step. Experience from other jurisdictions tells us that, once established, invasive plants can adapt to a range of conditions. Using existing control programs from neighbouring jurisdictions is advisable.

The Northwest Invasive Plant Council of northern British Columbia (NWIPC 2008) has developed an Invasive Alien Plant Program. All invasive plant infestations reported through their 'hotline' are assessed and then entered into a province-wide web-based database. This allows all records to be housed within a BC-wide database that can be viewed on a map online by the public (Government of British Columbia 2008).

Reclamation alternatives: kill two birds with one stone?

It may be valuable to record all vegetation at survey sites, both native and non-native species. Recording all vegetation at disturbed sites would give clear information about which native plants are the most successful for colonizing disturbed ground. This information would thus be valuable for reclamation & restoration research in Yukon. Grasses have historically been used to reseed disturbed areas but they don't appear to be the first colonizers. Often species of the pea family were observed as the early successional species, such as Liquorice-root (*Hedysarum spp*.) or Locoweeds (*Oxytropis* spp.).

Foxtail Barley: a special case

Foxtail Barley (*Hordeum jubatum*) is considered a native species in Yukon. It is, however, opportunistic and spreading rapidly across Yukon landscape, both along roads and in agricultural situations. The Yukon public has voiced concern about this plant due to its socio-economic impacts: it is harmful to livestock and horses, it reduces crop yields and it forms 'monocultures' in once-diverse native ecosystems thus affecting ecotourism. A strategy for managing this species is in demand in Yukon and thus it should be part of an invasive species monitoring program.

Conclusions

Relative to most of North America, Yukon has very few invasive plant problems at present: North America has approximately 1400 invasive species and in Yukon 19 have been recorded. Very few species are behaving aggressively and invading new areas. We can't predict, however, which of the other non-native species in Yukon may develop into problem-invasive species. Some species recorded in this survey that need further monitoring and review include Bird's Foot Trefoil, Red Fescue, Alfalfa, Sainfoin, Scentless False Mayweed and the clovers (*Trifolium* spp.). Though these species are currently not believed to be aggressive, they are widespread and may respond to favorable changes in climate. The plants excluded from the analysis (Table 1) also need to be reviewed.

This survey was successful in providing baseline data on non-native and invasive plants along major highways in Yukon. Furthermore, the sites surveyed may act as long-term monitoring sites. Over time it will be possible to track changes in the distribution of invasive plants at these sites to give an indication of spread in the territory. The results can also be used within an Early Detection and Rapid Response strategy for Yukon.

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Appendices

Appendix I. Field Data Sheet for the 2007 surveys.

Yukon Roadside Invasive Plant Inventory 2007- Field Data Sheet

Survey Date: _____/_____/_____ **Observers**: _____
month / dd / yyyy

GPS Waypoint #_____

Latitude:_____ **Longitude**:_____ **Elevation**: _____m **GPS precision** _____m

Note: Datum is WSG 84 and Coordinate Format is degrees/minutes/decimal seconds (60° 12' 34.56"N)

Highway/ Road (name & #):_____ (km post: _____)

Location Description:_____

Site No.: _____ (circle): rest stop/ pullout/ gravel pit/ bridge crossing/ other:_____

Total Area Surveyed: _____hectares (Note: 1/100 Hectare = 5.64 m radius, 1/200 hectare = 3.99m radius)

GPS track/polygon created to capture site? (Y/N)_____

Surrounding Vegetation Community Description:_____

_____

Disturbance Types (see legend): _____

_____

Invasive Plant Species *(4 letters genus, 4 letters species)*	% Cover *(see legend)*	Stem Count *	Voucher Spec. #	Aggressive-ness *(see legend)*	Comments (phenology, effects on ecosystem, etc.)

D. Comments:

_____

_____

_____

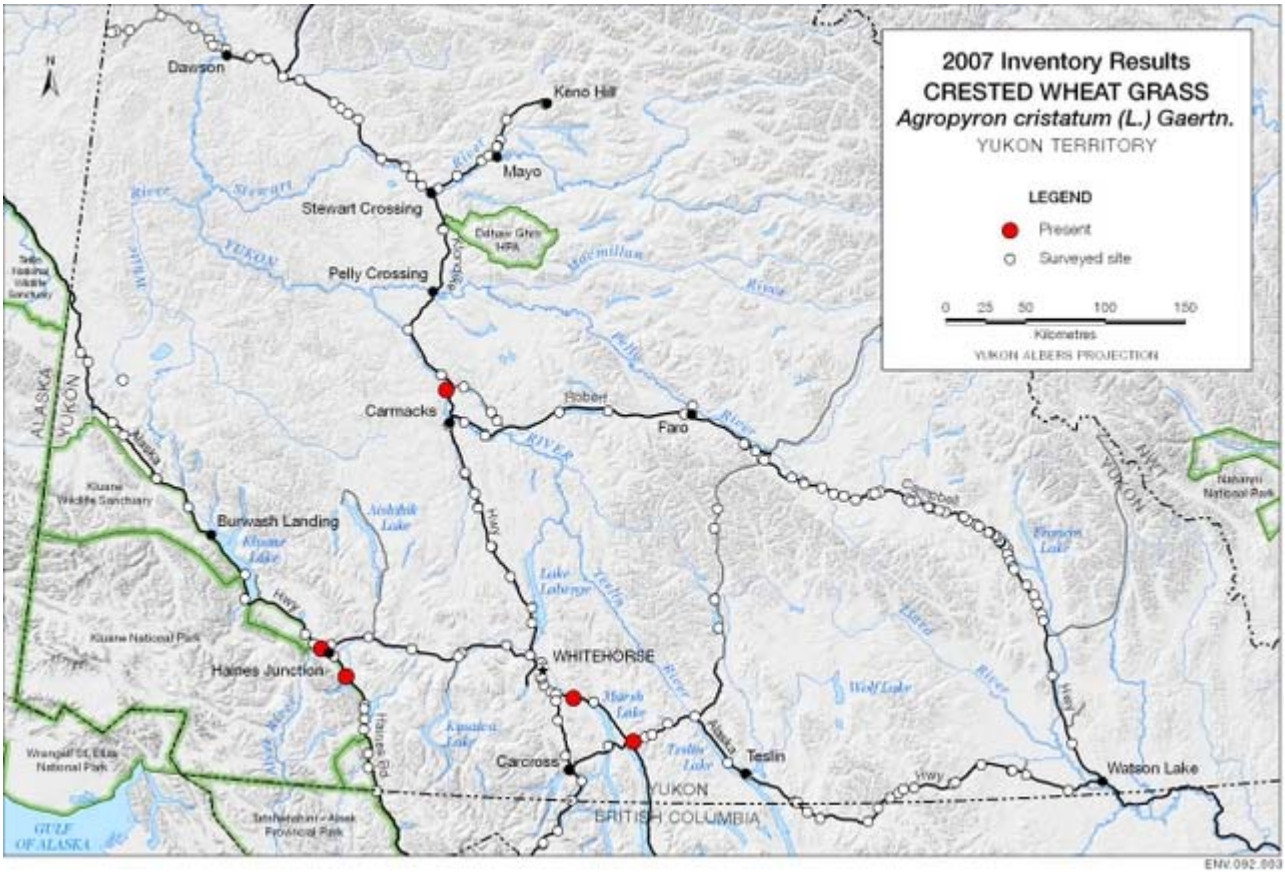
_____

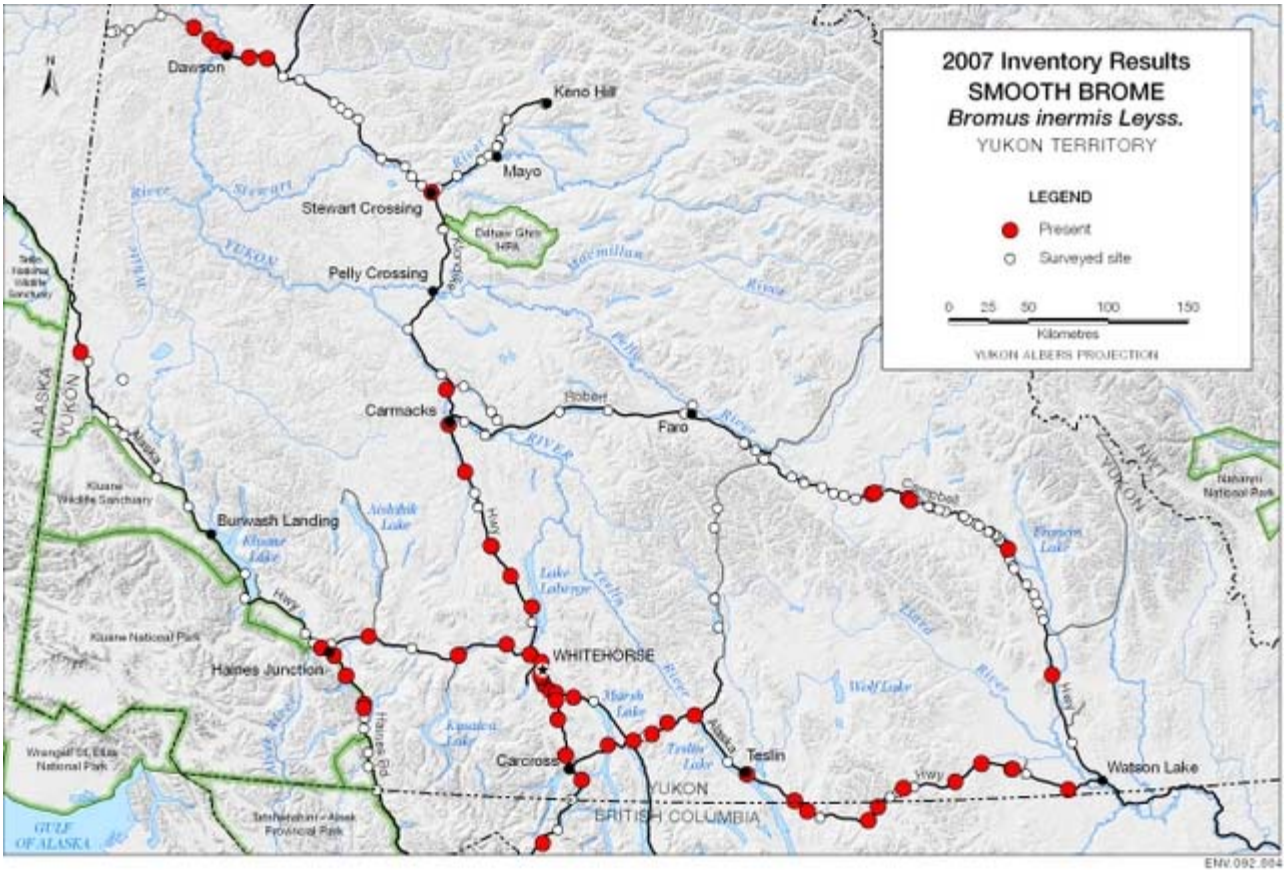
Stem Count classes: A=1-5; B=6-25; C=26-50; D=51-150; E=151-500; F=500+

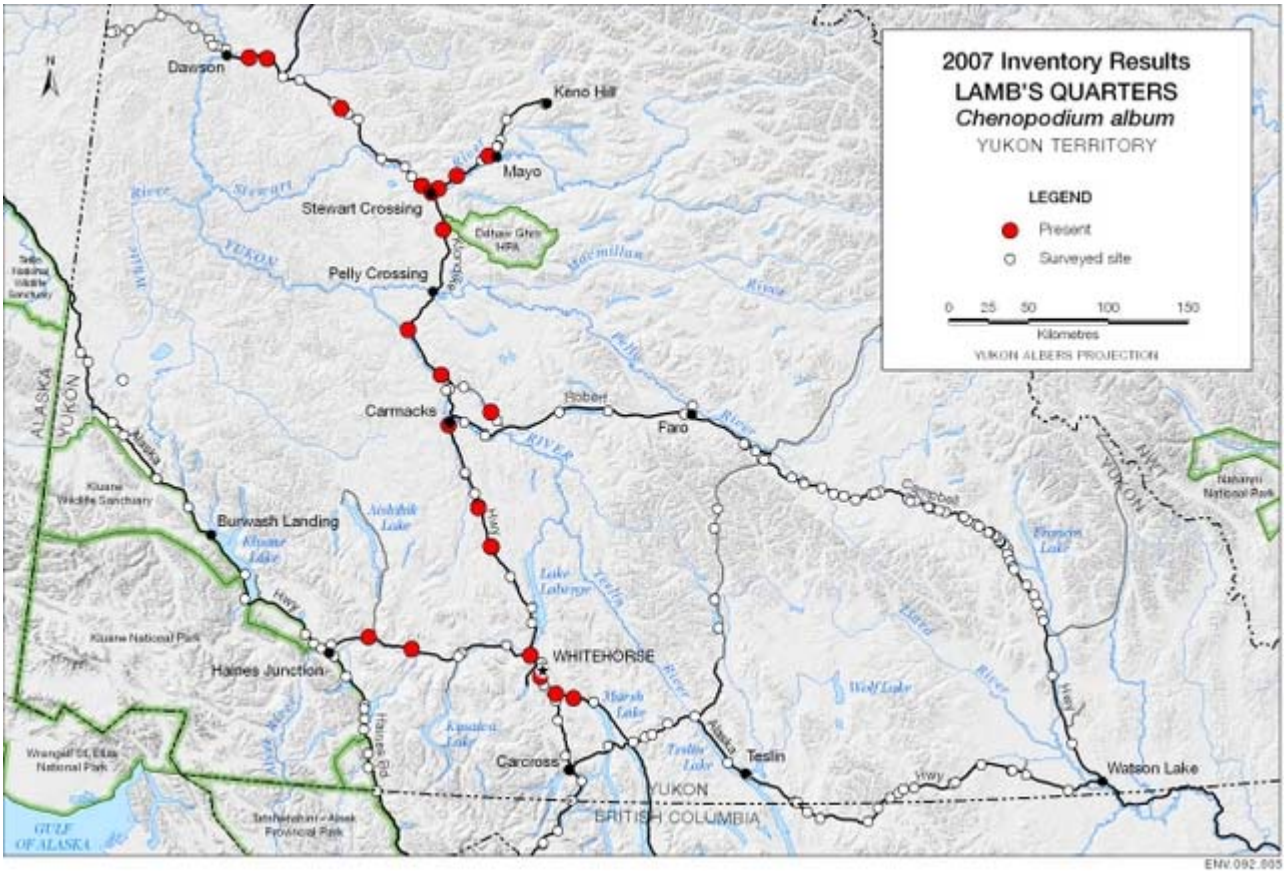
Appendix II. Non-native and invasive plants within First Nation Traditional Territories.

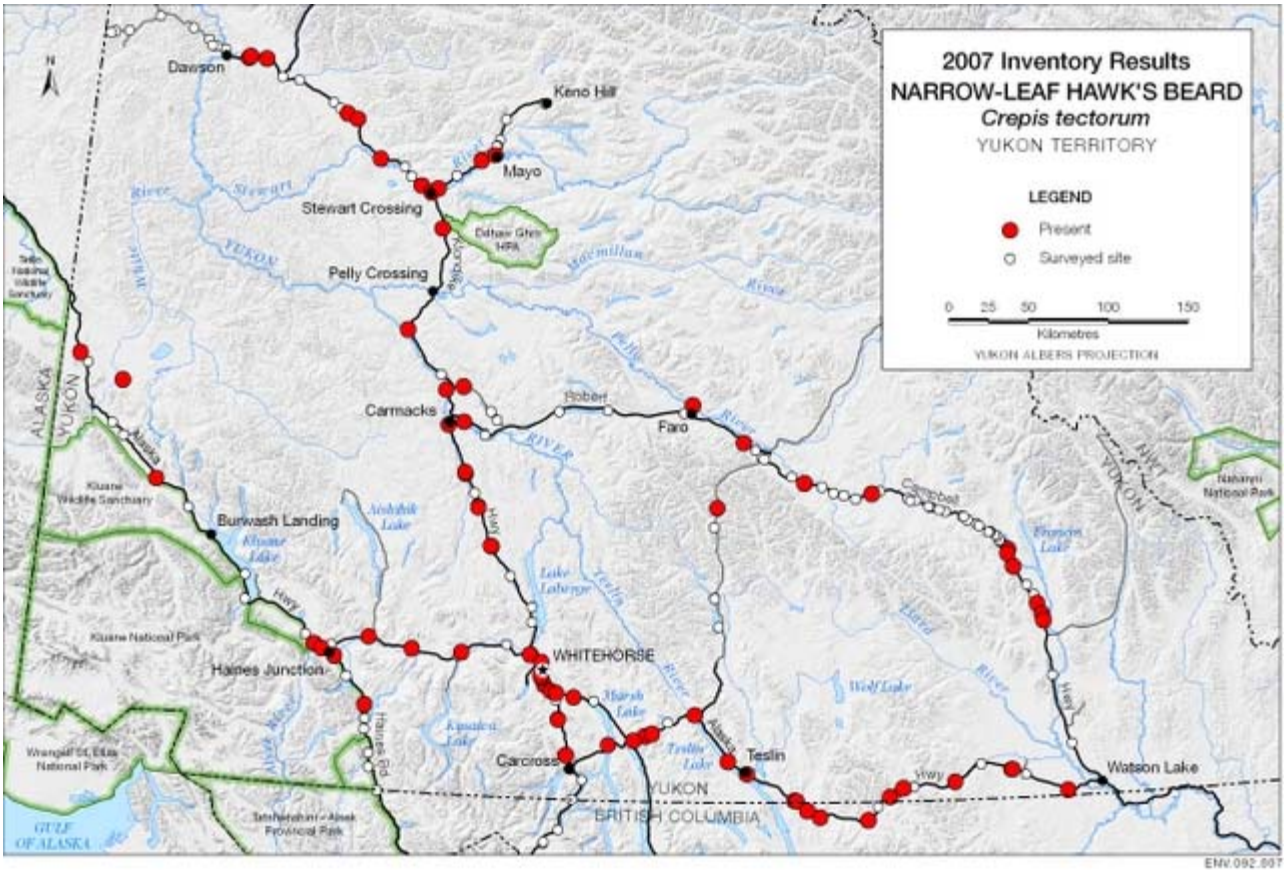
FN traditional territories	Trondek Hwech'in	Nacho Nyak Dun	Selkirk	Kluane	White River	Little Salmon / Carmacks	Kaska Dena	Teslin Tlingit	Ta'an Kwach'an	Kwanlin Dun	Carcross / Tagish	Champagne & Aishihik
# of sites surveyed	**19**	**24**	**4**	**10**	**10**	**18**	**65**	**14**	**14**	**25**	**13**	**22**
total # of spp.	**15**	**12**	**6**	**10**	**10**	**13**	**14**	**13**	**15**	**16**	**12**	**14**
average # spp. per site	**3.0**	**2.3**	**3.0**	**2.1**	**2.1**	**3.0**	**1.2**	**3.4**	**4.1**	**3.5**	**2.4**	**2.9**
Crested Wheat Grass	0/19	0/24	0/4	0/10	0/10	1/18	0/65	0/14	1/14	1/25	1/13	2/22
Smooth Brome	6	1	0	1	1	5	11	6	12	18	8	10
Shepherd's Purse	1	0	0	1	1	0	0	2	1	1	1	0
Lamb's-Quarters	3	7	3	0	0	7	0	0	5	8	0	6
Narrow-leaf Hawk's beard	6	10	2	3	3	10	15	8	9	16	7	11
Creeping Wild Rye	1	0	0	0	0	0	0	0	0	0	0	2
Ox-eye daisy	0	0	0	0	0	0	1	0	0	0	0	0
Yellow Toadflax	0	0	0	0	0	0	0	0	1	1	1	0
Pineapple weed	12	10	1	6	6	9	5	7	5	8	3	6
Yellow Alfalfa/ Lucerne	0	0	0	0	0	1	4	1	1	1	0	3
White Sweetclover	3	14	4	4	4	11	14	2	7	12	1	7
Yellow Sweetclover	0	1	0	0	0	1	0	0	2	2	0	0
Reed Canary Grass*	0	0	0	1	1	0	0	0	0	0	0	1
Field Sow-thistle	0	0	0	0	0	0	0	0	2	2	0	0
Common Chickweed	0	0	0	0	0	1	0	0	0	0	0	0
Field Pennycress	0	0	0	0	0	0	1	0	0	0	0	0
Tufted Vetch	1	0	0	0	0	1	1	0	0	0	0	0
Red Fescue	0	0	0	0	0	0	0	2	0	0	0	0
Garden Bird's-foot Trefoil	0	0	0	0	0	0	1	0	0	0	0	0
Alfalfa	1	2	1	1	1	2	5	3	1	2	3	3
Sainfoin	0	0	0	0	0	0	0	0	0	2	0	0
Common Timothy	4	1	0	1	1	0	4	4	4	5	1	4
Annual Blue Grass	3	3	0	1	1	2	0	0	0	0	0	1
Common Catchfly	1	1	0	0	0	0	0	0	0	0	0	0
Alsike Clover	12	5	1	2	2	3	6	5	4	4	3	7
Red Clover	1	1	0	0	0	0	2	2	3	4	1	1
White Clover	1	0	0	0	0	0	10	4	0	0	1	0
Scentless False Mayweed	0	0	0	0	0	0	0	1	0	0	0	0

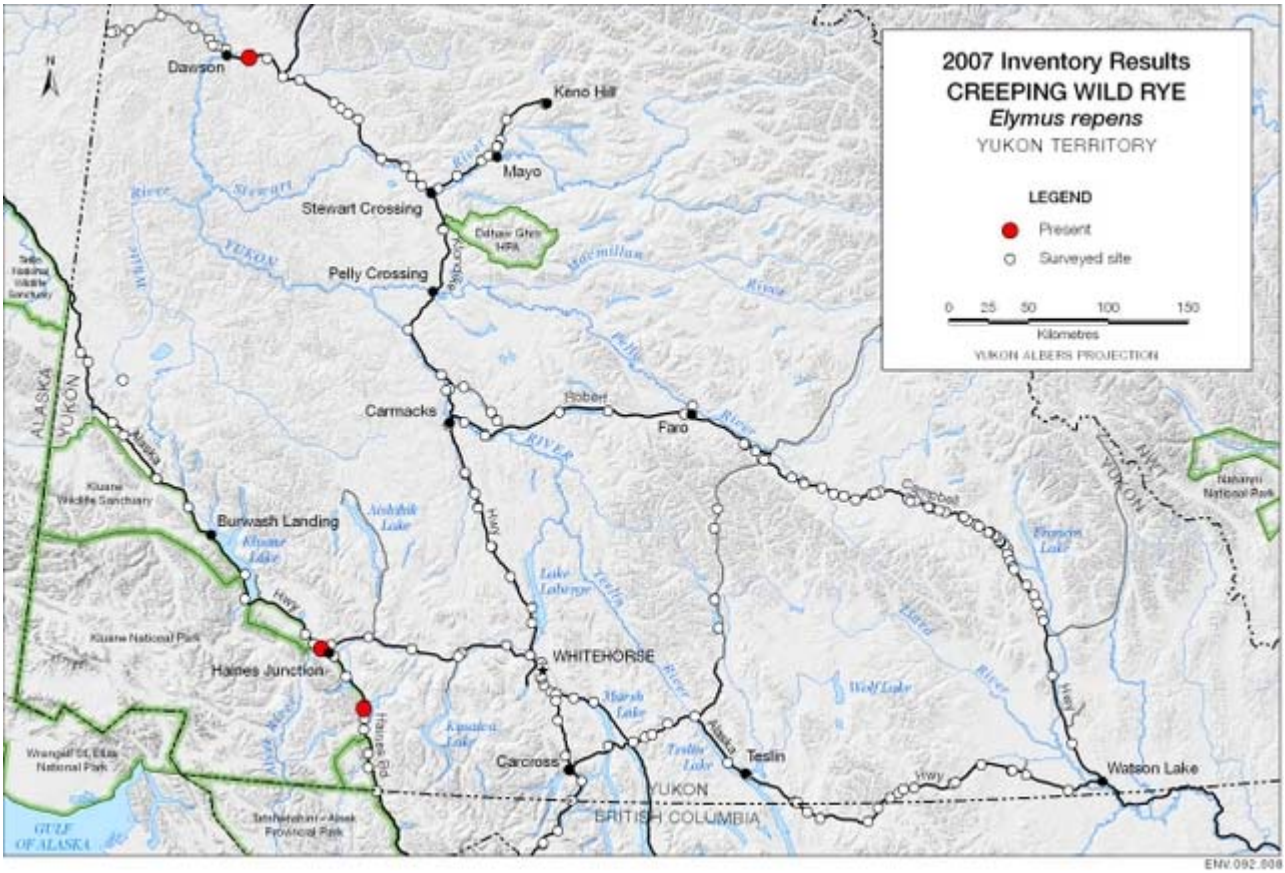
Appendix III. Distribution maps for 20 invasive or non-native species recorded at survey sites during the 2007 surveys. Again, it is important to note that these maps do not represent a comprehensive catalog of each species' Yukon distribution, but provide a record of presence at surveyed sites.

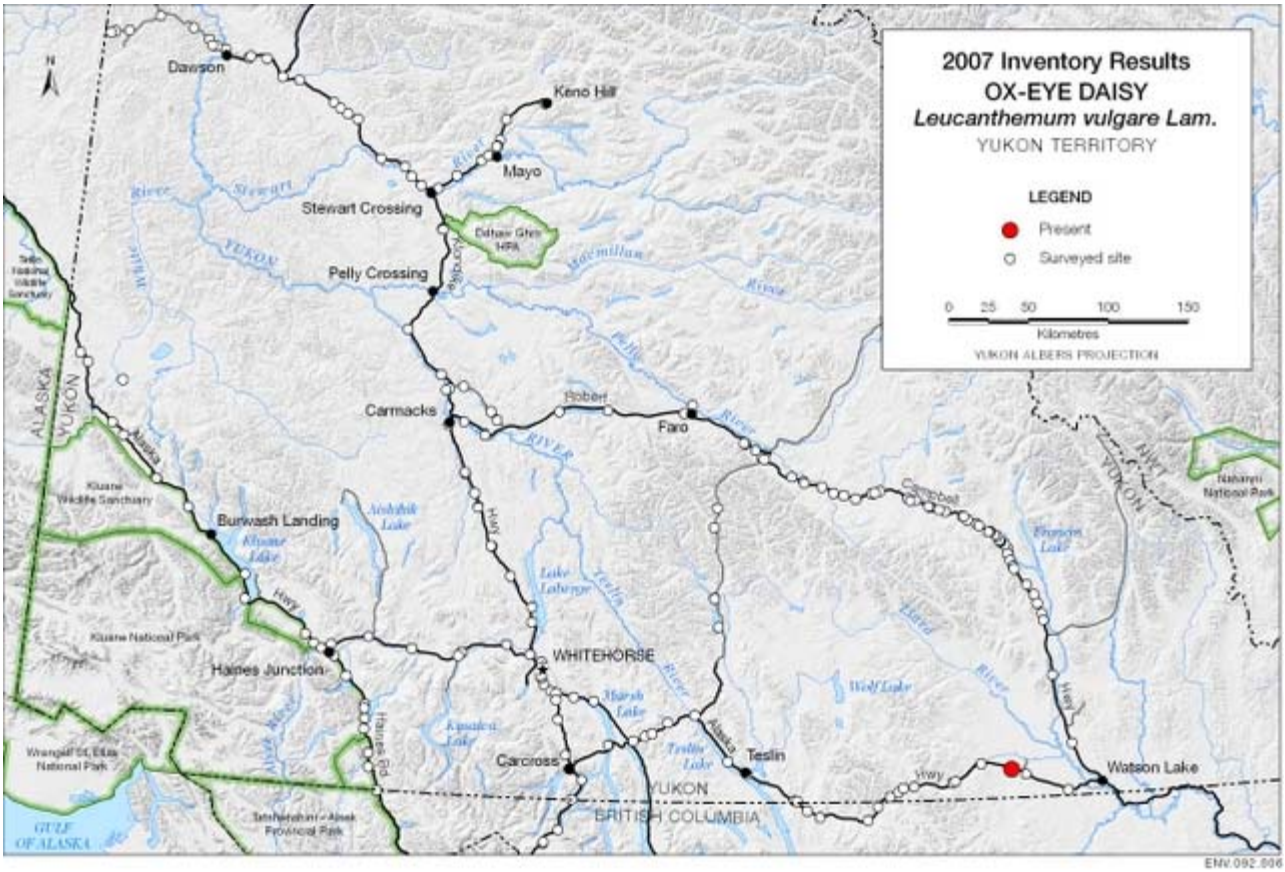

2007 Inventory Results
CRESTED WHEAT GRASS
Agropyron cristatum (L.) Gaertn.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.003

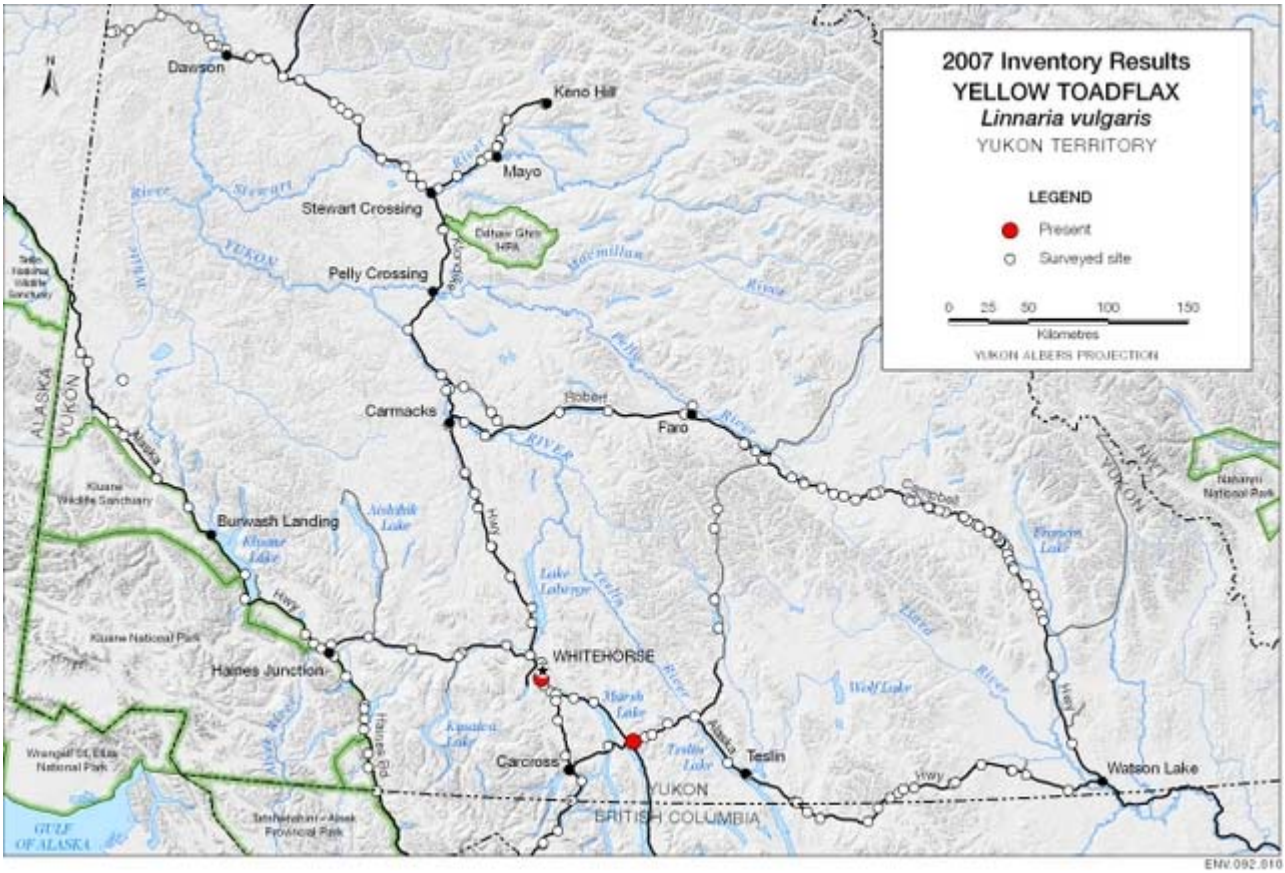

2007 Inventory Results
SMOOTH BROME
Bromus inermis Leyss.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.004

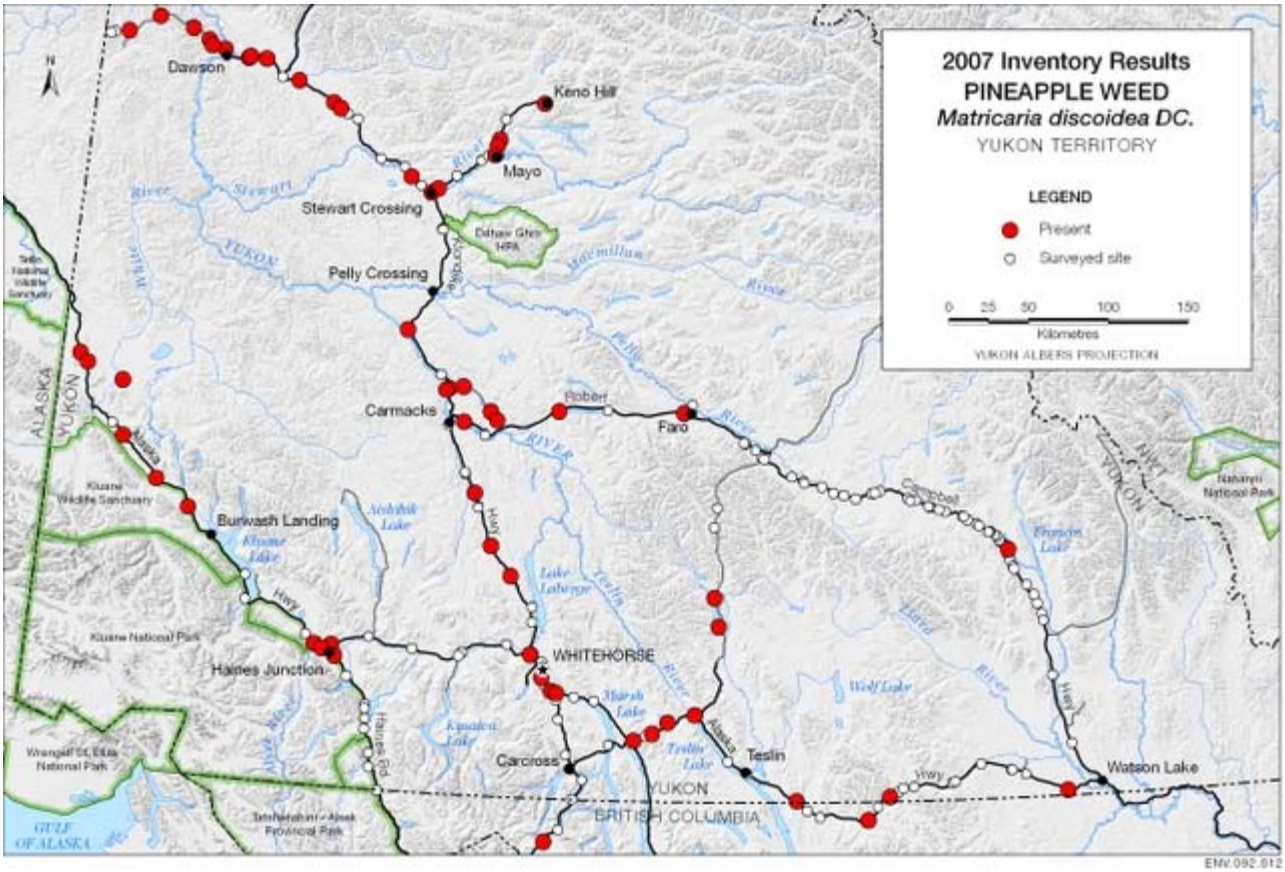

2007 Inventory Results
LAMB'S QUARTERS
Chenopodium album
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA

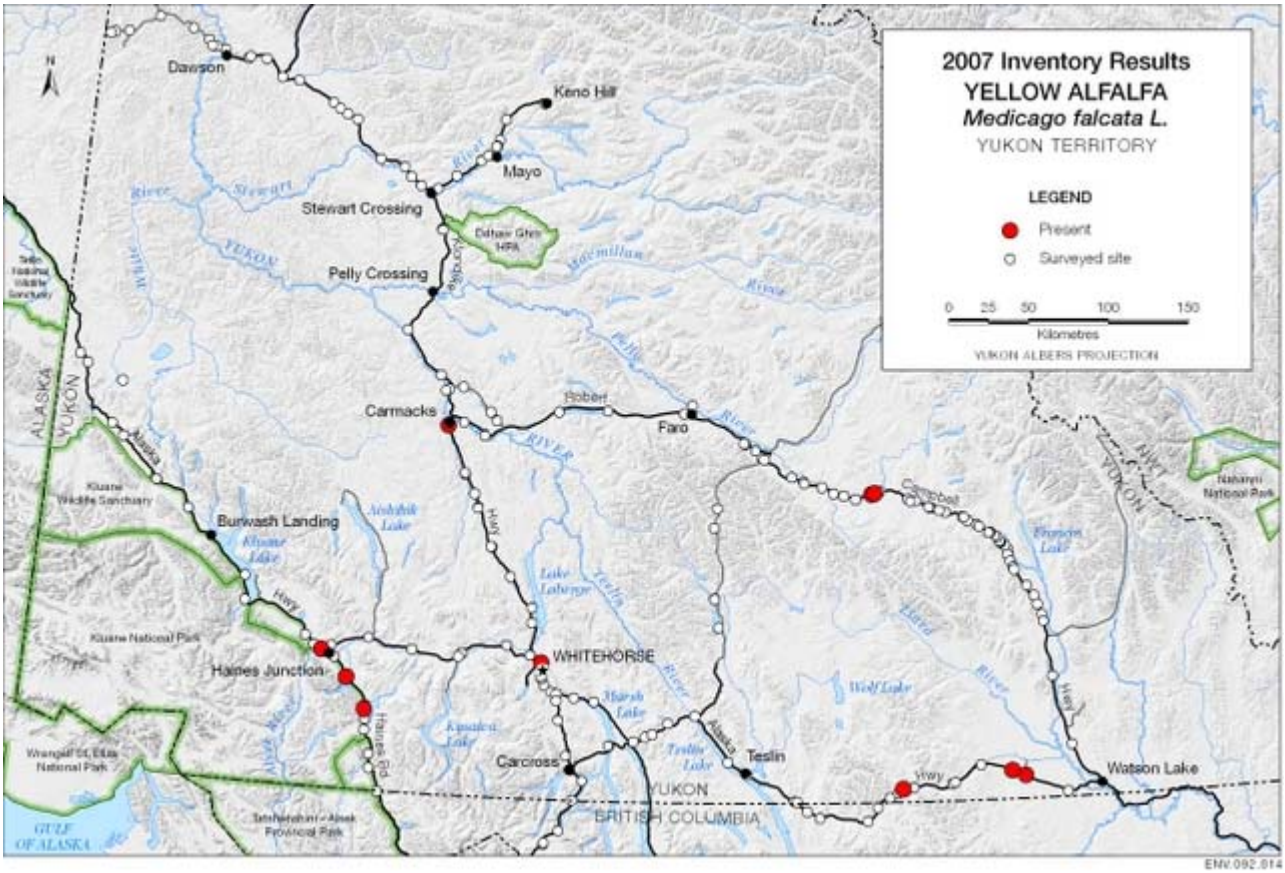

2007 Inventory Results
NARROW-LEAF HAWK'S BEARD
Crepis tectorum
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA

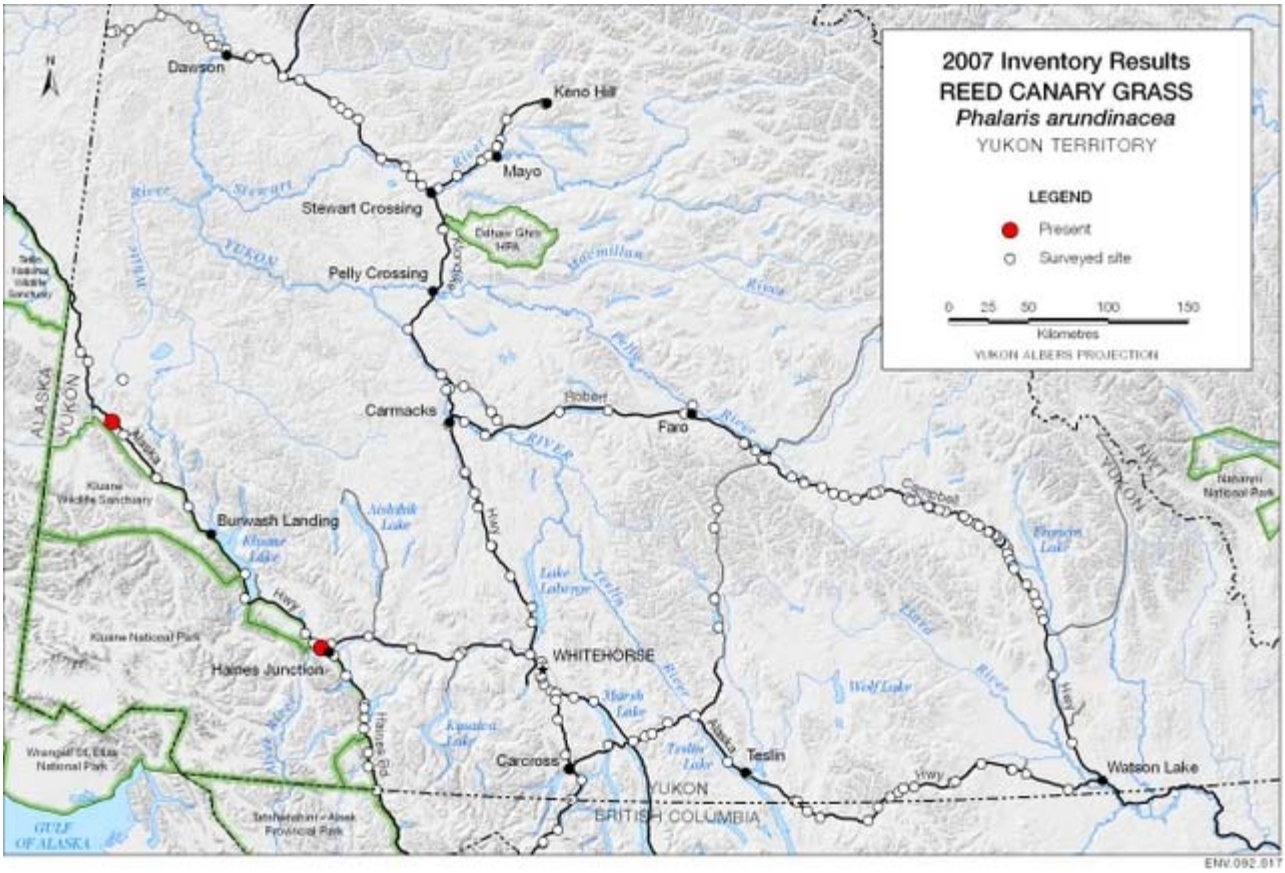

2007 Inventory Results
CREEPING WILD RYE
Elymus repens
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.006

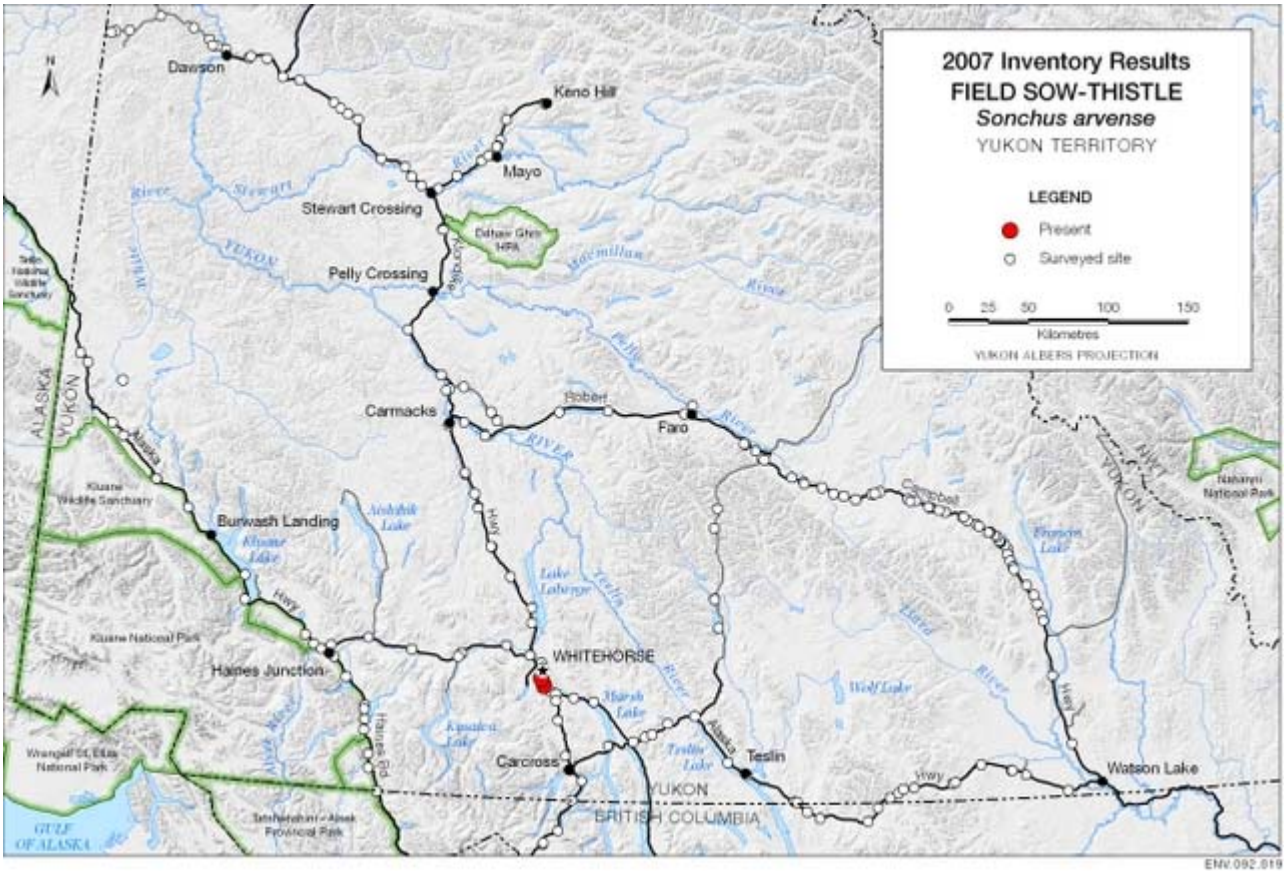

2007 Inventory Results
OX-EYE DAISY
Leucanthemum vulgare Lam.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.006

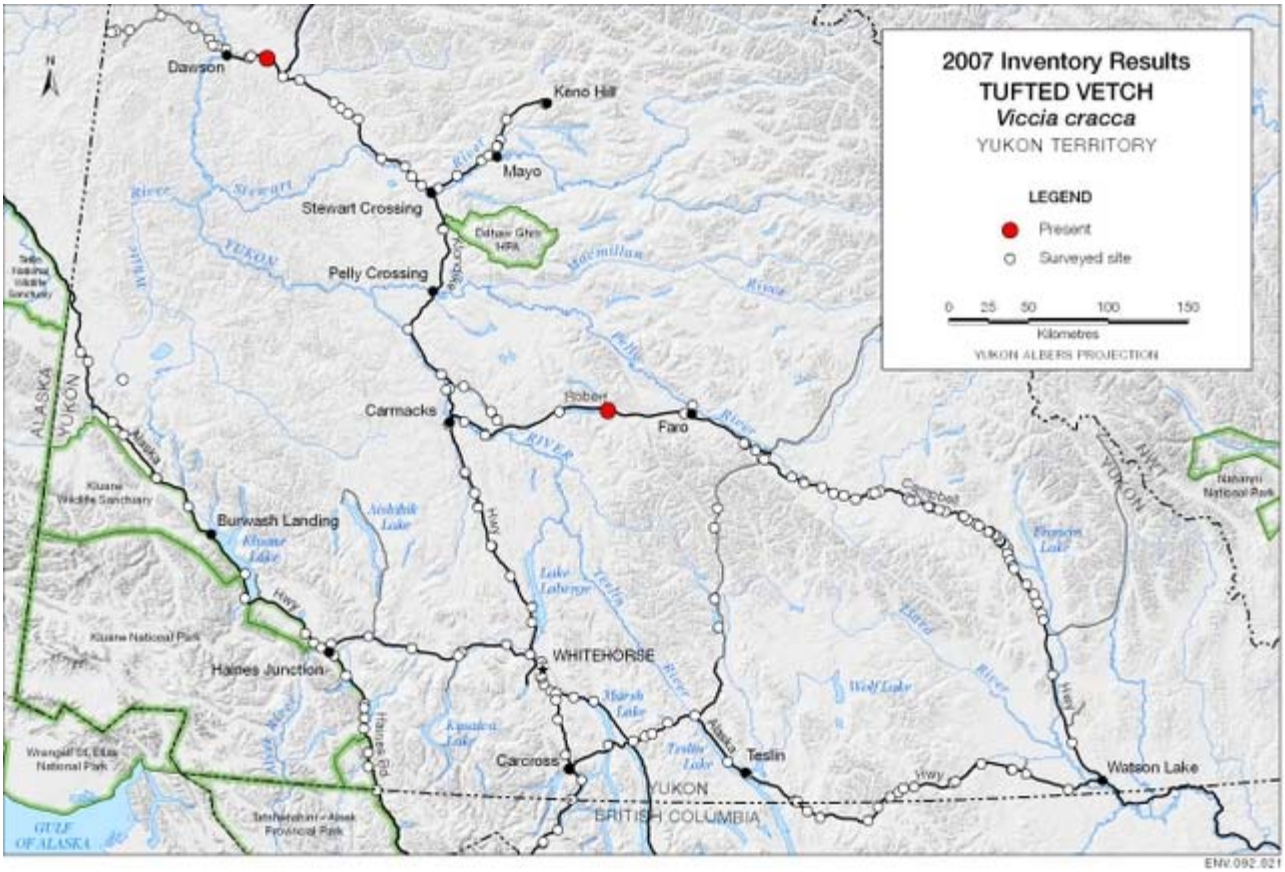

2007 Inventory Results
YELLOW TOADFLAX
Linnaria vulgaris
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.010

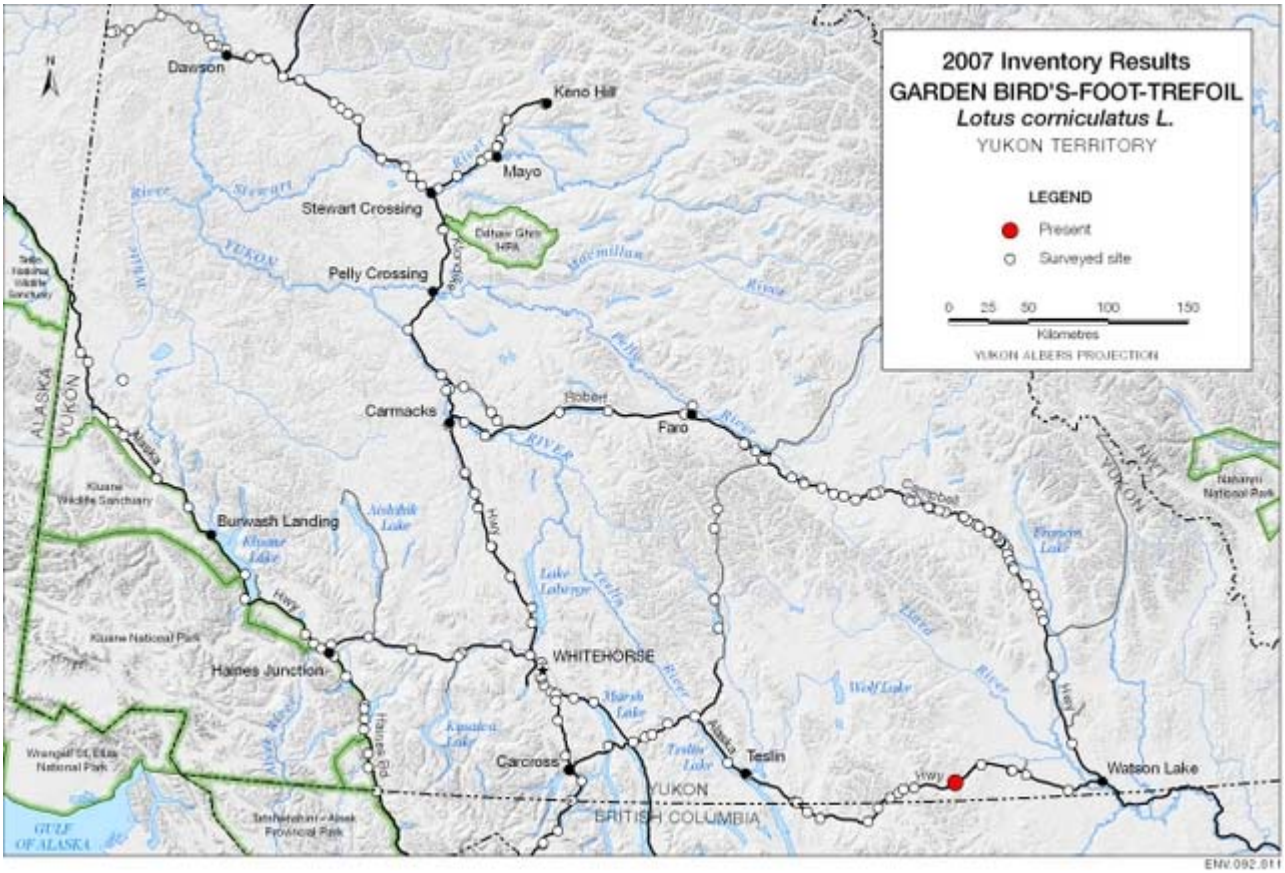

2007 Inventory Results
PINEAPPLE WEED
Matricaria discoidea DC.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.012

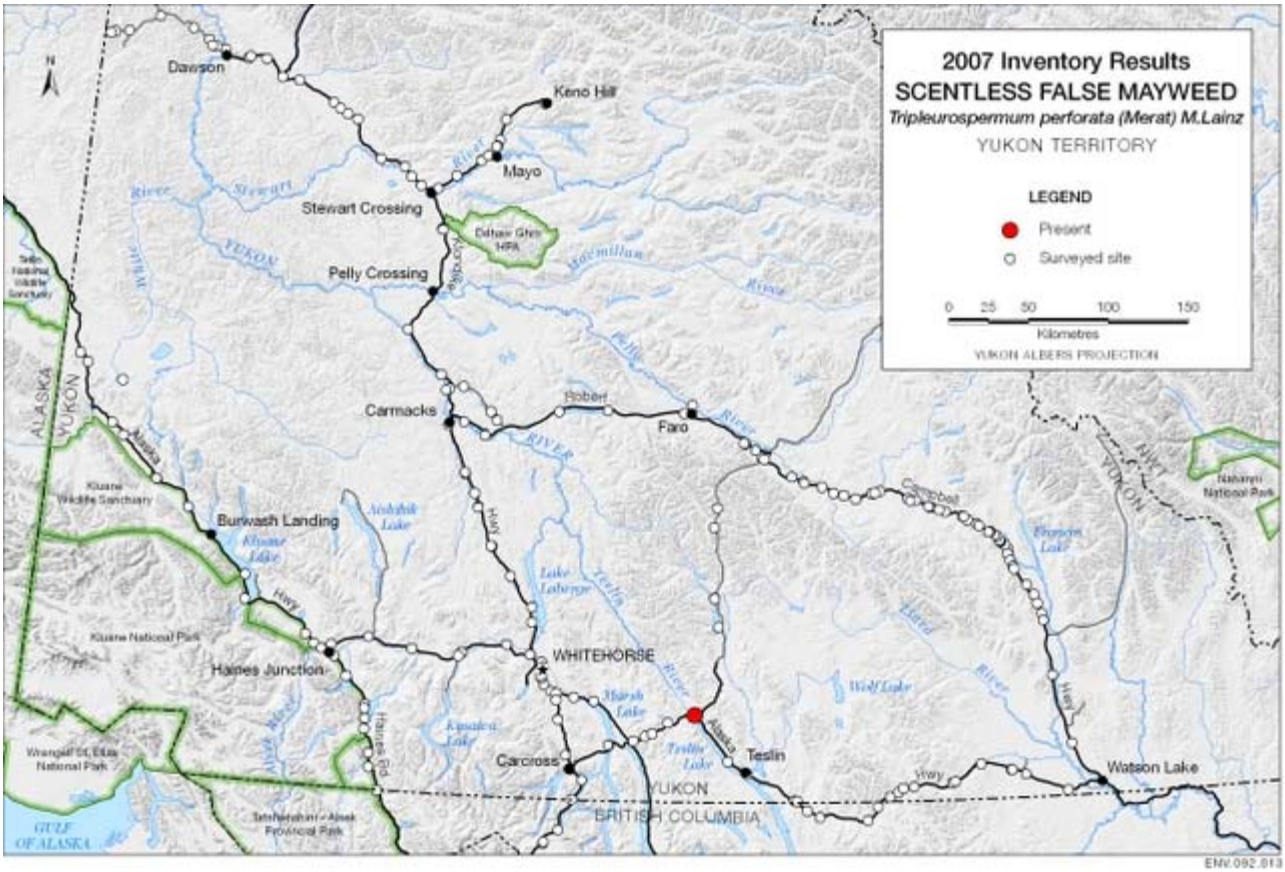

2007 Inventory Results
YELLOW ALFALFA
Medicago falcata L.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.014

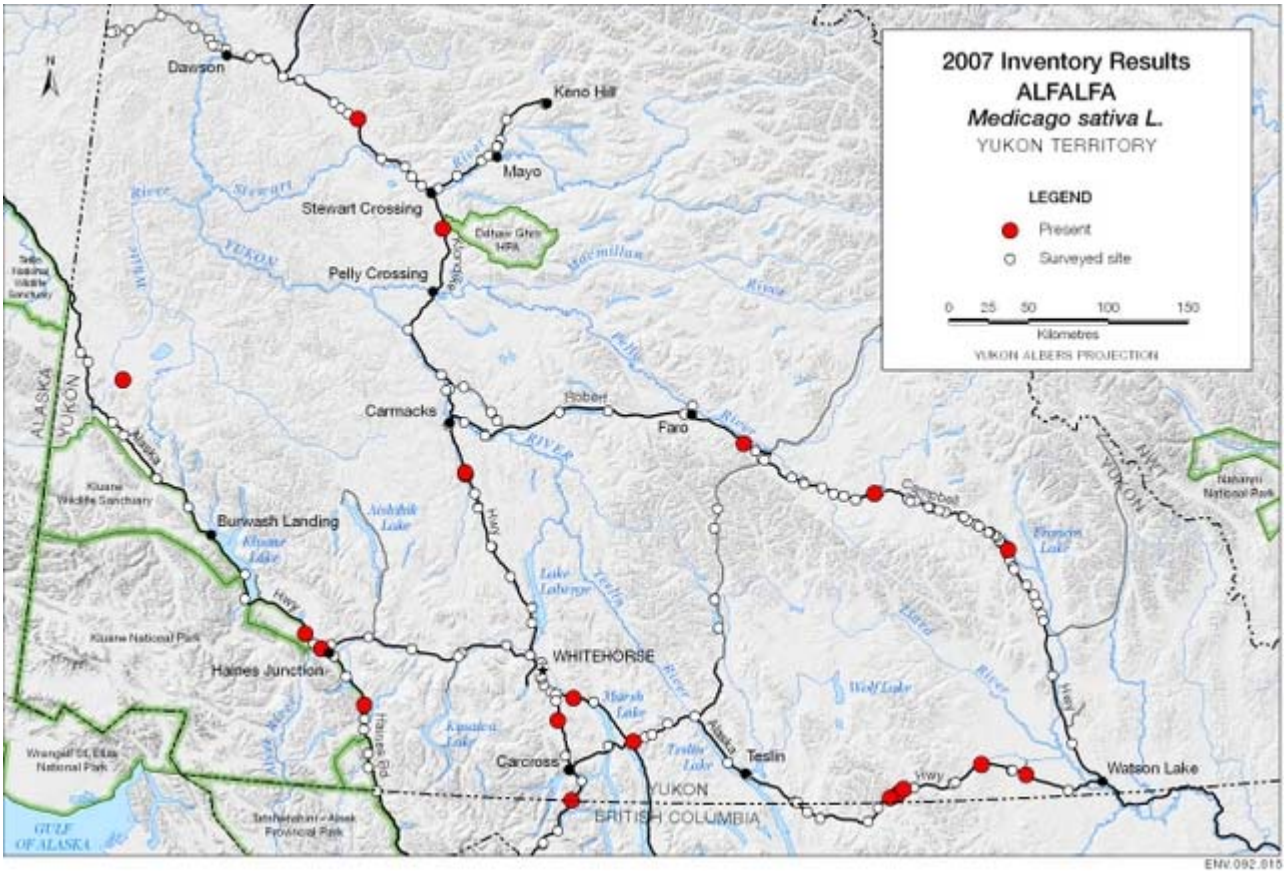

2007 Inventory Results
REED CANARY GRASS
Phalaris arundinacea
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.017

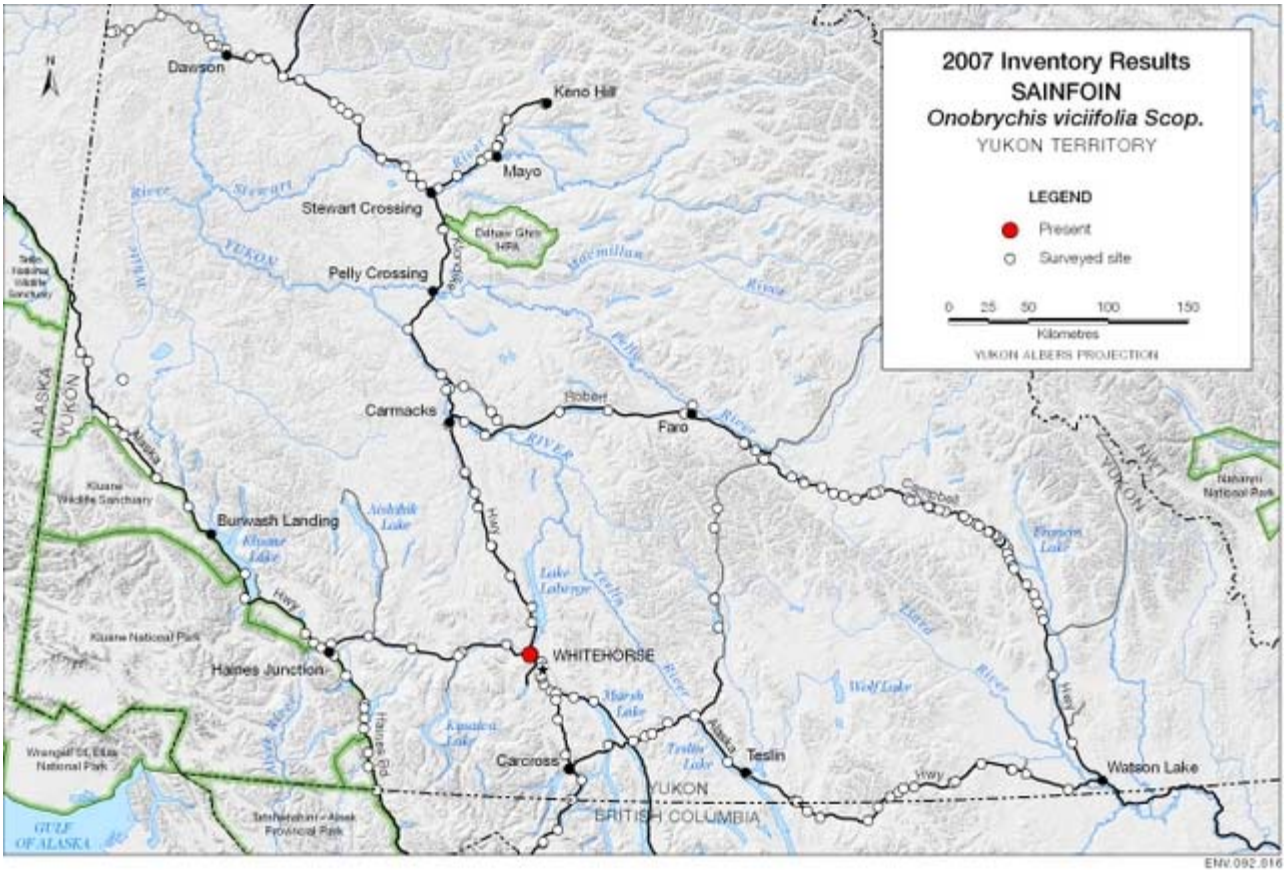

2007 Inventory Results
FIELD SOW-THISTLE
Sonchus arvense
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
N
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
ALASKA
YUKON
BRITISH COLUMBIA
GULF OF ALASKA
ENV.092.019

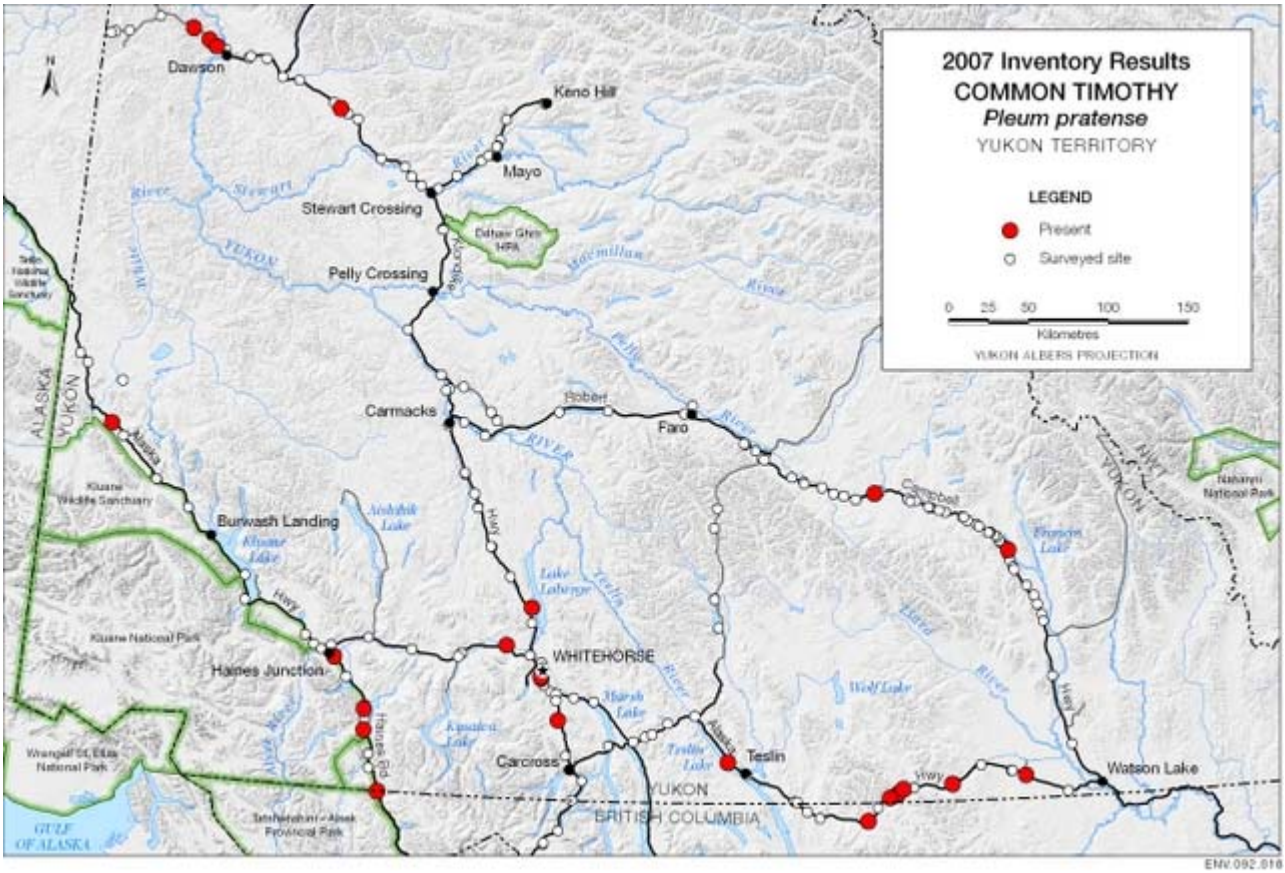

2007 Inventory Results
TUFTED VETCH
Viccia cracca
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
N
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
ALASKA
YUKON
BRITISH COLUMBIA
GULF OF ALASKA
ENV.092.021

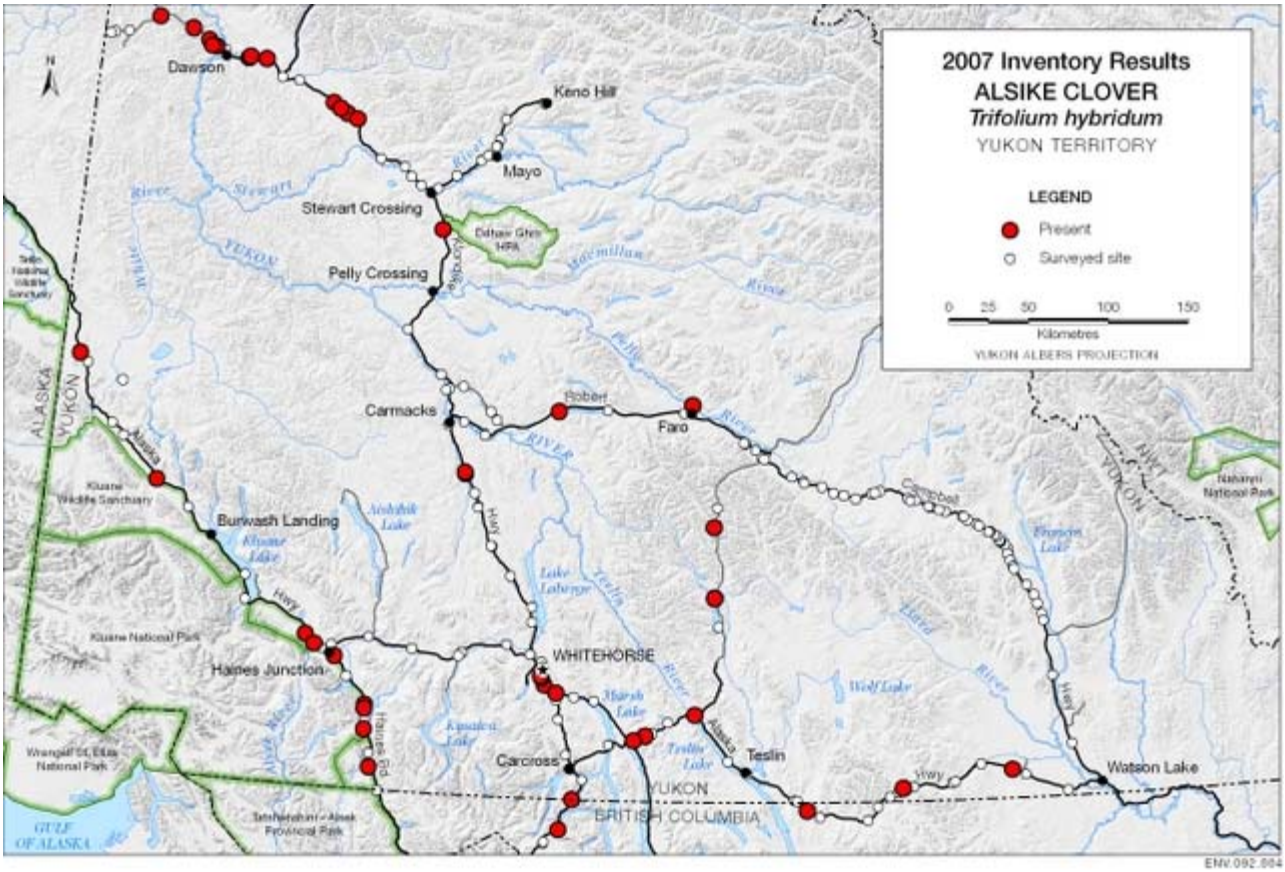

2007 Inventory Results
GARDEN BIRD'S-FOOT-TREFOIL
Lotus corniculatus L.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.011

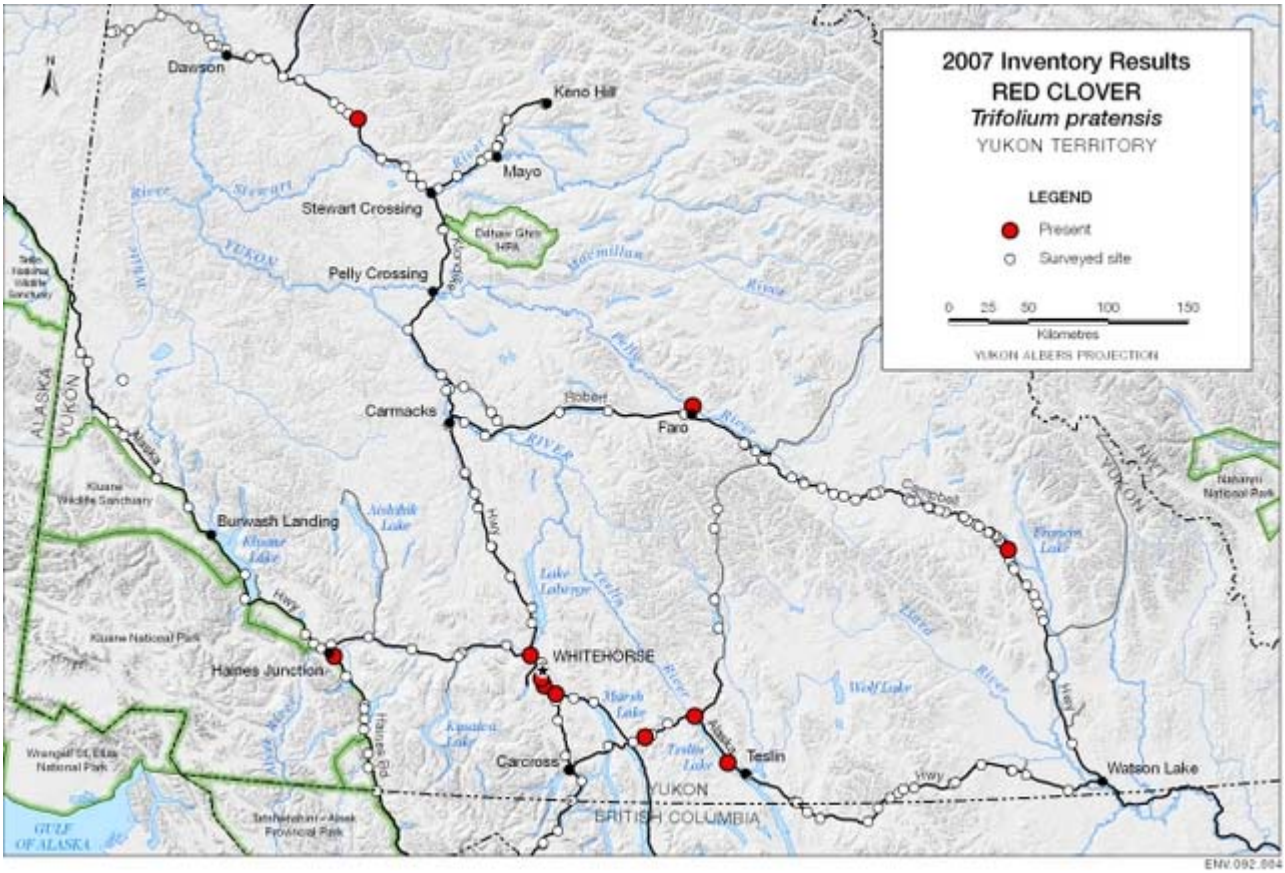

2007 Inventory Results
SCENTLESS FALSE MAYWEED
Tripleurospermum perforata (Merat) M.Lainz
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.013

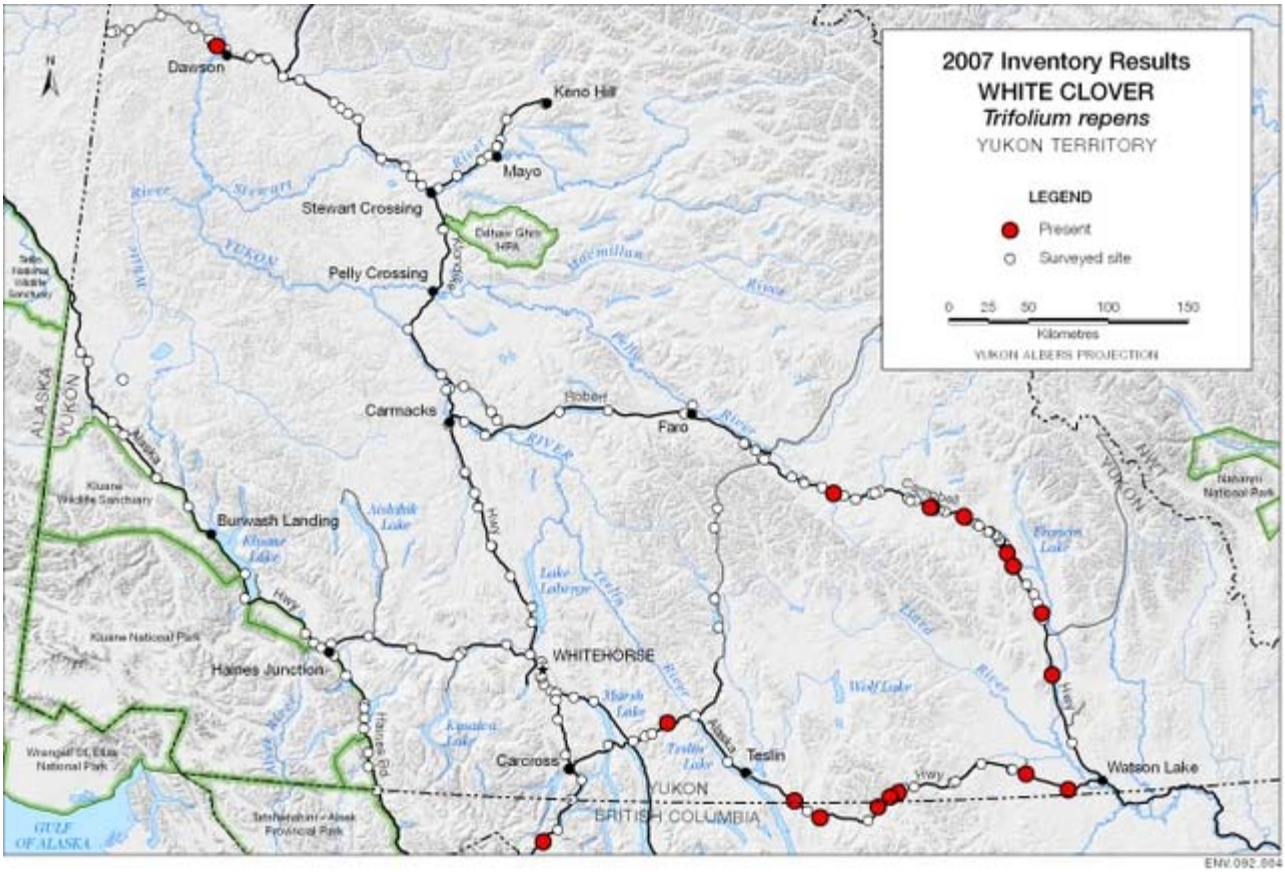

2007 Inventory Results
ALFALFA
Medicago sativa L.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.015


2007 Inventory Results
SAINFOIN
Onobrychis viciifolia Scop.
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.016


2007 Inventory Results
COMMON TIMOTHY
Pleum pratense
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.016


2007 Inventory Results
ALSIKE CLOVER
Trifolium hybridum
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.004


2007 Inventory Results
RED CLOVER
Trifolium pratensis
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.004


2007 Inventory Results
WHITE CLOVER
Trifolium repens
YUKON TERRITORY
LEGEND
Present
Surveyed site
0 25 50 100 150
Kilometres
YUKON ALBERS PROJECTION
Dawson
Keno Hill
Mayo
Stewart Crossing
Pelly Crossing
Carmacks
Robert
Faro
Burwash Landing
Haines Junction
WHITEHORSE
Carcross
Teslin
Watson Lake
YUKON
BRITISH COLUMBIA
ALASKA
GULF OF ALASKA
ENV.092.004