

**Bio-control of
Leafy Spurge
in Support of
Recovery of
Species at Risk
Year II** |

2002 Field Research Results

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Introduction

Leafy spurge (*Euphorbia esula*) is a deep-rooted perennial noxious weed that has rapidly spread across much of North America, especially throughout the western states and provinces. Leafy spurge will readily establish itself in a variety of environments, although it is quick to take advantage of disturbed sites. It can be found in Manitoba in pastures, agricultural lands, along roadsides and in wooded areas (Oliver, n.d.). Areas with high spurge densities and distributions also occur in the dry mixed grass prairie/sand dune habitat of the western spiderwort where there is less competition from native plants.

The western spiderwort (*Tradescantia occidentalis*) is a species that is restricted to sandy soils in open to partially destabilized sand dunes. The main threat to this species comes from encroachment of vegetation onto the dune systems. With changes in land management practices, especially suppression of burning and grazing, vegetation will overtake and stabilize areas of open sand, which is detrimental to the survival of the western spiderwort (Manitoba Conservation, n.d.). Vegetative succession from the mixed grass prairie/open sand dune habitat to aspen parkland is becoming evident in both of the project properties visited this season. Hastening the process of dune stabilization is the invasion of leafy spurge onto the sites.

When leafy spurge invades these habitats, the extensive root system of the spurge plant will help to stabilize the sand, which in turn aids other plant species in their efforts to colonize the sites. In 1992, the Committee On the Status of Endangered Wildlife in Canada (COSEWIC) assigned a threatened status to the western spiderwort. A threatened label means that the western spiderwort is likely to become endangered if limiting factors are not reversed (Government of Canada, 2002).

Project Description

The *Bio-Control of Leafy Spurge in Support of Recovery of Species at Risk* project is a research and demonstration project concerned with identifying effective bio-control strategies for leafy spurge with the aim of reducing the negative impact on the western spiderwort. Potentially, bio-control will involve two beetle species, the black leafy spurge flea beetle, *Aphthona lacertosa* and the black dot leafy spurge flea beetle, *Aphthona nigriscutis*.

Biological control is an attractive means of controlling leafy spurge in these ecologically sensitive sites, as it is host specific (Team Leafy Spurge, 2000). There is no danger of the *Aphthona* beetles preying upon or affecting other plant species. Biological control is also useful in areas where the landowners may be limited by the types of controls that can be used. For example, the leafy spurge flea beetles may be effective in areas where the terrain is too rough for herbicide application, or in areas where certain herbicides, such as picloram, cannot be applied due to the porous nature of the soil.

It is important to note that biological control alone will not eradicate the leafy spurge. It may, however, help to control the spread and reduce the density of leafy spurge on the site.

In this project's second year, research focused on two properties. These properties are:

- Manitoba Heritage Habitat Corporation (MHHC) Western Spiderwort site: NW 17-5-25W;
- And the Routledge Western spiderwort site.

The landowners of the Routledge site have requested that specific locations not be published due to sensitivity surrounding public awareness of the species at risk.

For Year II, project goals were:

- To conduct a follow-up on the vitality of the beetles released on the MHHC site in Year I, profiling beetle survival characteristics;
- To explore the feasibility of boosting beetle populations through additional releases in a controlled experiment;
- To establish a vegetative baseline and conduct initial release of beetles on the Routledge property, and;
- To collect data and compare it to baseline data for the MHHC site to initiate a longitudinal tracking of beetle populations and long-term impact on leafy spurge and its effects on species at risk (subject to availability of beetles).

Plant Descriptions

Leafy Spurge

Leafy spurge often has a shrubby appearance as it may have several stems growing from the crown. The stems are smooth, with numerous alternate linear-shaped pale blue-green or green leaves. Numerous yellow green bracts forming a flat-topped cluster start to appear from May to July. Often mistaken for the flowers, these bracts form a flat-topped umbel. The small, green and inconspicuous true flowers will emerge two weeks after the bracts (Oliver, n.d.). All parts of the leafy spurge plant contain milky white latex that is exuded when the plant is damaged.

Leafy spurge is one of the earliest plants to emerge in the spring, allowing it to claim the bulk of space, sunlight, available nutrients and water. It also has many other adaptations that give it a tremendous advantage over native vegetation. The root system of leafy spurge is extensive, often growing 26 feet (7.9 m) deep and 15 feet (4.6m) across. This system can sustain the plant through extended periods of drought, and allows it to recover quickly from grazing stress and herbicide damage. Movement of seeds or root fragments will easily spread leafy spurge from one area to another (Oliver, n.d.).

Western Spiderwort

Western spiderwort is a herbaceous perennial with fleshy roots specially adapted to growing in the dry sandy soils that comprise its habitat. Three rounded petals form a lovely flower that can range in colour from blue-purple, to white, or pink. The flowers are arranged in a cluster of up to 25 buds on the top of a slender stem. Usually, one flower will open per day, lasting only a few hours before fading. The leaves are grass-like, alternate and folded lengthwise. The western spiderwort traditionally flowers from mid-June until early July (Manitoba Conservation, n.d.).

The name of the western spiderwort derives from the sticky, stringy gel-like substance exuded from broken stems or leaves. When it dries, it forms spider web-like strands (Manitoba Conservation, no date).

The Manitoba Conservation Data Centre has classified the western spiderwort as very rare, and every few years, they conduct a survey of the Manitoba populations. There are only two major populations of this species in Manitoba: one in the Lauder Sandhills and another in the Routledge Sandhills. There are, however, some smaller populations occurring on private property, as well as on the Manitoba Habitat Heritage Corporation (MHHC) land discussed in this paper.

About COSEWIC

The Committee On the Status of Endangered Wildlife in Canada (COSEWIC) assesses and designates which native species are in danger of disappearing in Canada (Government of Canada, 2002). COSEWIC has assigned the status of threatened to the western spiderwort. This means that the species is likely to become endangered if limiting factors are not reversed.

Currently, COSEWIC consists of 29 voting members. These members represent federal, territorial, and provincial government wildlife agencies, the National Biosystematics Partnership, and the chairperson(s) of Species Specialist Subcommittees drawn from the member agencies or from museums, universities, or other sources (Government of Canada, 2002).

The voting members of COSEWIC assign a status to a species after reviewing status reports. The status report contains the best available information regarding the species biology, population size, trends in population size, distribution in Canada, and habitat availability. At the COSEWIC meetings, the situation of each species is discussed, and a status is assigned on the basis of consensus whenever possible. If not, a two-thirds majority vote is required to assign a particular species (Government of Canada, 2002).

Methods for collection of baseline data

Establishing a Transect Line

A minimum of 2 transects per property were set up, following the data collection methods of Rob Bouchier and Pauline Morton, with some modifications. One transect will act as a control, and the other will be used to measure the effects of released flea beetles. A permanent marker in the form of a large nail and a square piece of tin approximately 5 x 5 inches was set at the centre point of each transect.

A GPS reading was then taken for future reference.

The centre point served as the point of release for the flea beetles so that the halo effect of leafy spurge can be properly monitored over the next few years. (As the *Aphthona* larva feed on the roots of the leafy spurge, it will retard its growth creating a “halo” effect. The leafy spurge within this halo will be stunted, with fewer flowers and leaves compared to the leafy spurge outside of the feeding area. The halo will expand as the beetles move outward, moving to new food sources.)

As many of the transects as possible were set up where the leafy spurge encroaches upon the species at risk, so the effects of the bio-control on the leafy spurge and species at risk can be measured. In some cases this was not possible, due to site variations, or in areas where the conditions were not appropriate for the release of beetles. When this occurred, an appropriate release site was chosen so the leafy spurge flea beetles could be released and monitored in an appropriate leafy spurge patch closest to the species at risk.

One major site consideration was to release the *Aphthona* species where they are most likely to thrive. Release points tried to accommodate as many beneficial factors as possible:

- Full sun
- Good drainage
- Moderate leafy spurge density and height
- South facing slopes of hills (Team Leafy Spurge, 2000).

From the centre point, 10m transect lines extend out in the four cardinal directions (true N, S, E, and W).

Vegetation Sampling

Sampling, using a 1m x 0.25m wooden frame, occurred at 1,3,5, and 10m along each direction of the transect line. The frame was set to the right of the line, 0.5 m away from the string. This was to prevent sampling in areas where any trampling of the vegetation may have inadvertently occurred while setting up the lines.

Within each frame, flowering and vegetative shoots of leafy spurge were counted and recorded. The average heights of both the vegetative and flowering spurge were calculated by measuring at least 4 plants within the frame.

When they occurred, the numbers of western spiderwort stems were also counted within the plot marker. Last season, the heights of the western spiderwort plants found within the frame were measured. This practice was discontinued this season, as this information does not reflect the vigor of the plants, and is considered unnecessary for project results.

Cover estimates within the frame will be provided using the modified Daubenmeyer scale for leafy spurge, western spiderwort, grasses, forbs, litter, bare ground, woody species, lichen and moss.

Daubenmeyer scale

0	0
1	1-4%
2	5-24%
3	25-49%
4	50-74%
5	75-94%
6	95-100%

The field research for the Species at Risk project was undertaken during the flowering times of western spiderwort.

Assessing Beetle Populations

During the approximate peak beetle population, beetles were monitored using methods modified from Rob Bouchier and Pauline Morton. In Year I of this project, the vast majority of beetles released at the MHHC property were *A. lacertosa*. Because of this, the peak population date was used from Bouchier and Morton's research for the Lauder/Deloraine area. Data had been collected for a ten year period from weather stations in the area, averaged, and entered into a computer program which calculated the growing degree days (GDD). The peak population date Morton arrived at, July 9, was calculated based upon 1230 GDD for *A. lacertosa*.

The release site was visited three times — July 2, July 11 and July 19 — to check for beetles, ensuring that the peak beetle population was not missed.

Once the transect line was established, a sweep net was used to collect beetles at 1, 3, 5, and 10m along the transect lines in each of the four directions. At each stop, the vegetation was swept three times to the left of the line, and the beetles in the net were counted. After counting, the beetles were released. The vegetation to the right of the line was then swept, with the beetles again being counted and recorded. Care

was taken to avoid double counting by ensuring that the beetles were not released into the area that was going to be swept next.

Additional information

Additional plant species found in the transect area were recorded.

Average lateral root depths of leafy spurge within the transect area was also measured, determined by measuring the lateral root depths of at least 4 plants within the transect area.

A photograph of each transect was taken for future reference.

Area descriptions were also recorded (e.g., topography, shade, current land use, etc.) A rough map was drawn of each site, to aid in finding the marker in the future.

Field Equipment

GPS	compass
camera	containers for soil samples
string	tent pegs (to secure transect lines)
flagging tape	permanent site markers (spikes + tin)
10m measuring tape	bags for plant collections
25m measuring tape	small shovel or other digging implement
first aid kit	cell phone
hammer	frame 1m x 0.25m
writing material	sweep net

Results

Beetle Collection

Aphthona nigriscutis and *Aphthona cyparissiae* beetles were collected July 11, 2002 from the Brandon North Hill to the east of the RM of Cornwallis building. Part of the agreement with the city of Brandon to allow us to collect these beetles was to re-release a portion of the beetles near 18th street on the North Hill. *Aphthona nigriscutis* and *Aphthona cyparissiae* had been part of the original releases along this section of the North Hill, but have not fared as well as the populations further east. Approximately 2,000 beetles were released here, and the site was marked with a stake. The remainder of the collection was released at the Routledge area property (see Appendices 3 and 4 for details).

Hairy Prairie Clover

Western spiderwort is not the only plant from the COSEWIC threatened list that is found at the MHC site. Silky, or Hairy Prairie Clover (*Dalea villosa* var. *villosa*) was also located in this area. This plant was designated as threatened by COSEWIC in 2000. It is a perennial plant, with woody branching stems and compound leaves composed of 9-17 leaflets. The stem and leaves are covered in fine hairs, giving the

plant a soft, silky texture. Small purple flowers form a dense spike at the top of the stem. The preferred habitat of the silky prairie clover includes open to partially vegetated sand dunes, similar to the habitat requirements of the western spiderwort (Environment Canada; Species at Risk, 2002). Unfortunately, these habitat requirements leave it as vulnerable as the western spiderwort to the aggressive growth habits of leafy spurge and encroaching vegetation.

MHHC Site

The Manitoba Habitat Heritage Corporation site consists of a quarter section of property (NW 17-5-25W) with a ridge of high sandhills in the northeast corner. The steep westerly facing slopes of these sandhills are where the western spiderwort populations are generally found. The site is facing encroaching vegetation in the form of aspen, poison ivy, juniper, bearberry, chokecherry, wild rose, as well as leafy spurge.

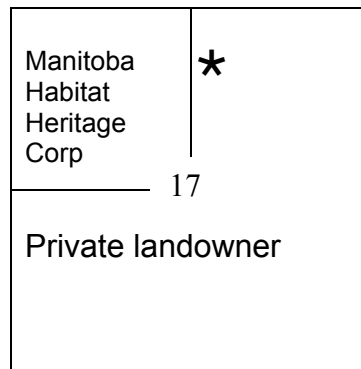
Appendix 7 compares the data from Year I and Year II of this project. The number of flowering leafy spurge plants in the release site remained essentially the same, with an average of 2 plants per quadrant. The average heights however decreased from an average of 33cm to 30cm. The non-flowering leafy spurge plants decreased in number from approximately 22 plants per quadrant to an average of 14 plants. The heights also decreased from an average of 20cm to 17cm.

The control site showed an increase in flowering leafy spurge plants, from an average of 15 plants per quadrant to 20 plants. The height however, decreased from 42 cm to 27cm. Non-flowering leafy spurge plants in the control site remained nearly the same from Year I to Year II of the project with an average of almost 1 plant per quadrant. The heights of the non-flowering plants increased from 15cm to nearly 20 cm. The number of western spiderwort stems in the control site quadrants increased by 2.

The original bio-control release at the MHHC site occurred during the 2001 field season. It included 12,000 beetles, 90% of which were *Aphthona lacertosa*, with the remaining 10% being *Aphthona nigriscutis*. This year, part of the project involved going back to monitor the release site. It produced some surprising results. All of the leafy spurge flea beetles found this year were *Aphthona nigriscutis* (see Appendix 6).

One possibility for these results is that the sand-based nature of the site favoured the survival of the *Aphthona nigriscutis*. *Aphthona lacertosa* are known to have a higher survival rate in heavier, clay/loam-based soils as opposed to *Aphthona nigriscutis*, which will tolerate lighter soils. *Aphthona lacertosa* were released in 2001 because at the time, they were the only species available in large quantities, and it was hoped they would survive and prosper. Although they were not located this season, it cannot be assumed the *Aphthona lacertosa* beetles did not survive. Possibly, they may have spread out from the original release point and relocated to a more suitable area.

The high numbers of *Aphthona nigriscutis* may also be the result of past releases done by John Johnston, the Cameron/Sifton/Glenwood weed supervisor for the landowner adjacent to the MHHC property. According to his documents, *Aphthona nigriscutis* were released onto the NE 17-5-25 section of land. Individual releases of 250 *Aphthona nigriscutis* were done in 1993, 1994, and 1995. The release point, marked by a ★ on the map of the section of land, shows the close proximity of the release to the MHHC site (Johnston, 2001-2002).



★- Beetle release

Over time, the leafy spurge flea beetles could easily have migrated over and through the sand ridges. Unfortunately, this information was not discovered until this field season, meaning the vegetative baseline information gathered last season may not reflect pre-biological control conditions. In any case, the presence of the leafy spurge beetles on the MHHC property is positive. Monitoring the site will still provide us with beneficial information regarding the efficiency of the *Aphthona* flea beetles in a sand-based habitat.

Routledge Property

The Routledge property includes a series of sandhills that contain one of the largest populations of western spiderwort in Manitoba. This property was originally purchased by a local family for recreational use, and in the process, they have become very involved in its conservation. The landowners have legitimate concerns over the widespread publishing of the location of their property and of the western spiderwort populations. They fear being overwhelmed by requests to view or study the site by the public, and they have therefore asked that the specific location of this site be withheld from this publication.

This was the first year of research to be conducted upon this property. This season was therefore dedicated to collecting baseline vegetative data and releasing initial populations of beetles on this property. Two release sites and a control site were set up. The release sites are at least ½ a kilometer apart so there should not be any overlap of beetle populations in the first few years.

There were two reasons to set up two separate release sites on the property instead of one aggregate release. First, the property is fairly extensive, with leafy spurge infesting a large portion of it. There is a large buffer zone of aspen bush in between prairie openings, so it is unlikely the beetles will move about on their own if they are to establish. Second, part of the research involved in this year's project includes monitoring the results of a "boosted" release site.

During the collection of beetles in Minot, North Dakota in the first year of the project, the local weed supervisor mentioned that by releasing a large quantity of beetles (or boosting the population) onto a site a year after the initial release, we may be able to increase the success of the insectary. The release site #1 on the Routledge property has been set up to act as a test site for this theory. This season, baseline vegetative information was gathered, and an initial release was made at this site (see Appendix 3 for results).

Limitations

Perhaps the most important limitation of the 2001 field season was the soil condition at the release sites. In the dry, sandy soil environment, the roots of leafy spurge must grow to deeper depths to find water. This is detrimental to the *Aphthona* larvae, which depend on the lateral root zone for food. The deeper the lateral roots, the harder it is for the larvae to access their only food source. The beetle population will be adversely effected as many larvae may starve because they cannot reach the critical pieces of root. Concentrating on releasing *Aphthona nigricutis* and *Aphthona cyparissae* may ameliorate part of this problem.

The peak population date for *Aphthona lacertosa* (released at the site in 2001) calculated for the area was July 9-10. The unseasonably cool weather at the beginning of summer may have had a factor in the numbers of beetles found at the site.

Many plant species also emerged a few weeks behind schedule. During June, July and August, the area suffered from very dry weather. Many plant species were stunted, and the grass was considerably less vigorous than in the previous year due to the lack of moisture. This made identification of plants without reproductive structures very difficult. In 2001, the site was surveyed June 19 as the western spiderwort was in the middle of its flowering cycle. In 2002, the plants were not surveyed until they flowered around July 15, a delay of nearly a month.

Conclusion

Because this project is still only in its second year, it is still far too early to conclude whether or not the biological control program will be successful. The survival and moderate number of beetles found this season at the MHHC site lends encouragement to the successful establishment of the bio-control at the Routledge property. Slight reductions in the leafy spurge density and size were found when comparing Year I and Year II data. However, as mentioned previously, this may be due to the delayed season, followed by extremely dry conditions. Further monitoring of these sites next season will help to provide us with a more accurate view of how well the leafy spurge flea beetles are doing in their assigned task.

Appendix 1: MHC Beetle Release Site Results

SAR Western spiderwort (*Tradescantia occidentalis*)

MHC - Beetle release site

Date Surveyed	July 15, 2002					
Legal description	NW 17-5-25W Owned by the Manitoba Habitat Heritage Corporation (MHC).					
GPS reading	N 49°28.877' W 100°49.227'					
General topography	Series of sand hills.					
Site topography	On plateau mid-way down a ridge, south-west aspect.					
<i>E. esula</i> patch size	The spurge is spread out through the property in patches and continuous lines.					
Vegetation association	Mixed grass and encroaching Aspen forest, though there is no tree or shrub shade at the site.					
Soil type	Sand					
Date beetles released	June 29, 2001					
Species	90% <i>Aphthona lacertosa</i> , 10% <i>Aphthona nigriscutis</i>					
Number released	12,000					
	<i>Euphorbia esula</i>				<i>Tradescantia occidentalis</i>	F – Flowering NF – Non-flowering All heights in cm
	Stems/0.25m ²		Average height F	Average height NF	Stems/0.25m ²	
	#F	#NF				
North 1m	4	14	33.6	19.3	0	
North 3m	0	13	NA	16.3	0	
North 5m	0	13	NA	17.7	0	
North 10m	0	38	NA	15.3	0	
East 1m	6	13	42.7	26	0	
East 3m	6	13	35.7	18.7	0	
East 5m	0	13	NA	15.7	0	
East 10m	4	10	35.7	23.3	0	
South 1m	2	15	14	17.3	0	
South 3m	4	19	20.3	18.7	0	
South 5m	3	26	28.3	15.7	0	
South 10m	0	11	NA	10	0	
West 1m	3	12	30	17	0	
West 3m	0	10	NA	9	0	
West 5m	1	8	31	9.3	0	
West 10m	0	0	NA	NA	0	

SAR Western spiderwort (*Tradescantia occidentalis*)

MHHC - Beetle release site

Cover classes									
	<i>Euphorbia esula</i>	<i>Tradescantia occidentalis</i>	Forbs	Grasses	Wood	Litter	Moss	Lichens	Bare ground
North 1m	3	0	1	3	1	5 thin	0	4	2
North 3m	2	0	1	2	2	2	0	5	2
North 5m	2	0	2	2	5	4	0	2	2
North 10m	3	0	2	2	2	2	2	6	2
East 1m	3	0	3	2	4	5	0	2	2
East 3m	3	0	1	2	0	4	0	2	2
East 5m	2	0	1	2	2	2	2	2	2
East 10m	3	0	2	3	3	4	0	4	2
South 1m	3	0	1	4	0	4	0	2	2
South 3m	3	0	1	4	0	3	0	0	3
South 5m	4	0	1	No data	0	2	0	0	No data
South 10m	2	0	0	2	0	1	0	0	6
West 1m	3	0	1	3	0	5 thin	0	2	2
West 3m	2	0	2	2	0	2	0	0	5
West 5m	2	0	3	2	3	1	0	0	3
West 10m	0	0	1	2	3	0	0	0	5
Cover classes						0	0		
						1	1-4%		
						2	5-24%		
						3	25-49%		
						4	50-74%		
						5	75-94%		
						6	95-100%		

SAR Western spiderwort (*Tradescantia occidentalis*)

MHHC - Beetle release site

Other plant species within the plot marker	
North 1m	<i>Arctostaphylos uva-ursi</i> , <i>Carex sp.</i> , <i>Comandra sp.</i> , <i>Rhus radicans</i> , <i>Stipa comata</i>
North 3m	Unknown grass, <i>Carex sp.</i> , <i>Panicum sp.</i> , <i>Rhus radicans</i>
North 5m	<i>Andropogon hallii</i> , <i>Arctostaphylos uva-ursi</i> , <i>Carex sp.</i> , <i>Equisetum hyemale</i> , <i>Juniperus horizontalis</i> ,
North 10m	Unknown grass, <i>Arctostaphylos uva-ursi</i> , <i>Dalea villosa var. villosa</i> ,
East 1m	<i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Prunus virginiana</i> , <i>Rhus radicans</i> , <i>Stipa comata</i>
East 3m	<i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Rhus radicans</i> , <i>Stipa comata</i>
East 5m	<i>Andropogon hallii</i> , <i>Arctostaphylos uva-ursi</i> , <i>Rhus radicans</i> , <i>Stipa comata</i>
East 10m	Basal leaves, Unknown grass, <i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Rosa sp.</i> , <i>Stipa comata</i>
South 1m	Unknown grass, Unknown forb, <i>Carex sp.</i> , <i>Rhus radicans</i> , <i>Stipa comata</i>
South 3m	<i>Carex sp.</i> , <i>Rhus radicans</i> , <i>Sporobolus cryptandrus</i> , <i>Stipa comata</i>
South 5m	Unknown grass, <i>Carex sp.</i> , <i>Rhus radicans</i> , <i>Sporobolus cryptandrus</i> , <i>Stipa comata</i>
South 10m	<i>Sporobolus cryptandrus</i>
West 1m	<i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Rhus radicans</i> , <i>Sporobolus cryptandrus</i>
West 3m	<i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Liatris ligulistylis</i> , <i>Rhus radicans</i> , <i>Thermopsis rhombifolia</i>
West 5m	Unknown grass, <i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Chrysopsis villosa</i> , <i>Dalea villosa var. villosa</i> , <i>Juniperus horizontalis</i> , <i>Rhus radicans</i> , <i>Sporobolus cryptandrus</i>
West 10m	Unknown grass, Basal leaves, <i>Carex sp.</i> , <i>Dalea villosa var. villosa</i> , <i>Juniperus horizontalis</i> , <i>Koeleria cristata</i> , <i>Sporobolus cryptandrus</i>
Other plants in the transect area	
<i>Artemisia frigida</i> , <i>Calamovilfa longifolia</i>	
See Appendix 8 for common names	
This list may not include all of the species found within the plot marker area	

Appendix 2: MHC Control Site Results

SAR Western spiderwort (*Tradescantia occidentalis*)

MHC – Control Site

Date Surveyed	July 15, 2002				
Legal description	NW 17-5-25W Owned by the Manitoba Habitat Heritage Corporation (MHC).				
GPS reading	N 49°23.853' W 100°49.185'				
General topography	Series of sand hills.				
Site topography	On side of ridge, south-west aspect.				
<i>E. esula</i> patch size	The spurge is spread out through the property in patches and continuous lines.				
Vegetation association	Mixed grass/Aspen forest, though there is no tree or shrub shade at the site.				
Soil type	Sand.				
	<i>Euphorbia esula</i>				<i>Tradescantia occidentalis</i>
	Stems/0.25m ²				
	#F	#NF	Average height F	Average height NF	Stems/0.25m ²
North 1m	0	0	NA	NA	1
North 3m	0	0	NA	NA	2
North 5m	0	0	NA	NA	0
North 10m	0	0	NA	NA	0
East 1m	2	5	29.5	17.3	2
East 3m	0	5	NA	26.7	0
East 5m	0	0	NA	NA	0
East 10m	0	0	NA	NA	0
South 1m	0	0	NA	NA	0
South 3m	0	0	NA	NA	0
South 5m	0	0	NA	NA	0
South 10m	2	2	24.5	20.5	0
West 1m	0	0	NA	NA	0
West 3m	0	2	NA	14.5	0
West 5m	0	0	NA	NA	0
West 10m	0	0	NA	NA	0

F – Flowering
NF – Non-flowering

All heights in cm

SAR Western spiderwort (*Tradescantia occidentalis*)

MHHC – Control Site

Cover classes									
	<i>Euphorbia esula</i>	<i>Tradescantia occidentalis</i>	Forbs	Grasses	Wood	Litter	Moss	Lichens	Bare ground
North 1m	0	2	0	2	2	2	0	0	4
North 3m	0	2	1	4	2	2	0	0	3
North 5m	0	0	2	3	6	4	0	2	2
North 10m	0	0	2	4	3	5	0	2	2
East 1m	2	1	2	3	2	2	0	0	5
East 3m	2	0	2	3	2	2	0	0	4
East 5m	0	0	2	3	0	0	0	0	5
East 10m	0	0	0	4	3	3	0	0	3
South 1m	0	0	0	4	2	2	0	0	5
South 3m	0	0	1	4	0	0	0	0	4
South 5m	0	0	0	3	2	2	0	0	3
South 10m	2	0	2	3	2	2	0	0	3
West 1m	0	0	1	4	2	2	0	0	4
West 3m	2	0	2	4	4	4	0	0	2
West 5m	0	0	0	5	2	2	0	1	2
West 10m	0	0	2	4	4	4	0	0	5
Cover classes							0	0	
							1	1-4%	
							2	5-24%	
							3	25-49%	
							4	50-74%	
							5	75-94%	
							6	95-100%	

SAR Western spiderwort (*Tradescantia occidentalis*)

MHHC – Control Site

Other plant species within the plot marker	
North 1m	<i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Rosa</i> sp., <i>Sporobolus cryptandrus</i>
North 3m	Basal leaves, <i>Andropogon hallii</i> , <i>Rosa</i> sp., <i>Sporobolus cryptandrus</i>
North 5m	Basal leaves, <i>Andropogon hallii</i> , <i>Artemisia ludoviciana</i> , <i>Juniperus horizontalis</i> , <i>Poa</i> sp., <i>Rhus radicans</i> , <i>Rosa</i> sp.
North 10m	Basal leaves, <i>Andropogon hallii</i> , <i>Artemisia ludoviciana</i> , <i>Carex</i> sp., <i>Poa</i> sp., <i>Rhus radicans</i> , <i>Rosa</i> sp.,
East 1m	<i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Chenopodium leptophyllum</i> , <i>Rosa</i> sp., <i>Sporobolus cryptandrus</i>
East 3m	Unknown grass, Unknown forb, <i>Andropogon hallii</i> , <i>Chenopodium leptophyllum</i> , <i>Koeleria cristata</i> , <i>Rosa</i> sp., <i>Stipa comata</i>
East 5m	Unknown forb, <i>Andropogon hallii</i> , <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Chenopodium leptophyllum</i> , <i>Poa</i> sp.
East 10m	Unknown forb, <i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Poa</i> sp., <i>Rosa</i> sp.
South 1m	<i>Andropogon hallii</i> , <i>Juniperus horizontalis</i> , <i>Rosa</i> sp., <i>Sporobolus cryptandrus</i>
South 3m	Unknown forb, <i>Andropogon hallii</i> , <i>Koeleria cristata</i>
South 5m	<i>Koeleria cristata</i> , <i>Juniperus horizontalis</i> , <i>Stipa</i> sp.,
South 10m	<i>Ambrosia psilostachya</i> , <i>Bouteloua gracilis</i> , <i>Chenopodium leptophyllum</i> , <i>Composite</i> sp., <i>Juniperus horizontalis</i> , <i>Koeleria cristata</i> , <i>Panicum</i> sp., <i>Sporobolus cryptandrus</i>
West 1m	<i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Chenopodium leptophyllum</i> , <i>Rosa</i> sp.
West 3m	<i>Ambrosia psilostachya</i> , <i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Composite</i> sp., <i>Juniperus horizontalis</i> , <i>Rosa</i> sp., <i>Stipa comata</i>
West 5m	<i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Chenopodium leptophyllum</i> , <i>Juniperus horizontalis</i> , <i>Stipa comata</i>
West 10m	<i>Andropogon hallii</i> , <i>Carex</i> sp., <i>Chenopodium leptophyllum</i> , <i>Rosa</i> sp., <i>Stipa comata</i> , <i>Sporobolus cryptandrus</i>
Other plants in the transect area	
<i>Artemisia campestris</i> , <i>Calamovilfa longifolia</i> , <i>Lithospermum incisum</i> ,	
See Appendix 8 for common names	
This list may not include all of the species found within the plot marker area	

Appendix 3: Routledge Property, Beetle Release #1 Results

SAR Western spiderwort (*Tradescantia occidentalis*)

Release # 1, Routledge Property

Date Surveyed	July 17, 2002				
Legal description	Withheld upon request of landowners.				
GPS reading	Withheld upon request of landowners.				
General topography	Series of hills and ridges extending through property.				
Site topography	On crest of small ridge.				
<i>E. esula</i> patch size	Continuous throughout property.				
Vegetation association	Mixed grass and encroaching Aspen parkland, though there is no tree or shrub shade at the site.				
Soil type	Sand.				
Date beetles released	July 12, 2002				
Species	<i>Aphthona nigriscutis</i> and <i>Aphthona cyparissae</i> mixed				
Number released	Approximately 4,000 beetles				
	<i>Euphorbia esula</i>				<i>Tradescantia occidentalis</i>
	Stems/0.25m ²				
	#F	#NF	Average height F	Average height NF	Stems/0.25m ²
North 1m	7	4	32.5	14.5	0
North 3m	6	4	47.3	29.8	0
North 5m	2	11	35.5	16.5	0
North 10m	4	9	36	23.3	0
East 1m	2	17	39.8	21.8	0
East 3m	4	14	37.3	21	0
East 5m	11	10	38	22.5	0
East 10m	4	4	28.3	19	0
South 1m	3	9	36	17.5	0
South 3m	20	24	40.3	18.8	0
South 5m	4	10	31.8	No data	0
South 10m	0	11	NA	20.3	0
West 1m	1	8	33	16.3	0
West 3m	2	5	26.5	11.8	0
West 5m	4	8	36	No data	0
West 10m	1	19	64	48.8	0

F – Flowering
NF – Non-flowering

All heights in cm

SAR Western spiderwort (*Tradescantia occidentalis*)

Release # 1, Routledge Property

Cover classes									
	<i>Euphorbia esula</i>	<i>Tradescantia occidentalis</i>	Forbs	Grasses	Wood	Litter	Moss	Lichens	Bare ground
North 1m	2	0	1	5	3	4	0	1	2
North 3m	3	0	2	2	5	5	0	0	2
North 5m	3	0	1	3	3	3	0	4	1
North 10m	1	0	2	3	5	5	0	0	3
East 1m	5	0	1	5	3	5	0	0	1
East 3m	3	0	1	5	3	5	0	1	1
East 5m	4	0	1	5	3	5	0	0	0
East 10m	1	0	1	6	0	5	0	5	0
South 1m	3	0	1	5	2	4	0	0	1
South 3m	5	0	1	5	2	6	0	0	0
South 5m	3	0	0	5	0	5	0	2	1
South 10m	3	0	0	4 thin	4	2	0	0	3
West 1m	2	0	1	5	5	4	2	2	1
West 3m	2	0	1	5	5	5	0	2	1
West 5m	3	0	1	5	3	5	0	0	0
West 10m	4	0	4	2	4	6	0	0	0
Cover classes						0	0		
						1	1-4%		
						2	5-24%		
						3	25-49%		
						4	50-74%		
						5	75-94%		
						6	95-100%		

SAR Western spiderwort (*Tradescantia occidentalis*)

Release # 1, Routledge Property

Other plant species within the plot marker	
North 1m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Juniperus horizontalis</i>
North 3m	Basal leaves, <i>Carex</i> sp., <i>Galium boreale</i> , <i>Juniperus horizontalis</i> , <i>Smilacina stellata</i> , <i>Symphoricarpos</i> sp.
North 5m	Basal leaves, <i>Andropogon scopiarus</i> , <i>Anemone canadensis</i> , <i>Arctostaphylos uva-ursi</i> , <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Galium boreale</i> , <i>Juniperus horizontalis</i> , <i>Symphoricarpos</i> sp.
North 10m	Basal leaves, <i>Anemone canadensis</i> , <i>Carex</i> sp., <i>Juniperus horizontalis</i> , <i>Rhus radicans</i> , <i>Symphoricarpos</i> sp.
East 1m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Bromus</i> sp., <i>Carex</i> sp., <i>Comandra</i> sp., <i>Prunus virginiana</i> , <i>Rosa</i> sp.
East 3m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Prunus virginiana</i>
East 5m	<i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Mammillaria vivipara</i> , <i>Prunus virginiana</i>
East 10m	Unknown grass, <i>Carex</i> sp., <i>Comandra</i> sp.
South 1m	<i>Carex</i> sp., <i>Prunus virginiana</i> , <i>Sporobolus cryptandrus</i> , <i>Stipa</i> sp.
South 3m	Unknown grass, <i>Carex</i> sp., <i>Comandra</i> sp., <i>Rosa</i> sp.
South 5m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Bromus</i> sp., <i>Carex</i> sp., <i>Stipa</i> sp.
South 10m	<i>Bromus</i> sp., <i>Carex</i> sp., <i>Juniperus horizontalis</i>
West 1m	Unknown grass, <i>Agropyron</i> sp., <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Juniperus horizontalis</i> , <i>Poa</i> sp.
West 3m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Juniperus horizontalis</i>
West 5m	Unknown grass, <i>Bouteloua gracilis</i> , <i>Carex</i> sp., <i>Comandra</i> sp., <i>Juniperus horizontalis</i> , <i>Sporobolus cryptandrus</i>
West 10m	<i>Maianthemum canadense</i> , <i>Prunus virginiana</i> , <i>Rhus radicans</i> , <i>Rubus ideaus</i> , <i>Symphoricarpos</i> sp.
Other plants in the transect area	
<i>Calamovilfa longifolia</i>	
See Appendix 8 for common names	
This list may not include all of the species found within the plot marker area	

Appendix 4: Routledge Property, Beetle Release #2 Results

SAR Western spiderwort (*Tradescantia occidentalis*)

Release #2 – Routledge property

Date Surveyed	July 17, 2002				
Legal description	Withheld upon request of landowners.				
GPS reading	Withheld upon request of landowners.				
General topography	Series of hills and ridges extending through property.				
Site topography	On steeply sloped side of ridge, west aspect.				
<i>E. esula</i> patch size	Continuous throughout property.				
Vegetation association	Mixed grass and encroaching aspen parkland, though there is no tree or shrub shade at the site.				
Soil type	Sand.				
Date beetles released	July 12, 202				
Species	<i>Aphthona nigriscutis</i> and <i>Aphthona cyparissae</i> mixed				
Number released	Approximately 4, 000				
	<i>Euphorbia esula</i>				<i>Tradescantia occidentalis</i>
	Stems/0.25m ²				
	#F	#NF	Average height F	Average height NF	Stems/0.25m ²
North 1m	10	17	28	17.3	0
North 3m	4	17	19.5	10.8	1 plant with 4 stems
North 5m	2	13	30.5	17.5	0
North 10m	3	4	24	14.5	1
East 1m	12	38	29	15.8	1
East 3m	18	18	24.3	13.5	0
East 5m	16	15	30.25	15.5	0
East 10m	Data unavailable – heavy poison ivy and brush				
South 1m	2	8	26.5	12.5	0
South 3m	0	3	NA	15	0
South 5m	0	4	NA	16.5	1
South 10m	0	0	NA	NA	2
West 1m	2	16	22	21	0
West 3m	0	3	NA	20.7	0
West 5m	0	4	NA	17.8	0
West 10m	0	0	NA	NA	1

F – Flowering
NF – Non-flowering

All heights in cm

SAR Western spiderwort (*Tradescantia occidentalis*)

Release #2 – Routledge Property

Cover classes									
	<i>Euphorbia esula</i>	<i>Tradescantia occidentalis</i>	Forbs	Grasses	Wood	Litter	Moss	Lichens	Bare ground
North 1m	5	0	2	2	2	2	4	0	3
North 3m	3	2	1	3	1	3	1	0	4
North 5m	3	3	2	4	1	4	1	0	3
North 10m	2	2	2	2	1	3	5	0	1
East 1m	5	2	0	3	1	3	5	0	1
East 3m	5	0	1	2	2	5	3	0	4
East 5m	5	0	1	5	5	5	0	0	2
East 10m	NA	NA	NA	NA	NA	NA	NA	NA	NA
South 1m	2	0	0	5	3	5 thin	5	0	1
South 3m	2	0	2	6	4	5	2	0	0
South 5m	2	2	0	5	3	5	3	0	1
South 10m	0	2	1	5	1	5 thin	5	0	3
West 1m	3	0	2	3	3	3	2	0	4
West 3m	2	0	0	4	1	3	2	0	5
West 5m	2	0	0	5	0	5	3	0	3
West 10m	0	2	4	5	2	5	3	0	1
Cover classes						0	0		
						1	1-4%		
						2	5-24%		
						3	25-49%		
						4	50-74%		
						5	75-94%		
						6	95-100%		

SAR Western spiderwort (*Tradescantia occidentalis*)

Release #2 – Routledge Property

Other plant species within the plot marker	
North 1m	<i>Asclepias sp.</i> , <i>Smilacina stellata</i> , <i>Sporobolus cryptandrus</i> , <i>Symphoricarpos sp.</i>
North 3m	Unknown grass, <i>Koeleria gracilis</i> , <i>Sporobolus cryptandrus</i> , <i>Symphoricarpos sp.</i>
North 5m	<i>Andropogon hallii</i> , <i>Artemisia campestris</i> , <i>Lygodesmia juncea</i> , <i>Stipa sp.</i> , <i>Symphoricarpos sp.</i>
North 10m	Unknown grass, <i>Carex sp.</i> , <i>Lygodesmia juncea</i> , <i>Smilacina stellata</i> , <i>Symphoricarpos sp.</i> ,
East 1m	Unknown grass, <i>Agropyron sp.</i> , <i>Carex sp.</i> , <i>Symphoricarpos sp.</i>
East 3m	Unknown grass, <i>Prunus virginiana</i> , <i>Smilacina stellata</i> , <i>Symphoricarpos sp.</i>
East 5m	Unknown grass, <i>Agropyron sp.</i> , <i>Prunus virginiana</i> , <i>Rosa sp.</i> , <i>Smilacina stellata</i> , <i>Symphoricarpos sp.</i>
East 10m	<i>Euphorbia esula</i> , <i>Prunus virginiana</i> , <i>Parthenocissus quinquefolia</i> , <i>Rhus radicans</i> , <i>Rosa sp.</i> , <i>Symphoricarpos sp.</i>
South 1m	Unknown grass, <i>Andropogon hallii</i> , <i>Symphoricarpos sp.</i>
South 3m	<i>Andropogon hallii</i> , <i>Artemisia frigida</i> , <i>Rhus radicans</i> , <i>Symphoricarpos sp.</i>
South 5m	<i>Andropogon hallii</i> , <i>Juniperus horizontalis</i> , <i>Rhus radicans</i> , <i>Symphoricarpos sp.</i>
South 10m	Basal leaves, <i>Andropogon hallii</i> , <i>Symphoricarpos sp.</i>
West 1m	Unknown grass, <i>Andropogon hallii</i> , <i>Asclepias sp.</i> , <i>Lithospermum incisum</i>
West 3m	<i>Andropogon hallii</i> , <i>Sporobolus cryptandrus</i>
West 5m	<i>Andropogon hallii</i> , <i>Sporobolus cryptandrus</i>
West 10m	Basal leaves, Unknown grass, <i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Koeleria gracilis</i> , <i>Lithospermum incisum</i> , <i>Solidago missouriensis</i>
Other plants in the transect area	
<i>Calamovilfa longifolia</i>	
See Appendix 8 for common names	
This list may not include all of the species found within the plot marker area	

Appendix 5: Routledge Property, Control Site Results

SAR Western spiderwort (*Tradescantia occidentalis*)

Control site – Routledge Property

Date Surveyed	July 17, 2002				
Legal description	Withheld upon request from landowners.				
GPS reading	Withheld upon request of landowners.				
General topography	Series of hills and ridges extending through property.				
Site topography	Half way up a sand ridge, south aspect.				
<i>E. esula</i> patch size	Continuous throughout property.				
Vegetation association	Mixed grass and encroaching aspen parkland, though there is no tree or shrub shade at the site.				
Soil type	Sand.				
	<i>Euphorbia esula</i>				<i>Tradescantia occidentalis</i>
	Stems/0.25m ²				
	#F	#NF	Average height F	Average height NF	Stems/0.25m ²
North 1m	1	4	21	12.8	0
North 3m	0	6	NA	1.25	0
North 5m	0	59	NA	8.1	0
North 10m	1	81	26	8.3	0
East 1m	4	38	27.3	15.8	0
East 3m	12	7	29.8	12.8	0
East 5m	6	22	30.8	18.5	0
East 10m	2	2	15.5	9.5	0
South 1m	4	8	17.5	13	0
South 3m	0	31	NA	12.5	0
South 5m	0	5	NA	14	0
South 10m	0	0	NA	NA	0
West 1m	0	1	NA	5	0
West 3m	0	6	NA	7	0
West 5m	0	1	NA	5	0
West 10m	0	1	NA	13	0

F – Flowering
NF – Non-flowering

All heights in cm

SAR Western spiderwort (*Tradescantia occidentalis*)

Control site – Routledge Property

Cover classes									
	<i>Euphorbia esula</i>	<i>Tradescantia occidentalis</i>	Forbs	Grasses	Wood	Litter	Moss	Lichens	Bare ground
North 1m	2	0	1	4	0	2	5	0	2
North 3m	2	0	2	2	0	3 thin	5	0	1
North 5m	5	0	1	2	1	1	5	0	1
North 10m	5	0	2	3	0	3	6	0	1
East 1m	5	0	2	5	0	3	6	1	1
East 3m	5	0	2	4	0	3	5	1	1
East 5m	5	0	2	2	1	5 thin	5	0	2
East 10m	2	0	2	3	1	5	4	0	1
South 1m	3	0	1	5	0	4	4	1	2
South 3m	4	0	1	2	2	3	5	0	3
South 5m	2	0	2	5	0	4	3	0	3
South 10m	0	0	1	3	3	1	1	0	4
West 1m	1	0	2	4	0	3	5	0	1
West 3m	2	0	2	5	0	5 thin	2	0	0
West 5m	1	0	1	3	0	2	3	0	5
West 10m	2	0	1	3	3	2	3	0	2
Cover classes						0	0		
						1	1-4%		
						2	5-24%		
						3	25-49%		
						4	50-74%		
						5	75-94%		
						6	95-100%		

SAR Western spiderwort (*Tradescantia occidentalis*)

Control site – Routledge Property

Other plant species within the plot marker	
North 1m	Basal leaves, <i>Andropogon hallii</i> , <i>Carex sp.</i> , <i>Comandra sp.</i>
North 3m	Basal leaves, Unknown grass, <i>Carex sp.</i> , <i>Chrysopsis villosa</i> , <i>Comandra sp.</i> , <i>Sporobolus cryptandrus</i>
North 5m	Basal leaves, Unknown grass, <i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Koeleria gracilis</i> , <i>Sporobolus cryptandrus</i>
North 10m	Basal leaves, Unknown grass, <i>Carex sp.</i> , <i>Dalea purpurea</i> , <i>Mamillaria vivipara</i>
East 1m	Basal leaves, Unknown grass, <i>Carex sp.</i> , <i>Comandra sp.</i> , <i>Dalea purpurea</i>
East 3m	Basal leaves, <i>Carex sp.</i> , <i>Dalea purpurea</i> , <i>Potentilla pensylvanica</i>
East 5m	Unknown grass, <i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Potentilla pensylvanica</i> , <i>Smilacina stellata</i>
East 10m	Basal leaves, <i>Carex sp.</i> , <i>Andropogon scoparius</i> , <i>Juniperus horizontalis</i> , <i>Lithospermum incisum</i> , <i>Sporobolus cryptandrus</i>
South 1m	Unknown grass, <i>Carex sp.</i> , <i>Comandra sp.</i> , <i>Koeleria gracilis</i> , <i>Stipa sp.</i>
South 3m	Unknown grass, <i>Carex sp.</i> , <i>Juniperus horizontalis</i> , <i>Dalea purpurea</i>
South 5m	Basal leaves, <i>Andropogon scoparius</i> , <i>Carex sp.</i> , <i>Dalea purpurea</i>
South 10m	Unknown grass, <i>Andropogon scoparius</i> , <i>Arctostaphylos uva-ursi</i> , <i>Carex sp.</i> , <i>Comandra sp.</i>
West 1m	Basal leaves, <i>Carex sp.</i> , <i>Comandra sp.</i> , <i>Lithospermum incisum</i> , <i>Mamillaria vivipara</i> , <i>Stipa sp.</i>
West 3m	Unknown grass, <i>Carex sp.</i> , <i>Comandra sp.</i> , <i>Chenopodium leptophyllum</i> , <i>Lithospermum incisum</i> , <i>Sporobolus cryptandrus</i>
West 5m	Unknown grass, <i>Comandra sp.</i>
West 10m	Unknown grass, <i>Andropogon scoparius</i> , <i>Arctostaphylos uva-ursi</i> , <i>Bouteloua gracilis</i> , <i>Carex sp.</i> , <i>Dalea purpurea</i>
Other plants in the transect area	
<i>Calamovilfa longifolia</i> , <i>Tragopogon dubius</i> , <i>Populus deltoides</i>	
See Appendix 8 for common names	
This list may not include all of the species found within the plot marker area	

Appendix 6: MHHC Year II, Beetle counts

July 2, 2002

	North		South		East		West	
	east	west	east	west	north	south	north	south
1m	6	11	4	4	5	2	4	5
3m	2	4	4	6	1	2	3	8
5m	1	2	6	8	9	5	0	1
10m	0	0	1	1	1	3	1	0

All beetles collected were *Aphthona nigriscutis*, unless otherwise specified.

July 11, 2002

	North		South		East		West	
	east	west	east	west	north	south	north	south
1m	4	3	2	2	0	0	2	0
3m	0	5	1	2	0	1	0	0
5m	1	0	1	1	1	1	0	0
10m	3	0	0	1	2	2	0	1

All beetles collected were *Aphthona nigriscutis*, unless otherwise specified.

July 19, 2002

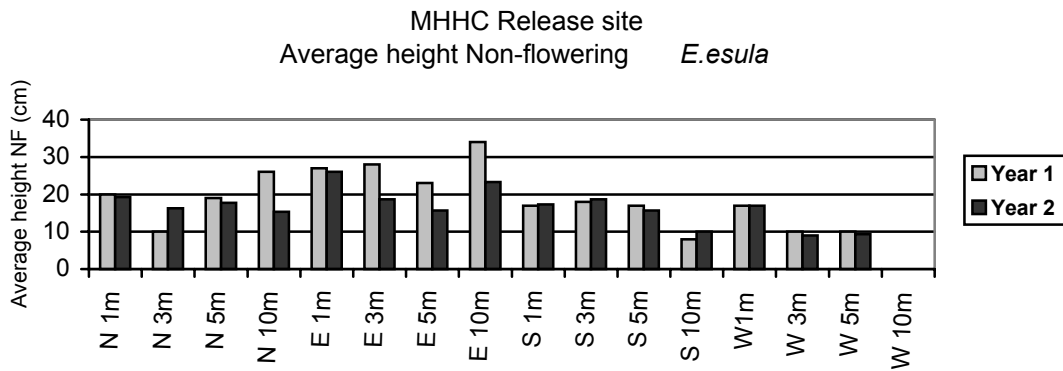
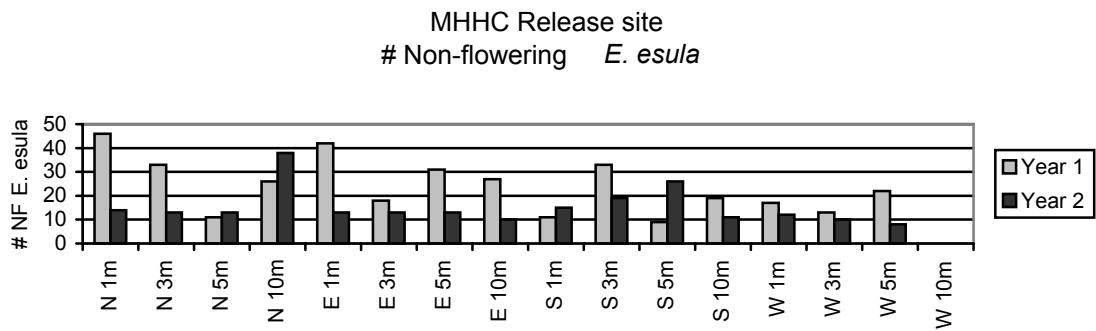
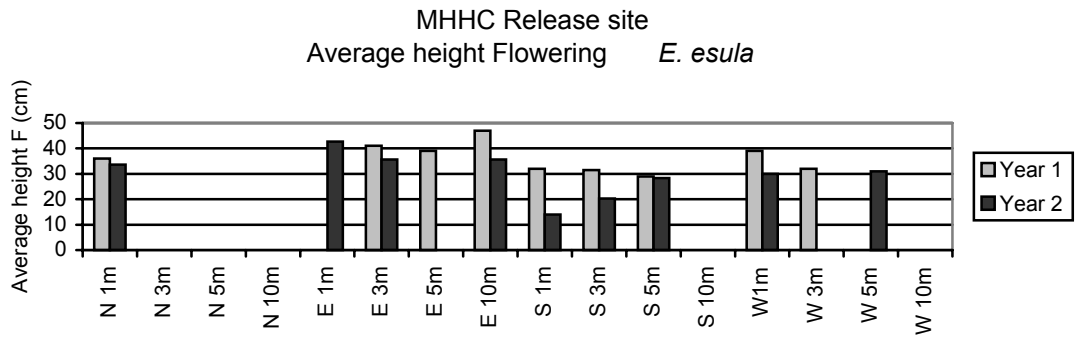
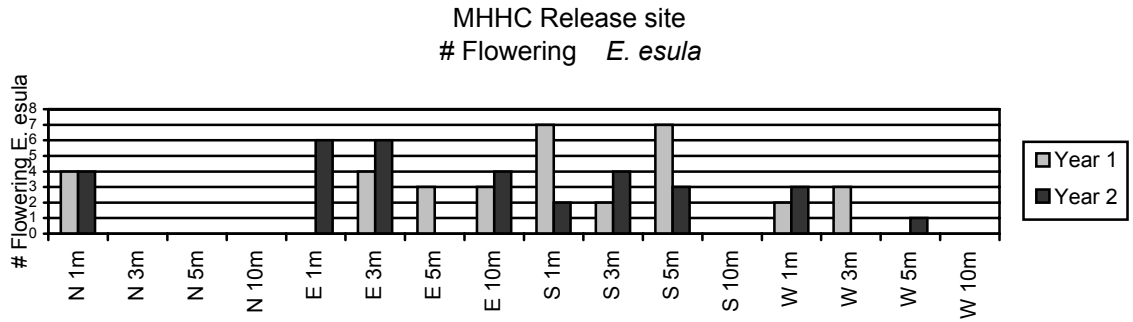
	North		South		East		West	
	east	west	east	west	north	south	north	south
1m	17	1	4	10	3	13	4	7
3m	2	5	15	9	6	9	9	1
5m	7	7	3	1	4	21	1	0
10m	11	6	0	2	7	2	0	0

All beetles collected were *Aphthona nigriscutis*, unless otherwise specified.

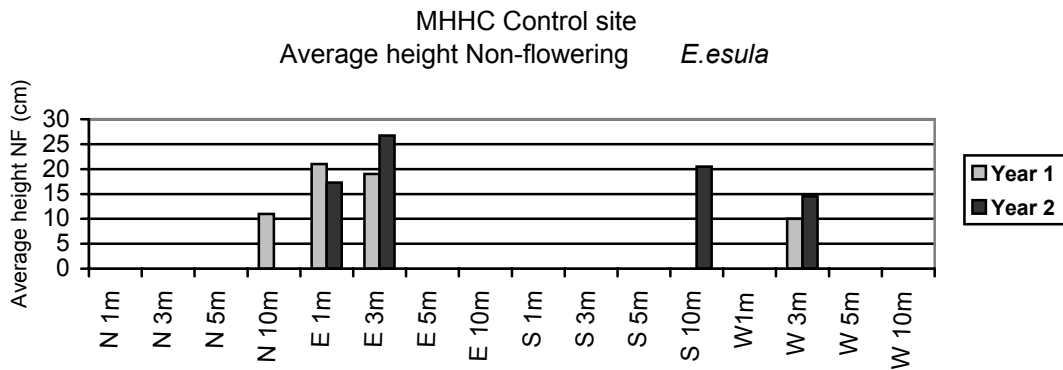
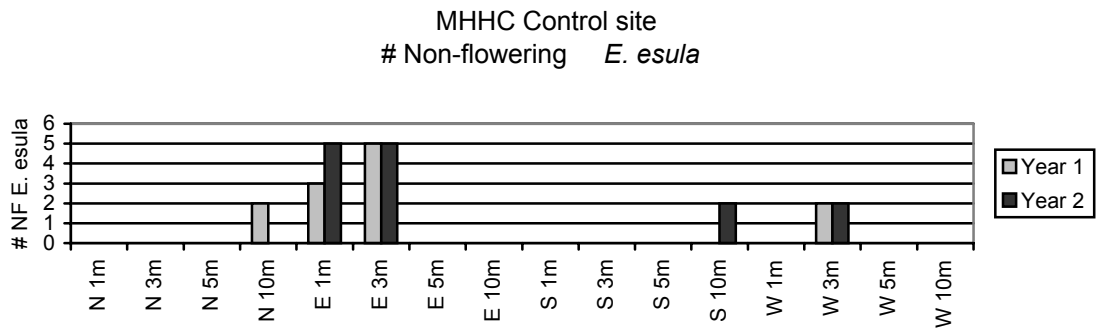
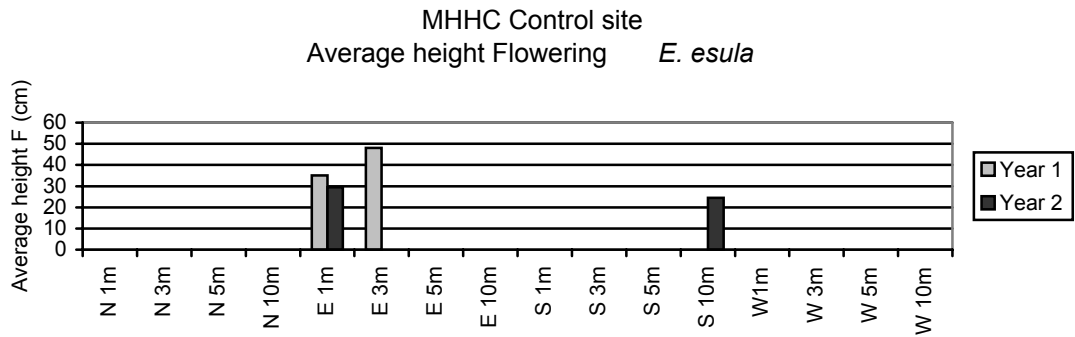
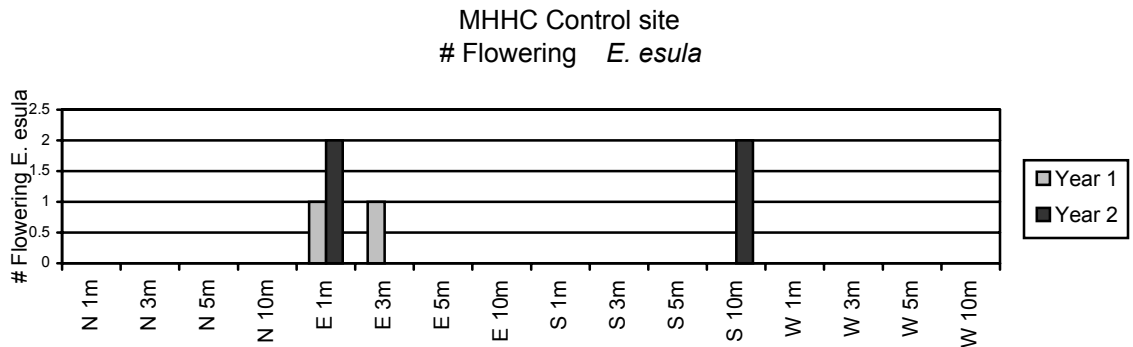
Once the transect line was established, a sweep net was used to collect beetles at 1, 3, 5, and 10m along the transect lines in each of the four directions. At each stop, the vegetation was swept three times to the left of the line, and the beetles in the net were counted. After counting, the beetles were released. The vegetation to the right of the line was then swept, with the beetles again being counted and recorded. Care was taken to avoid double counting by ensuring that the beetles were not released into the area that was going to be swept next.

Appendix 7: MHC site Year I and II Comparison Charts

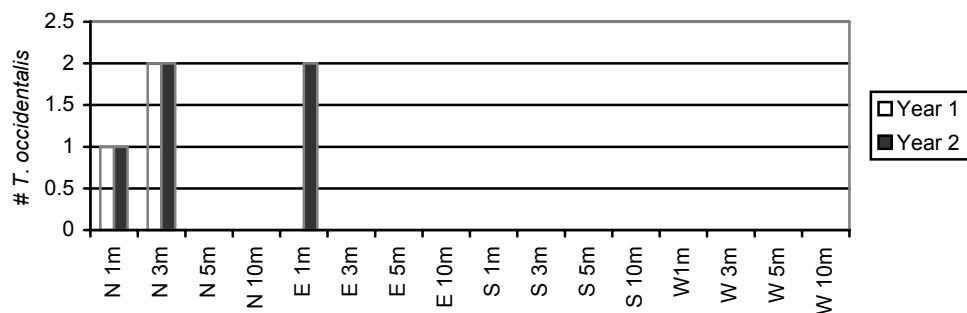
MHC Release site



MHHC Control site



MHHC Control site
Tradescantia occidentalis



Appendix 8: Scientific and Colloquial Names of Plants

Scientific Name	Colloquial name
EQUISETACEAE	
<i>Equisetum hyemale</i>	Common scouring rush
<i>Equisetum laevigatum</i>	Smooth scouring rush
PINACEAE	
<i>Juniperus horizontalis</i>	Creeping juniper
GRAMINEAE	
<i>Agropyron subsecundum</i>	Awned wheatgrass
<i>Andropogon gerardi</i>	Big bluestem
<i>Andropogon scoparius</i>	Little bluestem
<i>Bouteloua gracilis</i>	Blue grama
<i>Bromus sp.</i>	Brome
<i>Bromus kalmii</i>	
<i>Calamovilfa longifolia</i>	Sand grass
<i>Elymus canadensis</i>	Canada wild rye
<i>Festuca sp.</i>	Fescue
<i>Koeleria gracilis</i>	June grass
<i>Panicum sp.</i>	Millet
<i>Poa sp.</i>	Blue grass
<i>Sporobolus cryptandrus</i>	Sand dropseed
<i>Stipa sp.</i>	Needle grass
<i>Stipa comata.</i>	Spear grass
CYPERACEAE	
<i>Carex sp.</i>	Sedge
COMMELINACEAE	
<i>Tradescantia occidentalis</i>	Western spiderwort

LILIACEAE

<i>Allium sp.</i>	Onion
<i>Lilium philadelphicum</i>	Wood lily
<i>Maianthemum canadense</i>	Wild Lily-of-the Valley
<i>Smilacina stellata</i>	Star flowered Solomon's Seal

ORCHIDACEAE

<i>Cypripedium calceolus</i> var. <i>parviflorum</i>	Yellow lady's slipper
<i>Cypripedium candidum</i>	Small white lady's slipper

SALICACEAE

<i>Populus deltoids</i>	Cottonwood
<i>Populus tremuloides</i>	Aspen poplar
<i>Salix sp.</i>	Willow

BETULACEAE

<i>Betula occidentalis</i>	River birch
<i>Corylus Americana</i>	American hazelnut

CHENOPODIACEAE

<i>Chenopodium leptophyllum</i>	Narrow-leaved goosefoot
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SANTALACEAE

<i>Comandra pallida</i>	Bastard toadflax
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CARYOPHYLLACEAE

<i>Cerastium sp.</i>	Chickweed
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RANUNCULACEAE

<i>Anemone canadensis</i>	Canada anemone
<i>Anemone cylindrica</i>	
<i>Anemone multifida</i>	Cut-leaved anemone
<i>Thalictrum sp.</i>	Meadow rue

CRUCIFERAE

Arabis holboellii var. *collinsii*
Erysimum asperum

Rock cress
Western wallflower

SAXIFRAGACEAE

Heuchera richardsonii

Alumroot

ROSACEAE

Fragaria virginiana
Geum triflorum
Potentilla pensylvanica
Prunus virginiana
Rosa sp.
Spiraea alba

Smooth wild strawberry
Three-flowered avens, Prairie smoke
Prairie cinquefoil
Choke cherry
Wild rose
Narrow leaved meadowsweet

LEGUMINOSAE

Glycyrrhiza lepidota
Dalea candidum
Dalea purpurea
Dalea villosa var. *villosa*
Psoralea argophylla
Psoralea esculenta
Thermopsis rhombifolia

Wild licorice
White prairie-clover
Purple prairie-clover
Hairy prairie-clover
Silverleaf psoralea
Indian breadroot
Golden-bean

EUPHORBIACEAE

Euphorbia esula

Leafy spurge

ANACARDIACEAE

Rhus radicans

Poison-ivy

CACTACEAE

Mamillaria vivipara
Opuntia polycantha

Pincushion cactus
Prickly-pear cactus

ELEAGNACEAE

Eleagnus commutata

Silverberry, Wolf-willow

PRIMULACEAE

Androsace septentrionalis

Pygmyflower

ASCLEPIADACEAE

Asclepias sp.

Milkweed

CONVOLVULACEAE

Convolvulus sp.

Bindweed

LABIATAE

Monarda fistulosa

Wild bergamot

BORAGINACEAE

Lithospermum canescans

Hoary puccoon

Lithospermum incisum

Narrow-leaved puccoon

SOLANACEAE

Physalis virginiana

Prairie ground cherry

SCROPHULARIACEAE

Orthocarpus luteus

Owl's-clover

RUBIACEAE

Galium boreale

Northern bedstraw

Houstonia longifolia

Long-leaved bluets

CAPRIFOLIACEAE

Symphoricarpos sp.

Snowberry

Symphoricarpos albus

Snowberry

CAMPANULACEAE

Campanula rotundifolia

Harebell

COMPOSITAE

Ambrosia psilostachya var. *coronopifolia*

Perennial ragweed

Lygodesmia juncea

Skeletonweed

Tragopogon dubius

Yellow goat's-beard

Achillea millefolium

Yarrow, Milfoil

Antennaria aprica

Low everlasting

Artemisia campestris

Plains wormwood

Artemisia frigida

Pasture sage

Artemisia ludoviciana var. *ludoviciana*

Prairie sage

Aster sp.

Aster

Aster ptarmicoides

-

Chrysopsis villosa

Hairy golden-aster

Erigeron canadensis

Canada fleabane

Erigeron glabellus

Smooth fleabane

Gaillardia aristata

Great-flowered gaillardia

Helianthus laetiflorus var. *subrhomboides*

Beautiful sunflower

Liatris punctata

Dotted blazingstar

Solidago sp.

Goldenrod

Solidago missouriensis

Low goldenrod

Solidago nemoralis

Showy goldenrod

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