



SITE C INVASIVE MANAGEMENT AND BIOCONTROL
PRESENTED BY: THOMAS HATCH AND NOLAN

MYERS



Good morning, my name is _____, and with me is _____. Today we're here to talk about the invasive plant management program on the Site C Clean Energy Project, some of the components of an integrated vegetation management program we utilize, and specifically the use of a biocontrol agent to treat a challenging site infested with Dalmatian toadflax. As you can see from this photo taken in 2020, the infestation was quite extensive and pervasive.

KEY POINTS



INTRODUCTION

RINSE STATION

OTHER CONTROL METHODS UTILIZED

BIOCONTROL THROUGHOUT THE YEARS



While the biocontrol of Dalmatian toadflax will be the highlight of our presentation, we'd also like to cover some other components of the invasive management program at Site C. Just to provide some context and background on our work. We'll begin with an introduction including some of the challenges we face in our day-to-day work, other methods of invasive species control we utilize, as well as the types of sites we monitor and treat. We'll also discuss a preventative measure utilized at Site C, being the vehicle rinse station, some of the direct methods of control, and finally a closer look at our biocontrol project and the monitoring results over the past several years.



INTRODUCTION



Since 2009, BC Hydro, in collaboration with stakeholders and with the consulting support of Pathfinder, has developed and implemented a noxious weed management program at Site-C. This began with consultation of landowners for treatment of noxious weeds on property that was eventually to be inundated with water when filling the reservoir and has evolved into treatment of noxious weeds across the entire project footprint.

As with all noxious plant management efforts, achieving long-term control and eventual eradication of invasive species requires a multi-year, integrated approach. The Site-C program employs a combination of control methods, including targeted herbicide applications, mechanical removal, and biocontrol.

INTEGRATED VEGETATION MANAGEMENT

PREVENTION,
CONTROL AND
EVALUATION



As many of you know, Integrated Vegetation Management is an ecosystem-based strategy for controlling unwanted vegetative growth while promoting healthy, stable, and low-maintenance plant communities. It focuses on creating resilient landscapes that resist invasion of noxious weeds through a holistic and adaptive approach rather than relying solely on reactive measures like herbicide application or repeated mowing. This first photo demonstrates an example of this adaptive approach: a site reclaimed with a native seed mix to prevent the establishment and proliferation of invasive species.

INTEGRATED VEGETATION MANAGEMENT

PREVENTION,
CONTROL AND
EVALUATION

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Here we see a more direct method of invasive control we utilize: a side by side with a tank of herbicide for dense infestations spread across a large area. Herbicide is still applied selectively, based on site conditions and prevalence of noxious weeds.



INTEGRATED VEGETATION MANAGEMENT AT SITE C

Inventory and control of invasives
weeds is constant and always
changing.

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One of the consistent aspects in working in an ever evolving and changing landscape is the changes to inventory of invasives due to construction or site disturbance. This first photo is an overview of a packed gravel site previously used as a laydown yard and had housed a warehouse in the past. We found a few scattered noxious weeds such as Russian thistle in the packed gravel, but most of the noxious weeds we find on this site are Canada thistle and sow thistle on the vegetated edges of the site.



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The site has been reclaimed this fall, with the beginning of the process shown in this photo. This transition from a packed gravel yard to disturbed soil will likely change our inventory and location of invasives in the next growing season.

Due to the large laydown yards, spread of topsoil stockpiles for reclamation efforts, constant machinery movement in active construction sites and vehicle traffic coming and going from site, vigilance and frequent monitoring are essential at Site C.

INTEGRATED VEGETATION MANAGEMENT AT SITE C

Wide variety of site types that
informs treatment decisions



We also treat a wide variety of sites on Site C. This can vary from well vegetated hillsides, roadside ditches, or even the dam face itself. This photo illustrates the variety of sites with a 27-ha open gravel pit, and the vegetated berms that surround it.

INTEGRATED VEGETATION MANAGEMENT AT SITE C

Wide variety of site types that
informs treatment decisions

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Other unique sites we survey and treat include reclaimed quarries such as in this photo. Each of these sites present their own unique challenges and help to inform our decisions on the best methods to safely and effectively treat for invasive plants.



INTEGRATED VEGETATION MANAGEMENT AT SITE C

Difficulties in working in a multi-
employer workplace.

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Another component of our work is navigating a multi-employer workplace. Surveying and treating an area can be difficult without interfering with construction operations, illustrated by this photo where active hauling is occurring. Treating sites and monitoring changes on a timely schedule can be difficult when coordinating between multiple contractors for site access, not to mention the numerous site orientations our crew goes through every year.



PREVENTING THE SPREAD OF INVASIVE PLANTS AT SITE C

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The primary prevention method to stop the spread of invasive weeds is the vehicle rinse station, which was recently decommissioned this fall due to construction activities wrapping up. The first rinse station at Site C was a singular power washer for cleaning light duty vehicles, and as you can tell from this photo, has been expanded upon significantly to handle industrial trucks. This system worked by having an automatic sensor that activates the rinse bars while the operator drives over them. By driving over, the rinse bars cleaned the vehicle's undercarriage and wheel wells of any vegetative material, or mud and dirt which may contain invasive plant seeds. The automated rinse station was located adjacent to Gate B and was available for use from the end of May until early October. To prevent invasive species transference, vehicles and equipment that have gone off the main road and/or have driven through vegetation can use the rinse station to remove invasive weed materials.



PREVENTING THE SPREAD OF INVASIVE PLANTS AT SITE C

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Typically, this system received about 1700 uses annually. That number has been declining in recent years due to construction of the project winding down, less traffic and equipment being on site, and the transition to reclamation activities beginning. 85% of use of the rinse station was light duty trucks, 7% lowbed and equipment transport, 5% delivery trucks, and 3% machinery or heavy equipment.

There were some challenges to running this system. For example, maintenance of the system occurred nearly daily, whether that's troubleshooting power washers and sump pumps, cleaning back check valves of debris, or washing the concrete pad to ensure mud and sediment doesn't accumulate. Of course, there's also management to ensure that the rinse station is being used on vehicles and equipment that has gone through vegetation and not just being used to clean work trucks at the end of the day.

CONTROL OF INVASIVES AT SITE C

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Direct approaches for noxious plant management in Site C begins with a project wide inventory in the spring, using data from the previous year and our fall inventory to inform noxious weed location and densities. Sites are surveyed and noxious plants occurrences are recorded using GPS capable devices. Density and distribution codes are recorded to track inventory change throughout the year. Herbicide usage, pictured here where a crew member is equipped with a backpack sprayer, is our primary method of direct control.

CONTROL OF INVASIVES AT SITE C

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Another method of direct control is mechanical removal via hand pulling of noxious plants, as demonstrated in this photo. This is reserved for when weather conditions prevent herbicide application, or when vegetative growth has exceeded the point where herbicide application would be effective. Chemical and mechanical treatments occur throughout the summer using data gained during spring inventory to inform the best method of approach. Daily weather conditions are also used to inform treatment options. Post treatment monitoring and inventory occurs in the early fall to assess success and adjust next-year's strategies.

BIOCONTROL AT SITE C

Decision making process behind biocontrol

- Site has a steep slope
- Covers 12.5 hectares
- Maintenance of natural vegetation for slope stability and erosion protection
- Species found infesting slope (*Linaria dalmatica*)
- Proximity to Peace River

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As a part of the Integrated Vegetation Management plan, Pathfinder has also utilized biocontrol in the form of the release of stem mining weevil to control Dalmatian toadflax growing beside River Road along the Site C mainline. The site is mostly covered in grass species, with the occasional cactus and shrubby patches interspersed. This site posed a unique set of challenges when considering treatment options. The site exists on an incredibly steep slope, covers a 12.5-hectare area, and was dominated with Dalmatian toadflax. The steep slope posed challenges both to worker safety and slope stability. Broadcast spraying would've been necessary due to the extent and density of the Dalmatian toadflax infestation. The loss of vegetation because of broadcast spraying would have had an adverse effect on slope stability. In addition, the risks of slips, trips and falls would have been too great to safely treat the area multiple times. Proximity to the Peace River also contributed to excluding herbicide as a treatment option. At this point, Pathfinder had begun to explore using biological agents.

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A Ministry of Environment representative contacted Pathfinder about their own use of stem mining weevil near the site. After some discussions back and forth, Pathfinder began to monitor stem mining weevil at the adjacent site, as well as expand it's use to the River Road site.

While complete eradication of the target species is usually not possible with biocontrol alone, overtime it can reduce invasive weed density and cause a shift in community composition back to dominantly native plant species.

MECINUS JANTHINFORMUS

One of several insects approved for biocontrol of Dalmatian toadflax in Canada.

- Adults overwinter within stems
- Feed on shoot tips in spring
- Lay eggs within stems
- Larvae feed until pupation
- All feeding reduces nutrient reserves and ability to translocate nutrients

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The stem mining weevil is one of several insects approved for biocontrol of Dalmatian toadflax within Canada. Adults overwinter within Dalmatian toadflax stems, emerging in the spring to feed on shoot tips and mate. Females chew holes into the toadflax stems to lay eggs, where the larvae remain and feed until they pupate in midsummer before emerging as adults. Adult feeding on the plant stems reduce nutrient reserves and can impair the plants' ability to translocate nutrients. Heavily attacked plants will stunt, turn brown and shrivel.

This photo shows multiple stem mining weevils preparing to overwinter within the stem.

SITE MAPPING AND LAYOUT



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The implementation of a biocontrol program involves several steps. Initially, the site was examined and mapped to determine the scope of the infestation and the suitability for biocontrol. After this assessment, the bioagent was released and subsequent documenting and monitoring can occur. This map shows the locations of release sites that we currently monitor.

M. JANTHINFORMUS COLLECTION AND RELEASE

Collection and release in 2019

- Occurred on May 23
- ~2,600 individuals collected in Nelson, BC and transported to Site C
- Released at 13 sites throughout the 12.5-hectare site



On May 23, 2019, approximately 2,600 stem mining weevils were collected in Nelson, BC by FLNRORD (Ministry of Forests, Land, Natural Resource Operations and Rural Development) and subsequently transported to Site C by Pathfinder. The weevils were released at 13 stakes along the 12.5-hectare infestation. A transect was set up along the middle of the slope, with approximately 80 metres between stakes. Release occurred when the toadflax plants were pre-bud emergent and not yet flowering.

On September 18, 2019, the first three release sites were monitored to determine if the weevils had successfully established. Monitoring showed early signs of establishment, including feeding damage and stem tunneling.

M. JANTHINFORMUS COLLECTION AND RELEASE

Collection and release in 2020

- Occurred on May 22
- ~2,600 individuals collected near Kamloops, BC and transported to Site C
- Released at 13 new sites approximately 100 m up slope from previous release points



A year later, on May 22, 2020, an additional 2,600 stem mining weevils were collected near Kamloops, BC by the Ministry and transported to Site C by Pathfinder. The weevils were released at 13 new sites along the 12.5-hectare infestation. A new transect was established upslope of the previous year's stakes, with approximately 100 metres between sites. Release occurred when the toadflax plants were pre-bud emergent and not yet flowering.

On September 22, 2020, all 26 plots were examined for evidence of stem mining weevil establishment and dispersal. Plants were examined externally for adult weevils and evidence of weevil feeding and burrowing. When adults were discovered, their distance and direction from release point were recorded. Sites were examined for a maximum of 10 minutes. These methods follow the IAPP (Invasive Alien Plant Program) monitoring methods for release of a biocontrol agent.

M. JANTHINFORMUS FOLLOW UP AND MONITORING

Supplemental releases occurred in the springs of 2021-2023

Monitoring has occurred upon supplemental releases and in the fall

- Dispersion from release sites
- Density distribution around stake
- Photos in each cardinal direction from stake



Release site monitoring has continued annually since 2019. Timed monitoring is done at each release site looking for stem mining weevil adults or signs of their presence, while density and distribution information for the Dalmatian toadflax is also collected. Photos are taken at each stake facing each cardinal direction to standardize data and visually monitor the effectiveness of the biological control agent, as well as to follow changes in the Dalmatian toadflax infestation.

There were supplemental releases of stem mining weevil from 2021 to 2023, but supplemental releases were not required in 2024 and 2025 due to our monitoring results.

Between the initial release in spring of 2020, and the most recent monitoring in July 2025, the distribution of the Dalmatian toadflax across the slope has changed drastically.

M. JANTHINFORMUS FOLLOW UP AND MONITORING

Supplemental releases occurred in the springs of 2021-2023

Monitoring has occurred upon supplemental releases and in the fall

- Dispersion from release sites
- Density distribution around stake
- Photos in each cardinal direction from stake

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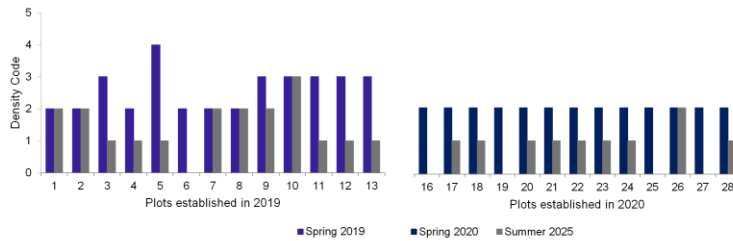
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Prior to release, Dalmatian toadflax was distributed densely and uniformly across the slope. However, during the 2022 and 2023 supplemental stem mining weevil releases, some releases could not be done at the release stake as there was simply no Dalmatian toadflax growing immediately at the stake. Weevils were instead released at the nearest patch of toadflax that could be found.

Sequential photos between years were taken at each plot to visually assess the changes in Dalmatian toadflax density and distribution. Changes in the Dalmatian toadflax growth and life stage throughout the year complicate comparisons within the year, but subsequent years monitoring photos has made population assessments easier.

CHANGES IN DENSITY FROM 2019 TO 2025



T.7.2. Select the density distribution code of Invasive Species that approximates their extent. Q2b (pg. 22) or mark NA.

Code 1	Code 2	Code 3	Code 4	Code 5	Code 6	Code 7	Code 8	Code 9
Rare individual, a single occurrence	Few sporadically occurring individuals	Single patch or clump of a species	Several sporadically occurring individuals	A few patches or clumps of a species	Several well spaced patches or clumps of a species	Continuous uniform occurrence of well spaced individuals	Continuous occurrence of a species with a few gaps in the distribution	Continuous dense occurrence of a species

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This figure shows the change in density of the Dalmatian toadflax populations over time at the currently monitored release sites established in 2019 and 2020. From the 2019 stakes, the most prominent changes were observed at stakes 3, 5, 11, 12 and 13. However, density has either been reduced or maintained at all stakes from the initial survey in the spring of 2019.

This is also reflected in the plots established in 2020, with the most drastic changes seen at stake 16, 19, 25 and 27. As with the first 13 plots established, all stakes have been observed having a reduction or maintenance of density from initial surveys done in the spring of 2020.

RESULTS – STAKE
26 WEST

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July 2020

The most obvious changes have been observed at stake 25 facing west. As shown in this photo, flowering Dalmatian toadflax covers nearly the entire hillside.

RESULTS – STAKE
26 WEST

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July 2025

Flash forward to July 2025, and this same hillside was observed to have nearly no Dalmatian toadflax across the same slope, with natural vegetation being retained.

RESULTS - STAKE 26 WEST



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Here's a side-by-side comparison — one of our most dramatic results.



RESULTS – STAKE 12 NORTH

September 2020

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A less obvious, but still considerable change was observed at stake 12 facing north. In this first photo, Dalmatian toadflax that had gone to seed can be seen surrounding the stake, as well as continuing further up the hill side.



RESULTS – STAKE 12
NORTH

September 2024

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However, from monitoring in 2024, this same area was toadflax free.

RESULTS - STAKE 12 NORTH



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Again, here's the before-and-after comparison.

RESULTS – STAKE
20 EAST



September 2020

A similar situation to the last can be found at stake 20 facing east. Dalmatian toadflax that had gone to seed can be seen directly around the stake in the foreground in 2020

RESULTS – STAKE
20 EAST



September 2024

By 2024 this same stake was toadflax free.

RESULTS – STAKE 20 EAST



The recovery of grass species cover is clearly visible in the paired images.



July 2020

RESULTS – STAKE 6
SOUTH

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And finally, this photo shows flowering Dalmatian toadflax spread extensively south of stake 6 in July of 2020.



July 2025

RESULTS – STAKE 6
SOUTH

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However, this same stake is found to have no Dalmatian toadflax during monitoring in July of 2025.

RESULTS - STAKE 6 SOUTH



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And here's a side by side.

During monitoring this summer, monitors had to survey farther out from the release points to locate Dalmatian toadflax. There was no Dalmatian toadflax observed at Stakes 6, 16, 19, 25, and 27. While there was no toadflax located near stake 27, during the timed monitoring, an adult stem mining weevil was discovered outside the plot stake in the direction towards Stake 28 This indicates that the biocontrol agents are dispersing well across the slope.

FUTURE OF BIOCONTROL AT SITE C

Continued monitoring for dispersal

- Weevils found in Dalmatian toadflax in another site ~ 300m from release sites

Additional supplemental releases if required

- Last supplemental release was 2023

Continued monitoring of release sites until 2026



These stakes will continue to be monitored into 2026 and potentially beyond to determine the establishment and dispersal of the stem mining weevil. Evaluating the success of the biocontrol agent includes examining the abundance of the agent, the impact on the target species, the potential for non-target effects, and the response of the native plant species and communities to the reduction of the invasive plant. There may also be further supplemental releases in the case that low population numbers are observed next year while monitoring, but at this point, it appears that the weevil population has become very well established within the site.



THANK YOU
ANY
QUESTIONS



Thank you for your time this morning and thank you for listening in on what we believe to be a very successful case of biocontrol agent use to curb a pervasive infestation on a difficult to treat site. We're proud to share this example of collaboration between BC Hydro, Pathfinder, and provincial partners, and we look forward to your questions.