

Targeted Goat Grazing Trials

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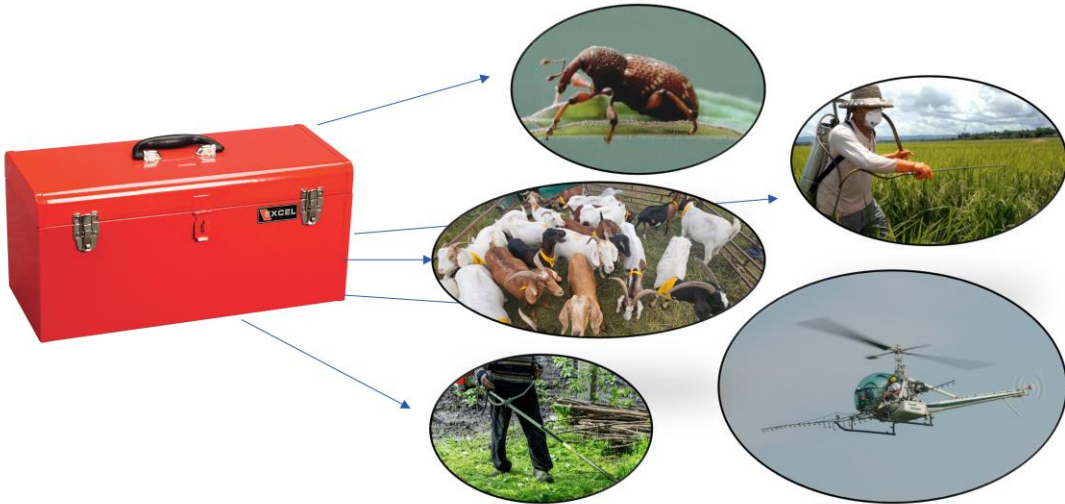
1. Setting the stage
2. Research methods
3. Results
4. Discussion
5. Next steps



Why Vegetation Management Matters

- Infrastructure impacts: encroachment, abrasion, corrosion
- Wildfire risk: fuel buildup; maintained ROWs can function as firebreaks
- Safety hazards: danger trees affecting crews and public
- Access constraints: blocked roads, valves, and rights-of-way

Setting the stage





- Project was proposed and developed in late 2022 with Enbridge, Spectrum Resource Group and ISCBC staff members.
- A 3-year, targeted goat browsing project with an applied research demonstration was created.
- Conducted as an environmentally friendly alternative for controlling invasive and problematic vegetation on utility right-of-ways.

Rocky Ridge Vegetation Control



Owner/Lead: Conrad Lindblom – Beaverlodge, AB

Role in Project:

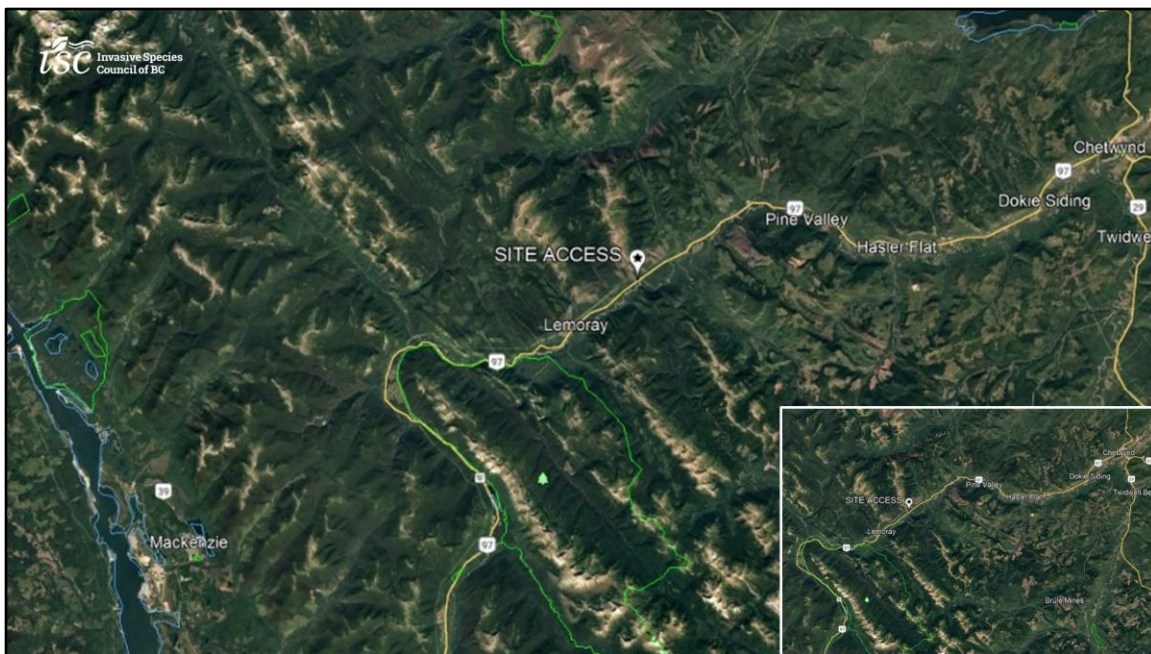
- Managed and supervised the targeted goat grazing herd
- Provided animal care, herding logistics, and on-site operational support.
- Worked field crews to maintain data quality and site safety.

Expertise:

Over 20+ years of experience in western Canada.

- Specializes in ecological vegetation management using goats
- Has worked on numerous pilot projects, studies and reclamation projects with First Nations, municipalities, government and parks.
- Focused on sustainable, low-impact land restoration and invasive species control.

Research Question:
Is targeted goat grazing a viable option
for invasive & undesirable species
management on utility right-of-ways?



Site Selection

- 11 potential sites were inspected and viewed along the Enbridge right-of-way north of Prince George before project kickoff.
- A site was selected south of Chetwynd, BC that had access for livestock staging, herders, dogs, water, and space for vehicles and a crew camp.
- The site also had to contain an abundance of different invasive plants as well as a safe operating area, free of future construction work activities.
- The right-of-way needed to be large enough to have an operational area and a control area adjacent to each other.
- Laid out grazed vs. control plots using GPS and tape; marked 0.5 ha plot corners for herder reference before grazing began.
- Established photo points (4 corners → centre, and centre → 4 corners) in both treatment and control areas.

Targeted Grazing Site:

- 0.5-ha Site on Enbridge pipeline ROW near Chetwynd, BC. Mixed open/lightly wooded terrain, flat.





Control Site: adjacent GPS-bounded plot with identical vegetation and monitoring, left ungrazed over the same period to isolate browsing effects.

Field Procedures



Site Setup:

- Spectrum field technicians marked the **operational area** with 7 cones (North/South boundaries + center) and pink ribbon for limits.
- Crews then marked a smaller **control area** (3 cones + center).
- Photos taken from 4 corners and center stake (8 total).

Materials:

1 meter by 1-meter wooden square, GPS unit, Camera/Phone, Hi Vis Vests, H2s Monitor, 10+ Contractor Bags, Markers, Cones, Pink Ribbon and a Knife/Blade/Trimmer

Field Procedures



Sampling & Cutting:

- Crew randomly selected **5 plots (1 m²)** on the site **before** grazing.
- Cut vegetation 5–10 cm from ground; collected all plant material into labeled bags.
- Included all vegetation types in plot (invasives, natives, shrubs, conifers).
- Recorded GPS points, photos, and plot IDs (Plot 1–5).

Weighing Procedure:

- Stored samples overnight in Prince George.
- Biomass sorted into monocots, dicots, deciduous, conifers and weighed (wet).
- Weighed each group in pounds using a scale to record totals.

Grazing Procedures

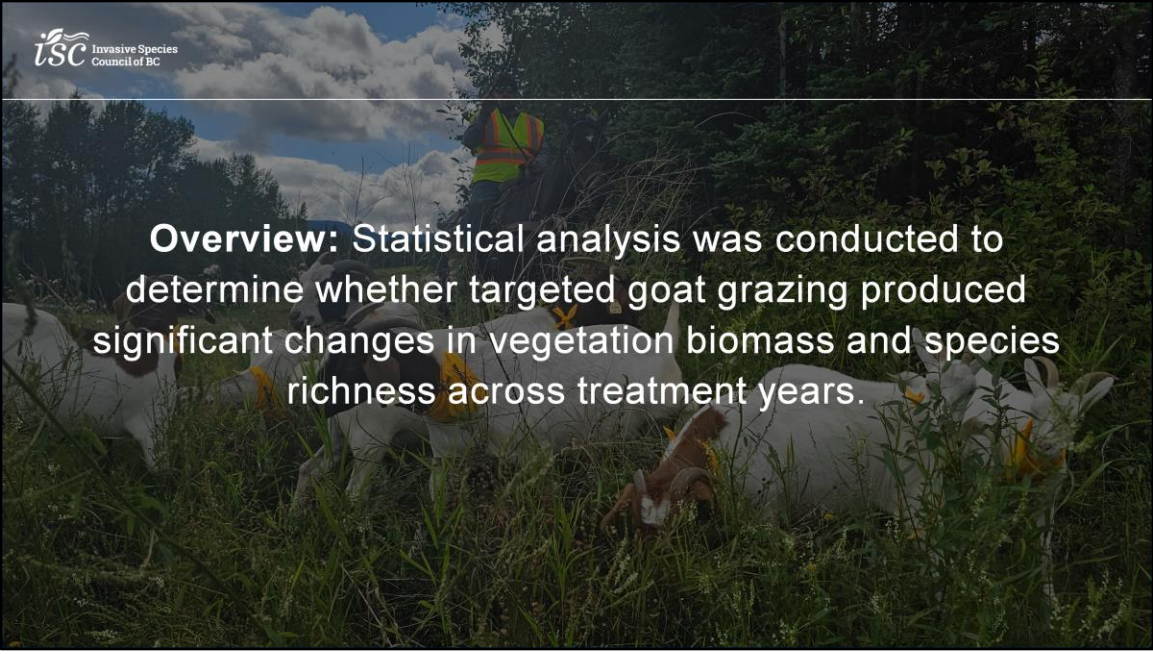
Thirty goats grazed the demonstration plot for **7 days**.

- Goats were herded to all corners of the demonstration plot to ensure all vegetation was covered
- Livestock were monitored and controlled by staff on horses and dogs to ensure the goats stayed on site.
- The goats were housed in pens at night for water and protection from wildlife.

Post Grazing Procedures

- Field staff returned to site approximately one month after grazing activities ended.
- Crew randomly selected **5 additional plots (1 m²)** on the post grazed biomass to reclip, weigh and compare treatment vs. control.





Overview: Statistical analysis was conducted to determine whether targeted goat grazing produced significant changes in vegetation biomass and species richness across treatment years.

Primary Analysis:

Paired two-sample t-test for means was used to compare

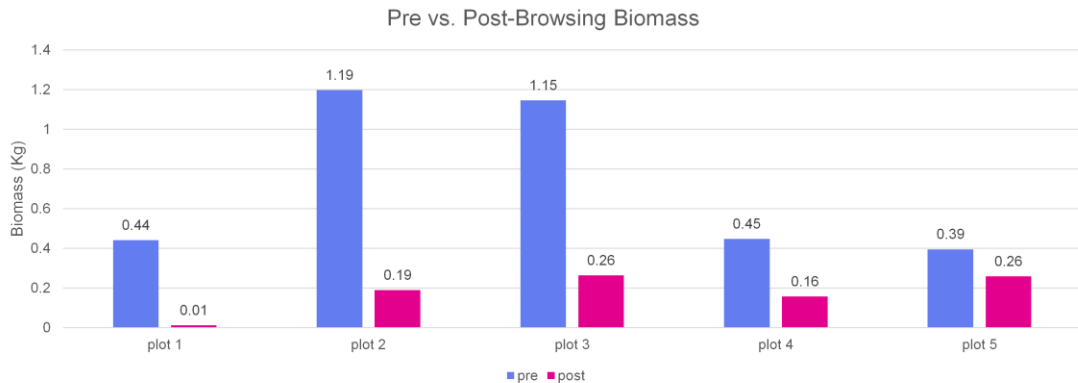
- 2024 - pre- vs. post-browsing biomass
- 2024 - pre- vs. post-browsing species richness
- 2023 vs. 2024 pre-grazing biomass

*Grazing data was transformed to meet the normality requirements of the t-test

Pre- vs. Post-Browsing Biomass

Question:

Is there a change in biomass following goat browsing?



Key Points:

- Results demonstrated a **statistically significant** decrease in live biomass post-browsing
- Biomass samples were collected before and after browsing within identical quadrats..
- Indicates effective suppression of overall vegetation growth through targeted grazing.

Pre vs. Post-Browsing Biomass (2024)



Pre-Browsing (August)



Post-Browsing (October)

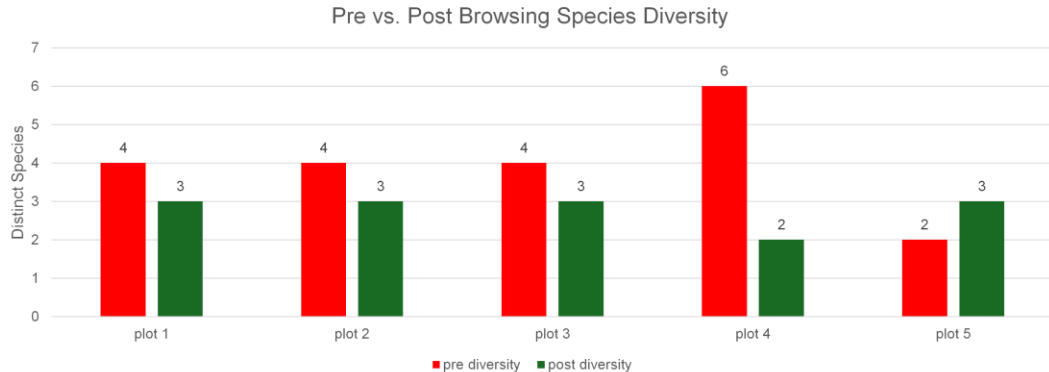
Assumption Testing

All datasets were tested for normality using the *Shapiro–Wilk test* and for **homogeneity of variance** using *Levene’s test*. When assumptions were violated, data were **log-transformed** to meet the requirements of parametric analysis.

Pre- vs. Post-Browsing Sp. Diversity

Question:

Is there a change in species richness following goat browsing?



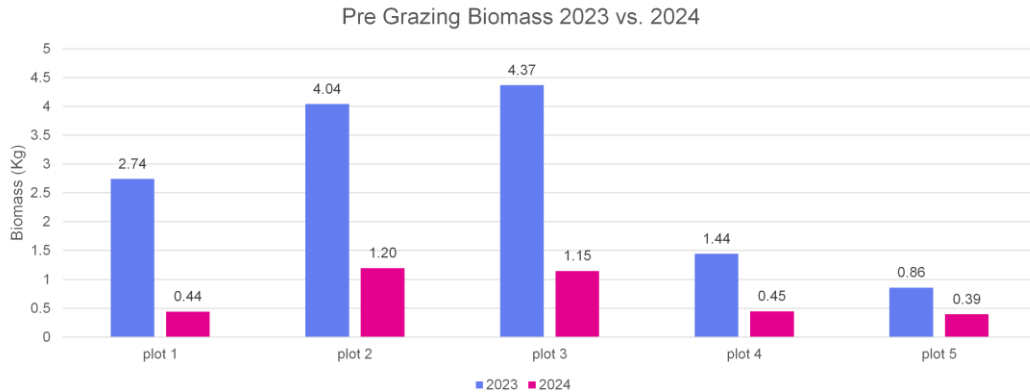
Key Points:

- No statistically significant difference detected
- Species presence and abundance recorded before and after grazing in matched plots.
- Suggests goat browsing reduces biomass without major shifts in overall plant diversity.

2023 vs. 2024 Pre-Grazing Biomass

Question:

Is there a difference in the amount of biomass retreatment, year to year.



Key Points:

- There was a significant difference in the amount of biomass
- Slight but consistent reduction in biomass observed in grazed areas.
- Demonstrates treatment effect while maintaining ecological stability.



August 2023



August 2024

Assumption Testing

All datasets were tested for normality using the *Shapiro–Wilk test* and for **homogeneity of variance** using *Levene’s test*. When assumptions were violated, data were **log-transformed** to meet the requirements of parametric analysis.

Summary of Statistical Tests

- Browsing in 2024 reduced aboveground biomass, confirming the treatment had a measurable effect.
- Species diversity did not change significantly after browsing in 2024, suggesting the treatment primarily affected quantity, not community composition.
- Comparing 2023 and 2024 pre-grazing/browsing biomass is cautioned because 2024 data were reprocessed (dead material excluded), so year-to-year differences reflect both treatment conditions

Identifying Limitations

1. Research Project Limitations
2. IVM Implementation Limitations

Project Limitations

- Single site (0.5 ha ROW near Mackenzie, BC) — limited ecological representativeness.
- Small sample size (5 pre/post plots) → lower statistical power.
- Short monitoring window (one season/year) → no long-term vegetation/succession data.
- Seasonal/annual variability in plant growth not controlled.
- Some pre/post plots not perfectly matched because biomass was fully clipped.
- Selective grazing by goats → uneven pressure on species.
- Metrics focused on biomass and species counts only (no soil, habitat, or wildlife measures).
- Visual/photo monitoring introduces observer bias.

Implementation Limitations

- Herd size and browsing duration constrained by logistics and staging requirements.
- Need for suitable, secure ROW sites with access for goats, herders, vehicles, and water.
- Browsing intensity hard to standardize across days and micro-sites.

- Weather and site conditions can disrupt planned grazing windows.
- Integration with existing utility/ROW maintenance schedules not yet tested at scale.
- Economic performance vs. mechanical/chemical methods not fully evaluated.
- Public/landholder acceptance and livestock-on-ROW policies may limit deployment.

Program Expansion

- Conduct additional trials across multiple regions and vegetation types to improve data reliability.
- Extend monitoring over several growing seasons to evaluate long-term vegetation recovery and grazing sustainability.

Assumption Testing

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Operational Improvements

- Increase replication and control plot use for stronger statistical comparisons.
- Incorporate species-specific biomass tracking to refine understanding of selective grazing impacts.
- Explore integrating **remote sensing** or **UAV imagery** for large-scale vegetation monitoring.

Assumption Testing

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Integration with Management Programs

- Combine goat browsing with mechanical, chemical, and re-vegetation methods as part of a broader Integrated Vegetation Management (IVM) strategy.
- Develop best-practice guidelines and training modules for land managers and contractors.

Assumption Testing

All datasets were tested for normality using the *Shapiro–Wilk test* and for **homogeneity of variance** using *Levene’s test*. When assumptions were violated, data were **log-transformed** to meet the requirements of parametric analysis.

