Glyphosate – Response in a Forested Environment

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Ecosystem Science and Management

Outline

THINKING OF FORESTS IN A NEW WAY

FOOD AVAILABILITY

FOOD CHEMISTRY

IMPLICATIONS OF GLYPHOSATE USE FOR FOREST VALUES

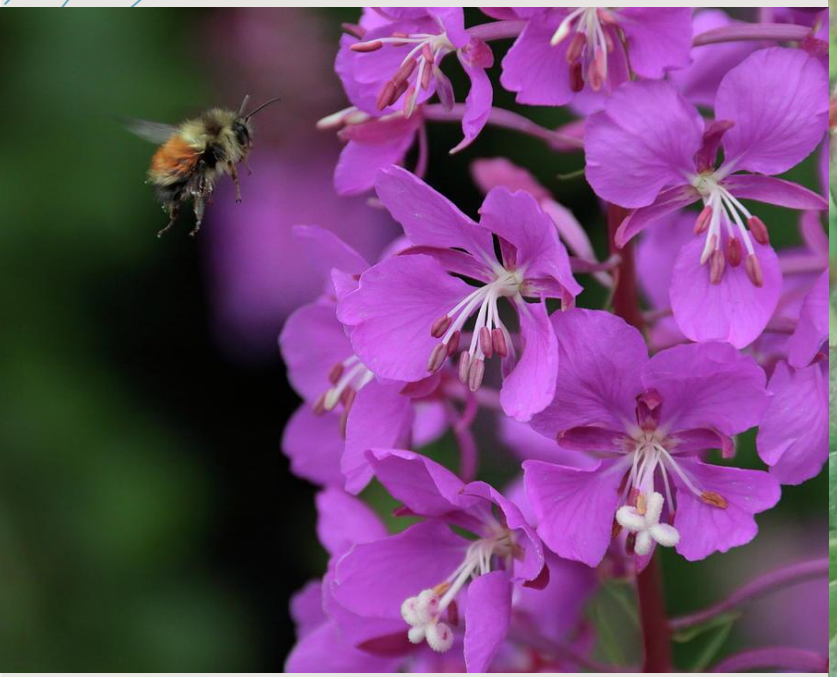
A diversity of values

- In 2023 we find higher demand for diverse and resilient forests
  - Management for more than timber
  - Land and food sovereignty
  - Reduced fire risk
  - Forest Landscape Planning

Focus Shift - Lead to research questions

- From a wildlife perspective –
  - What types of foods are available in cutblocks after broadcast glyphosate applications?
  - Do foods contain the same nutritional profiles if exposed to sub-lethal glyphosate concentrations?
- From a human perspective –
  - Are foods within cutblocks safe to eat?
  - Does herbicide use impact fire resilience?

How much food is available in sprayed cutblocks?



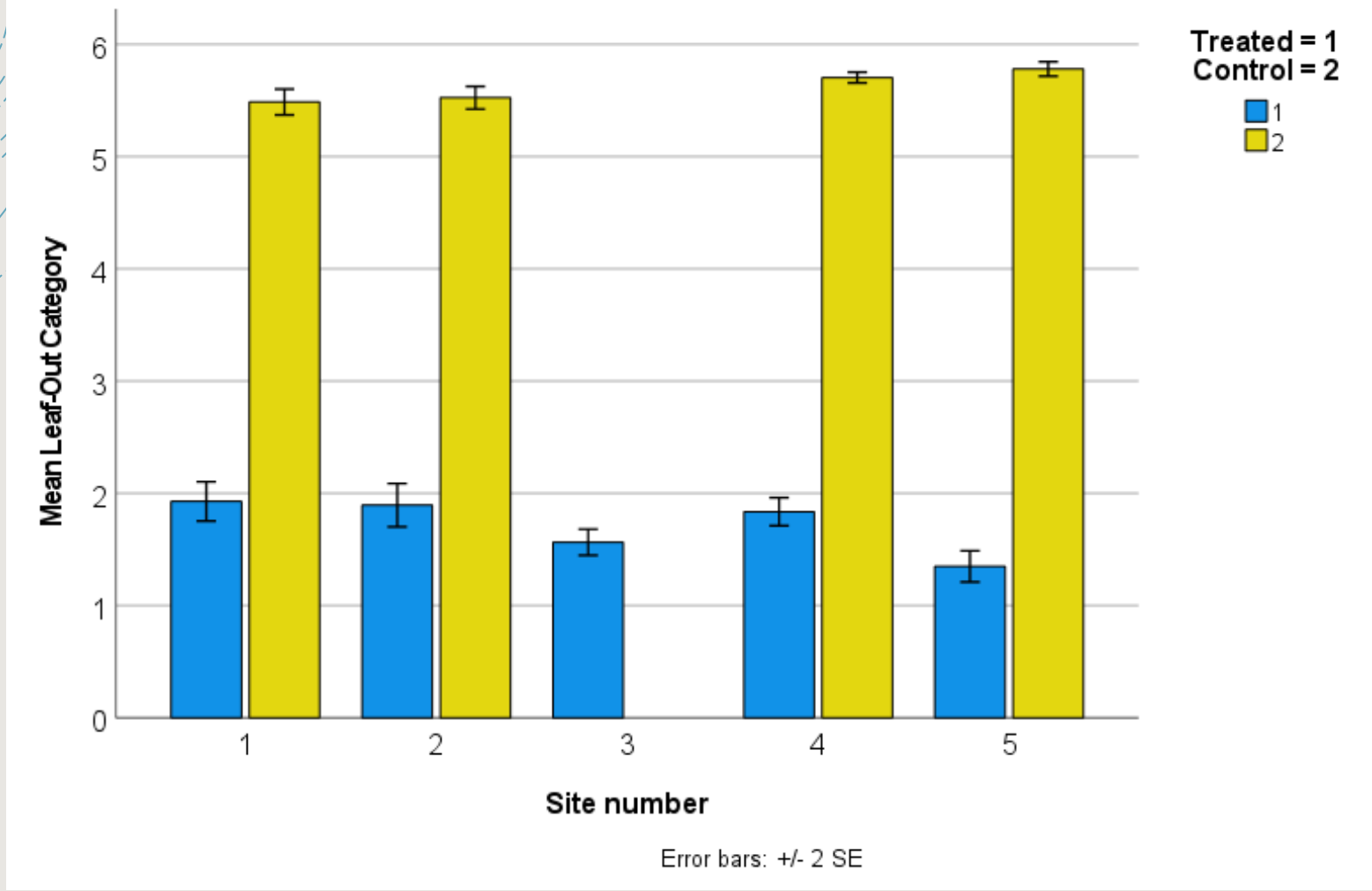
Chris Christensen

Twining Vine Garden 2023

gardenia.net/plant/rosa-acicularis

Allie Golt, MSc. Candidate

Leaf-out



Mean leaf-out category by site (see categories in Table 3.3). Data obtained from cutblocks treated with glyphosate-based herbicide (GBH) (treated) and untreated forestry cutblocks (control) one year prior to surveys in northern BC, Canada.

Allie Golt, MSc. Candidate

Leaf-out

- No category 5 or 6 plants in treatment areas (those with all normal leaves) vs. all plants category 5 & 6 in controls.

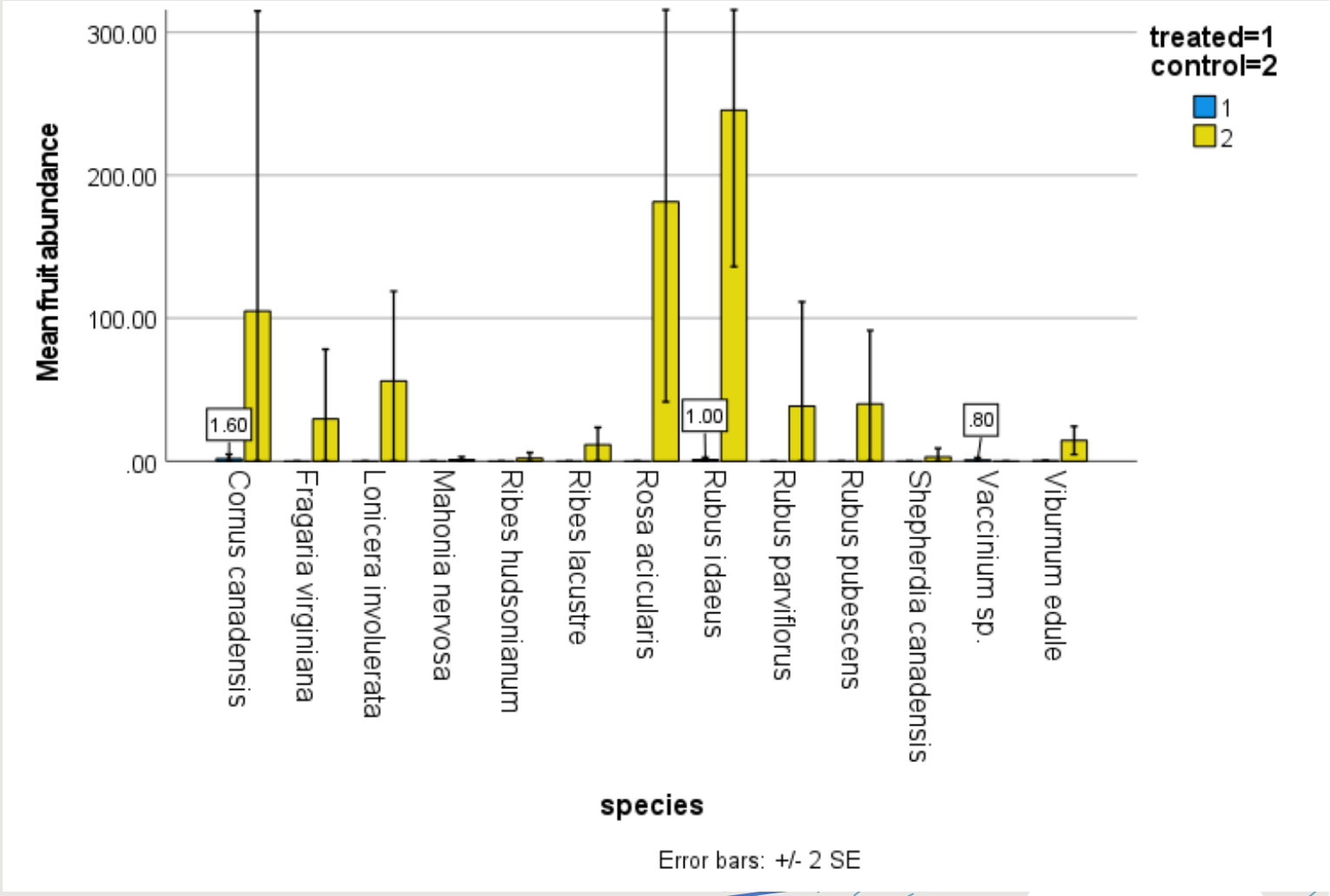
- 40.45% of plants were category 1 vs. 0% category 1 in controls

Categories	Characteristics
1	No leaf out on any stems
2	Just starting to leaf out on at least one stem
3	Abnormal bunching of leaves on at least one stem
4	Some normal leaves, but mostly abnormal leaves
5	Normal leaves (no chlorosis or bunching)
6	Normal leaves as above and producing fruit
7	Category 3 with flowers
8	Category 4 with flowers

Allie Golt, MSc. Candidate

Fruit Production

Mean fruit abundance by species, approximated by multiplying the mean abundance of the fruit bearing plant species for each block by the mean fruit category assigned. Data obtained from cutblocks treated with glyphosate-based herbicide (GBH) (treated) and untreated forestry cutblocks (control) one year prior to surveys in northern BC, Canada.



Allie Golt, MSc. Candidate

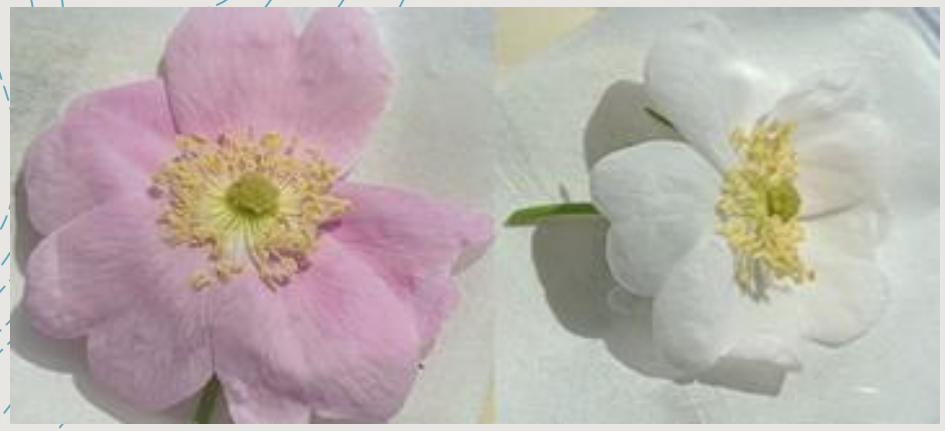
Fruit Production

+ 99.17% of fleshy-fruit producing plants in treated cutblocks produced no fruit one-year after treatment

+ 9.06% produced no fruit in nearby control areas

Species	Common name
Cornus canadensis	bunchberry
Fragaria virginiana	wild strawberry
Lonicera involuerata	black twinberry
Mahonia nervosa	Oregon grape
Ribes hudsonianum	northern blackcurrant
Ribes lacustre	black gooseberry
Rosa acicularis	prickly rose
Rubus idaeus	red raspberry
Rubus parviflorus	thimbleberry
Rubus pubescens	trailing raspberry
Shepherdia canadensis	soapberry
Vaccinium spp.	blueberry, huckleberry
Viburnum edule	highbush cranberry

Golt and Wood 2021
Frontiers in Plant Science

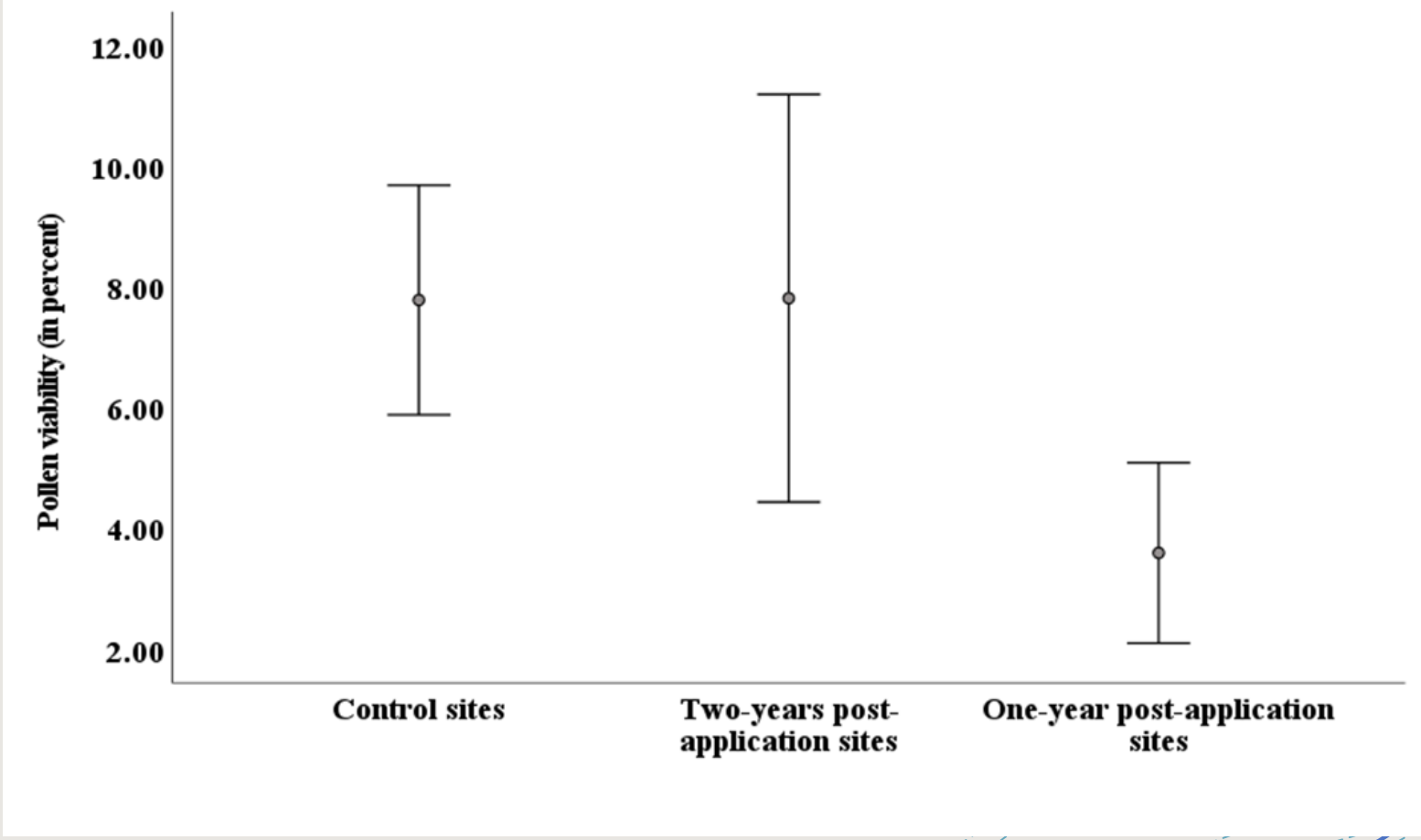


1-2 years after application – reproductive viability

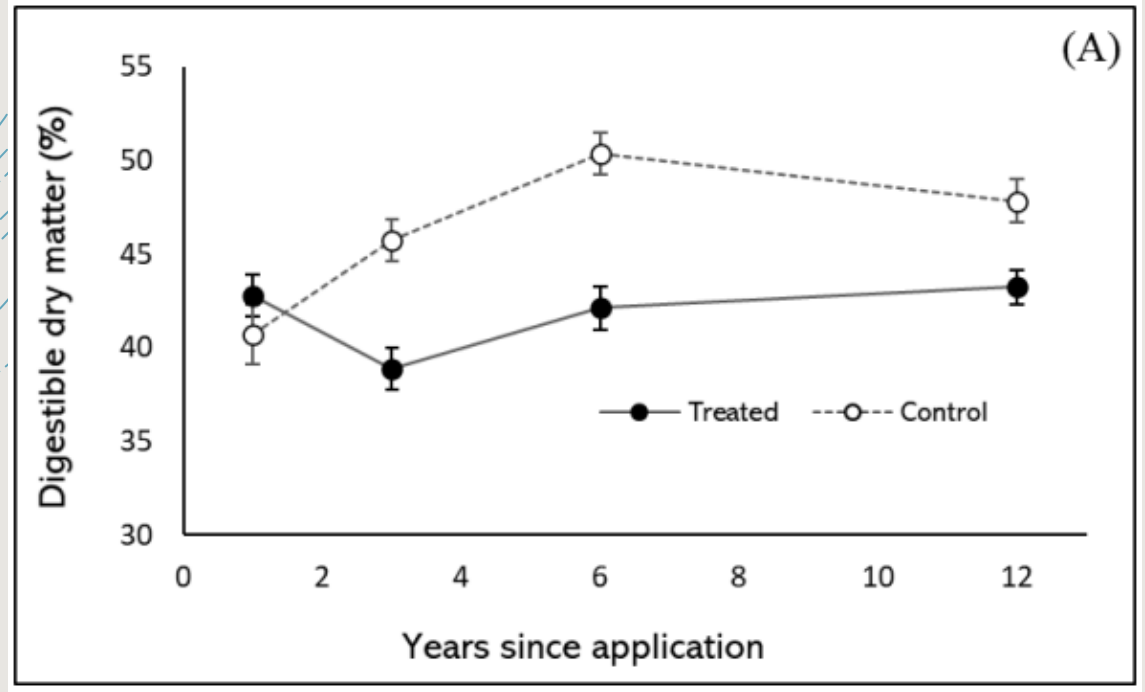
Allie Golt, MSc. Candidate

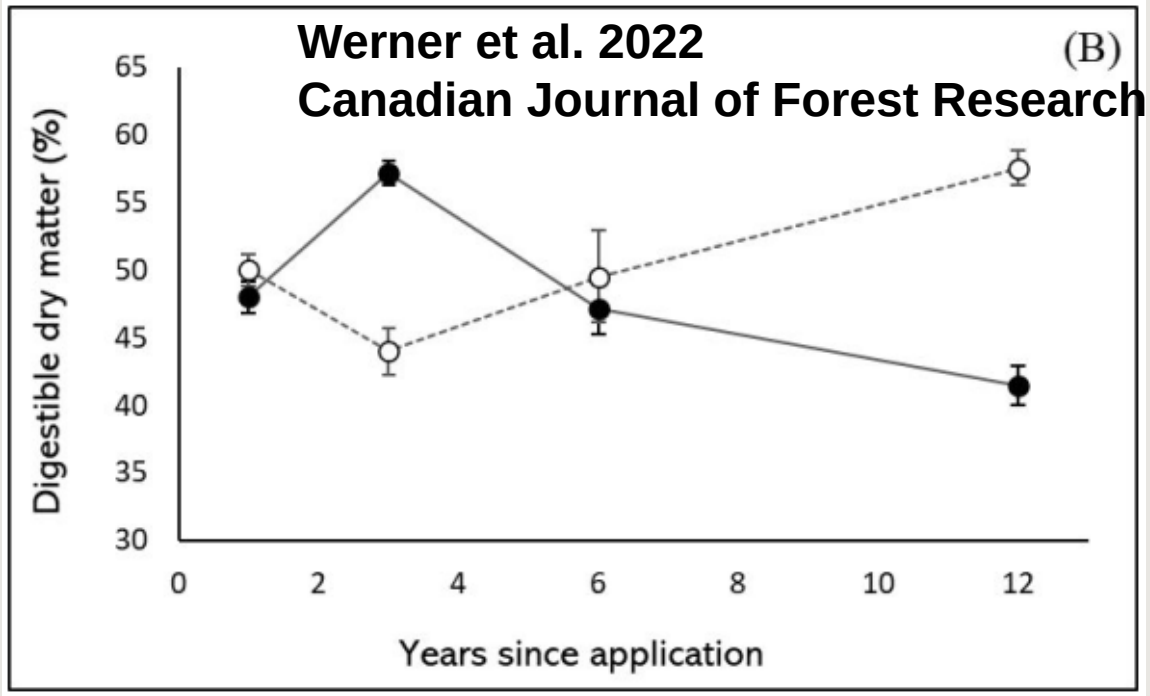
Pollen Viability

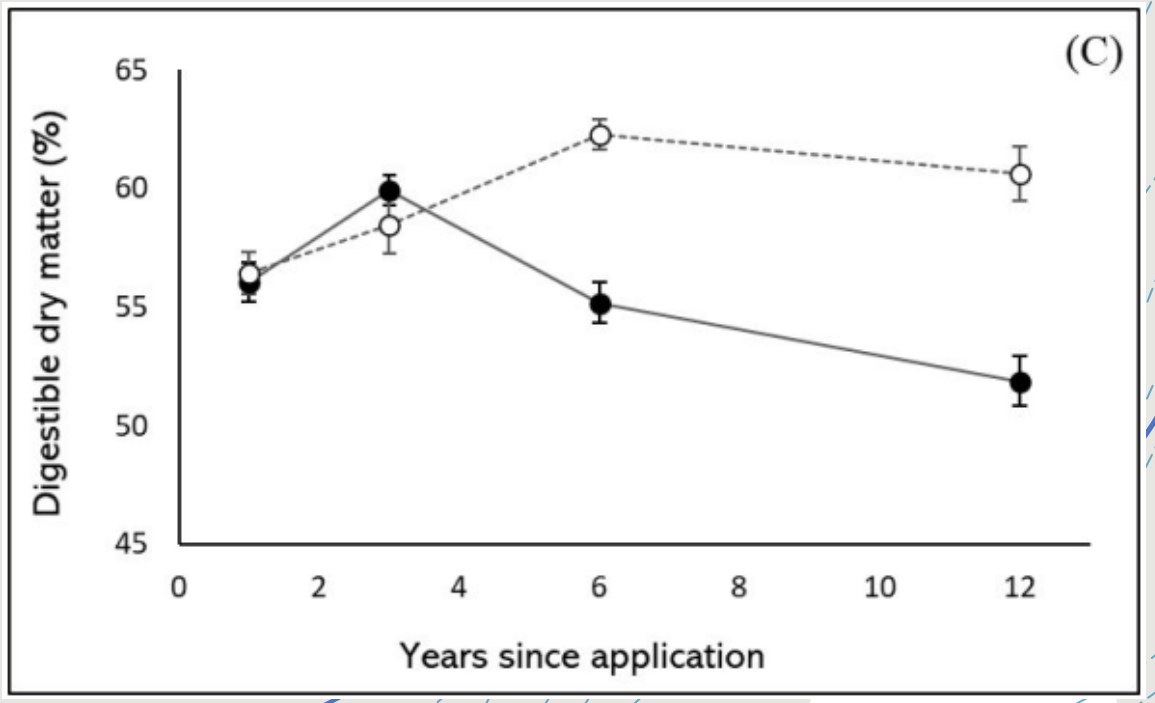
Mean pollen viability present in *C. angustifolium* flowers collected from operational forestry cutblocks untreated (control sites) and treated with glyphosate-based and sampled in northern BC, Canada, one- and two-years post glyphosate treatment ($\alpha < 0.05$). Error bars: +/-2 standard error.



Digestible energy (dry matter)







Mean (±SE) digestible energy concentrations from Bebb's willow (A), red osier dogwood (B), and fireweed (C) collected from cutblocks treated 1, 3, 6, and 12 years after glyphosate-based herbicide application (black circles) compared with untreated control blocks of identical age (open circles); north-central BC

Conclusion: food is significantly reduced post-spray

Does food nutrition change in sprayed cutblocks?

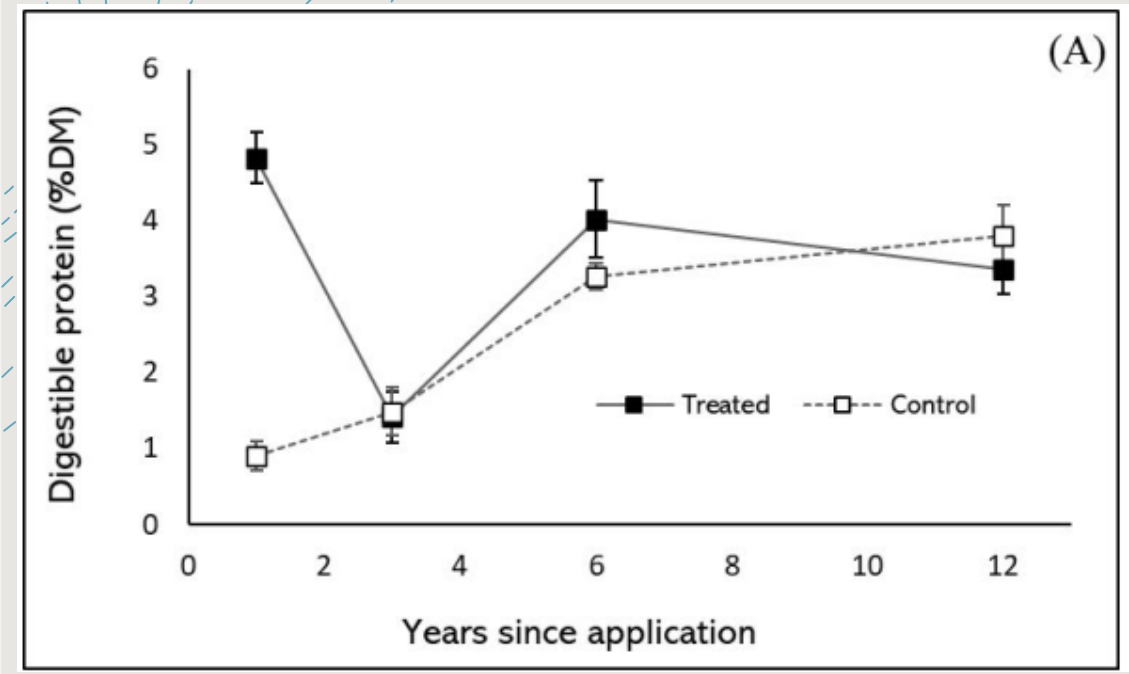
Josh Cassidy/KQED

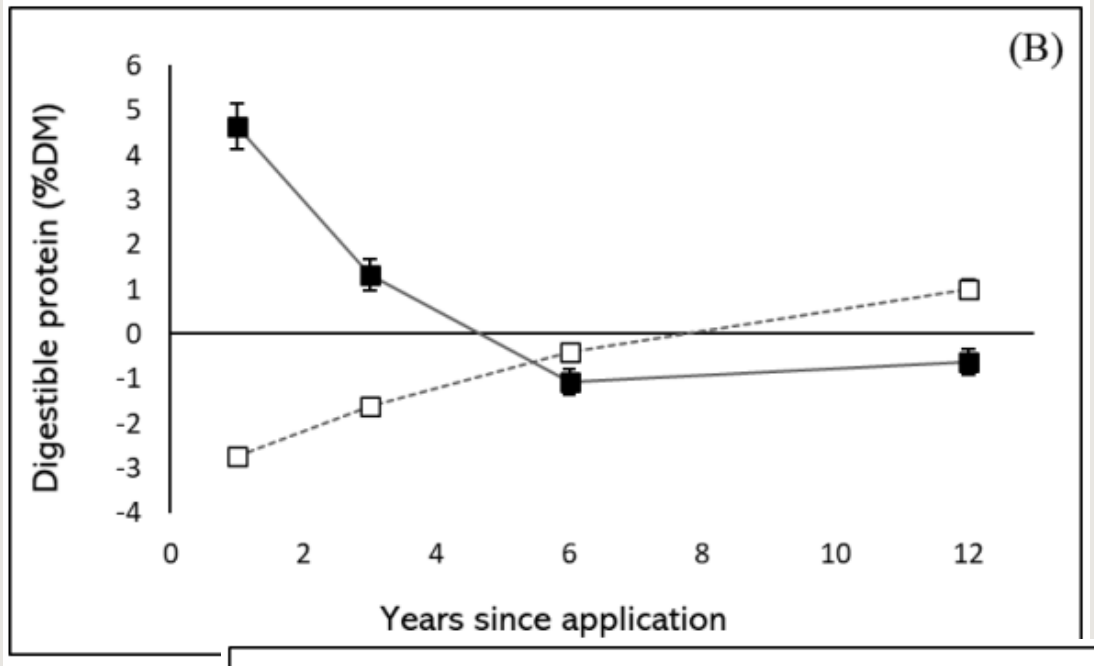
Wiseaboutbears.com

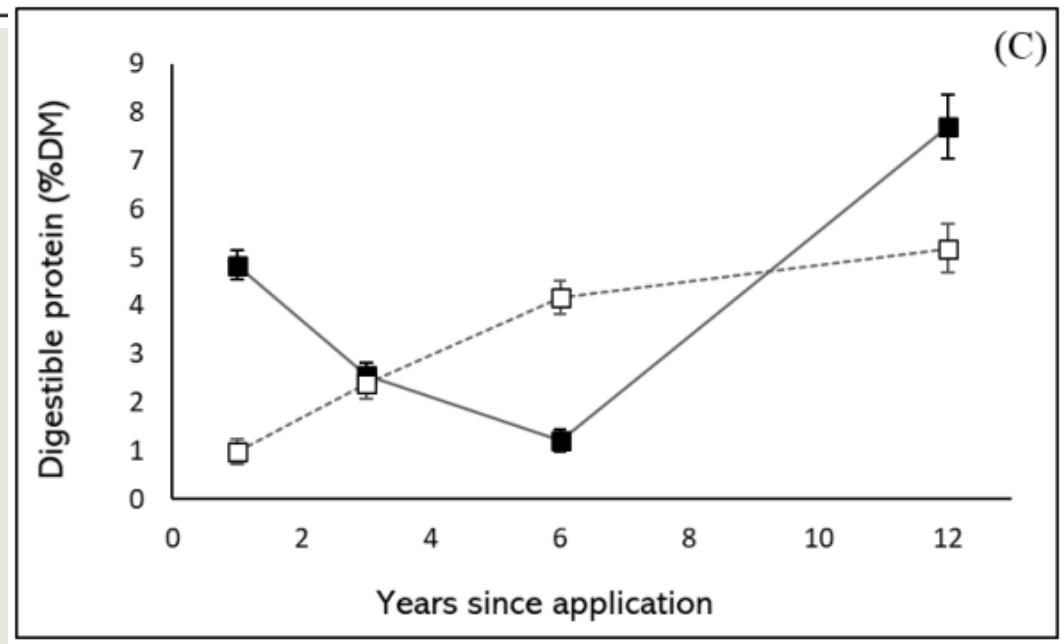
Alberta Biodiversity Monitoring Group

Available protein

Werner et al. 2022
Canadian Journal of Forest Research



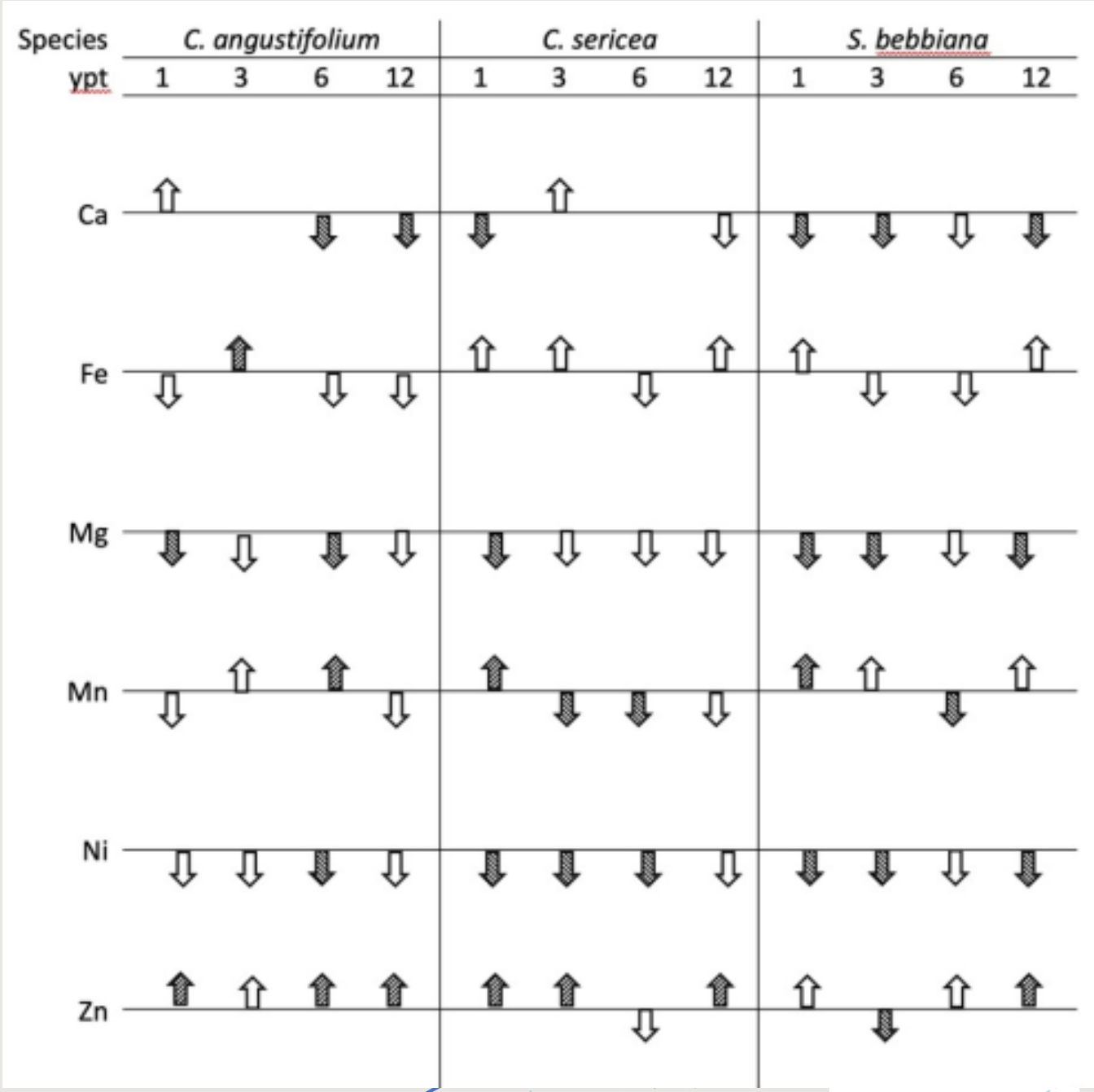




Mean (±SE) digestible protein concentrations from Bebb's willow (A), red osier dogwood (B), and fireweed (C) collected from cutblocks treated 1, 3, 6, and 12 years after glyphosate-based herbicide application (black squares) compared with untreated control blocks of identical age (open squares); north-central BC.

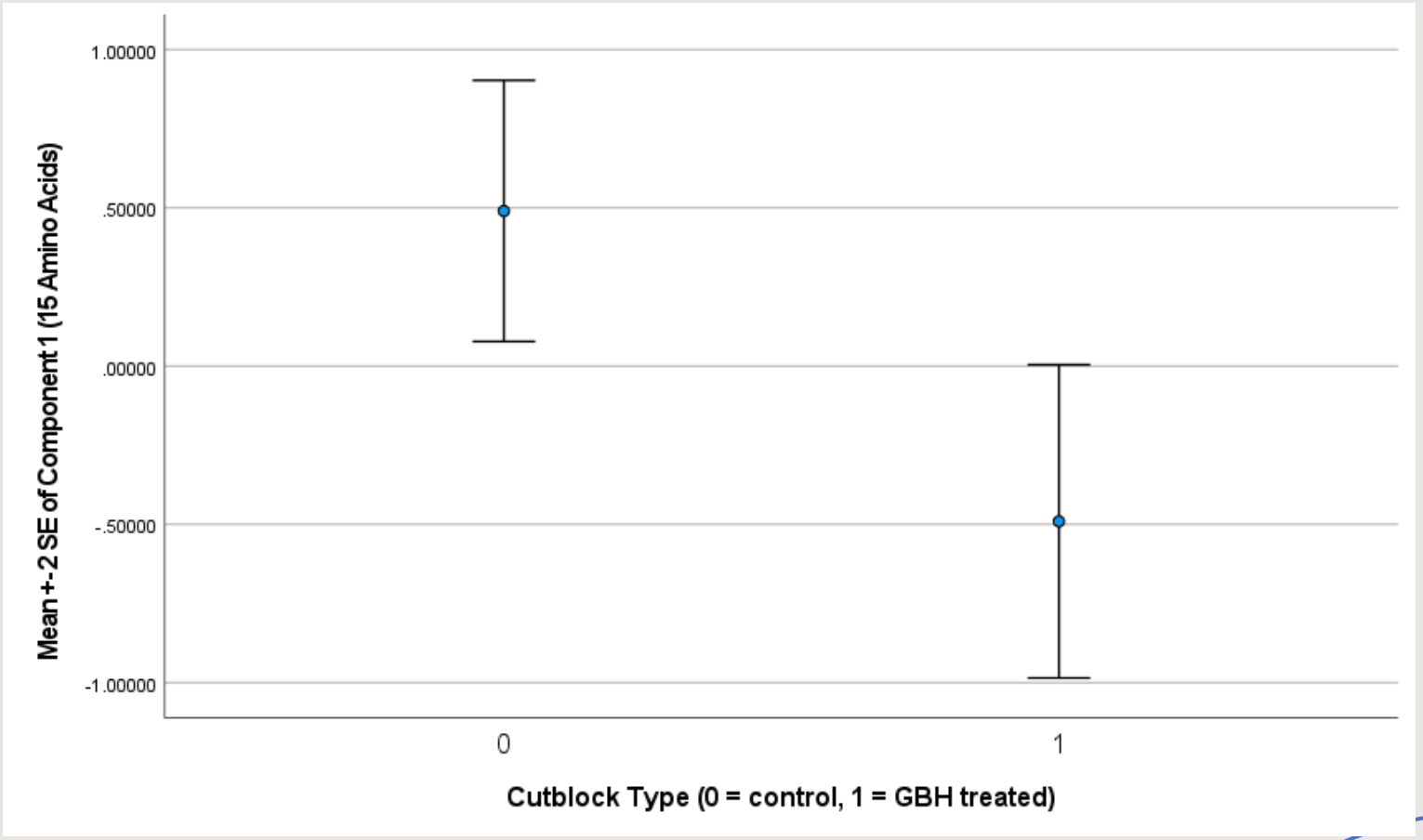
Interactions with minerals

- Effect of glyphosate-based herbicide treatment on nutrient concentrations in each of three plant species (Chamaenerion angustifolium, Cornus sericea, and Salix bebbiana), as determined through comparison of treated and control samples from each treatment year (1, 3, 6, and 12 years post-treatment (ypt)). Increases in median nutrient concentrations with treatment are indicated by upward-facing arrows, and decreases with treatment by downward-facing arrows. Statistically significant trends are indicated with hatched arrows.



Nutrition of flowers

- High in protein and amino acids



Component Matrix[a]

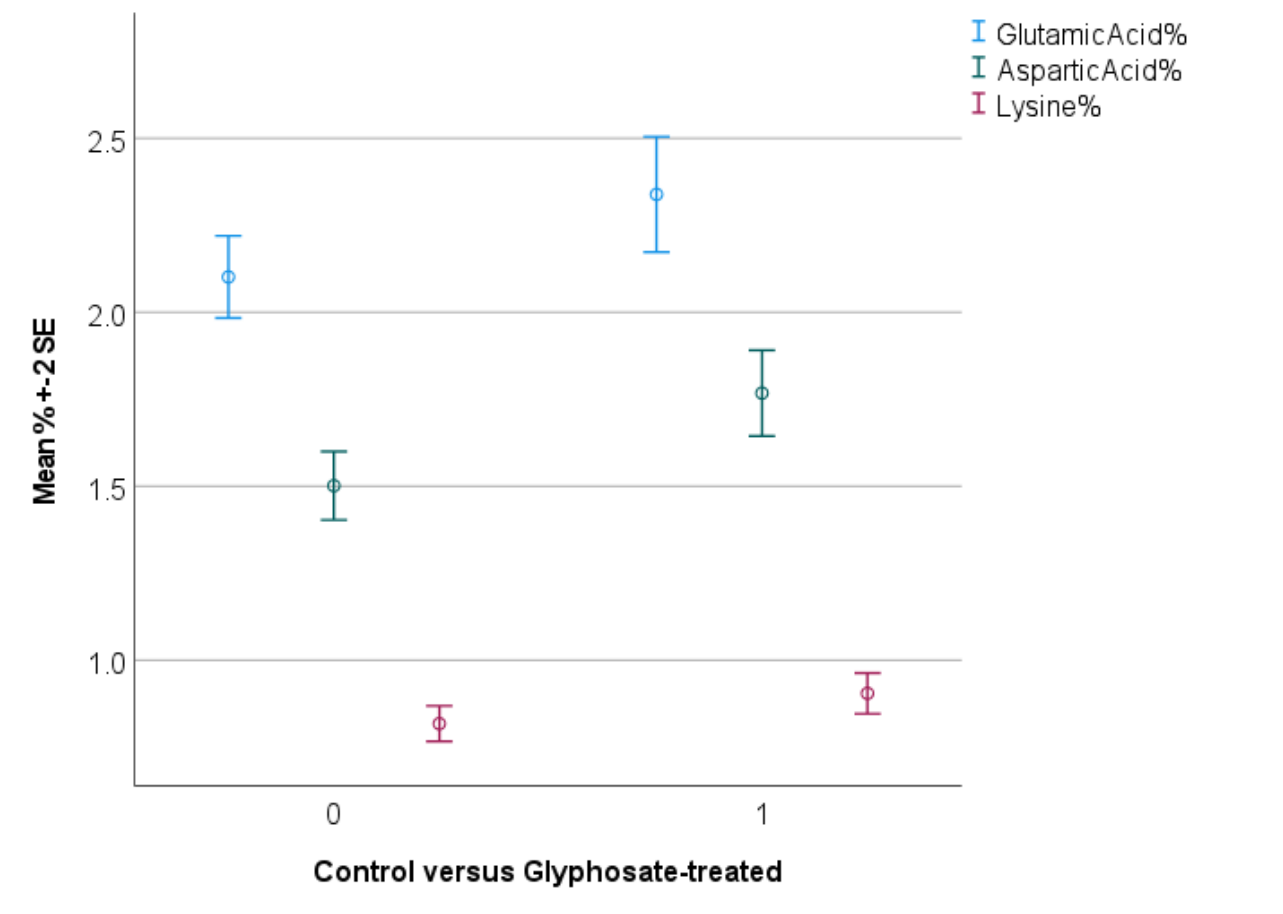
	Component 1	Component 2
Alanine%	.943	.088
Arginine%	.948	.116
AsparticAcid%	.923	.232
GlutamicAcid%	.823	.164
Glycine%	.915	-.313
Histidine%	.893	-.188
Isoleucine%	.849	-.472
Leucine%	.970	-.019
Lysine%	.887	.026
Phenylalanine%	.896	-.080
Proline%	.723	-.147
Serine%	.515	.831
Threonine%	.811	.546
Tyrosine%	.893	-.010
Valine%	.880	-.426

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Roy Lukes

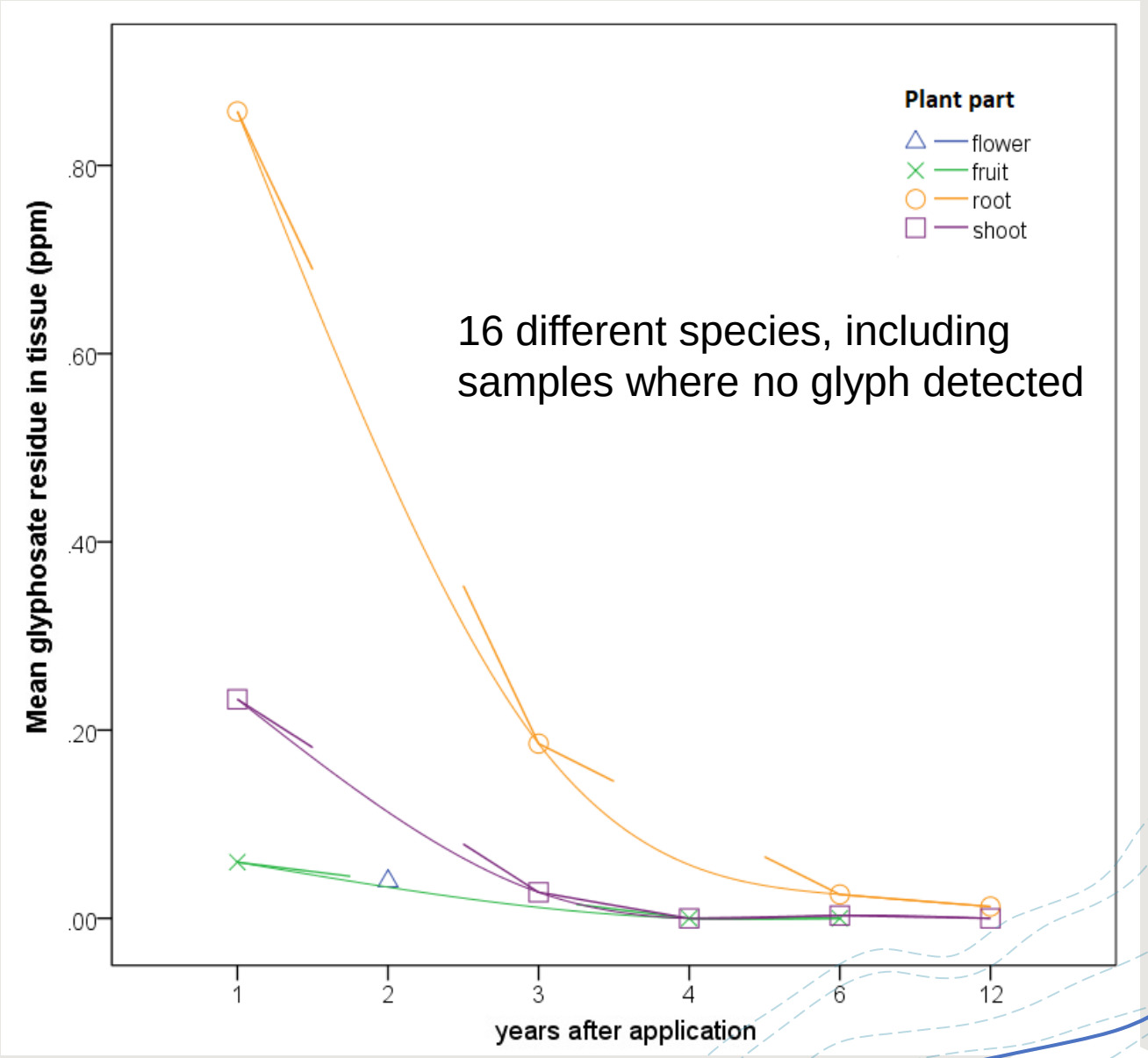
Nutrition of flowers



Conclusion:
Sub-lethal GBH influences plant chemistry

Are forest foods safe to eat?

This depends on your perspective.



Glyphosate use a forest values

Wildlife values and traditional land use practice values are reduced using GBH

Future research on how GBH and fire interact (hypothesized that GBH would reduce resilience to fire)

In forest management, GBH remains a tool for meeting timber objectives only

Moving towards a focus on multiple objectives with timber no longer being the primary objective in all cases, we can expect the use of GBH to decrease in forest practices

THANK YOU

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