Canada Thistle:
An Invasive Alien Plant in our "Neck of the Woods"

Jessica Humber[1]
and
Luise Hermanutz[2]

[1]M.Sc. Candidate
[2]Associate Professor / Supervisor
Department of Biology
Memorial University of Newfoundland

IAS Workshop
January 2008

MEMORIAL UNIVERSITY

Parks Canada Parcs Canada

Canada

Major Forest Disturbances in Gros Morne NP

Insect Disturbance

Domestic Cut

- Forest disturbance is common in Gros Morne NP
- Balsam fir ~ 36% of all vegetation in the park
- Advanced regeneration well-adapts fir to high disturbance regime

Evidence of moose impact is not hard to find!

- Lack of regeneration since 80's
- Heavy browsing pressure (70% of stems)
- -Moose threshold max = 0.7 moose/km^2
- -Extreme moose demographics
  - 1971: Avg 0.14 moose/km^2
  - 1998: Avg 4.3 moose/km^2
    - As high as 14.6 moose/km^2

St. Paul's Insect Disturbance

Near Glenburnie

Cut Block 302

Mill Brook Exclosure

Mill Brook Trail

Community Composition Shift: Invasive Plants


Canada Thistle Monoculture

The Role of Moose in Thistle Invasion

- Removal of advance regeneration prior to disturbance
- Browsing newly emerging fir
  - No seed bank
- Vectors for transport (moose trails)
- Trample native vegetation; prolong period of disturbance

(Ref: Rose & Hermanutz 2004)

Canada Thistle Profile

- Native range: southeastern Europe and the eastern Mediterranean
- Entry date into NA: 1600s
- Current distribution in NA: All Canadian provinces and 44 U.S. states; status as a noxious weed
- Means of Introduction: Unintentional; likely a contaminant of crop seed and/or ship's ballast
- Pathways of spread: primarily agricultural activities

Canada Thistle – An Expert Invader

- Canada thistle is a successful invader:
  - Reproduces vegetatively / horizontal roots
  - Forms monocultures
  - Root fragments produce new plants
  - Many seeds / Long viability (~21 yrs)
  - Defense from herbivores

- Possible ways thistle might inhibit balsam fir regeneration:
  - Out-competition for resources
  - Physical exclusion (e.g. dense roots)
  - Shading? (unlikely)
  - Allelopathy (Kazinczi et al. 2004)

Methods of Control / Eradication

- Eradication/control methods have been derived from agricultural settings:

    1) Mowing / Hand Cutting
    2) Digging / Tillage
    3) Herbicide
    4) Biocontrol

- 2 or more techniques may need to be combined
- May not be feasible in natural areas

Focus of Study:

To evaluate the impacts of Canada thistle invasion on balsam fir stand regeneration in boreal forest disturbances

Part 1 – How Serious is the Current State of GMNP's Disturbed Forests?

- Objective 1 – Better understand the severity of Canada thistle invasion and the status of balsam fir regeneration in disturbed sites
  - Surveyed:
    - Density of Canada thistle
    - Density of balsam fir seedlings / adults
    - Height of fir and presence / absence of browsing …

  in 25 sites disturbed either naturally or by harvesting activity

Objective 2 – Identify suitability of existing forest floor seedbed to conifer regeneration in disturbed sites (n=20) in comparison to their forest edges

To Put it Simply…

- Very high thistle densities (max = 48 shoots/m^2)
- Very low balsam fir seedling densities (as low as 0.14 / m^2)
- Balsam fir (including small seedlings <30cm) is severely browsed (83.3%)
- Balsam fir seedlings rarely found growing amongst Canada thistle
- Favored seedbeds for fir were hypnaceous feathermosses (40%) & mixed litter (23%); very few fir grew alongside herbaceous weeds

Part 2 – Balsam Fir Seed Addition Experiment

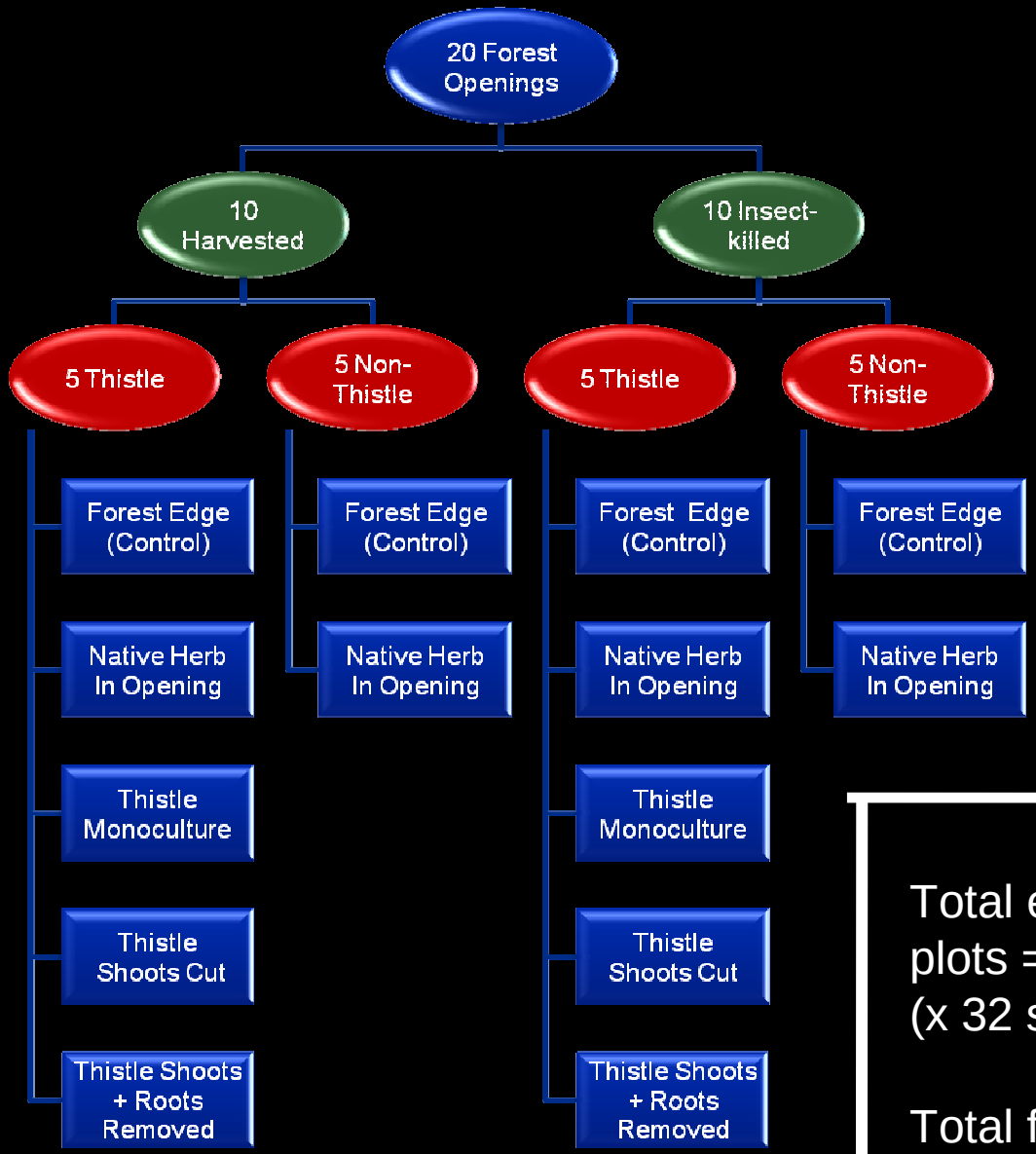
- Objective 1

  – Can balsam fir germinate, grow, and survive amongst Canada thistle monocultures?

- Objective 2

  – Can Canada thistle eradication/management attempts improve the success of balsam fir?

Seed-Addition Methods:



Total experimental plots = 130
(x 32 seeds each)

Total fir seeds planted = 2240

Initial Results:
Seedling Emergence

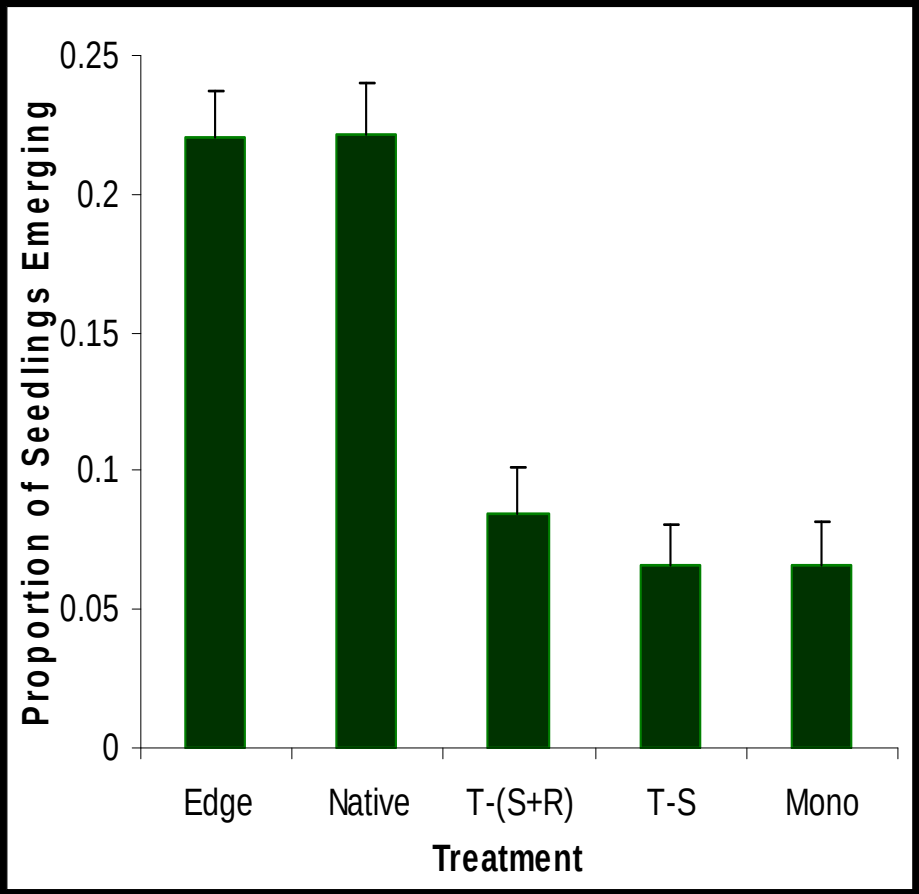


Fig 1 – Proportion of balsam fir seedlings emerging in each experimental treatment (+ SE Mean)

- Overall rate of emergence 3x higher in non-thistle plots than thistle plots, regardless of if in disturbed substrate or forest control

Initial Results:
Seedling Survival

- High rates of seedling mortality (64.1% mortality over season)
- Almost all mortality (94%) was from predation (e.g. voles, slugs, etc.)

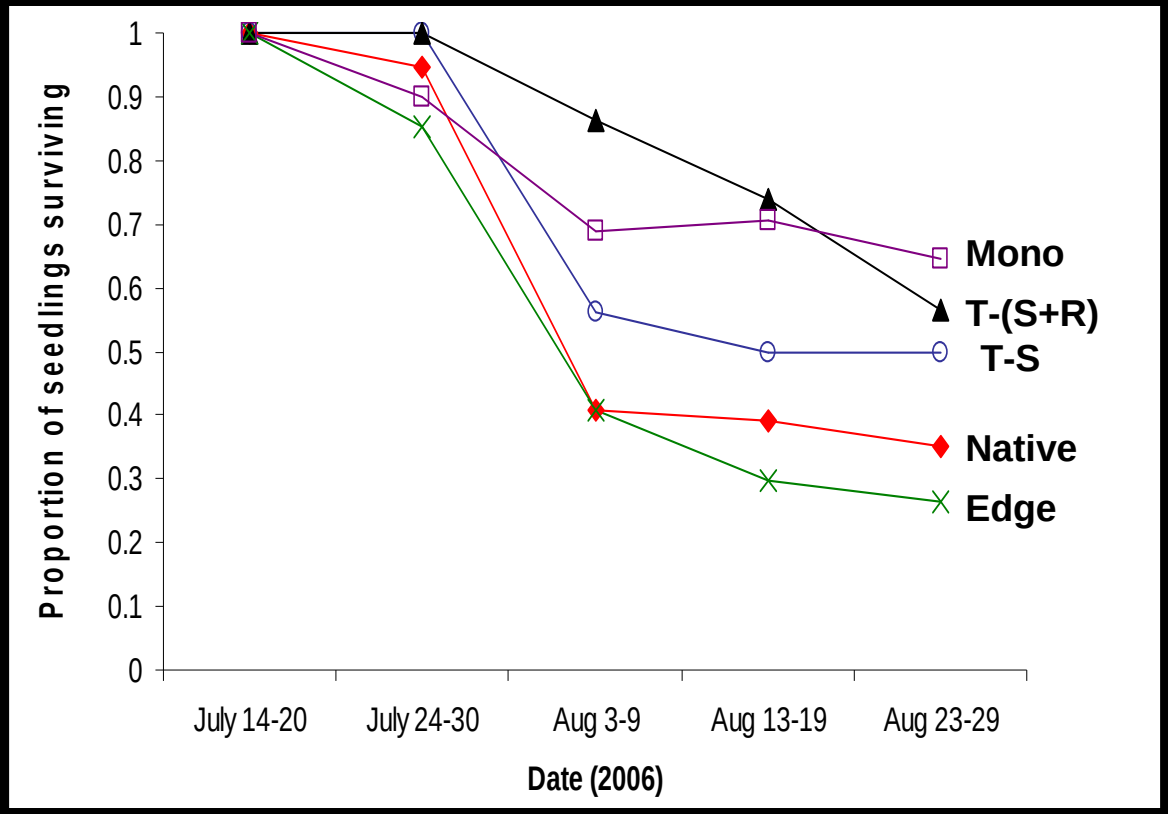


Fig 2 – Proportion of balsam fir seedlings surviving through the growing season in each treatment

Over-winter survival:

• Of all the seedlings still alive at the end of the summer, 59.8% survived until the following May

• Many fir (47.1%) growing in thistle treatments survived until May!

Initial Results:
Effect of Disturbance Type

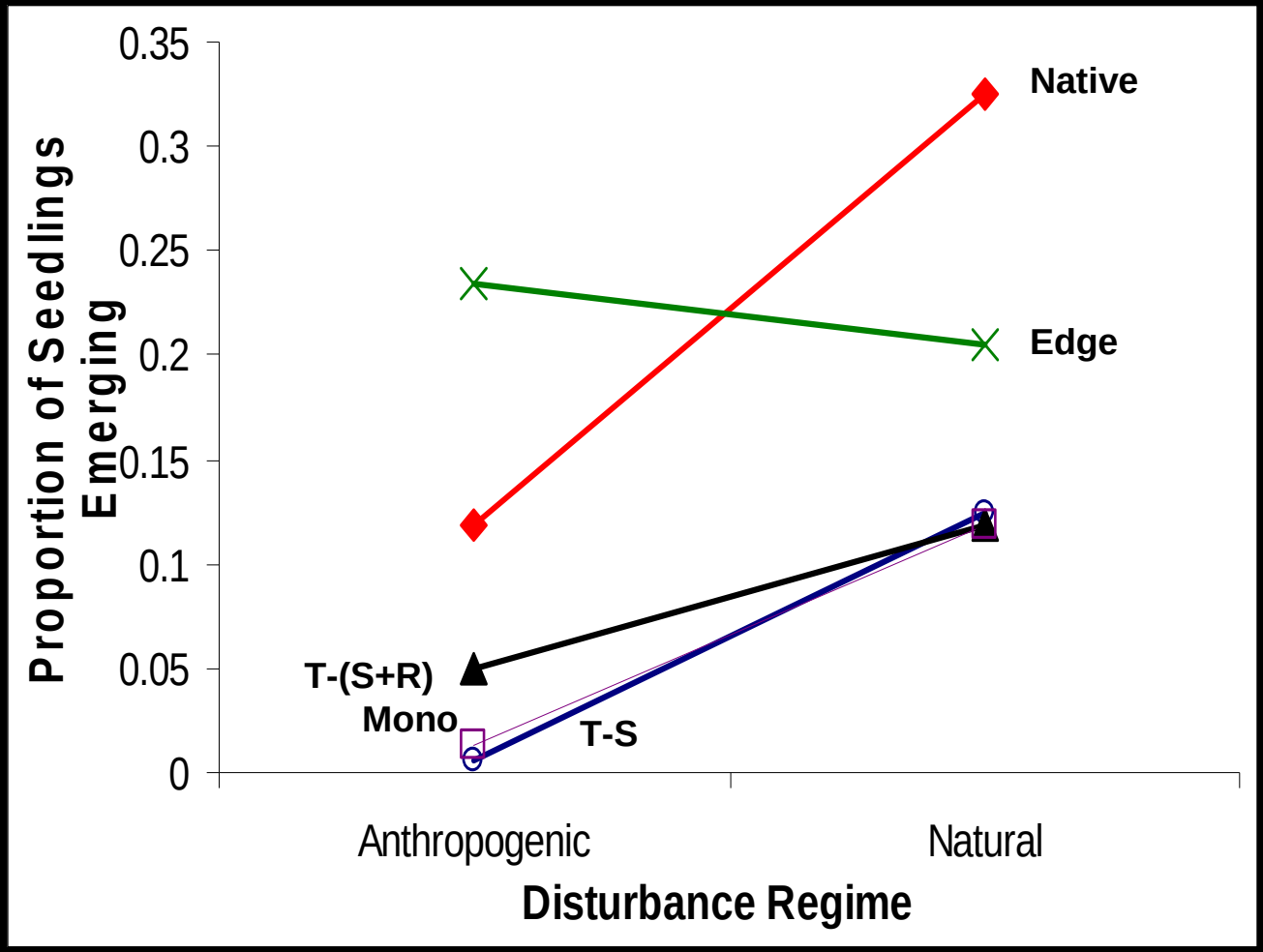


Fig 3 - Proportion of balsam fir seedlings emerging in each experimental treatment in anthropogenic and natural disturbances

Initial Results:
Effect of Disturbance Type

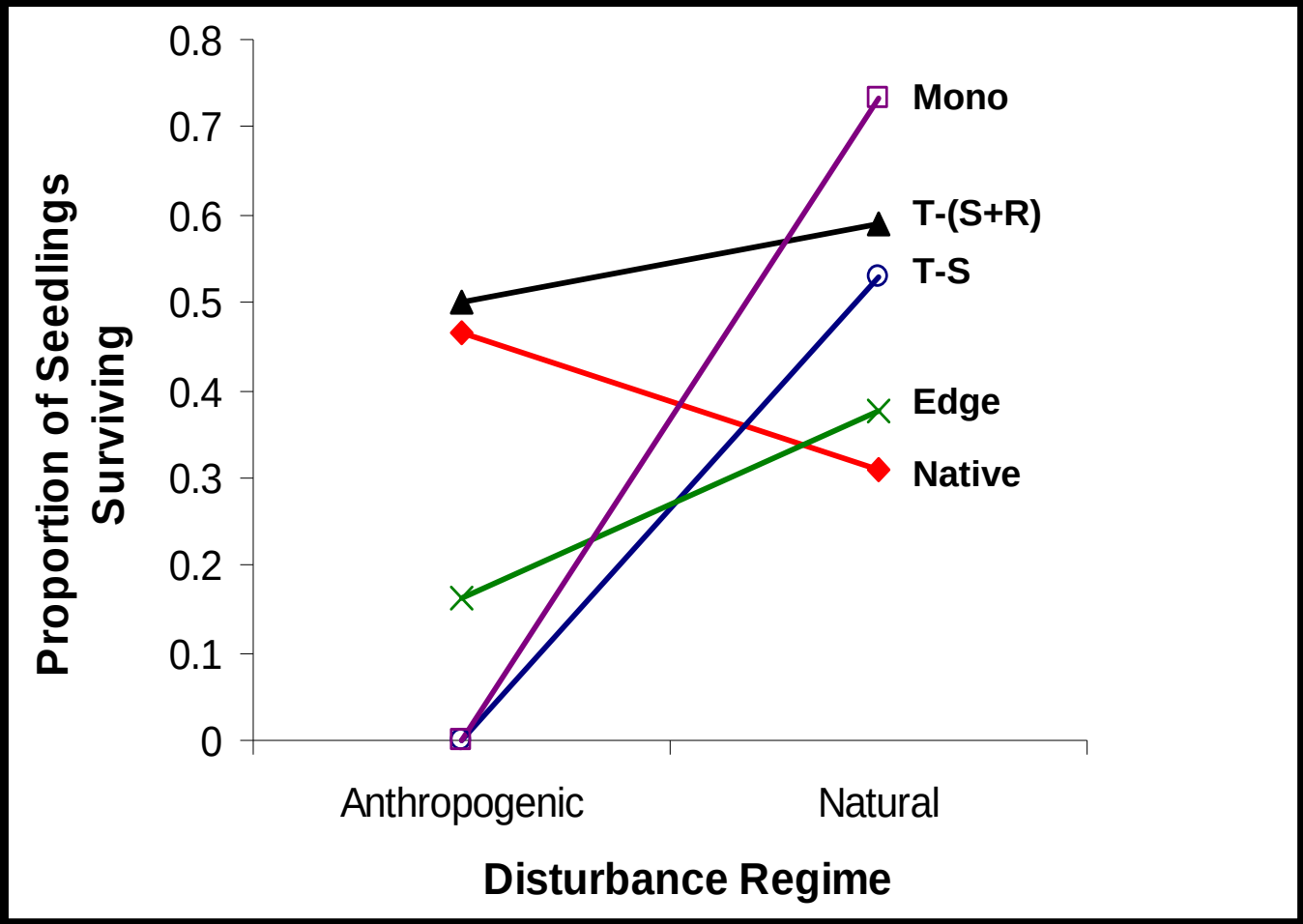


Fig 4 - Proportion of balsam fir seedlings surviving to end of August in each experimental treatment in anthropogenic and natural disturbances

Could planting fir seedlings be a viable option?

•Planted 432 fir seedlings (1yr) into 4 sites

•Survival over one summer = 98.4%

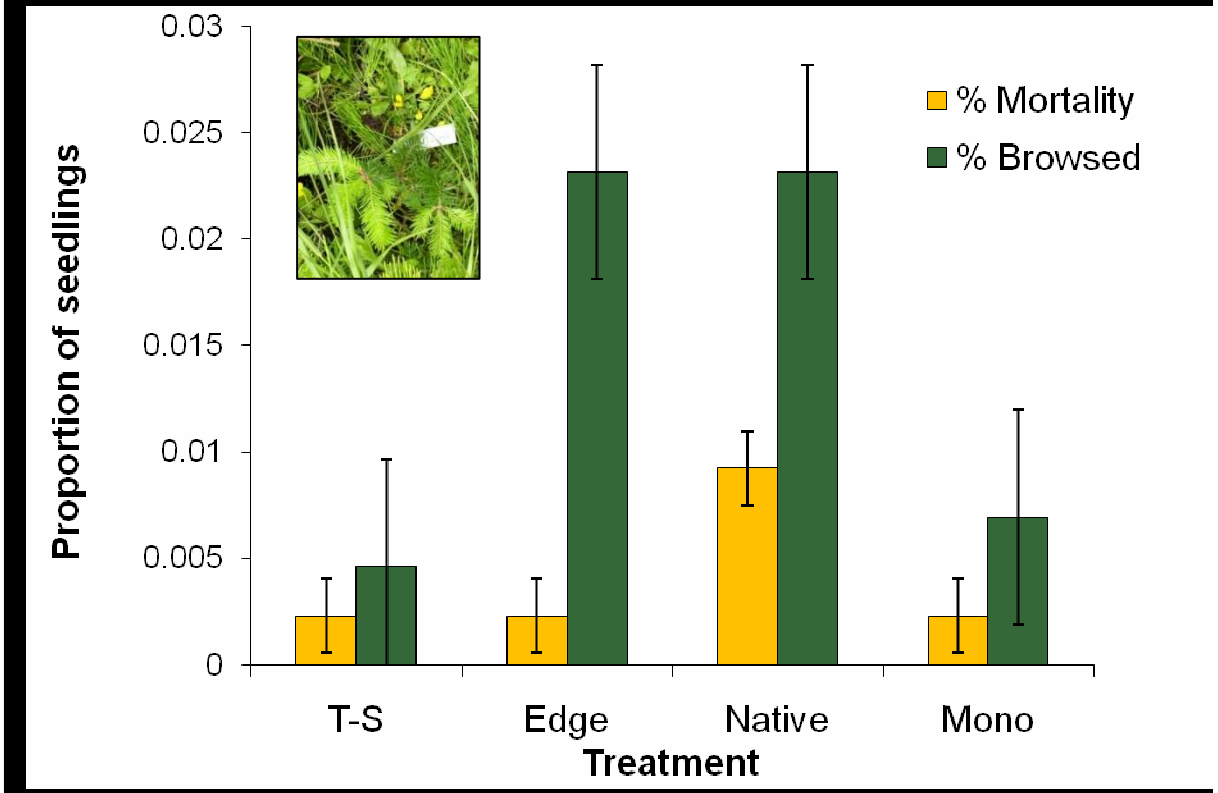


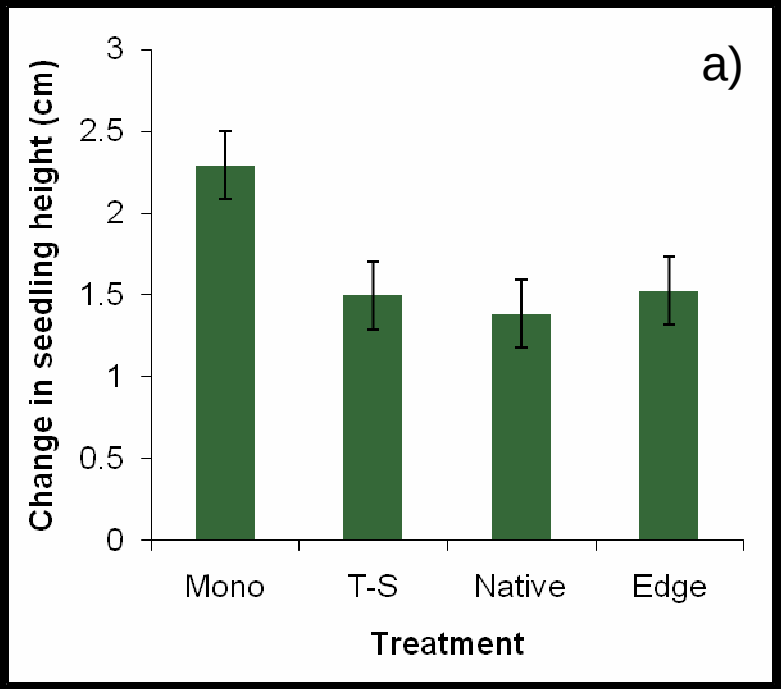
Fig 5 – Proportion of 1-year old balsam fir seedlings suffering mortality or browsed (±SE) in one season

•All mortality (little) was due to dessication, not predation

•Only 25/432 seedlings (5.8%) were browsed

•Fir browsing may be decreased amongst thistle

Could planting fir seedlings be a viable option?



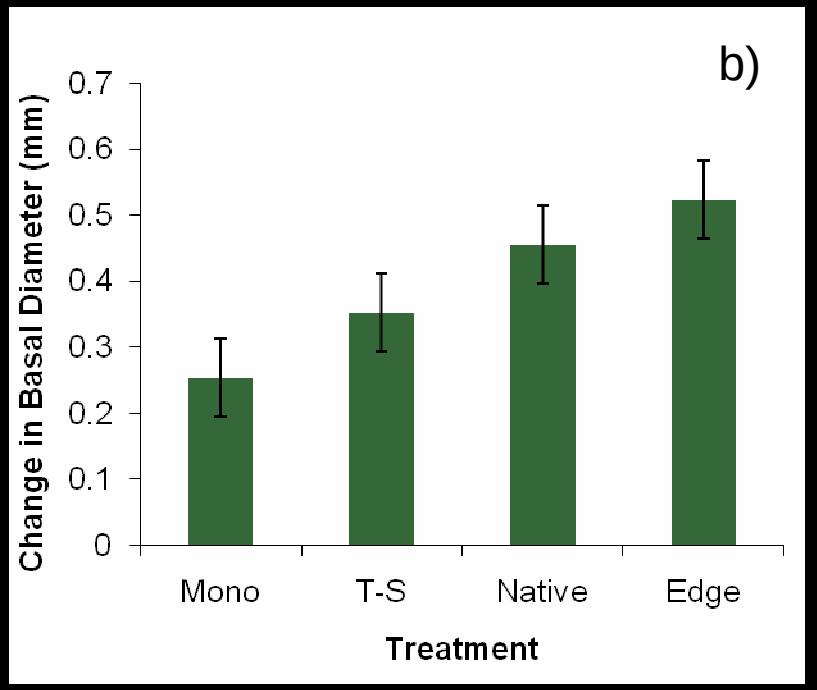


Fig 6 – Change in 1-yr old balsam fir seedling a) height and b) basal diameter during one summer after being transplanted into various field treatments (± SE Mean)

Allelopathy Questions To Be Answered:

- 1) Does Canada thistle inhibit native tree species through allelopathy?
- 2) Does inhibition depend on the source of the aqueous extracts?
- 3) Are native tree species differentially inhibited, suggesting the potential to alter community composition and succession?
- 4) At what early life history stage (seedling emergence, survival or growth) are native trees most affected?

Part 3: Allelopathy

Experiment 1:

- Applied various Canada thistle aqueous extracts to balsam fir, white spruce, and birch seeds planted in potting soil

- Treatments / Extracts:
  - Live leaves
  - Leaf litter
  - Minced leaves (comparison)
  - Roots
  - Soil
  - Distilled water (control)
  - Native tree seedling extract

Created realistic extracts by simulating natural field conditions

Monitored:

- Germination (% and time to)
- Growth (height, dry AG and BG biomass)
- Mortality

Part 3: Allelopathy

Experiment 2:

- Used activated charcoal to look for evidence of allelopathic chemicals in soil
- Plant balsam fir, white spruce, and white birch seeds into each treatment:

A) Potting soil with removed thistle monoculture (+/- AC)
B) Potting soil (+/- AC) - CONTROL

C) Field soil with removed thistle monoculture (+/- AC)
D) Uninvaded field soil (+/- AC) - CONTROL

Putting Together the Puzzle: (Preliminary) Conclusions

- It is important to better understand levels of seed rain into disturbed sites
  - Total of 96 seed traps set up in 4 sites (2 insect, 2 cut) at varying distances from forest edge

- Initial results indicate planting 1-year old fir seedlings could be the most viable management step to help restore ecological integrity to Gros Morne's forests, BUT…

- At current densities, moose will still ultimately control the fate of regeneration in these sites. Even if fir can win the battle with Canada thistle, it still has to fight an ongoing war with moose.

Acknowledgements

- Supervisor: Dr. Luise Hermanutz (MUN)
- Committee: Dr. Tom Knight (GMNP) & Dr. Paul Marino (MUN)
- Summer Field Assistants: Karen Kennedy, Kelly Humber, and Maria Stapleton
- GMNP Staff, Julie Robinson, Susan Squires, Gina Whelan, Family, and countless others
- Funding: NSERC, Parks Canada, MUN

Selected References

- Burzynski, M., Knight, T., Gerrow, S., Hoffman, J., Thompson, R., Deering, P., Major, D., Taylor, S., Wentzell, C., Simpson, A., Burdett, W. 2005. State of the Park Report: An assessment of ecological integrity. Gros Morne National Park of Canada.

- Kazinczi, G., Beres, I., Mikulas, J., and Nadasy, E. 2004. Allelopathic effect of *Cirsium arvense* and *Asclepias syriaca.* Journal of Plant Diseases and Protection 19: 301-308.

- McLaren, B.E., and Janke, R.A. 1996. Seedbed and canopy cover on balsam fir seedling establishment in Isle Royale National Park. Canadian Journal of Forest Research 26: 728-793.

- Rose, M., and Hermanutz, L. 2004. Are boreal ecosystems susceptible to alien plant invasion? Evidence from protected areas. Oecologia 139: 467-477.

- Taylor, S. 2000. Gros Morne National Park forest inventory resource data. Gros Morne National Park, Rocky Harbour.


THANK YOU!