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

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Major Forest Disturbances in Gros Morne NP

- 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/km²
- Extreme moose demographics
  - 1971: Avg 0.14 moose/km²
  - 1998: Avg 4.3 moose/km²
  - As high as 14.6 moose/km²
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/m²)

• Very low balsam fir seedling densities (as low as 0.14 / m²)

• 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:

20 Forest Openings

- 10 Harvested
  - 5 Thistle
    - Forest Edge (Control)
      - Native Herb In Opening
      - Thistle Monoculture
      - Thistle Shoots Cut
      - Thistle Shoots + Roots Removed
  - 5 Non-Thistle
    - Forest Edge (Control)
      - Native Herb In Opening
      - Thistle Monoculture
      - Thistle Shoots Cut
      - Thistle Shoots + Roots Removed

- 10 Insect-killed
  - 5 Thistle
    - Forest Edge (Control)
      - Native Herb In Opening
      - Thistle Monoculture
      - Thistle Shoots Cut
      - Thistle Shoots + Roots Removed
  - 5 Non-Thistle
    - Forest Edge (Control)
      - Native Herb In Opening
      - Thistle Monoculture
      - Thistle Shoots Cut
      - Thistle Shoots + Roots Removed

Total experimental plots = 130 (x 32 seeds each)
Total fir seeds planted = 2240
Initial Results: Seedling Emergence

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

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

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

- Only 25/432 seedlings (5.8%) were browsed
- Fir browsing may be decreased amongst thistle

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

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

Created realistic extracts by simulating natural field conditions.
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
• 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.
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Selected References


