A conceptual framework for the spruce budworm ‘Early Intervention Strategy’

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Source: NB Woodlot owners webpage
Cape Breton Highlands, 1977
Foliage Protection Strategy
Silvicultural Strategy
Population Control Strategy
Management strategy is built from Population dynamics

~35-40 year outbreak cycle
What drives spruce budworm outbreak cycles?
Silvicultural hypothesis

Forest regeneration cycles drive budworm outbreaks

BUT...

Tree ring data too short and imprecise

Forest regeneration cycle takes ~70 years
Silvicultural hypothesis 2.0

Forest composition influences outbreak intensity

To an extent...

More hardwood content =
Less defoliation &
shorter duration
Zhang et al. 2018

Balsam fir:black spruce ratio influences
stand susceptibility
Bognounou et al. 2017

Silvicultural strategies?
Oscillatory hypothesis

Predator-prey cycles drive budworm outbreaks
Oscillatory hypothesis

Predator-prey cycles drive budworm outbreaks

Only data for collapsing populations

...but, no data for the rise

Royama 1984
Oscillatory hypothesis

Outbreaks are synchronous across the landscape

Moth dispersal does not spread outbreaks

Regional outbreaks are inevitable

1975
Foliage protection strategy

Prevent tree mortality (keep defoliation <50%)

High-value stands

2 years defoliation & High L2 densities

Wait it out...

Only 4% of area treated, but ~85% successful

Main strategy since the 1950’s!
Epicentre Hypothesis
(Double equilibrium hypothesis)

Outbreaks spread ‘contagiously’

Density-dependent moth dispersal
Régnière & Nealis 2019

No natural enemy release
Bouchard et al. 2018

Mate-finding Allee effect
Régnière et al. 2012

2007-2013

Outbreaks spread 'contagiously'

Epicentre Hypothesis
(Double equilibrium hypothesis)

Outbreaks spread ‘contagiously’
Population control strategy

Target ‘hotspots’ & slow or stop spread.
Early Intervention Strategy

Population control strategy

Target ‘hotspots’ & slow or stop spread.
Early Intervention Strategy

Conceptual Framework:

1) Population dynamics

2) Monitoring: Hotspots and treatment areas

3) Efficacy and non-target effects

4) Communication and outreach

5) Benefits > costs
Early Intervention Strategy

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Fall 2017

‘Hotspot’: >7 L2 per branch

Régnière et al. 2019 (Unpubl.)
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Population Control Trials

- ~4.2 million ha of DDT
- ~99% budworm mortality!

But...
- Populations quickly rebounded
- 25% of sites retreated annually.
- Decimation of parasitoids and prey (and therefore also predators).
- Insecticide resistance.

Conclusion: “Let’s recalibrate for Foliage Protection!”
How do we control pest populations?

Populations can compensate for some culling (or harvest)...

Avoid provoking compensatory responses and thereby “add” mortality
How do we control pest populations?

We need to ‘add’ mortality:

1) Control populations while densities are relatively low.
How do we control pest populations?

We need to ‘add’ mortality:

2) Control over large areas to limit sources of immigration.
How do we control pest populations?

We need to ‘add’ mortality:

3) Avoid impacting natural enemies or other non-target organisms.

Eveleigh et al. 2006
Early Intervention Strategy

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9. Rivers of Death

From the green depths of the offshore Atlantic many paths lead back to the coast. They are paths followed by fish, although unseen and intangible, they are linked with the outflow of waters from the coastal rivers. For thousands upon thousands of years the salmon have known and followed these threads of water, and so have the birds and other life forms, which depend on

DDT - 1962

Fenitrothion - 1982

The fight to stop the aerial insecticide spraying of the forests of Eastern Canada,

by Elizabeth May

The author lives in Margaree Harbour, Cape Breton where she is head cook at her family’s restaurant on board an old fishing schooner, the Marline Elizabeth.

She is currently a student of the Faculty of Law of Dalhousie University and plans to practice environmental law. While remaining involved in opposing the aerial spraying, she stays active in the movement against the development of titanium mining in Nova Scotia.
Communications Strategy

(1) To be a credible primary source of information and education
   Scientists and experts lead the discussion sharing accurate information

(2) Share our research program with Atlantic Canadians
   Public awareness of the situation and what is being done to address it

(3) Engage stakeholders to inform them with updates on our efforts
   Stakeholder communications & outreach
   Responsive and accurate information
Communications

Strategy:

1) Transparent and proactive engagement
   - public, aboriginal communities, foresters, politicians, media, etc.

2) Scientists communicate on the science

3) Directly address issues raised by the public
Early Intervention Strategy

*Conceptual Framework:*

1) Population dynamics

2) Monitoring: Hotspots and treatment areas

3) Efficacy and non-target effects

4) Communication and outreach

5) Benefits > costs
Benefits > Costs?

• Uncontrolled budworm outbreak = \(~$15 \text{ billion loss over 30 years} \).

• Research that increases efficacy of components makes EIS more cost-effective:
  - Population dynamics, moth dispersal modelling, genomics, radar work, satellite, community science, DSS, climate change, etc.

• Cost-benefit balance will likely vary regionally.

• In some cases, ‘Foliage Protection’ may be more cost-effective.
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5) Benefits > costs
Maps by: Luke Amos-Binks, DERD

Foliage protection thresholds: Nicolas Girard, SOPFIM
March 13, 2019

Spruce Budworm – Why do we Care and Management Alternatives

Dr. David MacLean, Emeritus Professor of Forest Ecology
Faculty of Forestry and Environmental Management University of New Brunswick

March 20, 2019

A Conceptual Framework for the Spruce Budworm Early Intervention Strategy

Dr. Rob Johns
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March 27, 2019

Operational Requirements for a Successful Early Intervention Strategy

Drew Carleton
Manager of Forest Health
New Brunswick Department of Energy and Resource Development

Luke Amos-Binks
Forester
New Brunswick Department of Energy and Resource Development

Andrew Morrison
Operations Manager
Forest Protection Limited

April 3, 2019

Communications and Outreach – Important Pillars for a Successful Program

April 10, 2019

Ecological Impacts of Using Early Intervention to Control Spruce Budworm

Dr. Michael Staehly
Research Scientist
Canadian Forest Service
Atlantic Forestry Centre

Dr. Véronique Martel
Research Scientist
Canadian Forest Service
Laurentian Forestry Centre

April 17, 2019

Early Intervention Strategy for Spruce Budworm: Does it Work? Can we do it More Efficiently?

Dr. Sara Edwards
Postdoctoral Fellow
Forest Protection Limited

E-Lectures are on Wednesdays
from: 1:30 p.m. - 2:30 p.m. EST / 2:30 p.m. - 3:30 p.m. AST / 10:30 a.m. - 11:30 a.m. PST