Update on the threat of mountain pine beetle to boreal and eastern pines

Barry J. Cooke & Vince Nealis, Canadian Forest Service
Edmonton, IBFRA, October 2013
Mountain pine beetle range expansion and risk assessment in Canada

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Vince Nealis
Natural Resources Canada
Canadian Forest Service

29 Mar 2012, Penticton
Genetic evidence of MPB long distance dispersal events

What influences MPB dispersal?

Lorraine MacLauchlan, BC Ministry of Forests, Lands and Natural Resources Operations

Figure 7. Climatic suitability for mountain pine beetle in Canada according to three models and their composite for climate data using observed normals, 1971-2000 and climate-change estimates 2001-2030.
The dotted line and inverted parabola are linear and quadratic fits to the endemic and epidemic phase data – a method of endemic-epidemic niche modeling advocated by Berryman (1999). The points Xn and Xu refer to the stable endemic equilibrium and the unstable equilibrium (i.e. outbreak threshold). (Epidemic equilibrium, Xp, not labelled) The family of negative exponential curves are computed from Powell & Bentz (2009), with En varying annually. The two models reflect different assumptions, and yield different conclusions, as to the mechanism by which outbreaks are supposed to occur. According to Berryman’s (1999) multi-niche model, outbreak occurs when the dotted line and parabola intersect above the horizontal R=0 replacement line, leading to cusp-catastrophe through a saddle-node bifurcation. According to the non-eruptive model there is no catastrophic bifurcation leading to outbreak. Rather, populations grow to a stable upper equilibrium point whenever climate is warm enough to permit populations to grow at all.
Host defense relaxation: a necessary condition for eruption and eruptive spread

(a) Allee effect of host defense strong

log component recruitment vs. log density mass-attack (trees/ha/yr)

hidden truth vs. observable fact

X_p

convergence of theory and data
Host defense relaxation: a necessary condition for eruption and eruptive spread

(b) Allee effect of host defense weakened

The Tria Project
Mountain Pine Beetle System Genomics
Range Expansion Risk Assessment

likelihood of occurrence
in the absence of control further range expansion is likely

consequences
lower impact through prairie provinces
regulatory response (Plant Protection Act)?

uncertainties
low uncertainty on system state (ADS, r, G:R, adult trapping)
dispersal, eruptive thresholds, sex ratios?
weather variability an irreducible uncertainty

response
no commercial capacity for sanitation harvesting
leading edge populations undetectable, untreatable
Information

Assessment

Response

Integrate and adapt

What do we know?

What does it mean?

What do we do?
Partner Puzzle

PROVIDERS
Knowledge Service

Universities

CFS

CFIA

Provincial

STEWARDS
Legislated Responsibilities
## Workshops and Participants

### 1. Key areas of uncertainty (Edmonton, 28 September 2011)

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### 2. Dispersal and spread (Victoria, 23 February 2011)

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### 3. Fire-risk (Teleconference, 6 April 2011)

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### 4. Risk assessment (Victoria, 18-19 October 2011)

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Reference:

Partner Puzzle

Universities

Basic Ecology

CFS

Risk Models

CFIA

Risk Mgmt.

DSS

Provincial

STEWARDS
Legislated Responsibilities

PROVIDERS
Knowledge Service
Warming climate / Gain in cold tolerance
Importance of host defense

(a) Allee effect of host defense strong
climate cool

log component recruitment vs log density mass-attack (trees/ha/yr)

5 t/ha/y
Warming climate / Gain in cold tolerance
Importance of host defense

(a) Allee effect of host defense strong
climate warm

log component recruitment

log density mass-attack (trees/ha/yr)
Warming climate / Gain in cold tolerance
Importance of host defense

(b) Allee effect of host defense weakened
climate cool

log component recruitment

log density mass-attack (trees/ha/yr)

3 t/ha/y
Warming climate / Gain in cold tolerance
Importance of host defense

(b) Allee effect of host defense weakened
climate warm

log component recruitment

log density mass-attack (trees/ha/yr)

critical release
MPB continued expansion eastward, northward, into higher elevations and along the eastern slopes

...These are all novel habitats, where prior assumptions about the factors influencing MPB population dynamics may not hold true

Beetle sex ratios do not always follow the 2:1 assumption used in risk models.

What factors are influencing sex ratios?

James and Janes, unpublished