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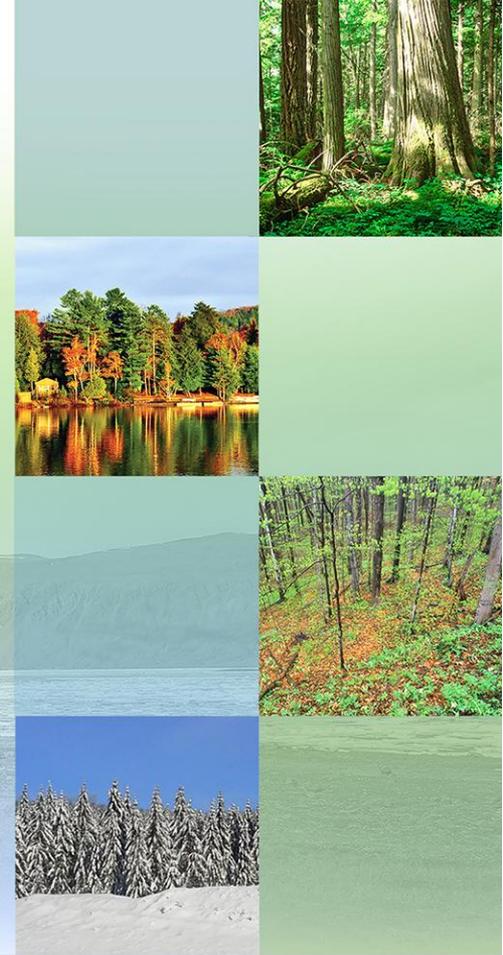
Emerald ash borer population dynamics and range expansion in Canada

Chris J K MacQuarrie

Canadian Forest Service, Great Lakes Forestry Centre

Sault Ste. Marie, Ontario, Canada

Christian.Macquarrie@Canada.ca



Acknowledgements

- EAB PREPSYS organizers for invitation
- GLFC pest management team



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Key messages

1. Range expansion in Canada slower than in US.
2. Population dynamics influenced by stage of infestation.
3. Frequency of 2-year lifecycle varies across landscape.

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Range expansion in Canada

Found in Windsor, ON 2002

Initial response included an ash-free zone

Ultimately ineffective



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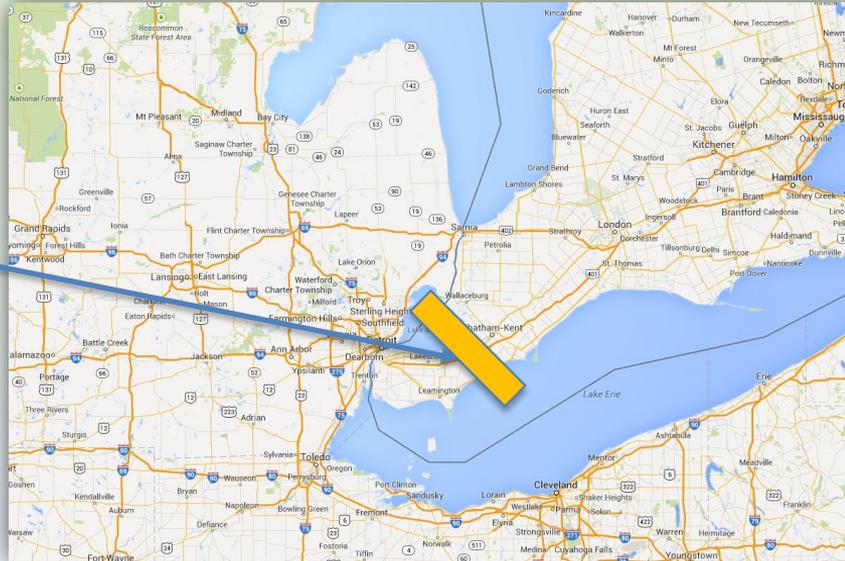
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Initial response included an ash-free zone

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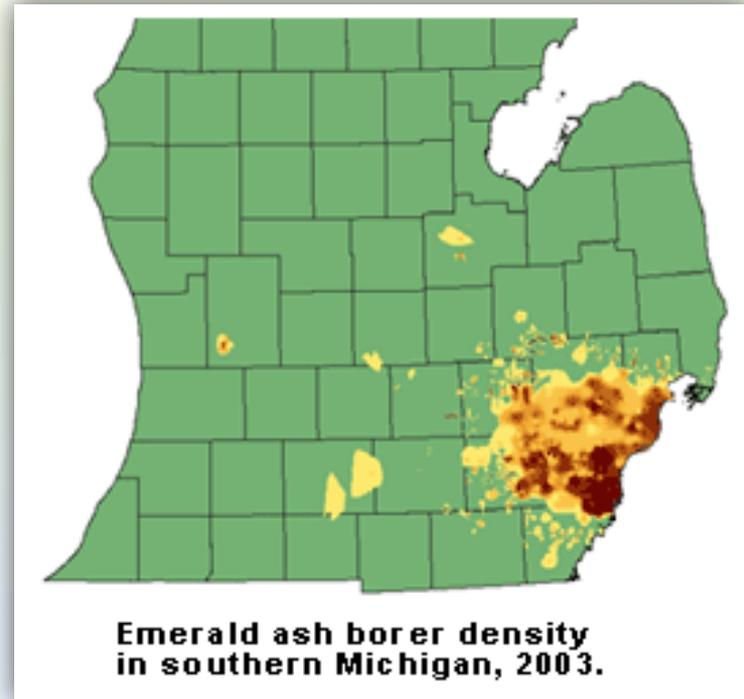
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Range expansion in Canada

Ash free zone ineffective
because invaded area was
already large

Detection techniques were not
sufficient to find small, incipient
populations



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Range expansion in Canada

2006 known range had only increased by 165 Km to London, Ontario

Some damage now mapped by air but still primarily retained in southwest Ontario



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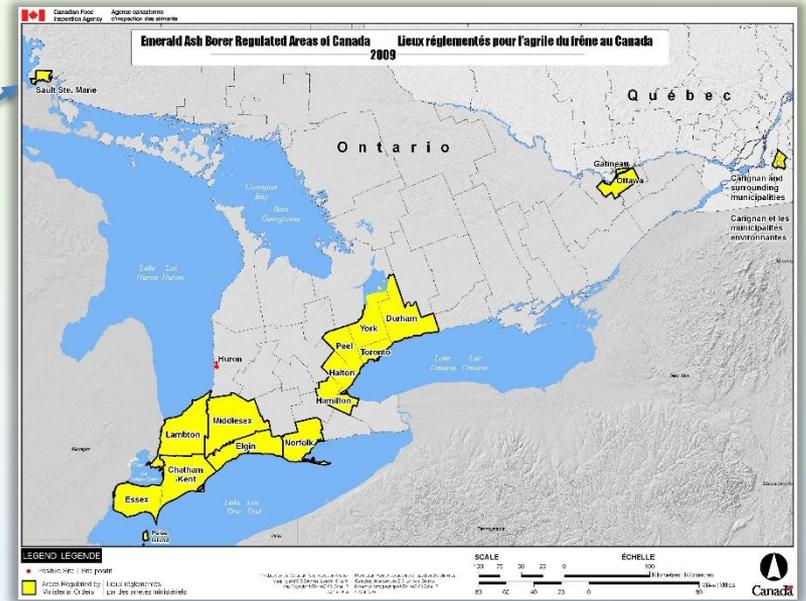
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Range expansion in Canada

2009 detected in Quebec, Ottawa & in Sault Ste. Marie

N. expansion a result of a cross-border jump from Michigan



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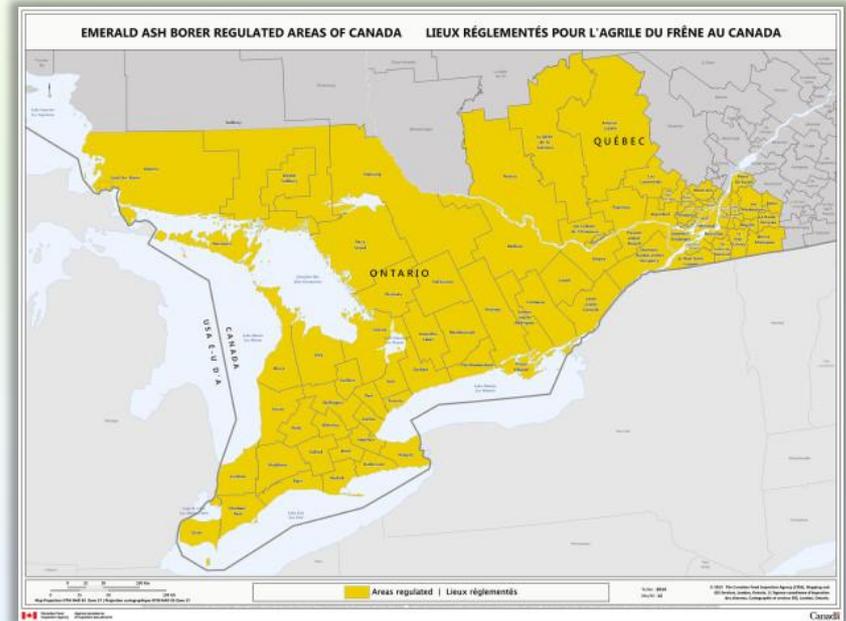
Range expansion in Canada

By 2015 range has expanded to Ottawa & parts of Montreal (850 Km)

Distribution is patchy and non-continuous
regulated area != infested area

Indicative of medium-distance transport of wood

Also indicator of change in survey method by CFIA



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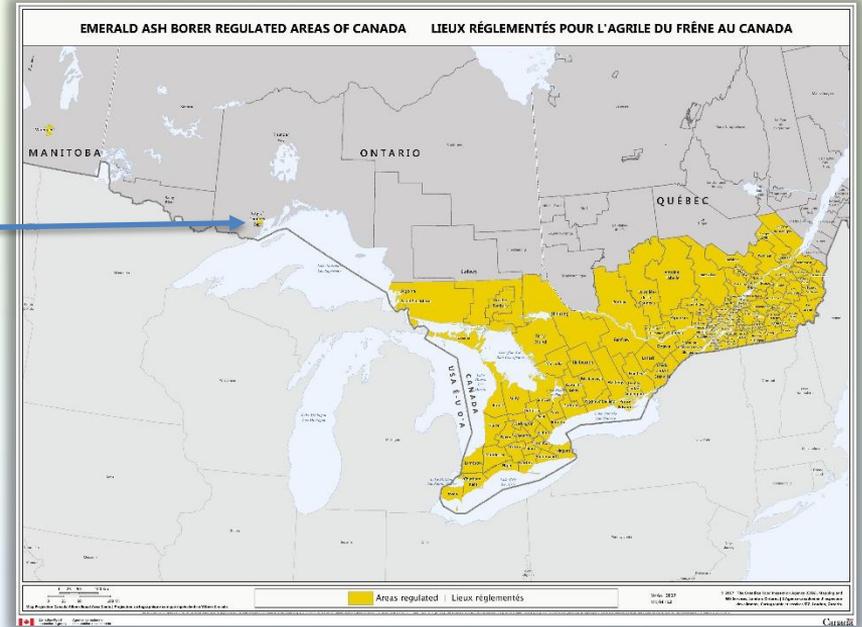
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Range expansion in Canada

2016 brings significant range expansion

2016 – Thunder Bay



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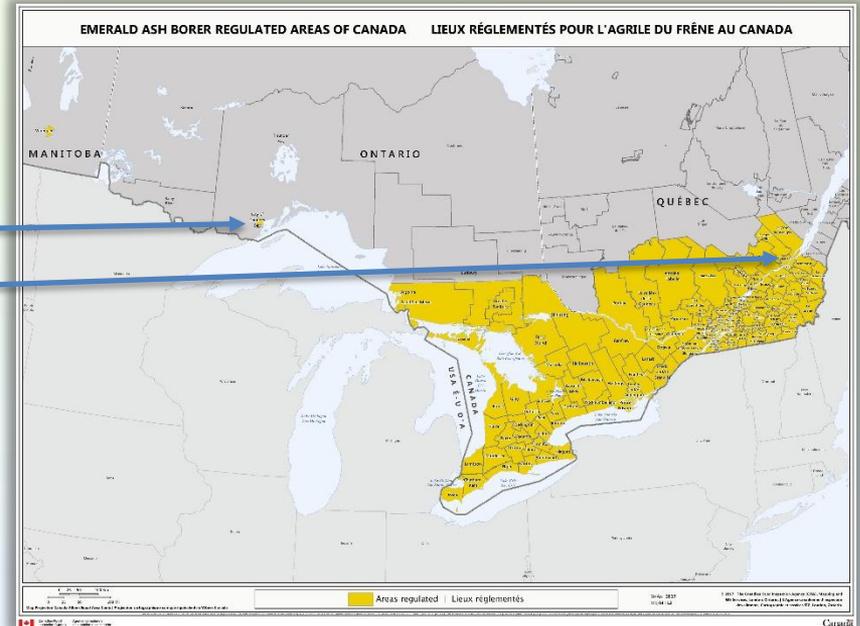
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Range expansion in Canada

2016 brings significant range expansion

2016 – Thunder Bay

2017 (summer) – Quebec City



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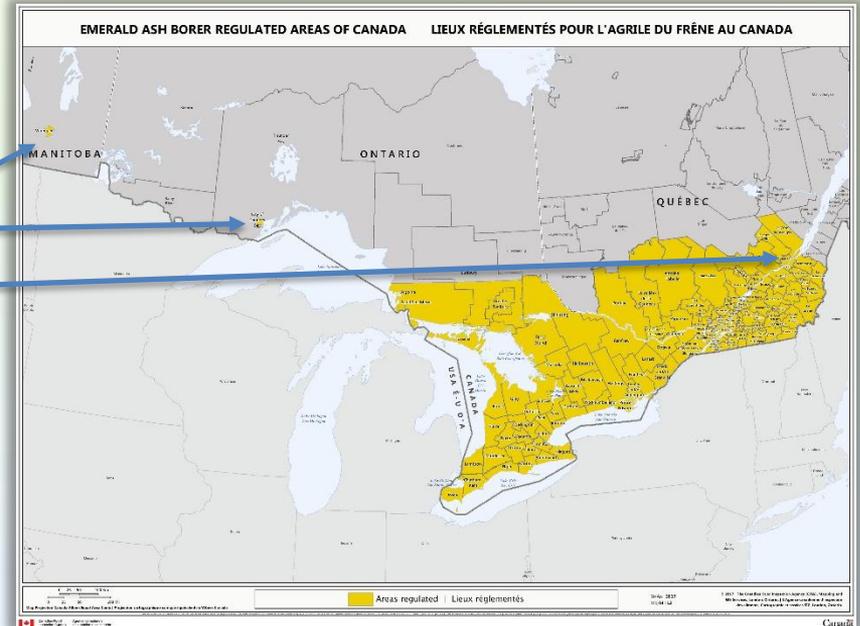
Range expansion in Canada

2016 brings significant range expansion

2016 – Thunder Bay

2017 (summer) – Quebec City

2017 (winter) – Winnipeg



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Range expansion in Canada

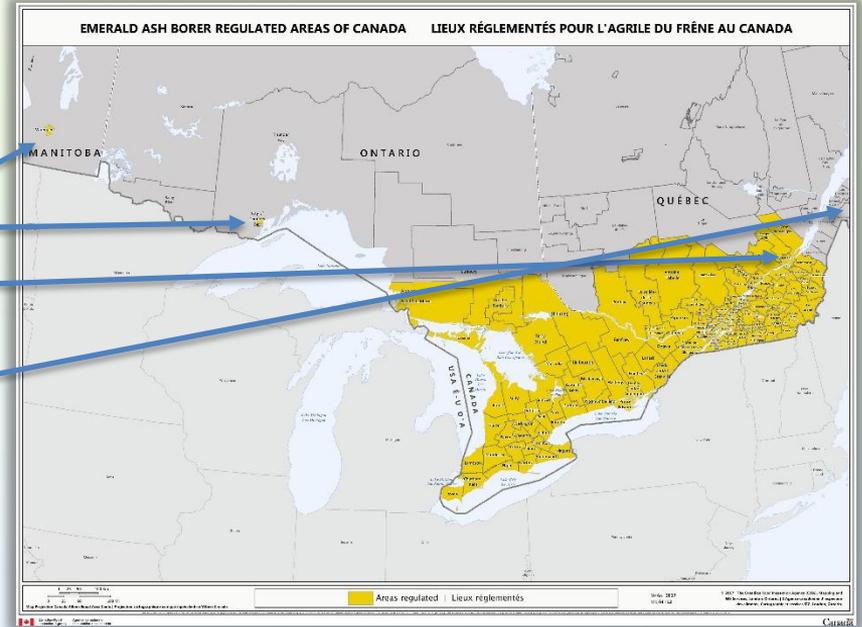
2016 brings significant range expansion

2016 – Thunder Bay

2017 (summer) – Quebec City

2017 (winter) – Winnipeg

2018 (summer) – New Brunswick



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Range expansion in Canada

2016 brings significant range expansion

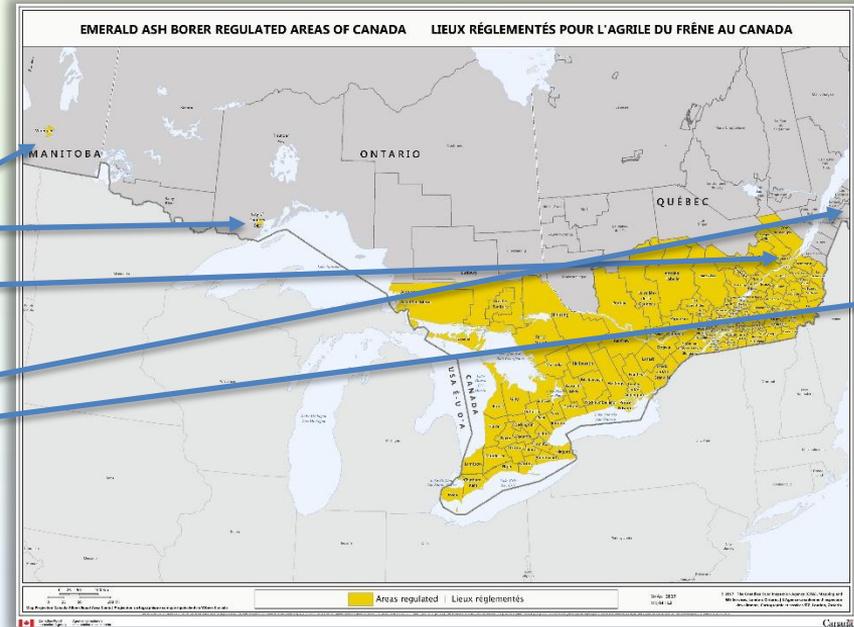
2016 – Thunder Bay

2017 (summer) – Quebec City

2017 (winter) – Winnipeg

2018 (summer) – New Brunswick

2018 (fall) – Nova Scotia



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Range expansion in Canada

Low human population density

Low ash density and non-contiguous distribution

Climate and weather limiting population growth & expansion



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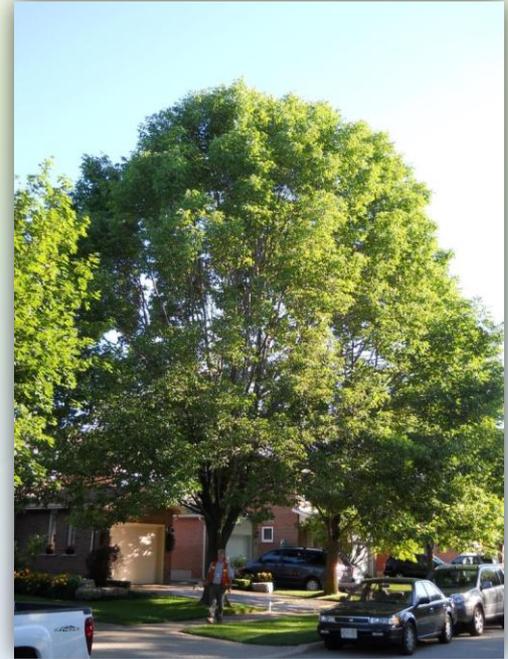
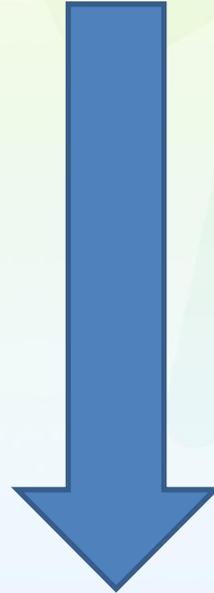
Population dynamics

EAB infestations begin in the tops of trees

Progress downwards over time girdling and killing the tree

What mortality factors influence populations?

top down



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Population dynamics

Selected & felled infested trees

ID'd crown and trunk sections

Immediately peeled 50%

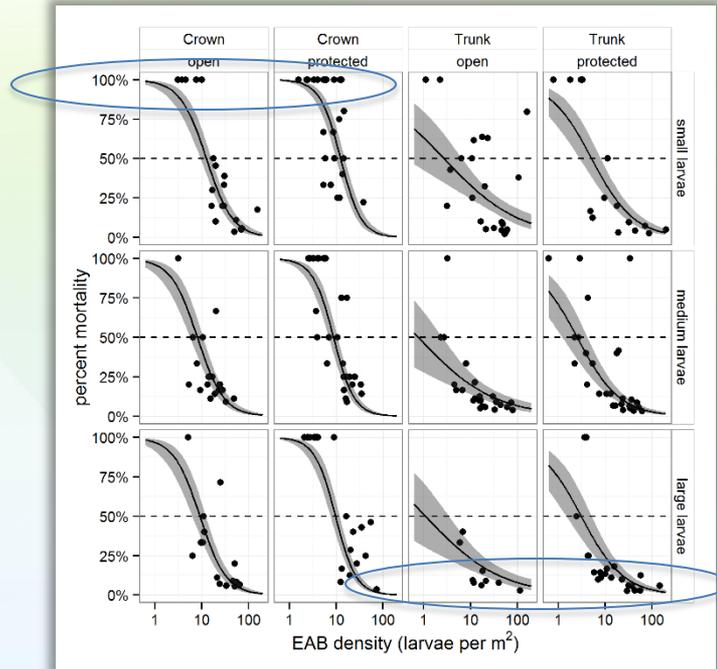
Reared the other 50% until next sampling, then peeled

Counted #, size and fate of all insects.



Population dynamics

At low density
most EAB are dead



At high density
most EAB are alive

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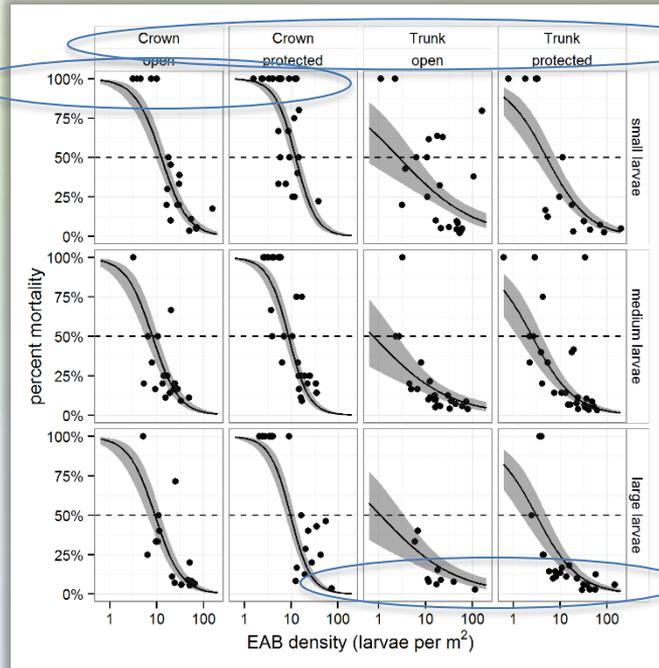
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Population dynamics

At low density
most EAB are dead



External mortality factors do
not play a large role

Differences among
size (age) of larvae:
younger do worse

At high density
most EAB are alive

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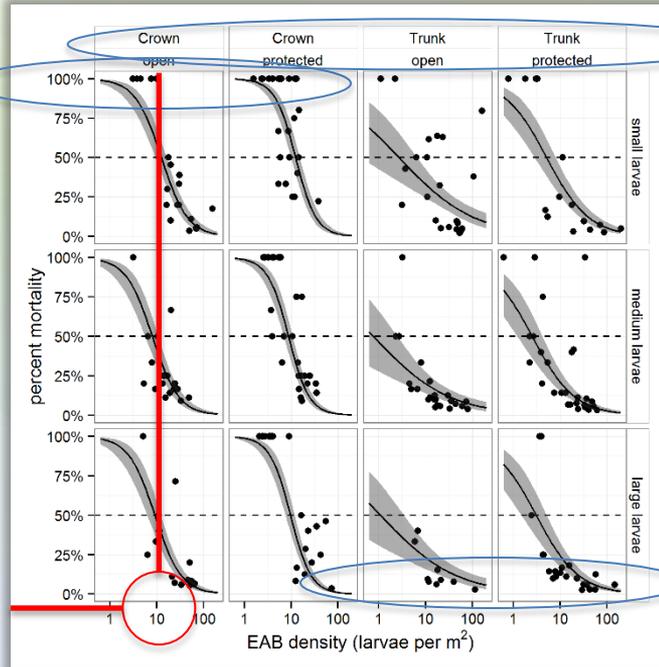
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Population dynamics

At low density
most EAB are dead

External mortality factors do
not play a large role



Differences among
size (age) of larvae:
younger do worse

At high density
most EAB are alive

<50% mortality above 10
EAB/m²: critical density

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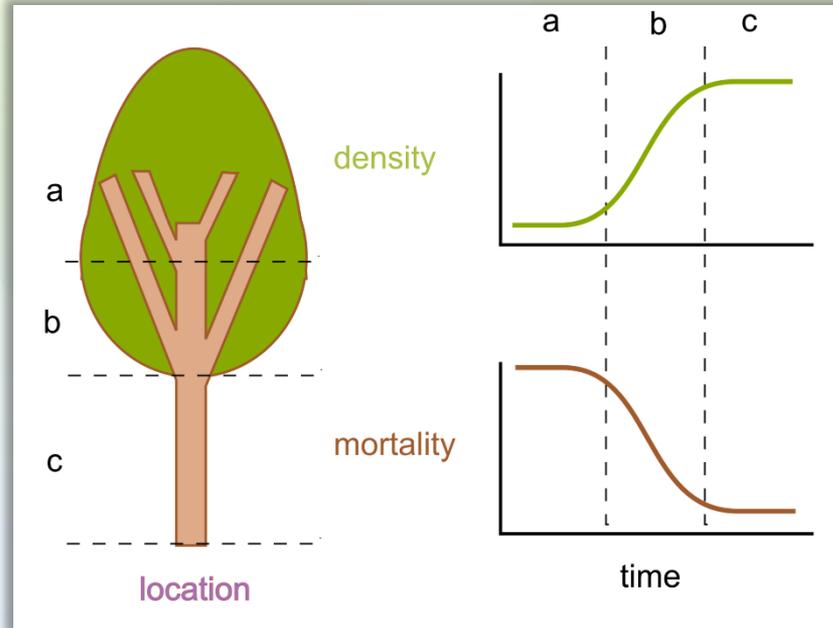
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Population dynamics

Small, incipient populations in the crown experience high mortality. As populations grow & move downwards mortality decreases & tree mortality accelerates.



So what keeps populations small?

Host resistance?
Climate?
Both?

Population dynamics – host resistance

Recent evidence shows ash trees can resist
EAB larval feeding

These responses can be triggered in naïve,
North American ash

Does tree condition impact performance of
adults?



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Population dynamics – host resistance

Reared adults from infested trees

Created mating pairs & infested healthy & girdled trees

Cut infested trees & reared adults from caged & uncaged section

Assessed emergence & adult performance.



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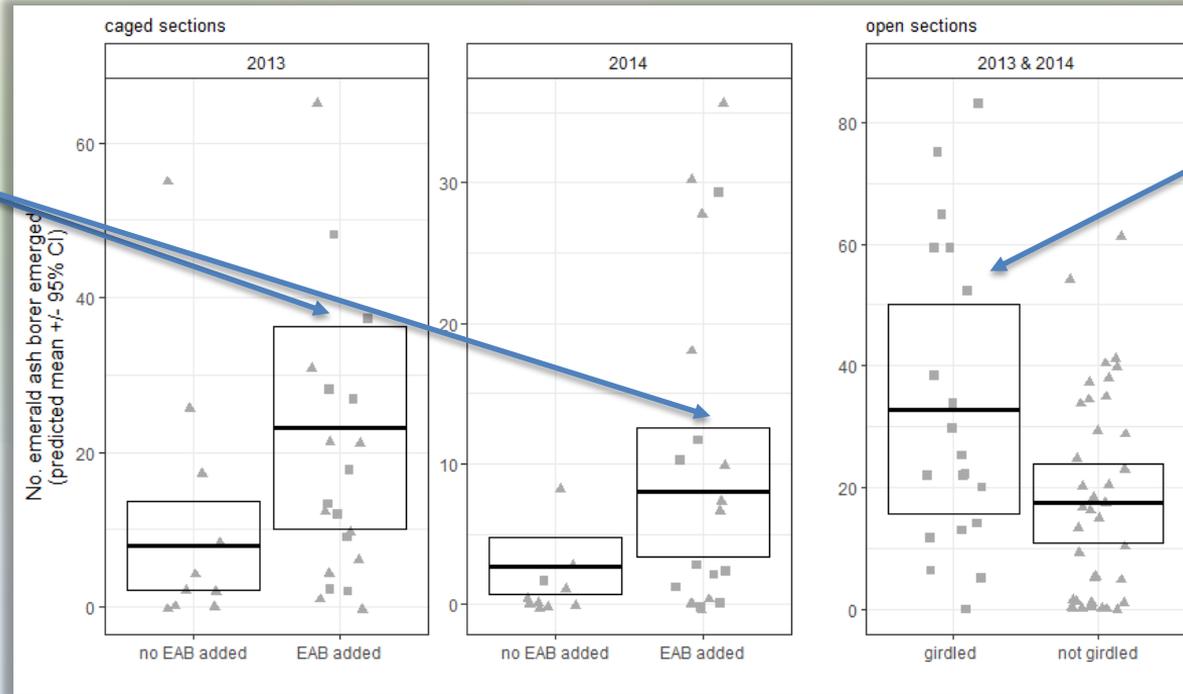
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Population dynamics – host resistance

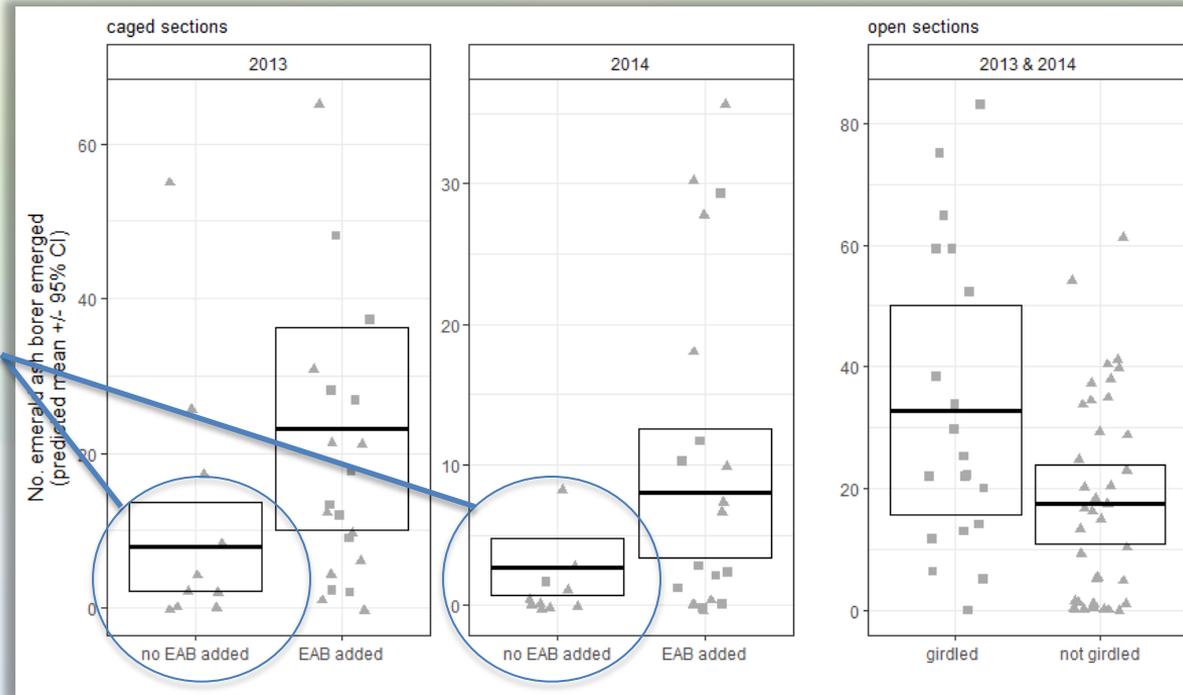
No effect of girdling in caged sections of trees where we added beetles



More EAB from girdled trees colonized by wild EAB

Population dynamics – host resistance

Some emergence from caged sections where beetles not added (controls). Probably 2 year life cycle individuals



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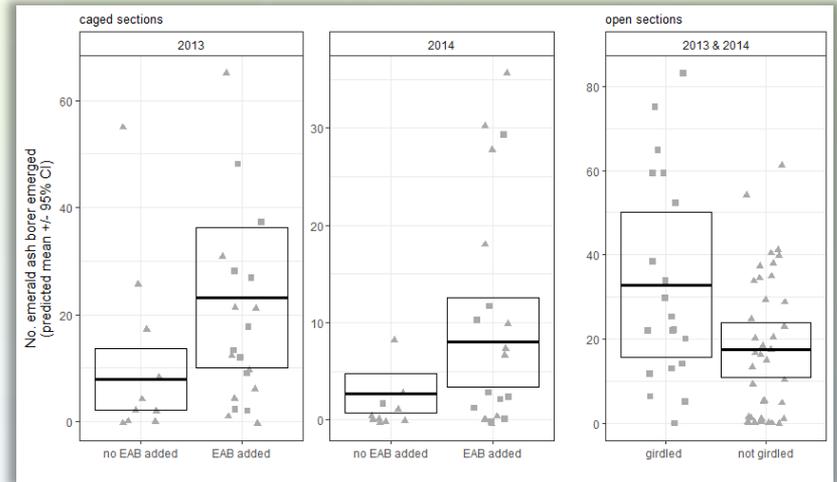
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Population dynamics – host resistance

Interpretation:

Greater emergence from unhealthy trees a function of female choice (e.g., attraction), not increased performance of individual larvae on stressed trees.

No effects on timing of emergence, adult lifespan or fecundity in offspring of individuals in caged sections...



Population dynamics – host resistance

Synergistic
effect of tree
condition on
size:



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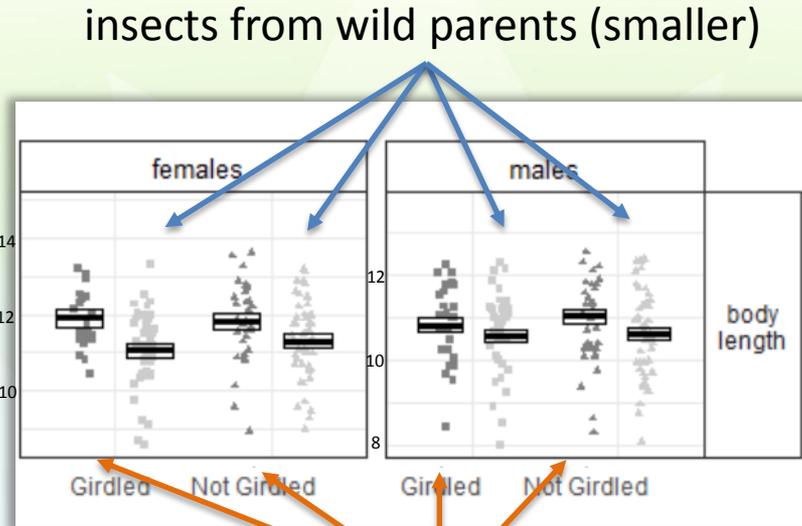
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Population dynamics – host resistance

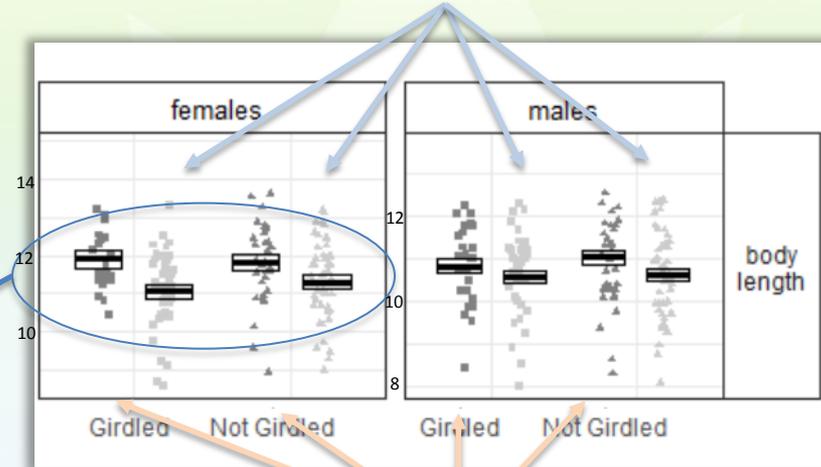
Synergistic effect of tree condition on size:



insects from caged parents (larger)

Population dynamics – host resistance

insects from wild parents (smaller)



Synergistic effect of tree condition on size:

Differences are larger in girdled (unhealthy) trees

insects from caged parents (larger)

Population dynamics – host resistance

Interpretation:

Smaller EAB the result of increased larval competition, not change in host condition.

Suggests that host condition (in early stage infestations) does not influence population dynamics of the adult stage.



Population dynamics - climate

Does frequency of 2 year life cycle vary with latitude in Canada?

Obtained samples from 7 sites (yellow completed, red ongoing) over 7.5 ° latitude

Dissected & determined age.



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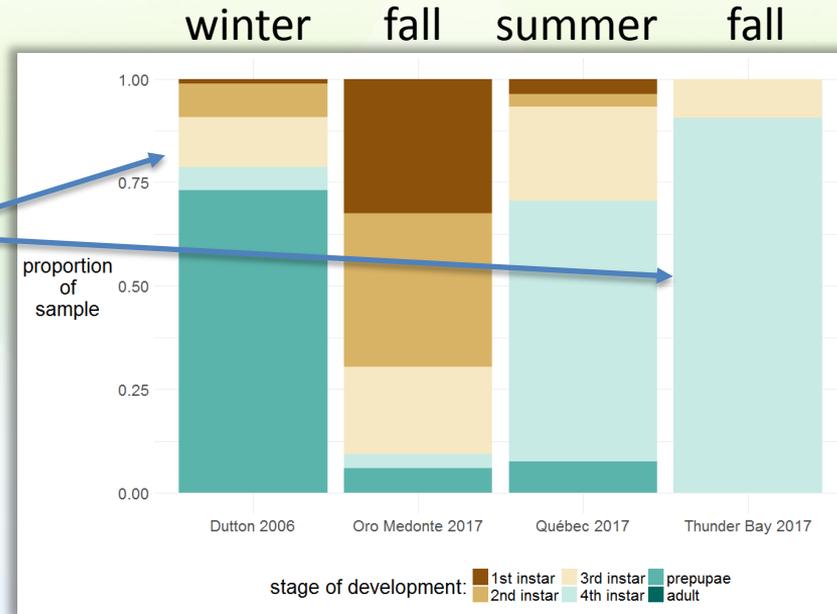
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Population dynamics - climate

Frequency of 2 year life cycle varies from 25% to >95 %



Time of year samples taken

No clear pattern with latitude (yet!)

Increasing latitude

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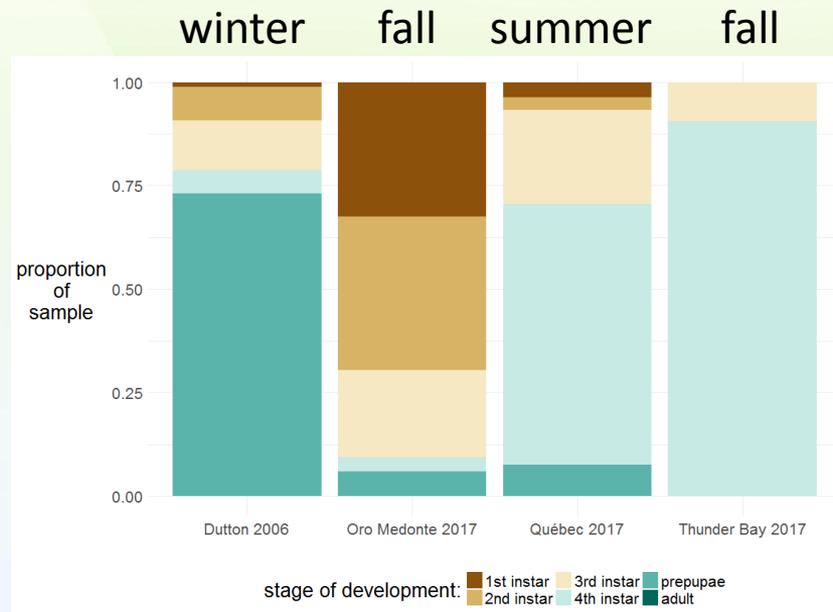
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Population dynamics - climate

Results suggest 2 year dynamics important in Canada for predicting range expansion, growth rates & for timing of management tactics.

Standing question for Canada and for at-risk range in Europe

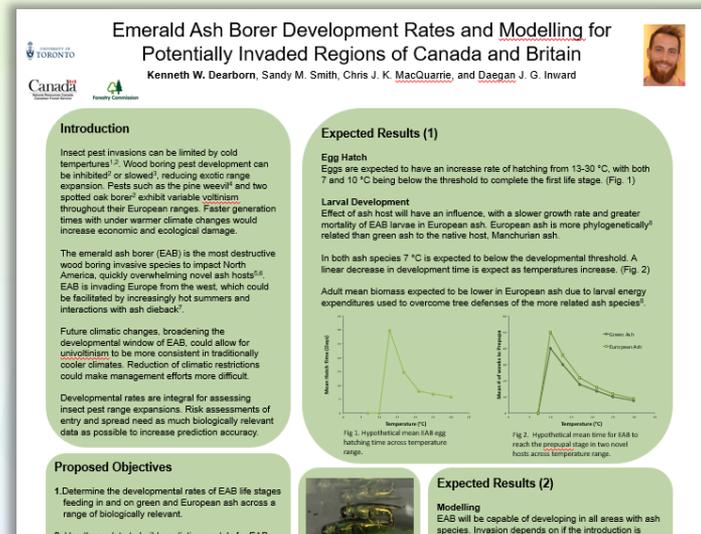


Population dynamics - climate

Next steps:

1) Developing stage specific growth rates for North American and European hosts (see Ken's poster!)

2) Testing evolution of cold-hardiness in Canada since introduction (w/ Brent Sinclair Western Univ.)



Key messages

1. Range expansion in Canada slower than in US.
2. Population dynamics influenced by stage of infestation.
3. Frequency of 2-year lifecycle varies across landscape.

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