Update on biological control of introduced *Phragmites australis* in Ontario

UNIVERSITY OF TORONTO

Agriculture and Agri-Food Canada

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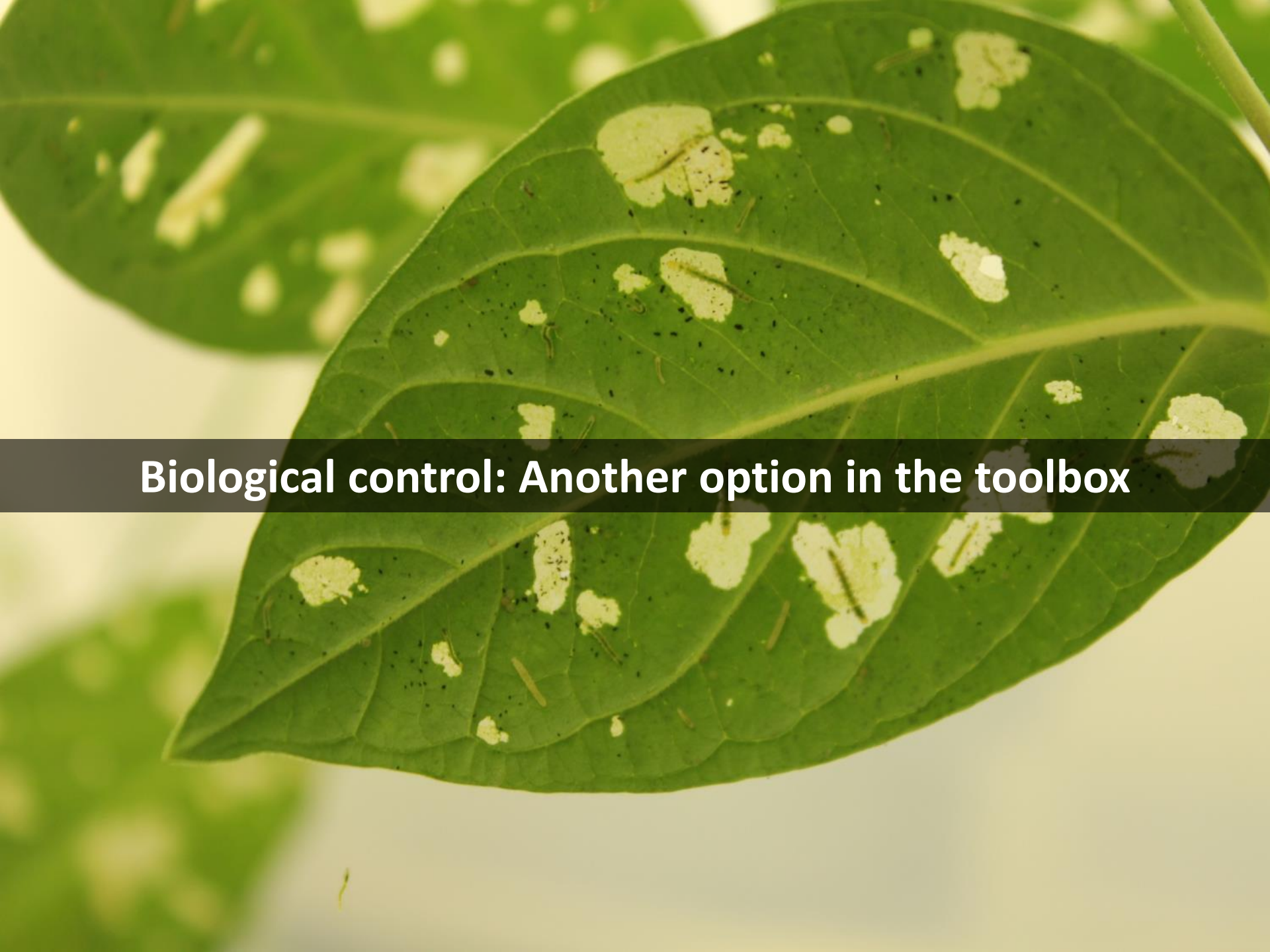
OIPC & OPWG Invasive Plant Conference 2020


Biological control: Another option in the toolbox

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Biological Control (Biocontrol):

The use of live organisms (insects) to suppress an introduced pest (weed).

Rationale?

- Weeds introduced with fewer natural predators → biocontrol reunites weed + predators.
- Self-sustaining (insects reproduce and track the host).
- Cost-effective at large scale.
- Host-specific → low environmental impact.

Biological control: Another option in the toolbox

Biocontrol is often turned to as an option of last resort…

Do Nothing

Herbicide

Cultural Control

Biocontrol

All options need to be weighed on the basis of impact and risk to **target** AND **non-target species**.

Biological control: Another option in the toolbox

Biocontrol is often turned to as an option of last resort…

INTEGRATED PEST MANAGEMENT

Do Nothing

Herbicide

Cultural Control

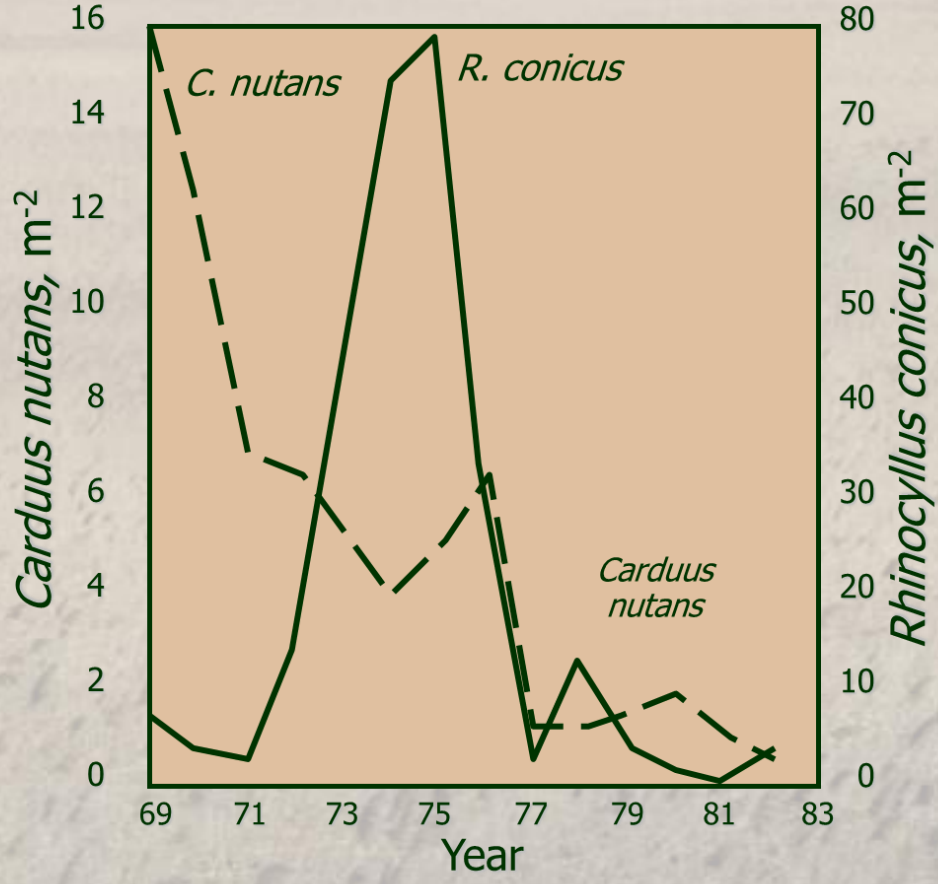
Biocontrol

Provides an additional option in the **Integrated Pest Management (IPM)** toolbox.

Biological control: Another option in the toolbox

Realistic goal is **NOT** complete eradication, but added pressure that will decrease weed populations over time (**long-term solution**).

Nodding thistle



Seedhead Weevil

Harris (1984)

Biological control of introduced *P. australis*

Biological control of introduced *P. australis*

Biological control of introduced *P. australis* in North America has been in development for over 20 years.

Initial explorations identified 175 species of **European natural enemies**…

Biological control of introduced *P. australis*

Candidates narrowed down to two **stem-boring noctuid moths**:

(Formerly *A. geminipuncta*)

Both are natural reed bed pests of *P. australis* in its native range.

Biological control of introduced *P. australis*

Basic life history and impact of *A. neurica* & *L. geminipuncta*:

- Eggs overwinter under leaf sheaths.
- Larvae emerge to mine shoots in spring/early summer.
- Pupae develop in stems.





- Attack rates > 50 % of stems common.
- Stems wilt above attack, height can be reduced by 50-60 %.

Biological control of introduced *P. australis*

A key step in implementing biocontrol is **host range testing**.

- **46 species** tested (native North American, introduced, economically significant, threatened & endangered).

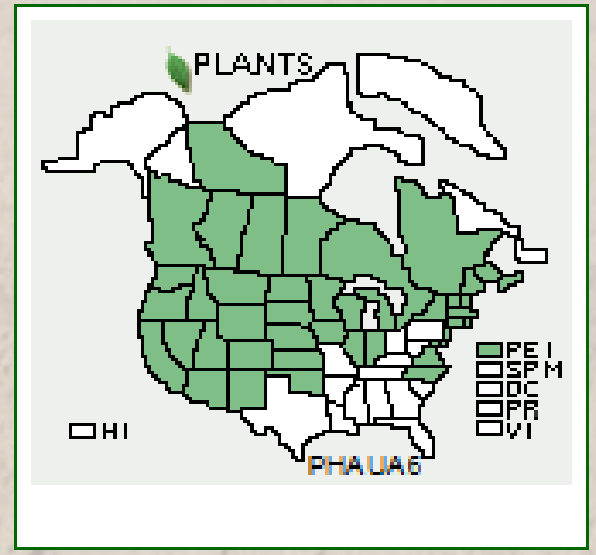
Extensive testing including lab and field, no-choice vs. choice, assessing feeding, survival, and oviposition.

Blossey et al. (2018)

Biological control of introduced *P. australis*

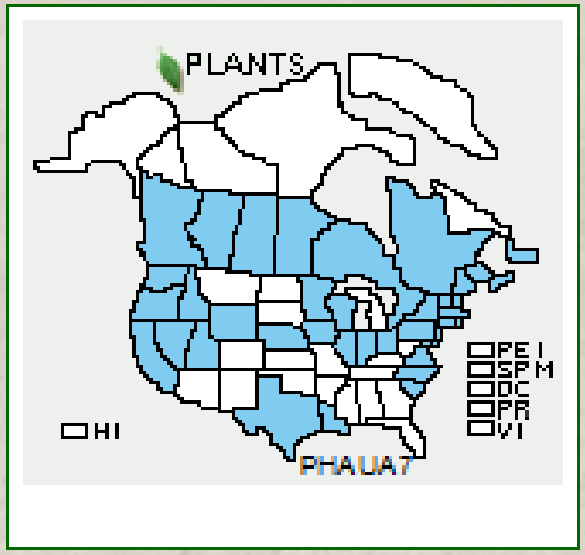
An added complication is the **complex phylogenetics** of *P. australis* and the conservation value of **native *Phragmites***.

Native



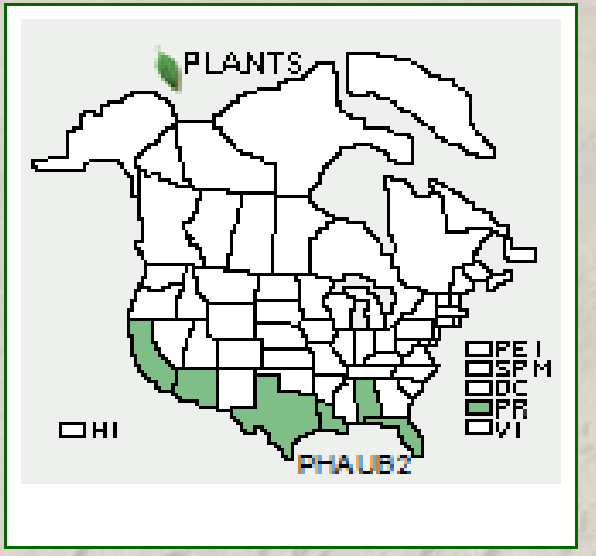
P. australis americanus

Introduced



P. australis australis

Gulf Coast (???)



P. australis bearlandieri

Native *P. australis* already threatened by **competition** and **hybridization** → test for **subspecies specificity** of biocontrol.

USDA Plants

Biological control of introduced *P. australis*

SUMMARY of host range testing:

Both insects highly specific to *Phragmites* genus.

- Require minimum diameter stems (≥ 5 mm) to develop in.
- Eggs must overwinter under leaf sheaths.

Strong preference for introduced lineage.

- Few eggs laid on native in open field choice (6.5 %).
- Egg/larval mortality high on native (drops leaf sheaths in fall/winter).
- Native stems typically smaller diameter.

Biological control of introduced *P. australis*

Program Status:

- **Biocontrol agent selection** – COMPLETE
- **Host range testing** – COMPLETE

A PETITION FOR OPEN–FIELD RELEASES OF *ARCHANARA GEMINIPUNCTA* AND *ARCHANARA NEURICA*, POTENTIAL BIOLOGICAL CONTROL AGENTS OF INVASIVE *PHRAGMITES AUSTRALIS* IN NORTH AMERICA

Submitted by

Bernd Blossey[1], Richard Casagrande[2], Lisa Tewksbury[2],
Hariet Hinz[3], Patrick Häfliger[3], Andrea Dávalos[4] and Rob Bourchier[4]

20 November 2018

- **Canada-USA release petition** – submitted November 2018
  - APPROVED in Canada by Canadian Food Inspection Agency (CFIA) April 2019. PENDING in USA.

Current projects

Current projects: Research goals

Current projects guided by two **broad research goals**:

(1) **Assess the distribution, impacts, and interactions of different *P. australis* lineages (native, introduced, hybrid) in southern Ontario.**

(2) **Implement early stages of a biological control program for *P. australis* in southern Ontario.**

Current projects: (1) Assess Ontario *P. australis*

1a. Survey southern Ontario *P. australis* populations

- Find and describe different lineages and sublineages.
- Other surveys exist, but need to account for **regional variation**.
- Particular interest in potential native × introduced **hybrids**.
- Identify candidate experimental/release/**nurse sites**.

Current projects: (1) Assess Ontario *P. australis*

Hybrid *P. australis*

- Initially thought rare, more putative examples being found in Las Vegas, New York, Virginia, etc.

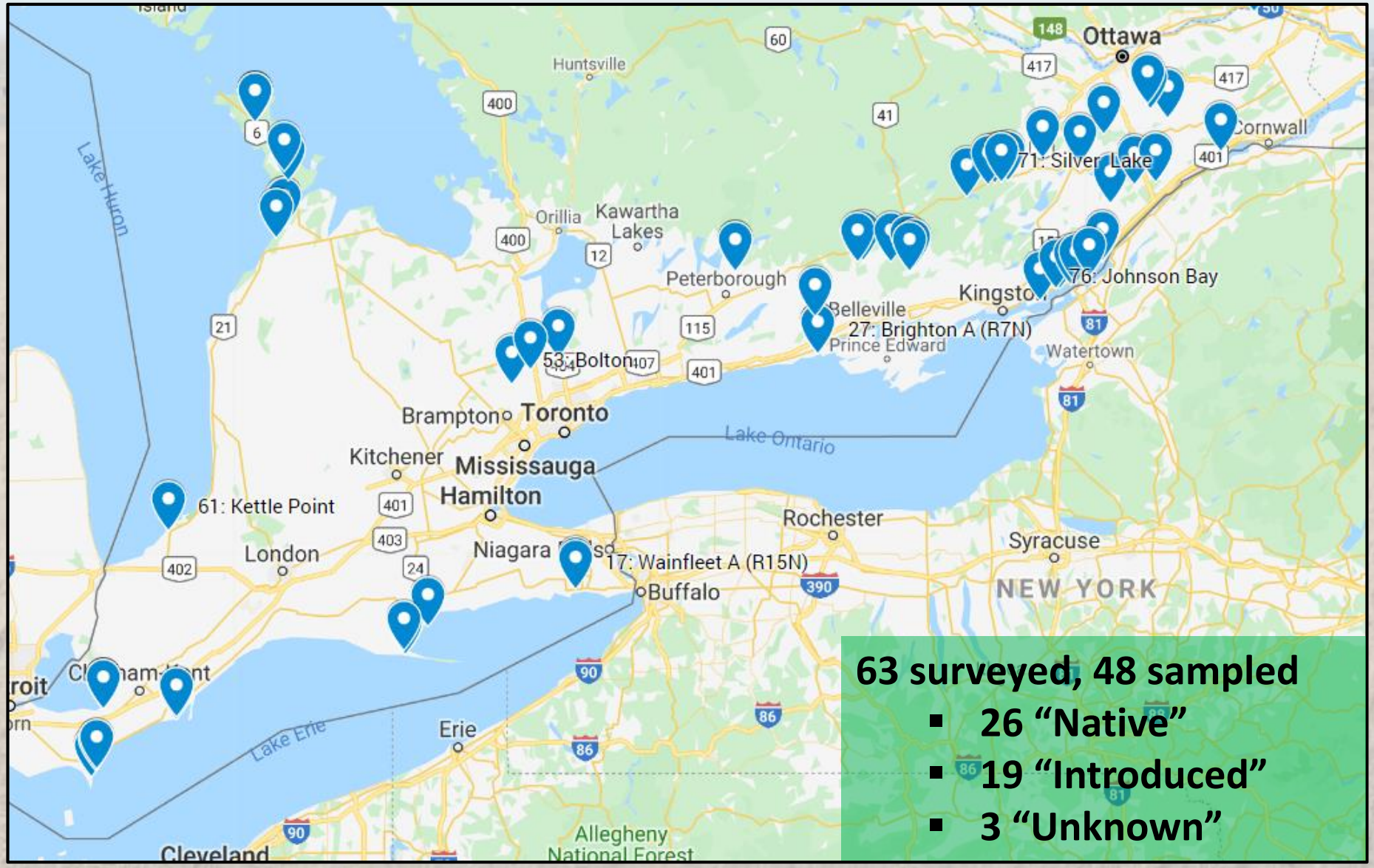
- Conservation threat to native lineage.

- Intermediate morphology may complicate **identification** or **susceptibility to biocontrol**.

Paul et al. (2010); Saltonstall et al. (2014, 2016); Wu et al. (2015)

Current projects: (1) Assess Ontario *P. australis*

Late summer/early fall 2019 preliminary survey (COMPLETE):



Current projects: (1) Assess Ontario *P. australis*

Late summer/early fall 2019 preliminary survey (COMPLETE):

- Mapped populations, measuring 20+ patch and stem properties.
- Genetic determination in progress (Dr. Tyler Smith, AAFC).

Current projects: (1) Assess Ontario *P. australis*

1b. Experimental interactions between *P. australis* lineages.

- Many impacts of *P. australis* not in dispute, but often **anecdotal**.
- Particular interest in assumed **competition** between native/introduced/hybrid populations.

Current projects: (1) Assess Ontario *P. australis*

1b. Experimental interactions between *P. australis* lineages.

Detailed monitoring of unusual & intermixed stands
(Spring 2020-Fall 2021)

Common garden/greenhouse competition experiments
(Spring 2020-Fall 2021)

Current projects: (2) Implement biocontrol

2a. Develop and scale up rearing protocols for biocontrol agents.

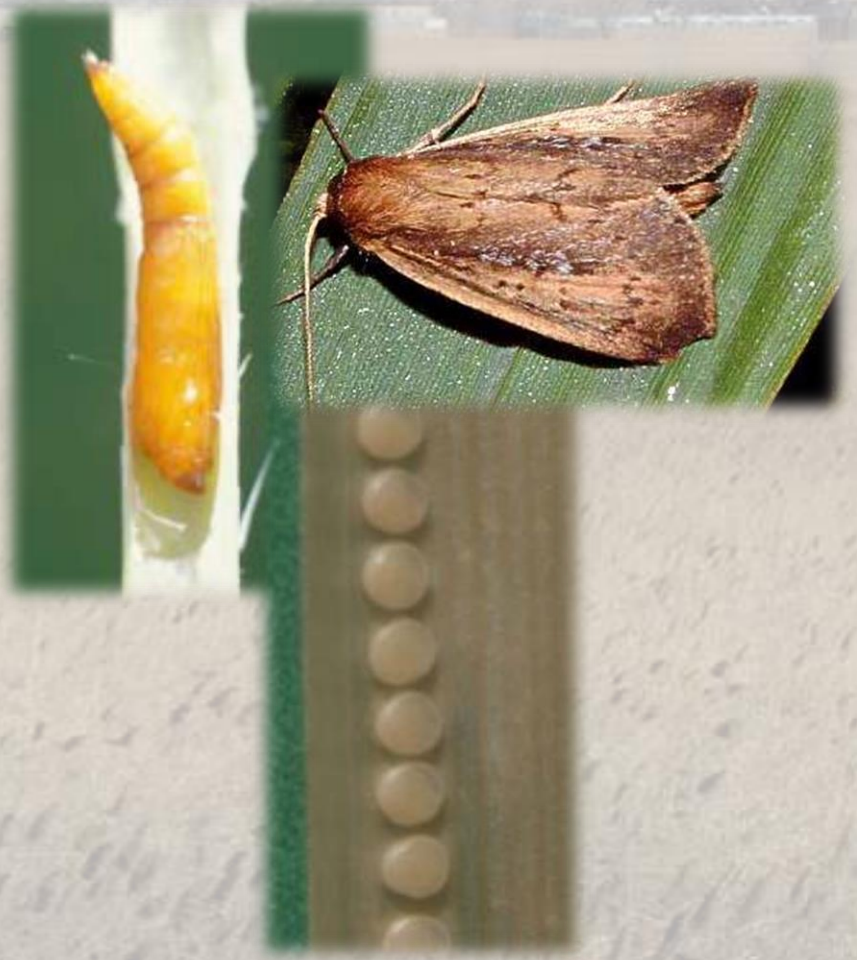
- Larger releases require protocols for **rearing** on artificial diet and **egg/pupal storage**.
- Artificial diet already for *A. neurica*, development for *L. geminipuncta* (Winter 2021).
- Storage protocol for *A. neurica* (egg, pupae) overwintering (Fall 2020-Spring 2022).

Current projects: (2) Implement biocontrol

2b. Develop and test agent release methods and establish nurse sites.

- **Release methods** (e.g., caged pupae vs. caged adults vs. eggs) that maximize **establishment** and **overwintering success**.

- **Pilot releases** with *A. neurica* (Spring 2020, Spring 2021).



Current projects: (2) Implement biocontrol

2b. Develop and test agent release methods and establish nurse sites.

- Site selection from previous surveys.
- Sites with distinct introduced and native patches in **close proximity**.

Current projects: (2) Implement biocontrol

2c. Develop and use monitoring protocols to assess agent release success and impacts.

Girdling

Wilting

- **Monitoring** essential "before, during, and after" (Blossey, 1999).
- Overwintering, characteristic feeding damage, *P. australis* impact, etc. (Spring 2020 onwards).
- Distinction between **feeding damage** and long-term **demographic impact**.

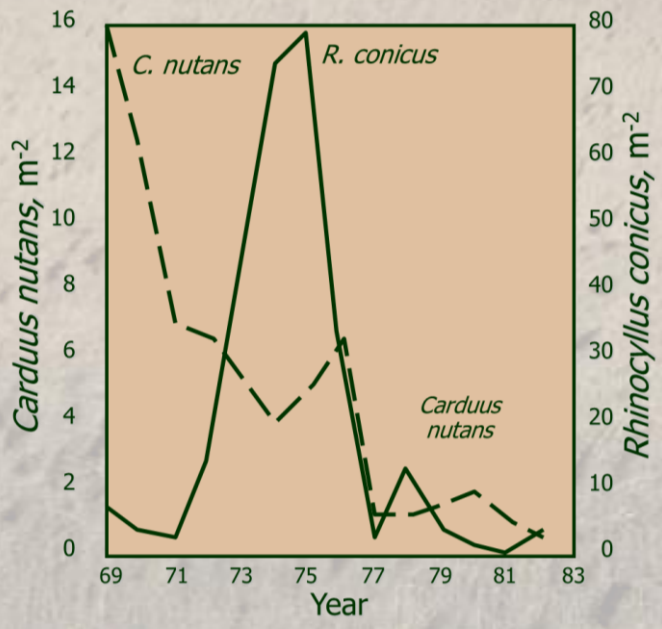
Summary & next steps

Summary

Reminders about biocontrol:

- **Long-term** solution for a **large-scale** problem.
- Objective is NOT immediate or complete eradication.
- Assessment of risks includes costs of other management or no action.
- Not a panacea, but an additional option in the **IPM toolbox**.

E.g., Purple loosestrife biocontrol (1980s-Present)



Summary

What has been done so far:

- Biocontrol agent selection.
- Host range testing.
- Preliminary rearing protocols.
- Canadian release approved.
- Southern Ontario field surveys.

Work to date made possible by support from:

Invasive Species Centre
Ontario Ministry of Natural Resources and Forestry
Ducks Unlimited Canada Conserving Canada's Wetlands
University of Toronto
Agriculture and Agri-Food Canada
MITACS

Next steps

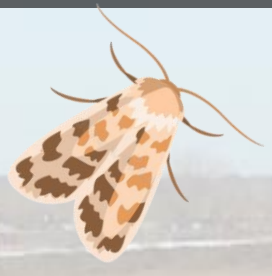
Program currently at a **research stage** → developing background data, rearing & release capacity on a pilot scale.

Continuing growth over the next several years and on (**long-term project**).

Additional support and collaborators for:

- Funding.
- “Interesting” sites (intermixed stands OR unusual morphology).
- Capacity for scaling up insect rearing, distribution, and release.

Acknowledgments



Thank you to all our collaborators and supporters.

Invasive Species Centre

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Ministry of Natural Resources and Forestry

Ducks Unlimited Canada
Conserving Canada's Wetlands

Mitacs

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