

Biocontrol of Garlic Mustard and Buckthorn, an Update

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Gassman



Where is garlic mustard a problem?



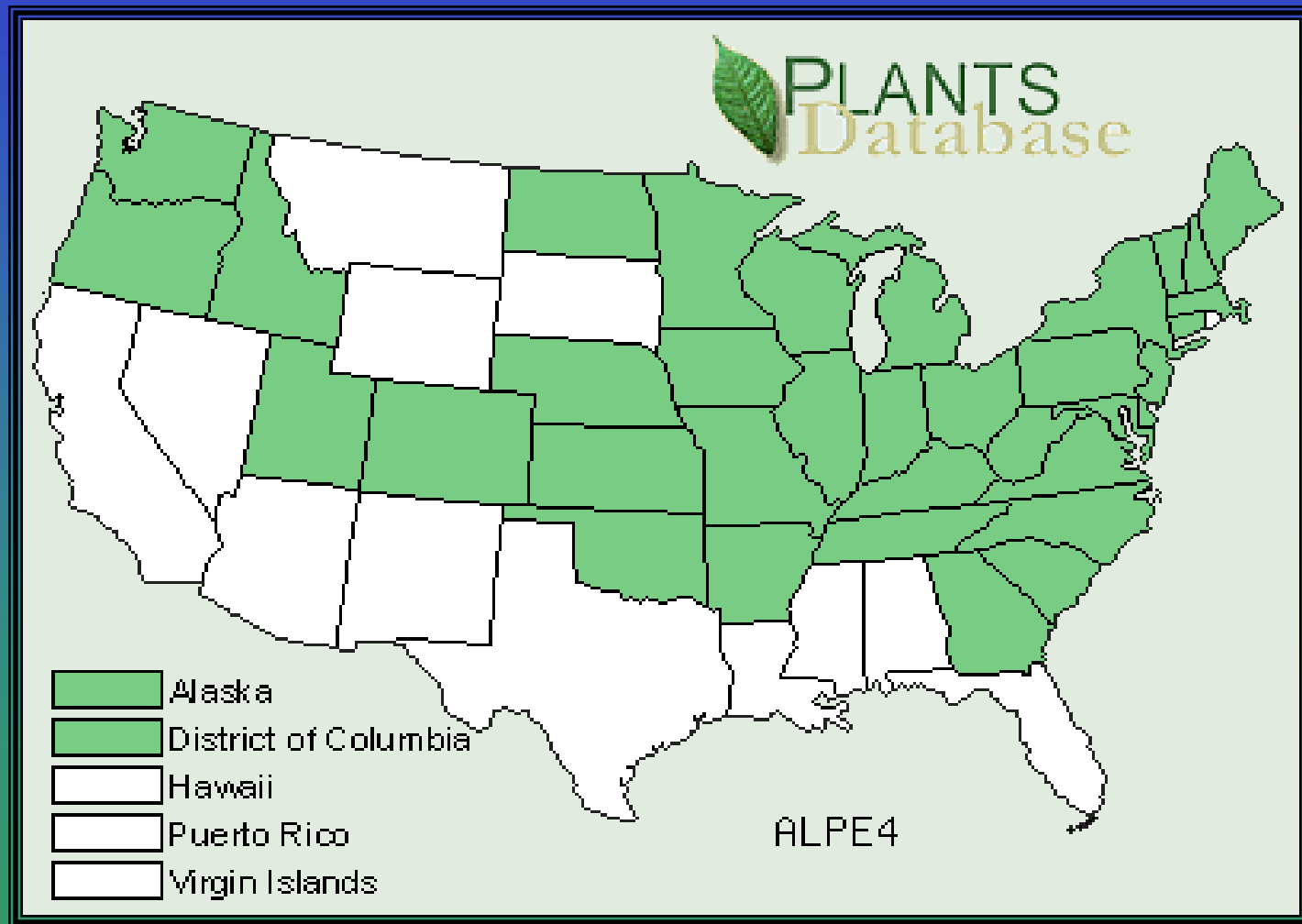
Garlic mustard
is a problem in
the forest understory
where it can crowd
out more desirable
native species





Garlic mustard is also a problem along forest edges and pathways

Garlic mustard distribution by state



Garlic mustard is a biennial plant



Becker

Garlic mustard seedlings
emerge early in the spring



Garlic mustard grows as a rosette during the first year.

In the spring of the second season, garlic mustard rosettes bolt and flower.



Garlic mustard flower



**Garlic mustard
plants form seed
capsules in early
summer**



Seeds mature by mid-July



Mature garlic mustard seeds

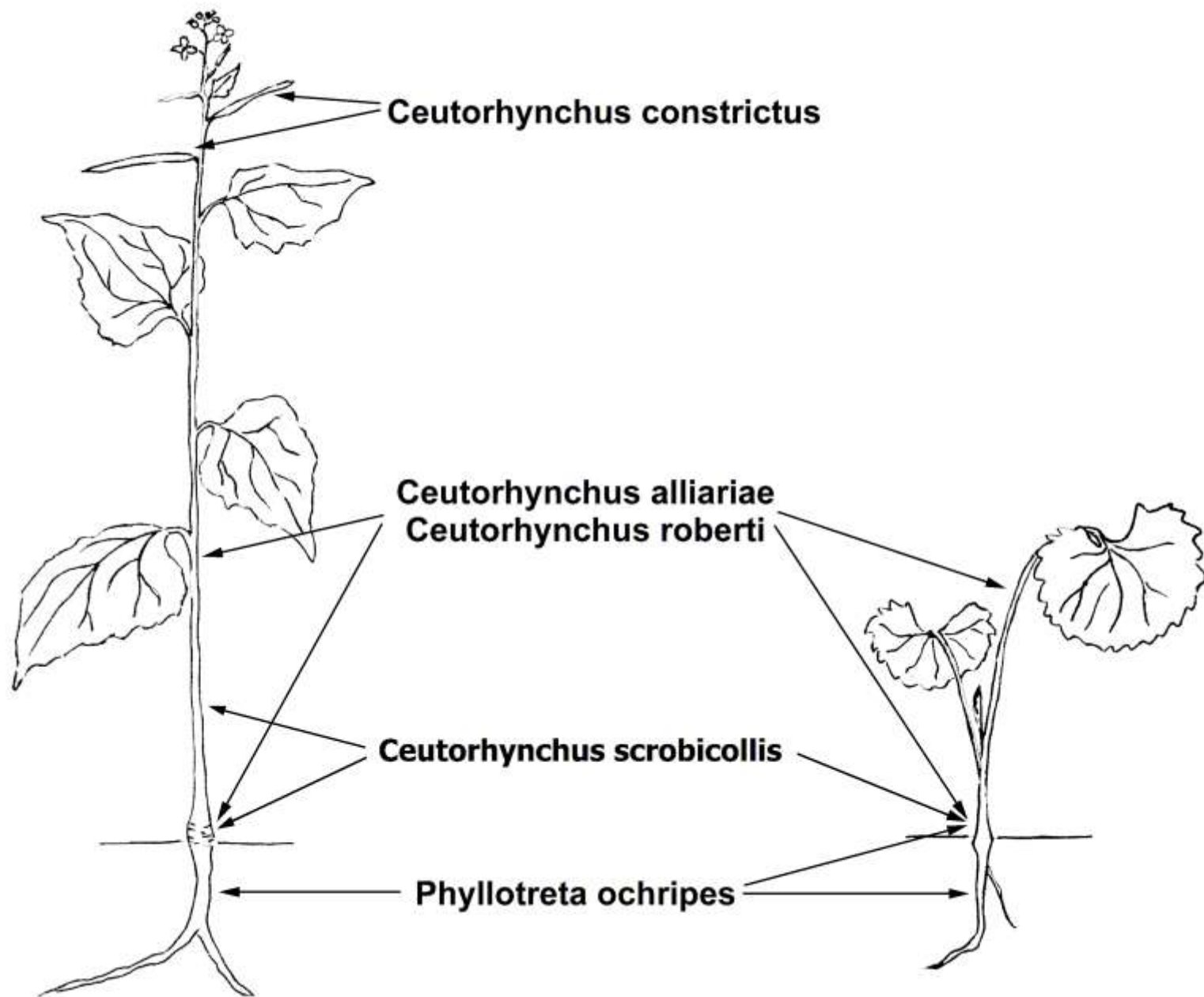


Becker

Potential Garlic Mustard Biocontrol Insects

Potential Biocontrol Insects for Garlic Mustard

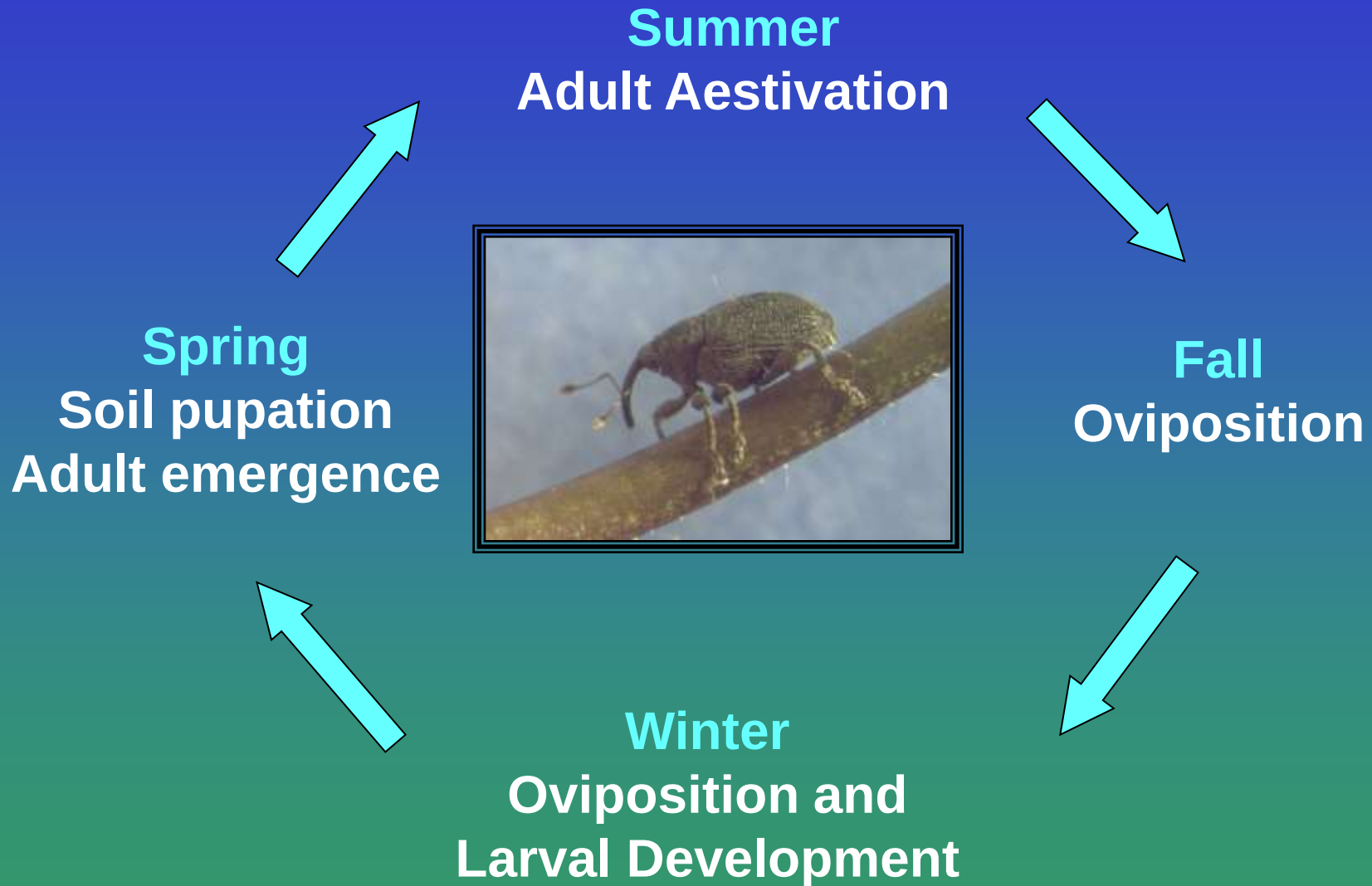
- *Ceutorhynchus scrobicollis* - crown miner
- *Ceutorhynchus roberti* – stem miner
- *Ceutorhynchus alliariae* – stem miner
- *Ceutorhynchus constrictus* – seed feeder

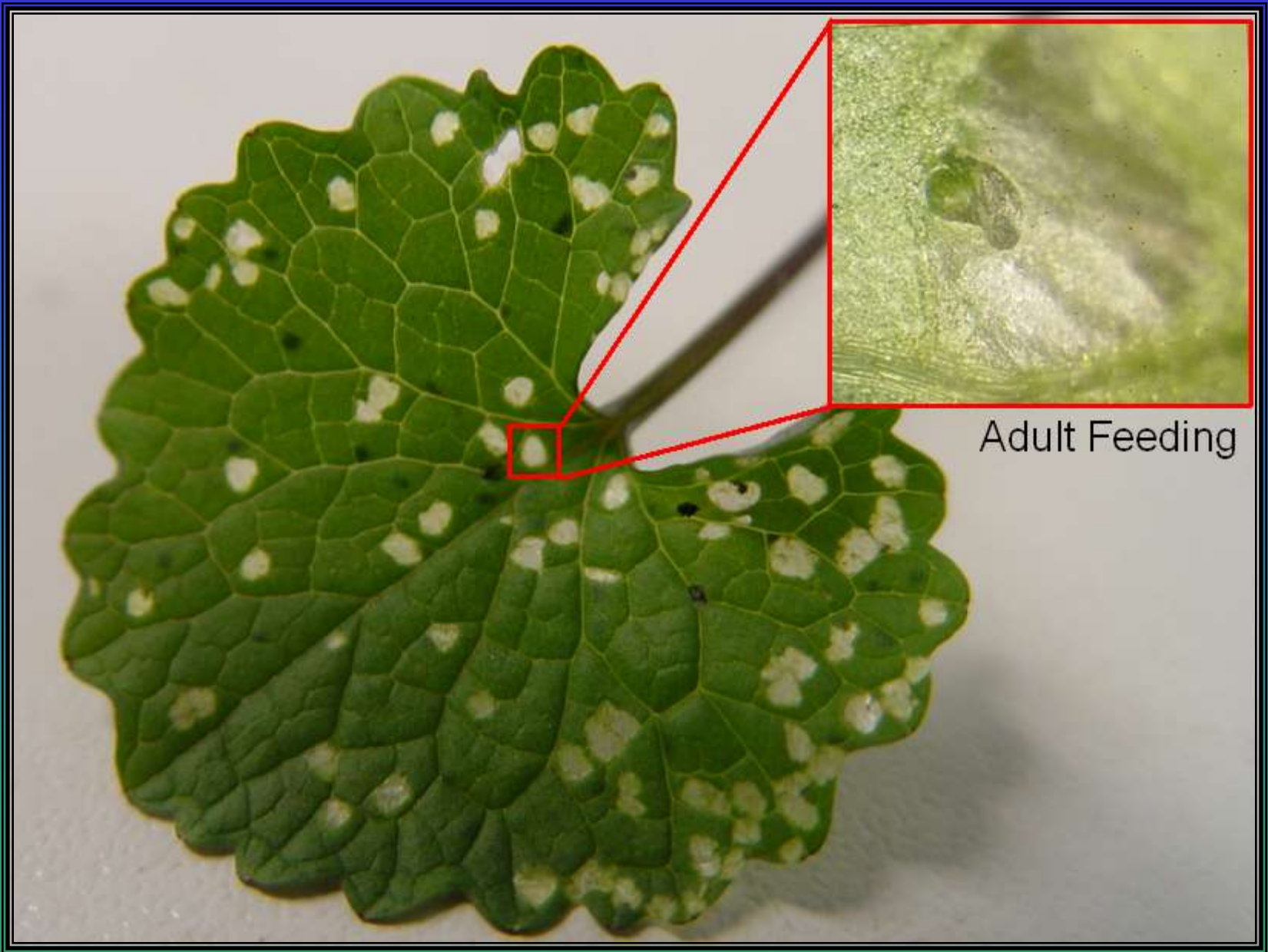


Ceutorhynchus scrobicollis



C. scrobicollis Life Cycle





Adult Feeding

Life Stages



Single egg

Frass

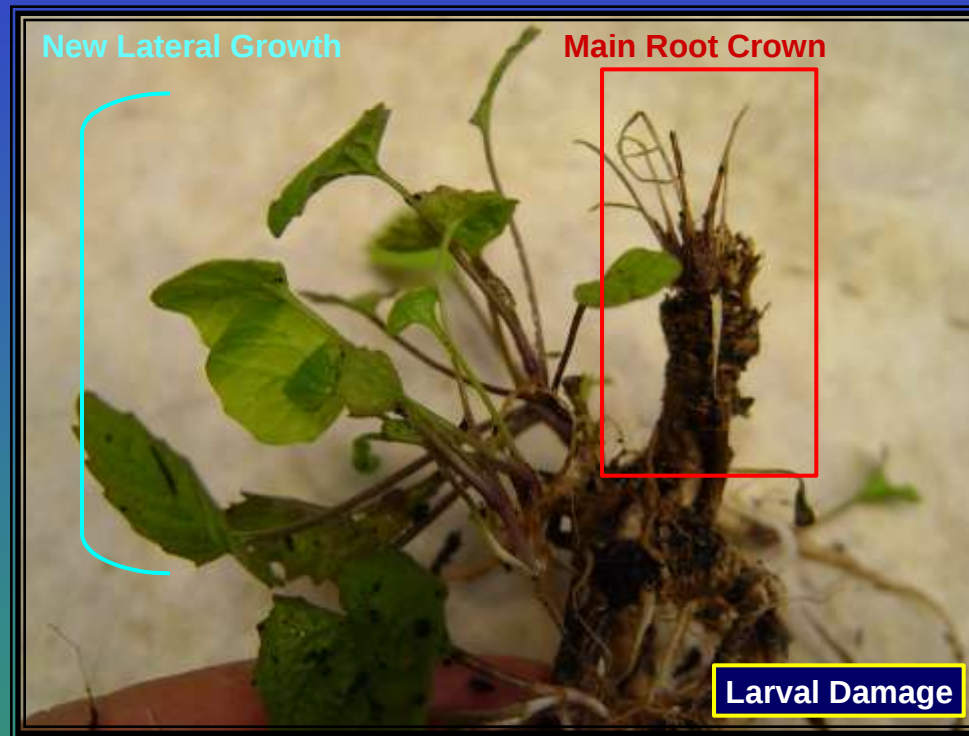


(Side View)



Larval Tunnel

- light-brown frass
- 3 instars (head capsule size)
- Exit plant to pupate



Impact of *C. scrobicollis* on garlic mustard plants

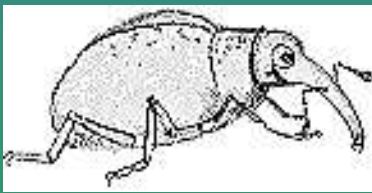
- Increased plant mortality
- Reduced above ground biomass
- Reduced seed output

Shoot Miners

C.alliariae and *C. roberti*



CABI-Bioscience



CABI-Bioscience

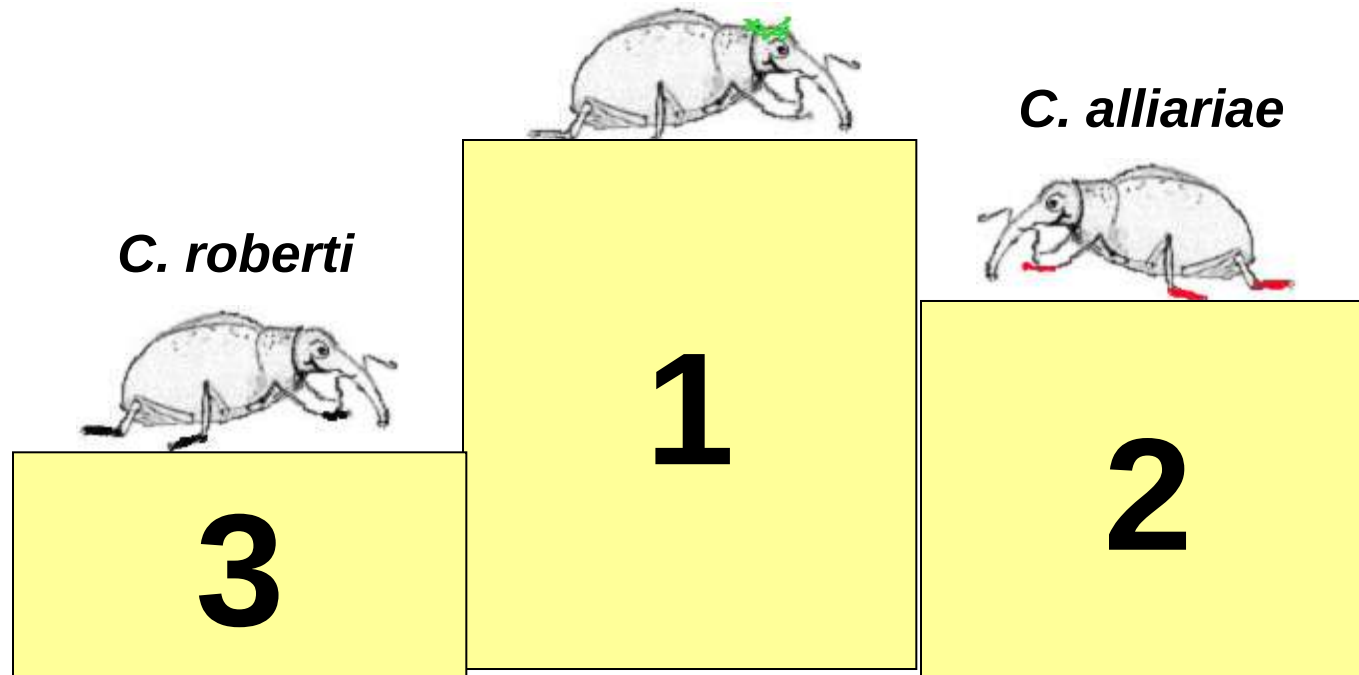
Seed feeder

Ceutorhynchus constrictus



- ♦ lays eggs from mid-May to mid-June (approx. 170 eggs/female)
- ♦ pupates in soil, emerges the following spring
- ♦ widely distributed
- ♦ seed loss in the field up to 18%

Ceutorhynchus scrobicollis



..not to forget *Ceutorhynchus constrictus*..

Host Range

Set of plant species on which a biological control insect can feed and develop (McEvoy, 1996)

The ideal biological weed control insect would only complete its life cycle on the target weed

High Security Containment Facility University of Minnesota, St. Paul, MN



Results of Host Range Testing *C. scrobicollis*

- 88 plant species included in no-choice testing
- 51 plant species included in larval development tests.

Results of Host Range Tests

C. scrobicollis

- No plant species outside of the Brassicaceae family were attacked by *C. scrobicollis*.
- Within the Brassicaceae family, many plant species were accepted for oviposition but did not support larval development.
- In larval development testing, only one native mustard species (*Rorippa sinuata*) supported the development of adults.
- When both garlic mustard and *Rorippa sinuata* were included in single choice testing, only garlic mustard was attacked. We believe that under field conditions, the risk of attack to *Rorippa sinuata* is very low.

Current Status of Host Range Testing Program

- Petition submitted to the Technical Advisory Group for Biological Control Agents of Weeds (TAG).
- At TAG reviewers' request we have included 10 additional native mustards, most native to southern California, in host range testing.
- Additional testing should be completed this winter and the TAG petition will be re-submitted.

Buckthorn

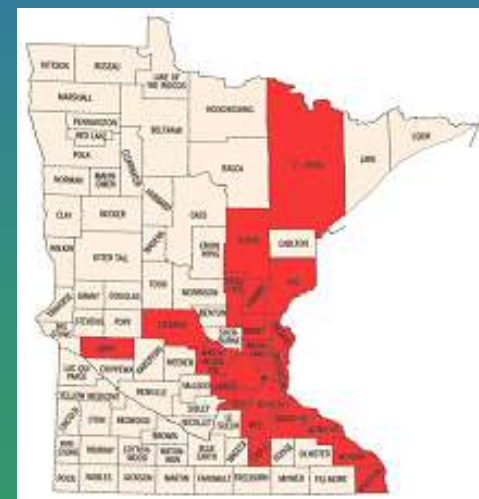
- Native to Europe
- Forms canopies in forest understory
- Impacts
 - Reduced diversity
 - Ecosystem function
 - Reduce regeneration of tree seedlings
 - Bird nesting



Common buckthorn
(*Rhamnus cathartica*)



Glossy buckthorn
(*Frangula alnus*)



(Heneghan et al. 2002; Schmidt and Whelan 1999)

Potential for Buckthorn Biocontrol

- Research initiated in 2001
 - CABI Switzerland
- Looking for biological control agents specific to *R. cathartica* and *F. alnus*
 - 7 *Rhamnus* species native to the US
 - 5 *Frangula* species native to the US
- 39 specialized arthropods were identified
- 10 were studied further
- Host-specificity testing 2003-present

5 high-priority species for further research

Species	Feeding guild	Field hosts
<i>Trichoermes walkeri</i> (Homoptera, Triozidae)	Sap-sucker/ leaf gall inducer	<i>R. cathartica</i>
<i>Cacopsylla rhamnicola</i> (Homoptera, Psyllidae)	Sap-sucker	<i>R. cathartica</i> ; occurrence on <i>F. alnus</i> needs to be confirmed
<i>Trioza rhamni</i> (Homoptera, Triozidae)	Sap-sucker / pit-gall inducer	<i>R. cathartica</i>
<i>Wachtiella krumbholzi</i> (Diptera; Cecidomyiidae)	Seed-feeder	<i>R. cathartica</i>
<i>Lasioptera kosarzewskeella</i> (Diptera ; Cecidomyiidae)	Seed-feeder	<i>R. cathartica</i>

Gassman et al. 2008 report to
LCCMR

Trichochermes walkeri

(Homoptera, Triozidae)
sap-sucker/leaf gall inducer



Photos by A. Gassmann

Phytoplasma found in *T. walkeri*

- Phytoplasma '*Candidatus* Phytoplasma rhamni' (buckthorn witches' broom) has been detected in two populations of *T. walkeri* in Switzerland.
- *T. walkeri* is the first insect host record for this phytoplasma.
- Need additional studies
- Is the phytoplasma in the US?



Photos of other witches broom/ yellows phytoplasmas
Photos from <http://en.wikipedia.org/wiki/Phytoplasma>

Cacopsylla rhamnicola

(Homoptera, Psyllidae)
sap-sucker



Photos by A. Gassmann

Gall midges



Photos by A. Gassmann

Current status of biocontrol

- Continue to perform host-specificity tests on potential biocontrol agents
- Challenges
 - Obtaining and growing native *Rhamnus* and *Frangula*
 - Need insects with specificity and high damage levels
- *Frangula alnus* (glossy buckthorn)
 - Difficulty finding host-specific insect species
 - Difficult to grow *F. alnus* at CABI
 - Work is now focused on *Rhamnus cathartica*

Current status of biocontrol

- ***Rhamnus cathartica* (common buckthorn)**
- Consultation with outside experts will direct work in 2010-2012
- Continue to assess the feasibility of using *T. walkeri*, *C. rhamnicolla*, and *W. krumbholzi* as biological control agents for *R. cathartica*.
- Study the causes of the high levels of seed and seedling mortality of *R. cathartica* observed in Europe as a step toward identifying additional potential biological control agents including pathogens.

**We would like to thank the
following for funding these
projects:**

- **USDA Forest Service**
- **Minnesota Department of Natural Resources**
- **Legislative-Citizen Commission on Minnesota Resources**

**Letters of support for garlic mustard
biocontrol project**

**Please contact Jeanie Katovich
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