English Broom

Biological control in the Alpine National Park

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Director
Workshop outline

What is biocontrol and why is English Broom a target?

History of biocontrol of English broom.

Important agents: Broom gall mite, Broom seed-feeding beetle

Identification, collection, storage and redistribution of agents

Nursery site: care and maintenance

Data collection

Weed Biological Control Portal on the Atlas of Living Australia.

Practical: gall mite and beetle harvesting and release
Presentation is available on the web

www.australisbiological.com.au
Why is English Broom a threat?

- Invades high quality native vegetation
- Displaces native vegetation
- Prevents tree regeneration (Australia)
- Reduces habitat availability - fauna
- Allelopathic
- Increases fuel biomass
- Changes soil nutrition – N
- Reduces accessibility
- public and private land
- Mitta Mitta, Big, Victoria Rivers, Middle Ck
- Many outliers
- Dense in Dandenong and Creswick areas
Private property on tributary of Big River
Host biology and ecology

• Introduced around 1800’s – long establishment period
• Widespread and intractable infestations
• Multiple introductions likely
• Declared in 1902 (Victoria)

• Large habitat, latitudinal and altitudinal range
• Ecological impacts are high
• Transformer species
• WoNS (3 species) (English, Montpellier, Flax-leaf)

• Biennial fruiting patterns
• Not all flowers produce fruits
• High level of seed rain
• Long-term persistence in seed bank (20 years)
• Hybridisation occurs – complex genetics, hybrid vigour
• Killed by fire.
• Germination stimulated by fire

• Highly susceptible to herbicides
• Seed bank
Tree lucerne, Tagasaste
Biological control

Europe
• 240 arthropods and pathogens (natural habitat)
• 70 species - relevance for biocontrol

Australia
• Very few diseases and pests

Biocontrol
• Commenced in USA (1959)
• Twig-mining moth released (1960)
• Seed weevil released (1964)

• Commenced in NZ (1981)
• Twig-mining moth accidentally introduced (1950)
• 6 species released
Biological control in Australia

- Commenced (1993)
- 4 species released
- Twig-mining moth, Seed-feeding beetle, Broom psyllid, Gall mite

Alpine National Park

- Commenced (1995)
- Currently active
- 19 years
- 94 release sites
- 150 release occasions
- Three agents established:
Twig-mining moth
*Leucoptera spartifoliella*

**Adult**
Lyonetiidae
(related species on *Alphitonia, Banksia* and *Hakea*)

cocoon

larval mine
Broom psyllid
*Arytainilla spartiophila*
Broom seed-feeding beetle
*Bruchidius villosus*
Broom gall mite *Aceria genistae*

Figure 1. *Aceria genistae* adults: female (top) and male (bottom), white arrows indicate genital region.

Figure 3. *Aceria* adult (left arrow) with immatures and egg (right arrow) inside a broom gall.
Broom rust
*Uromyces pisi-sativi*

- widespread
- detected 2003
- invades stems and foliage
- causes leaf drop
- can be damaging – variable
- loss of photosynthetic capacity
Potential new agents

Broom shoot moth
*Agonopterix assimilella*

Broom leaf beetle
*Gonioctena olivacea*
Biological control basics

- Classical biological control
- Agents approved through a strict assessment process
- Selection of agents - highly specific and damaging
- Agents are released from natural pests and diseases
- Potential to achieve high densities in country of introduction
Biological control is a dynamic ecological process with mostly unpredictable outcomes

- climate
- host genetics
- host phenology
- novel pests and diseases

![Graph showing changes in host density over time before and after biological control.](image)
Agent interactions

Additive affects \( 1 + 1 = 2 \)

Synergistic affects \( 1 + 1 = 4 \)

Negative affects \( 1 + 1 = 0 \)

<table>
<thead>
<tr>
<th>Affect host by</th>
<th>Seed-feeding beetle</th>
<th>Gall mite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce growth</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Reduce vigour</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Reduce seed production</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reduce spread</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Summary

• Three agents well established
• Distribution restricted (gall mite, seed beetle)
• Negative impact on broom health
• less seed
• less vigour
• reduce spread
• reduce density (with time)
• no sign of parasitism (yet)
• additive effects
Future outlook

- Gall mite and seed-feeding beetle will continue to spread and increase in density
- Impacts of new pests and diseases are uncertain
- Predatory mites??
- Beetle appears free of parasitism (small wasps)
- Widespread bush fire will set-back impacts
- Redistribution will be required from nursery areas
- Density of English broom may decline after 2-3 bush fires
- Integrated control needs to be maintained
Why redistribution?

- two agents are restricted in distribution
- limited distribution increases risk of loss (fire, over-harvesting)
- natural dispersal restricted in the alps (mountains)
- expedite impact
Collecting and holding agents

**Seed-feeding beetle**

- Adults live for 12 months (naturally)
- Tolerate cool conditions - alpine
- Adults feed on pollen, larvae on seeds
- Adults active in Spring – early summer
- Hibernate in winter (crevices, old pods)

- Collected by beating from flowering plants (October-December)
- Pooted in vials
- Collect in morning (below 22°C) (flight)
- Stored in ventilated contained (with corrugated cardboard or tissue)
- Kept at 5-10°C out of direct sunlight
- No need to feed if holding for 2-3 days

- 200+ beetles/site
- Introduce to flowering/fruiting plants
- Release on moderate to dense patch of Broom
- Tip beetles on new plant/s
- Avoid areas where Tagasaste is important
• Observed to feed on tagasaste in New Zealand.
• Will not damage the use of tagasaste for forage, windbreak, or apiary purposes
• Commercial production of tagasaste seeds could possibly be affected if large populations occur builds up.
• Should this be a concern, removal of fallen pods or use of insecticides is suggested.
Collecting and holding agents

Galling mite

- Adults and nymphs feed on young plant tissue
- Form galls on stem and flower buds
- Colonial – hundreds within a single gall
- Adults/nymphs active Spring- Autumn
- Hibernate in new buds (winter)
- Commence feeding in early spring

- Collect as galls on stem sections
- Fresh active galls (light green) (not last seasons galls (brown))
- Collect October-March
- Introduce to new plants as loose stems, or tied stems
- 500-1000 galls per new site
- loose stem sections approx 20 cm long preferable
- whole plant method (potted inoculated plants placed in field)

- Keep galls moist and out of sunlight
- Hold on plastic or hessian bags (2 days max)
- Avoid hot dry weather for releases
## Plant-feeding organisms found on English broom in the Alps

<table>
<thead>
<tr>
<th>Order</th>
<th>Family (species)</th>
<th>Common Name</th>
<th>Number of sites (Frequency)</th>
<th>Damage¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepidoptera</td>
<td>Tortricidae</td>
<td>Leaf tier</td>
<td>14 (25%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Geometridae</td>
<td>Looper Moth</td>
<td>22 (39%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>?Nolidae</td>
<td>Hairy caterpillar</td>
<td>7 (12%)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Pyralidae (Etiella behrii)</td>
<td>Lucerne seed web moth</td>
<td>22 (39%)</td>
<td>L</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>Curculionidae</td>
<td>Pale weevil</td>
<td>5 (9%)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Cerambycidae</td>
<td>Longicorn beetle</td>
<td>1 (2%)</td>
<td>L</td>
</tr>
<tr>
<td>Phasmatodea</td>
<td>Phasmdidae</td>
<td>Stick Insect</td>
<td>2 (4%)</td>
<td>N</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>Cicadellidae</td>
<td>Leaf Hopper</td>
<td>1 (2%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Pseudococcidae</td>
<td>Mealy Bug</td>
<td>4 (7%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Aleyrodividae</td>
<td>White Fly</td>
<td>12 (21%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Flatidae</td>
<td>Pale Leaf Hopper</td>
<td>11 (19%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Membracididae</td>
<td>Horned Tree Hoppers (A)</td>
<td>9 (16%)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Membracididae</td>
<td>Horned Tree Hoppers (B)</td>
<td>1 (2%)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Lygaeidae</td>
<td>Rutherglen Bug</td>
<td>3 (5%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Margarodidae</td>
<td>Cushion Scale</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Aphrophoridae</td>
<td>Spittle Bug</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Aphid (Acyrthosiphon pisum)</td>
<td>Pea Aphid</td>
<td>22 (39%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Coccidae (Parthenolecanium rufulum)</td>
<td>Broom scale</td>
<td>26 (46%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Coccidae</td>
<td>Flat black scale</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Coccidae</td>
<td>Flat white scale</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Pentatomidae</td>
<td>Green vegetable bug</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Tubiliferae</td>
<td>Thrip</td>
<td>1 (2%)</td>
<td>N</td>
</tr>
<tr>
<td>Thysanoptera</td>
<td>?</td>
<td>Twig die-back</td>
<td>16 (28%)</td>
<td>?M</td>
</tr>
<tr>
<td>Pathogen</td>
<td>?</td>
<td>Black stem spot</td>
<td>15 (26%)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>?</td>
<td>Black stem banding</td>
<td>17 (30%)</td>
<td>?M</td>
</tr>
<tr>
<td></td>
<td>?</td>
<td>Stem canker</td>
<td>1 (2%)</td>
<td>L</td>
</tr>
</tbody>
</table>
Lepidoptera - larvae

Nolidae  Tortricidae  Geometridae
Hemiptera – stem/leaf suckers

Pea Aphid
Acyrthosiphon pisum

Broom scale
Parthenolecanium rufulum

Thripidae, Cicadellidae, Aleyrodidae
Lucerne seed pod moth
*Etiella behrii*

Seed feeders

Adult

Seed-feeding beetle

Larva
Stem banding pathogen

Stem blotch pathogen

Broom rust
Cerambycidae - stem borers
Redistribution guidelines

*General guidelines*

• The rate of removal cannot exceed the rate of population increase. This is applicable to the population as a whole, and less so for individual sites.

• Harvesting needs to be regulated in the early stages of population establishment to ensure founder populations are not damaged.

• Well established populations need less if any regulation

• Knowledge sharing or training is required to ensure material is collected, handled and released to achieve high levels of success.
Assessment and monitoring methods

Four important questions

What do we want to monitor?
What will we measure?
How will the information be used to improve broom management?
Where and how will we store the data?
What do we want to monitor?

Has it established?

Where is it and has it spread?

Is it having an impact on the host?

How is the vegetation changing as a result of biocontrol?
basic monitoring design
(establishment)

- presence/absence on 5 plants/point
- density of agents/20 random stems (specified length or diameter)
- repeat over time
Atlas of Living Australia – Biological Control Portal

Welcome to the national site for recording the distribution of weed biological control agents

This website aims to centralise information on the known distribution, availability and redistribution methods of weed biological control agents in southeastern Australia. This will help to enhance community knowledge and adoption of biological control and enable its benefits to be enjoyed by more people and its impacts to be better understood.

Register
Create your personal account here.

Find
Keep an eye out for evidence of insect or rust damage on target weeds. If you see any evidence or the bugs
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<table>
<thead>
<tr>
<th>Date</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Location</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 Nov 2014</td>
<td><em>Phytocoris curvicescens</em></td>
<td>Pardosa curvis &lt;br&gt;stem-boring beetle</td>
<td>-35.52516, 144.970556</td>
<td>weebiocontrol</td>
</tr>
<tr>
<td>11 Nov 2014</td>
<td><em>Pococystis myracanthi</em></td>
<td>Bridal creeper rust &lt;br&gt;fungus</td>
<td>-37.81239, 145.23847</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>23 Oct 2014</td>
<td><em>Telanthus hirtus</em></td>
<td>Gorse spider mite</td>
<td>-36.58633, 145.01173</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>23 Oct 2014</td>
<td><em>Unaphora stella</em></td>
<td>Spider thistle galls</td>
<td>-36.9526, 145.914534</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>23 Oct 2014</td>
<td><em>Meligethes planipennis</em></td>
<td>Pardosa curve &lt;br&gt;pollen beetle</td>
<td>-35.52503, 145.532414</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>18 Oct 2014</td>
<td><em>Megaliodes larvae</em></td>
<td>Pardosa curve &lt;br&gt;crown weed</td>
<td>-36.437362, 145.249181</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>18 Oct 2014</td>
<td><em>Longitarsus echi</em></td>
<td>Pardosa curve &lt;br&gt;feet &lt;br&gt;beetle</td>
<td>-36.43784, 145.249249</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>14 Oct 2014</td>
<td><em>Megaliodes larvae</em></td>
<td>Pardosa curve &lt;br&gt;crown weed</td>
<td>-36.14739, 146.905073</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>10 Oct 2014</td>
<td><em>Unaphora stella</em></td>
<td>Spider thistle galls</td>
<td>-36.94384, 145.903815</td>
<td>Tmolloy</td>
</tr>
<tr>
<td>07 Oct 2014</td>
<td><em>Longitarsus echi</em></td>
<td>Pardosa curve &lt;br&gt;feet &lt;br&gt;beetle</td>
<td>-35.54737, 146.905117</td>
<td>Tmolloy</td>
</tr>
</tbody>
</table>
English broom gall mite

Click on the map to set the location of the sighting. You can drag the newly created location around the map to change the coordinates.
Record your observation location here

To enter a location zoom in to where you made the sighting and click on the exact point on the map.

The coordinates are inserted into the latitude and longitude fields on the form.

It is important to get the location as accurate as possible - record your confidence in the accuracy of your location marker in the field provided.

You can fine tune the location by zooming in further, clicking on the marker spot on the map, and dragging it to the correct place.

Latitude
Longitude

(Yes: The co-ordinate projection is in WGS84 decimal lat/long.)

Accuracy (meters)
General locality (e.g. access Rd)
Nearest Town
State

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Record your bio-control agent observations

English broom seed-feeding beetle
Braconidae villosa

Number of broom seed pods examined
Number of broom seeds pods with seed feeding beetle

Sample collected by
Sample assessed by

Notes

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Please attach pictures or movies to help your observation

Please attach photos or movies here
Browse
Clear

Atlas of Living Australia – Biological Control Portal

- establishment records
- simple and easy
- community resource
- anybody and use it
- extremely useful
Acknowledgements

Natalie Brida
Felicity Brooks
Charlie Pascoe
Rick Box