



Attack of the clones

The introduced willow sawfly

Nematus oligospilus

in Australia

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CSIRO - Health and Biosecurity



Outline

- Willows
- Willow sawfly
 - Native plants
 - Distribution
 - Population genetics
 - Invertebrate community
- Conclusions

Invasive organisms

- Have major negative impacts in their new environments
 - Species diversity and abundance
 - Native communities
 - Ecosystem processes
e.g. fire regime



Willows



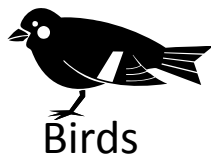
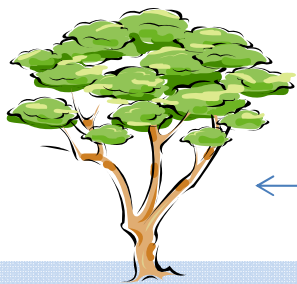
- Salicaceae - *Salix* sp.
 - Subgenera: *Vetrix* and *Salix*
- No native willows in Australasia
- 32 taxa naturalised
- Invasive in streams and wetlands



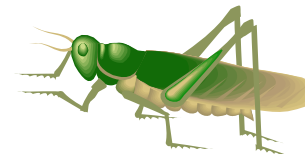


Riparian zone

Riparian vegetation



Birds

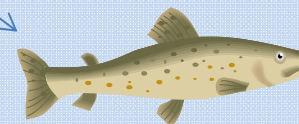


Terrestrial invertebrates

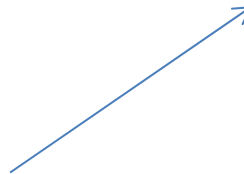
In-stream

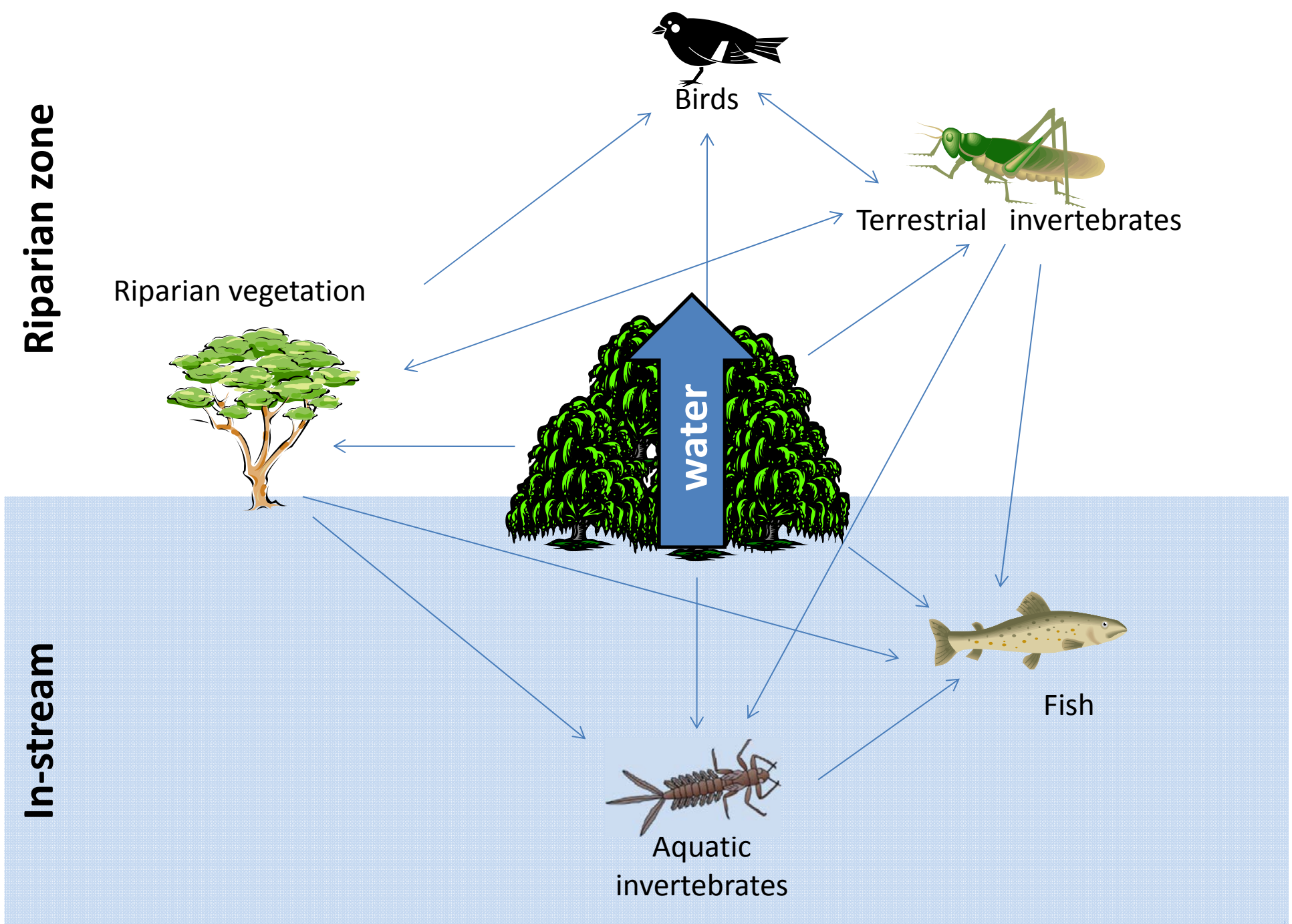


Aquatic invertebrates



Fish





Benefits

- Erosion control
- Ornamental
- Shelterbelt
- Fodder
- Apiculture
- Cricket bat
- Basket making



Australia

- Weed of National Significance
- Willow enthusiasts don't agree
- Large control program



New Zealand

- Positive for erosion control
 - Breeding program/ planting
- Two taxa are significant pests





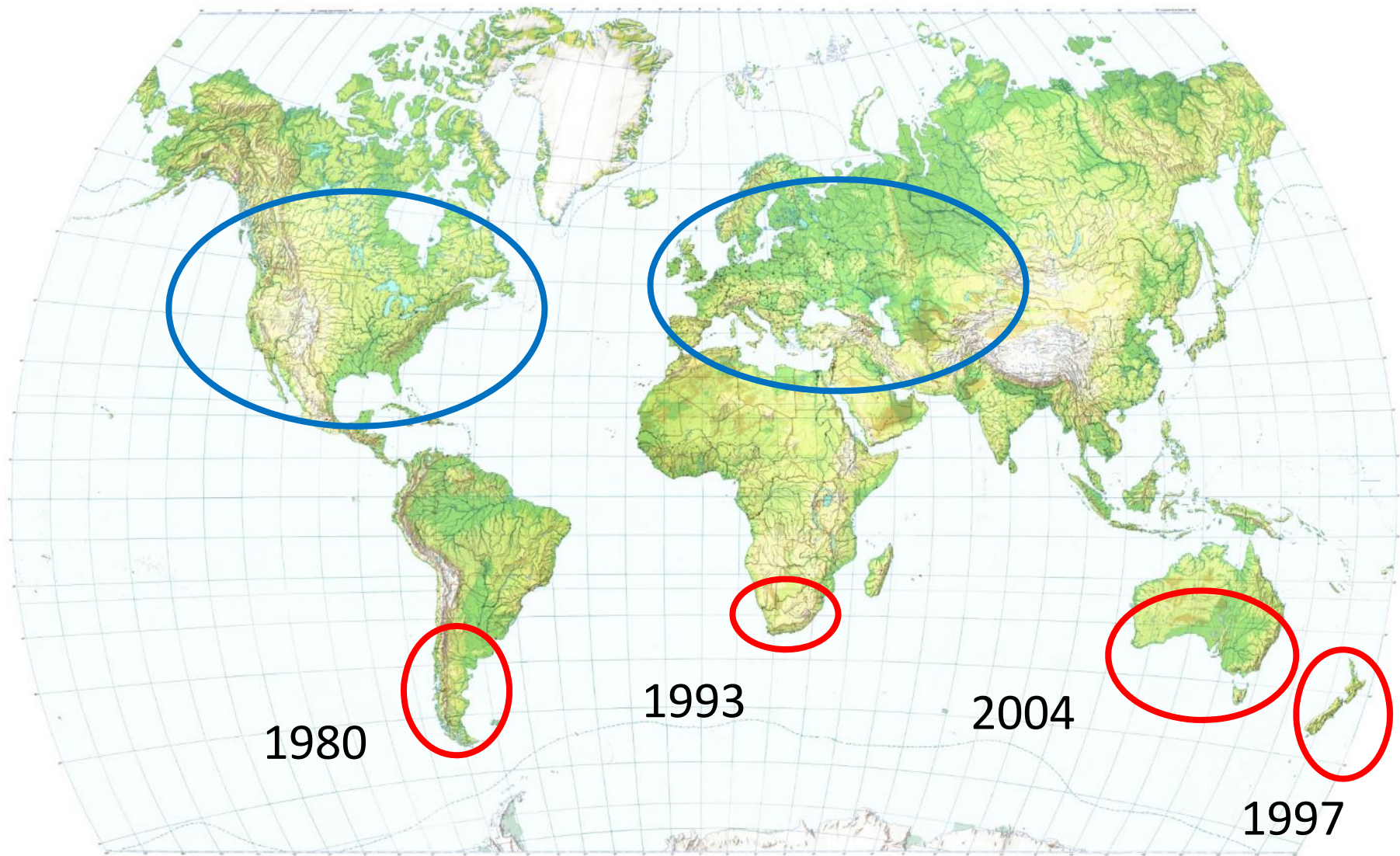
Willow sawfly

- *Nematus oligospilus*
(Hymenoptera: Tenthredinidae)
- Introduced to Australia - 2004
- Spread rapidly

Willow sawfly

- Native to Europe and North America





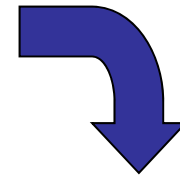
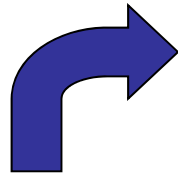
Willow sawfly



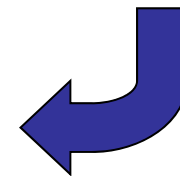
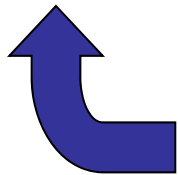
- Native to Europe and North America
- Complex taxonomy
 - Group of species?

Schmidt and Smith 2009

Lifecycle



Parthenogenetic in invasive range



Defoliation











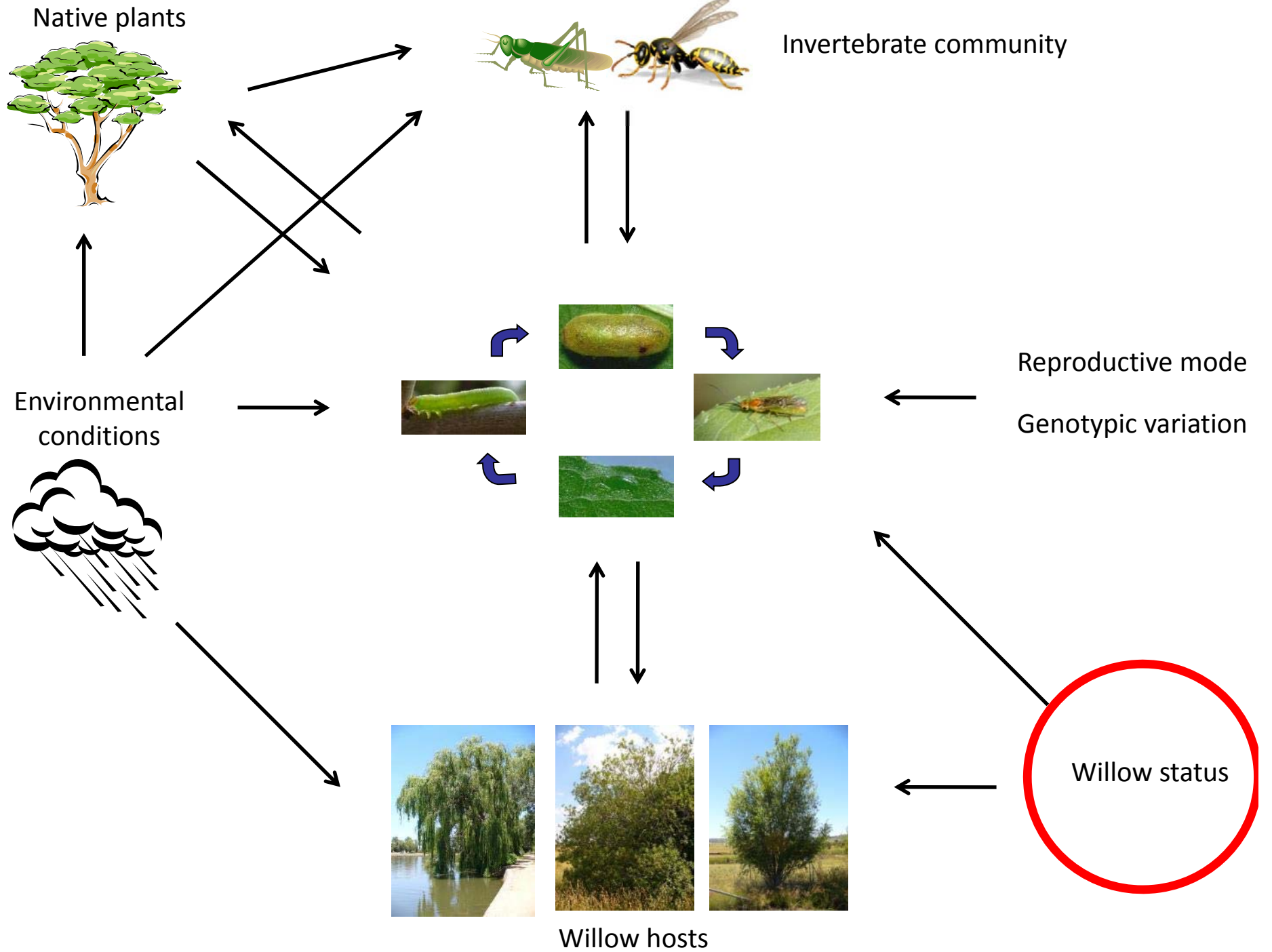


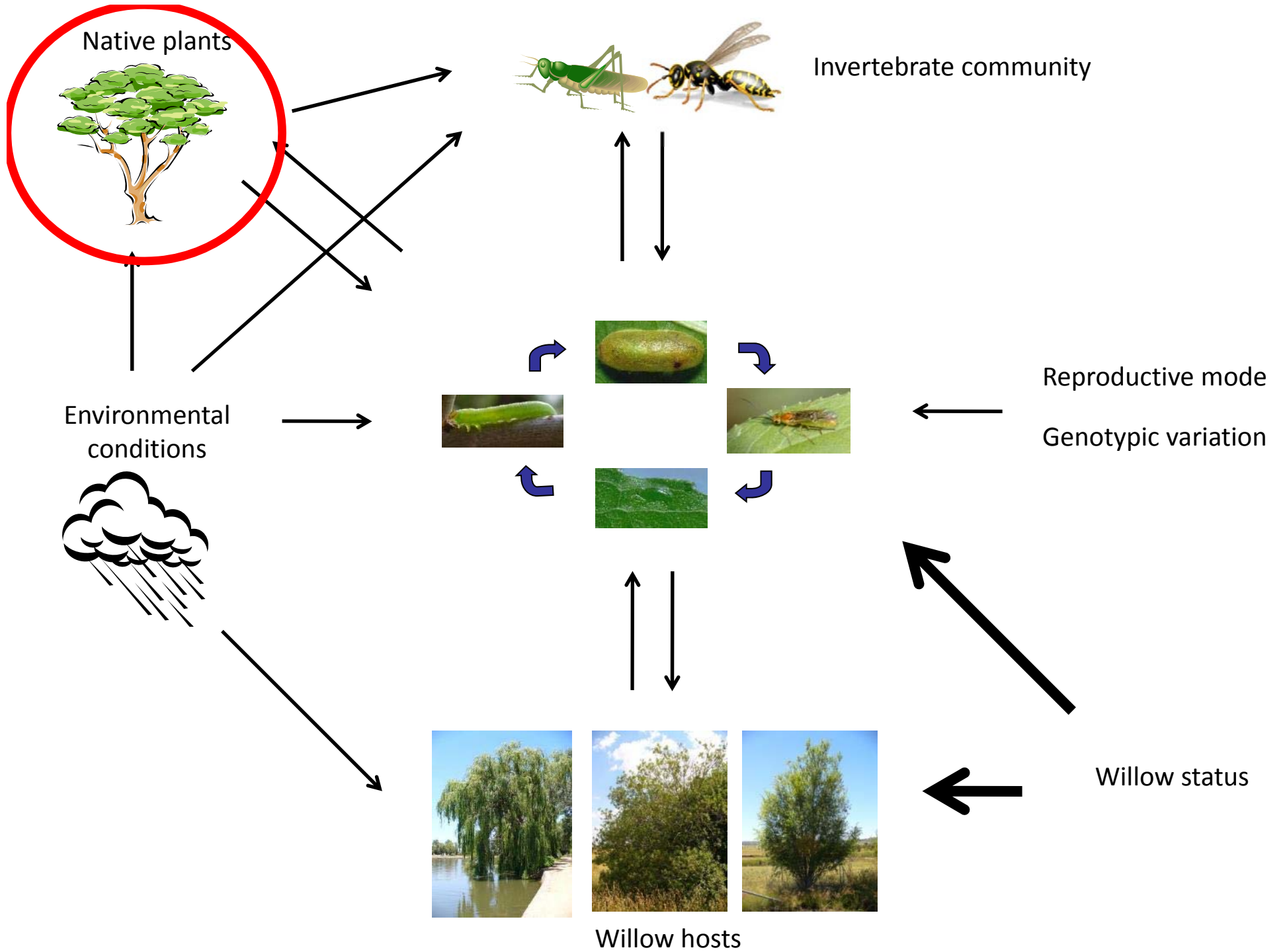




Die-back









1. Native plants

Aims

1. Assess *N. oligospilus* host range
2. Determine potential impact on native plants



Methods

Host-specificity testing

- Non choice feeding trial
- Oviposition

35 plant species tested

1. Closely related
2. Same habitat
3. Ecologically important native plants
4. Economically important exotic plants

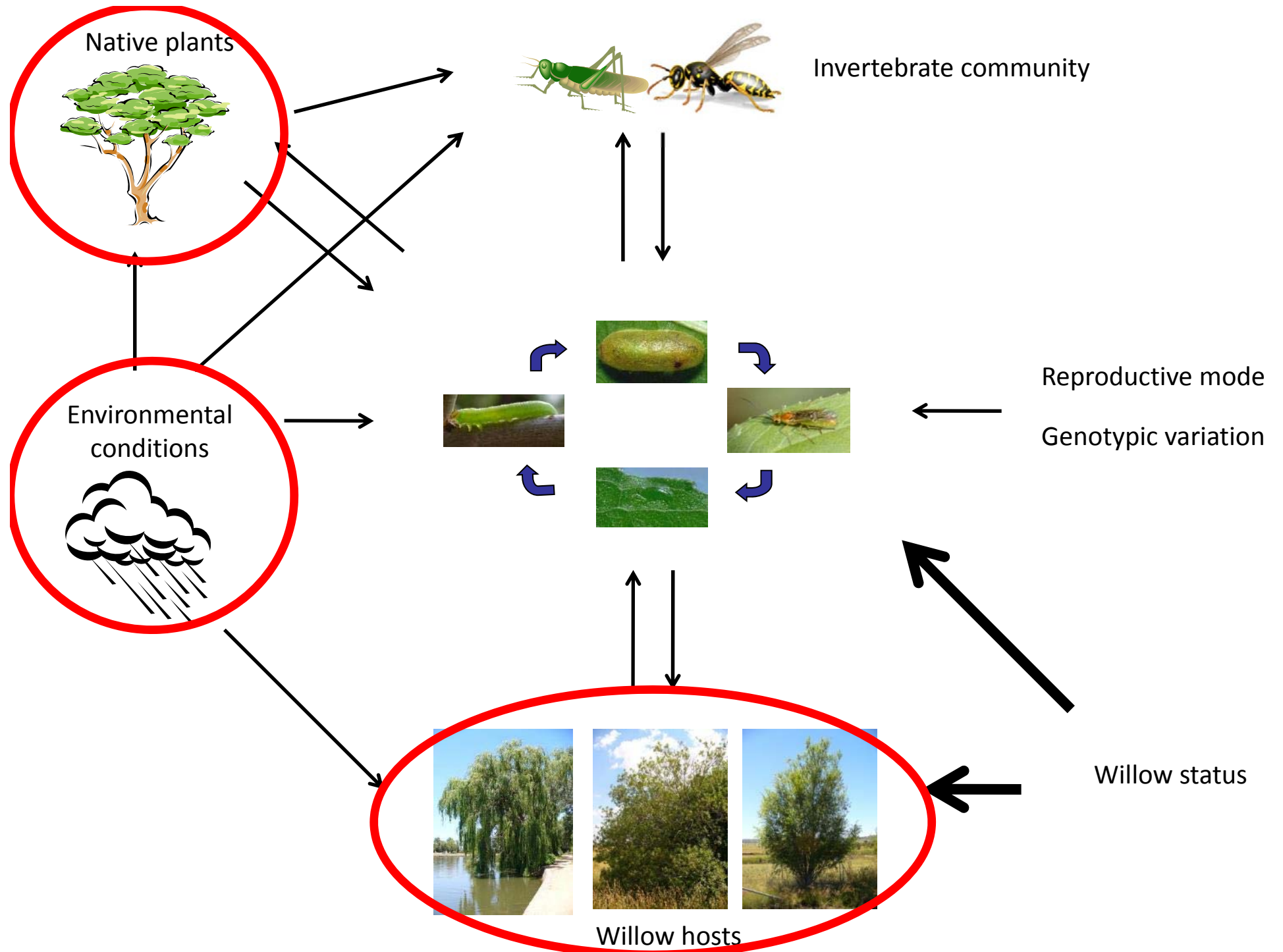
Results

Willows only:

- Extensive feeding damage
- Survival to adulthood
- Oviposition

Specific to willow spp.

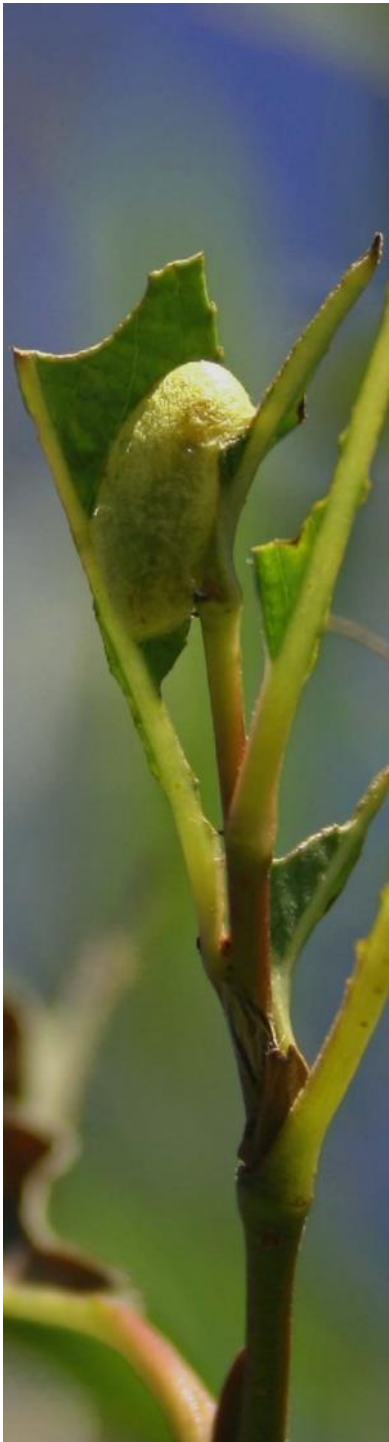




2-Environment/willows

Aims

1. Distribution / expansion
2. Climatic preference
3. Host preference

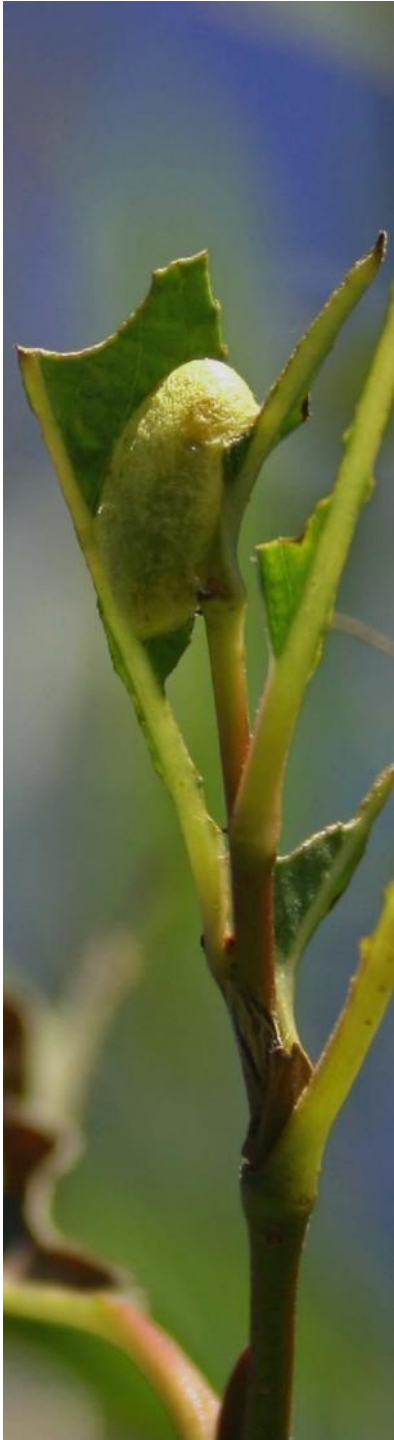


Field collection

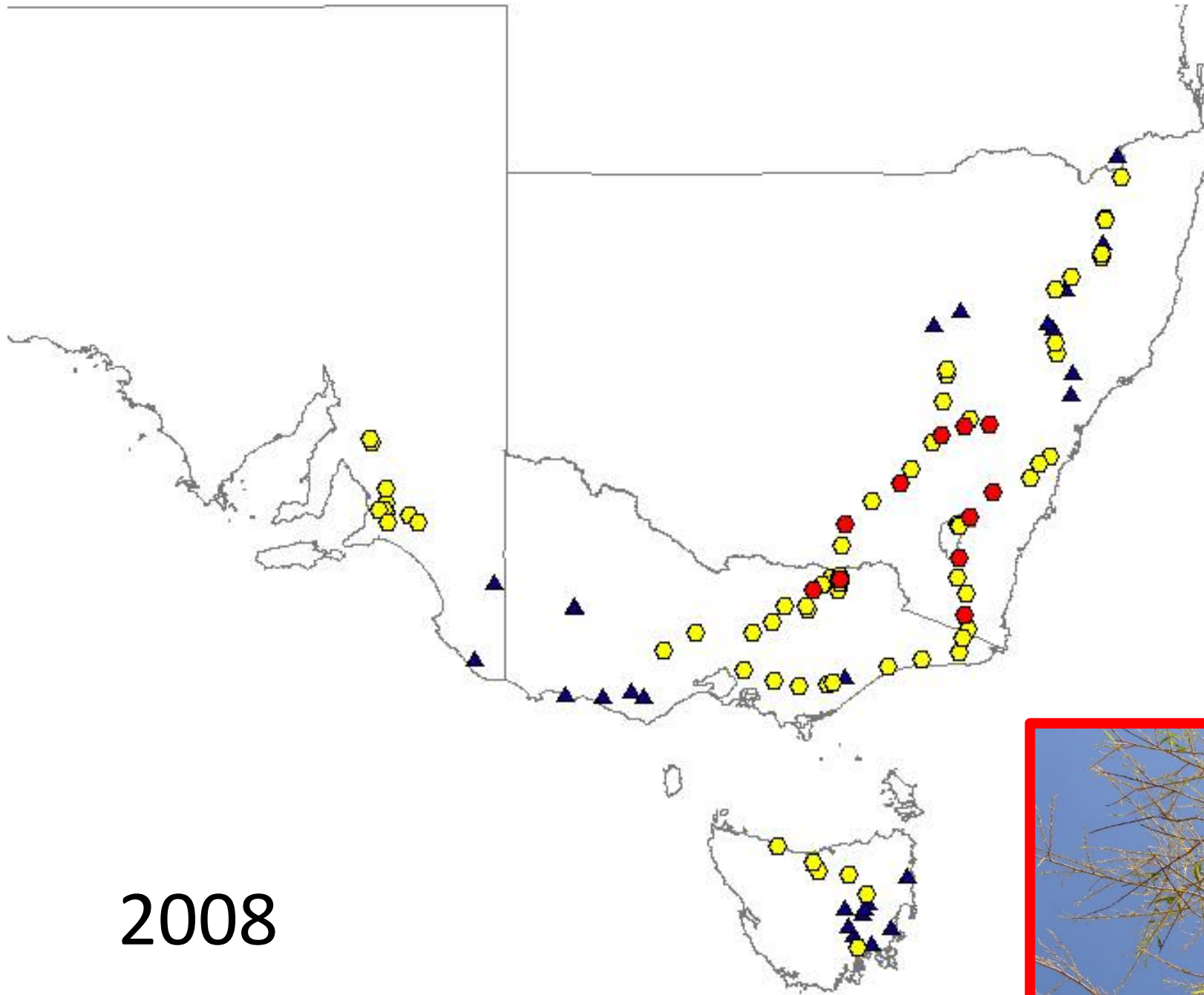
- Australia (> 100 sites)
 - Vic, SA, NSW, Tas, Qld (2008/2009)
 - WA (2010)
- New Zealand (22 sites) (2009)
 - Assess visually
 - Willow taxa
 - Population density



Results

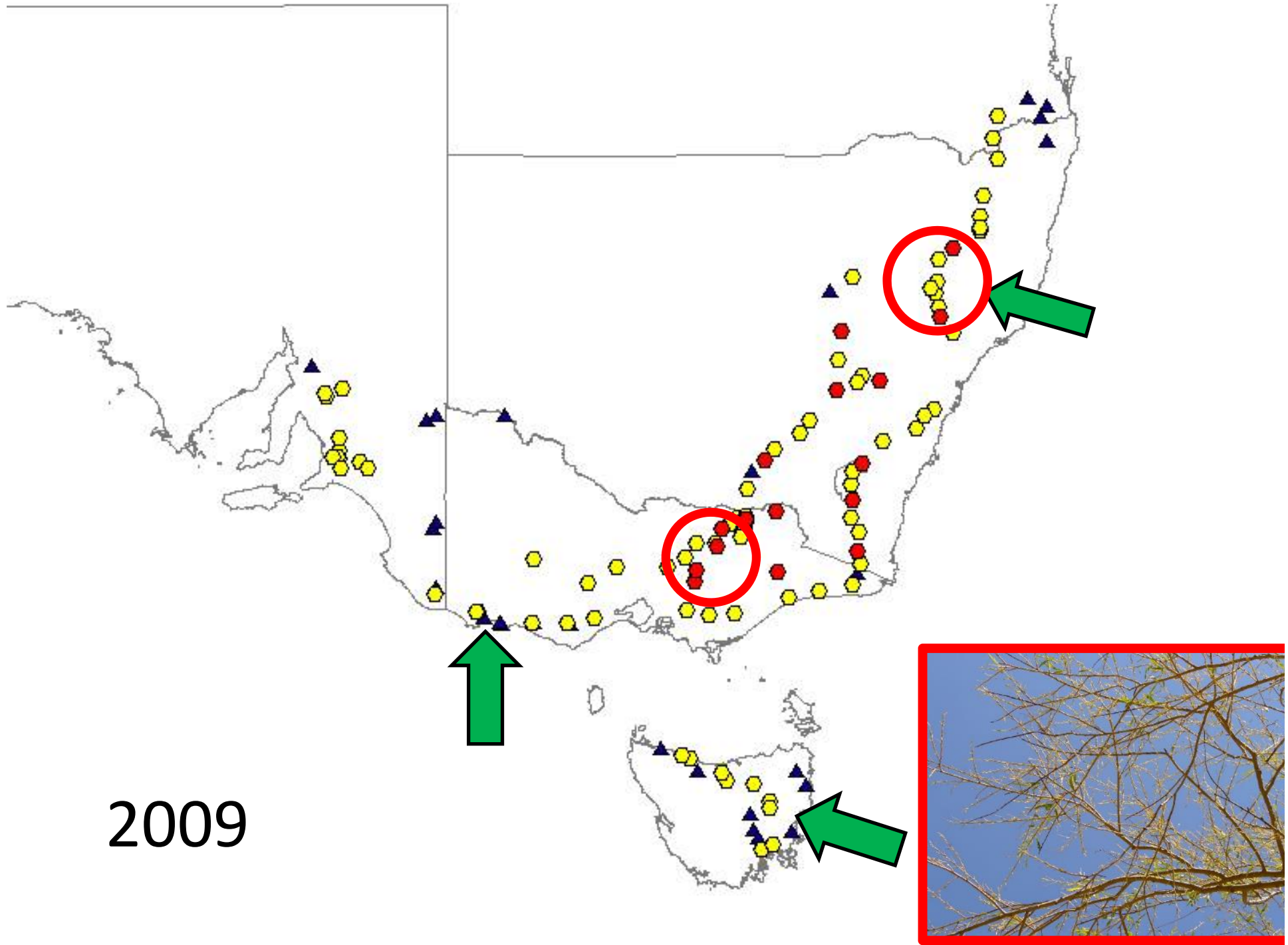


- Widespread
- Temperate areas
- Still expanding in Australia
 - Patchy distribution



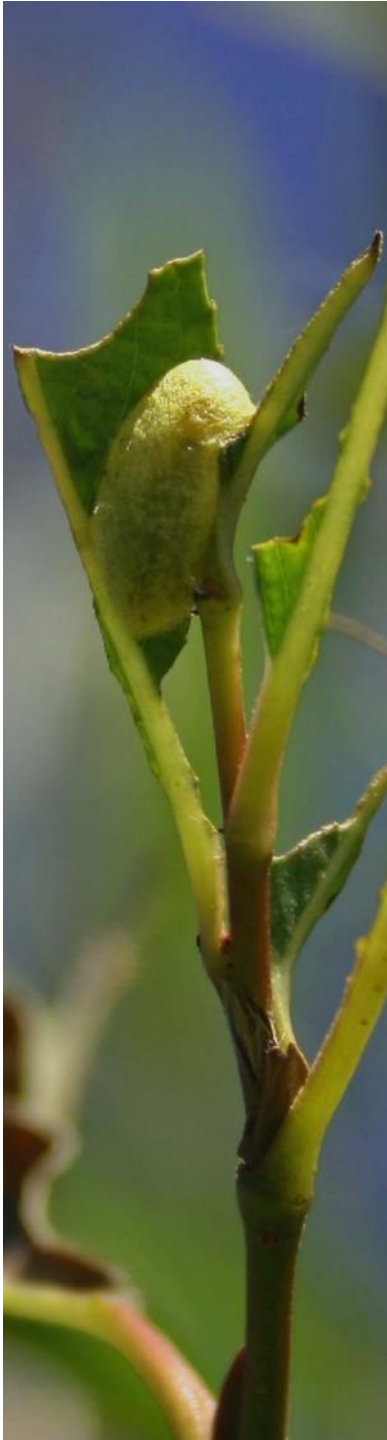
2008





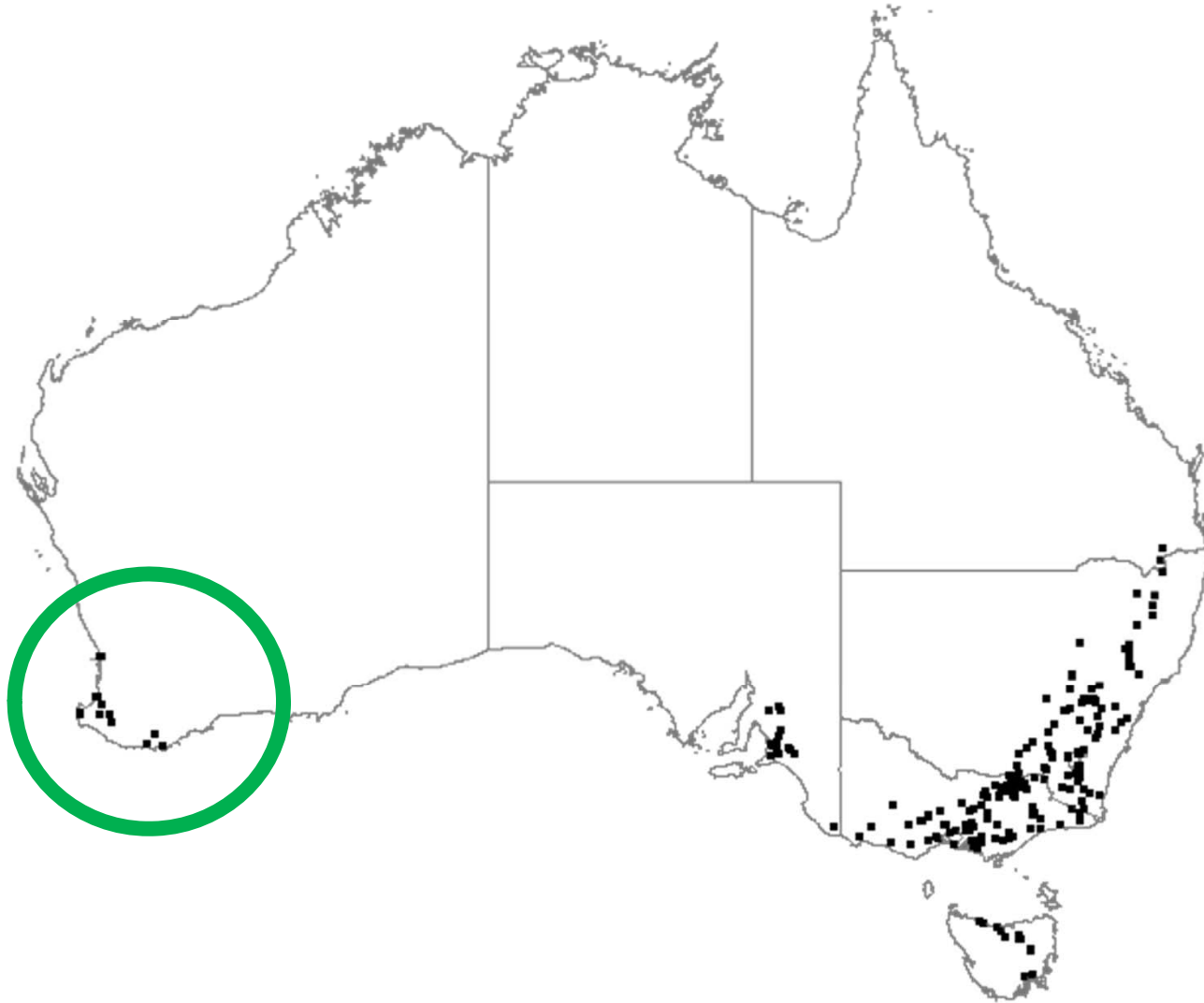
2009

Results

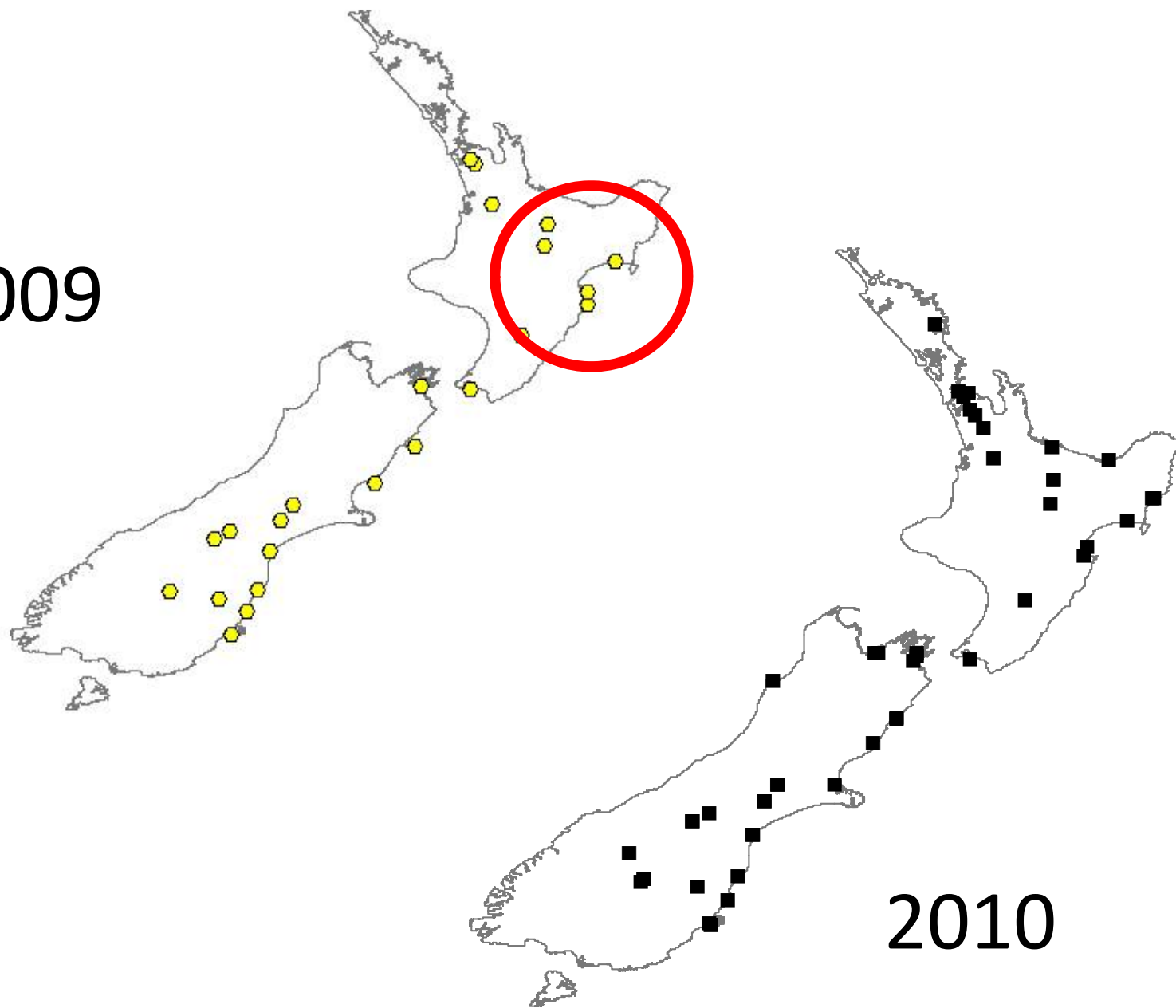


- Widespread
- Temperate areas
- Still expanding in Australia
 - Patchy distribution
- Everywhere in New Zealand
 - Low population density

Distribution in 2010



2009

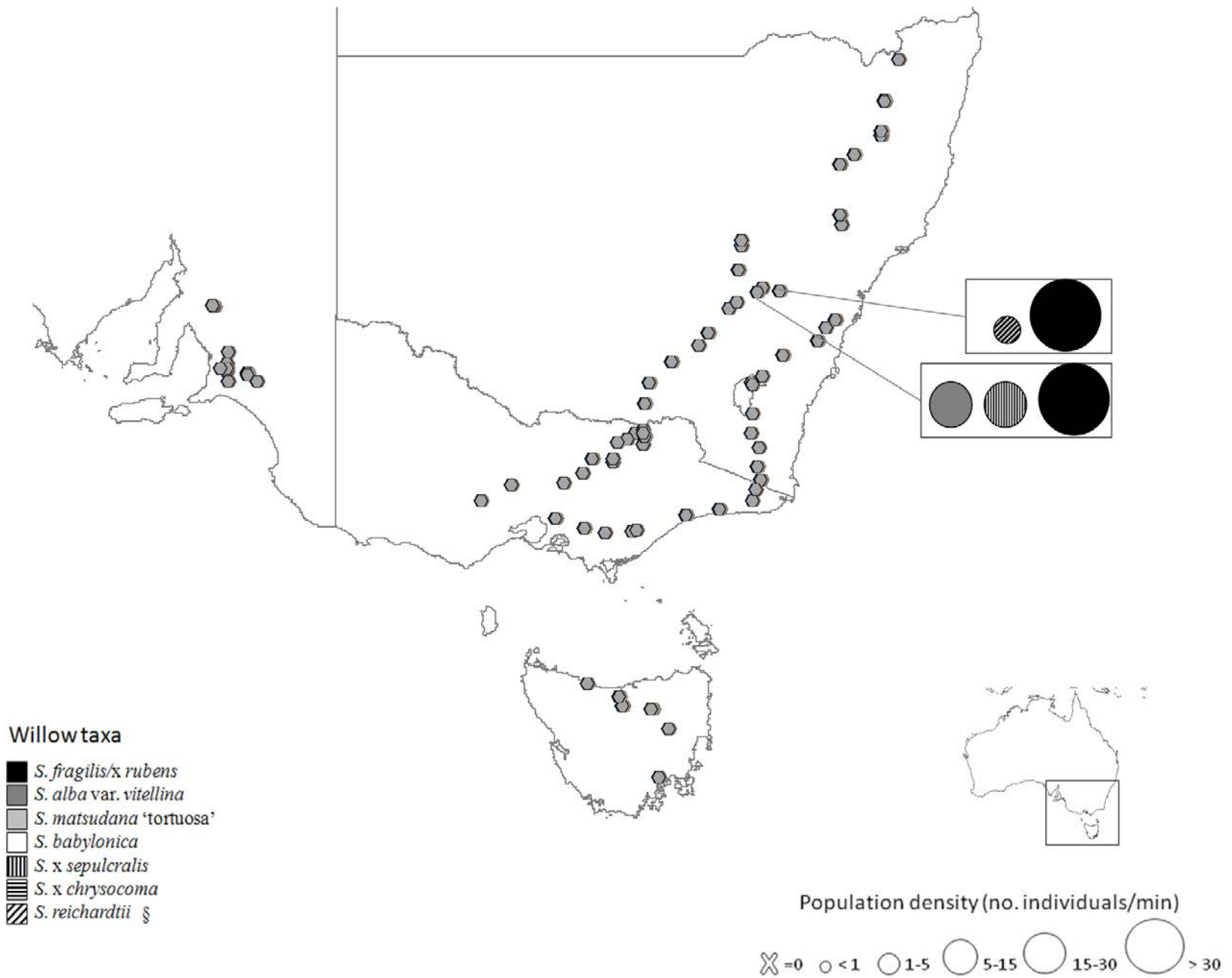


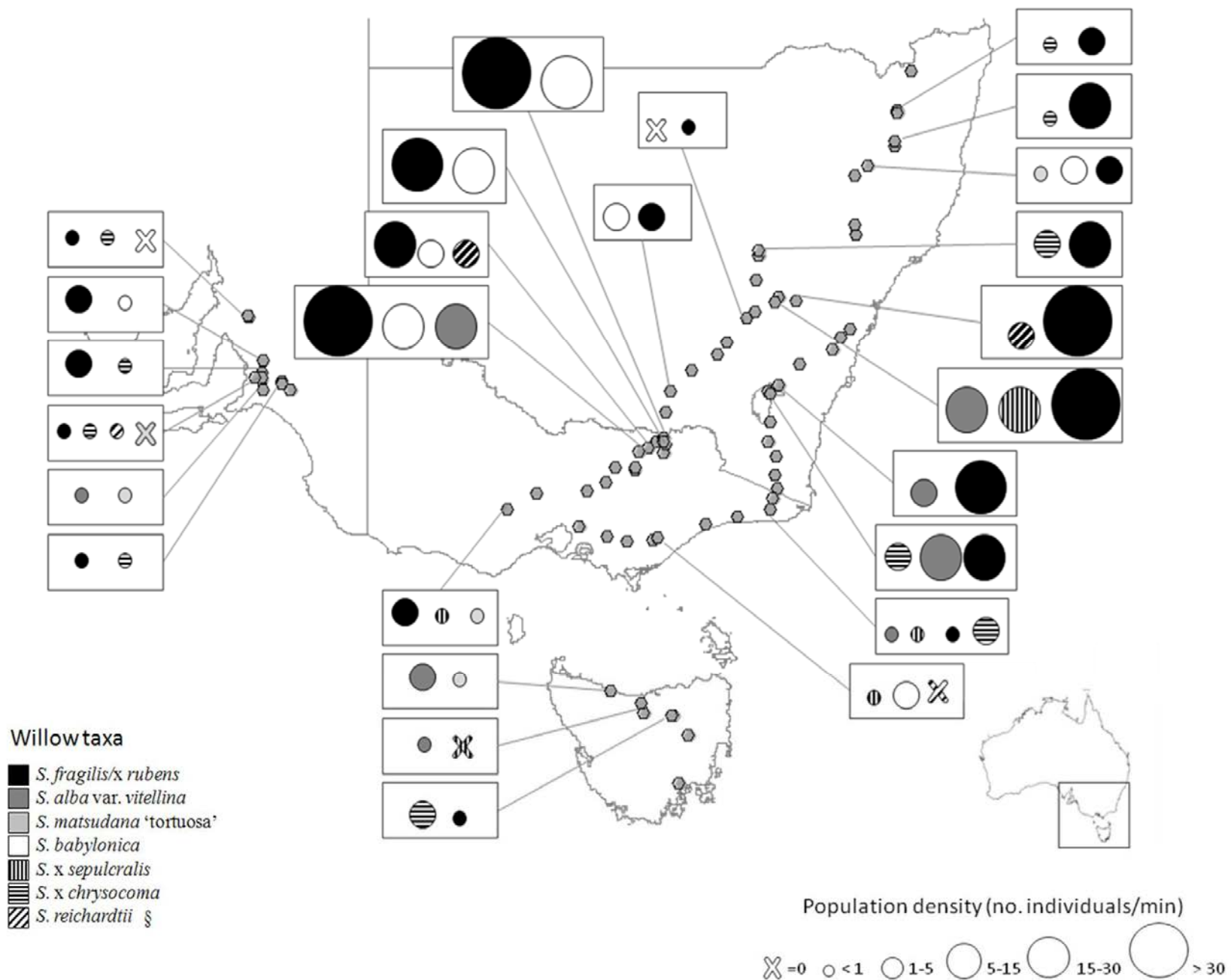
2010

Results

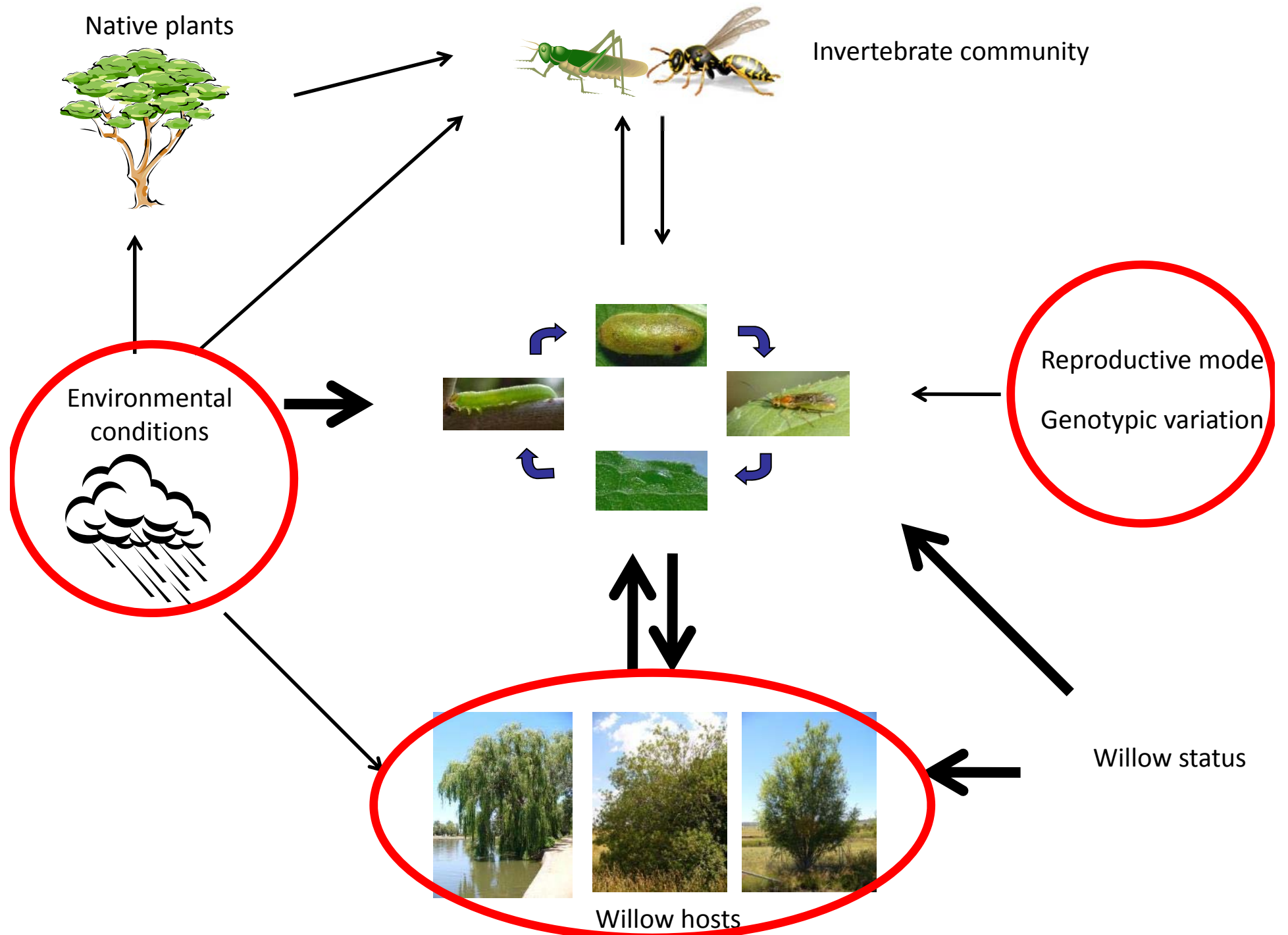
- On all willow taxa
- Different densities
- Rarely on shrub willows
- *Salix X rubens*











3-Population genetics

Aims

Determine:

- Reproductive mode
- Number of clones
- Dispersal
- Specificity to willow taxa
- Different climatic regions



Methods

- Microsatellite marker development
 - 41 markers
 - 300 *N. oligospilus* - invasive range
 - 12 tenthredinid species



Methods

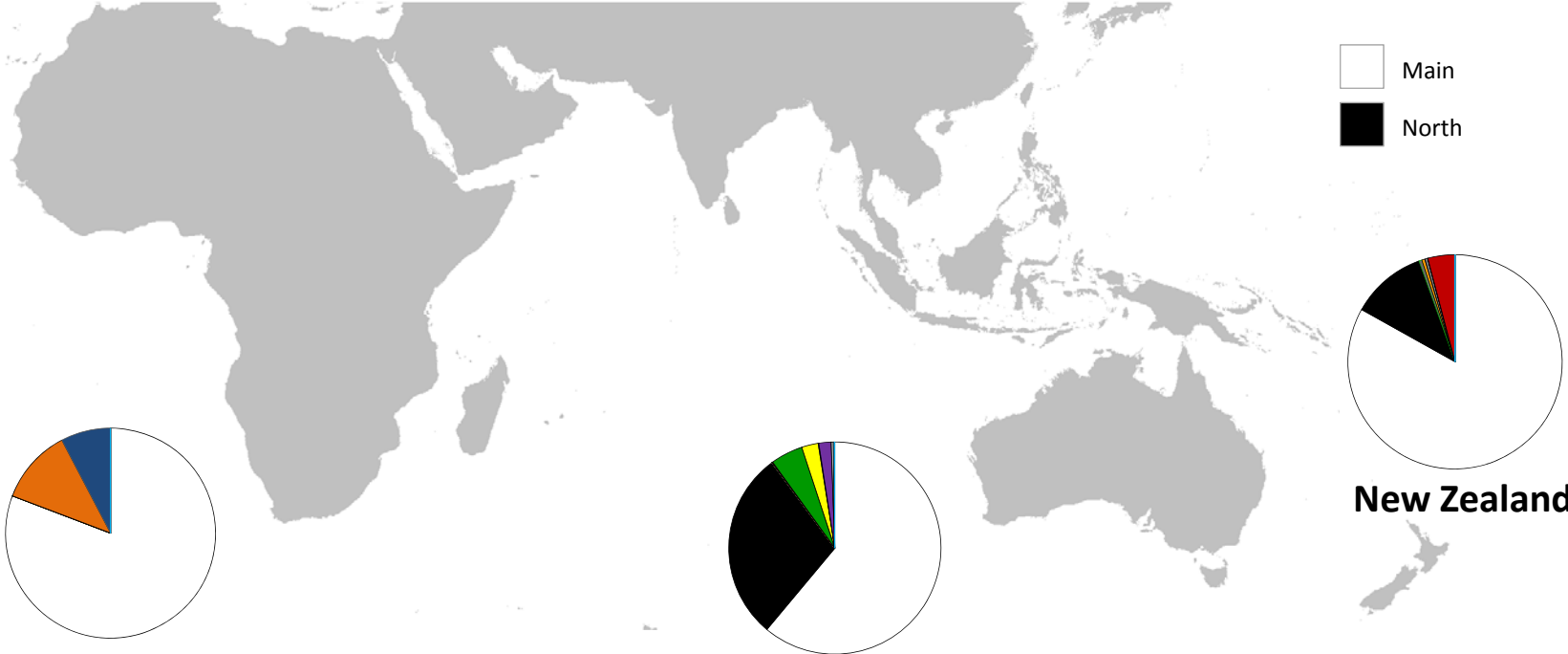


- 25 markers
 - Screened >1000 individuals
 - New Zealand
 - Australia
 - South Africa
 - 10 individuals/site/tree

Results



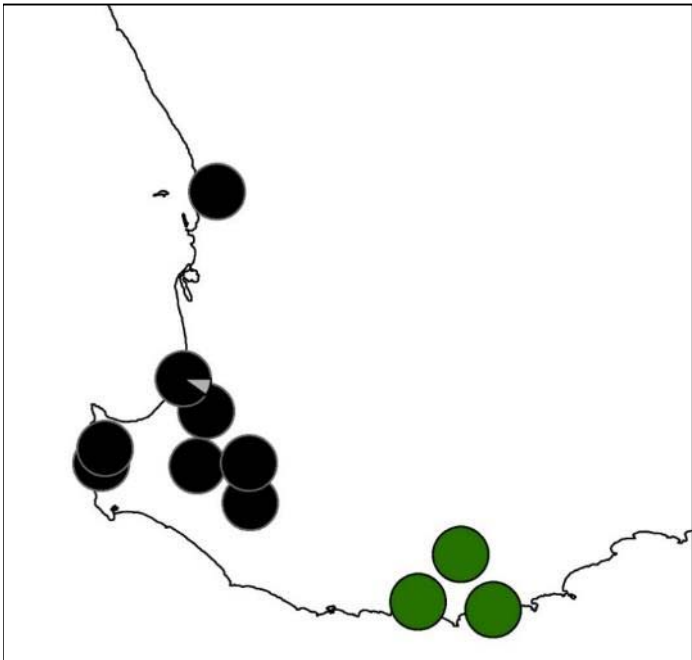
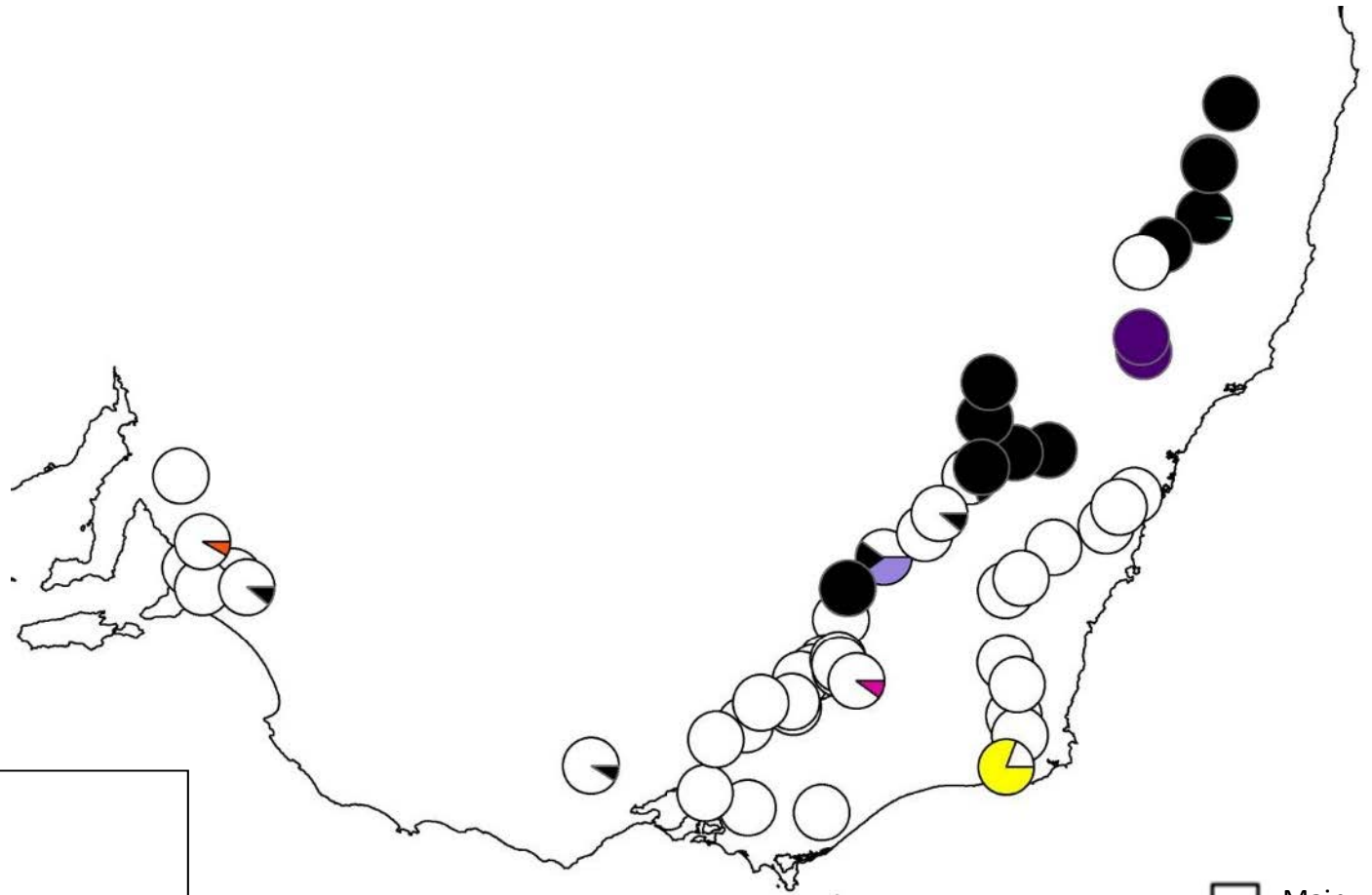
- Parthenogenetic
 - males present (2!)
- 16 genotypes
 - Closely related
- 2 superclones



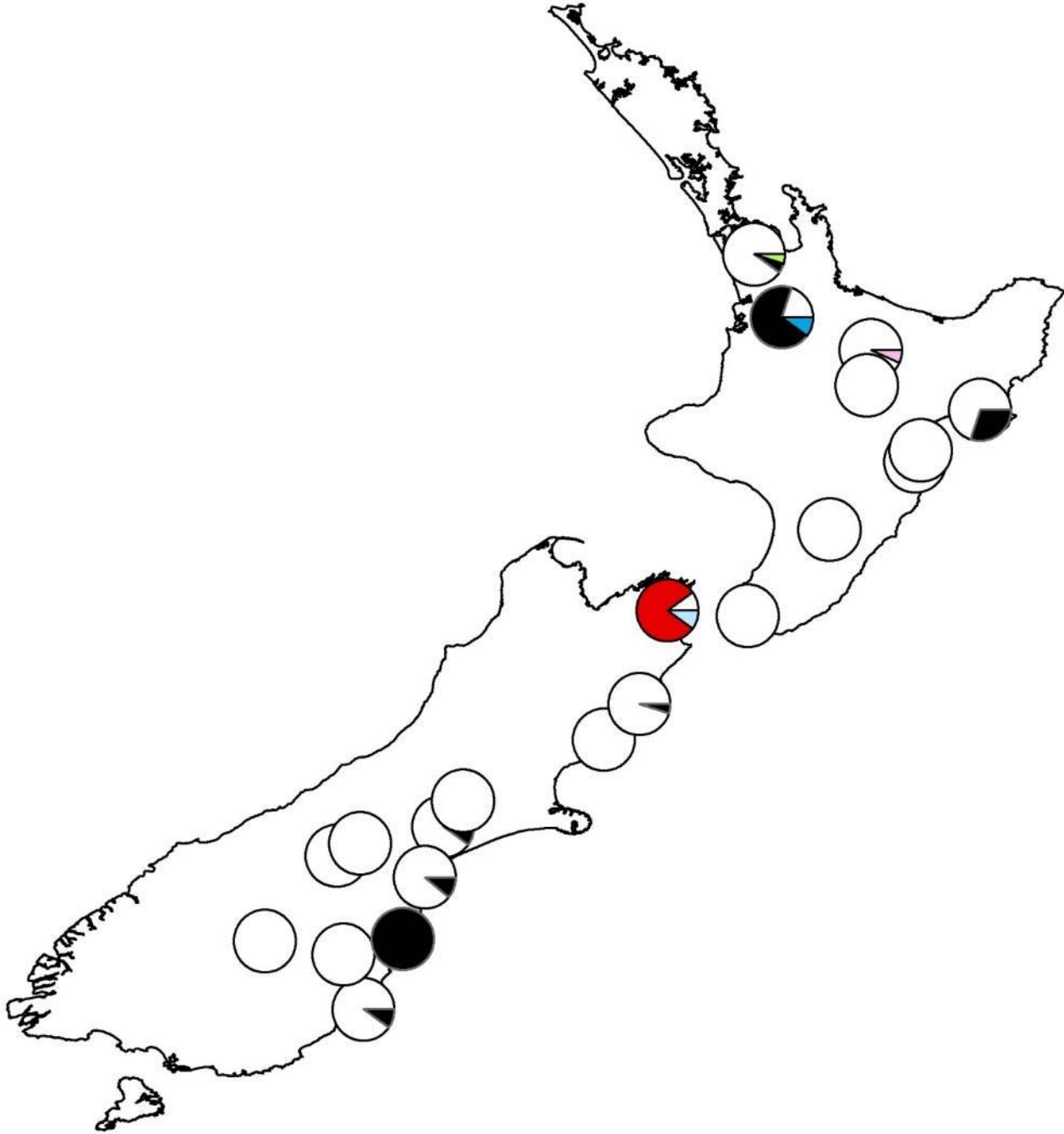
South Africa
N=26
No. clones: 3
Unique clones: 1

Australia
N=912
No. clones: 10
Unique clones: 7

New Zealand
N=219
No. clones: 7
Unique clones: 5



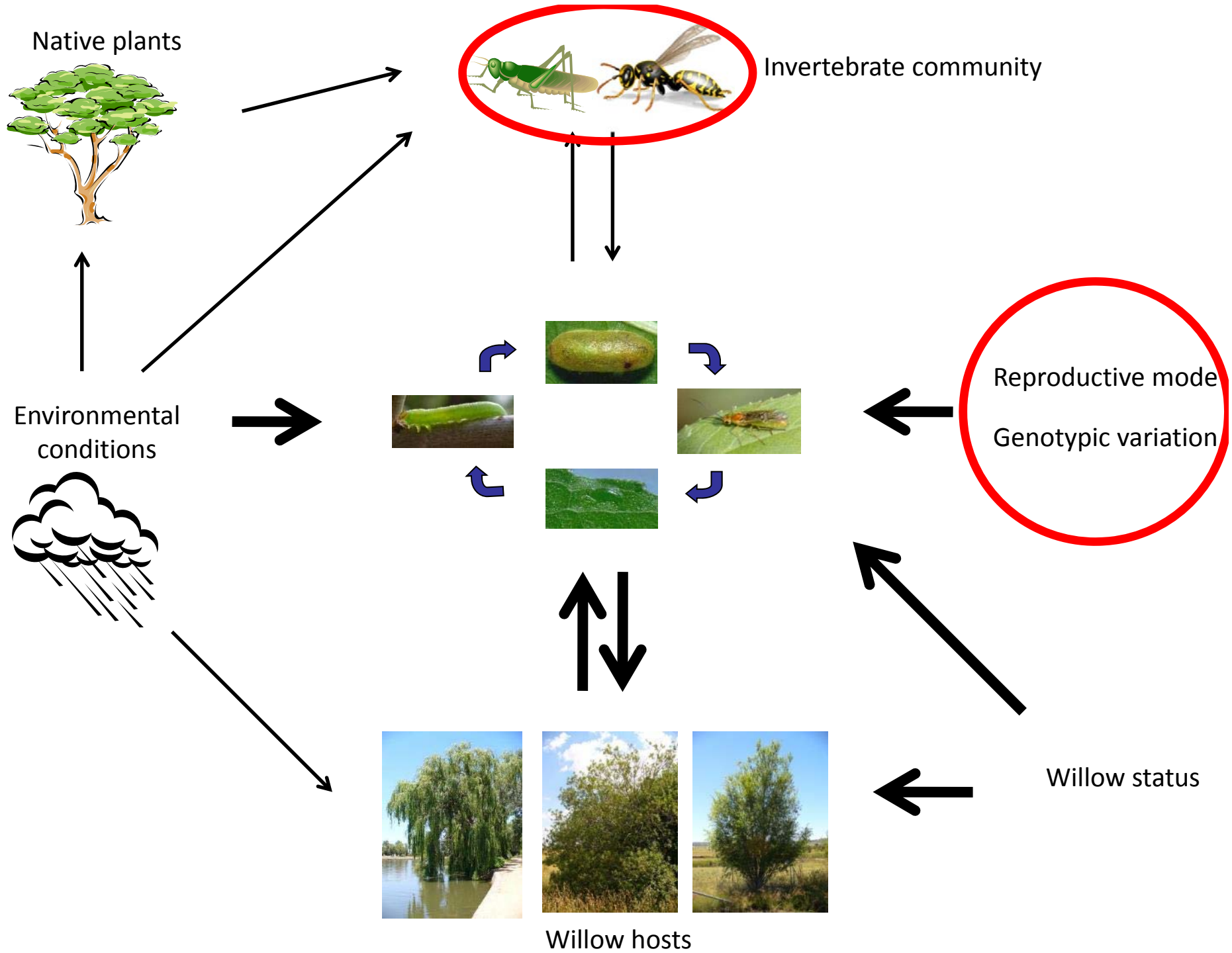
-  Main
-  North
-  Aus1
-  Aus2
-  Aus3
-  Aus4
-  Aus5
-  Aus6/SA
-  Aus7
-  Aus8

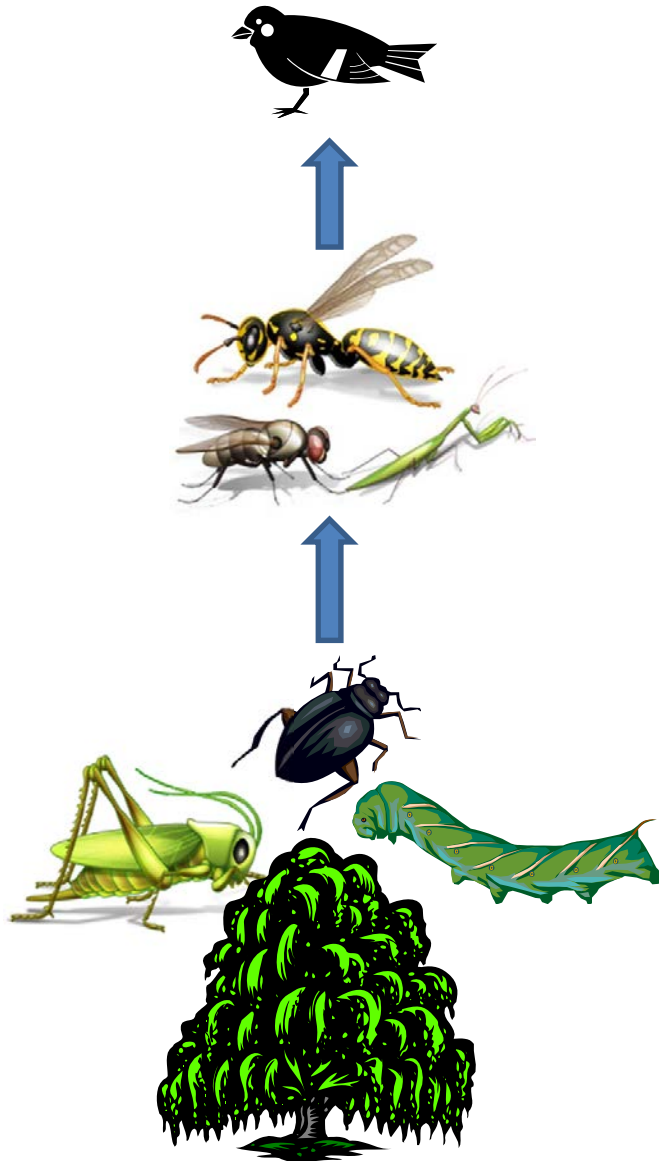


Results



- 2 superclones
 - Wide climatic tolerance
 - No specificity to willow taxa
- Rare clones are localized
- Few introductions





native

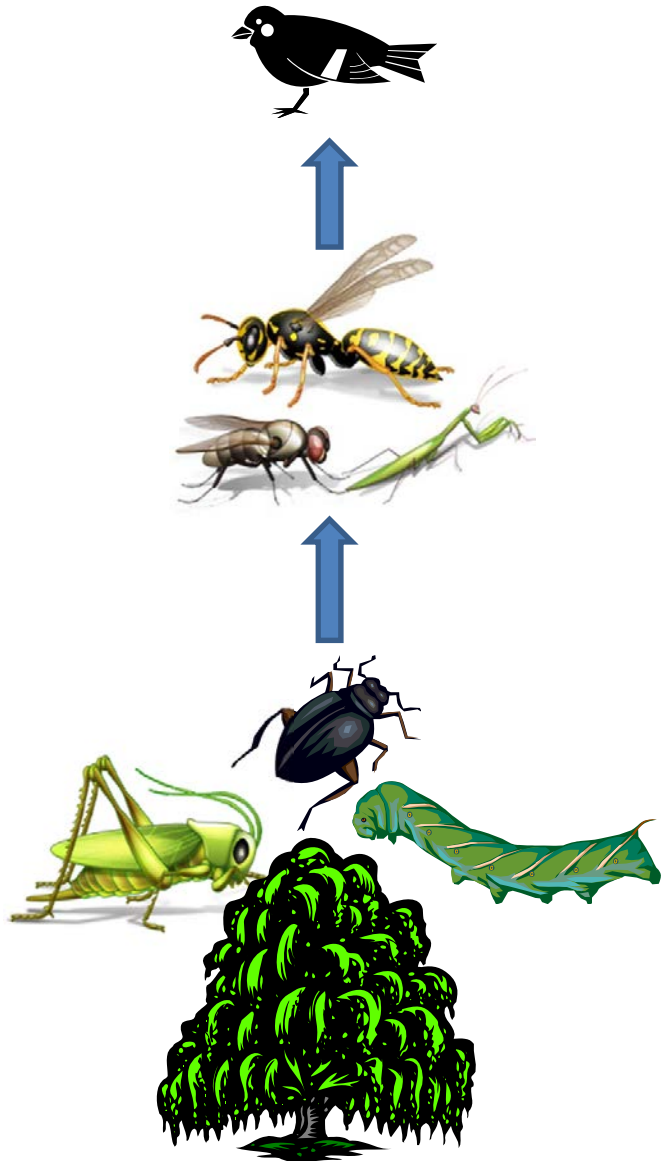
Lower biodiversity

Enemy release hypothesis

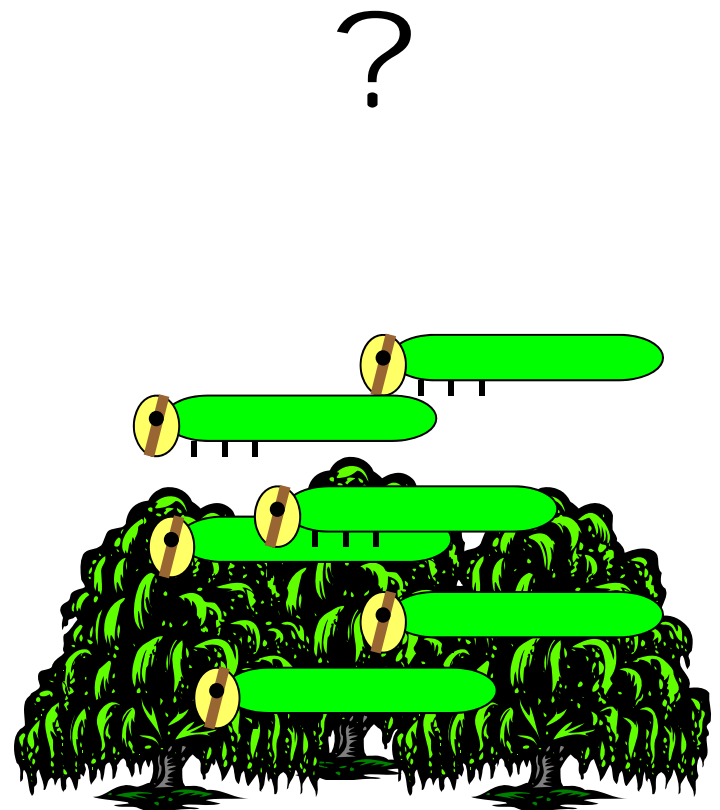
?



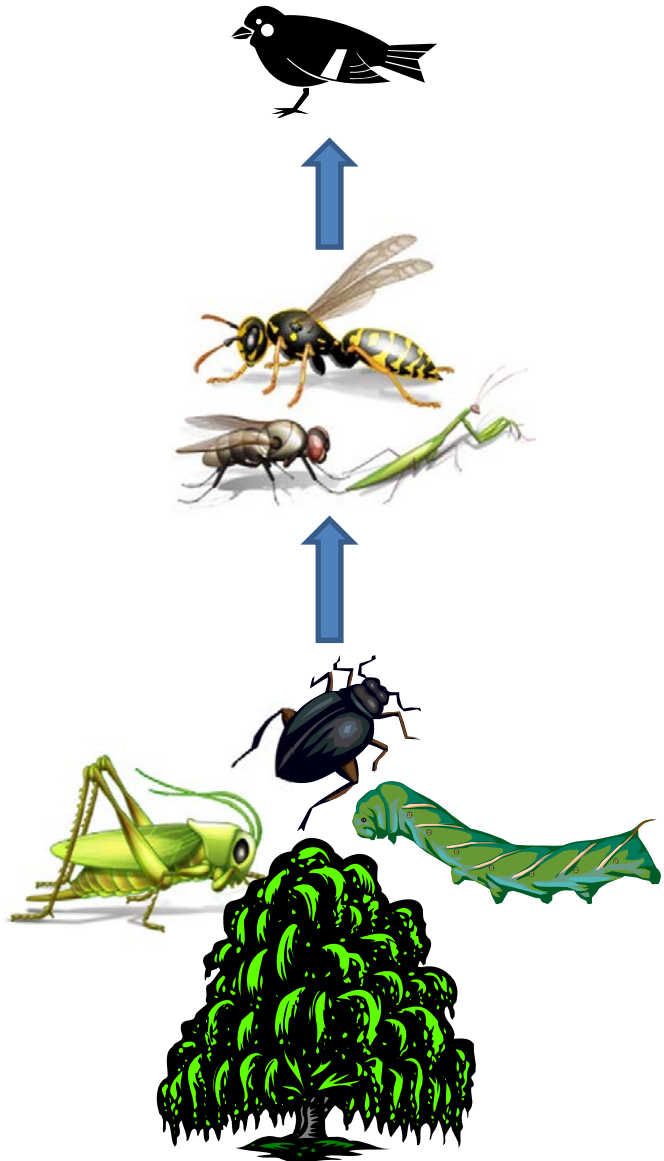
invasive



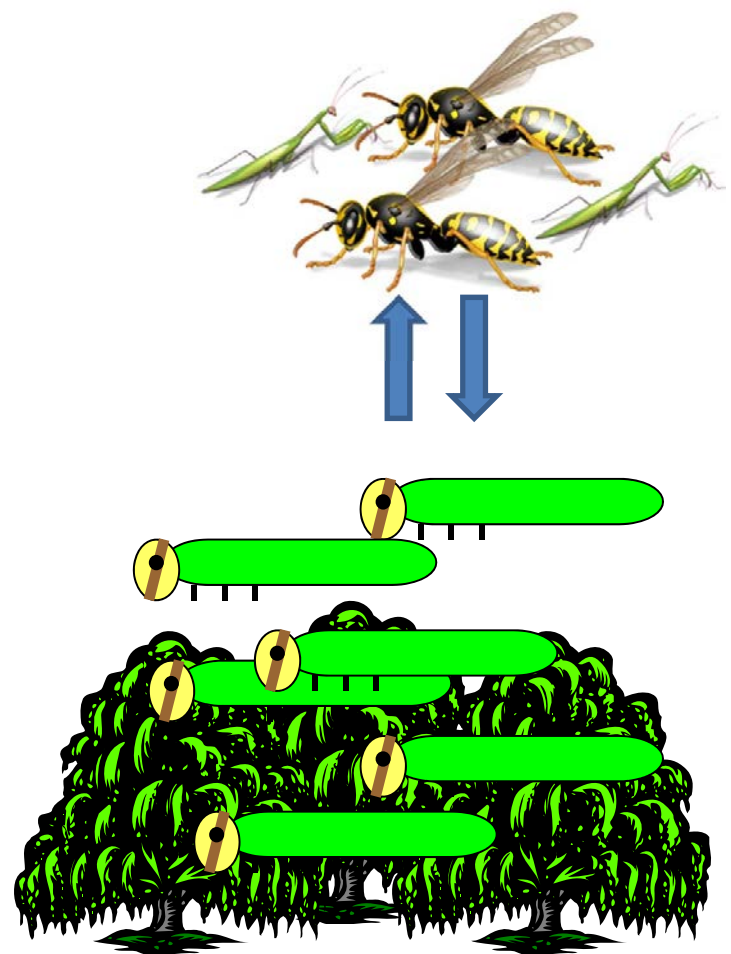
native



invasive



native



invasive

4- Invertebrate

Aim

- Compare invertebrate communities on willows under low and high sawfly densities





Field sites

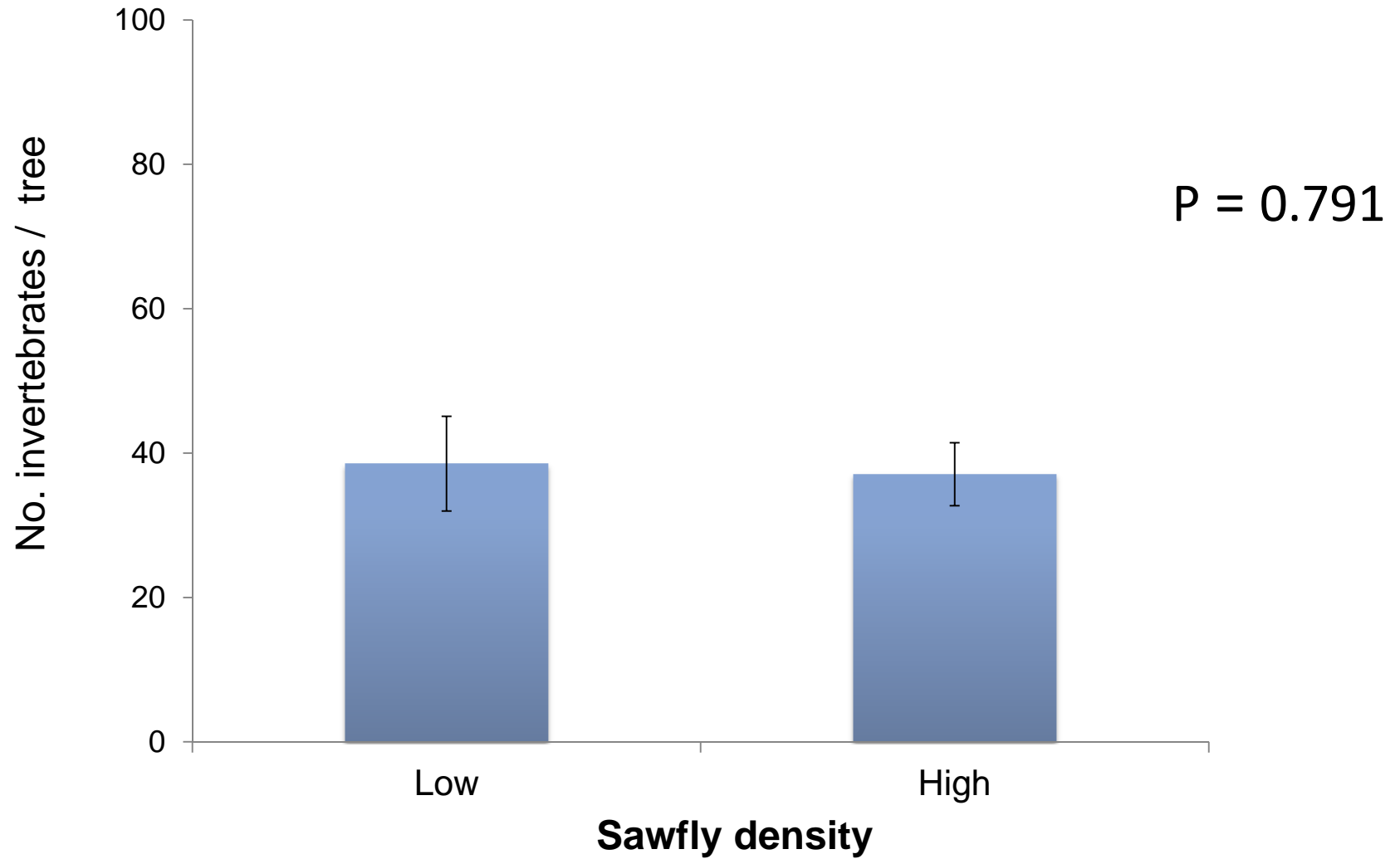
- 6 sites
 - Low and high sawfly densities
- *Salix x rubens*
- 5 trees per site

Methods

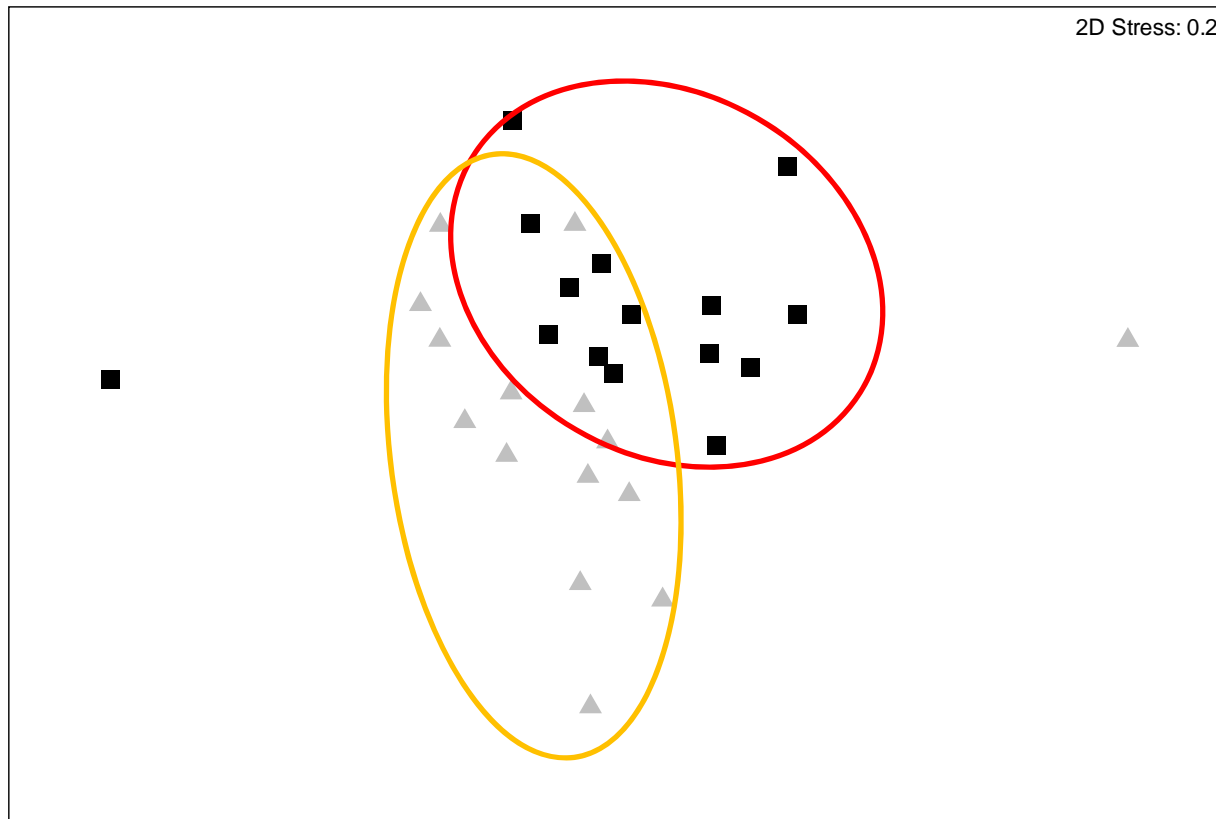
1. Visually
 - Target sessile organisms
2. Sweep net - 3 sides of trees
3. Sort to orders/
functional groups



Total abundance



Community composition



$P=0.001$

Low

More herbivores



High



Low

More herbivores



High

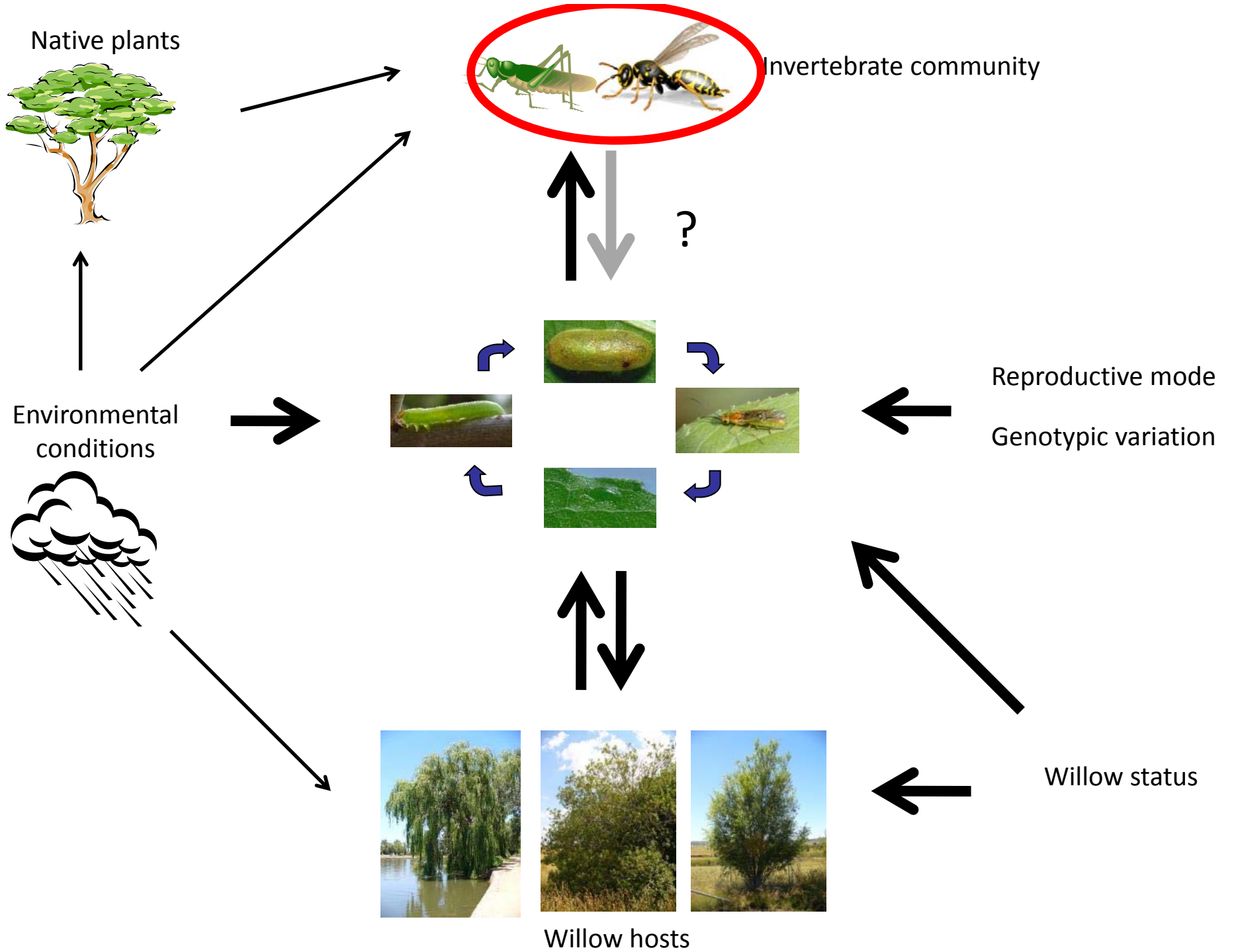
More predators



Results

- At high sawfly densities
 - More generalist predators
- Enough to control *N. oligospilus*?







Summary

- Pest or beneficial?
- Widespread and still expanding in Australia
- Specific to willows
- Some willow preferences
- Two superclones
 - Wide tolerance

Future research



- Effect on other trophic levels



Acknowledgements

- Dennis O’Dowd
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