Bio-Protection
Bioprotection science for New Zealand

What roles do biogeography and climate play in non-native invertebrate invasion

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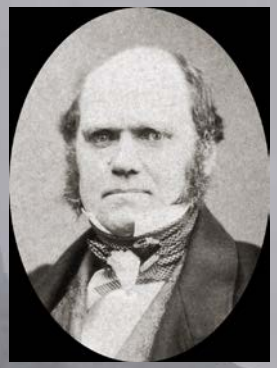
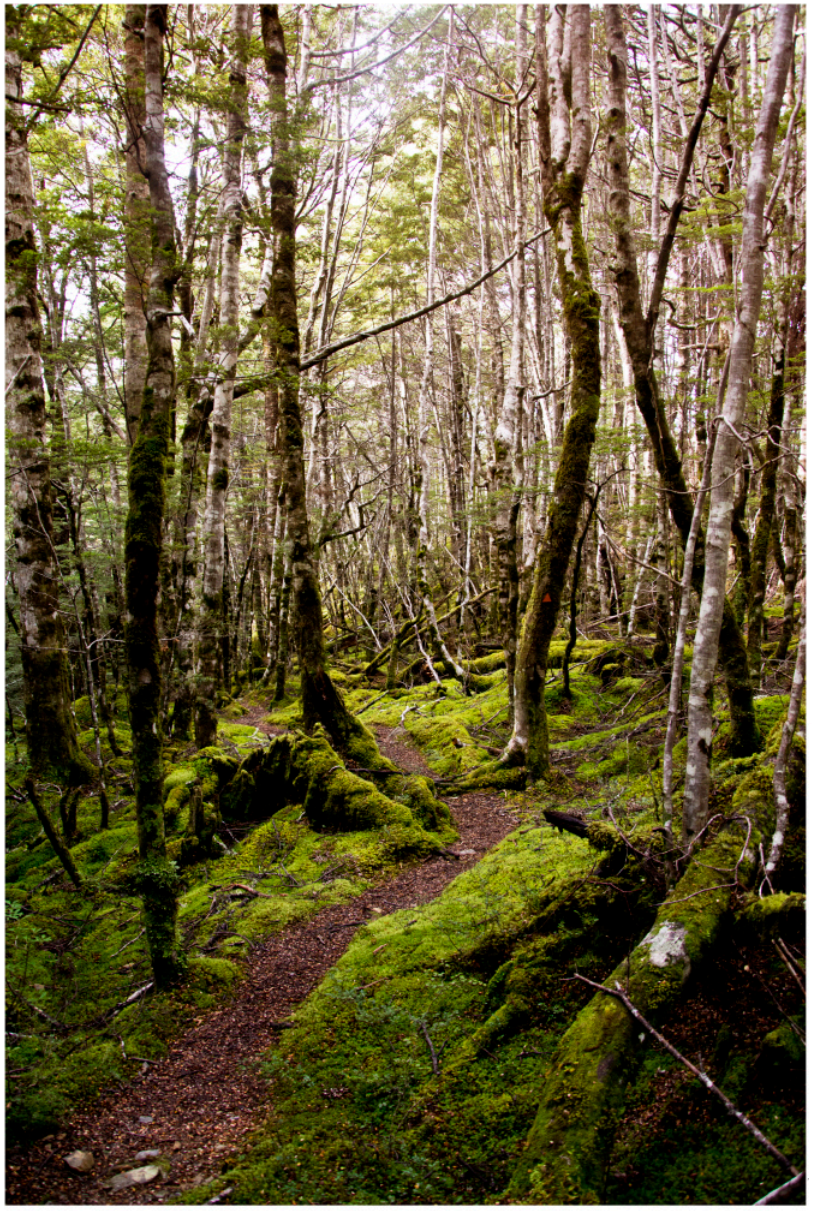
New Zealand reality



Charles Darwin
(1835)

"I believe we were all glad to leave New Zealand. It is not a pleasant place."

New Zealand unique natural ecosystems



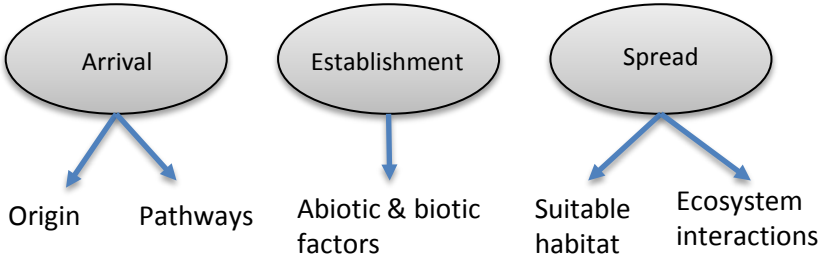
The overall aim of my research is to improve the risk assessment of invasive invertebrate species establishment and impact in indigenous ecosystems.

Non-native species

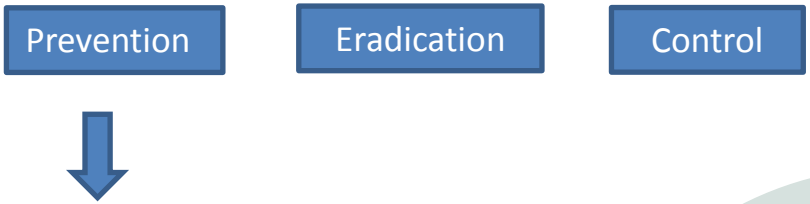
Establishment

Biodiversity loss

Invasion process characteristics



Management strategies



Pest risk assessment

Why invasive invertebrates?

Economic impacts

United States

- Destroy $14.7 billion of crops and forests each year

(Langor et al. 2009 & Pimentel, 2011)

New Zealand

- 90% of the country's invertebrate pests
- $ 165 million of loses from (key invertebrate aliens)

(Pimentel, 2002 & Brockerhoff et al. 2010)

Ecological Impacts

- Pests and predators of native species

New Zealand

Red back spider

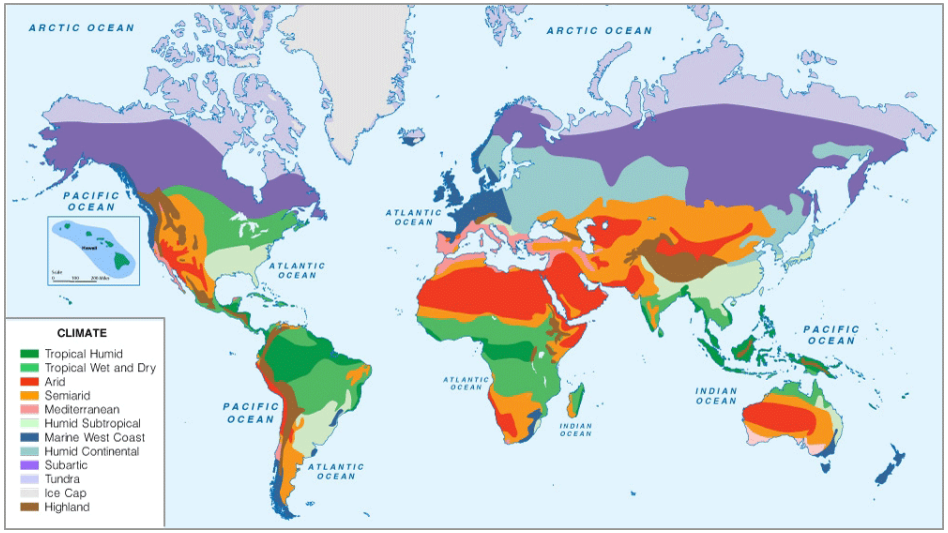
United States

Elm bark beetles

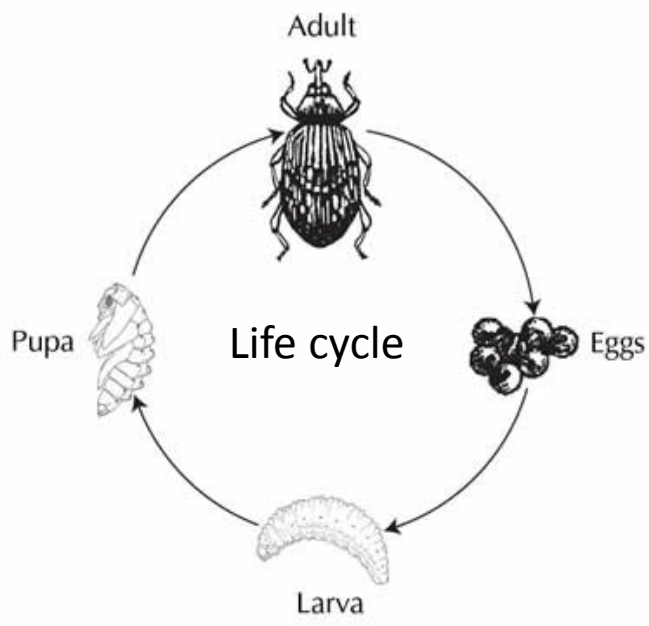
Climate and host's biogeography

Invasive herbivore invertebrates

Weather and climate



Poikilothermic species

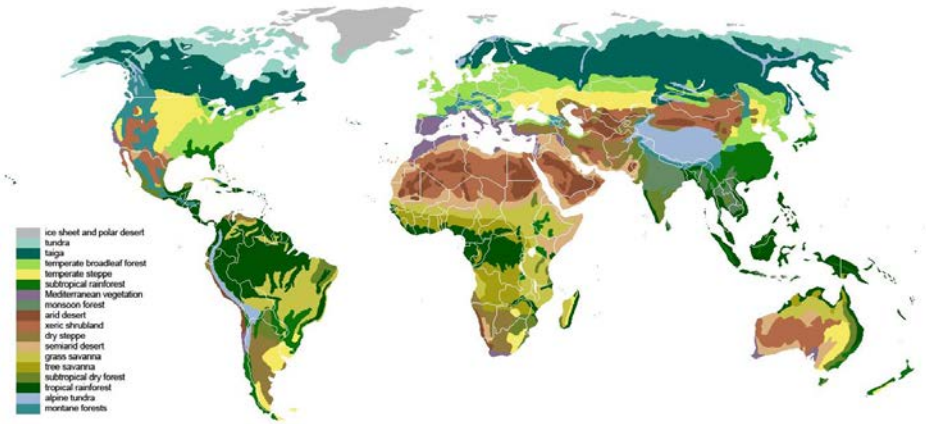


Climate and host's biogeography

Invasive herbivore invertebrates

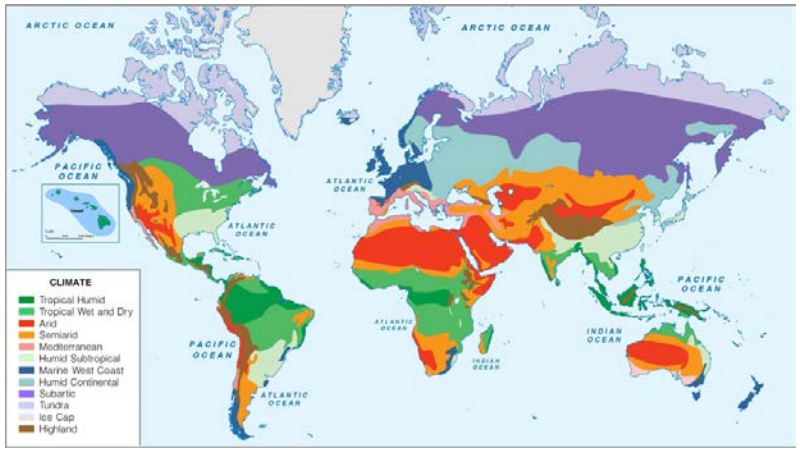
Host availability

Plant distribution

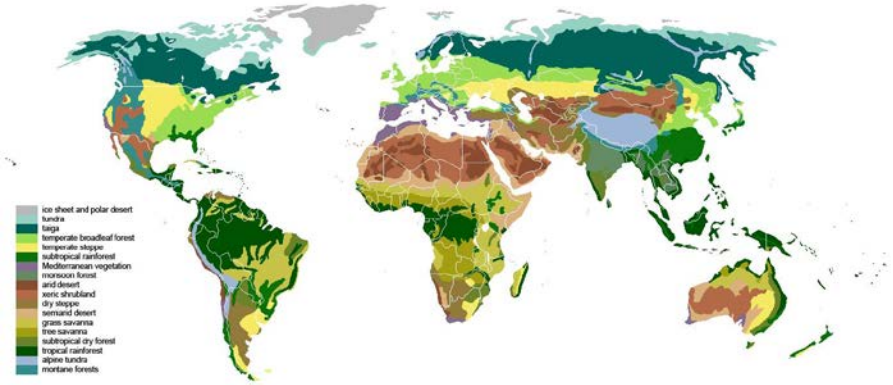


Objective and hypothesis

O: Determine the importance of biogeography and climate for risk assessment of the potential invasion and impact of non-indigenous invertebrates in natural ecosystems.



World climate



World biomes based on the type of dominant plant

H: Regions with climatic and biogeographic affinities are more likely to share invasive invertebrate species.

Applicability

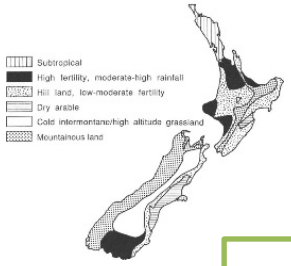
Help the policy makers and risk managers to prioritize their actions and efforts.

Methods: Climate Matching

Reference regions (‘home locations’)

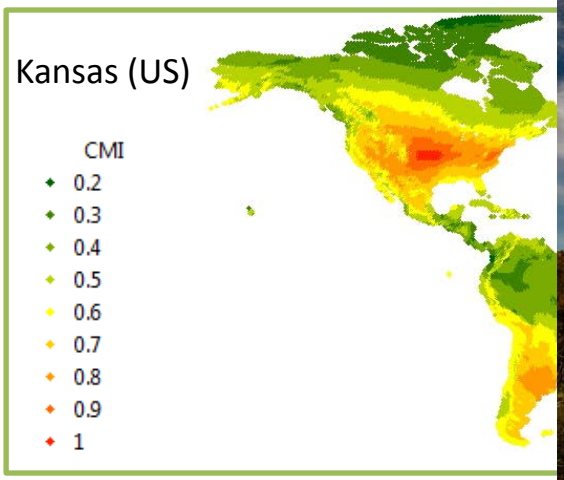
KANSAS (US)

NEW ZEALAND



CLIMEX

‘Regional climate matching’



Methods: Biogeographic Matching

Plant similarities

- Families distribution
- Genus distribution

→

Jaccard index
(similarity coefficient)

Jaccard distance

vegdist()
'vegan'

→

Similarity coefficient

Plant diversity and richness

- Families distribution
- Genus distribution

→

Faith's Phylogenetic Diversity (PD)
Sum of the total phylogenetic length of each sample

Species richness (SR)

Phylomatic

pd()
'picante'

Methods: Logistic regression (GLM)

RESPONSE

GLM1 Kansas

11 known invasive

3

GLM2 New Zealand

7 known invasive

Presence/ Absence

GBIF

Non-native beetles

PREDICTORS

Plant/Host

Jaccard index plant families
Jaccard index plant genus

gen_jaccard
fam_jaccard

Similarity variables

Climate Matching
CM 0 -1

Composite match index
CMI

Climate

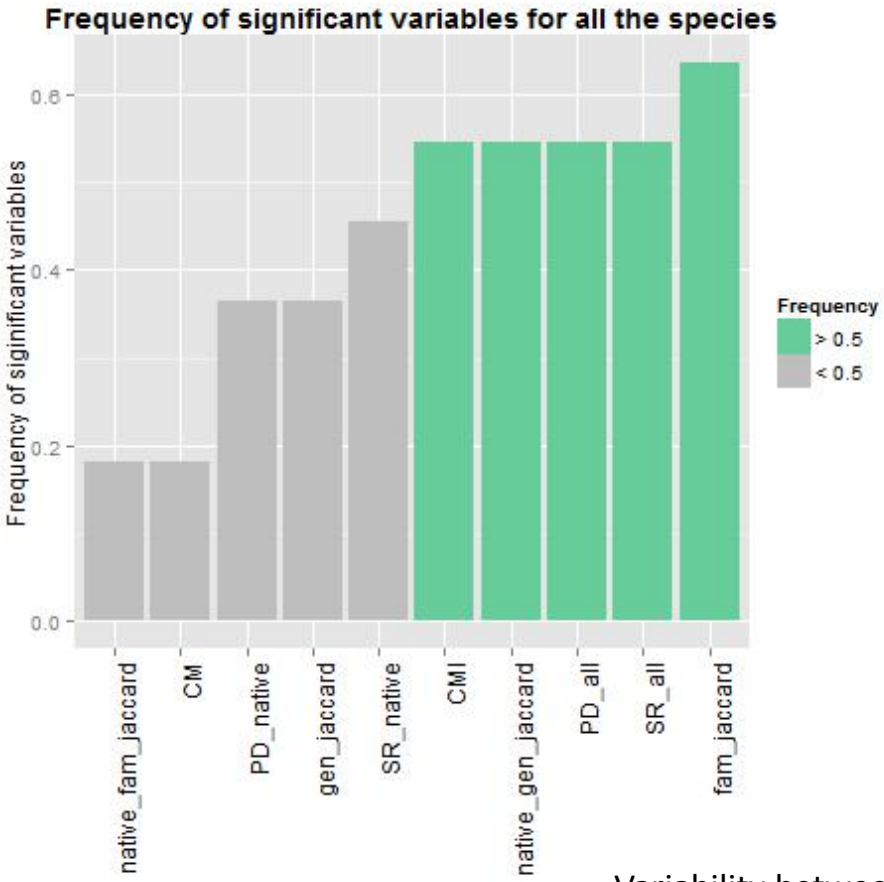
Plants phylogenetic diversity & species richness

PD & SR

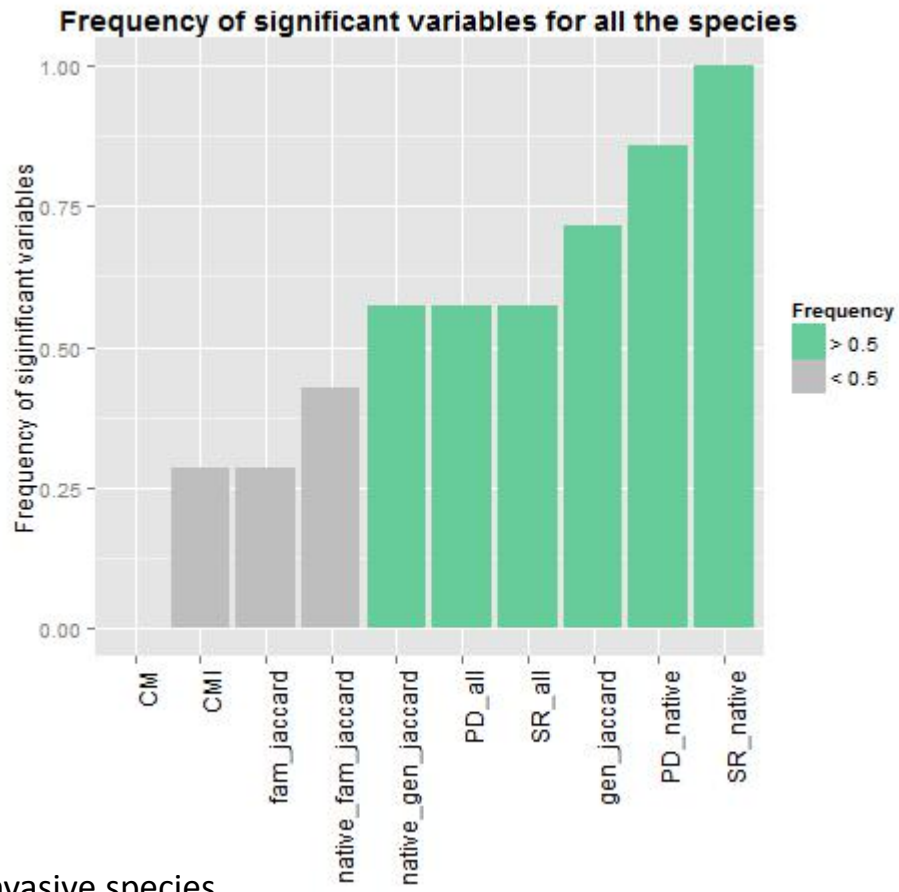
World distribution

Results and discussion: GLM variable selection

Kansas



New Zealand



- Variability between invasive species
- Plant similarity is significant for both regions (**jaccard**)
- CLIMEX Climate matching is not significant for New Zealand → **High climatic variability**

→ **Host's distribution**

Results and discussion: Model performance

Kansas

Invasive Species	Percentage
Anthonomus grandis	30.2%
Hypera posica	42.9%
Otiorhynchus sulcatus	48%
Otiorhyncus ovatus	56.8%
Rhinocyllus conicus	49.3%
Sitona cylindricollis	53.7%
Sitona hispidulus	41.8%
Sitophilus zeamis	28.8%
Scolytus multistriatus	52.2%
Scolytus rugulosus	27%
Scolytus schevyrewi	46.2%

New Zealand

Invasive Species	Percentage
Gonipterus scutellatus	44.9%
Listoderes crostriostris	49.4%
Otiorhynchus sulcatus	53.1%
Otiorhynchus rugosostriatu	44.3%
Rhinocyllus conicus	45.2%
Scolytus multistriatus	53.9%
Pantomorus cervinus	47.8%

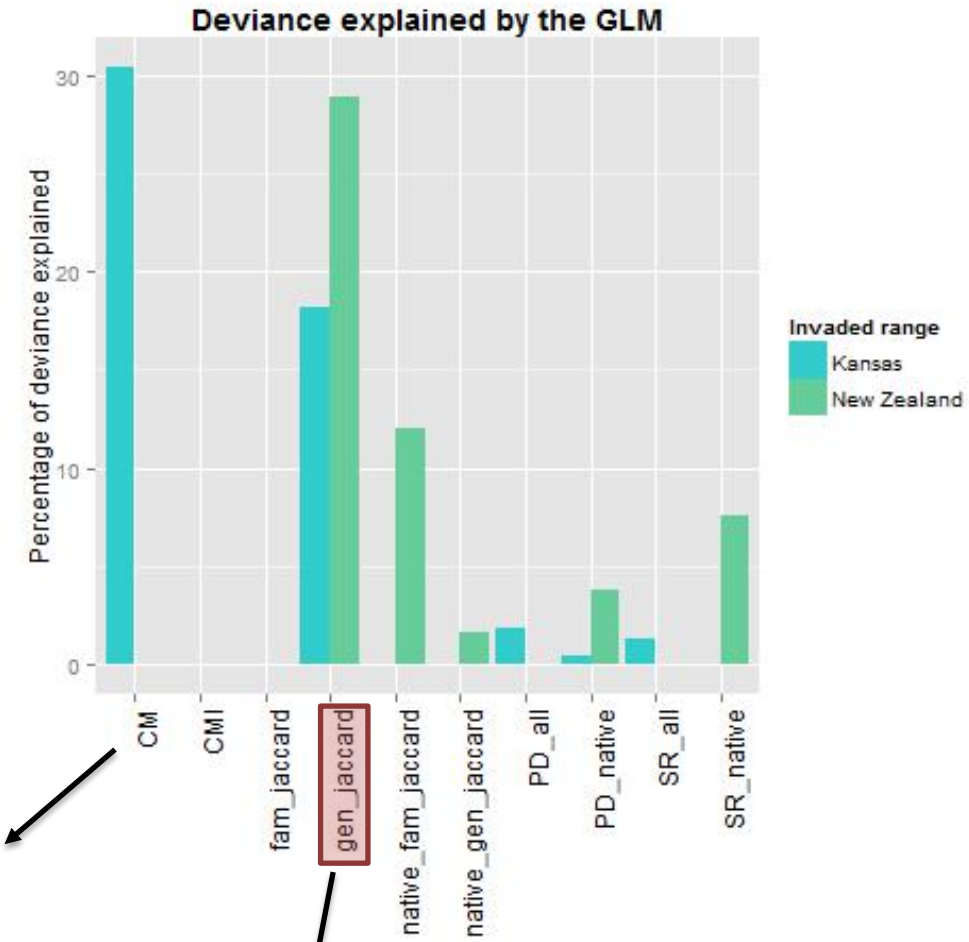
- Variability between invasive species in the same invaded range.
- Variability between species shared for the two invaded ranges.

- Low percentage of deviance explained by the models.
- All the models have a significant deviance explained.

Results and discussion: *Scolytus multistriatus*

European elm bark beetle

- **Monophagous**
- True bark beetle
- Prime vector of the Dutch elm disease fungus
- Hosts: US native and introduced elms.



Presence Regions with climatic affinities with Kansas

Plant similarity at genus level

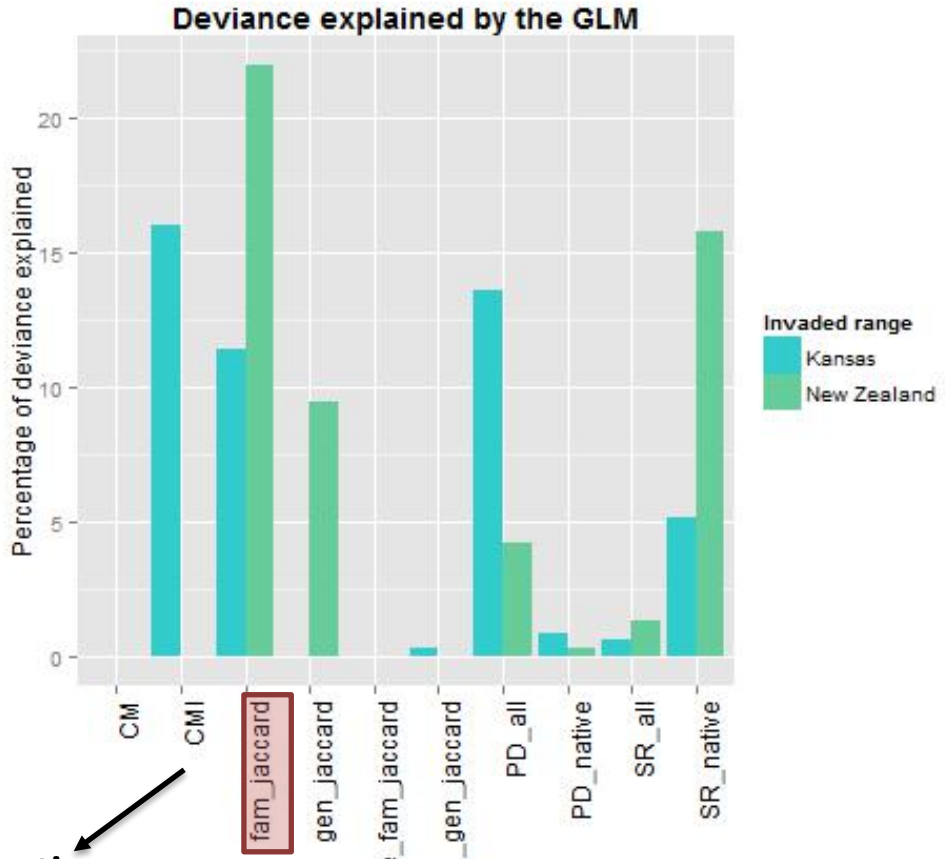
Results and discussion: *Otiorhynchys sulcatus*

Black vine weevil

- **Polyphagous**
- Root weevil
- Primary species afflicting crops globally
- Hosts: angiosperms: Rosales, Primulales, Saxifragales and Ericales.

(Van Tol, et al. 2012)

Plant similarities between countries could be a good predictor of potential source regions of herbivore invasive invertebrates.

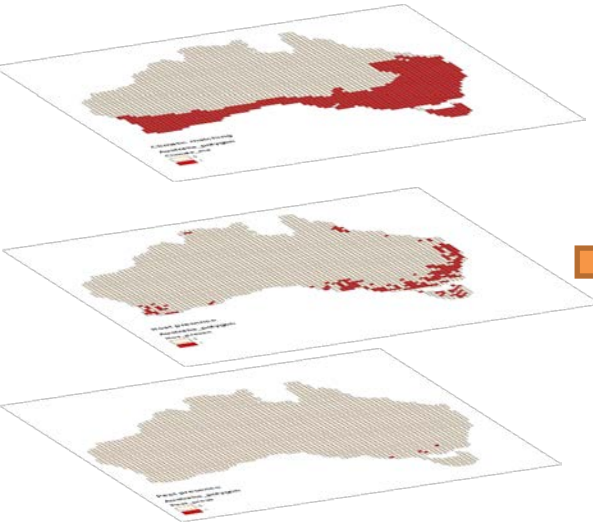


Presence Regions with climatic affinities with Kansas

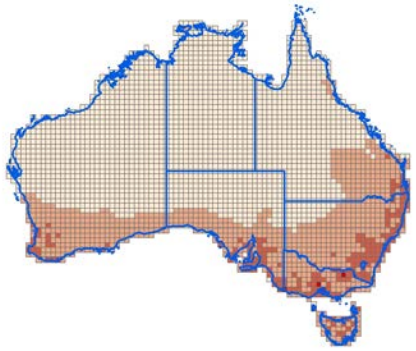
Plant similarity at family level

Future directions to improve risk assessment

- Is there a general pattern?
- Regional scale: how will affect the significance and deviance of the variables studied?



Australia

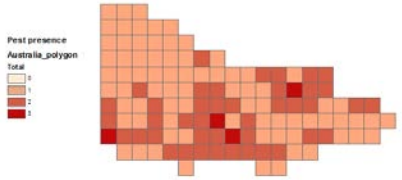


Climate Matching

Host presence

Pest presence

Victoria State



Species Richness

Faith's Phylogenetic Diversity: calculates the sum of the total phylogenetic branch length for one or multiple samples.

Mean pairwise distance: calculates mean pairwise distance separating taxa in a community.

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https://mricartnz.wordpress.com/

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