

AMY VAUGHAN

PREDICTING
INVASIVENESS
USING HIGH
PRIORITY
EXEMPLAR
SPECIES

THE TEAM



Co-leads

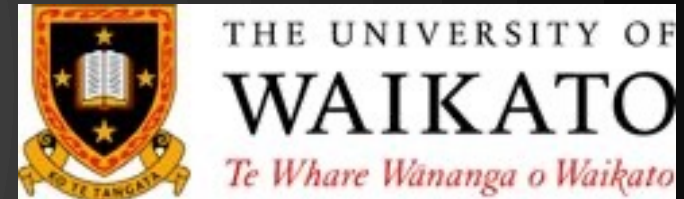
- Manpreet Dhami- MWLR
- Ang McGaughran- UoW

Postdoc

- Ellie Parvizi- UoW

Machine Learning advisor

- Tony Smith- UoW



The problem



Current approaches



A pathway to an accurate predictive tool?

PREDICTING
INVASIVENESS
USING HIGH
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SPECIES

INVASIVE SPECIES

Threaten native biota and impact primary industries

Increased trade and climate change increase vulnerability

Exotic organisms that impact health, agriculture, freshwater and indigenous flora and fauna

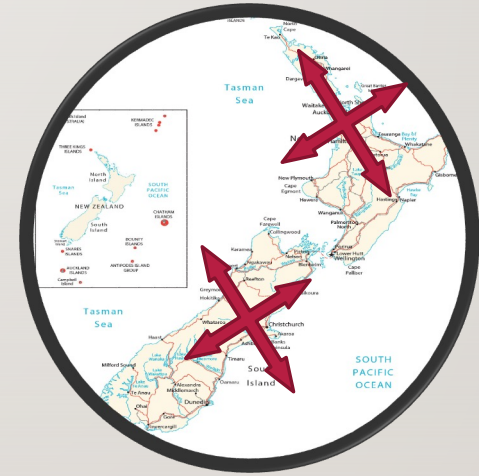
MECHANISMS OF INVASION



INTRODUCTION

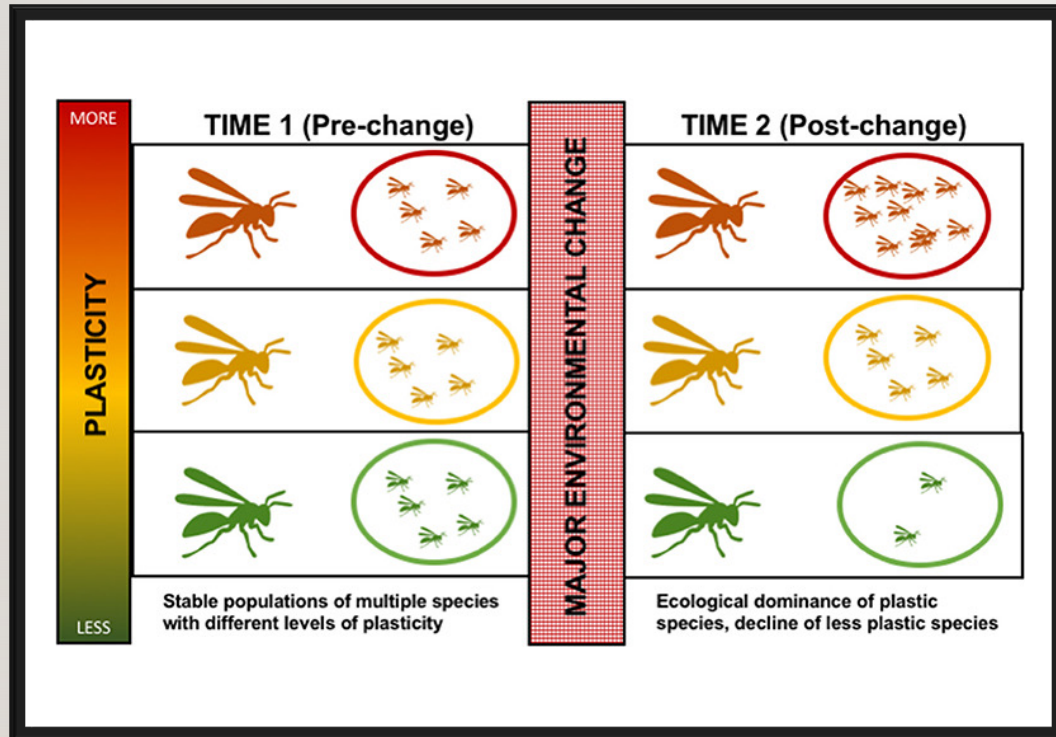


ESTABLISHMENT



SPREAD

A MECHANISTIC ABILITY TO INVADE



Genomic mechanisms of invasiveness

Duplications/ SNPs

Acquired beneficial traits

Manfredini F, Arbetman M, Toth AL. A Potential Role for Phenotypic Plasticity in Invasions and Declines of Social Insects. *Frontiers in Ecology and Evolution*. 2019;7.

AOTEAROA NEW ZEALAND

Impact globally (\$70b USD)

Impact New Zealand (\$4.3b NZD)

Land use and traffic increases invasive species

Risk escalating



German wasp



Argentine ants



Great white butterfly

CURRENT PREDICTION METHODS

- Environmental factors - currently using climate
- Risk pathways
- Statistical profiling from traits database
 - Occurrence, morphology, behaviour
- Genomics - the way forward?

RISK ASSESSMENT

Likelihood of entry

Likelihood of
establishment

Likelihood of spread

Impact (social, cultural,
environmental, economic)

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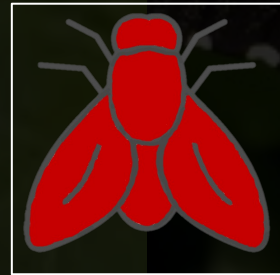
Likelihood of spread

Impact (social, cultural,
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GENOMIC TRAITS-BASED MACHINE LEARNING FRAMEWORK



Identify genome encoded features that are associated with an organism's ability to proliferate



Training framework using known invasive species to produce a scaled prediction output that categorises risk



High risk, medium risk, low risk categorisation

MACHINE LEARNING



Using data to predict output values- in this case invasiveness score



Predicting patterns within the data

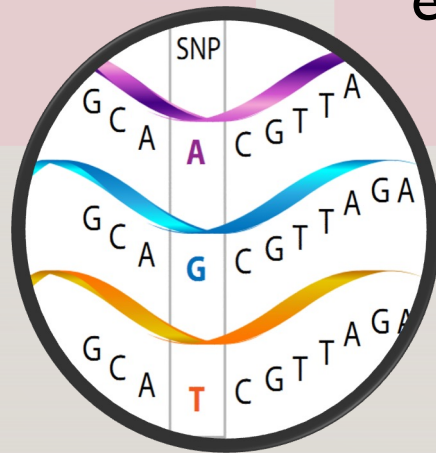


Characteristics determining 'invasiveness' not well defined

DATA TYPES FOR IDENTIFICATION OF GENOMIC TRAITS

SNPs

Intra and inter gene changes to beneficial genes



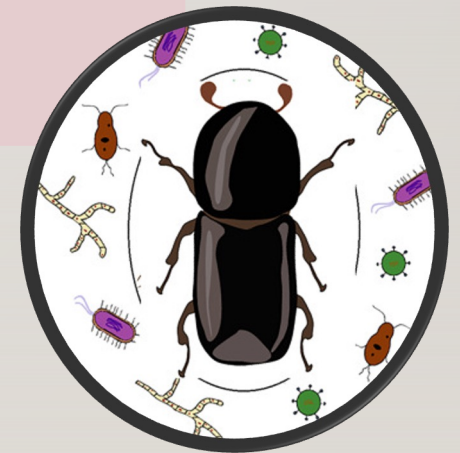
Genomes

Presence/absence beneficial genes; gene family evolution



Microbiome

Beneficial microbes that are associated with invasive populations





Queensland fruit fly

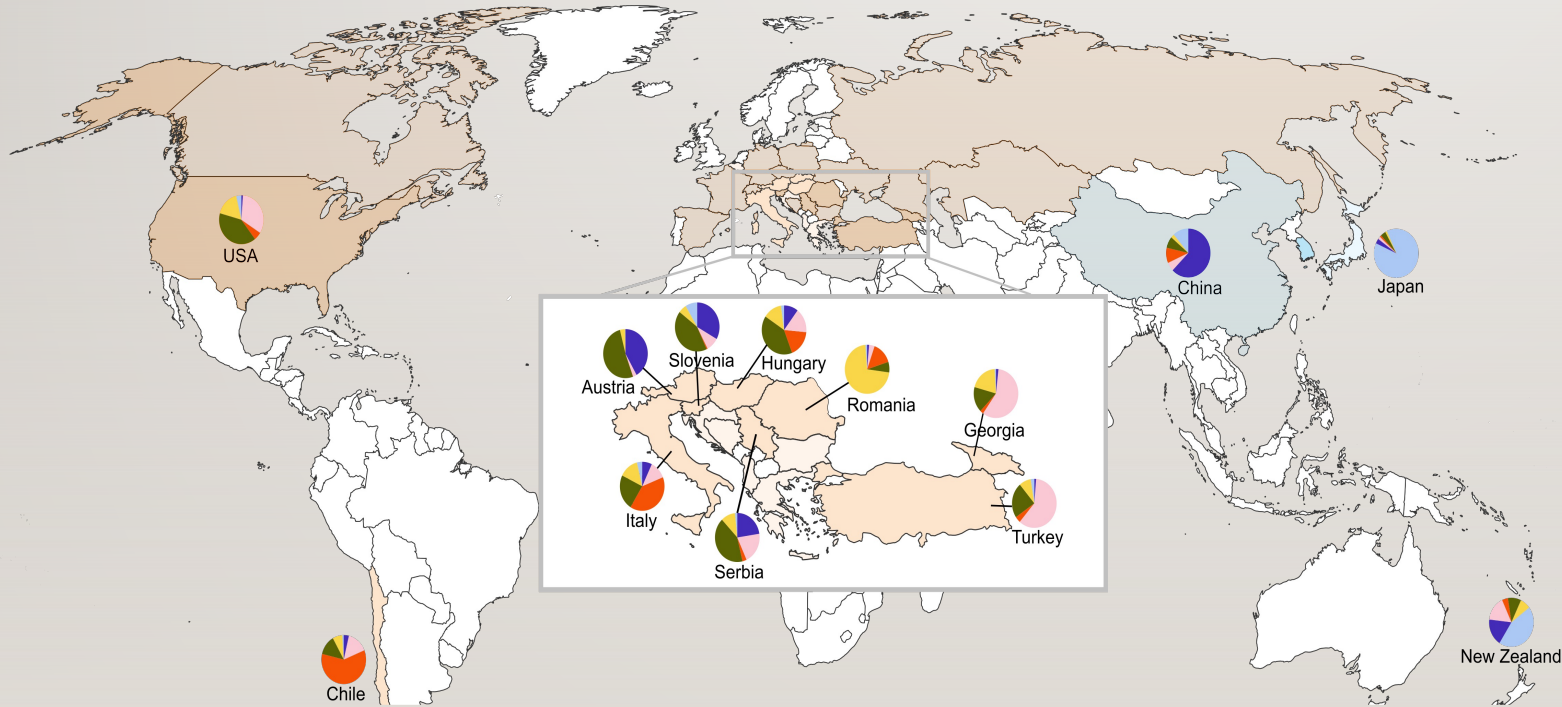


Drosophila suzukii



Brown marmorated stink bug

POPULATION GENOMICS



- Tracing sources of invasion
- Understanding the role of evolutionary adaptation in invasion success
- Predicting invasion potential
- Development of a comprehensive database of genomic traits from invasive and non-invasive populations

BIOSECURITY APPLICATIONS

- Predictive score of invasiveness for imminent threats
- Better management and biosecurity outcomes with potential for any mechanistic insights
- Particularly useful for 'unknown' species (e.g., fungi, viruses, bacteria)
 - Ultimately, the tool will be species agnostic



THANKS! ANY QUESTIONS?

Acknowledgements

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