Potential spread of invasive species in NZ: modelling, mapping & art

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Invasive Species

- Pests, Non-native, Alien Species
- Greatest Threat to Biodiversity and Native Species
- Impacts Agriculture, Horticulture, Forestry and Related Industries
- Economic/Social Costs: Risk Management and Mitigation, Health and Socio-Cultural Well-being

- Biosecurity 2025: “Biosecurity team of 4.7 million”
- Predator Free 2050: remove major threats to native wildlife

- Decision and Planning
- Information and Education
- Scientific data -> Models -> Maps -> Art as a Cultural Lens
<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Suitability modelling of Argentine ant, Northern Pacific seastar, Rosy Wolf Snail – (Applied GIS Students Unitec)</td>
<td>NETS Biosecurity Conference</td>
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<td>2017</td>
<td>Brown Marmorated Stinkbug, Myrtle Rust</td>
<td>Climate Journal, NETS Biosecurity Conference</td>
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<tr>
<td>2018</td>
<td>Species Distribution Models – Applied GIS, Self-Directed Studies (Bachelor of Applied Science), Drone Imagery for Vegetation Mapping</td>
<td></td>
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</tbody>
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Model and Map Production

- **Downloaded Occurrence Data (GBIF*, NVS)**
- **ArcMap (SDM Toolbox): Redundancy, Rarefy, Latitude Bias**
- **Corrected/Rarefied Occurrence**
- **ArcMap Raster Tools: Cross Correlation, Conversion for Modelling**
- **Selected Rasters**
- **Modelling Tools: Dismo in r (SVM, RF, Maxent, GLM), Maxent**
- **Suitability Maps: Projected to Different Areas and/or Future/Past Conditions**

*Global Biodiversity Information Facility*
Art and Information Production Workflow

Suitability Maps: Projected to Different Areas and/or Future/Past Conditions

Output Generation

- Publications
- Story Maps
- Art


**Bractocera tryoni** (Queensland fruitfly)

- Native of Australia
- Most serious pest for fruits and vegetables
- Single fly findings cause for major control efforts in Auckland (2012) and Whangarei (2014)
- Impacts:
  - Major pest of Fruit Crops

Ref/image source: http://www.biosecurity.govt.nz/pests/
http://www.issg.org/database/species/search.asp?st=100ss
**Trachycarpus fortunei** (Chinese Fan Palm, Chinese Windmill Palm)

- Native to Central South China, Burma and Northern India
- Cold-hardy palm
- In 100 of World’s Worst Invader List
- Climate change bio-indicator
- Impacts:
  - competition
  - shade
  - form dense stands

Ref/image source: http://www.issg.org/database/species/search.asp?st=100ss
Halyomorpha halys (Brown marmorated stink bug)

- Very Destructive orchard pest
- Stinky household invader
- Native to China, Japan, Korea and Taiwan
- 4 Ships with BMSB turned away in 2018
- $1.8-$3.6B Impact to NZ Economy
Current – Worldclim database
Future: 2050 and 2070 – CGIAR database
Representative Concentration Pathways (RCP) and their Corresponding CO₂ concentrations
- (RCP2.6) 421 ppm
- (RCP4.5) 538 ppm
- (RCP6.0) 670 ppm
- (RCP8.5) 936 ppm

Downscaled and Clipped to NZ territory
Results: Chinese Windmill Palm

- Current
- RCP 2.6 2050
- RCP 2.6 2070
- RCP 8.5 2050
- RCP 8.5 2070

Habitat Suitability:
- High
- Low
- Occurrences

Distance in Kilometers:
- 0
- 50
- 100
- 150
- 200
- 250
- 300
- 350
- 400
- 450
- 500
- 550
- 600
- 650

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Results: Chinese Windmill Palm Model

Current | RCP 2.6 2050 | RCP 2.6 2070 | RCP 8.5 2050 | RCP 8.5 2070
---|---|---|---|---

Presence/Absence

Comparison
Results: Brown marmorated stink bug
Results: Queensland Fruitfly

- Current
- RCP2.6 2050
- RCP2.6 2070
- RCP8.5 2050
- RCP8.5 2070

Legend:
- Blue: Absence for Both
- Green: Tararua Only
- Yellow: GFF Only
- Red: Presence for Both
NZ Territories BMSB presence prediction with climate change

Current

RCP 8.5 2070
A performance based consensus approach for predicting spatial extent of the Chinese windmill palm (Trachycarpus fortunei) in New Zealand under climate change

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Abstract
A performance based consensus approach for predicting spatial extent of the Chinese windmill palm (Trachycarpus fortunei) in New Zealand under climate change was developed using a regional algorithm with inputs of climate, occurrence information and habitat suitability. A logistic regression model was developed and projected into New Zealand to provide a visualization of suitability for the species in current and future conditions. In order to establish, validation accuracy was first checked for the sub-national model and the environmental variables checked for over-corresponding and overfitting. The model was then validated using a receiver-operating characteristic analysis and the predictions of all the sub-nation model. Modeling results were then analyzed for the current and future climate scenarios. The final model was then used to predict the spatial extent of the species under the different climate scenarios.

Keywords: Chinese windmill palm; habitat; climate change; modeling; climatic niche; New Zealand; climate change.
http://arcg.is/1zSTASH
3D Viewing Output from ArcGIS Pro

Suitability Models:
RCP8.5 2070
RCP2.6 2070
Current
Centroid Movement
Fly in the Ointment by Hamish Foote, 2015

QFF and impact on Taraire, with associated Silver Paint Lichen

“The painting requires the viewer to see the impacts of invasion on native biodiversity, an examination through the lens of a cultural rather than fiscal currency” (Foote et al., 2017)
Current and Future Work

- Drone Acquired Imagery for Ecological Restoration/Weed Management
- NDVI/NDRE Based Vegetation Classification
- GIS Capability Building for He Ripo Kau
Summary and Conclusion

Suitability mapping of invasive species provides knowledge and information products that supports decision making, planning and strategy formulation for risk management.

Presentation of map outputs in different formats ensures provisions for varied interpretations, provide the ability to cater to a diverse audience and allow for a variety of provocations when looking at invasive species through different lenses, including cultural, scientific and fiscal ones.