Future proofing plantation forests from pests

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Plantation forests within New Zealand

- New Zealand has 1.8 million ha in plantations (6.7% land area)
- Comprise ~90% *Pinus radiata*
- *Pinus radiata* susceptible to many insects, pathogens
- Lack of species diversification high risk to NZ economy
Pest impact to the forest industry

- Several important forest pests already established in NZ
- Losses to industry high
- Large potential for greater losses under climate change
- Sub-tropical pests often very invasive
Objectives

• Determine climatic suitability for three key plantation pests under current and future climate
  – *Fusarium circinatum* (pitch canker), devastating disease
  – Pine processionary moth - defoliating insect
  – *Buddleja davidii* – highly invasive weed
• Determine potential impact of pine processionary moth on plantation forests
The model

• CLIMEX, a process based distribution model

• Projecting potential distribution of invasive pests

• Global meteorological database
  – ~50 km² grid resolution,
  – Generated from 1961 to 1990 climate normals
The model

- Climate linked to distribution through process-based algorithms
- Integrates a population’s response to climate via:
  - Growth index and eight stress indices
- Indices parameterised from presence data or laboratory measurements
- Model outputs Ecoclimatic Index, that indicates the suitability of climate for the pest.
Climate change scenarios

• Six scenarios (to 2080’s) covering a range of climate sensitivity
  – Three Global Climate Models
    ▪ CSIRO Mark 3.0 (2.11 °C)
    ▪ NCAR-CCSM (2.47 °C)
    ▪ MIROC-H (4.13 °C)
  – Two standard IPCC scenarios
    ▪ Medium emissions (A1B)
    ▪ High emissions (A2)
Pitch canker

- Not currently in NZ, but problematic in USA, Spain
- Devastating disease of pines - can suppress growth or kill the tree
- *Pinus radiata* considered the most susceptible pine species
- Most unwanted disease in many countries with plantation pines
Pine plantations

Current climate E1
Future climate scenarios

CSIRO

NCAR

MIROC
Buddleja davidii (butterfly bush)

- Current weed in New Zealand
- Very popular, attractive garden plant
- Also, high impact weed, fast growth, prolific seed production
- Rated most problematic weed in central North Island
- Competes strongly with trees, particularly during juvenile period
Current and potential *B. davidii* distribution

*B. davidii* distribution

Current climate EI
Future climatic suitability

B. davidii distribution

Current climate E1

MIROC

[Maps and charts showing distribution and climate suitability]
Climate matching

- UK has been extensively invaded
- Matches climate in Southland, Otago, Canterbury to UK
- Match in terms of min., max., temp, rainfall quantity and pattern
- CMI > 0.7 biologically relevant, >0.8 close match
Control measures

- Include on RPMS Canterbury, Otago, Southland, Marlborough
- Remove horticultural threats
- Prevent spread into strategic exclusion zone
- Biological control
  - Preliminary success with *Cleopus japonicus*
Pine processionary moth

- Not currently in New Zealand
- Pine processionary moth significant defoliator of pines in Europe
- Of interest as radiata pine is a preferred host
Projected potential distribution

Current climate
Projected potential distribution

Current climate

Future climate

Eccolimic Index (EI)
- Unsuitable (0)
- Marginal (1 - 5)
- Suitable (6 - 25)
- Optimal (>25)
Linking climate suitability to plantation growth losses
Plantation productivity under current and future climate

• Simple empirical model used
• Mean national projected merchantable volume
  – 566 m³ ha⁻¹ under current climate
  – Range 512 to 531 m³ ha⁻¹ under climate change
• Model only accounts for effects of climate change on air temperature and water balance
Effect of pine processionary moth on volume production under current and future climate

- Assuming PPM dispersed throughout NZ
  - Under current climate projected mean volume reductions of 16%
  - Under climate change mean volume reductions of 31%
  - Range of 29% to 33% between scenarios
Further work

• Three year MAF SLMACC project 2009 -2012

• Develop DSS that accounts for both direct (environment) and indirect effects (biotic, abiotic factors) of climate change on growth and rate of return

• DSS will possibly provide impetus to diversify the plantation estate
Acknowledgements

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Papers, popular articles from project

- Watt, M.S., Kriticos, D.J., Bourdôt, G.W. 2010 Nothing pretty about Buddleia. MAF Biosecurity 97, 30-31