

Future proofing plantation forests from pests

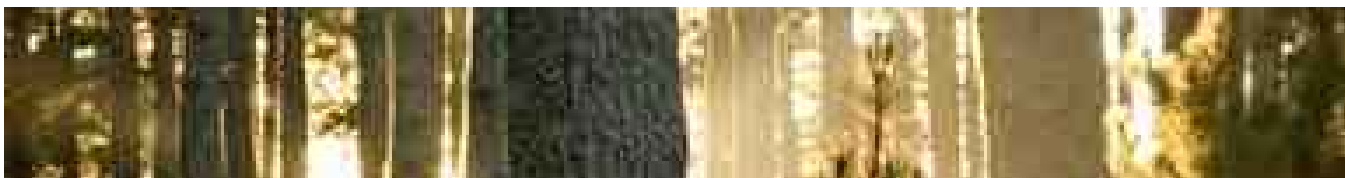
Michael Watt, Rebecca Ganley, Darren Kriticos,
Karina Potter, Lucy Manning, Graeme Bourdot, Nita Tallent-Halsell



Plantation forests within New Zealand

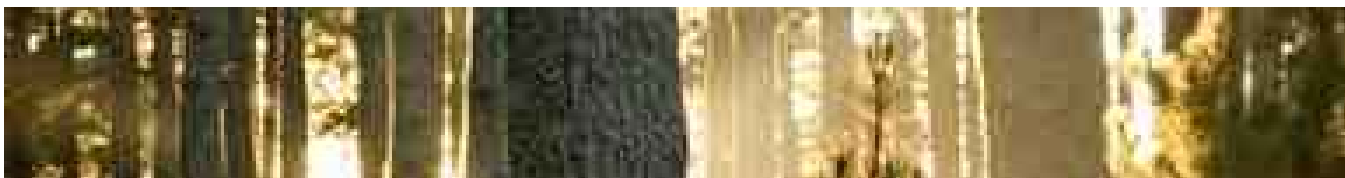


- New Zealand has 1.8 million ha in plantations (6.7% land area)
- Comprise ~90% *Pinus radiata*
- *Pinus radiata* susceptible to many insects, pathogens
- Lack of species diversification high risk to NZ economy



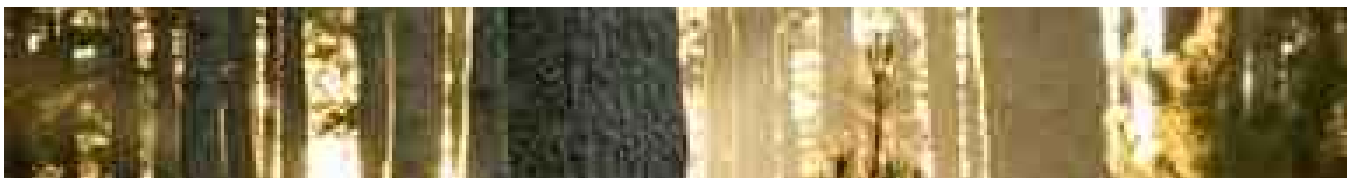
Pest impact to the forest industry

- 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



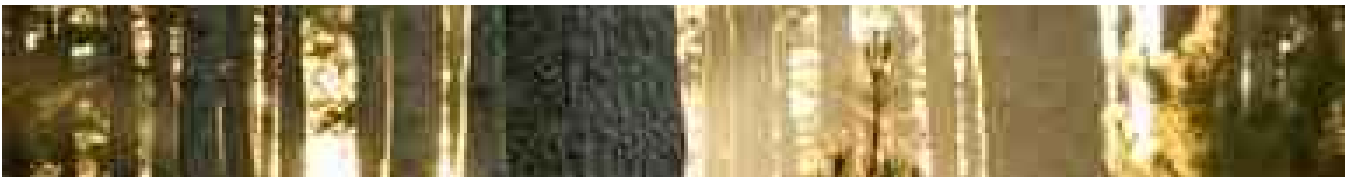
Objectives

- 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



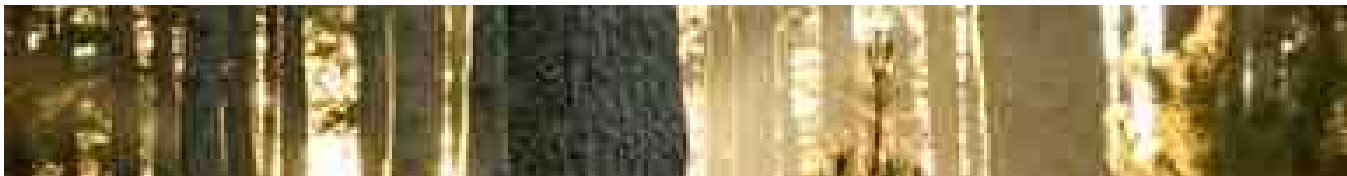
The model

- 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



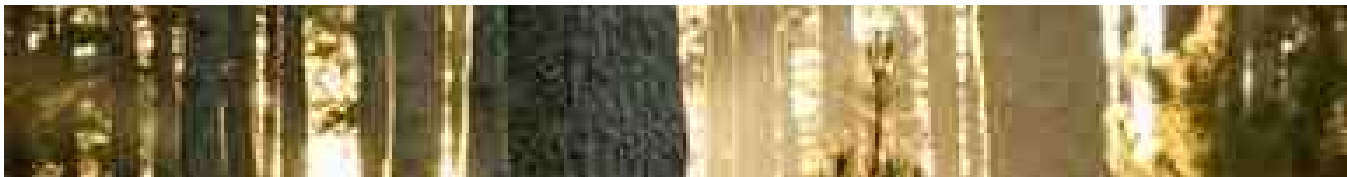
The model

- 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

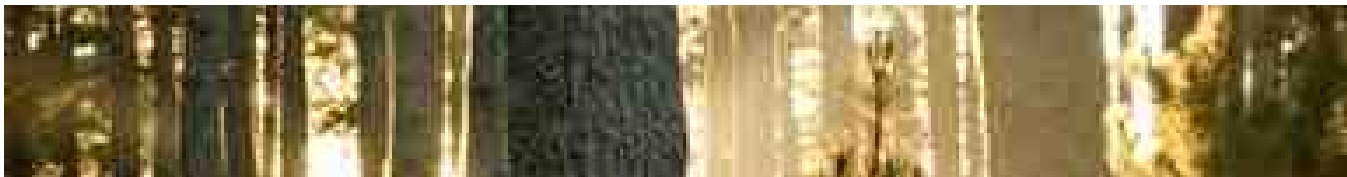
- Six scenarios (to 2080's) covering a range of climate sensitivity
 - Three Global Climate Models
 - CSIRO Mark 3.0 (2.11 °C)
 - NCAR-CCSM (2.47 °C)
 - MIROC-H (4.13 °C)
 - Two standard IPCC scenarios
 - Medium emissions (A1B)
 - High emissions (A2)



Pitch canker



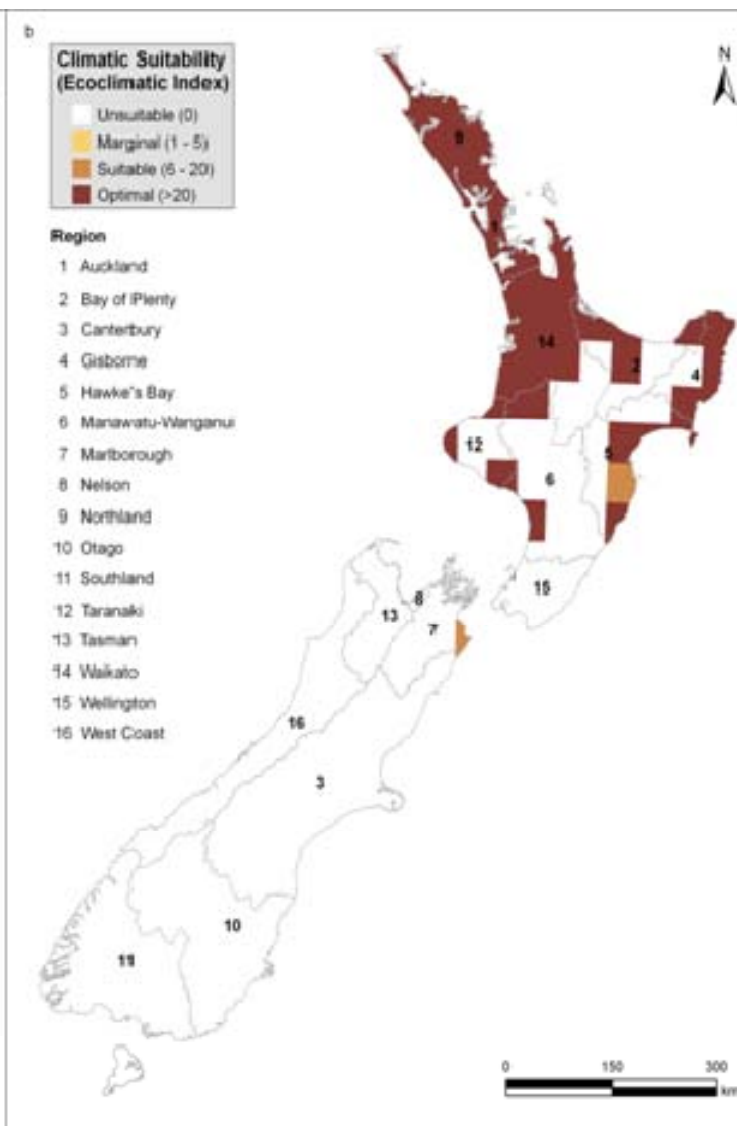
- **Not currently in NZ**, but problematic in USA, Spain
- Devastating disease of pines - can suppress growth or kill the tree
- *Pinus radiata* considered the most susceptible pine species
- Most unwanted disease in many countries with plantation pines



Pine plantations



Current climate EI

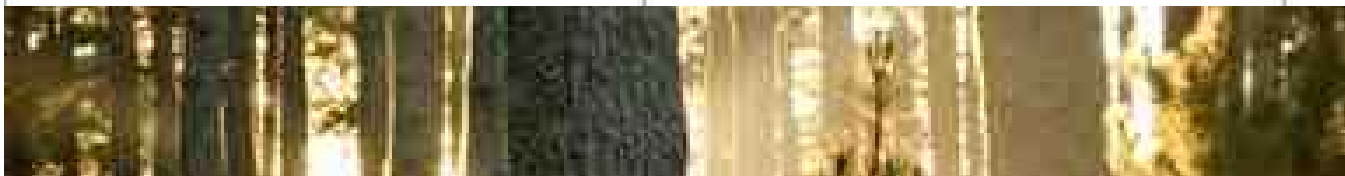
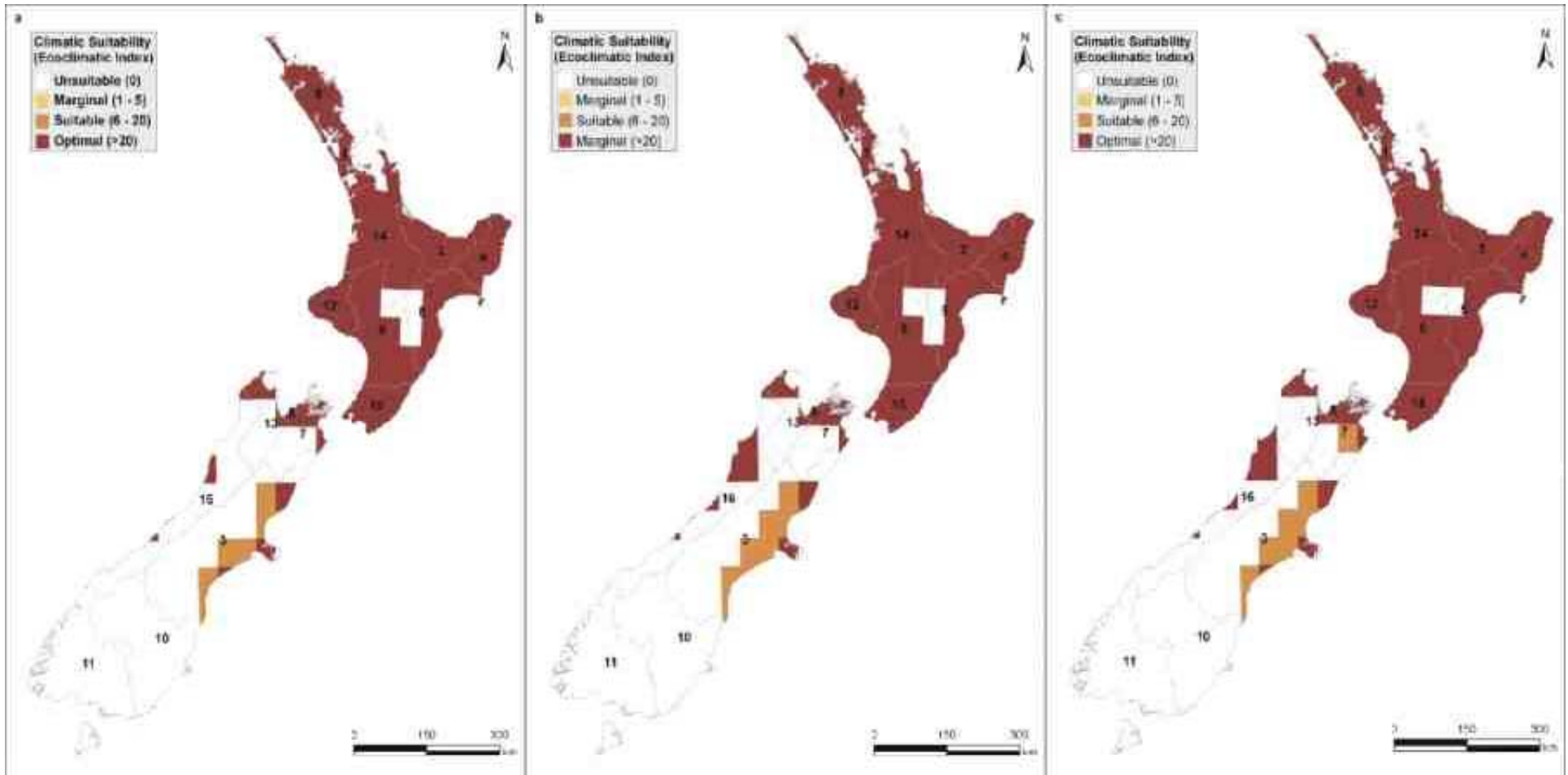


Future climate scenarios

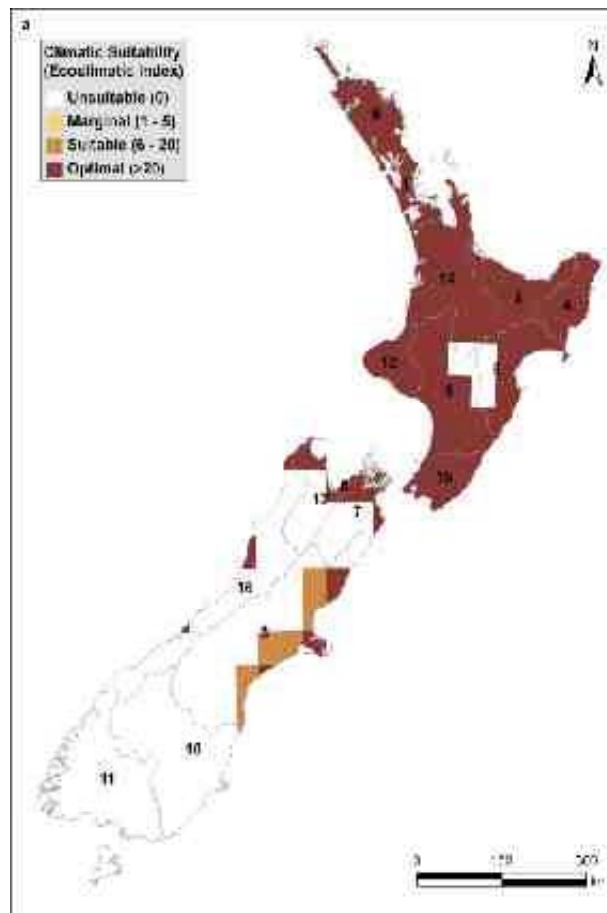
CSIRO

NCAR

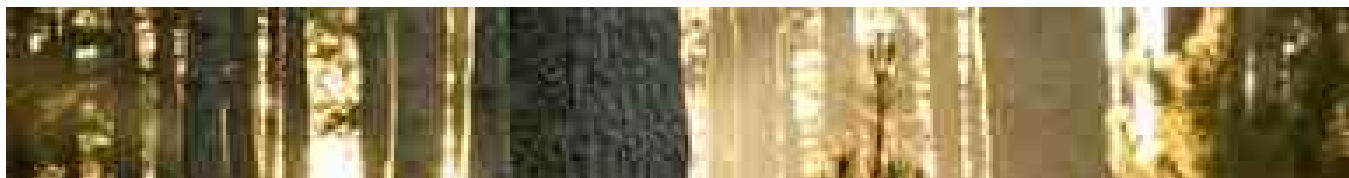
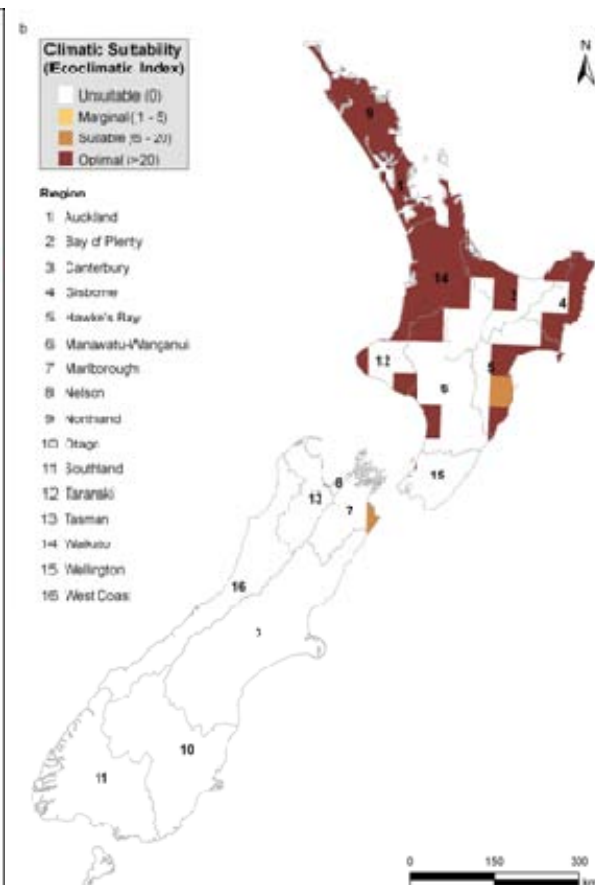
MIROC



Future climate

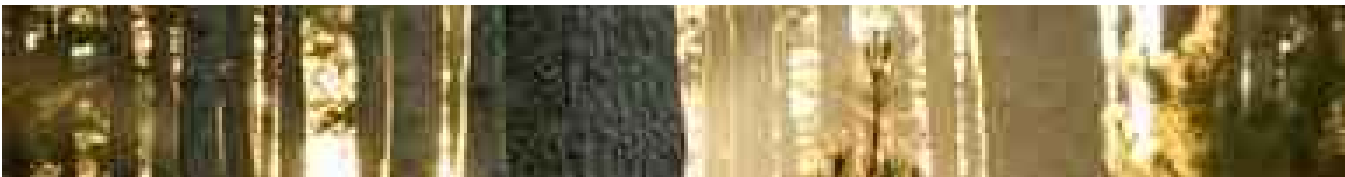


Current climate



Buddleja davidii (butterfly bush)

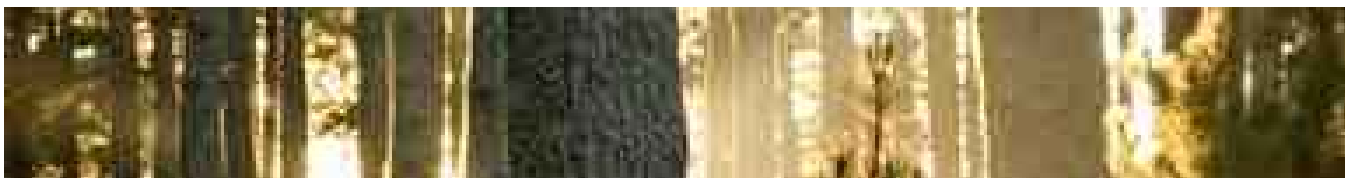
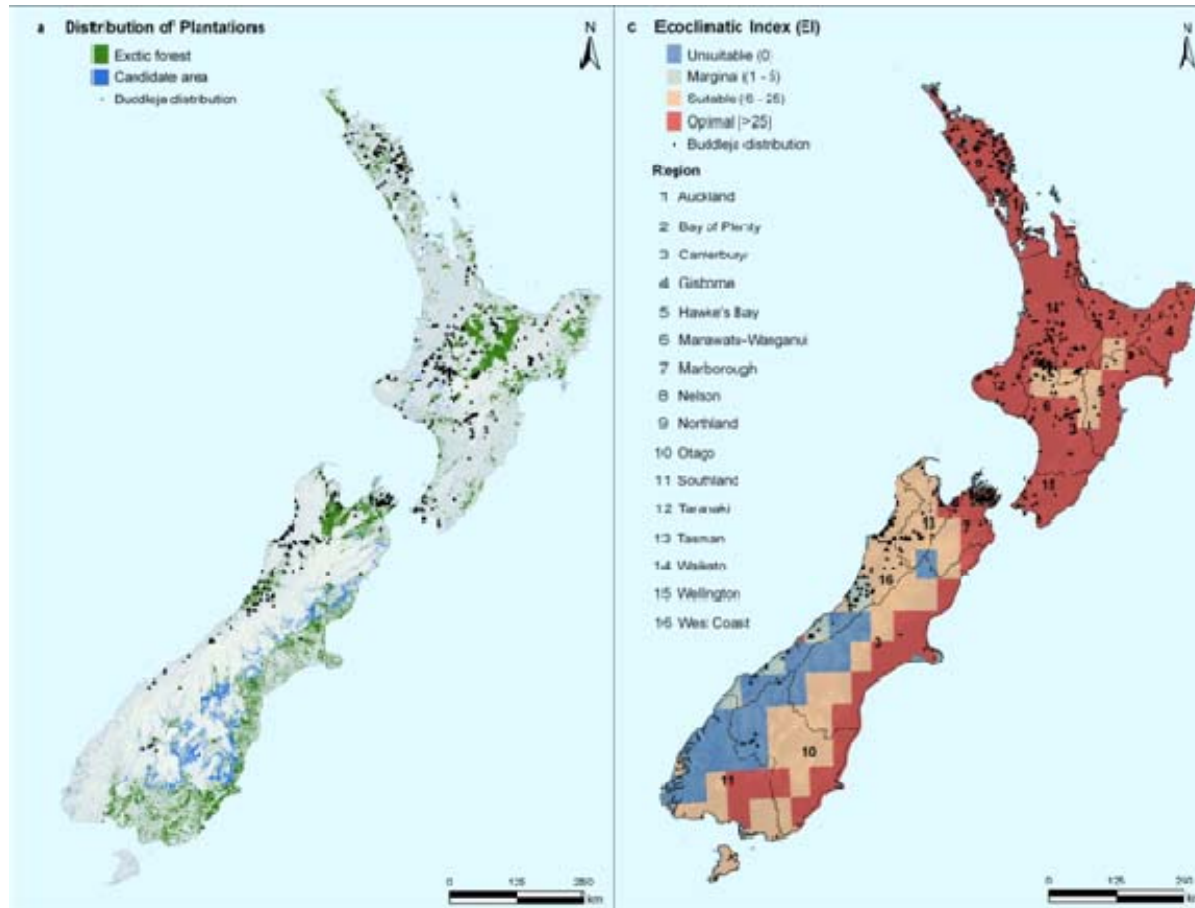
- **Current weed in New Zealand**
- Very popular, attractive garden plant
- Also, high impact weed, fast growth, prolific seed production
- Rated most problematic weed in central North Island
- Competes strongly with trees, particularly during juvenile period



Current and potential *B. davidii* distribution

B. davidii distribution

Current climate EI

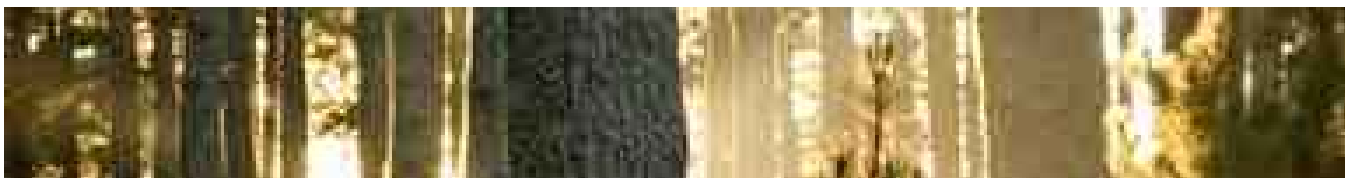
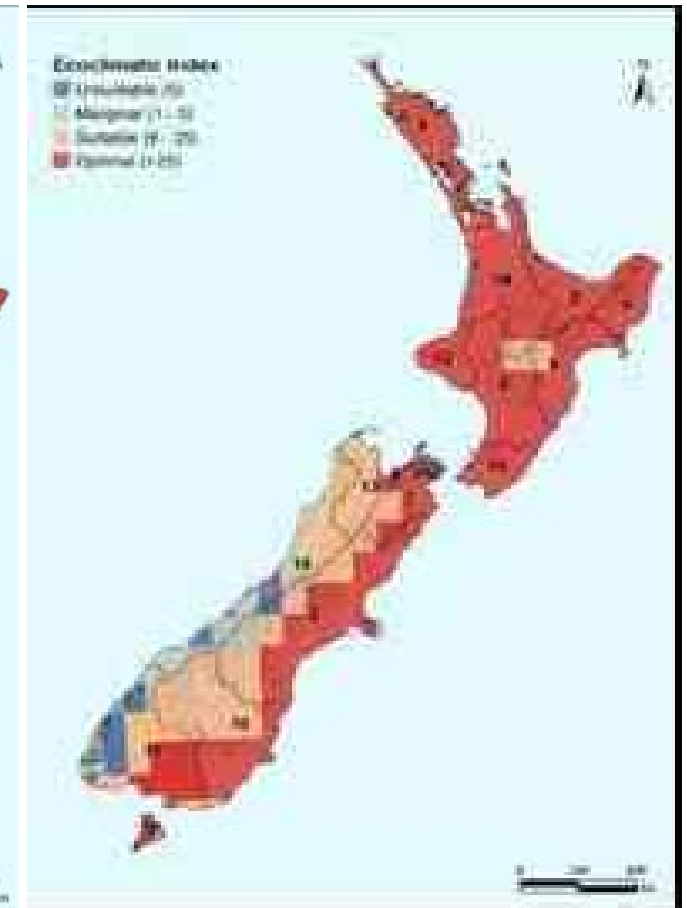
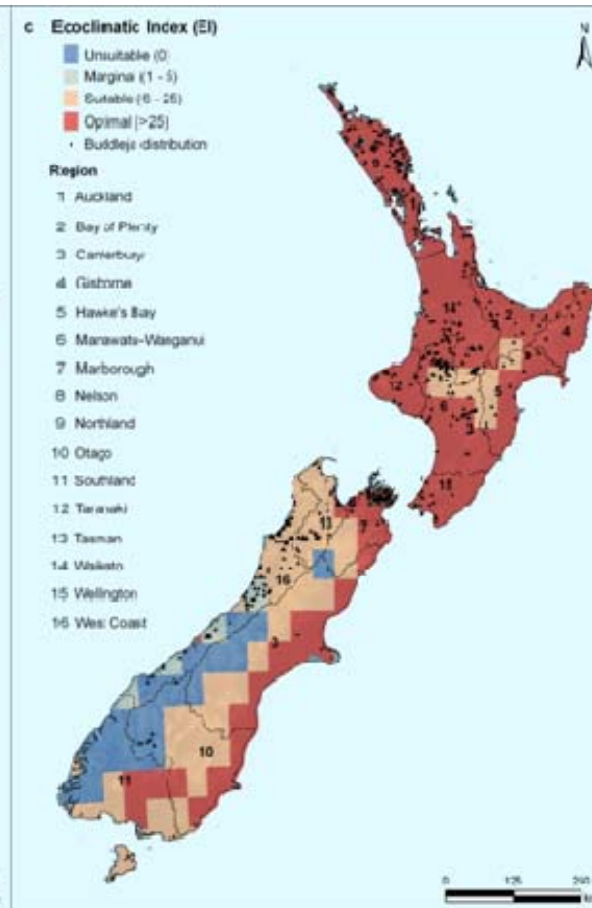
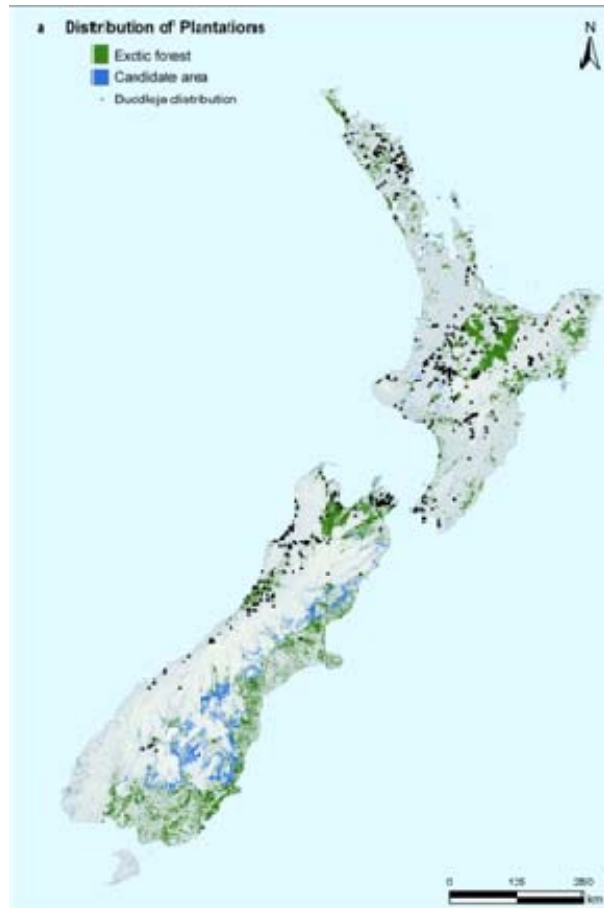


Future climatic suitability

B. davidii distribution

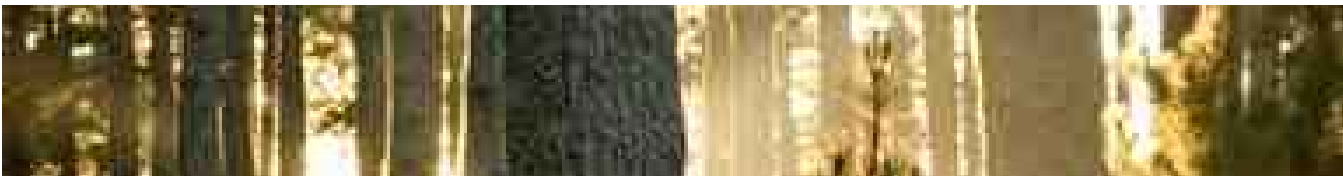
Current climate EI

MIROC

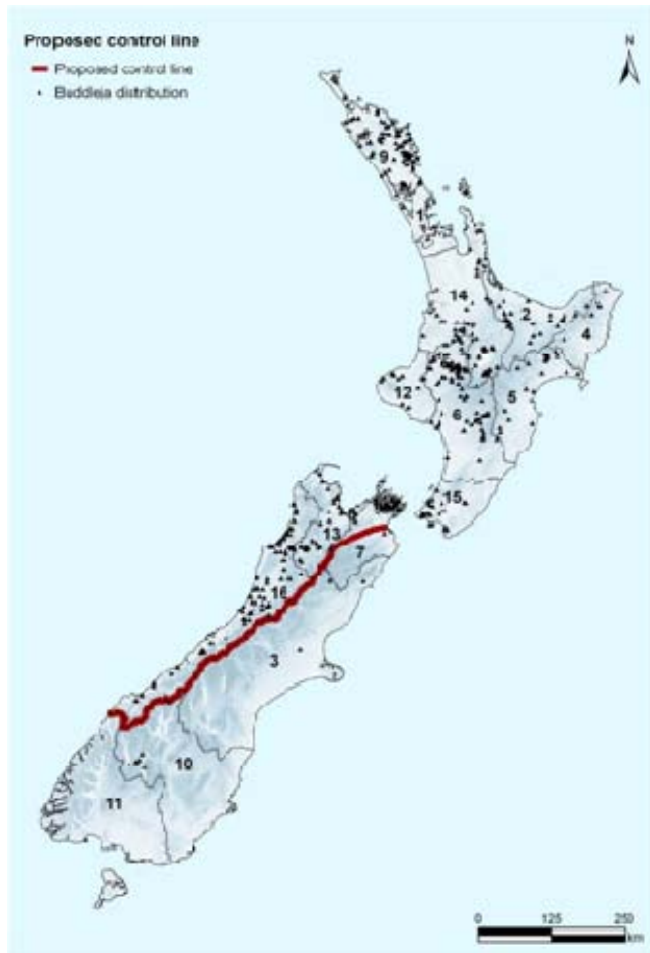


Climate matching

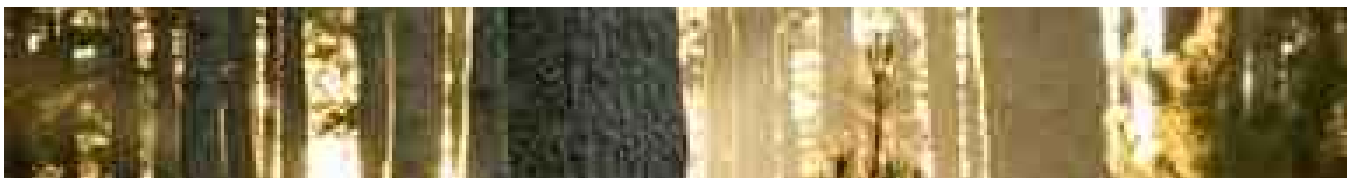
- UK has been extensively invaded
- Matches climate in Southland, Otago, Canterbury to UK
- Match in terms of min., max., temp, rainfall quantity and pattern
- CMI > 0.7 biologically relevant, >0.8 close match



Control measures

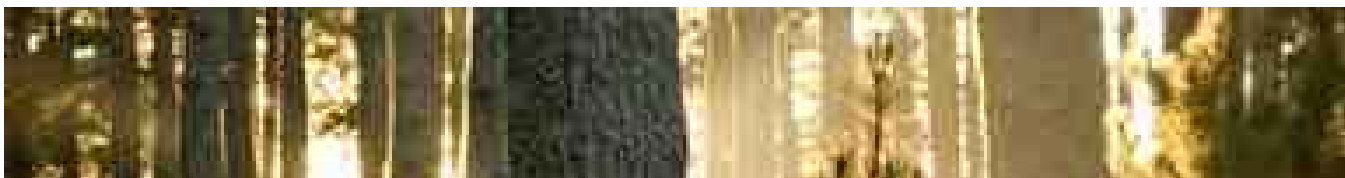


- Include on RPMS Canterbury, Otago, Southland, Marlborough
- Remove horticultural threats
- Prevent spread into strategic exclusion zone
- Biological control
 - Preliminary success with *Cleopus japonicus*

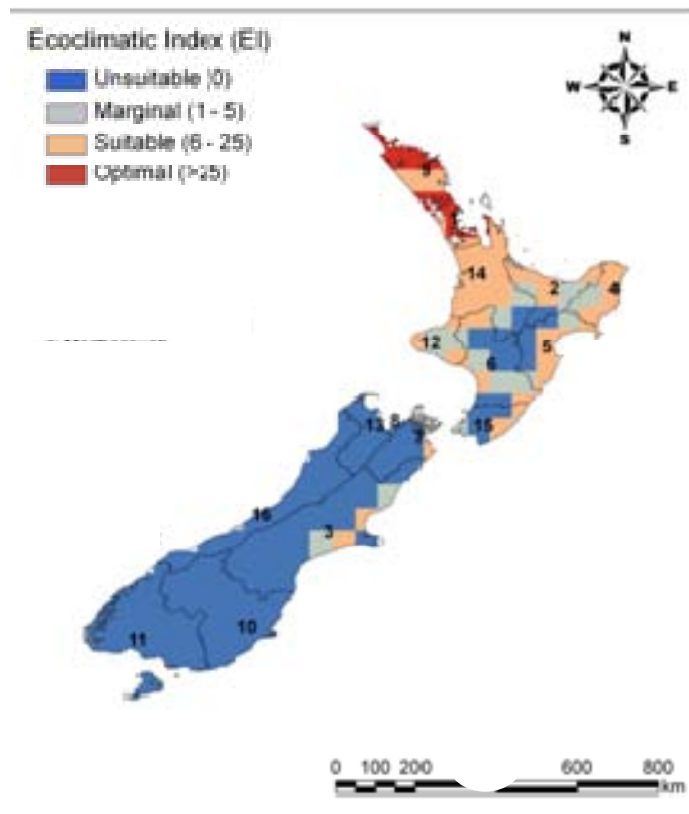


Pine processionary moth

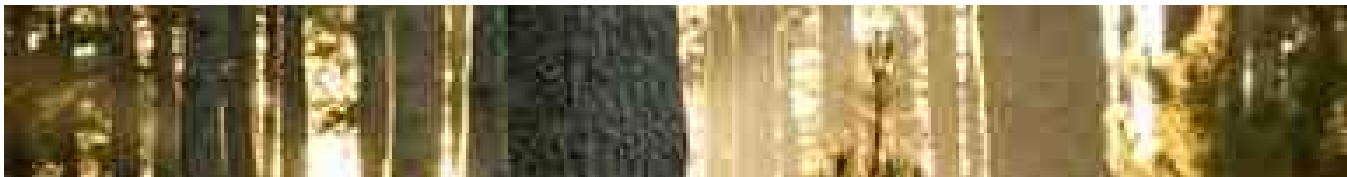
- **Not currently in New Zealand**
- Pine processionary moth significant defoliator of pines in Europe
- Of interest as radiata pine is a preferred host



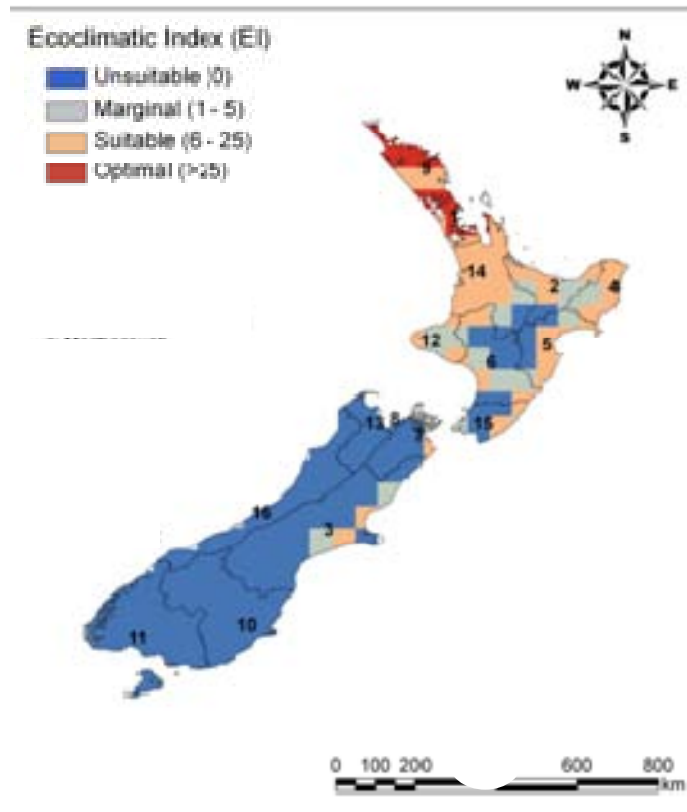
Projected potential distribution



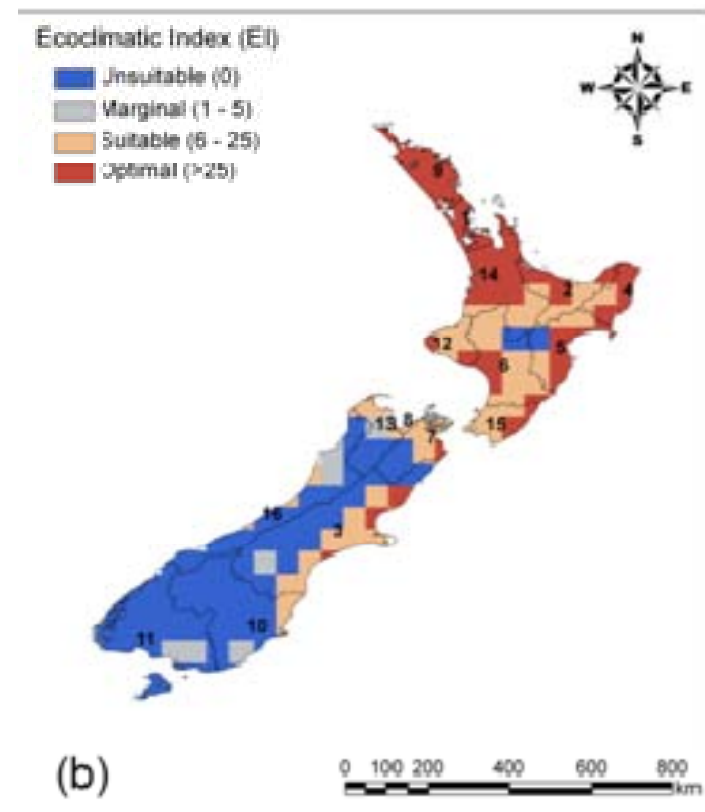
Current climate



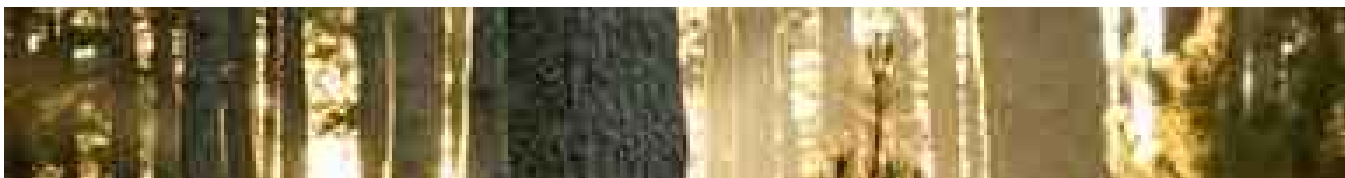
Projected potential distribution



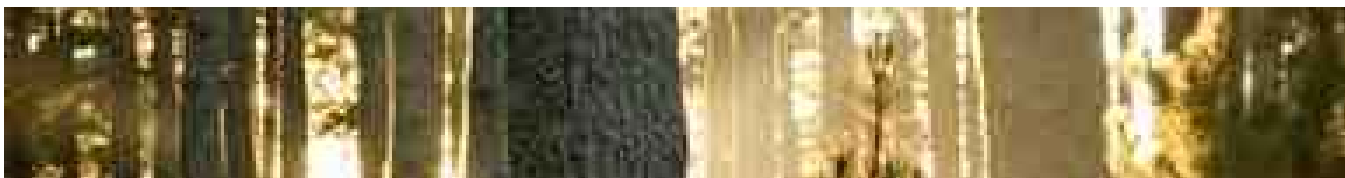
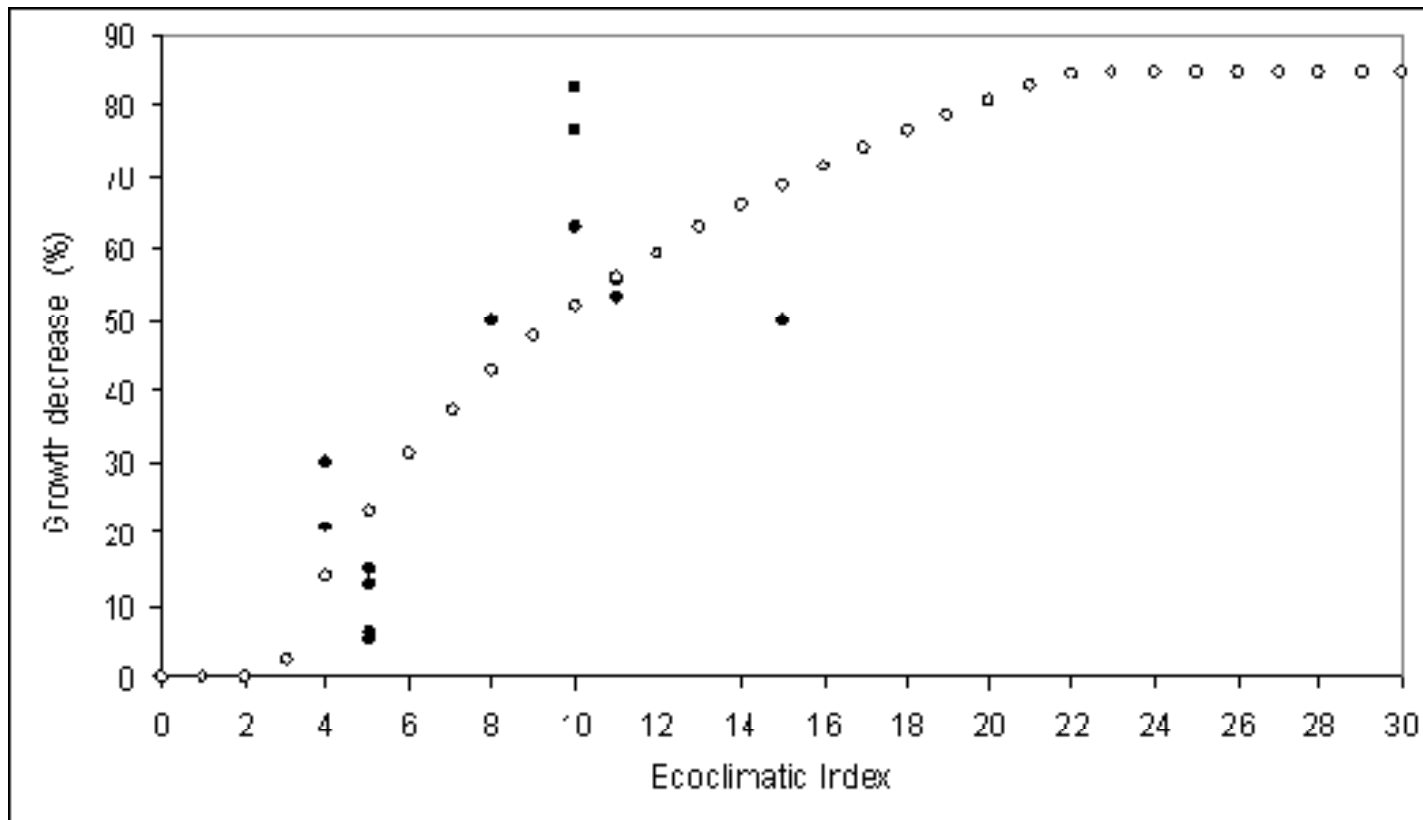
Current climate



Future climate

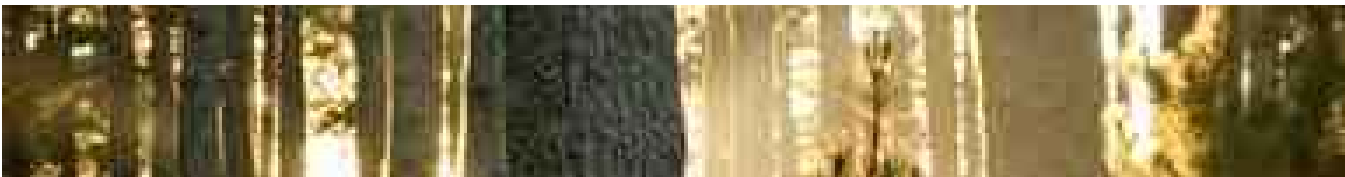


Linking climate suitability to plantation growth losses



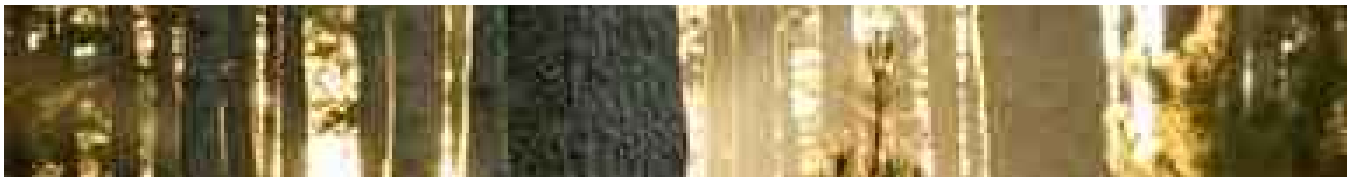
Plantation productivity under current and future climate

- 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



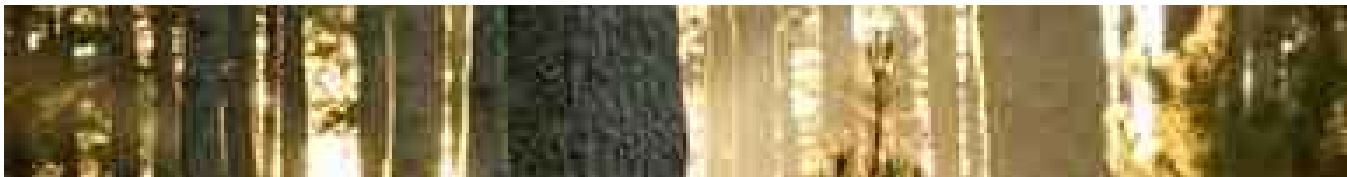
Effect of pine processionary moth on volume production under current and future climate

- 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

MAF for funding the 1 year “Future proofing plantation forests from pests project”

Papers, popular articles from project

- Watt, M.S., Kriticos, D.J., Potter, K.J.B., Manning, L.K., Tallent-Halsell, N., Bourdot, G.W. (in press) Using species niche models to inform strategic management of weeds in a changing climate. *Biological Invasions*.
- Watt, M.S., Kriticos, D.J., Bourdôt, G.W. 2010 Nothing pretty about *Buddleia*. *MAF Biosecurity* 97, 30-31
- Watt, M.S., Ganley, B.J., Kriticos, D.J., Manning, L.K. Dothistroma needle blight and pitch canker: the current and future potential distribution of two devastating diseases of *Pinus* species. Submitted *Canadian Journal of Forest Research* February 2010.
- Kriticos, D.J., Watt, M.S., Potter, K.J.B., Manning, L.K., Alexander, N.S., Tallent-Halsell, N. Managing invasive weeds under climate change: Considering the current and potential future distribution of *Buddleja davidii*. Submitted to *Weed Research* December 2009.

