Plant & Food™ Research
Rangahau Ahumāra Kai

Disease climatic risk model interpretations at multiple spatial scales

Can remote sensing provide microclimate or plant growth measures to improve predictions for epidemiological process?

Rebecca Campbell, MBIE Science Whitinga Fellow

Robert Beresford

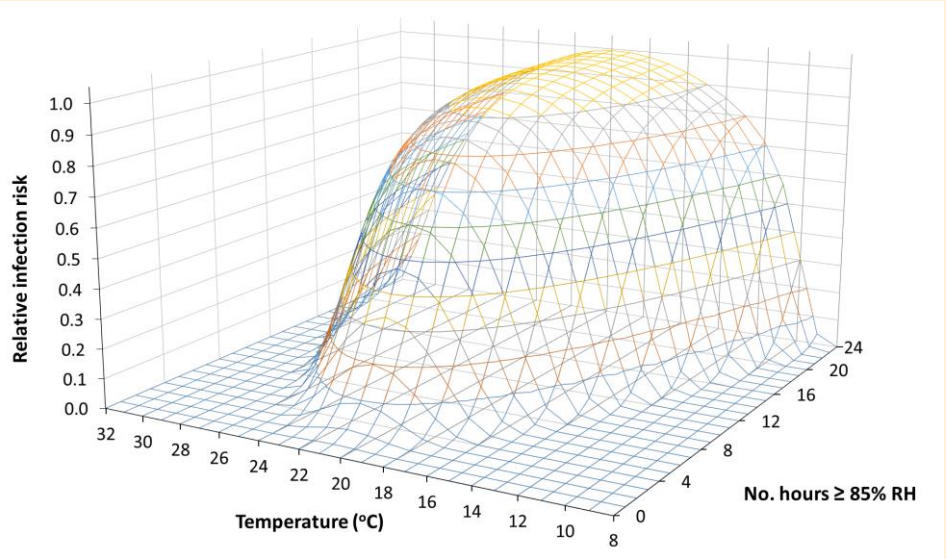
Episense satellite meeting, August 2023

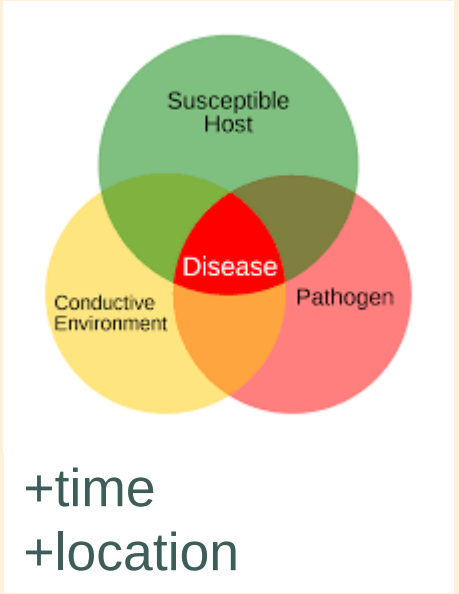
Climatic risk models

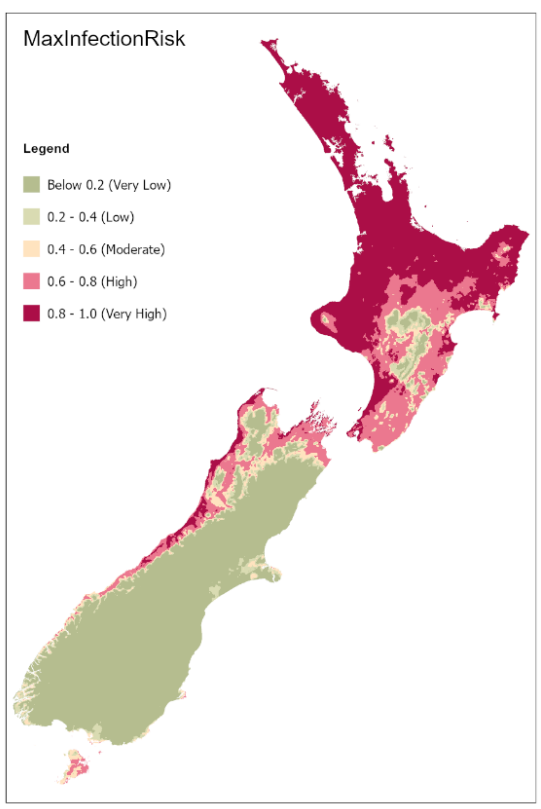
- Different resolution data, used for different purposes
  - Process model, hourly weather data
- Often used for:
  - Assess risk of invasions
  - Inform management actions

- How sensitive is interpretation of these models to
  - Different sensors
  - Locations and microclimate
  - Plant responses
- **Can remote sensing data help these applications?**

- What does this mean for our use and development of risk models?





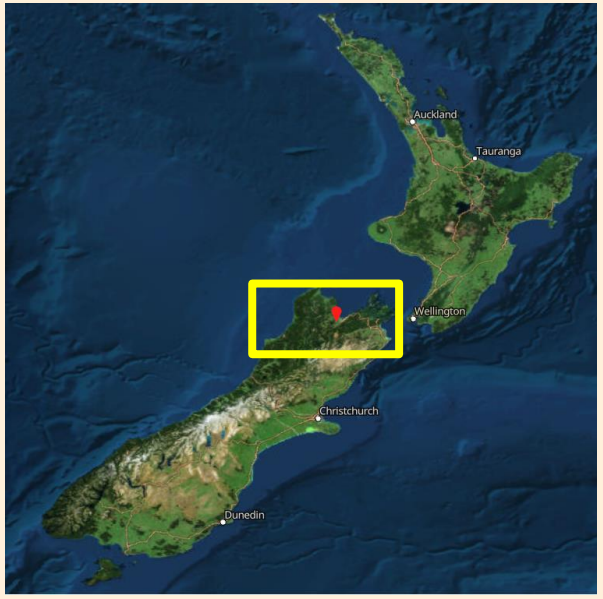


The case study disease – Myrtle rust

- Tropical – warm temperatures, moisture/humidity
- Existing climatic risk model – process model
- Dry dispersed - wind
- Infects Myrtaceae (many host plants, perennial, woody)
- Actively growing susceptible plant tissues (young growth)
- Case study plants
  - Rōhutu, *Lophomyrtus obcordata*

Study site – Nelson, Te tau ihu

- Indigenous planting restoration areas
- Edge gradients into existing native forest patches
  - Small patches, disturbed bush



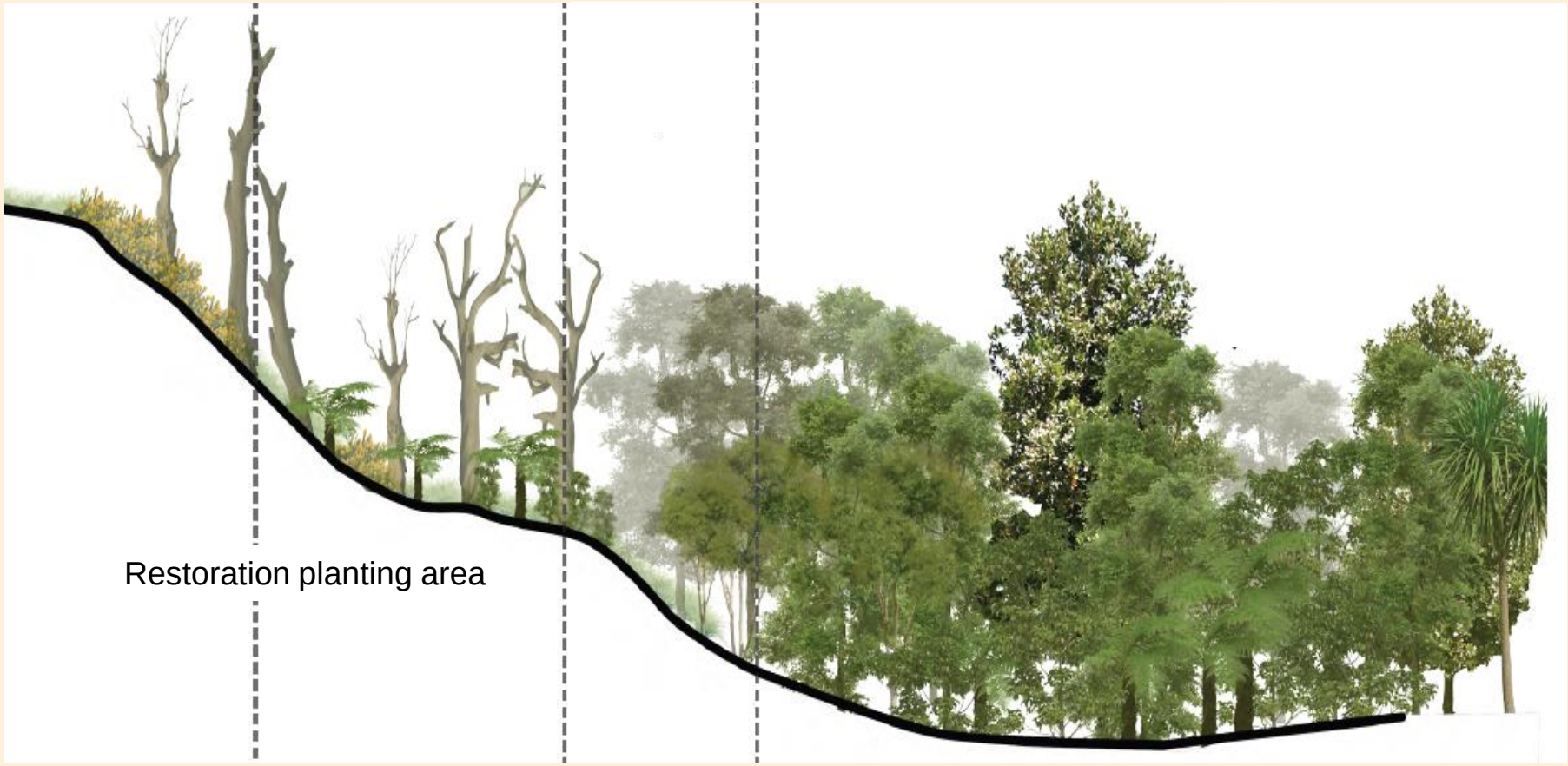
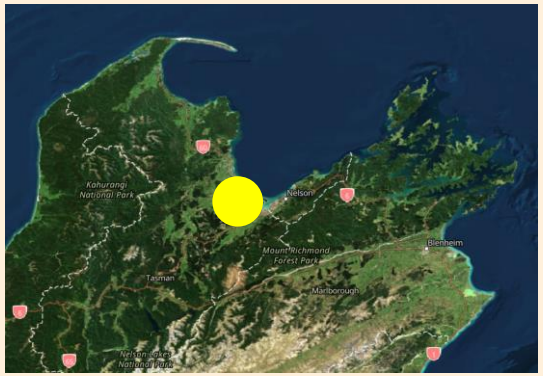


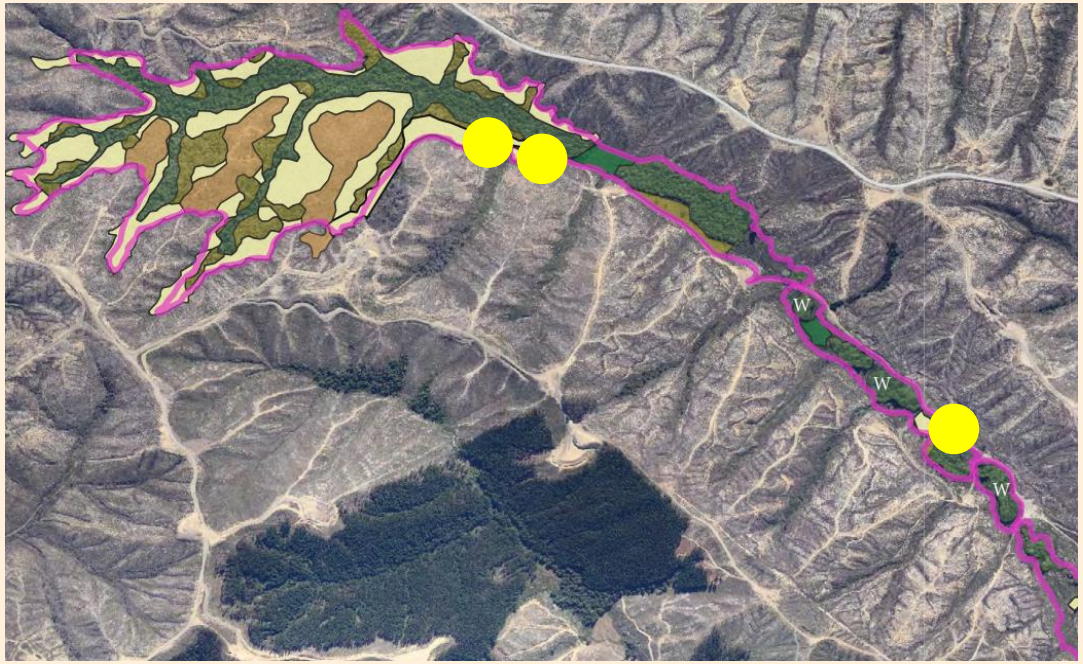
Image: Kūmānu Environmental (2021)

- Within pine forestry plantation

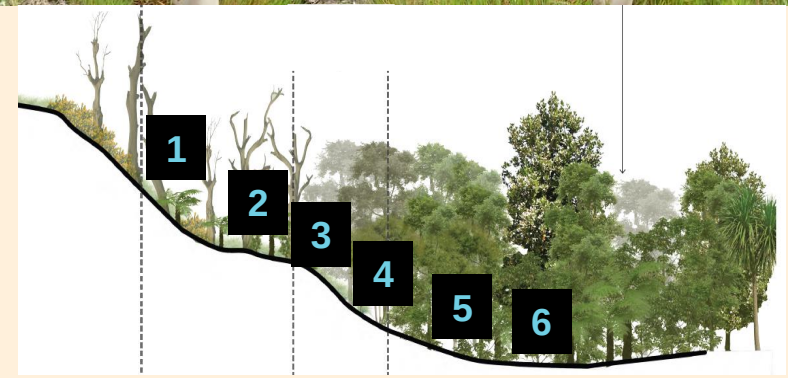
Scales of plant, pathogen, environment



Region



Valley



Transects (x 3, 6 distances across edge)

Scales of plant, pathogen, environment

Plant - Rōhutu
(x3 at each distance)

Branchlet
(x5 on each plant)

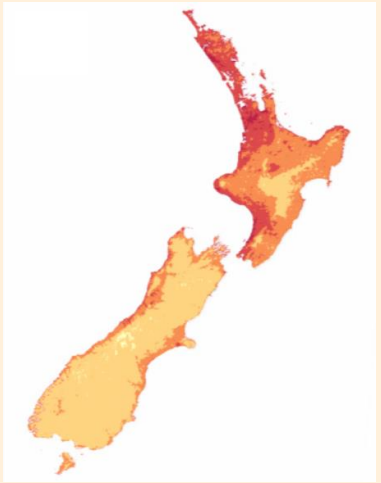
Growth tips
(count of active leaf emergence, dieback, fruit, flowers, etc.)

Comparing sensors, housing, set up

Regional weather station (Metwatch)

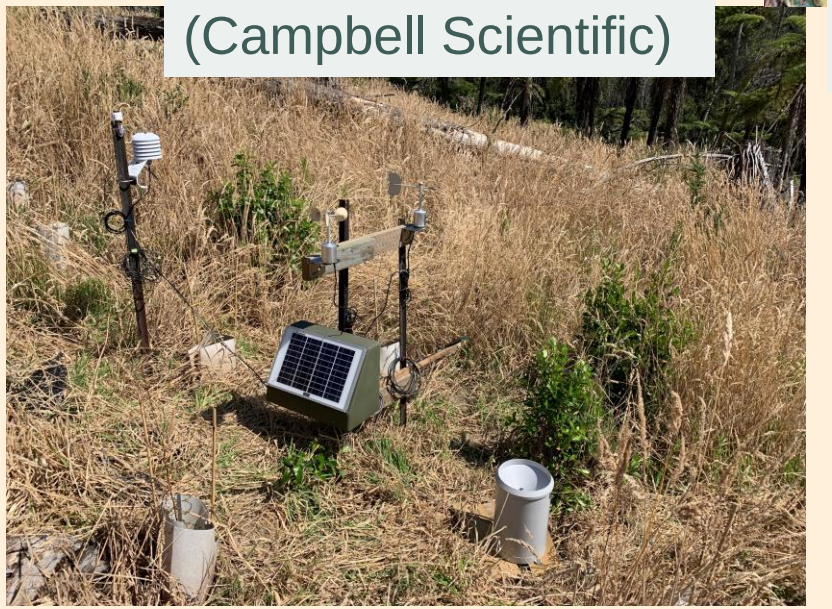
Local weather station (Campbell Scientific)

Microclimate sensors (Xsense)



National grid (NZCSM, NIWA) 1.5km grid

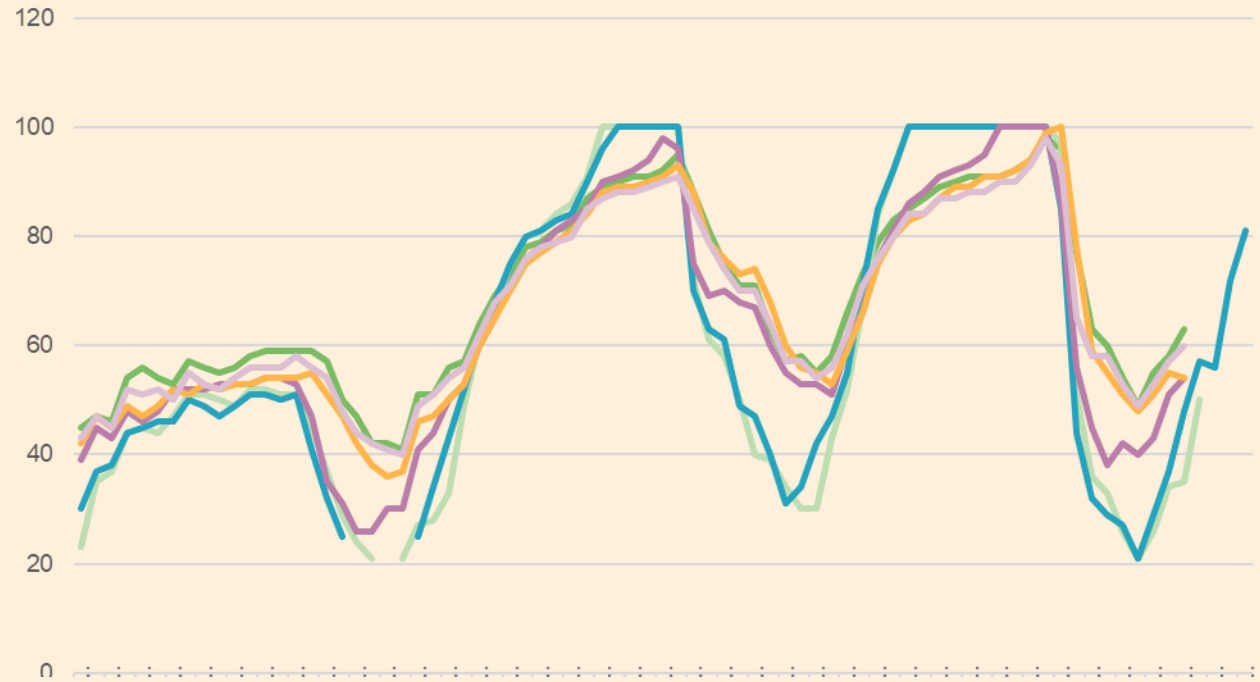
Remote sensed data?



Local microclimate at a forest edge

Air temperature (℃)

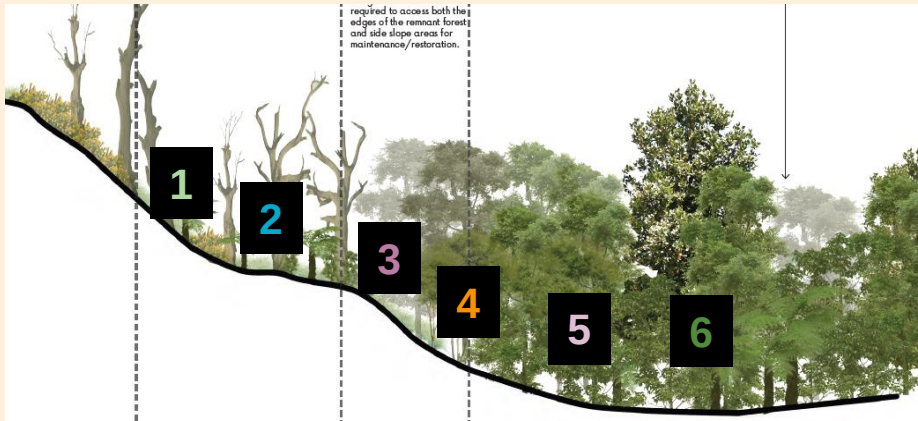
Relative Humidity (%)



Time (hourly)

Distance

1
2
3
4
5
6



Modelled infection risk

3 transects

N facing

S facing

Most observed rust

Highest predicted infection risk

Most plant growth

Infection risk index (mean over last 7 days)

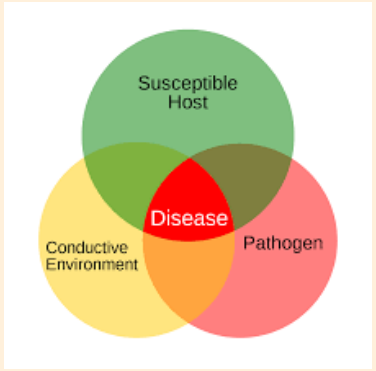
0.0
0.2
0.4
0.6
0.8

Feb 15 Mar 01 Mar 15 Apr 01 Feb 15 Mar 01 Mar 15 Apr 01 Feb 15 Mar 01 Mar 15 Apr 01

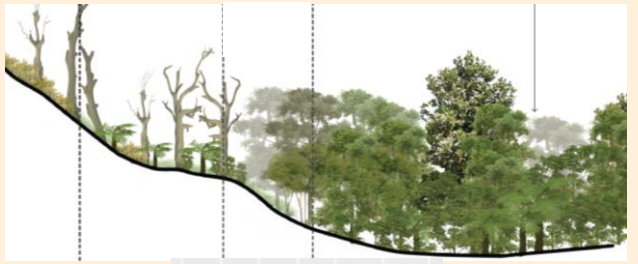
Distance
1
2
3
4
5
6

Influence on model output & interpretations

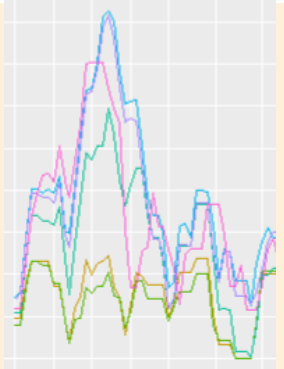
- Difference between sensors less than differences from edge to interior
  - Closest Metwatch weather station at least 10 km away



- Infection risk and plant growth/susceptibility different across the forest edge
  - Risk higher further into forest away from edge
  - Interactions with plant growth – plant growth higher at the edge
  - Rust more prevalent at the edge and just inside the edge

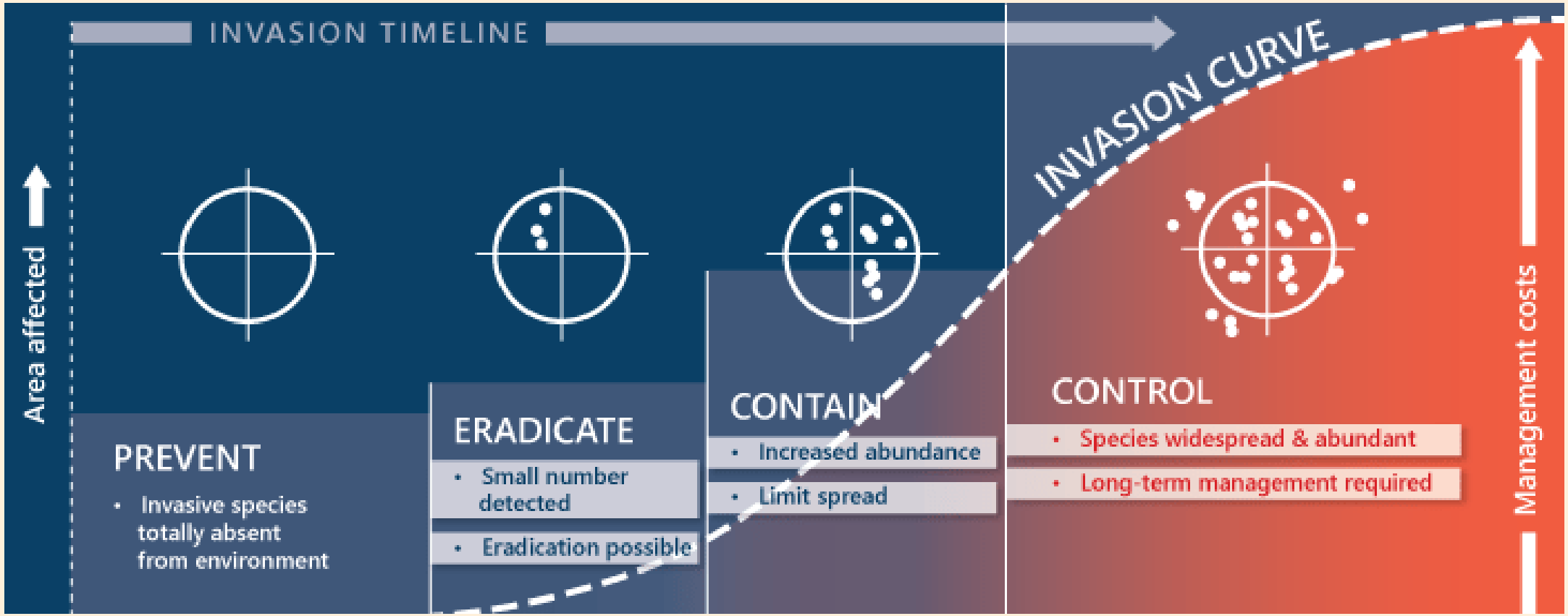


- Large amount of disturbed or ‘edge’ habitat in NZ
  - Implications for disease risk and management
  - E.g. Xylella vectors, invasion at edges, habitat disturbance
  - Effective length of disease ‘season’



- Magnitude of differences in risk across the forest edge are large enough to trigger different management choices (e.g. decision support, thresholds)

When do risk models help, what scale of precision and accuracy are needed for each?



Better outcomes if higher resolution modelling?

What is the intended purpose of the model?

What resolution is biologically meaningful?

Optimise when and where to look and manage?

What resolution is meaningful to management?

Fiona Ede

Plant & Food Research
Rangahau Ahumāra Kai

TASMAN ENVIRONMENTAL TRUST

B3 Science Solutions for Better Border Biosecurity AOTEAROA NEW ZEALAND

TASMAN PINE FORESTS LTD

ROYAL SOCIETY TE APĀRANGI

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

MBIE Science Whitinga Fellowship

A smart green future. Together.

Thank you

Rebecca.Campbell@plantandfood.co.nz

plantandfood.co.nz

Presentation disclaimer

Presentation for

International Congress for Plant Pathology, Lyon, France, Satellite event: How to combine remote sensing with epidemiological modelling to improve plant disease management, 19-20th August 2023

Publication data:
Campbell, Rebecca & Beresford, Robert. May 2023. Disease climatic risk model interpretations at multiple spatial scales. A Plant & Food Research PowerPoint presentation.
Job Code: P/391001/01

Presentation prepared by:
Rebecca Campbell
Scientist, Epidemiology & Disease Management
August 2023

Presentation approved by:
Nick Waipara
Science Group Leader, Plant Pathogen Environment
Augst 2023

For more information contact:
Rebecca Campbell
Email: rebecca.campbell@plantandfood.co.nz

This report has been prepared by The New Zealand Institute for Plant and Food Research Limited (Plant & Food Research).
Head Office: 120 Mt Albert Road, Sandringham, Auckland 1025, New Zealand, Tel: +64 9 925 7000, Fax: +64 9 925 7001.
www.plantandfood.co.nz