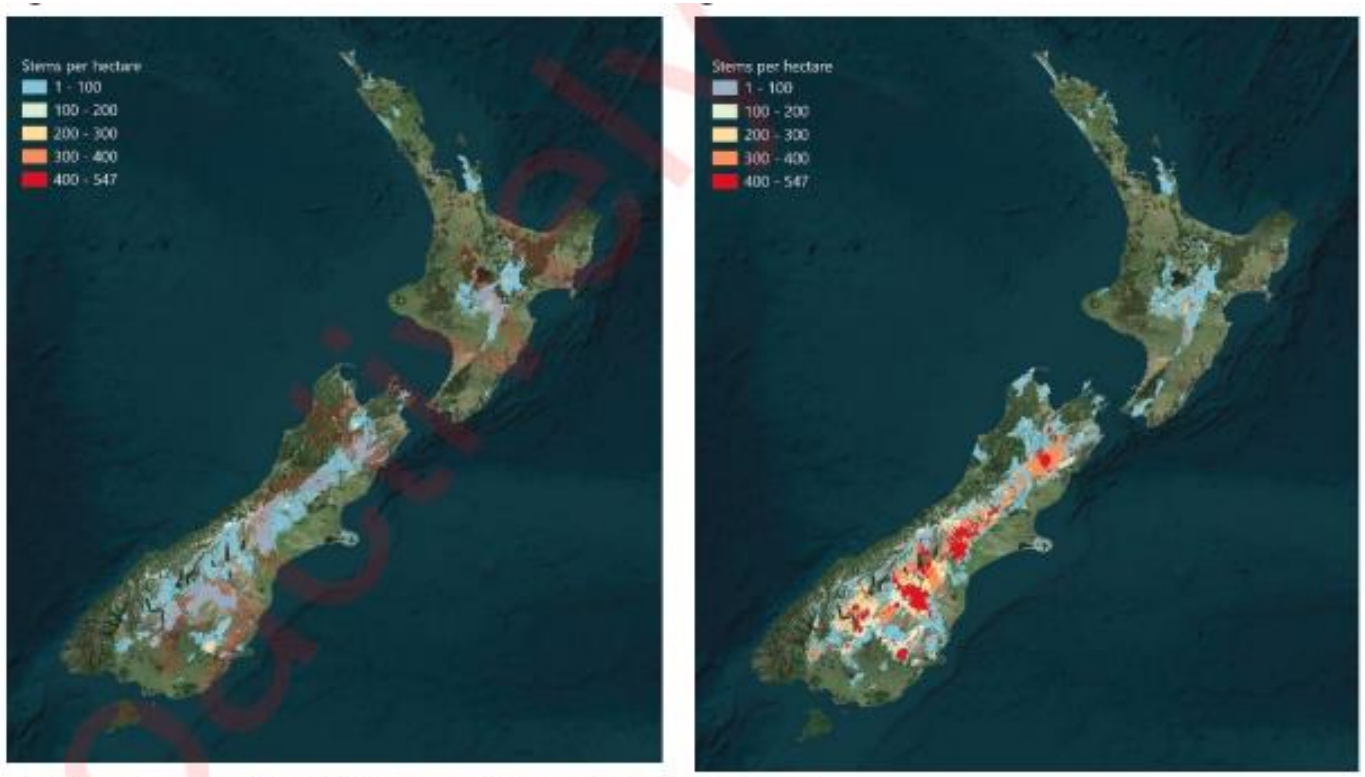
Detecting Pre-coning Wilding Conifers in New Zealand

Introductions

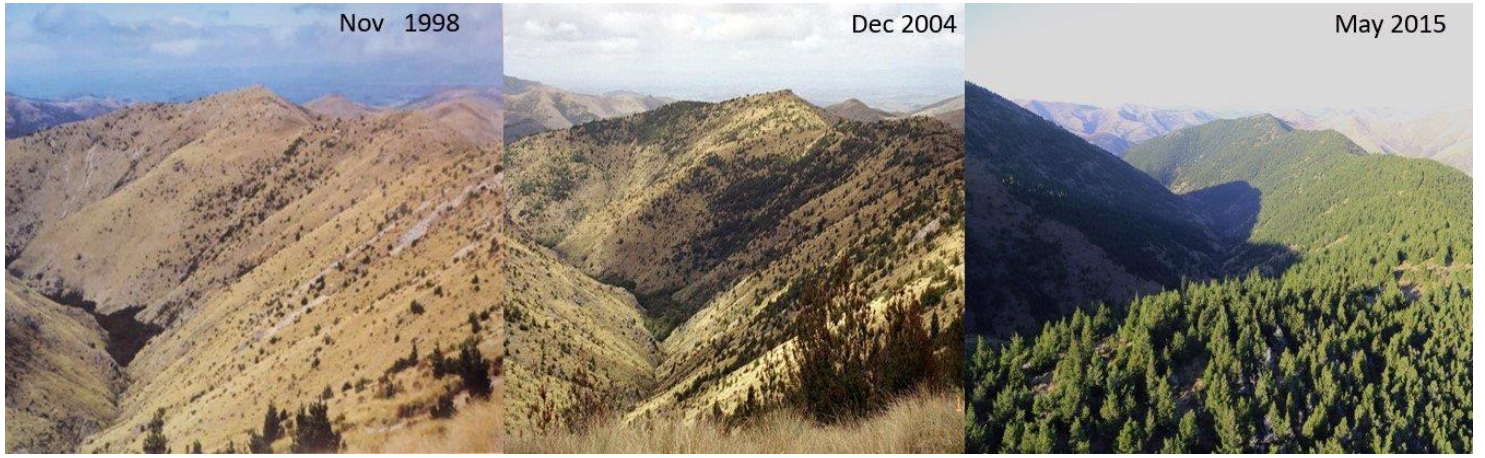
- Design and Evaluation, Biodiversity Heritage and Visitors, NZ Department of Conservation based in Christchurch
- My background is threatened species work (parrots?!)
- Development and application of monitoring methodologies for conservation
- Since 2017 wilding pines work - increasing remote sensing

Scope of the problem

- Origins – legacy Crown planting to stabilise land/stop erosion & commercial
- > 2 million ha infestation (rangelands & indigenous vegetation
- 80% of this classified as sparse
- Sparse to Dense in 30 years (14-21 yrs for *Pinus contorta*)
- A growing issue
- Control costs NZ$100-$3,000/ha denser = more expensive
- Disjointed regional efforts to control (official and community led)
- Erratic resource injections
- Satellite detection of conifers density 1 km sq grid

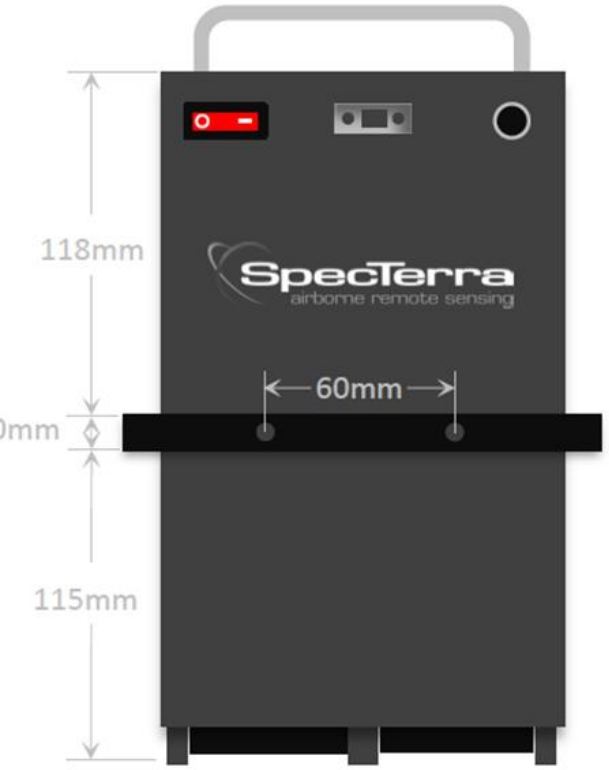


Source: Forecast spread was developed in conjunction with Manaaki Whenua



Reducing cost?

- **Movement from Sparse to Dense in 30 years (14-21 years for *Pinus contorta*)**
- **Control costs NZ$100-$3,000/ha**
- **Denser = more expensive**
- **Return rates for subsequent control high (esp. *Pinus contorta*)**
- **Kill them when small!**



Detection of small pre-coning trees??

- Can we do this?
- Break out the No. 8 wire plus:
  - Aircraft
  - RGB Canon camera
  - High resolution multispectral sensor (Specterra HiRAMS)
  - Mounts
  - Software to drive the gubbins

CAMERA	FLIGHT HEIGHT (FEET ABOVE GROUND LEVEL)		
	1100	2200	4400
Canon 5DS r (50 mm)	3.0 cm	6.0 cm	12.0 cm
High resolution airborne multispectral sensor (HiRAMS)	10.0 cm	20.0 cm	40.0 cm

Initial Study Area

- 332 ha
- Wilding pine infested shrub and grassland
- Destocked and returning to public conservation lands (Tenure Review)
- Major seed source!

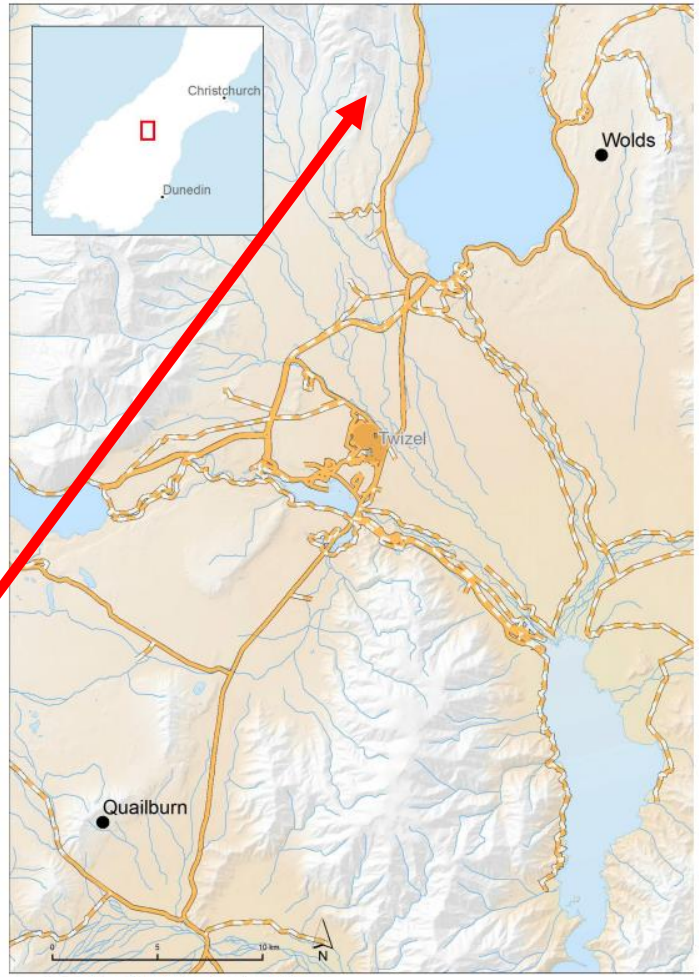


Figure 1. Locations of the Wolds and Quailburn study areas.

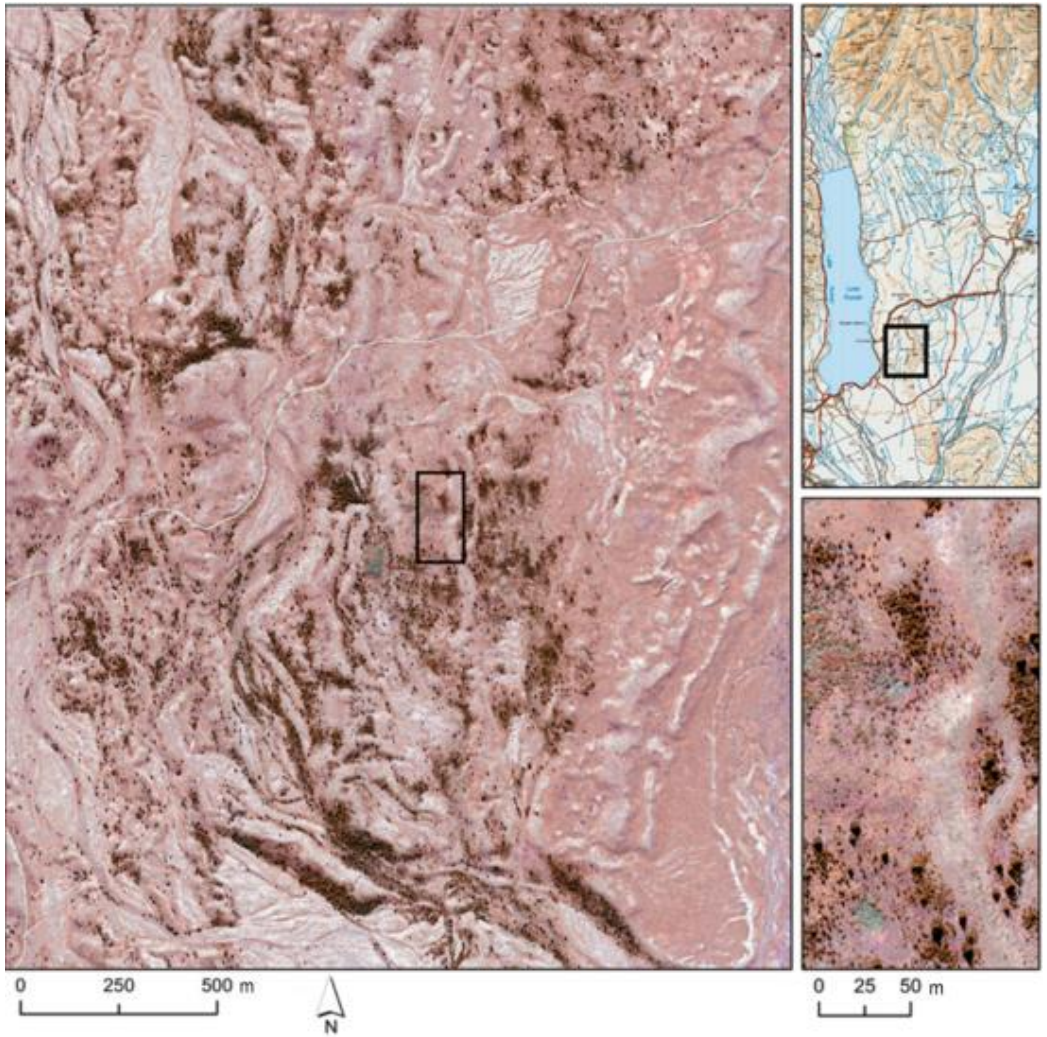
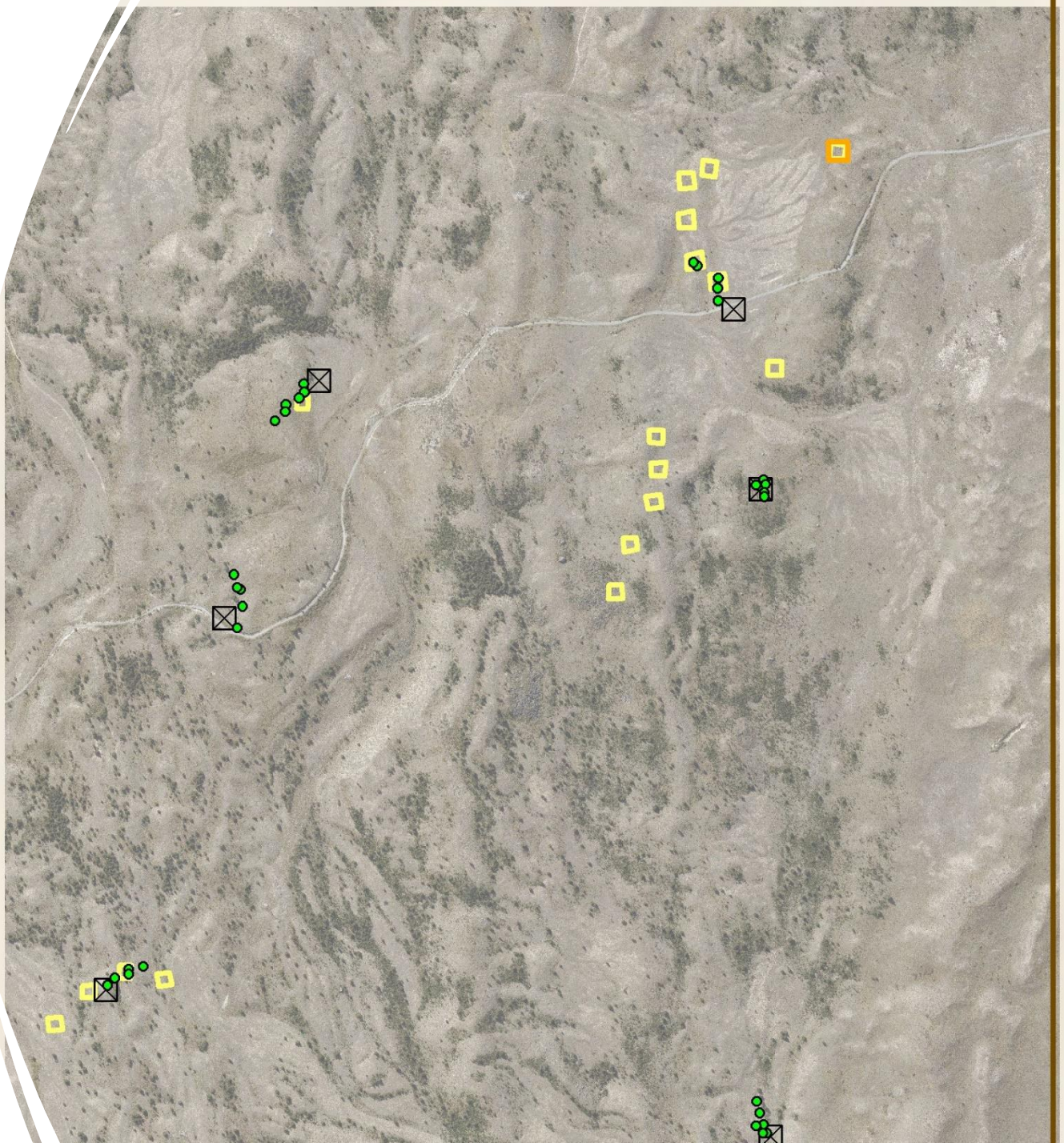


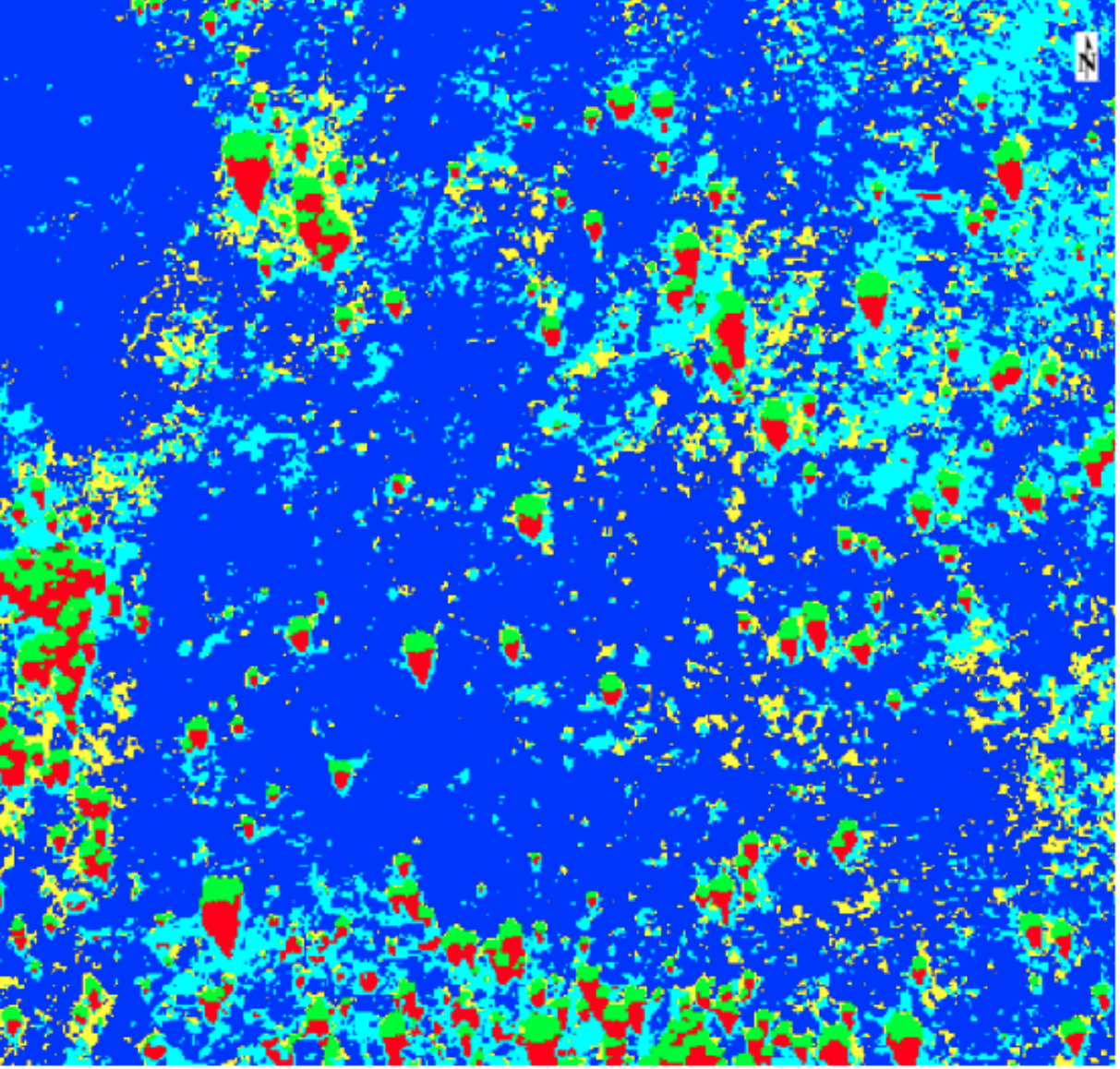
Figure 5. High resolution airborne multispectral sensor (HiRAMS) four-band (near infrared (NIR), red, red-edge) image of the Wolds study area and a magnified subsection.

Some ground-truthing

- Ground truthing woes – spatial inaccuracy and missing GCPs




GCP.1



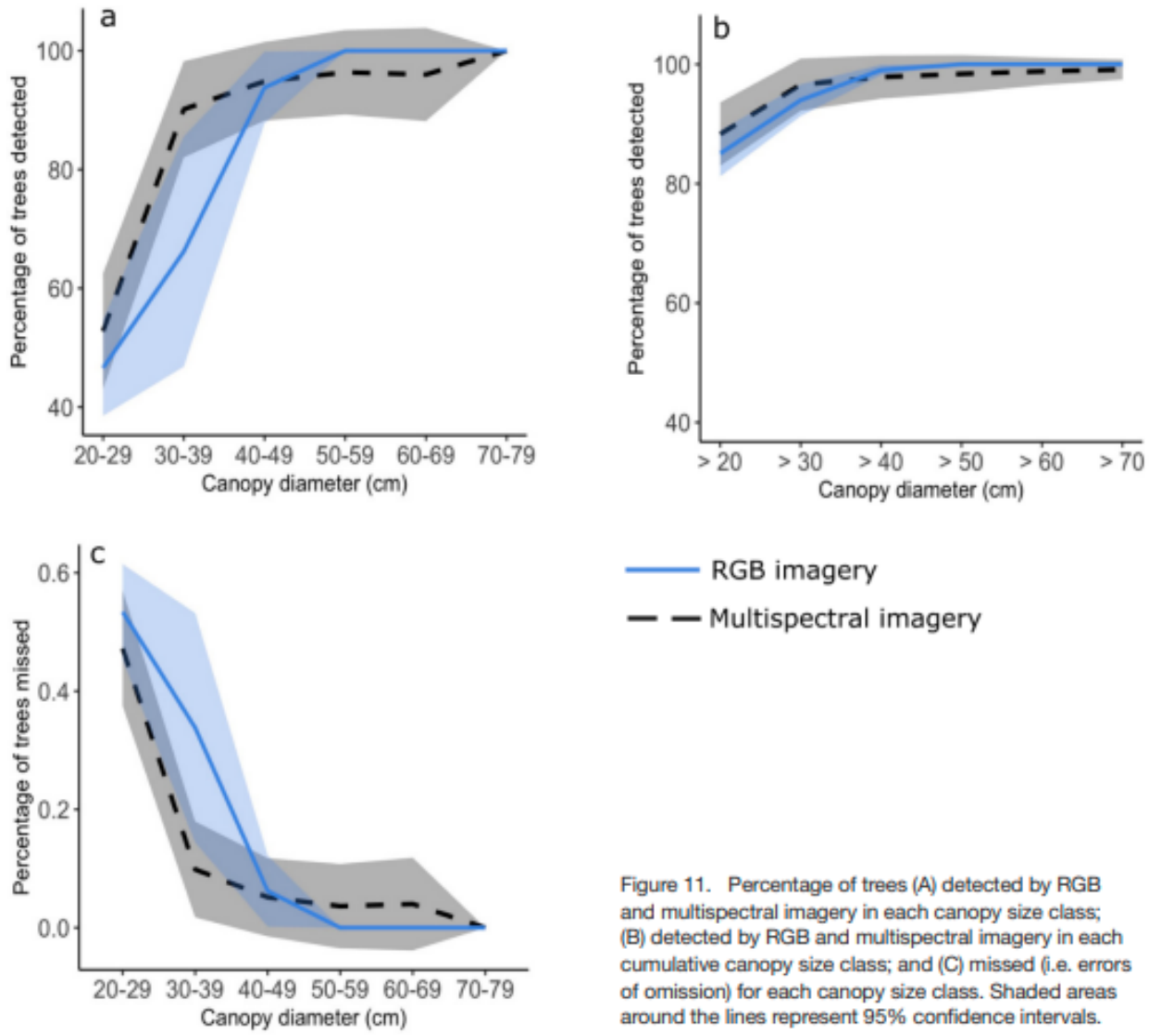


Figure 11. Percentage of trees (A) detected by RGB and multispectral imagery in each canopy size class; (B) detected by RGB and multispectral imagery in each cumulative canopy size class; and (C) missed (i.e. errors of omission) for each canopy size class. Shaded areas around the lines represent 95% confidence intervals.

Results

- **Importance of IR band**
  - 90% detection of trees (30-39 cm diam.) using IR (cf.65% for RGB alone)
  - Increased to 95-100% detection for canopy diam. >40 cm (RGBi)
- **Costs**
  - ~10x less expensive than current random helicopter searches for scattered/sparse infestations in high contrast environments
  - Return rates drop from 2 years to 3 years
- **Spatial Accuracy and Image Resolution**
  - Spatially accurate training data essential
  - Tune optimal resolution to detect highest proportion of pre-coning trees to optimise cost savings
- **Planning/Audit tool for control operations**

Automating detection

- Manual detection fine(?) for small areas
- Initial attempts to automate using Support Vector Machines (SVM) in R (POC)
- Application to other sites for which ground truth data available as part of control operations
- AI methods work in this instance (if you have the training data!)

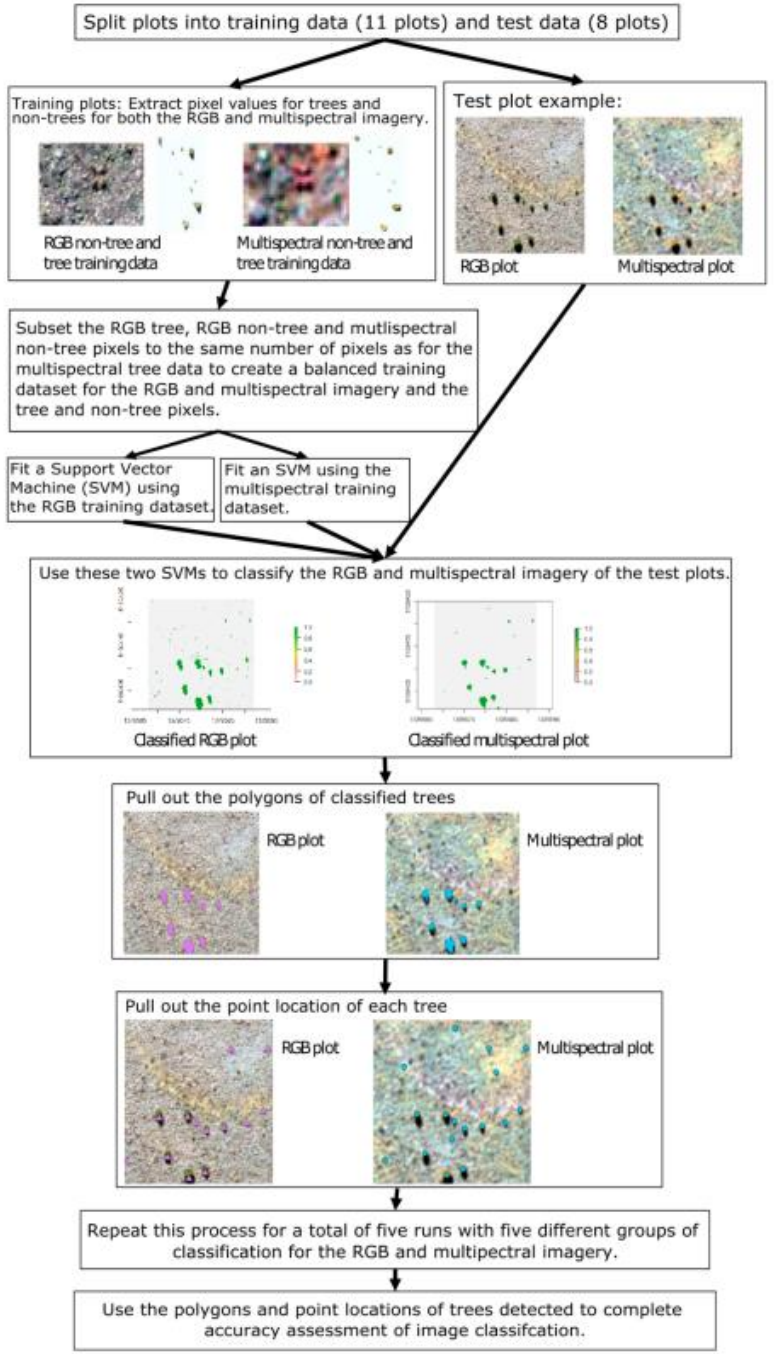


Figure 7. Generalised methodological workflow for image classification using support vector machine (SVM) models.

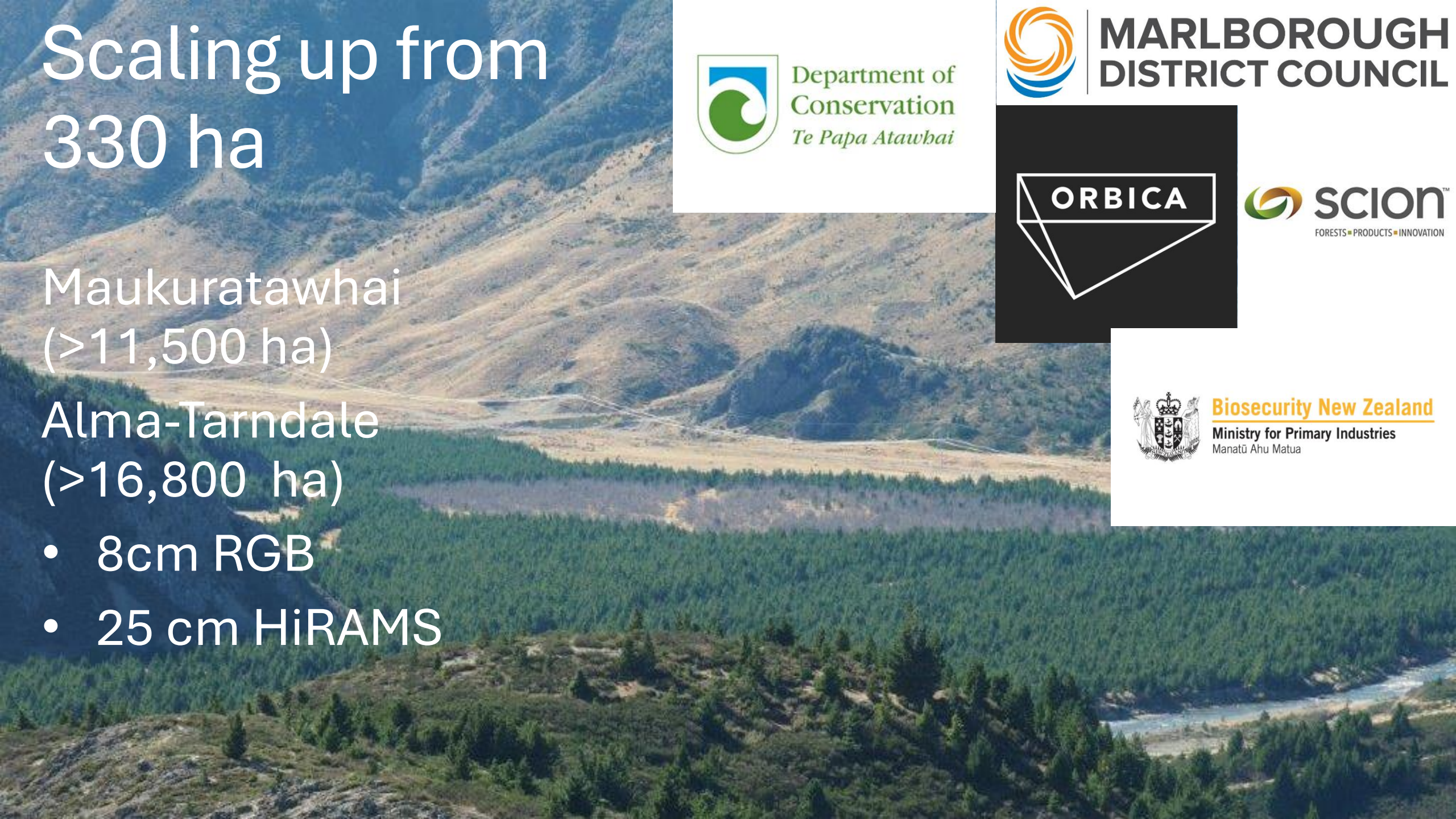
Better cameras and bigger scales

Scaling up from 330 ha

Maukuratawhai (>11,500 ha)

Alma-Tarndale (>16,800 ha)

- 8cm RGB
- 25 cm HiRAMS

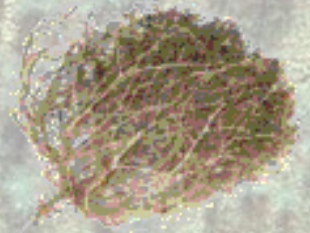


Phase One iXM 5 cm RGBi (3000 ft/915 m)

30-40 cm crowns = ✓

Improvements

- Bigger scales, better cameras, lower contrast mixed environments
- More ground truthing and more collaboration
- Industry involvement (PF Olsen)
- Then……



Is anything still happening? Yet another funding crunch……

Acknowledgements

- Rowan Sprague
- Volunteers and Community Groups that continue to fight the good fight