



Managing ecological impacts of naturalised willow in New Zealand

Willows in NZ

- 17 *Salix* taxa introduced to NZ
 - soil erosion
 - wetland drainage
 - stock fodder and shelter
 - aesthetic reasons
- *S. fragilis* & *S. cinerea* naturalised and most widely distributed



S. fragilis ecology

Source: USGS
Source: NASA, NGA, USGS
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S. cinerea ecology

Source: USGS
Source: NASA, NGA, USGS
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Ecological impacts



Non-forest freshwater wetland communities particularly vulnerable



A photograph showing a dense thicket of young plants, likely a shrub or small tree, growing in a field of tall grasses. The plants have thin, light-colored stems and small, green, oval-shaped leaves. The grasses are tall and thin, creating a textured background. The overall scene is a natural, outdoor setting with bright lighting.

1-2 Years



10 - 15
Years



What has been learnt about willow control?

ground based methods - accurate control of willows at small accessible sites



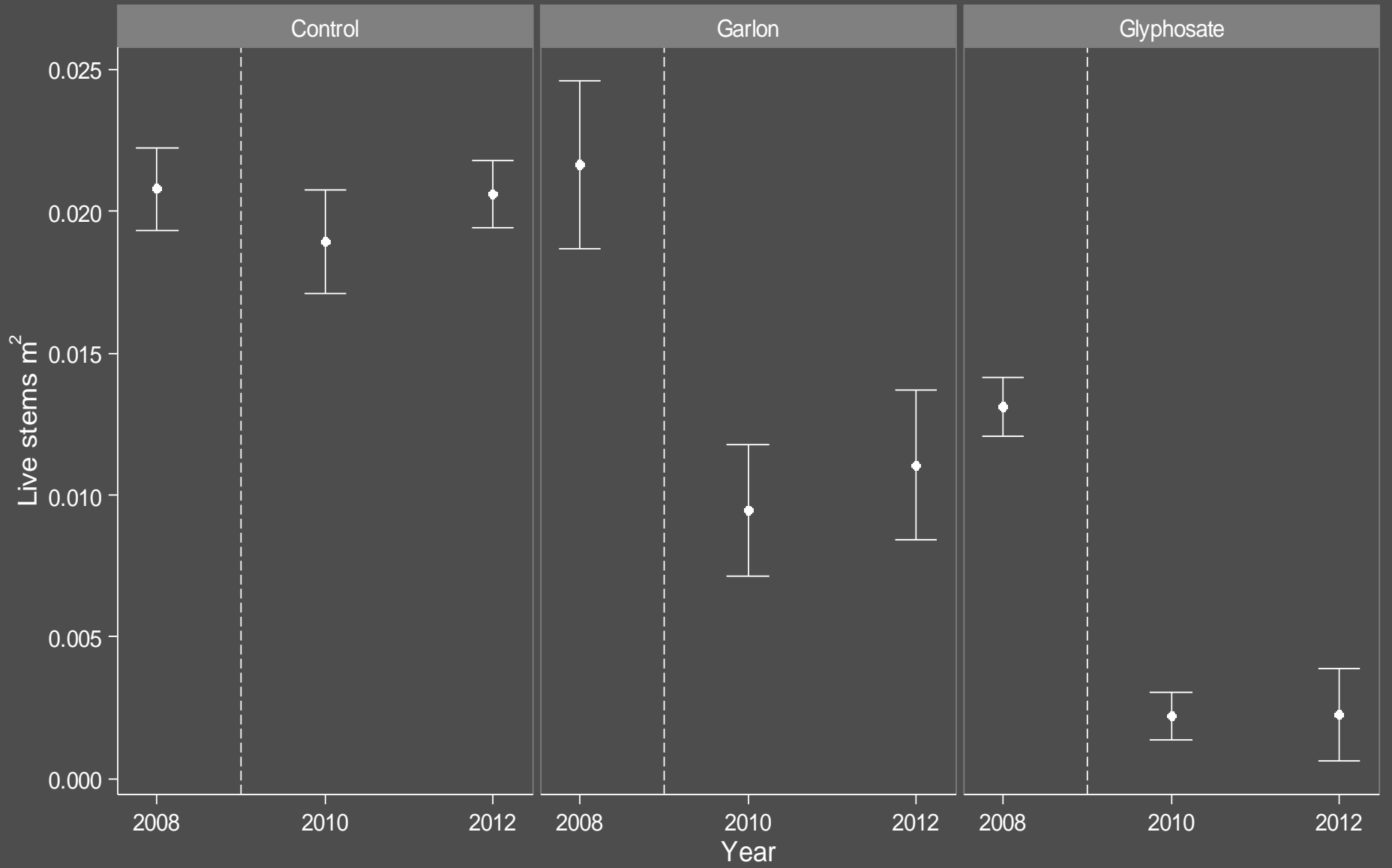
but, ground based methods too expensive & impractical for large scale willow control



aerial application of herbicides cheap & can reduce willow dominance at large spatial scales

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Salix fragilis





Ecological outcomes poorly understood



2 years post treatment - glyphosate



but glyphosate causes non-target mortality where willow canopy is sparse/absent

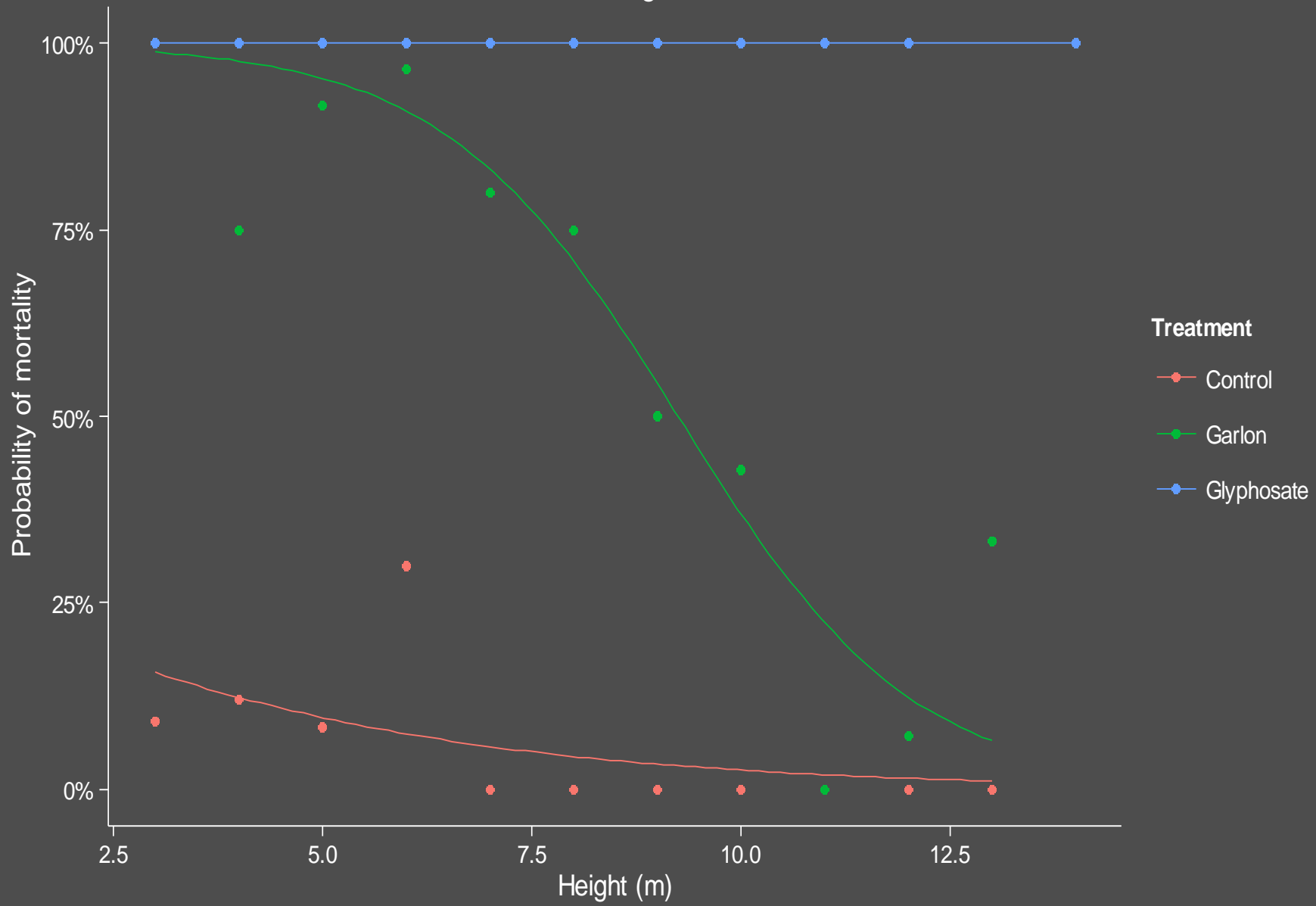


2 year post treatment - triclopyr



triclopyr (targets monocots) but variable efficacy

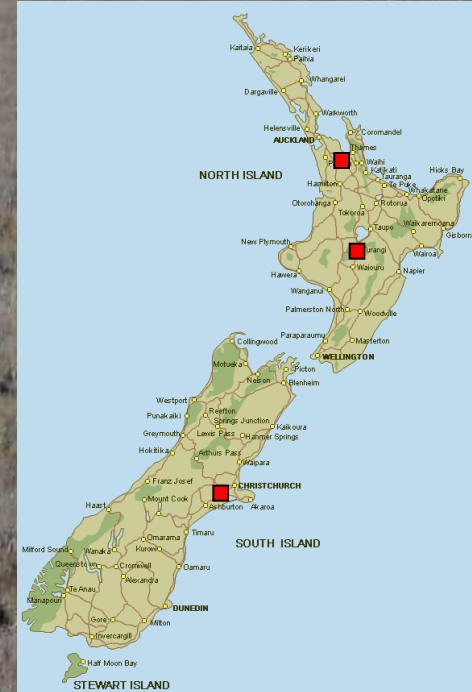
Salix fragilis



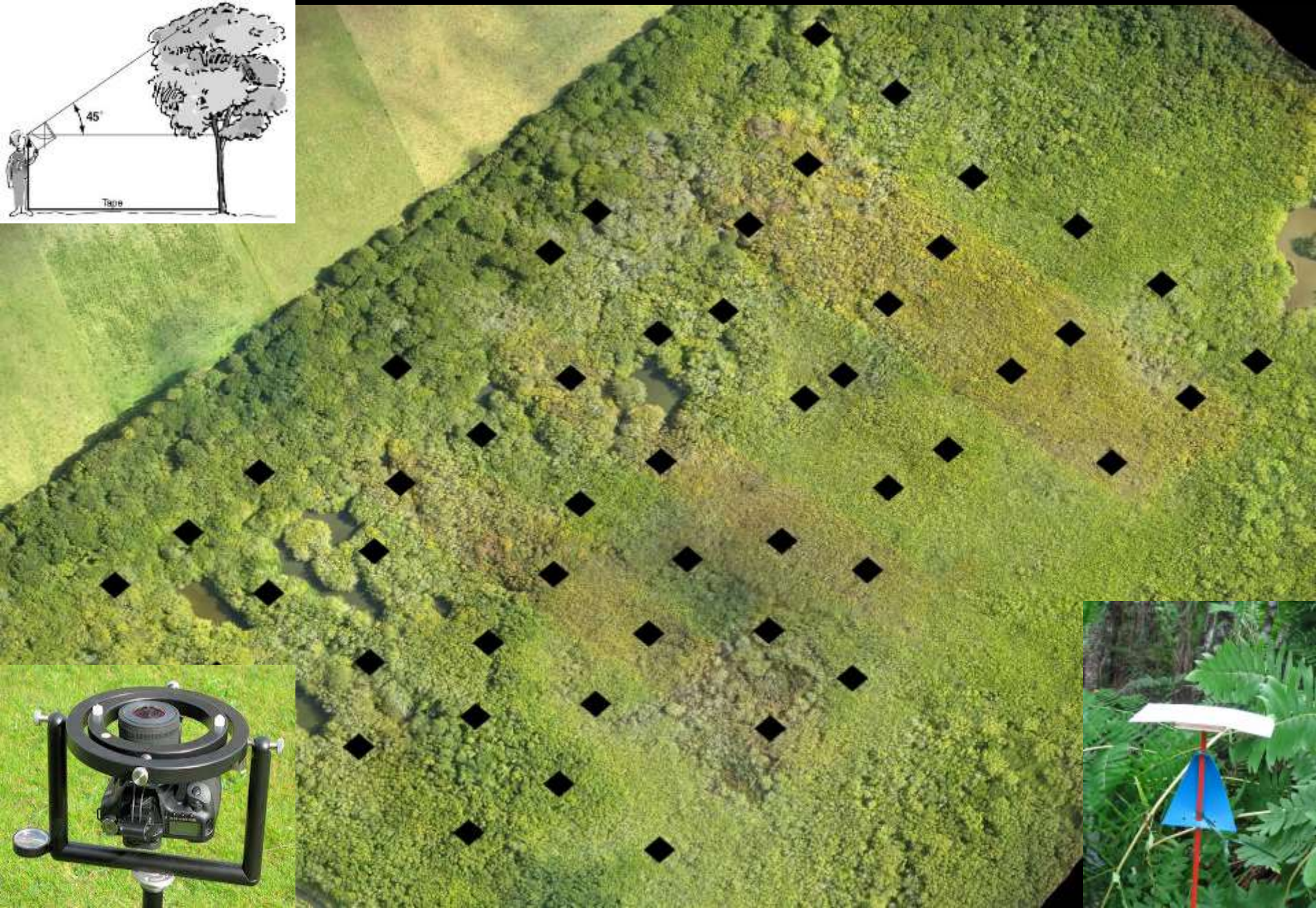
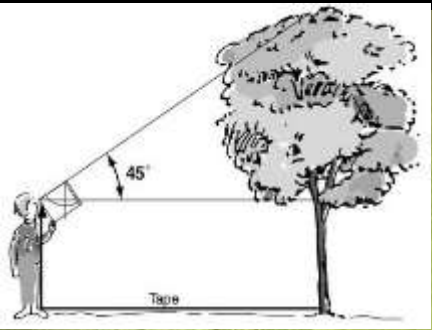


2 years post – non-treatment

The large scale willow control project



The large scale willow control project



Drone based photogrammetry

high resolution (<5cm pixels) NIR & RGB imagery

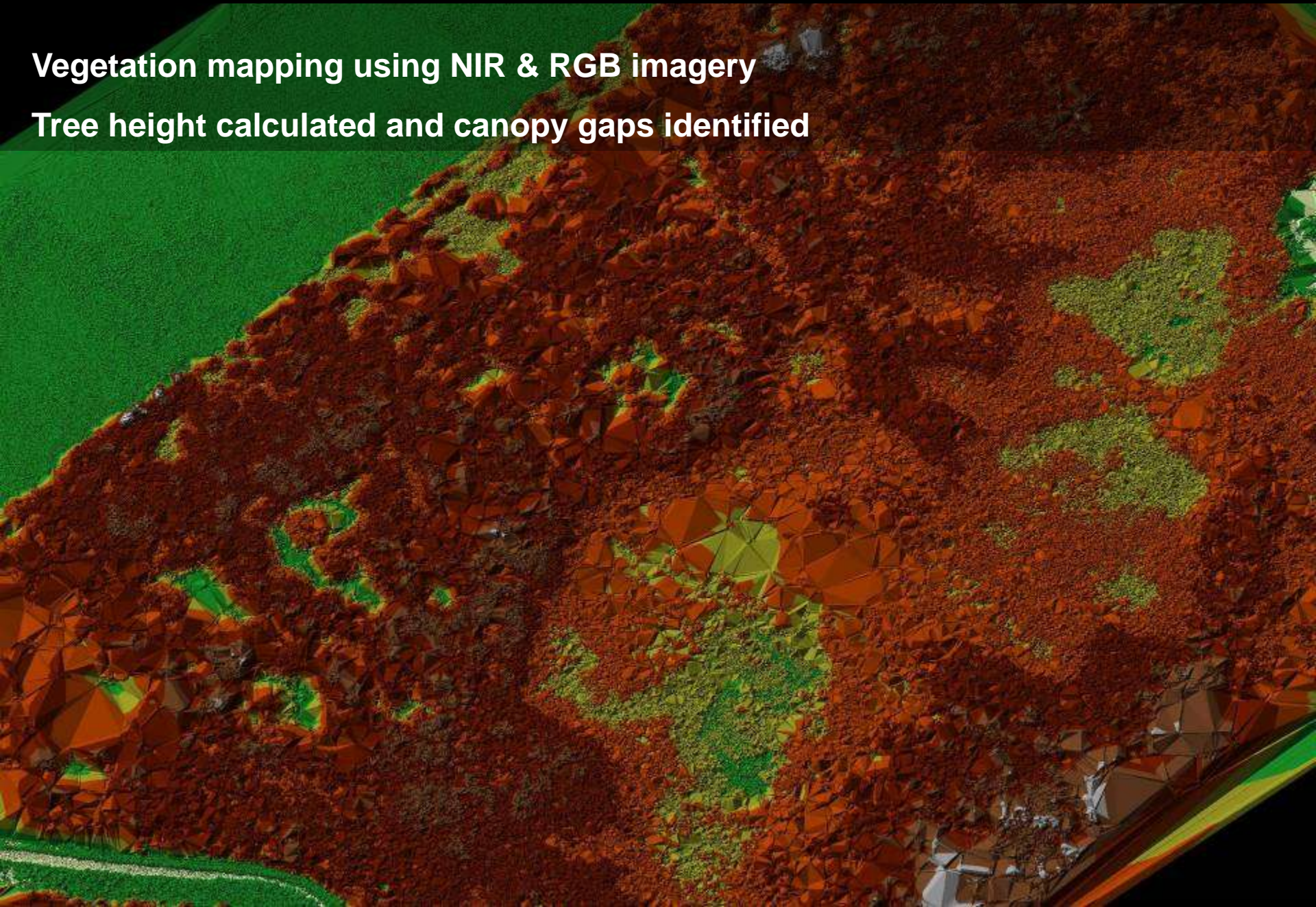
dense point cloud (3d surface model)



Photogrammetric data useful

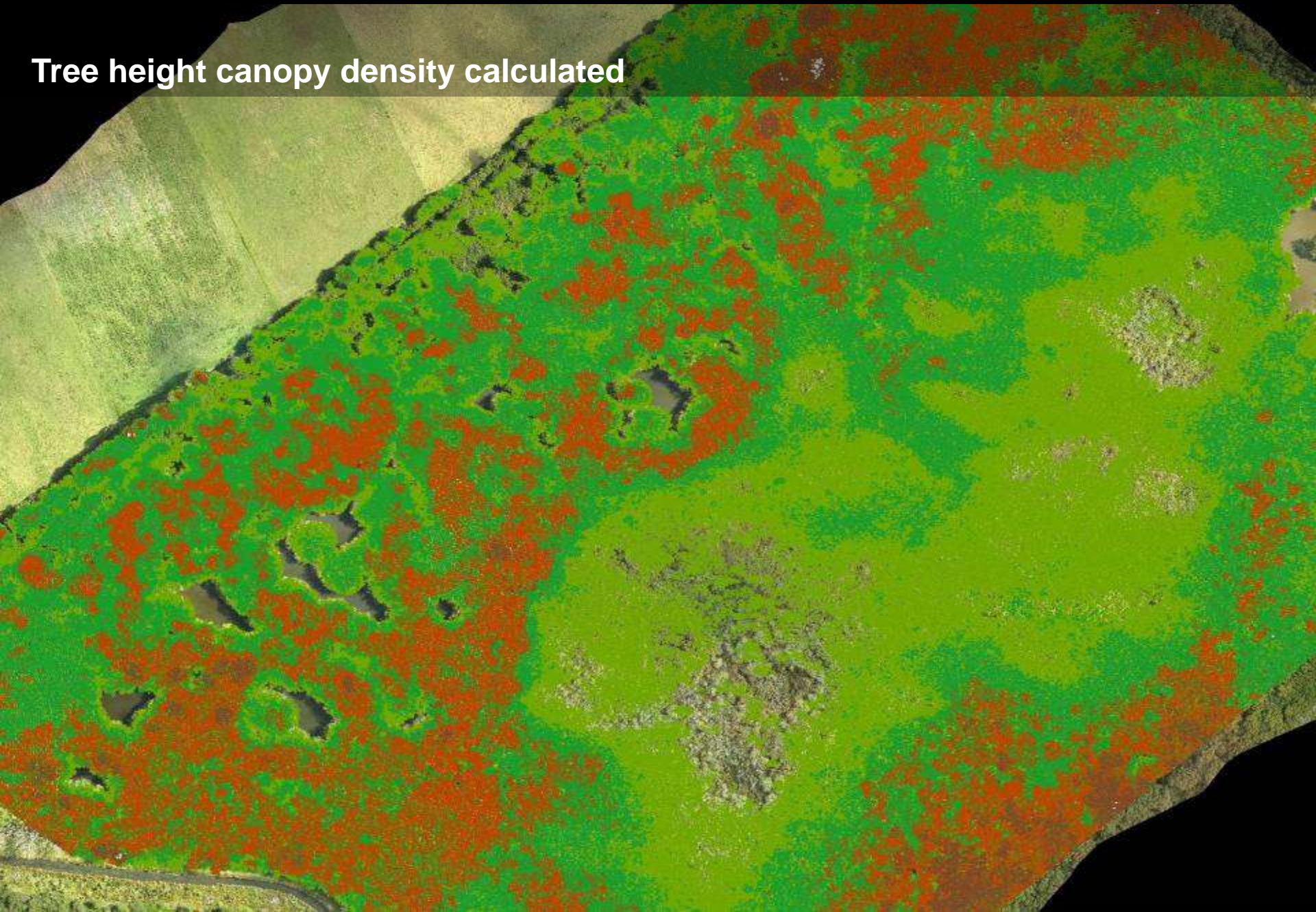
Vegetation mapping using NIR & RGB imagery

Tree height calculated and canopy gaps identified



LiDAR data useful

Tree height canopy density calculated



Harts Creek

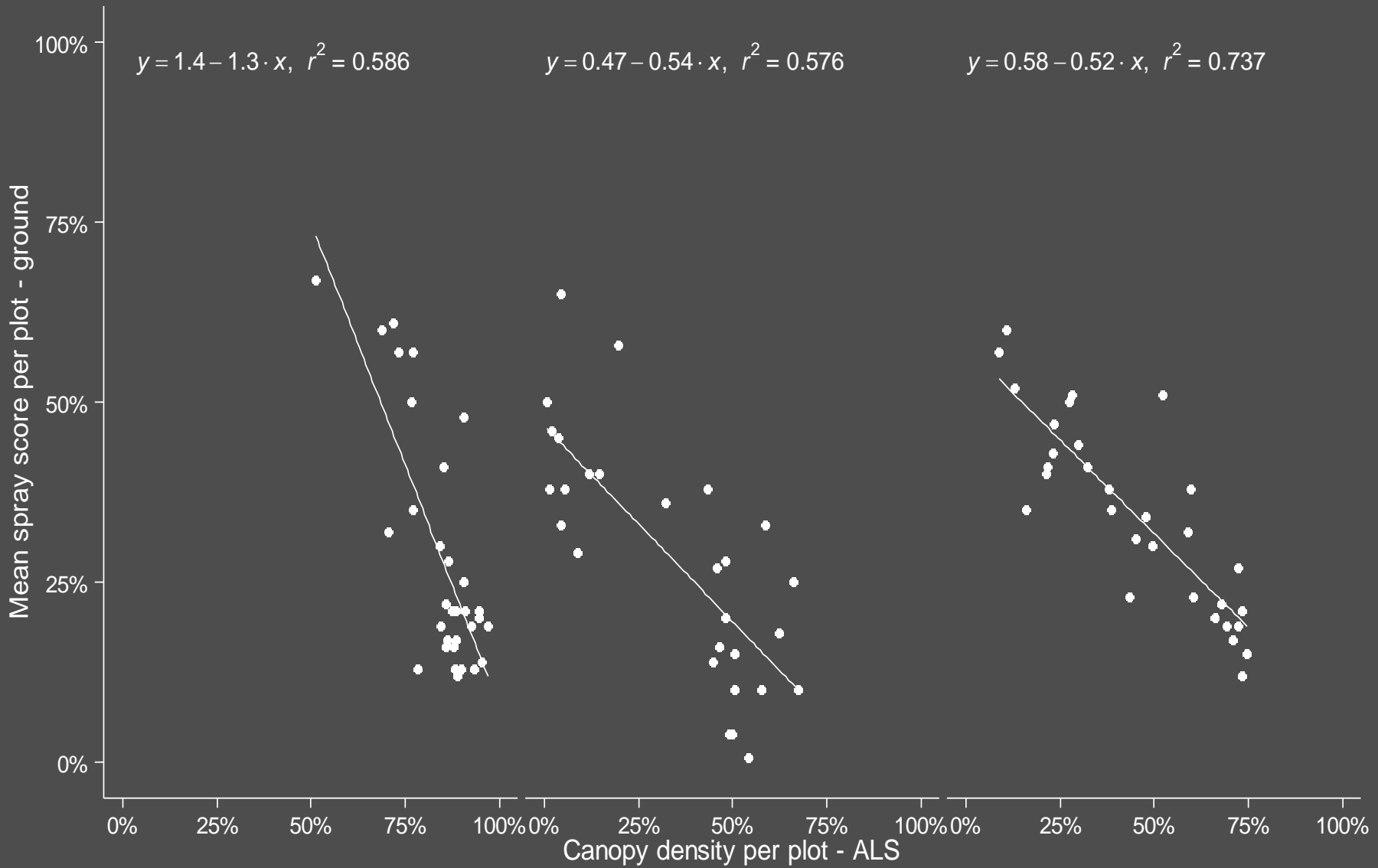
$$y = 1.4 - 1.3 \cdot x, \quad r^2 = 0.586$$

Tongariro delta

$$y = 0.47 - 0.54 \cdot x, \quad r^2 = 0.576$$

Whangamarino

$$y = 0.58 - 0.52 \cdot x, \quad r^2 = 0.737$$



Can variable flow technology enhance ecological outcomes of willow control?



Questions?

