Urban ecological restoration: the new frontier?

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Pestival; Aotea Centre

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

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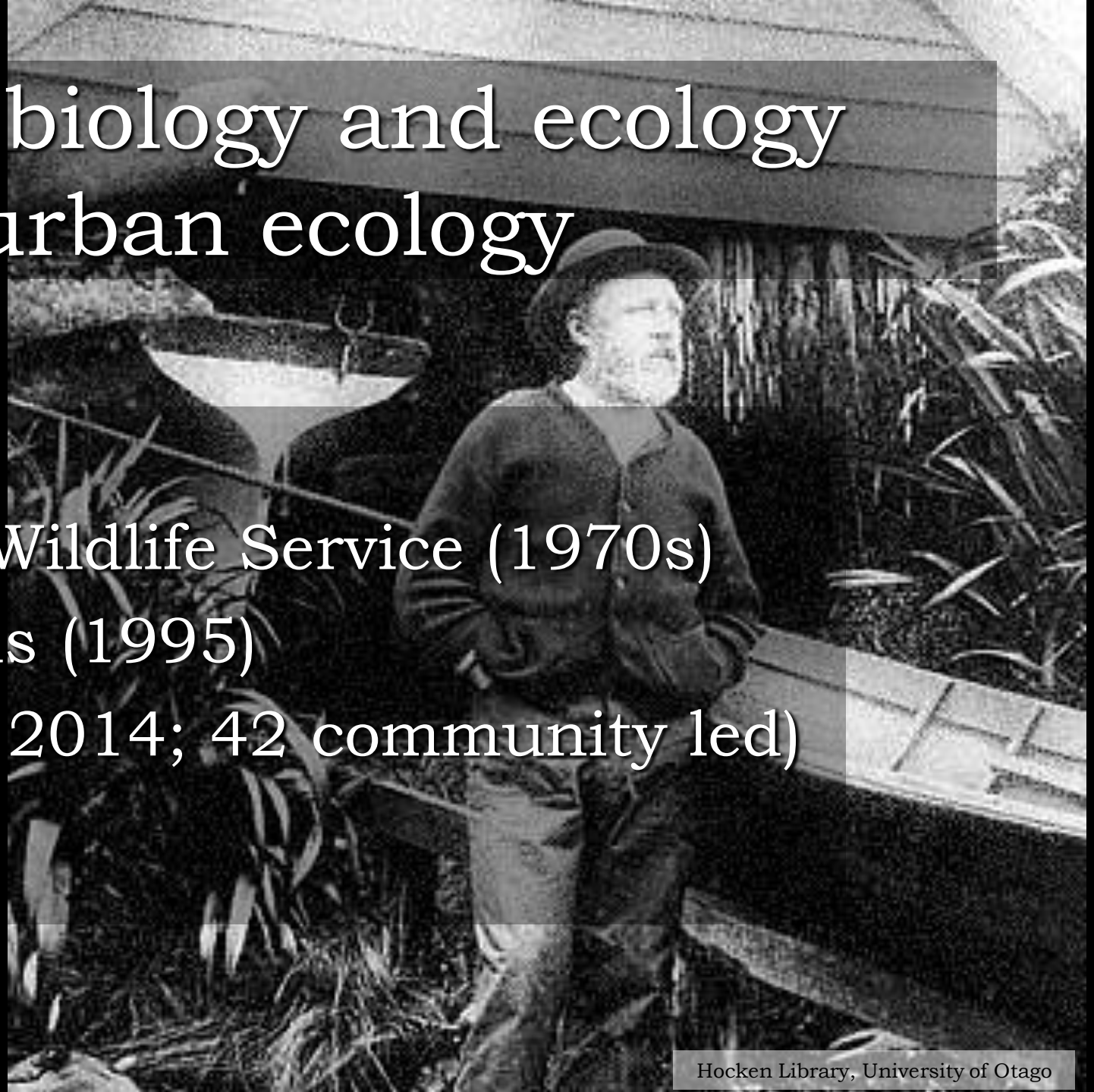
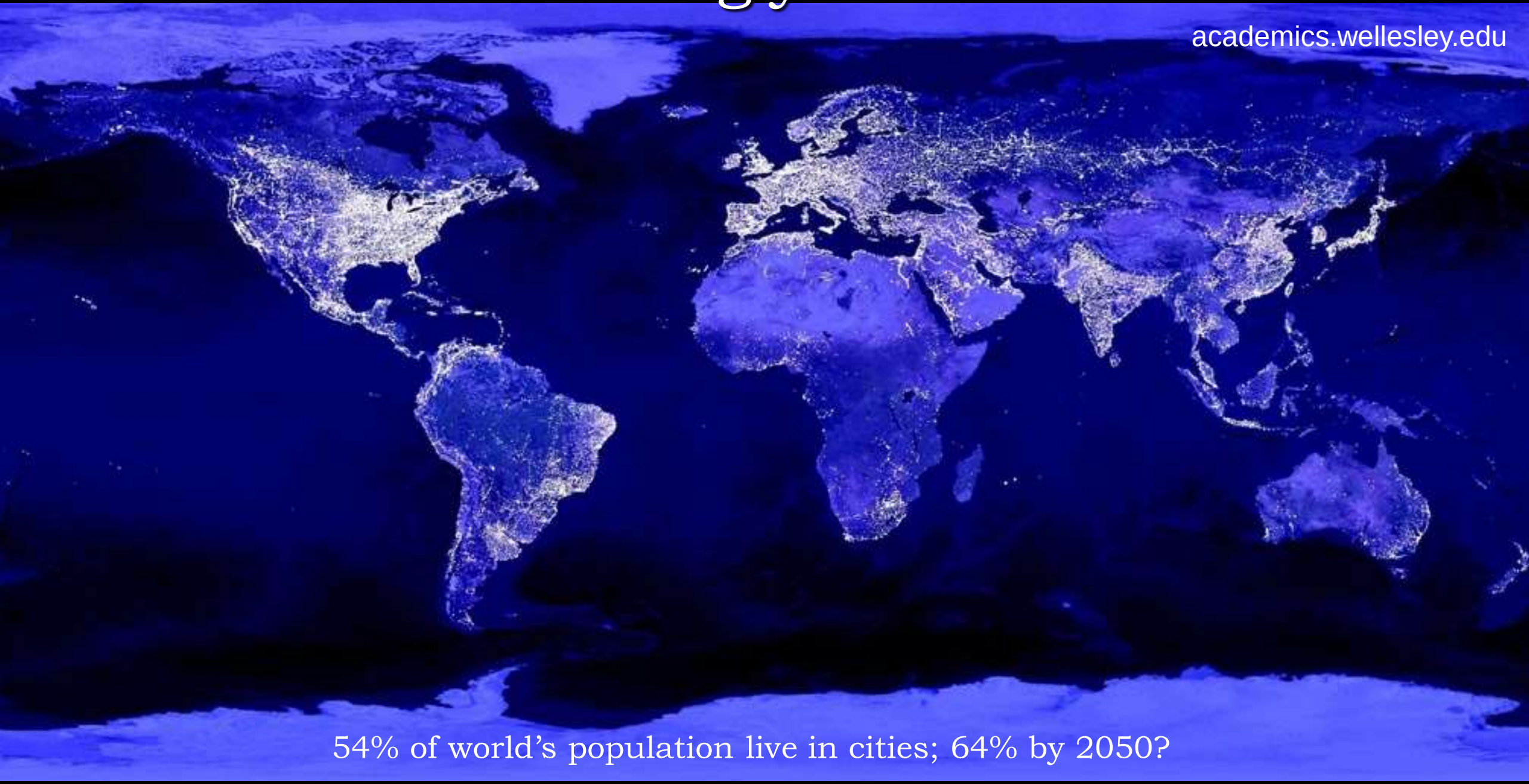
Conservation biology and ecology before urban ecology

- Richard Henry (1894)
- Offshore islands/NZ Wildlife Service (1970s)
- DOC mainland islands (1995)
- Sanctuaries (73 as of 2014; 42 community led)



Hocken Library, University of Otago

An increasingly urban world



54% of world's population live in cities; 64% by 2050?

City footprints

- London 125 X its land area
- Tokyo 3 X area of Japan
- average world citizen eco-footprint of 2.7 ha while there are only 2.1 ha of bio-productive land and water per capita on earth
- “Earth provides enough to satisfy everyman’s need but not everyman’s greed”

https://www.gdrc.org/; http://data.footprintnetwork.org/

What if ?

Cities are viewed not as a problem but the solution to saving biodiversity

- Nature
- Native plants and animals
- Greenspace
- Natural capital

B. McQuillan

What is urban ecology?

- ecosystems that include humans living in cities and urbanizing landscapes
- an emerging, interdisciplinary field that aims to understand how human and ecological processes can coexist in human-dominated systems
- and help societies with their efforts to become more sustainable

Adapted from: https://www.ius.edu/field-station/what-is-urban-ecology.php

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NZ urban centres

87% urban dwellers

NZ's 20 urban centres

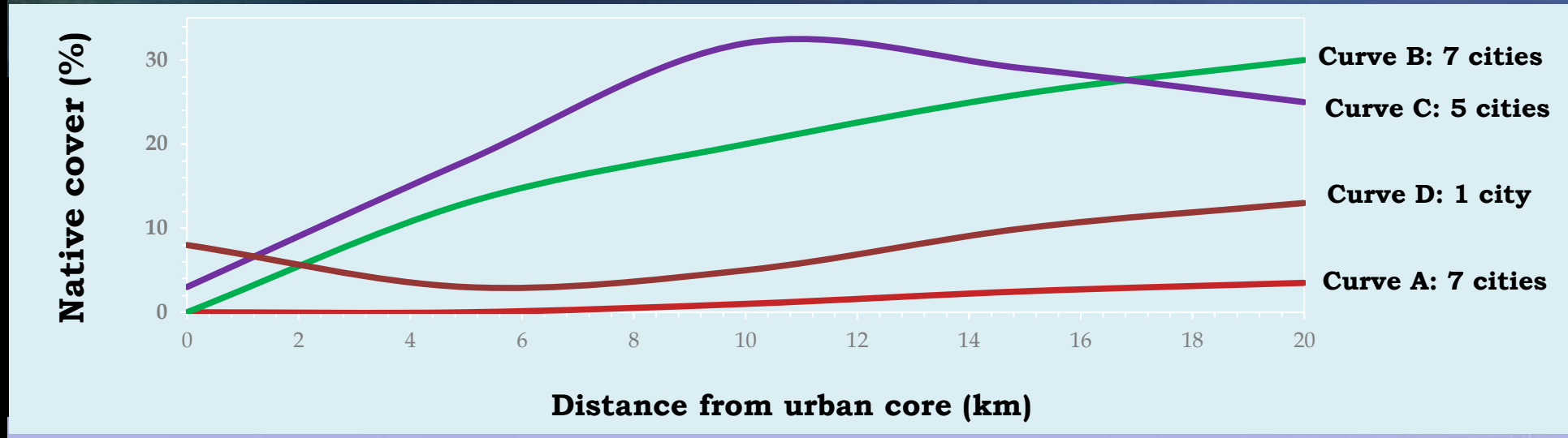
- 87% urban dwellers: 4.6M people
- Mean urban centre: 118,764 people
- Mean urban area: 114,188 ha
- Mean area urban core: 4,809 ha
- Native vegetation cover: <1 – 8.9%

[Clarkson, Wehi & Brabyn 2007: *Urban Ecosystems*]

Dunedin: C

New Plymouth: D

Urban-periurban interactions and management implications



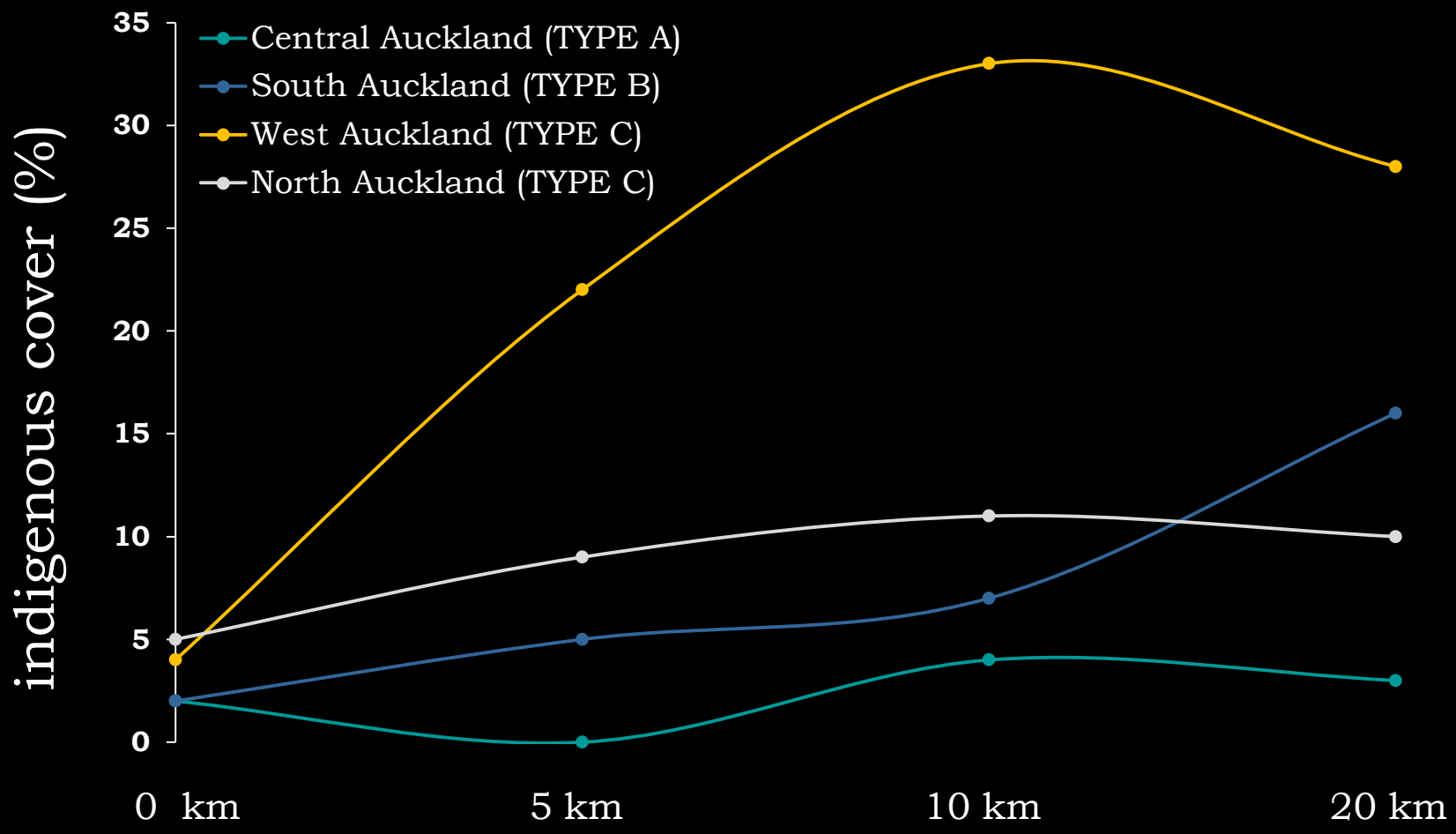
Nelson: B

Hamilton: A

Clarkson, Wehi & Brabyn 2007: A spatial analysis of indigenous cover patterns and implications for ecological restoration in urban centres, New Zealand

Google

Auckland urban centres



Why 10%?

- Semi-arbitrary but:
  - Species area curves and fragmentation (Hanski 2000-2015)
  - Forest cover & pest control study: restoration should be a priority in landscapes where cover is near or below 5–10%. "*Further forest clearance in these low cover landscapes is likely to have large impacts on native bird communities, while even small increases in forest cover may produce large benefits*" (Ruffell & Didham 2017: *New Zealand Journal of Ecology*)

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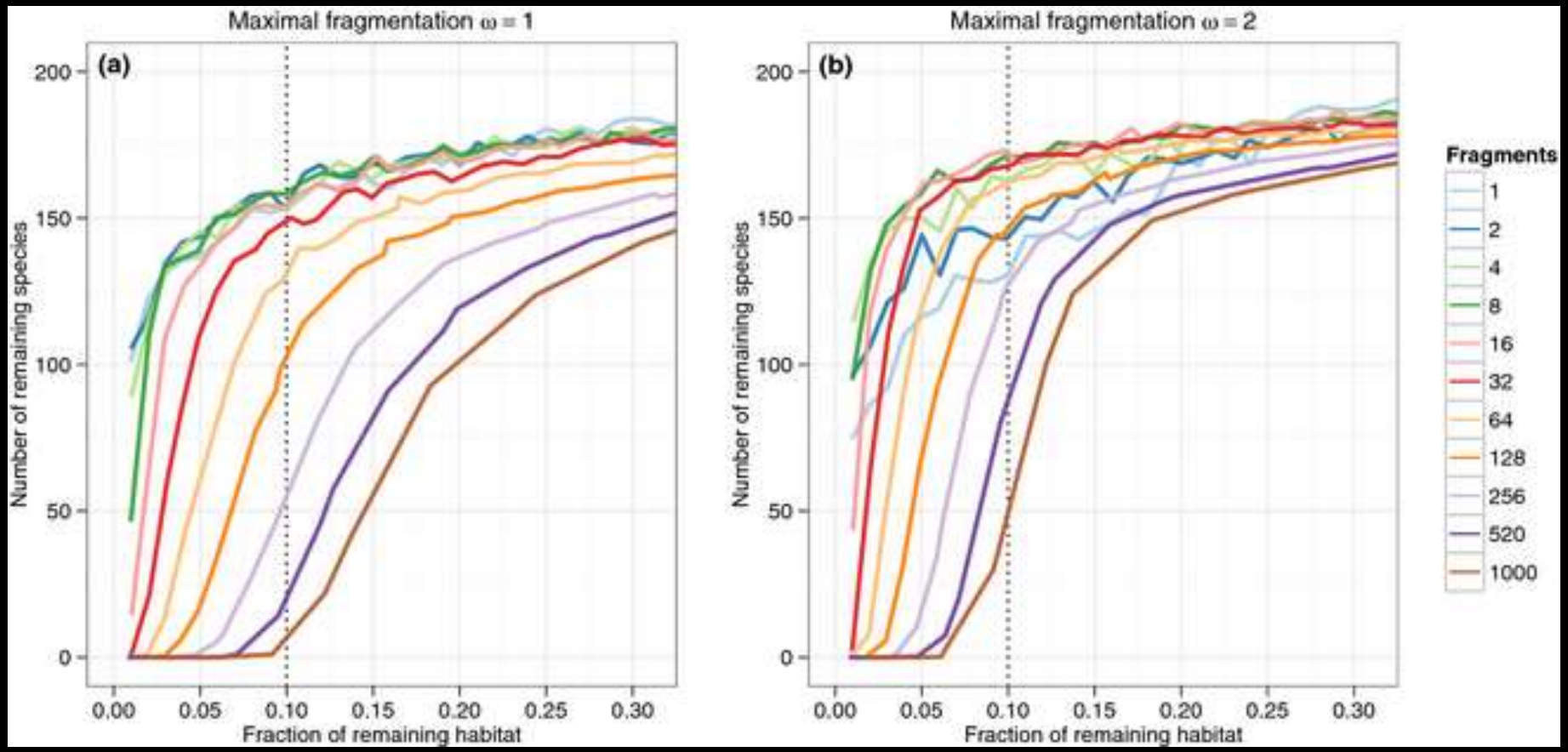
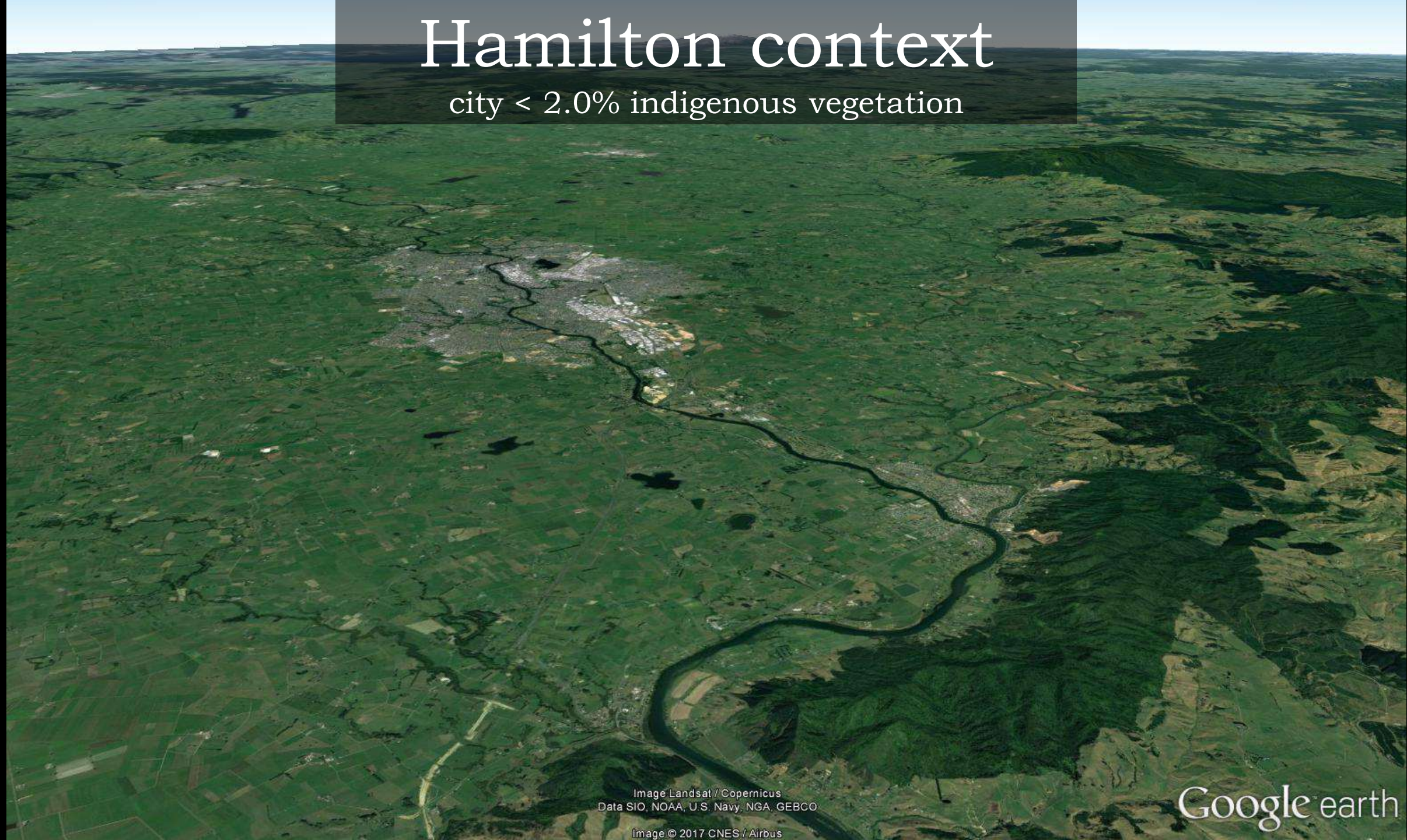
Habitat fragmentation and species richness



[Hanski 2015: *Journal of Biogeography*]

Hamilton context

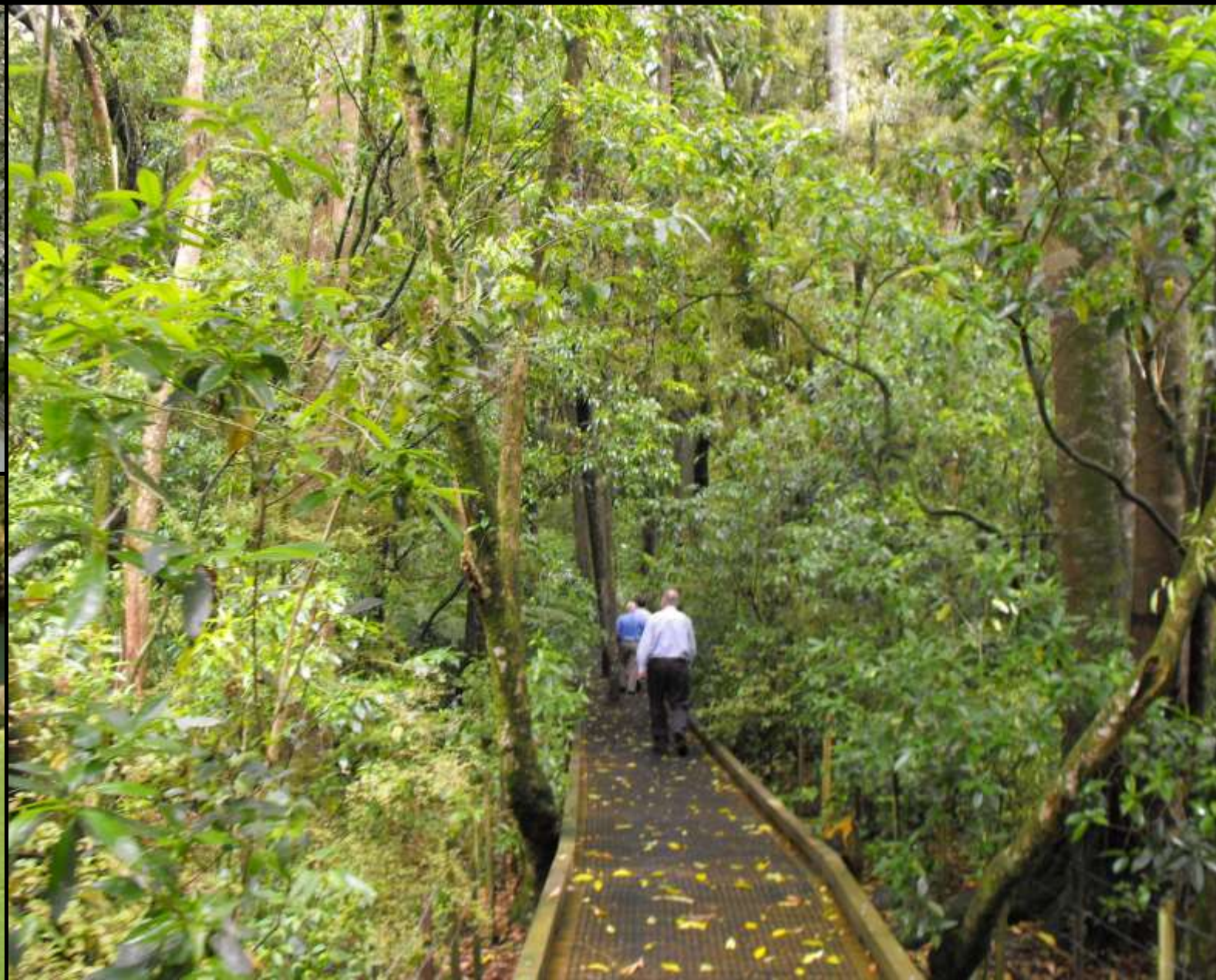
city < 2.0% indigenous vegetation



Subdivision development history

W. V. Silvester

Native dominated remnants (67 key sites): mean = 1.1 ha



Restoration of extant patches

- Removing weeds and pests
- Buffering
- Expanding and connecting
- In cities like Hamilton, Napier, Hastings and Christchurch reconstruction/ retrofitting of indigenous habitat is needed

K. J. Wallace

Reconstruction

- Moving beyond revegetation
- Target ecosystems/habitats
- Full assemblages and species occupancy
- Building habitat for all components of ecosystems; not just bringing back birds

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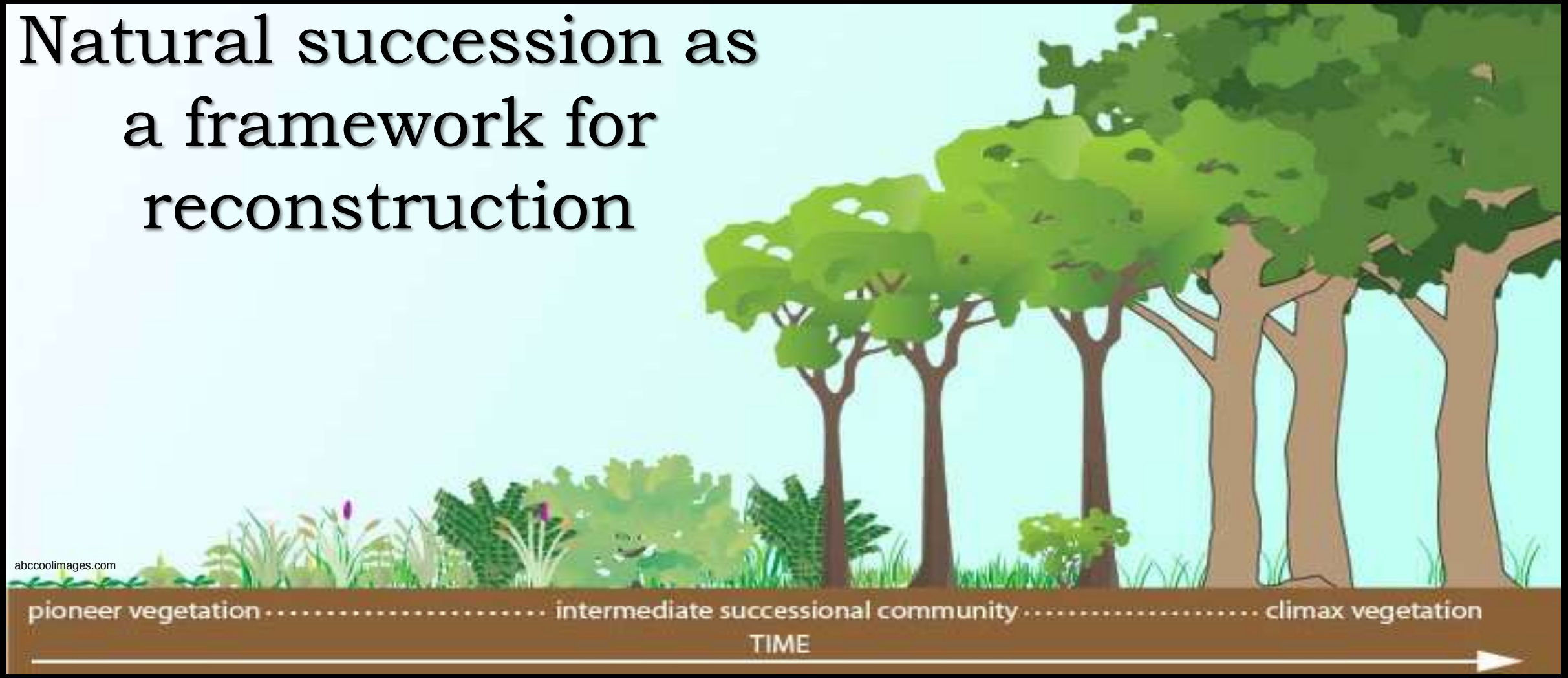
Natural succession as a framework for reconstruction



"The ultimate challenge for ecologists is to reconstruct ecosystems"

(AD Bradshaw; 1983)

Linking natural succession and recovery to restoration & reconstruction

- Using a successional framework
- Understanding the different constraints and opportunities
- Understanding the environmental drivers

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Mangakotukutuku Gully

Novel gully vegetation: willow with minimal native understorey

R. Veitch

ALLUVIAL PLAINS

Low lying floodplain

Occasional flooding

Predominant lowland

Includes swamp maire

Understorey ponga, mapou

Hangehange, kiekie and supplejack.

Ferns, herbs, grasses & sedges

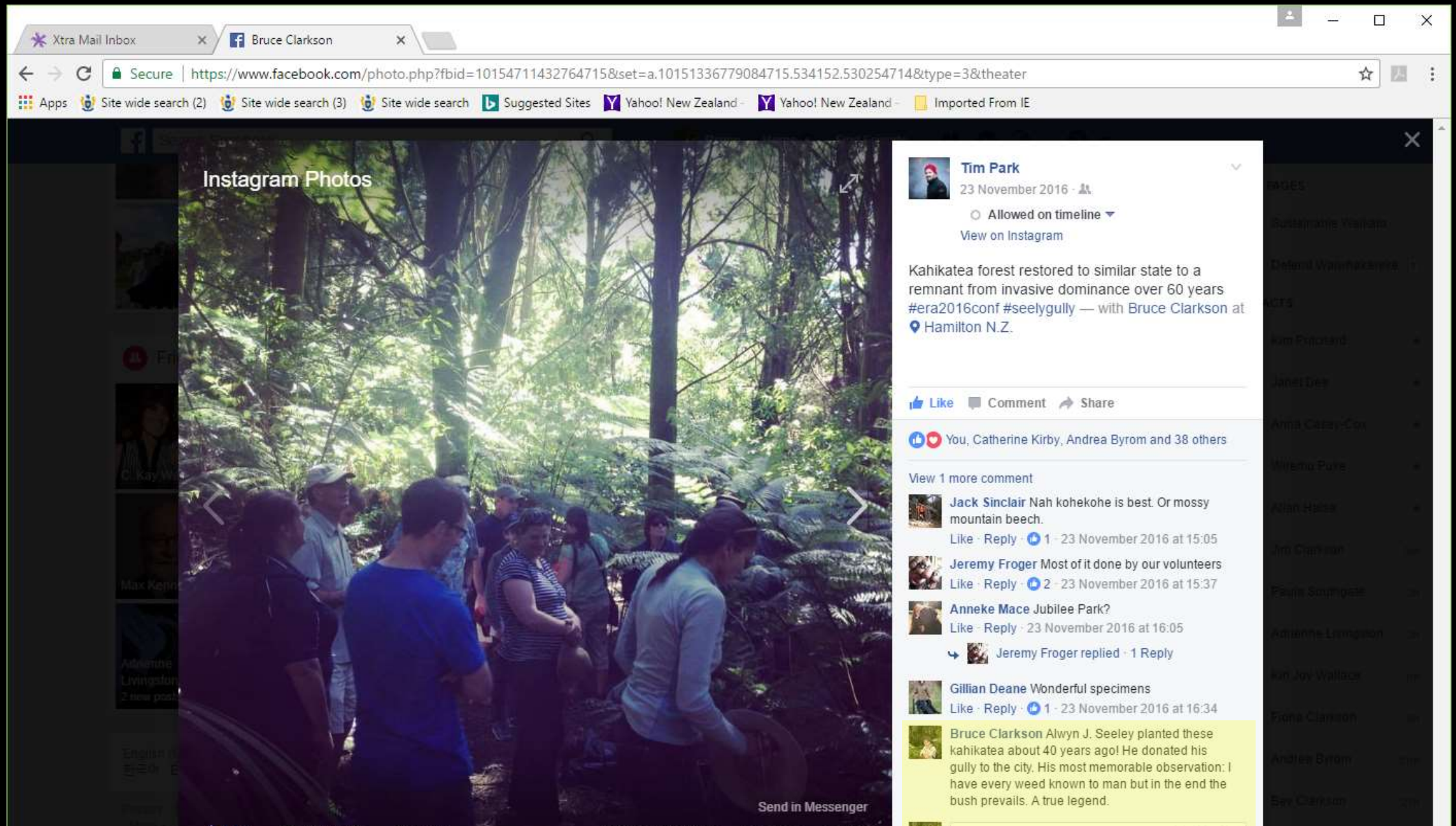
Target: Kahikatea/Pukatea-Swamp Maire forest

Restored? 7 years & 20 years

Mangaiti

Onukutara

Seeley Gully: restored 40+ years?



Kauri/Kanuka (ridge crest)

Tawa/Rimu (hillslope)

Kahikatea-Pukatea (semi-swamp)

Harakeke (lake margin/swamp)

Lake/aquatic habitat

Recommended covenant area

Waiwhakareke Natural Heritage Park:

First tree planted in 2004!

2004: 0 ha

2016: 31 ha


June 2016 Arbor Day Planting:
1800 people; 28000 plants; 3 ha; 3 hours
P. Drury for Hamilton City Council

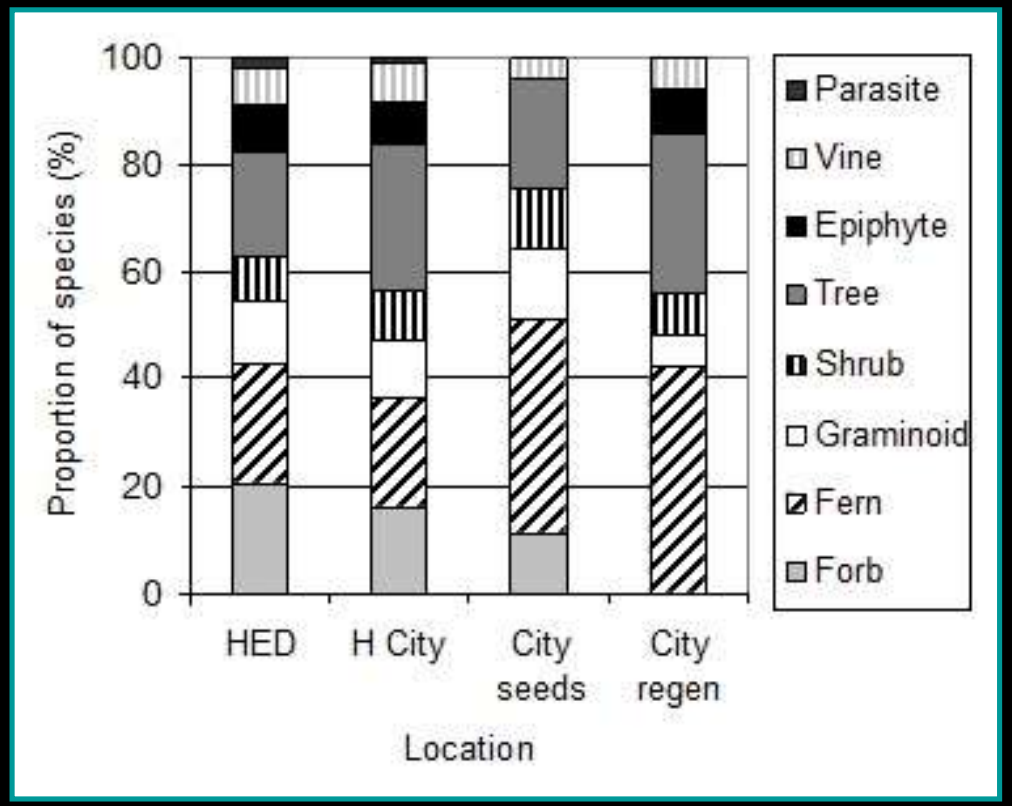
Learning from restoration planting and informing management

[*Some results from our Waikato Urban Ecology team projects*]

- Species filters and traits
- Species richness & regeneration
- Cover, richness and enrichment planting
- Seed banks and seed rain
- Seed predation
- Environmental drivers of native regeneration
- Reinstating a late successional tree (tawa) and specialised shrub epiphytes

Species filters and traits

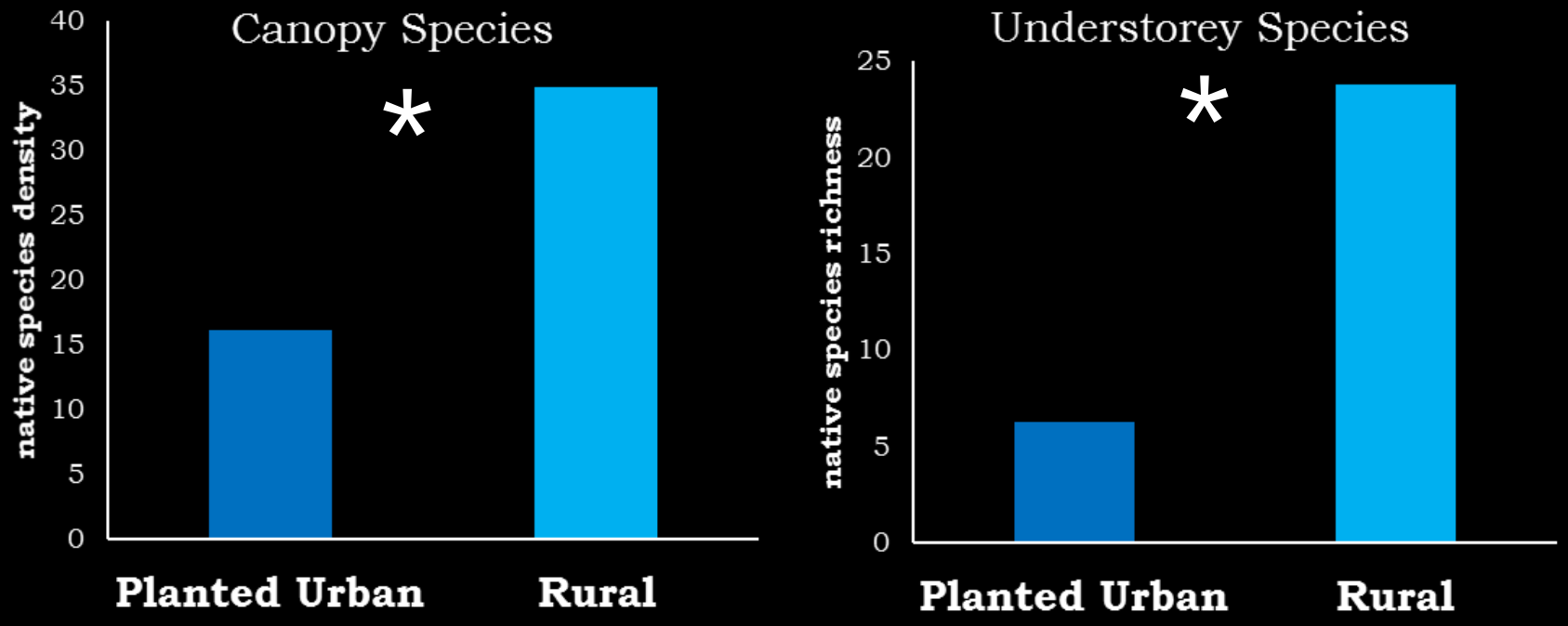
- The city's native species complement is only a subset of what should be present
- Plant traits influence which species remain (HED: total vascular spp = 343, HC: total spp = 195)



[Overdyck 2014: *PhD thesis*]

Species filters and traits

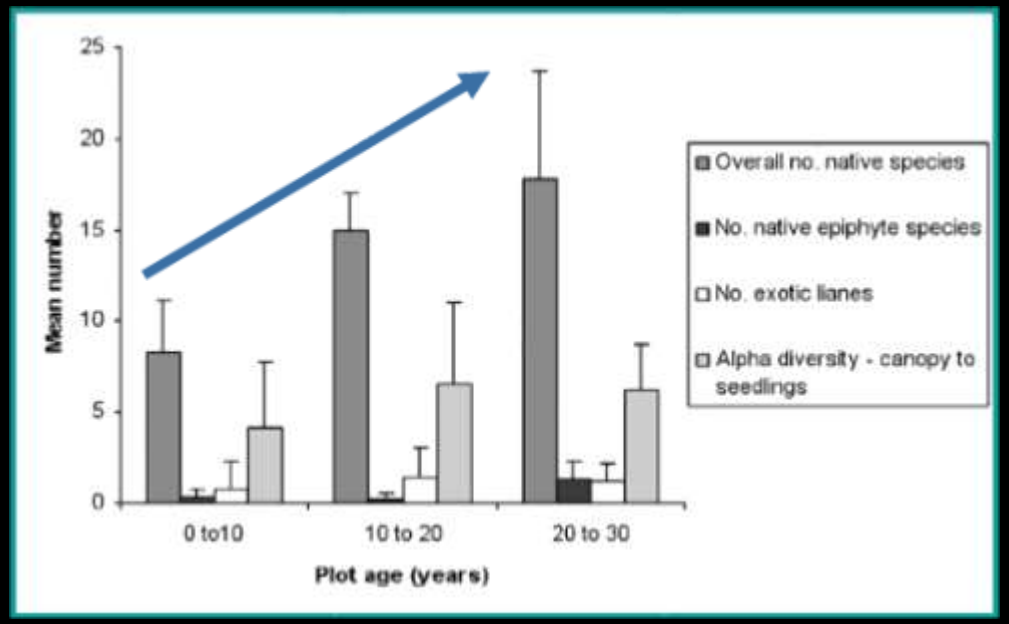
- Native species used in restoration planting are only a subset of what could/should be used in a systematic approach
  - Planted urban canopy species 46% that of rural forests
  - Planted urban understorey species 26% that of rural forests



[adapted from Overdyck & Clarkson 2012: *New Zealand Journal of Ecology*]

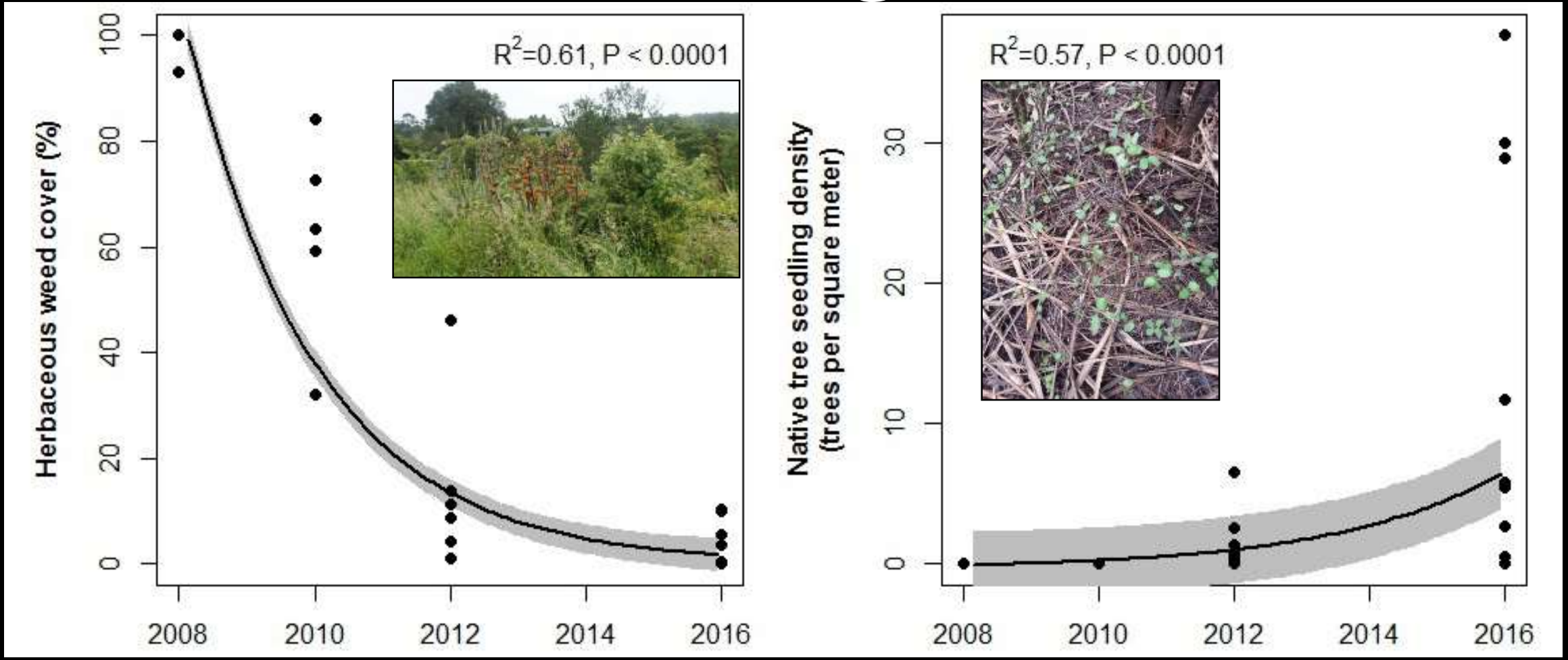
Species richness in 3 age classes

- Native plant richness increases with time after restoration



[MacKay, Wehi & Clarkson 2011: *Urban Habitats*]

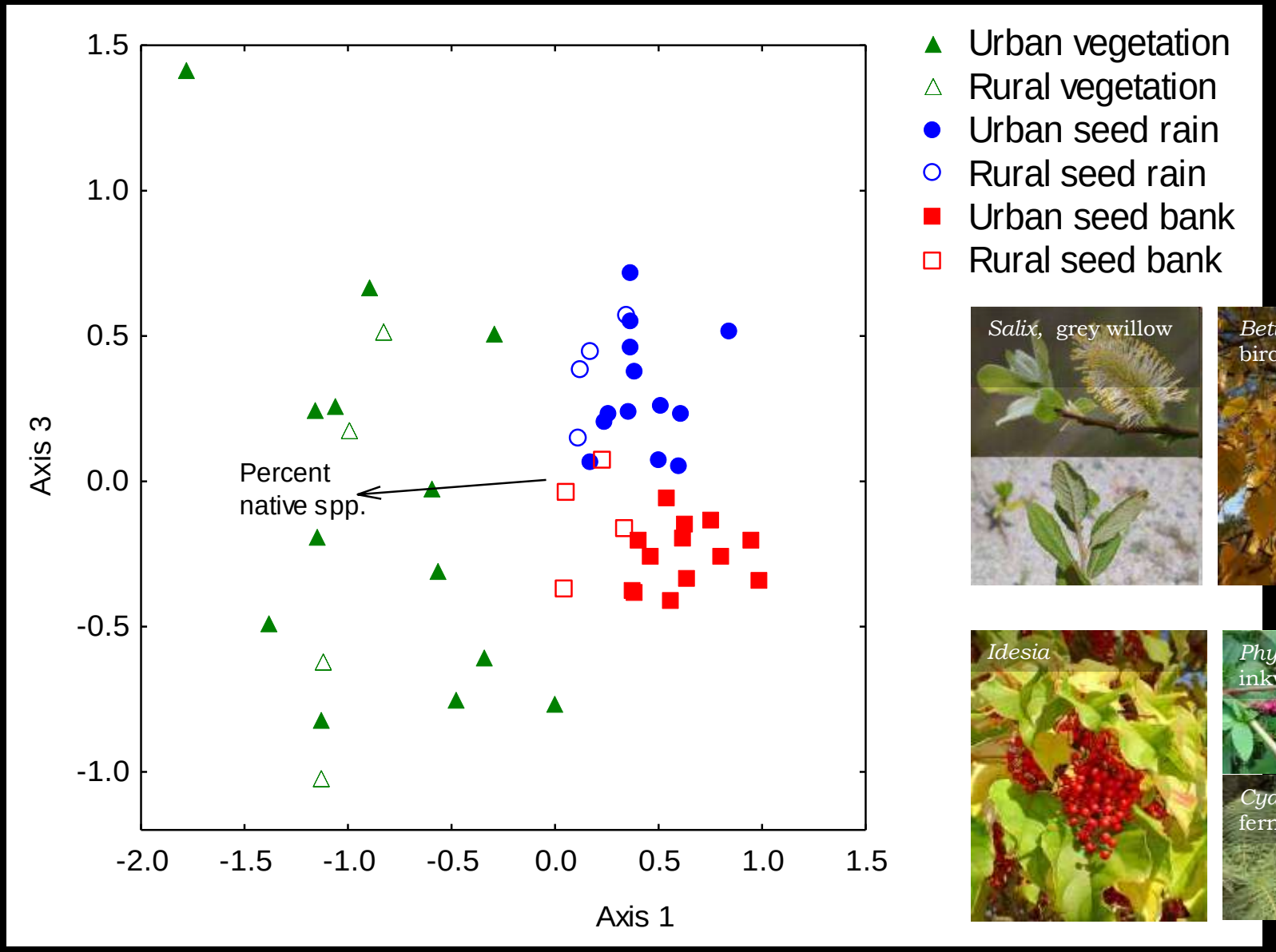
Canopy cover reduces weeds and initiates regeneration



[Laughlin & Clarkson: *submitted*]

Photo credits left: C. Kirby, right: R. Nepia

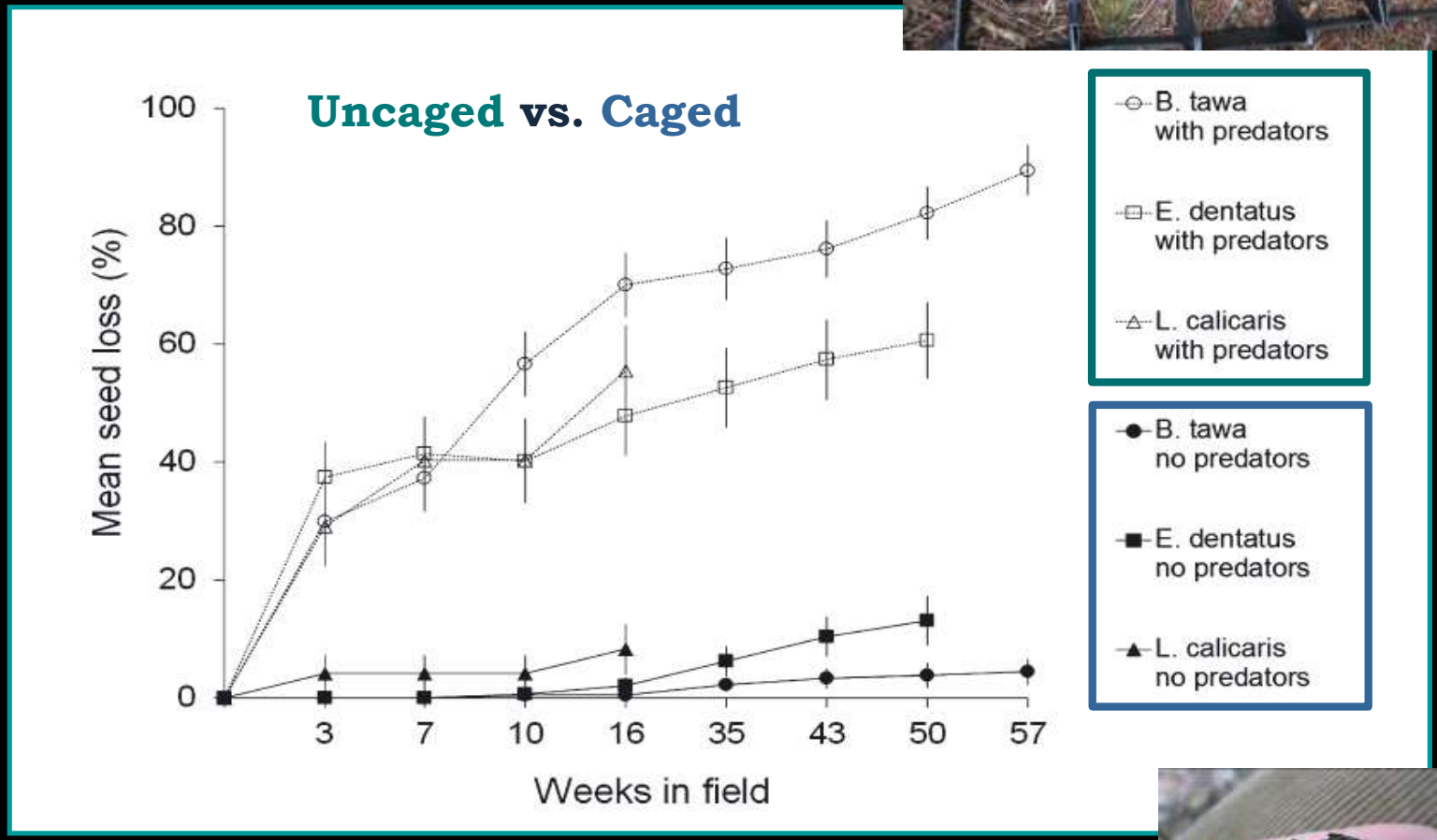
Species composition



[Overdyck & Clarkson 2012: *New Zealand Journal of Ecology*]

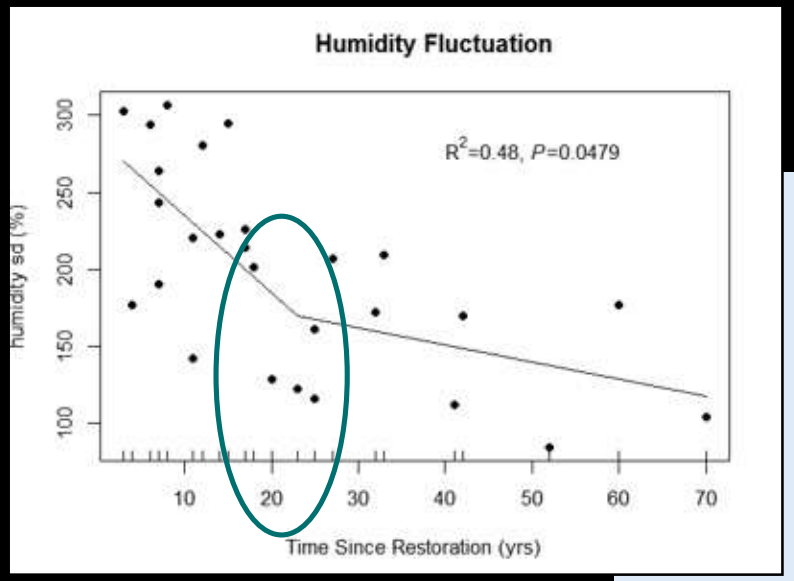
Predation and broadcast seeding trial

- Significant loss of large seeds and fruits to predation (58%) compared to caging (4%)
- Removal of fruit flesh and clay ball application resulted in only 35% loss to predation

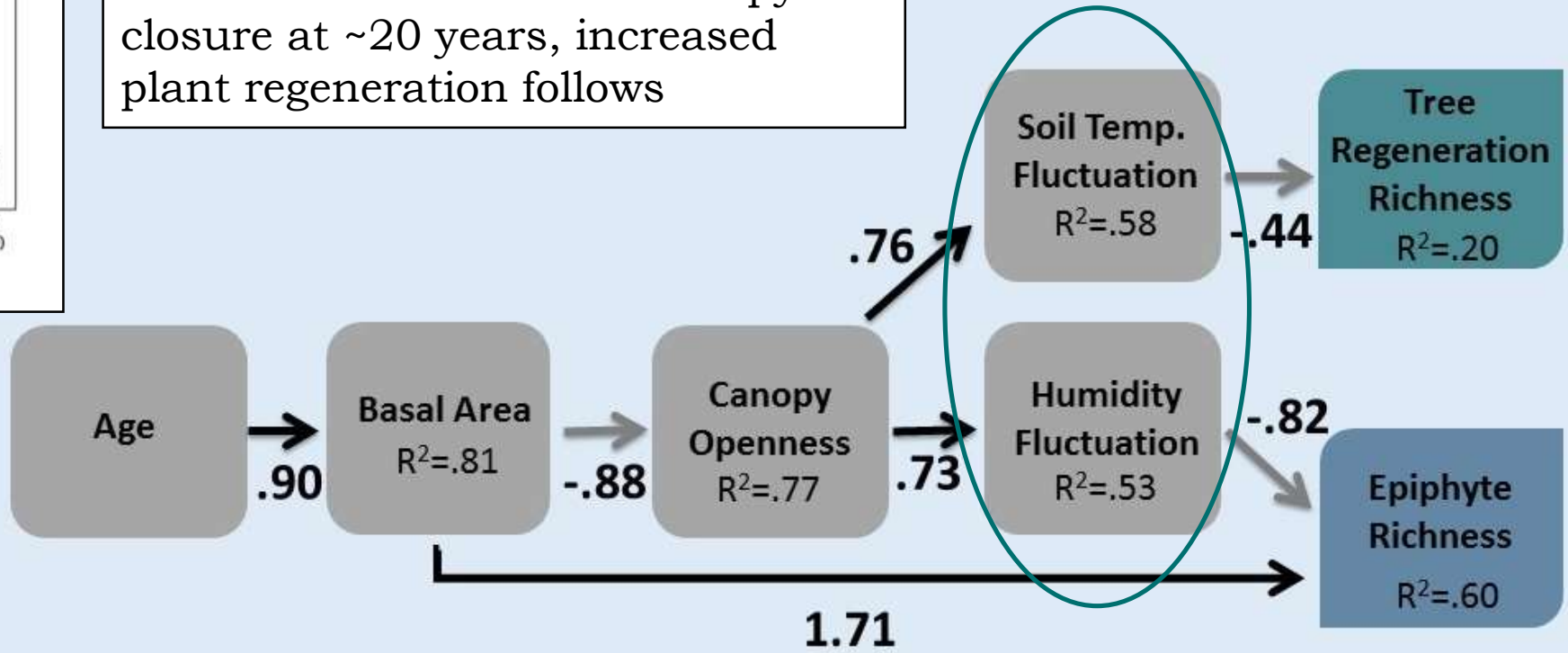


[Overdyck, Clarkson, Laughlin & Gemmill 2013: *Restoration Ecology*]

Environmental drivers of native plant regeneration



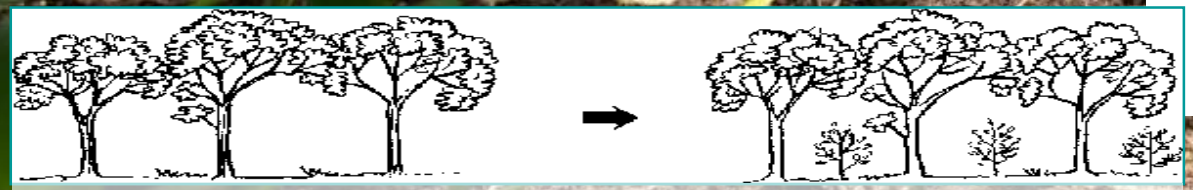
Fluctuating environmental conditions stabilise with canopy closure at ~20 years, increased plant regeneration follows



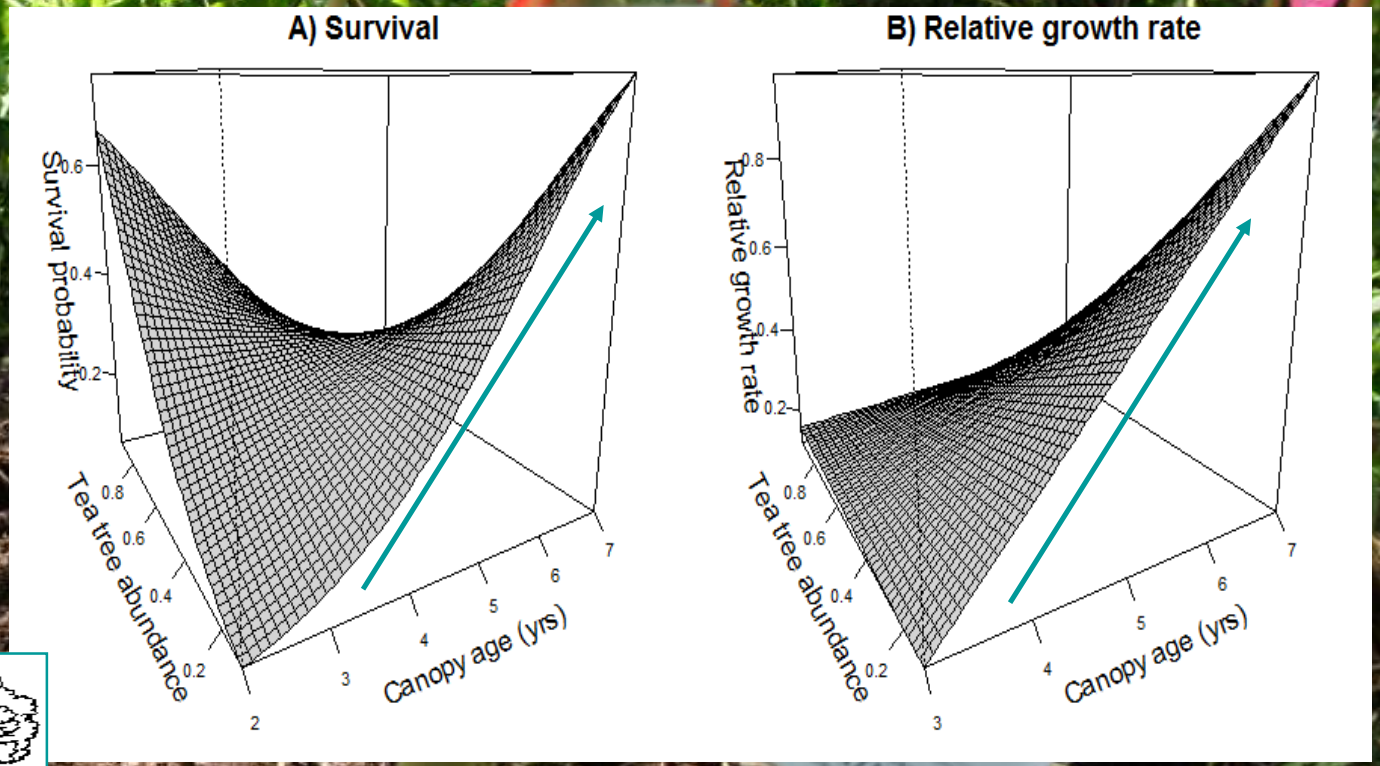
[Wallace, Laughlin & Clarkson 2017: *Ecological Applications*, threshold analysis: appendix S3]

Conditions for enrichment planting

- Survival and growth increase with canopy age



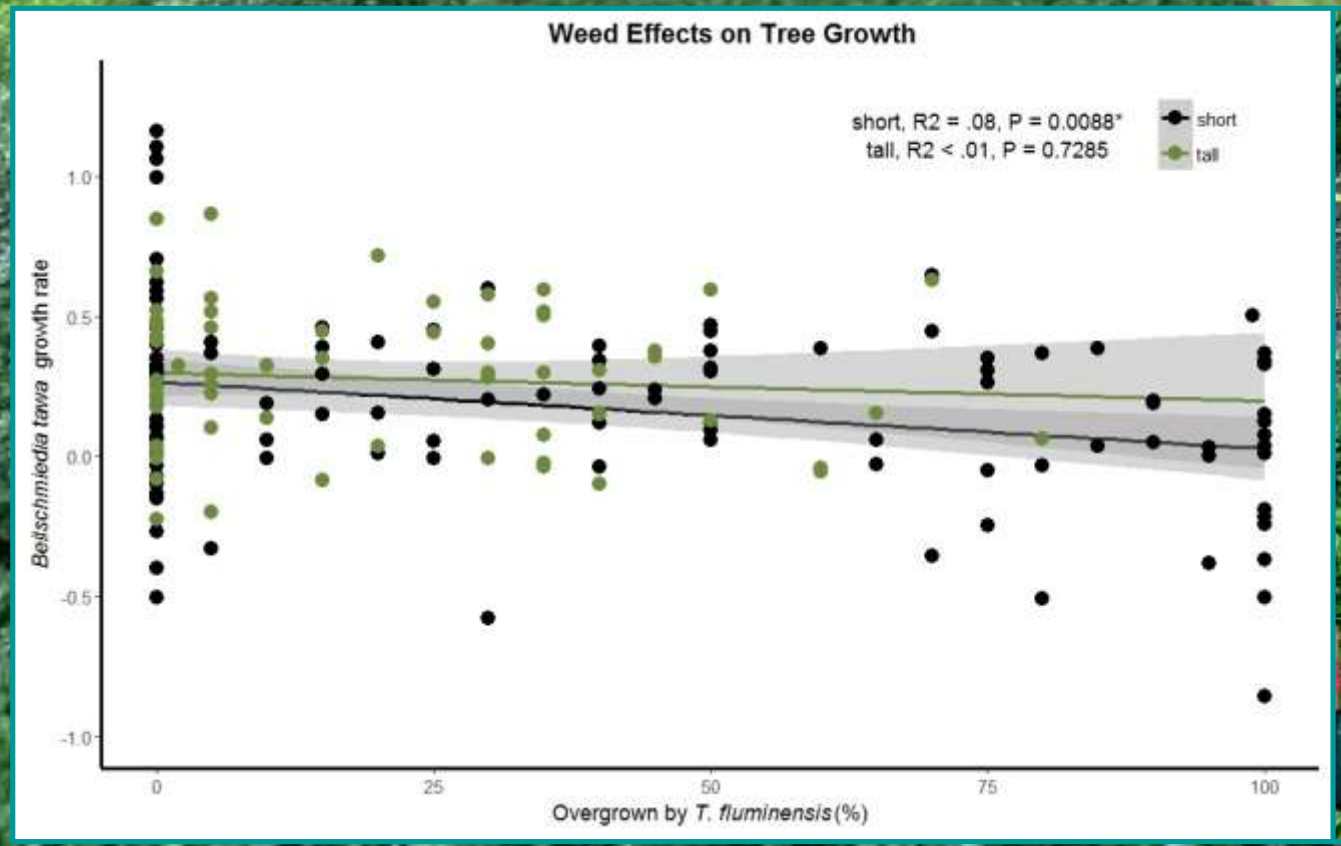
Enrichment tree seedlings planted under established canopy.



[Laughlin & Clarkson: *submitted*]

Enrichment despite exotic competition

- Mulching and weeding insignificant, *B. tawa* growth rate best when planting 1 m tall trees



[Wallace 2017: ***submitted PhD thesis***]

Reintroducing specialised shrub epiphytes

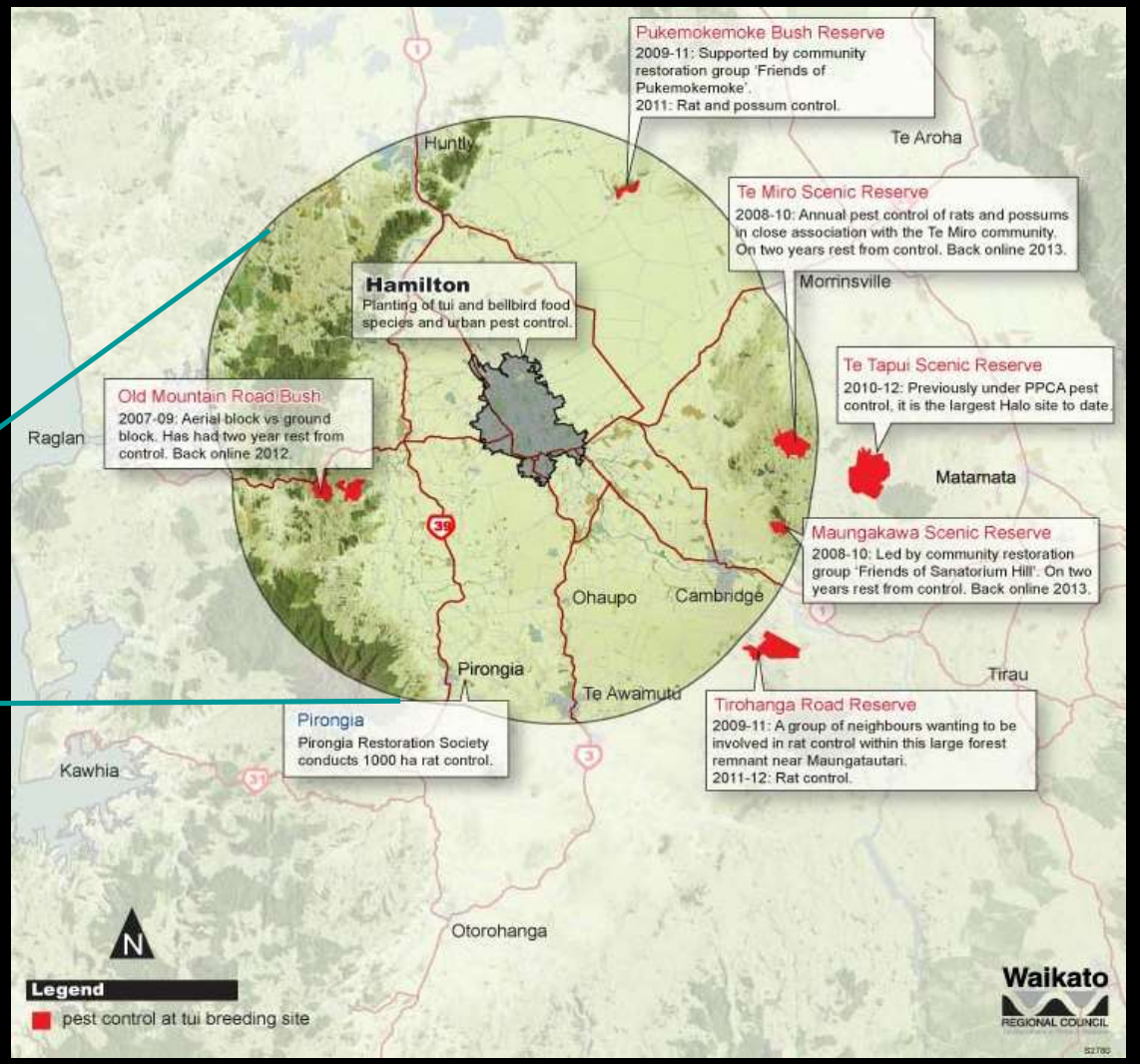
[Bryan 2013: *NZ Epiphyte Workshop Proceedings*]

Hamilton Halo

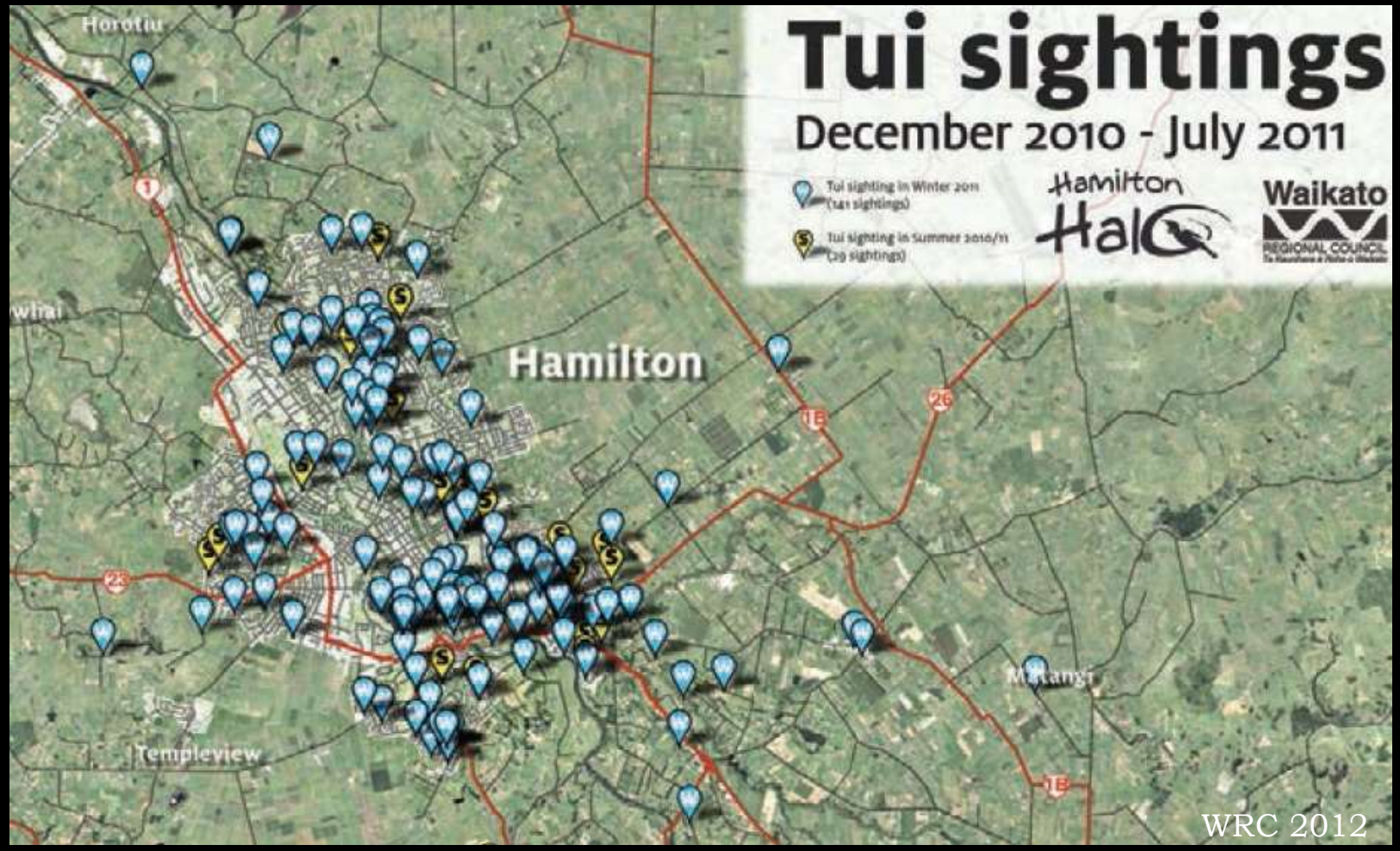
Pre-Halo breeding success <30%

Bait stations in 75 metre grids during breeding season: Sep – Jan

Populations controlled for 3 years then rested for 2 years



Tui tipping point



Reported sightings:

2007: 11

2008: 28

2009: 490

First nest 2007!

Sightings peaked in 2009 when the birds were a real novelty, now they are becoming the norm and reports of sightings have dropped off.


Retrofit corridors of native flora to attract the native fauna

Success?


hihi


kaka


tieke


kiwi

P Brown

Different solutions for Different cities

Hamilton City:

Restore the gullies and link them to the river, the lakes and forest remnants

Potential 810 of 9427 hectares; 8.6%

Restore 10 hectares

Reconstruct 190 hectares

Constraints

- Altered soil, climate, pollutants and processes
- Habitat isolation and fragmentation
- Novel species assemblages
- Lack of ecological knowledge
- Lack of social acceptance
- Varied views and value systems
- Human-wildlife conflicts

Mangaiti Gully Restoration Group

Opportunities

- Engaged and well-informed public
- Potential for intensive human intervention
- Lack of grazing animals
- Some predators less common
- Coordinated interagency action
- Convergence of disciplines and capability

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Multiple benefits: not just biodiversity!

- Filtering air and water
- Cooling heat islands
- Co-use corridors
- Social cohesion
- Carbon sequestration to counteract greenhouse gases
- Health and recreation benefits

C. Kirby

[adapted from: http://www.conservationmagazine.org/2014/02/7-benefits-bringing-nature-back-cities/]

"Reconnecting children with nature and providing a well-informed public could be the most important applications of urban ecology"

McKinney 2002;
Louv 2005

Urban restoration is the new frontier

C. Kirby

But are we doing enough?

Imagine your city
in 2050!

Your city could
be a Sustainable
& Biophilic City!

Cities will determine the fate of the remaining biodiversity of our regions, our nation, and the planet.

"There will be no sustainable world without sustainable cities!"

-Herbert Girardet