Bringing indigenous nature back into New Zealand towns and cities

Bruce D. Clarkson
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”

What if?

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

- Nature
- Native plants and animals
- Greenspace
- Natural capital
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
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]
Urban–periurban interactions and management implications

Clarkson, Wehi & Brabyn 2007: A spatial analysis of indigenous cover patterns and implications for ecological restoration in urban centres, New Zealand
Why 10%?

- 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)
- Draft NPSIB: Policy 19: Restoring indigenous biodiversity depleted environments; A target for indigenous cover, which in urban areas and peri-urban areas must be at least 10 per cent
Habitat fragmentation and species richness

Extinction threshold? \hspace{1cm} Percolation threshold?

[Hanski 2015: Journal of Biogeography]
Hamilton Ecological District
(160,000 ha): basin and foothills

City 2%+ of native cover (200 ha)

ED <2% of original
2,500 ha

42 QEII covenants mean 4.4 ha; total 185 ha
Scenic etc. reserves 385 ha
Subdivision development history
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
Reconstruction

- Moving beyond revegetation
- Target ecosystems/habitats
- Full assemblages and species occupancy
- Building habitat for all components of ecosystems; not just bringing back birds
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
- Bridging theory and practice
Mangakotukutuku Gully
Novel gully vegetation: willow with minimal native understorey
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

B. R. Clarkson
Seeley Gully: restored 40+ years?
Waiwhakareke Natural Heritage Park:
First tree planted in 2004!
2004: 0 ha

2018: 36 ha
June 2016 Arbor Day Planting:
1800 people; 28000 plants; 3 ha; 3 hours
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
Permanent monitoring network

- Began in 2006;
- Expanded as planting cover increases;
- Six 4 m$^2$ wetland bog and twenty five 100 m$^2$ forest plots.
GIS based planting tool

- Species, planting density and spacing
- 235 Plant species
- Hamilton basin flora
  - Landform
  - Vegetation type
- Successional stage thresholds
  - Canopy cover
  - Humidity
- Third iteration of planting plan
Environmental conditions constitute thresholds

Fluctuating environmental conditions stabilise with canopy closure at ~20 years, then increasing plant regeneration

[Wallace, Laughlin & Clarkson 2017: *Ecological Applications*, threshold analysis: appendix S3]
Temporal Dynamics:
Critical Thresholds in Forest Restoration

We can manage forest ecosystems to successfully cross these thresholds

(Wallace, Laughlin & Clarkson 2017: Ecological Applications)
Enrichment planting amongst weeds

Mulching and weeding not significant, *Beilschmiedia tawa* growth rate best when planting 1 m tall trees

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
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.
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]
Reintroducing specialised shrub epiphytes

[Bryan 2013: NZ Epiphyte Workshop Proceedings]
Riparian planting
Other corridors
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
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
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

[adapted from: http://www.conservationmagazine.org/2014/02/7-benefits-bringing-nature-back-cities/]
Figure 1. Urban green space provides several well-known pathways for population health improvement. However, through recent developments in microbiome science, public health practice could realise an additional health improvement pathway by exposing populations to healthier environmental microbiomes found in more biodiverse urban green spaces. We have
“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
1.1 Urban restoration plantings
   - Laughlin, Hartley, & Wallace

1.2 Urban lizard fauna
   - Nelson & Hartley

1.3 Urban predator profiles
   - Innes, Wilson, & Van Heezik

2.1 Maori urban restoration cultural values
   - Whaanga & Wehi

2.2 Urban greenspace benefits
   - Van Heezik & Freeman

2.3 Cross-sectoral alliances
   - Collins

Research Partners: Waikato; Landcare Research; Otago; Victoria
But are we doing enough?

Imagine your city in 2050!

Your city could be a Sustainable & Biophilic City!
Wellington: NZ’s first Biophilic City

Naturespace: > 97 projects
Twelfth anniversary of Nelson Biodiversity Strategy
Naturespace: >10 projects

NELSON NATURE

- The Brook Waimarama Sanctuary: creating a mainland island
- The Nelson Halo: extending bird habitat
- Dun Mountain Mineral Belt: 135 ha wilding pines controlled
- River & Stream care: riparian plantings for erosion & fish habitat

Project Maitai
New Plymouth: Mouniga to Moana
Naturespace: >7; Restore Taranaki
Tauranga

Naturespace >11; Bay of Plenty Conservation Alliance

Mauao Historic Reserve restoration, including native plantings, Grey Petrel (ooi) and Blue Penguin (kororaa)
- Kopurererua Valley restoration: native planting and recreation
- Matua saltmarsh walkway: recreation and biodiversity protection
- Johnson Reserve: native planting and recreation
Clarkson et al. 2007

Christchurch: Type A Curve

[Graph showing indigenous cover (%)]

indigenous cover (%)

km

0 km 5 km 10 km 20 km
Christchurch: opportunity from disaster?
Avon-Ōtākaro Ecological Corridor (c. 600 ha)

<table>
<thead>
<tr>
<th>10% Target</th>
<th>Min. top up needed:</th>
<th>Max. top up needed:</th>
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<tbody>
<tr>
<td>(%)</td>
<td>1.5% New Plymouth</td>
<td>9.5%+ Christchurch</td>
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<tr>
<td>Area</td>
<td>35 ha New Plymouth</td>
<td>1365 ha Christchurch</td>
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He tangata He tangata He tangata
Kaitiakitanga

Natural ecosystems
Communities of interest
Community ecosystem
Funding ecosystem
Super Cooperation
Implementation
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