Ecological Restoration in New Zealand

Parks for Biodiversity

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Images as credited

New Zealand is internationally renowned for the scenic beauty of its national parks and nature reserves, embodied in pristine forests, lofty peaks and wide lakes swathed across the countryside. It is probably less well-appreciated that the average New Zealander lives in an environment that is intensely urban. At least 86 percent of the population lives in settlements of a thousand persons or more, which is the definition of an urban area by the New Zealand government.[1] Nevertheless, no urban site is ever very far from extensive natural or semi-natural habitats, where New Zealanders enjoy abundant opportunities to re-connect with nature.

The aesthetic appreciation of biodiversity and the use of wilderness as a recreational resource are firmly woven into the collective consciousness of the New Zealand people. These values have inspired a set of unique and ambitious attempts to reincorporate wild nature into city environments. This article first introduces the concept of ecological restoration in the context of New Zealand's environmental history, and then highlights particular features of a range of projects relevant to the ecological management of city parks. It concludes by proposing some common themes and learning points from the New Zealand experience of enhancing urban ecology.

Ecological Restoration in New Zealand's Cultural Context

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. It aims to return an ecosystem to its historic trajectory and recover its former biotic expressions to the extent which contemporary conditions allow.[2] The broad enthusiasm of New Zealanders for ecological restoration initiatives may be attributed to several aspects of New Zealand's socio-environmental history.

Firstly, because New Zealand was one of the last major landmasses to be colonised by humans, it is relatively easy to characterise pre-disturbance targets for restoration based on modern records.

Secondly, because of its long biotic isolation, New Zealand's plants and animals evolved such that they look visually distinct compared to introduced organisms from the Northern Hemisphere. This facilitates the ability of non-scientists to identify, protect and monitor them. Perhaps more importantly, it allows them to serve as potent symbols of national identity, a form of social capital for the young nation.

Thirdly, ecological restoration initiatives dovetail well with the cultural revival of indigenous Māori in recent decades. Social institutions (e.g., Resource Management Act, 1991) are now in place to empower people of Māori heritage to renew traditional ties to their lands, based on principles of guardianship and sustainable resource use. As a result of all these factors, ecological restoration is in fact sufficiently well-established in New Zealand for it to be described as an industry in its own right.

OPPOSITE, TOP & BOTTOM The New Zealand pigeon or kereru (*Hemiphaga novaseelandiae*), an important species for native seed dispersal targeted for rehabilitation by the Kaipatiki Project (Top photo: Bridget Baker; Bottom photo: Rob Dally).

ABOVE, CLOCKWISE FROM TOP LEFT Location of Karori Wildlife Sanctuary, overlooking the western suburbs of Wellington city; North Island Robin (*Petroica longipes*), one of the native bird species reintroduced to Karori Wildlife Sanctuary; Fig. 1. Fence profile at Karori Wildlife Sanctuary showing its height, top-cap overhang, base skirting and perimeter clearing which have successfully excluded exotic predators, such as cats, rats and possums for 16 years (Photos: Tony Wills [From Wikipedia]).

Karori Wildlife Santuary

Karori Wildlife Sanctuary, a 250-hectare wildlife preserve on the outskirts of Wellington, is undoubtedly a flagship of New Zealand's ecological restoration movement. Established in 1995, it was the world's first wildlife sanctuary to be completely protected with an exclusion fence system targeted at a complete suite of pest species. This measure was necessary because in New Zealand, exotic predators are the biggest single threat to the survival of native fauna on the mainland islands, where they have proven impossible to eradicate. The fence, 8.6 kilometres long and built at the cost of $240 million, was specifically designed to exclude mammalian predators, such as cats, possums, rats, mice and stoats (Figure 1).[3] Despite rigorous maintenance and monitoring protocols, mice have occasionally re-invaded, which require continuous trapping effort to be kept up within the sanctuary. The key benefit of the fence is that it has allowed the re-introduction of rare native animals, such as little spotted kiwi (*Apteryx owenii*), tuatara (*Sphenodon punctatus*) and Cook Strait giant weta (D*einacrida rugosa*). The absence of exotic predators allow individuals of these species opportunities to re-establish self-sustaining populations, while the existence of the enclosure greatly facilitates the monitoring of re-introduced populations.

Another exemplary feature of Karori Wildlife Sanctuary is its investment in education and outreach. The park is a provider of Learning Experiences Outside the Classroom (LEOTC) programmes designed to complement and enhance classroom learning. In 2009 and 2010, over 5000 students visited the sanctuary to participate in a variety of environmental education programmes tailored to the needs of children from 5 to 18 years of age. The urban location of the sanctuary allows it to tap into a significant base of community support. A network of over 400 volunteers and 5000 members who donate labour, expertise and annual subscriptions helps to keep operating costs down, and grows a sense of ownership in the wider community.[4] Although it may not be necessary or feasible to replicate the fenced sanctuary model overseas, Karori Wildlife Sanctuary suggests that capital-intensive ecosystem restoration can enhance urban biodiversity and simultaneously be a significant social asset.

The Kaipatiki Project

The Kaipatiki Project in North Shore, Auckland, has adopted a smaller-scale (but no less exemplary) approach to restoring the natural ecology of an urbanised area. Established in 1998, it seeks to promote ecological management of the local stream catchment and raise community awareness of ecology and environmental sustainability. The organisation is community-based, and relies largely on the efforts of a committed team of around 50 volunteers and 3 full-time staff. A particular focus of this project is stream restoration through riparian planting of native vegetation. As of 2007, 9000 plants had been planted, which has increased water clarity through increasing shade levels. The riparian plantings have also reduced the problem of streamside rubbish dumping by acting as a protective buffer. A comprehensive stream assessment was conducted in 2004 to establish baseline ecological conditions, and monthly water quality testing is carried out by volunteers. The project also offers free biodiversity consultations and native plants for owners with streamside properties to guide residents with plant selection and ecologically-sensitive landscaping.

Taking a catchment-scale approach to enhancing urban biodiversity has two principal advantages. Firstly, monitoring stream water quality and biodiversity is a cost-effective means of managing the general ecological status of the wider catchment, because streams integrate flows of urban pollutants well. Moreover, changes in water quality along the stream length can be used to target specific areas for more focused restoration efforts. Secondly, it is easier to foster community involvement within a natural watershed because households have a clearer sense of their environmental responsibilities from their individual contributions to domestic wastewater discharge.

A separate focus of the Kaipatiki Project is the rehabilitation of local populations of a keystone native bird species, the New Zealand wood pigeon or kererū (*Hemiphaga novaeseelandiae*). This species plays a primary role in dispersing the seeds of large-fruited native plants. A number of initiatives have been put into place to encourage the re-establishment of kererū. Rats are trapped in a local nature reserve to reduce their predation intensity on wood pigeon. A year-long survey was run to determine temporal gaps in food supply of this species over the year, and seedlings of appropriate food-providing plant species were planted around a local nature reserve. In addition, a comprehensive community education programme was conducted. This included initiatives such as donating food plant species to schools and residents, educating the public on trapping exotic predators, such as rats on residential properties, and producing an educational pamphlet explaining the ecological importance of this species for native forest ecosystems. To assess the effects of all these measures on wood pigeon populations, transect counts are organised in the local nature reserve.

There is growing international recognition that ecological restoration should not be limited to enhancing species diversity per se, but should also concern itself with restoring the vitality of natural interactions between species such as pollination and dispersal. In this context, the Kaipatiki Project provides a good example of a more holistic approach to ecological restoration. By targeting a species, which has strong positive interactions with many other species, the capacity of an ecosystem to restore itself through natural ecological interactions can be re-built.

ABOVE, TOP Ladies get involved in native plantings, Kaipatiki streamside (Photo: The Kaipatiki Project).
ABOVE, BOTTOM Native plantings along Kaipatiki stream margin by the Kaipatiki Project (Photo: The Kaipatiki Project).
OPPOSITE Mature (over 400 year old) kahikatea (*Dacrycarpus dacrydioides*) as canopy emergents in Riccarton Bush (Photo: The Riccarton Bush Trust).

WAIWHAKAREKE NATURAL HERITAGE PARK

The city of Hamilton designated Lake Waiwhakareke and its surroundings of (60 hectares) for development as a Natural Heritage Park in 2004. Prior to this, the lake was highly degraded due to nutrient-rich run-off from cattle pasture. Using the lake for cattle grazing and lay-off had thoroughly altered its ecology from that of an acidic, peat swamp ecosystem with low productivity to a hypertrophic water body subject to seasonal algal blooms. This project therefore involves the complete re-construction of the lake ecosystem and also aims to re-create from scratch three other forest types, which were originally widespread over the Hamilton basin (Fig. 2).[5] An interesting aspect of the restoration strategy adopted by this project is that plantings are being implemented in discrete spatial and temporal stages. Different areas of the park have been planted in a pre-determined sequence, beginning at the lake margins, and will progressively cover the drier portions of the site. Paths will be constructed to allow public access to completed sections at the earliest opportunity.

The spatial separation of planting effort serves several purposes. Restoration efforts at each stage are focused, as resources are available to resolve teething problems with establishment and maintenance quickly and effectively. Also, public support for the project can be maintained efficiently through staged access to sections as they are completed, which allows for good management of visitor expectations. In addition, it allows managers to adopt an experimental approach to plant establishment through trialing different plant densities and species combinations, thereby optimising the planting regime to site-specific conditions. Plantings are staged temporarily in that fast-growing, early-succession species are established first, to suppress weeds and to provide cover for more longer-living and more shade-tolerant species to be filled in later. Mirroring the natural process of ecosystem recovery in this way not only minimises problems with plant establishment, but also provides a varied habitat for different suites of bird and insect species to use over time.

RIGHT Fig. 2. Staged implementation plan of Waiwhakareke Natural Heritage Park (Photo: Hamilton City Council).
OPPOSITE Children planting flax (*Phormium tenax*) at a regular planting session, Waiwhakareke Natural Heritage Park (Photo: Hamilton City Council).

Riccarton Bush

Riccarton Bush in Christchurch was one of the first urban areas in New Zealand to be managed specifically for its biodiversity values. Established in 1914 by its own act of parliament, this 6.4-hectare patch is one of only two remnants of a once-widespread lowland podocarp (southern conifer) forest in the Canterbury district. Due to the great variety of initiatives which have been taken to preserve its biodiversity, as well as the availability of clear accounts of their respective outcomes over the years, the management history of this patch of urban forest is well worth considering. One point of note is the danger of using native plants of undetermined origins for restoration plantings. Before the 1970s, plant species which were native to the country but not to the region of Canterbury were established. In several instances, these had serious negative impacts on local biodiversity. For example, a tree species from the North Island (*Hoheria sexstylosa*) became invasive, displacing and hybridising with the local species Hoheria angustifolia.[6]

A related concern is that even when a species planted is native to a district, the new introductions could be sufficiently genetically distinct to result in outbreeding depression. This is a phenomenon in which the fitness of the resident individual is reduced, as hybrid offsprings of local and non-local parent plants may be less well-adapted to the target environment compared to the local parent. This problem is addressed in New Zealand through eco-sourcing, which refers to the practice of collecting seed from the same area in which it is intended to plant the plants grown from them. Eco-sourcing aims to maintain a representative genetic diversity of any species that is planted, rather than selecting plants based only on their site-hardiness and visual attributes. In so doing, it maintains the evolutionary potential of existing populations, as well as their local character. In 2001, the Waitakere City Council (Greater Auckland district) developed a code of practice and ethics of eco-sourcing, and this has since been recognised nationally as a guide for industry practitioners.[7] This includes recommendations to prefer the use of seeds over cuttings as propagation material, and the collection of seeds from as diverse a range of individuals, seasons and localities as possible. Whilst such a philosophically rigorous approach to plant sourcing may be impracticable in many other countries, it is important to acknowledge that biodiversity refers to biological diversity at all levels, including genetic diversity. To propagate only the best clones of any species would not only run contrary to the notion of increasing biodiversity, but would also reduce the resilience of plant populations to climate change or disease outbreaks.

A different challenge faced by the caretakers of Riccarton Bush is that of species loss, which is a common problem in isolated urban forest fragments worldwide. This may occur due to altered ecological conditions associated with edge effects or a changed microclimate, as well as to the biotic isolation of remaining individual plants from conspecific pollen and ovule sources. In Riccarton Bush, the number of indigenous plant species declined from 106 to 67 between 1870 to 1993.[8] There is increasing interest globally in the possibility of using residential gardens to increase urban biodiversity, particularly in conjunction with existing natural areas.

One recent study examined this prospect by examining if native species from Riccarton Bush were dispersing into adjacent private gardens.[9] Homeowners were also interviewed to determine their attitudes towards native woody species regenerating naturally in these gardens. This study found that a very limited number of native bush species were recruiting naturally in adjacent private gardens, and seedlings which did germinate were mostly removed promptly during weeding. Nevertheless, close to 80 percent of respondents indicated that they thought the expansion of Riccarton Bush would be a good thing, and more than 50 percent indicated that they would be prepared to plant Riccarton Bush species in their garden, provided they had control over the planting location.

These results suggested that there was a real potential for increasing the genetic connectedness of native plants in Riccarton Bush through providing plants, education and horticultural advice to local residents. More generally, private gardens provide many resources for urban wildlife, including opportunities for reproduction, corridors for movement, key food sources and habitat. Their contributions to the biodiversity of urban parks and environments are already substantial. If the attitudes of Riccarton residents are suggestive of those of urban gardeners in other cities, these contributions can be improved with education.

Concluding Remarks

This article has tried to paint a broad picture of the kinds of projects and activities which are characteristic of ecological restoration in New Zealand's urban environments. The four urban ecological restoration initiatives described above have all enjoyed a good measure of success and positive publicity domestically. Whilst a more rigorous analysis of the factors involved in their success is beyond the scope of this exposé, there are several themes common to the positive outcomes all these project which could be more broadly transferable to alternative socio-ecological contexts.

Firstly, generating support from communities immediately adjacent to an ecological development project is fundamental. Sustained funding for such projects is typically unreliable, especially in the long run. Enlisting local volunteers not only cuts operating costs, but cuts costs whilst improving the standard of establishment, monitoring and maintenance effort. This is firstly because locals identify more strongly with the outcomes of a project in their neighbourhood, and are likely to be more diligent. Locals are also in a much better position to notice problems on a day-to-day basis, and to monitor successful outcomes due to their daily presence in an area. There are many ways to engage the interest and commitment of locals. For example, Karori invests heavily in children's education, Waiwhakareke gives the public access to completed sections of the park while it is under construction, the Kaipatiki Project provides free ecological consultations, and all rely centrally on volunteer programmes.

Secondly, ecological management of any public area should be scientifically-informed. Input from capable scientists needs to be sought throughout the lifetime of a project. There are very practical reasons for this. If expert advice is not involved in the design of a park through aspects such as appropriate plant selection, reintroduction of wildlife or investigating multiple barriers to recovery, the best-intentioned efforts may fail from the outset. Moreover, if schemes for systematic and accurate long-term monitoring are not put in place, it can be hard to determine if any real progress has been made.

Finally, there is a need to recognise that restoring the natural ecological rhythms of a place will take time. It is easy for city-dwellers to apply the same expectations to biodiversity restoration as to building construction, with an emphasis on the finished product. Yet, it is typically both impossible and unnecessary to force nature's hand in this regard. In recognition of this reality, Karori Wildlife Sanctuary publicly embraces a 500-year vision. Its vision is that restoration will be complete in the valley when native forest emergents reach maturity, start to senesce, and begin the cycle anew with the next generation of their seedlings. But not all restoration initiatives may be large enough to bear that level of ambition. One way to build support for long-term commitment would be to set more achievable targets within shorter time scales, such as has been done at Waiwhakareke Natural Heritage Park.

Ultimately, the challenge of enhancing ecological values in urban parks involves recognising that everyone stands to benefit from a more inclusive approach to park management, not just plants and animals. Children enjoy looking for animals and exploring different places. Young people can put their energy to productive use through plantings and wildlife surveys. Adults enjoy aesthetic benefits of restored habitats, higher nearby property values, as well as opportunities for the sustainable harvest of living resources. Seniors can look forward to richer, more varied recreational experiences. Communities learn to work together, and all benefit from cleaner air and water. Altogether, these examples from New Zealand suggest that urban areas of a variety of sizes, localities and management histories can be successfully managed for ecological values. Urbanites everywhere need to believe that this is worthwhile. CG

1 *http://www.socialreport.msd.govt.nz/people/distribution-population.html*

2 Society for Ecological Restoration International Science & Working Policy Group, "The SER International Primer on Ecological Restoration" (2004) *www.ser.org & Tucson*: Society for Ecological Restoration International.

3 *http://www.sanctuary.org.nz/Site/Conservation_and_Research/Restoration/The_fence.aspx*

4 Karori Sanctuary Trust Annual Report 2010. *http://www.sanctuary.org.nz/Site/News_and_events/Annual_reports.aspx*

5 Waiwhakareke Natural Heritage Park Draft Management Plan 2010. *http://waiwhakareke.co.nz/43/have-your-say*

6 *http://www.rnzih.org.nz/pages/RiccartonBush.htm*

7 Leslie Haines and Chris Ferkins, "Where are we at with ecosourcing for biodiversity? Waitakere City, a case study," New Zealand Garden Journal 10 (2007): 1-9.

8 David A. Norton, "Edge effects in a lowland temperate New Zealand rainforest," DOC Science Internal Series 27 (2002) Department of Conservation, Wellington. 33p.

9 Brendan J. Doody, Jon J. Sullivan, Colin D. Meurk, Glenn H Stewart and Harvey C. Perkins, "Urban realities: the contribution of residential gardens to the conservation of urban forest remnants," Biodiversity and Conservation 19 (2010): 1385-1400.