

Nature Ways are green corridors connecting natural habitats that have been fragmented by urban development.

Overview

Nature Ways are green corridors connecting natural habitats that have been fragmented by urban development. They enhance and protect the precious biodiversity they support by creating routes for birds and butterflies to travel from one green space to another, bringing nature into urban environments to improve quality of life in the city. These corridors provide benefits for both the natural and urban environment and their respective inhabitants.

Nature Ways are part of the next phase of Singapore's greening, which involves the community and stakeholders in creating an environment conducive for biodiversity. Connecting and integrating greater biodiversity in the living environment requires a long-term effort, which is beginning to take off. This article incorporates insights on the implementation of Nature Ways from the Director of Streetscape, Oh Cheow Sheng, and Biodiversity Manager, Samantha Lai, of National Parks Board (NParks).

Connecting Fragmented Habitats Through Nature Ways

Singapore's rapid urbanisation in a limited land area has inevitably led to habitat fragmentation. Green areas are isolated from each other, impacting the biodiversity of these natural habitats, leaving some species vulnerable to extinction. The deforestation of 95 percent of the island's rainforest in the 1800s, and continued urbanisation after, has been linked to the local extinction of many forest-dwelling species, particularly among "butterflies, fish, birds and mammals".¹

To address some of these concerns and create pathways for small animals to travel between habitats, NParks began the Nature Ways programme in 2012. By January 2013, the Nature Way in

Kheam Hock area was completed, linking the Central Catchment Nature Reserve to Singapore Botanic Gardens. These linear green corridors, enriched with plantings, also connect areas of high biodiversity to urban areas.

However, NParks has largely had to carve its own path for Nature Ways due to Singapore's unique attributes, such as its limited land area, equatorial island geography, and dense urban infrastructure. Overseas case studies are generally larger in scale, have less emphasis on bringing biodiversity closer to the living environment, target larger animals, and require complex cross-border cooperation. Furthermore, the available information on sidewalk shrubbery of a similar scale tends to be far less comprehensive.

Biodiversity and the Urban Environment

Variability among living organisms from all sources is closely related, at both the macro and micro levels. The loss of macrodiversity is associated with the shrinking of microdiversity. This is associated with alterations of the indigenous microbiota, which suggests that health is linked to the biodiversity of the encompassing environment.² The development of the Singapore Index on Cities' Biodiversity is a testament to the centrality of biodiversity as an indicator of urban quality-of-life to governments.

Nature Ways aim to replicate the diverse composition and gradients of the tropical forests, selecting species to be planted along roads. A variety of trees, shrubs, and ground cover replicate the layers of emergent, mid-canopy, understory, and undergrowth in natural habitats,³ which provide shelter and food for transiting

animals. These layers maximise the volumetric space available to accommodate biodiversity by bridging the gap between the trees and grass layers.

Scientific consensus has linked green spaces, especially large contiguous ones,⁴ positively to human health in urban areas.⁵ Urban-planning targets, such as the Singapore Green Plan 2012, aim to provide the population with easy access to green spaces. With the introduction of Nature Ways, passers-by, and even commuters in vehicles, can experience the sounds of birds and insects, roadside plantings with greater aesthetic appeal, as well as improved air quality and cooler temperatures. Closer proximity to nature also brings about psychological and physiological health benefits while encouraging greater appreciation and conservation of nature. Additionally, the spread of Nature Ways and the conservation of other green spaces help to mitigate infrastructural problems, such as excess water runoff, thermal gain from built surfaces, and poor ventilation and air quality.

Selection of Plant Species

The fruit- or nectar-producing plants planted along the Nature Ways are selected to attract specific species of birds and butterflies, which beautify the surroundings. These animals drawn are also able to thrive among other types of urban greenery, such as skyrise greenery in built-up areas. Post-implementation studies and monitoring have noted increased sightings of birds and butterflies along the Nature Ways.

Native plants that complement the surrounding habitats are favoured over more exotic species. Currently, about 70 percent of the 200 plant species in the Nature Way planting palette are native, some of which are critically endangered species that have been salvaged and reintroduced into our urban green spaces. An example is the *Alpinia aquatica*, a ginger important to some butterfly species. Robust plant varieties are recommended in order to reduce maintenance costs and the need for frequent pruning, enabling Nature Ways to be more sustainable.

Potential risk factors are also part of NParks' considerations for plant selection. An example is the omission of *Bromeliads* from the planting palette due to rosettes that trap water and may inadvertently allow mosquitoes (a vector for dengue among other diseases) to breed. Research and continued monitoring of the Nature Ways to anticipate and prevent any unforeseen outcomes would remain a core component of their development.⁶

The shift from a "Garden City" towards a "City in a Garden" marks the next phase of Singapore's greening efforts. One of the key thrusts of the City in a Garden vision is outreach to the community to encourage participation in green initiatives such as Nature Ways. Inviting the communities and owners of adjacent lots to plant recommended species extends the Nature Ways and ensures a more continuous green corridor. Simultaneously, it raises awareness and increases the community's appreciation for biodiversity.

Nature Ways' Routes and Roots

The pilot project, Kheam Hock Nature Way, serves as a green connector linking the Central Catchment Nature Reserve to the Singapore Botanic Gardens. It taps on the abundant but segmented green patches in road reserves, around areas such as Command House, College Green, University Road Park, those abutting the Japanese Association and Pan Island Expressway,⁷ and even in private residential areas and condominiums.

Most recently, the Tengah Nature Way was unveiled in February 2014 and is slated for completion at the end of 2015. It links the Bukit Timah and Central Catchment Nature Reserves with the Western Catchment and is the longest of seven existing Nature Ways, the others being located in Punggol, Tanglin, Yishun, Admiralty, Tampines, and Kheam Hock. It is also the Nature Way with the greatest participation from the community.

Valuing Nature as a Community

The planting of Tengah Nature Way has involved more than 20 community groups, corporate organisations, and schools in the South West District that have come on board NParks' Community in Bloom (CIB) programme. CIB groups are residential gardening groups that work to create community in public and private properties, schools, and even roadsides. These CIB gardens would contain biodiversity-attracting plants to complement the Nature Way. Tengah Nature Way is a prime example of how Nature Ways connect not only fragmented natural habitats, but also different groups of our community via a shared passion for greenery.

The expertise and perspectives that exist outside of the public sector is key in the implementation of Nature Ways. For instance, the selection of species for Nature Ways and conducting of biodiversity-monitoring surveys leverage the knowledge and experience of private individuals and non-governmental organisations, such as Nature Society (Singapore), NUS Raffles Museum of Biodiversity, and ButterflyCircle.⁸ Schools, such as



1. Snapshots of wildlife that have been drawn to the existing Nature Ways.

2. Tengah Nature Way (13 kilometres) connects Bukit Timah and Central Catchment Nature Reserves with the Western Catchment (SAFTI Live Firing Area).

3. The pilot Kheam Hock Nature Way (1 kilometre) connects the Singapore Botanic

Gardens to the Central Catchment Nature Reserve (MacRitchie).

4. Tampines Nature Way (6 kilometres) connects Bedok Reservoir Park to Pasir Ris Park.

5. Yishun Nature Way (10.5 kilometres) connects Yishun Park to the Central Catchment Nature Reserve (Mandai).

6. Tanglin Nature Way (5.5 kilometres) connects Singapore Botanic Gardens to the Southern Ridges (Telok Blangah Hill Park).

7. Admiralty Nature Way (3.5 kilometres) connects Admiralty Park to the Central Catchment Nature Reserve (Mandai).

Hillgrove Secondary School, have signed up with NParks' Nature Way Monitoring and Greening Schools for Biodiversity programmes to conduct biodiversity audits in the vicinities of Nature Ways. The data generated by participating schools is supplemented by comprehensive surveys conducted by experts from National Biodiversity Centre.⁹

A culture of creative participation by the public, especially citizen scientists, will help to realise greening plans and make sense of the vast amount of data available.¹⁰ One example of successful citizen participation is the Insect Migration Association set up in Canada, now known as Monarch Watch, which tackled research on the migration of Monarch butterflies in 1975 before the age of computers. Such citizen-science conservation programmes continue to be a large part of Monarch butterfly conservation efforts.¹¹

The collection and sharing of data through platforms, such as the Greening Schools for Biodiversity programme that features an online data sharing platform, will broaden and increase knowledge of the health of the environment. Apps like Nature Society's bird identification apps, "Birds of Singapore" and "Butterflies of Singapore", leverage public appreciation of nature to pool data on the population and migration patterns of species by encouraging members of the public to report sightings of birds and butterflies in their neighbourhoods.

Singapore Chinese Girl's School, which was involved in the planting of the Kheam Hock Nature Way, educates students about gardening and biodiversity through its nursery. The school also sells plants to the community to share its knowledge and enhance biodiversity in private residences, attempting to place a value on natural heritage.¹² Museums and galleries would be unsustainable if cultural artefacts were not valued. Similarly, there should be greater awareness of the immense value of nature in order for current greening efforts to be sustained and appreciated.

Research and Opportunities of Nature Ways

Nature Ways present other ways for the private sector to engage with the natural environment. Singapore's relatively mature intellectual property law, infrastructural and economic support for a knowledge-based industry, and ratification of the Nagoya Protocol create an encouraging climate for firms and individuals to explore the myriad research opportunities for drug discovery, bio-prospecting, and academic study, among others.

The open data emerging from the Nature Ways could catalyse numerous smaller projects, such as interpreting bio-sensory data or algorithms and apps that assist bird and butterfly watchers. Tourism and recreational activities and outdoor educational programme for schools may be greatly expanded and open related opportunities for guides, apps, books, and tours.

The peripheral support industries around Nature Ways would be broader than the current landscape maintenance of roadside plants. Requirements for the pruning and watering of plants might be reduced due to the selection of resilient plant species, while

public involvement through CIB community patches, coupled with the drive to encourage more urban greenery, could usher in a host of companies dealing with propagation, maintenance, and monitoring on a consumer level. These support industries are likely to strengthen as the training and certification of green skills continue to develop as a priority of the City in a Garden vision.

It is not necessary to directly "sell Nature to save it",¹³ as long as the free market is able to organically develop its own value around environmental services. These are only a few of the ways in which Nature Ways can help to develop a strong and open commercial ecosystem around environmental services that both leverages and protects Singapore's natural heritage.

Future Plans

NParks has many future plans for refining and developing Nature Ways. There is plenty of room for the initiative, currently in its early stages, to grow. Besides expanding the length of existing Nature Ways from their existing 38 kilometres in total to 60 kilometres by 2015, NParks aims to refine their planting palette by widening the choice of tree and plant species and improve the selection criteria of these species with the growing networks of Nature Ways.

A more accessible and simpler planting palette would enable more schools, community groups, and land owners to attract birds and butterflies to their green spaces, while giving these species more room to flourish. Hong Kah Town Council's commitment to using the Nature Ways planting palette for its neighbourhood's renewal programme exemplifies the importance of the palettes in encouraging community involvement.

Community outreach and involvement is another focus of NParks, which seeks to sustain efforts in engaging the community, building a sense of ownership, and involving the community in co-creating the future of Singapore's living environment.

NParks is also investigating the use of historical vegetation patterns to determine the routes of the Nature Ways. This allows the natural infrastructure to be determined by natural frameworks rather than purely man-made logic.

Conclusion

The need for companionship and community, the fear of being alone, and the desire for freedom are not traits unique to humans—they are a reflection of the natural and physical laws that govern and connect us to one another and the complex web of interdependence we live in. Nature Ways is an important step in building a more comfortable, liveable, and healthy home that is in touch with nature. It is also an important first step in averting irreversible damage to the environment we live in by reaching out to other forgotten forms and pockets of life—connecting them to one another and ourselves. 

- 1 Barry W. Brook, Navjot S. Sodhi, and Peter K.L. Ng, "Catastrophic extinctions follow deforestation in Singapore," *Nature* 424 (2003): 420-426; and Marjorie Castelletta, Navjot S. Sodhi, and R. Subaraj, "Heavy extinctions of forest avifauna in Singapore: lessons for biodiversity conservation in Southeast Asia," *Conservation Biology* 14 (2000): 1870-1880.
- 2 Tari Haahtela, Stephen Holgate, Ruby Pawankar, Cezmi A. Akdis, Suwat Benjaponpitak, Luis Caraballo, Jeffrey Demain, Jay Portnoy, Leena von Hertzen, and World Allergy Organization (WAO) Special Committee on Climate Change and Biodiversity, "The biodiversity hypothesis and allergic disease: world allergy organization position statement," *World Allergy Organization Journal* 6 (2013): 3, accessed April 30, 2014, <http://www.biomedcentral.com/content/pdf/1939-4551-6-3.pdf>.
- 3 Kenny Khoo, and Cheryl Chia, "Creating Ways for Nature to Travel," *My Green Space* 17 (2013), accessed April 30, 2014, <http://mygreenspace.nparks.gov.sg/creating-ways-for-nature-to-travel/>.
- 4 Richard Mitchell, Thomas Astell-Burt, and Elizabeth A. Richardson, "A comparison of green space indicators for epidemiological research," *Journal of Epidemiology and Community Health* 65 (2011): 853-858.
- 5 Howard Frumkin, "Healthy Places: Exploring the Evidence," *American Journal of Public Health* 93 (2003): 1451-1456; Takano T., K. Nakamura, and M. Watanabe, "Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces," *Journal of Epidemiology and Community Health* 56 (2002): 913-918; and Andrew Lee, and Ravi Maheswaran, "The health benefits of urban green spaces: a review of the evidence," *Journal of Public Health* 33 (2011): 212-222.
- 6 Mark Goddard, Andrew J. Dougill A, and Tim G. Benton. "Scaling up from gardens: biodiversity conservation in urban environments." *Trends in Ecology and Evolution* 25 (2010): 90-98.
- 7 Khoo and Chia, "Creating Ways."
- 8 Khoo and Chia, "Creating Ways"; and Goddard, Dougill, and Benton, "Scaling up."
- 9 Goddard, Dougill, and Benton. "Scaling up."
- 10 Karen S. Oberhauser, and Michelle D. Prysby, "Citizen science: creating a research army for conservation," *American Entomologist* 54 (2008): 103-105.
- 11 Karen S. Oberhauser, and Michelle J. Solensky, eds, *The Monarch Butterfly: Biology & Conservation* (United States of America: Cornell University Press, 2004).
- 12 Channel NewsAsia, "NParks to rope in community to help grow Nature Ways," *XINMSN News*, February 2, 2013, <http://news.xin.msn.com/en/singapore/article.aspx?cp-documentid=251754584>.
- 13 Kathleen McAfee, "Selling nature to save it? Biodiversity and green developmentalism," *Environment and Planning D: Society and Space* 17 (1999): 133-154.



8. Planting for Tanglin Nature Way by the staff and students of Association of Persons with Special Needs Tanglin School along Alexandra Road.

9. Planting along Tengah Nature Way by Hillgrove Secondary School.