

CHAPTER 7

Nature Ways – Habitat Enhancement in Streetscape for Biodiversity

Lee Jia Hwa, Jason Yong Wai Weng & Oh Cheow Sheng

Introduction

We all prefer homes that are comfortable to live in with easy access to food; similarly, biodiversity habitats must be conducive for the diverse range of biodiversity, to cater to their different feeding habits and refuge needs. With more than 9,000 lane-kilometres of paved roads interconnecting the city-state of Singapore, covering 12% of the island's land area, the tension between nature areas versus urban spaces is a constant challenge for biodiversity to thrive and connect (Ministry of Transport, 2021). However, this could also be an opportunity if policies are designed to green up the city infrastructure.

Trying to create critical mass of greenery for our biodiversity is not by coincidence in Singapore. Government-led policies such as ensuring mandatory planting verges along all roads and green buffers along all developments have helped to achieve a certain amount of lush greenery across the island. Other policies and guidelines, such as gazetting nature reserves, easily accessible parks land distribution, tree conservation areas, Heritage Roads and Heritage Trees, have also been set in place to conserve areas with high biodiversity in a predominantly urban environment (National Parks Board, 2023b).

Developed by researchers at the Massachusetts Institute of Technology's (MIT) Senseable City Lab, Treepedia is an innovative metric tool that uses Google Street View panoramas to evaluate the Green View Index (GVI) of cities by measuring the amount of greenery as perceived along the street level in cities. According to Treepedia, Tampa is currently at the top of the list with the highest GVI score now at 36.15%. While Singapore is ranked as the second highest at 29.3% GVI (Fig. 1), its population density of 7,797 per square kilometres is six times higher than that of Tampa's (Massachusetts Institute of Technology, 2021). In a compact city state where it is critical to create a conducive living environment, greening strategies are essential to the softening of harsh infrastructures and the reduction of the urban heat island effect. The high global GVI score

indicates the effectiveness of the implementation of our greening policies that provides residents with lush greenery. In addition, nature can also be integrated into the city with suitable habitats where biodiversity can thrive.



Fig. 1. Green View Index of Singapore. (Image credit: Treepedia)

NParks' Ecological Profiling Exercise

An Ecological Profiling Exercise (EPE) was launched in 2021 to conduct research based on the ecological profile of green spaces in Singapore (URA, 2022). By identifying core habitats that are the source of rich biodiversity and mapping out buffers of complementary habitats, an ecological profiling tool was developed based on a Geographic Information System (GIS) least-resistance pathway model that hypothetically projects the movement of six key fauna species (forest birds and mammals) between the source habitats.

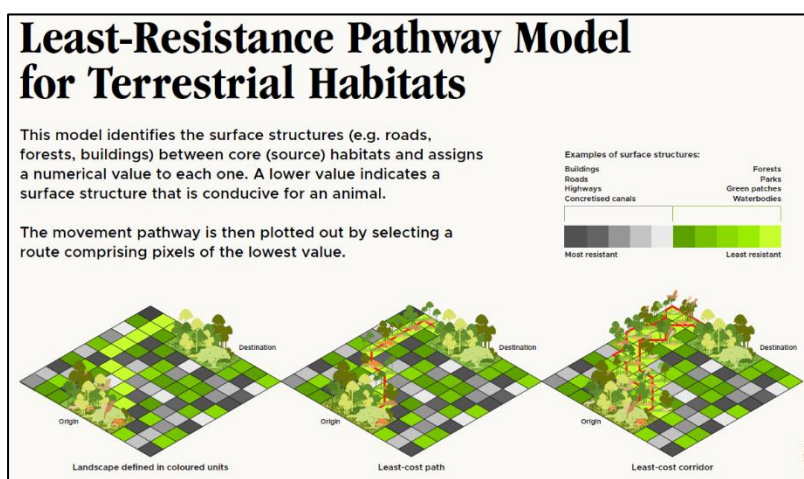


Fig. 2. Concept of Ecological Profiling Exercise (EPE) modelling.

The pathway behaviour is then modelled based on how easy or challenging it is for the fauna to move from one source habitat to another (Fig. 2). Ultimately, the projected connectivity is derived from the route(s) the key fauna species are likely to take to transit between core habitats. This allows us to better understand their behaviour for planners to consider where to avoid developing and conserve these routes to strengthen ecological connectivity. This also allows us to plan our Nature Ways routes to support connectivity. Research has also suggested that there is genuine potential for such passage ecology of nodes and corridors to serve as functional habitats for biodiversity, particularly when they are located nearer to more mature natural sources or patches (Sodhi *et al.*, 1999).



Fig. 3. Ecological Corridors derived from EPE.

Creating habitats with Nature Ways

Nature Ways are one of NParks' Streetscape division's initiatives for infusing biodiversity along our urban streetscape by connecting green nodes of biodiversity hotspots to create ecological corridors and enhance habitats. Nature Ways comprise complex multi-layered stratifications of tree canopies and a careful selection of biodiversity-attracting plants, and are part of an important strategy for biodiversity conservation. They enable immigration via ecological passages (facilitating the movement of fauna such as birds and butterflies between green nodes), and can thus reduce

the extinction of population species due to secondary forest giving way to development. Stakeholders of land that is adjacent to the roadside reserves are also encouraged to apply the Nature Way scheme to their land and strengthen the ecological network.

There are currently 49 Nature Ways (Fig. 3 & 4) across the island, with an estimated total distance of 190 kilometres (as of FY22) created, and the target is to achieve 300 kilometres by 2030 as part of the Singapore Green Plan 2030 to remake Singapore into a green, liveable, and sustainable home (National Parks Board, 2023c).

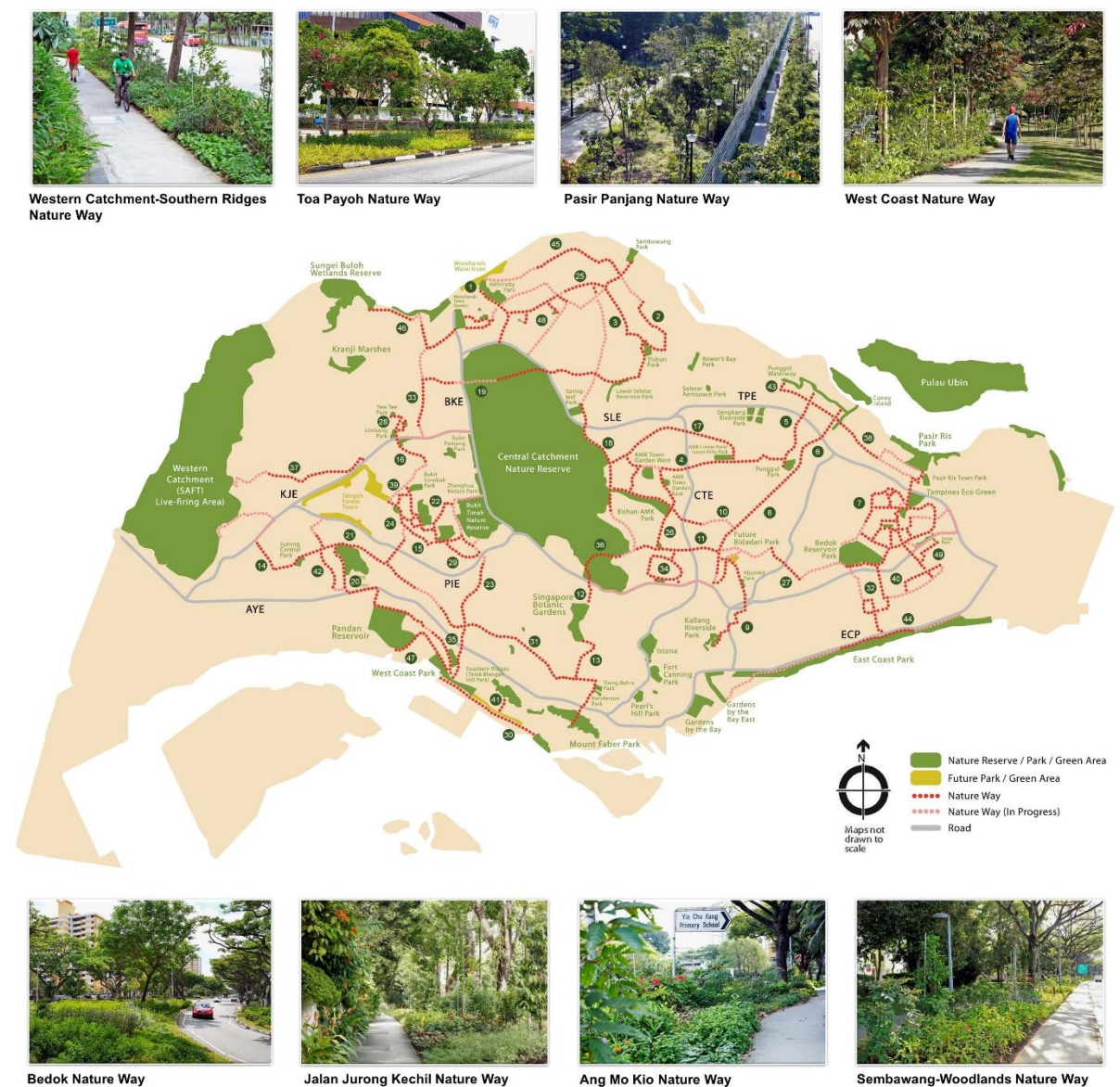


Fig. 4. Nature Ways progress update (as of FY22).

Designing for biodiversity

By replicating the natural structure of a forest (Fig. 5), Nature Ways encourage native fauna to forage and breed in the habitats within them, as food sources can be found at different levels along the streets. The emergent layer characterised by Dipterocarp or other taller canopy species, when fully mature, provides food for canopy-dwelling insectivorous birds and nesting sites for eagles and raptors (Fig. 6).

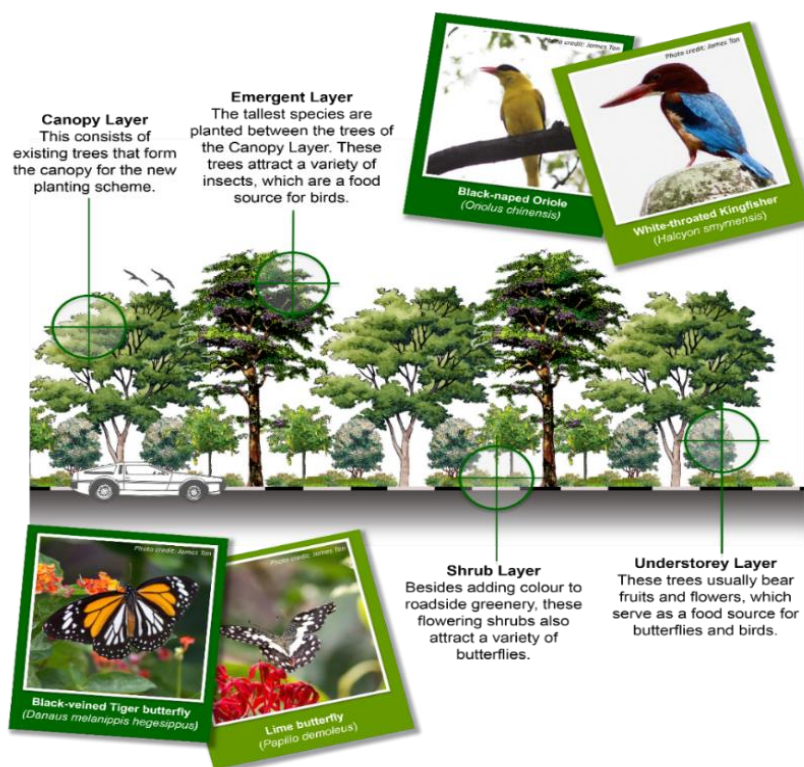


Fig. 5. Nature Way structure.

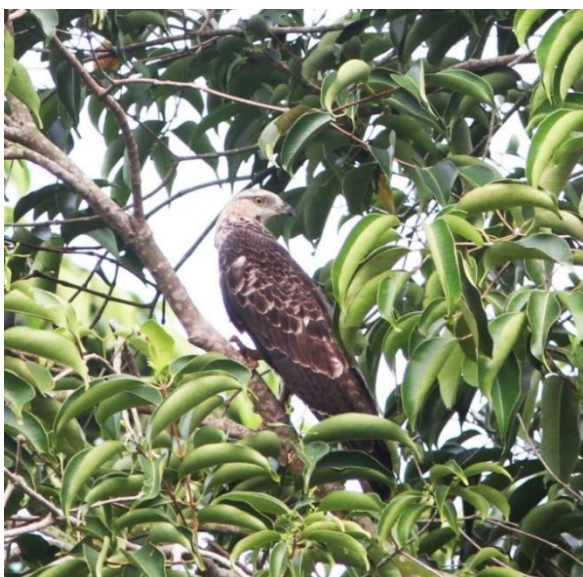


Fig. 6. An Oriental Honey Buzzard (*Pernis ptilorhynchus*) sighted on taller tree canopies along Keat Hong Nature Way (Old Choa Chu Kang Road).

The canopy layer is usually made up by the existing roadside trees which provide shelter and food for insectivorous birds as well as nectar-loving birds and butterfly species (Fig. 7 & 8).



Fig. 7. A Brown-throated Sunbird (*Anthreptes malacensis*) feeding on nectar sighted along Tampines Nature Way (Tampines Ave 5).



Fig. 8. A Yellow-vented Bulbul (*Pycnonotus goiavier*) eating fruits along Bishan Bidadari Nature Way (Ang Mo Kio Ave 1).

The understorey layer comprises smaller fruit-bearing trees that produce food sources for frugivorous birds and are also host plants for butterflies.

The shrub layer comprises flowering shrubs and the groundcover provides nectar for butterflies and nectar-loving birds. In addition to attracting other numerous insect species and spiders that are pollinators and food for birds, all these extra layers enhance the aesthetics of green infrastructure like roads and bring nature closer to the people (Fig. 9–11).



Fig. 9. A Lemon Emigrant butterfly (*Catopsilia pomona*) ovipositing along Ang Mo Kio Nature Way (Ang Mo Kio Ave 8).



Fig. 10. A Cruiser (*Vindula dejone erotella*) feeding on nectar flowers along Lornie Nature Way (Lornie Road).



Figs. 11. (A) A Golden Orb Web Spider (*Nephila pilipes*) sighted along Halus Nature Way (Sengkang East Drive); (B) Youth Nature of Stewards sighted a spider while doing a biodiversity survey on Nature Ways.

Enhancing species recovery to increase flora diversity

Besides planting bird- and butterfly-attracting plant species along the Nature Ways, NParks has also made a conscientious to enhance species recovery and re-introduce endangered plant species along the Nature Ways and other parts of Singapore. An example is the native Singapore Kopsia (*Kopsia singaporensis*), which was initially described by the first director of the Singapore Botanic Gardens, Henry Nicholas Ridley, from specimens sighted in Singapore in 1894. This rare species was collected in the wild in 1920 and was rediscovered in 2011 when it was collected from Nee Soon Swamp Forest (The Straits Times, 2023) (Fig. 12). The collected stem cuttings were then propagated and groomed at NParks' Pasir Panjang Nursery until they were established and ready to be introduced into Singapore's urban landscape (Fig. 13–15).



Fig. 12. Stem cuttings of Singapore Kopsia collected from a parent tree in Nee Soon Swamp Forest.



Fig. 13. Once the cuttings rooted, a landscape technician planted them in soil media incorporated with compost.



Fig. 14. Singapore Kopsia being nurtured and groomed at Pasir Panjang Nursery.

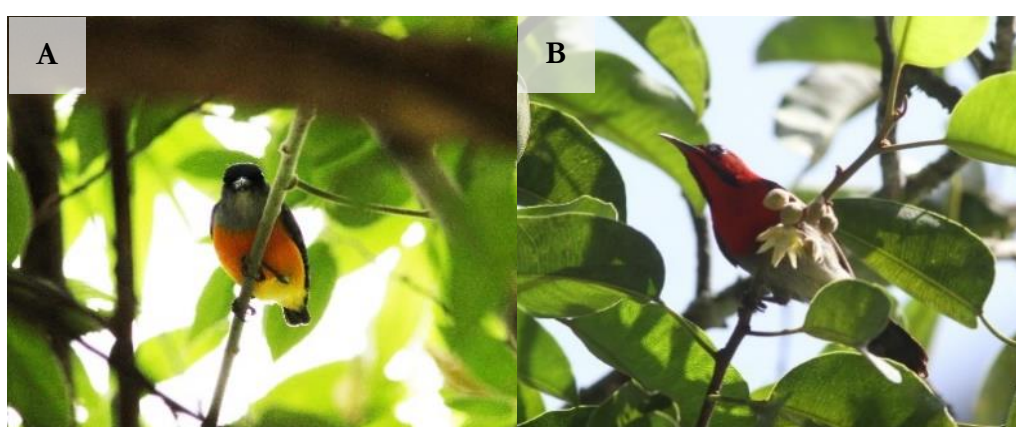


Figs. 15. Well-established planted Singapore Kopsia plants can now be seen along the streetscapes and parks of Singapore.

Singapore Kopsia has since been planted along Lornie Nature Way, Upper Thomson Nature Way and other parks and nature reserves in Singapore. Other lesser-known and vulnerable to critically endangered plant species being planted include Seashore Nutmeg (*Knema globularia*), Melunak Pusat Beludu (*Pentace triptera*), *Margaritaria indica*, Sea Beam (*Maranthes corymbosa*), Upper Hill Dipterocarp (*Shorea platyclados*), Resak Irian (*Vatica rassak*), Chendarah (*Horsfieldia irya*), Wild Tamarind (*Cajoba arborea*), and Menterbang (*Aidia densiflora*).

Monitoring success indicators of biodiversity sightings

During the development of Nature Ways, the National Biodiversity Centre conducts pre-planting and post-planting surveys to monitor species sightings. These surveys may also be part of citizen science programmes to engage various stakeholders such as members of Nature Society (Singapore), the community and students, while instilling ownership. Observations from these surveys appear to indicate that the addition of Nature Ways often resulted in an increase in bird (Fig. 16.) and butterfly species sightings. When Nature Ways are adjacent to parks, they enhance habitat diversity, leading to increased overall biodiversity.



Figs. 16. (A) An Orange-bellied Flowerpecker (*Dicaeum trigonostigma*) feeding on fruits at Bishan-Ang Mo Kio Park; (B) A Crimson Sunbird (*Aethopyga siparaja*) feeding on nectar flowers near Windsor Nature Park.



Figs. 17. Youth Stewards of Nature spotted a bird's nest on a Red Powderpuff Plant (*Calliandra emerginata*) along Simei Nature Way (Simei Road).



Figs. 18. A bird's nest spotted on Asam (*Elaeocarpus mastersii*) along Punggol Central Nature Way (Punggol Central).

The increased sightings and numbers of birds and butterflies, and observations of birds' nests (Fig. 17 & 18) at Nature Ways attest that Nature Ways have resulted in the creation of habitats for various faunal species.

Nature Ways can also serve to educate the public through on-site interpretative signage (Fig. 19) that contains species information of the plants growing there and the animals that may be attracted to the area. The signage is usually installed using funds from public, private and people (3P) sponsorship through the Garden City Fund (Garden City Fund, 2023).



Fig. 19. Grassroot Advisors, students and members of the community standing around an educational interpretative sign at the launch of Tampines Nature Way.

Nurturing future green guardians

More opportunities are also created for community to appreciate nature and get involved with citizen science participation such as SGBioAtlas (National Parks Board, 2023a), where records of any species sightings can be documented with a mobile application.

Tree planting constitutes a major portion of the implementation of Nature Ways. With the launch of the OneMillionTrees movement in 2020 to plant a million more trees across Singapore by 2030, NParks has worked closely with key partners including the Friends of the Parks communities, Community in Nature (CIN) schools, Community in Bloom (CIB) gardeners, volunteers, nature groups, corporate partners, other organisations, as well as members of the public to champion initiatives surrounding tree planting efforts (National Parks Board, 2023d).

NParks has also enlisted the help of youths to “adopt” Nature Ways through the “Be a Nature Way Steward” project, which is part of the Youth Stewards for Nature (YSN) programme since it was initiated in 2021 (National Parks Board, 2023e). The six-month YSN programme gives youths who are interested in horticulture, landscape architecture, environmental studies, biological or life sciences the opportunity to be involved in work groups mentored by NParks staff, in which they assist in the ideation and/or implementation of a real-world project (Fig. 20).



Figs. 20. Youth Stewards of Nature in action planting a tree along Simei Nature Way along Simei St 1, as part of the OneMillionTrees movement.

Conclusion

Singapore has evolved its streetscape greening strategies by incorporating design concepts of structural complexity and species diversity in the planting scheme for Nature Ways. This shift from the traditional monotonous planting scheme can help increase the resilience of streetscape greenery to any epidemic outbreaks (e.g., host-specific pathogens targeting on single plant species). The multi-layering of trees in Nature Ways also allows for the seamless replacement of greenery and shade when older trees die and younger trees grow to take their place – much like how a forest regenerates itself. As such, apart from enhancing habitats and creating more food resources for biodiversity, having more Nature Ways also prepares the streetscape for successional phases.

Imagine if all roads in Singapore are planted up intensively with Nature Ways – this will result in a network of linear ecological webs with all the roads inter-connecting to all corners of the island! Not only will we get to enjoy the shade under these green canopies, but everyone can also get closer to nature, enjoying a colourful and biodiverse environment all around Singapore.

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