



ESSAY

Singapore's Nature Conservation Masterplan

Networks for Biodiversity



Even as Singapore's population grows and the demands on its limited land increases, the small island-state continues to sustain a surprising trove of native biodiversity. **Kenneth Er** and **Dr Lena Chan** from the National Parks Board of Singapore share the country's strategies in developing a liveable and sustainable city.

On 9 August 1965, Singapore became an independent city-state. When Singapore celebrated her 50th birthday in 2015, the population had tripled and the per capita income had increased by more than 138 times. Singapore has had to allocate space for defence, housing, industries, infrastructure, public utilities, recreation and agriculture, all within an area of 718.3 square kilometres, to create a liveable place to live, work and play.

Yet, amidst this dense built-up urban landscape, Singapore remains richly endowed with native biodiversity: we have recorded around 2,145 plant species, 65 mammal species, 384 bird species, 109

reptile species, 318 butterfly species, 125 dragonfly species, more than 800 spider species, 256 hard coral species, and more than 200 sponge species. We continue to find new species of plants and insects, and rediscover species that were previously thought to be extinct. These biodiversity are harboured in a diversity of ecosystems, including lowland dipterocarp forests, secondary forests, freshwater swamps, grasslands, streams, mangroves, sandy beaches, rocky shores, inter-tidal mud-flats, sea-grass meadows and coral reefs.

How does Singapore defy the conventional wisdom that native biodiversity cannot exist in cities?



(Left) **Kenneth Er** is the CEO of the National Parks Board of Singapore.

(Right) **Dr Lena Chan** is the Director of the National Biodiversity Centre, National Parks Board of Singapore.



The Bukit Timah Nature Reserve, with high-rise residential buildings in the far background.



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Spearheading a Biophilic Ethos

A key factor is the biophilic ethos that the National Parks Board has adopted and is spearheading, to guide the city-state's development towards one of a liveable and sustainable city.

The National Parks Board (NParks), as the government agency responsible for greenery and biodiversity conservation, manages two National Parks, four Nature Reserves, 350 parks, 300 kilometres of park connectors and 3,500 kilometres of streetscape. It also administers 6,700 hectares of Tree Conservation Areas, and promotes skysrise greenery, which includes 72 hectares of green roofs, five hectares of vertical green walls, and gardens in the sky. NParks is responsible for policy formulation, biodiversity data management, and marine biodiversity conservation, including the management of the newly opened Sisters' Islands Marine Park.

All this is based on a vision to create conditions for nature to co-exist with a densely populated city—in short, to

create a biophilic city. To guide its work, NParks has systematically consolidated, coordinated, strengthened and intensified its biodiversity conservation efforts into the Nature Conservation Masterplan.

This framework comprises four thrusts:

1. Conservation of Key Habitats;
2. Habitat Enhancement, Restoration and Species Recovery;
3. Applied Research in Conservation Biology and Planning; and
4. Community Stewardship and Outreach in Nature.

Conserving Key Ecosystems

The key objectives of the first thrust are to safeguard and strengthen the core biodiversity areas; secure and enhance buffer areas; enhance and manage additional nodes of greenery throughout Singapore; develop ecological connections and integrate nature with the broader urban landscape.

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01 The Sisters' Islands Marine Park is a new initiative that aims to give Singaporeans a first-hand experience of the rich local marine biodiversity while safeguarding them.

02 The Nature Ways in Singapore extend from Singapore's core biodiversity areas, and are planted with specific trees and shrubs to facilitate the movement of animals between green spaces, while bringing nature closer to residents.



The core biodiversity-rich areas include the four nature reserves, i.e., Bukit Timah Nature Reserve, Central Catchment Nature Reserve, Sungei Buloh Wetland Reserve and Labrador Nature Reserve, as well as 20 other designated Nature Areas such as Pulau Ubin. These areas harbour the majority of Singapore's native biodiversity and, hence, are the key gene pool repositories and sources.

All these core areas are characterised by different natural ecosystems like lowland dipterocarp forests, secondary forests, freshwater swamps, streams and rivers, grasslands, rocky shores, sandy shores, inter-tidal mudflats, seagrass meadows, coral reefs, open water, etc. Many species are found only in some sites and nowhere else in Singapore.

To accord due consideration to all ecosystems, a Marine Conservation Action Plan was launched in June 2015. One of its key foci is the establishment of the Sisters' Islands Marine Park, which will house the coral nursery for all 255 hard coral species currently recorded in Singapore, such as the Neptune's Cup Sponge and giant clam. Coastal enhancement works are also in the pipeline.

NParks is aware that many rare and critically endangered species are found beyond the core areas. Hence, additional nodes of greenery that are important for biodiversity are enhanced and managed judiciously.



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One such example would be the green linkages that provide ecological connectivity for native fauna to forage and breed, and native flora to disperse to. Parks, streetscape, in particular Nature Ways, Park Connector Network, hectares of green roofs and vertical walls, and other greenery serve this purpose.

Another node of greenery is Singapore's famed tree-lined roadsides. NParks emulated the five strata found in forests by multi-layering the roadsides, and also planted a diversified range of species especially those with colourful blooms and selected plant species that are also good for certain fauna.

Singapore holds a strong stance on securing and safeguarding its biodiversity assets not simply to protect its natural heritage, but also in recognition of the diverse range of ecosystem services provided by them. Too often, humans take for granted the free ecosystem services provided by nature including, the reduction of ambient temperatures by tree canopies, the replenishment of oxygen and absorption of carbon dioxide by plants, the pollination by insects and bats, the dispersal of seeds by birds and animals, and the provision

of environments essential for human psychological, physical and mental health. NParks believes that biodiversity through adaptation and mitigation offers the most flexible insurance against the uncertainty of the extent of climate change effects.

Enhancing and Restoring Habitats and Assisting in Species Recovery

The second thrust of the masterplan is focused on the restoration of habitats in a bid to boost biodiversity. Natural sites in Singapore can be degraded as a result of natural phenomena like wind bursts or lightning, or human activities. To maintain the functional integrity of these sites, the physical structure would be repaired through habitat restoration efforts. For example, sites that suffer from edge effects or tree gaps would be planted with appropriate native species. Habitat enhancement techniques can be applied to urban landscapes or biodiversity-impooverished sites, and these works are guided by an ecological framework. The butterfly garden and creation of grasslands on Pulau Ubin are some examples.

The populations of Singapore's endemic species, critically endangered native species, and re-discovered species that were previously thought to be extinct are most likely to be low. Hence, these species need extra help for their populations to reach sustainable levels. Endemic species like the crab, *Johora singaporensis*, is found in Singapore and nowhere in the world. Many of the native orchids also require species recovery actions. NParks has planted food trees for the Banded Leaf Monkey and is monitoring their population. It is heartening to learn that they are reproducing and their numbers are increasing.

01 The Common Palm Civet is a shy, fruit-eating animal that often ventures out of its forest habitat to gardens and roof spaces of buildings in Singapore. This is a mark of the country's success in bringing nature into its cityscape.

02 The Admiralty Nature Way is one example of a multi-layered streetscape that mimics a forest structure. This added complexity favours a diversity of fauna species.



“...many rare and critically endangered species are found beyond the core areas... additional nodes of greenery [need to be] enhanced and managed judiciously.”



Strengthening Biodiversity through Applied Research Planning

The third thrust comprises the following initiatives: comprehensive surveys and long-term monitoring of ecosystems and species; quantitative ecological research; the application of up-to-date tools, including geographical information systems, numerical modelling, DNA technology, databases; and science-based policy formulation and management planning.

Surveys of the terrestrial and marine ecosystems continue to lead to the discovery of new species in Singapore, for example, a ginger recently named *Zingiber singaporense*, two Hanguana species, more than 150 species of the Dolichopodidae long-legged flies, and around 100 new marine organisms during the Comprehensive Marine Biodiversity Survey. Our well-trained botanists and zoologists have also been rediscovering species that were previously thought to be extinct. This indicates that we have yet to reach the plateau of the new species discovery curve.

NParks has progressed beyond the check-listing of species. To conserve species better, we recognise the need to understand the intricate inter-relationship of species to

“ [L]ong-term conservation of species is in a delicate balance... Conservation practices must be designed with good research and sound science.”

avoid tipping points. With the myriad flora and fauna species inhabiting limited natural ecosystems in Singapore, it is inevitable that several of the species will be rare, threatened or endangered. The long-term conservation of these species is in a delicate balance. There is not much room for us to make wrong management decisions. Therefore, conservation practices must be designed with good research and sound science.

NParks relies on improved Geographic Information System capabilities to better understand the distribution of species, identify biodiversity hotspots, map fragmented populations, and therefore, better acquire better ways to reconnect them. Ecological modelling using platforms like agent or individual-based models are useful predictive tools that play an important role in facilitating science-based decision-making.

Involving the Community for Inclusiveness

The fourth and last prong of the masterplan is aimed at garnering community involvement for biodiversity conservation and outreach. Mirroring NParks' Community in Bloom programme for gardening, the Community in Nature initiative is a national movement to connect and engage communities in conserving Singapore's natural heritage.

To ensure greater inclusiveness, NParks works with Resident Committees (volunteers within housing estates), families, corporates, education institutions, research institutions, and government agencies. Active participation can spur communities to be more

01 The Greening Schools for Biodiversity programme trains students to conduct wildlife surveys and use the information collected to create and implement an action plan for further greening and outreach.

02 The *Zingiber singaporense*, a ginger plant new to science, was recently discovered in the Central Catchment Nature Reserve. It shows that there Singapore has not reached the plateau for new species discovery.





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committed to nature conservation, hence citizen science forms one of the cores of the Community in Nature initiative.

The Greening Schools for Biodiversity Programme provides hands-on experience for students to carry out biodiversity surveys, document biodiversity, and enhance habitats around their school environs. The public can also partake in bird counts, butterfly counts, bioblitzs, and other biodiversity exploratory activities led by trained volunteers of all ages. NParks' annual Festival of Biodiversity brings together biodiversity enthusiasts and provides opportunities for the unconverted to experience biodiversity.



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Sustaining a Biophilic City

Our surveys have shown that rich biodiversity can still be found in Singapore. Conserving our nature reserves and nature areas, along with the way we manage our parks, Park Connector Network and streetscape, have ensured that we have suitable habitats for native biodiversity to thrive in Singapore. By reaching up the sky with vertical green walls and rooftop greenery or gardens and expanding our conservation efforts to the coastal and marine environments, we have added multiple dimensions to the understanding and practice of a biophilic city. In doing this, we aim to create a biophilia ethos that will guide our development in a densely populated city, making it more liveable and sustainable. ○