

# BIODIVERSITY CONSERVATION IN SINGAPORE

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## ABSTRACT

The climatic climax vegetation in Singapore is tropical evergreen rainforest, the richest of all known ecosystems. Only 5 percent of this still remains, but together with the diversity remaining throughout its other human-modified habitats, Singapore has some 1,500 plant species, over 360 birds, 117 dragonflies, and other dramatic species totals recorded in modern times. The marine environment contains nearly a third of the world's total species of corals, half of the Indo-Pacific total of seagrasses, and many other groups that are still being investigated with new discoveries every year.

Conservation of these resources depends on maintenance of their habitats, and is closely related to land use and environmental quality. Biodiversity conservation in Singapore is therefore dependent on the efforts of many government agencies, and these efforts also rely on participation by non-governmental organisations and support from the private sector. Conservation is thus a tripartite responsibility between the Public, Private and People sectors; it requires a strong legislative framework, with significant and dependable funding.

Although Singapore has been considered a "worst-case scenario", with catastrophic loss of biological diversity, there is still much to conserve. The direct and indirect economic benefits of biodiversity conservation more than repay the investments made in time, finance and manpower, and in fact Singapore cannot afford not to conserve its native biodiversity.

## INTRODUCTION

*"Singapore doesn't have any biodiversity to conserve. Even if we had, we could not afford to set aside land and money for biodiversity conservation. We need every inch and every cent for development."*

This is an imaginary quotation, but is it an unrealistic one? There probably are plenty of people in Singapore who would agree with it. Singapore has had a long history of development, and now has one of the highest national population densities in the world, with around 6,800 people per square kilometre. There is little remaining agricultural land; most food, water and energy sources are imported; and most Singaporeans live in multi-storey public housing. The economy depends on import-export, manufacturing, processing and value-added services. There is virtually no extraction of local natural resources.

However, it is a complete misconception that Singapore does not have any biodiversity to conserve. It is positively dangerous to suggest that biodiversity conservation is an expense better avoided. On the contrary, development without biodiversity is a strategy for failure, the only question being how long failure can be postponed. It is not even a matter of balance between conservation versus development, but how to ensure that biodiversity conservation secures the resource base needed for human survival and economic development.

In practice the socio-political decisions taken by Singapore do acknowledge the interdependence of conservation and development, since both are ingrained into the framework of legislation, administration and economic structure.



## LEGISLATION

Land use planning is fundamental to conservation. Therefore the Planning Act, the enabling legislation of the Urban Redevelopment Authority (URA), while not a conservation law per se, provides the framework for all area-dependent conservation. It gives URA the power to prepare ten-yearly Concept Plans and five-yearly Master Plans setting out the land use intentions of the whole of government, as a result of consultations between agencies and with the public and non-governmental organisations. Some aspects of the plans are overt conservation measures, including land designated for nature reserves, parks, park connectors, and additional nature areas secured under the Parks and Waterbodies Plan.

The National Parks Board Act 2005 and the Parks and Trees Act 2005 are merely the latest revisions to long-standing laws. The first establishes and empowers the National Parks Board (NParks) as a statutory board of government. The second details the parks and reserves, their status, and the actions and provisions applicable in those parks and reserves, as well as in other areas managed by NParks. These include the absolute protection of all plants and animals within such areas.

Wild animals and birds outside the NParks areas are protected by the Wild Animals and Birds Act 1965, administered by the Agrifood and Veterinary Authority (AVA) and some clauses jointly administered with NParks. It is currently under review. Various other agencies have legislation that prohibits the taking of, or damage to, any animal or plant within their property. These include the JTC (Parks) Regulations 1988, the Sentosa Development Corporation Regulations 1997, and the Public Utilities (Catchment Area) Parks Regulations 2006. The State Lands (Encroachment) Act is unique in applying also to marine areas, since, by administering the extraction of resources from the seabed, it is able to protect the living substrate such as coral reefs as well.

However, biodiversity does not respect political boundaries, and Singapore has increasingly become integrated into international law through conventions such as the UN Convention of Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC), the UN Convention to Combat Desertification (UNCCD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

## CURRENT STATUS OF BIODIVERSITY

Singapore has a rich variety of ecosystems. These include coral reefs, soft substrate and open seas, mangroves, mudflats, seagrass beds, rocky and sandy shores, lowland dipterocarp forests, coastal forests, freshwater swamp forests, secondary forest regrowth, wet and dry grasslands, forest streams, and reservoirs. Given their variety, the small total area of Singapore, and the intense development, each of these habitats can only contribute a small percentage to the total make-up of the Singapore landscape. Yet absolute green cover (all forms of plant life) amounts to 47 percent of the land area, of which NParks currently manages 10 percent.

The climatic climax vegetation in Singapore is the tropical evergreen rainforest, the richest of all known ecosystems. Only 5 percent of this still remains, and less than that is its primary forest. However, together with the diversity remaining throughout its other human-modified habitats, Singapore has some 1,500 surviving native plant species, over 360 resident birds and a historical total of 404 including migrants and vagrants), 117 dragonflies, and other dramatic species totals recorded in modern times. The marine environment contains 256 corals (nearly a third of the world's total), half of the Indo-Pacific total of seagrasses, and many other groups that are still being investigated with new discoveries every year.

At species level, there have been some major losses. Singapore retains 69 percent of its original 2,053 species of native higher plants (Tan 2008). Many of those surviving occur in small numbers over small areas, and therefore automatically become classed as threatened under global IUCN criteria (Ng & Wee 1994; Davison et al. 2008). The status of mobile animals is even more difficult to categorise than that of sedentary plants. Nevertheless, it is remarkable how much has survived two centuries of development, especially considering that much of that development occurred long before the rise of environmental consciousness (Turner et al. 1994).

## PRESSURES

### 1 Land use

In a small island city state with high population density, it is inevitable that land use pressures should be amongst the immediate impacts on nature. Proposals for land use change, or extensions of land use, infrastructure developments, and other such proposals are referred by the land use planning authorities to all other relevant agencies for consultation. An increasing human population, and shifts in the economic structure of the nation, mean that even the Concept and Master Plans are not immutable.

### 2 Poaching

To adapt a phrase, "low poaching does not mean no poaching". Songbirds, reptiles and large fishes have from time to time come under pressure. However, the urbanised way of life discourages a poaching mentality, thus this problem has usually been seen as manageable.

### 3 Pollution

Chemical pollution is typically well controlled, as concerns over human health translate into regulations that incidentally benefit the environment. Sedimentation, however, remains a topic of concern especially in the marine environment.

### 4 Climate change

Singapore aligns with the rest of the world in its concern over climate change, and acknowledges the close links between the environment and human wellbeing. Greenery, natural ecosystems and biological diversity are seen as key components in mitigation. Both forest on land and coral reefs at sea are seen as front-line defences against the impacts of climate change.

### 5 Limited habitat availability

The small area of Singapore inevitably limits the area available for species and ecosystems to survive. This constraint cannot be alleviated, but it can be mitigated by maximising the overlap of compatible land uses, by facilitating genetic connectivity between habitat fragments, and by encouraging recolonisation by plants and animals from other areas.



**ABOVE** Ecosystems along parts of Singapore's natural shores include mudflats and mangroves.  
**RIGHT** Volunteers participate in Team Seagrass monitoring.





The Singapore Asian Conservation Project has helped to increase numbers of the Oriental Pied Hornbill in Singapore.



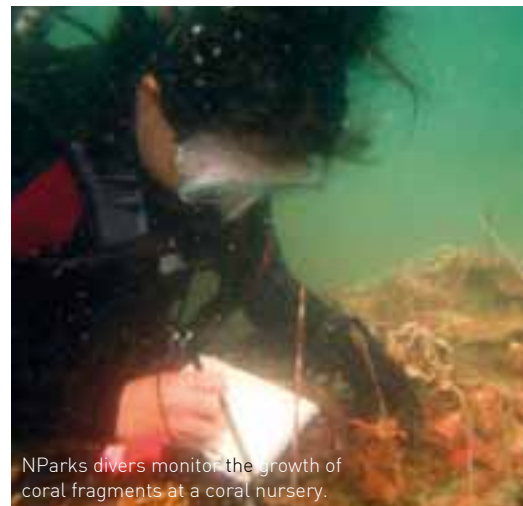
Wetland habitats in parks are being improved to enhance dragonfly populations.



A study of marine sponges, such as this bring pink from Chek Jawa, has revealed a rich array of species.



Habitat management is necessary to ensure the survival of the fern *Dipteris conjugata*.



NParks divers monitor the growth of coral fragments at a coral nursery.



The Striated Heron is a common resident found in mangroves and other habitats.



Nee Soon Swamp Forest is Singapore's only representative of the freshwater swamp forest ecosystem.

## RESPONSES

Singapore has set in place a legal framework whose main elements are described above. Other laws and regulations exist that support the basic framework described.

Human capacity is essential throughout society for effective conservation, and effective reaping of the benefits. This includes policymakers, legislators, planners, implementers in the various agencies such as NParks, the Public Utilities Board and the land agencies, site managers, as well as researchers, students from top to bottom of the educational system, and creation of a conducive business environment that enables the private sector to perceive the benefits of conservation.

Protection, conservation and management of species and ecosystems is concentrated on the four Nature Reserves at Bukit Timah, Central Catchment, Labrador and Sungei Buloh, at Pulau Ubin, and in other public parks and nature areas. This includes management of the habitat, management of public use, and a great deal of inter-agency consultation.

Where species have been lost, or habitats have become degraded, restoration is an option. Examples such as the facilitation of nesting by Oriental Pied Hornbills, programmes for the removal of invasive weeds such as *Dioscorea* and *Smilax*, the replanting of degraded forest patches, and habitat management to allow the survival of the fern *Dipteris conjugata*, practised since 2002, show what can be done.

Surveys need to be carried out because, in spite of Singapore's small size and long history of biodiversity research, astonishing discoveries can still be made. The giant tree *Dipterocarpus tempehes*, long considered endemic to Borneo, was only discovered in Singapore (and in Peninsular Malaysia) in 2005. Surveys of the long-legged flies *Dolichopodidae* have revealed 150 new species from Singapore during the past five years.

Given the richness of ecosystems, and the surprising finds that are possible, impact assessment is a necessity for large impactful projects. Environmental or biodiversity impact assessments are conducted as an administrative requirement, and conform with usual practice.

Permit systems are operated by NParks to

safeguard natural resources and to ensure the fair and equitable sharing of benefits. Applications can be made online, and the system is subject to continuing improvements.

Monitoring is conducted so as to determine whether conservation efforts are effective. This is done at ecosystem level (for example, satellite and aerial imaging of reefs, mudflats and coastlines), site level (for example, tree growth and mortality plots, track compaction, bushfire monitoring) and species level (for example, programmes for *Dipteris*, *Sonneratia caseolaris* and other locally rare plants, and studies of banded leaf-monkeys, flying lemurs, pangolins and mouse-deer).

Education and awareness are necessary to ensure public support for conservation, and to ensure that the benefits of conservation are returned to the public. NParks, like other agencies, conducts a wide range of exposure and training activities, from school visits to tertiary education. Public consultation is also practiced, either direct with members of the public or through non-governmental organisations, in developing the Concept and Master Plans, the Singapore Green Plan, and individual park or municipality developments.

Through international and regional agreements, and also through less formal channels, Singapore is able to play its part in the international scene. In addition to the international conventions mentioned above, Singapore works through the ASEAN Secretariat, the ASEAN Ministerial Meeting on the Environment (AMME), the ASEAN Senior Officials on the Environment (ASOEN), the ASEAN Senior Officials on Forestry (ASOF), and has an ASEAN Heritage Park. Singapore is a strong supporter of the ASEAN Centre for Biodiversity (ACB) and has hosted many meetings, workshops and training courses for the region through ACB. Singapore is working with the Convention of Biological Diversity to develop the Singapore Index for Cities' Biodiversity, a self-assessment tool and an example of how cities can contribute to international conservation.

## WHY DOES SINGAPORE DO THIS?

All of the above responses cost time, money and manpower. Singapore has made strategic decisions that these are worthwhile—indeed necessary—investments. Habitats and biological diversity are part of our national herit-

age, and a source of pride. They represent the soul of the nation just as much as buildings and history. Furthermore, Singapore's almost unique circumstances as an island city state give us an opportunity to be a leader in urban conservation, to learn lessons and develop techniques that will become relevant to other cities one or two or ten decades from now.

Singapore is aware of the importance of biological resources in biomedicines and biotechnology. Marketability of products such as Ecteinascidin-743, Contignasterol and Pseudopterosin E demonstrate what is possible. Singapore has biological resources of known use, such as horseshoe crabs for the production of Factor C in detecting bacterial contaminants, and many others of potential use such as the conotoxins from cone shells *Conus* spp. Agencies such as A\*STAR are gearing up to investigate such opportunities. Others are beginning to work on the rich resource of micro-organisms and fungi.

A physically and mentally healthy population requires recreation including relaxation, and connectivity with nature is considered to be a key to psychological wellbeing. The provision of green space, exercise facilities, learning opportunities, reduction of the heat island effect, the chances of fishing, snorkelling, diving, bird watching and butterfly watching, buffering of traffic noise, reduction of air-borne particulate pollution, are all health-related benefits from Singapore's nature and environment conservation policies.

Hence, Singapore considers nature conservation to be a pragmatic investment of time, effort and finance that is providing benefits every day to the people at large and to business, industry, health and education.

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