

Conserving biodiversity: the experience of Singapore

W. Chunneng & O. B. Lay

Department of Architecture, National University of Singapore, Singapore

Abstract

This paper reviews Singapore's experience with biodiversity conservation in order to clarify and understand the issues underlying the struggle of conservation within a rapidly developing urban context. In this paper, the history of biodiversity conservation in Singapore and some major phases that influenced the change of biodiversity are summarized. There are 3 main phases in this history – the colonial period, early independence and recent years. The study shows that the small size of Singapore emphasized environmental issues perhaps more quickly and clearly than in other larger nations. Particularly after independence, Singapore demonstrated a government intent on balancing the needs for development against the conservation and protection of the environment and biodiversity. With increased economic development and affluence, there was also a surprising increase in the scope of environmental and nature conservation legislation and campaigns in Singapore.

Our review reveals that much of the environmental devastation occurred during the colonial and early independence years. Given the lack of global awareness of environmental issues then, it is creditable that Singapore had already recognised and made some steps towards biodiversity and nature conservation. This awareness is demonstrably increased in recent years.

The experience of Singapore is not without its defects and failures. The paper concludes with a discussion of lessons to be drawn both from its success and its failures.

Keywords: biodiversity conservation, nature conservation, Singapore.

1 Introduction

Biodiversity management is a globally important issue and, despite its small size, Singapore is not exempt from playing its role. Recognising this, Singapore



signed the Convention of Biological Diversity (CBD) in 1992, and is committed to help halt the worldwide loss of plant and animal species.

Singapore is a small island of only 650 square kilometres which is almost entirely a city. Only 5% of the land area is currently set aside as nature reserve. Despite this, it still contains a rich biodiversity of plants and animals. Being in the equatorial belt, Singapore benefits from a rich natural heritage from its pre-colonial past. With tremendous growth during the colonial period, and then as an independent nation, it is hardly surprising that biodiversity has suffered greatly since then. While large numbers of plant and animal species have indeed been lost, there is some evidence that recent conservation measures have indeed slowed down, if not turned, the trend.

The value of studying the experience of Singapore is particularly to examine the extent to which biodiversity management can succeed within a fast-paced, densely developed, technologically advanced urban context. Emerging research indicates that the pollution from cities is not necessarily counter-balanced by large tracts of natural countryside. Further, landscape ecology tells us that the fragmentation caused by cities and urbanization can prevent species transmigration and thus exacerbate the devastation of natural landscape. If possible, it is therefore desirable to incorporate greenery within cities and create greenways to connect neighboring green patches. Within the city itself, greenery and biodiversity can contribute positively to the life and health of the city and its inhabitants.

2 History of nature conservation in Singapore

The history of nature conservation in Singapore is divided into three phases in this paper. Although it is somewhat arbitrary, the division of these three phases can help us understand the eco-transformation of Singapore as a result of changing social awareness and government policies in nature conservation.

2.1 The Colonial period

Singapore's ecosystem was transformed dramatically after it was founded by Sir Stamford Raffles in 1819. At that time, the island of Singapore was almost entirely covered by intact tropical forests. Mangrove flora along the coast made up of some 13% of the forest area (Corlett [1]). Freshwater swamps covered about 5%, and the remainder of the main island was apparently under lowland dipterocarp forest (Corlett [2]). The total human population then was estimated at around 150 and the impact of this small population on the island was negligible.

After the founding of the colony, Corlett [3] identified some major processes – deforestation, cultivation, succession and building – involved in the transformation of the primeval forest. Extensive deforestation took place between 1819 and the end of the nineteenth century during the colonial period. Large areas of forest were cleared for the cultivation of cash crops, such as gambir, pepper, coconuts, pineapple, and rubber. Wee and Corlett [4] predicted



that by 1883, about 93 per cent of the forest in Singapore had been cleared and almost half of the island was under cultivation. Most of the mangroves were also farmed for firewood and charcoal, prawn farming and to create freshwater reservoirs (Corlett [2]). The result of deforestation is a massive loss of biodiversity, and most of the extinction in Singapore happened during this period. After the Second World War, with the departure of the British, a shift in emphasis led to the conversion of agricultural land for more urbanization and industrialization. Agricultural activity was so much reduced as to become almost non-existent. Some abandoned cultivated land was succeeded by various wild plant communities.

2.1.1 Legislation and nature conservation

Although most of primary forests were cleared during this period, some natural habitats were fortunately preserved by the colonial government. The first botanic garden was founded in 1822, but closed down in 1829. It was reopened in 1836, but abandoned again in 1846. The present botanic garden was begun in 1859 as a venture by the Agri-Horticultural Society, and in 1875 the government took over the responsibility of running the garden (Burkill [5]). While the botanic garden was neither conceived nor managed as a natural habitat, it served the purpose of preserving specific plant species in a horticultural environment.

Alarmed at the extent of the ruination of the forests, forest protection in Singapore was initiated in the 1880s. Since then the forest on Bukit Timah, the highest hill in Singapore, has been protected by the government. It remains today as the last remaining patch of primary rainforest in Singapore. There are also some other nature reserves during this period, but they were worked for timber. By 1937 they were deemed to have been worked out and to be no longer of economic value. It appears then that nature conservation in Singapore began in the late 1880s. Although the policies did not aim to regain some of the lost biodiversity, it did at least slow down and protect some of the remaining ecology.

Legislation for nature conservation expanded in terms of coverage over the years. In 1884, the Wild Birds Protection Ordinance was passed. This was superseded by the Wild Animals Ordinance in 1904. A further amendment in 1941 gave protection to all vertebrates. The Nature Reserves Ordinance was enacted in 1951, and five forest reserves were designated as nature reserves, namely, Bukit Timah Reserve, Pandan Reserve, Kranji Reserve, Labrador Nature Reserve, and the Central Water Catchment Area.

2.2 1959 to the mid 1980s

Singapore gained self-government in 1959, and experienced speedy development from 1960 to 80s. Over the 14 year period from 1967 to 1982, the built-up area expanded by 80 per cent with a massive increase in allocation of land to industry, transport, public utilities and telecommunications, housing and commerce. All these developments resulted in a further reduction of land covered by forests, swamps, and agriculture, which registered a decrease of around 30-40 percent over the same period (Yuen [6]). From these early days, Singapore recognised



that as a small island nation, it had to be conservative in its use of land and its resources. This is evident in its various policies – the exclusion of heavy industries, its campaign to reduce littering and clean up polluted waters, its tight management of public housing and public spaces, and most significantly for our purpose, its environmental and landscaping policies and campaigns.

2.2.1 Legislation and nature reserves

The Nature Reserve Ordinance was upgraded to the Nature Reserve Act in 1970 and a Nature Reserve Board was set up to administer the Act. However, some additional loss of nature reserves was still to come. With continuous economic development of around 7% annually, the demand of land for development continued to increase. Several nature reserves had to give way to development. At first, areas of Pandan Nature Reserve (219ha) and Kranji Nature Reserve (20ha) were reduced for exploitation for mangrove timber and charcoal, and were finally degazetted. Labrador Park was downgraded to a nature park – thus allowing for commercial development. During this period, while nature conservation was doubtless a concern of the government in view of the increased scope of the legislation passed, it was clearly regarded as secondary to economic development. The balancing approach between environment and development of the Singapore government was already in evidence then.

2.2.2 The Garden City campaign

The Garden City campaign was launched in the 60s. Driven by this, active tree planting was carried out along roads and at open spaces and a hierarchy of parks and gardens were built in the new towns to soften the harshness of urban environment.

2.2.2.1 Tree planting campaign To avoid the harsh urban environment resulting from industrialization and public-housing construction in the 1960s, Mr Lee Kuan Yew, the Prime Minister of Singapore, inaugurated the tree-planting campaign in 1963, and this marked the beginning of the Garden City campaign (Yeh [7]).

The early policy was to plant as many trees as possible along the major roads and streets in order to achieve a green mantle as quickly as possible, so fast-growing trees were initially preferred. Exotic fast-growing species were introduced from other parts of the tropics and today they are more common than local species (Lee [8]). To facilitate quick results, the practice of “instant trees”, trees cultivated to quite a mature size in the nursery before planting, were widely used by the government and in private developments (Yeh [7]).

2.2.2.2 Clean and green city The concept of a Garden City was understood as more than just greenery but was translated in terms of both a clean and a green environment. In 1968, Mr Chua Sian Chin, then Minister for Health, stated during the second reading of the Environment Public Health Bill in Parliament: “The improvement in the quality of our urban environment and the transformation of Singapore into a garden city – a clean and green city – is the declared objective of the Government” (Lee [8]).



2.2.2.3 Urban beautification program Over the years, the creation of the garden landscape underwent several changes. In 1976, the urban beautification campaign was launched. It emphasized planting flowering shrubs and trees with colourful foliage and the development of parks (Yuen [6]). To bring a wide range of colour to the landscape, flowering plants were introduced from other countries with a similar climate. In the 1970s and 1980s plant introduction was very active, and as a result, there are many kinds of exotic flowering plants on Singapore's roadsides today – e.g. *Tabebuia rosea*, *Tpallida*, *Hibiscus* and *Lagerstroemia indica* (Lee [8]). Several better designed and more spacious parks with more facilities were built. In 1985, Singapore had thirty-two parks ranging from 0.8 to 206 hectares (Yeh [7]).

There are also other greening programmes, such as the planting of fruit trees in 1982 and 1983, plants and trees to enhance birdlife in 1983 and 1984 and scented flowers in 1990 in its neighbourhood parks and gardens (Savage [9]).

2.2.2.4 A city within a garden The concept of the Garden City became more defined and clearer in the 1980s. Since the desired green mantle has been established after many years of tree planting, a new direction for the Garden City was made. Singapore aimed to be a City within a Garden. This suggests a new direction and a more extensively green vision for Singapore: a city located within a garden filled with greenery, flowers, fruits and birds.

The Garden City concept was useful as a vision to encourage Singaporeans to clean the air, mitigate water pollution, and reduce noise and thus reduce the negative impacts of development on nature remnants inside or near the urban areas. It should be noted that the emphasis was on ornamental, recreational and environmental functions of greenery and the ecological role of greenery was often overlooked. Although some parks and gardens can function as stepping stones for certain small animals, and help counter the fragmentation of natural landscape, ecological principles were seldom taken into consideration in this phase.

The introduction of exotic species in the Garden City Campaign is another issue that should be highlighted. Mass introduction of exotic plant species has resulted in an urban landscape dominated by alien plants. In Singapore, as has been the experience elsewhere, the aliens, both plants and animals, are often more vigorous and can supplant the natives. Although our research has not uncovered any study on the damage of these exotic species to the local ecosystem, there is a need to monitor the situation closely.

2.3 After the middle 1980s

From the mid-1980s, the government began to pay more attention to the conservation of nature areas. By then, Singapore had developed into a nation of fairly evenly distributed affluence, and can turn its efforts towards preserving and improving what is left of the island's wildlife areas. Also, news of the global environmental crisis brought about a better understanding of the need for a balanced ecology and a heightened awareness of individual responsibility in



global conservation. Singapore stepped up its management of natural land resources (Sansom [10]).

2.3.1 Legislation and nature reserves

In 1990, the National Parks Act was enacted and replaced the Nature Reserves Act. Under this Act, the National Parks Board assumed the responsibility for the management of the national parks (Singapore Botanic Garden and Fort Canning Park), and the nature reserves (Central Catchment Area and Bukit Timah Nature Reserve). In 1993, the Ministry of the Environment published the Singapore Green Plan, and 19 nature areas (including nature reserves) were designated based on the Nature Society's *Master Plan for Conservation of Nature* (Briffett [11]). Except for the nature reserves, nature areas were not protected as such but were set aside until they are needed for development. These nature areas served as a refuge for native plants and animals.

As a result of the recommendations of the focus groups in the Concept Plan Review, as well as the requests and appeals of the public, in 1995, two pristine parcels of secondary forests, totalling 43.8 ha, were added to the Bukit Timah Nature Reserve.

In 10 November 2001, two new areas, Sungei Buloh Nature Parkland and Labrador Nature Area, were legislated as Nature Reserves under the National Parks Act. The two additional sites not only ensured that more of Singapore's indigenous key ecosystems are protected, but also provided valuable resources for education and outdoor recreational activities. Sungei Buloh Nature Park was conserved for its mangrove ecosystem, while the coastal vegetation and rocky shores of Labrador Nature Area warranted its protection. The legal protection of Sungei Buloh Nature Park and Labrador Nature Area reflected the government's approach of balancing the protection of valuable flora and fauna, and their ecosystems, while still maintaining an economically aggressive policy (Mah [12]).

2.3.2 Park connector network

In 1992, the *Straits Times* [13] reported that a proposal for an island-wide park connector network by the National Parks Board was published. It was described as "a tapestry of green to make parks and nature sites more accessible to the public and to provide corridors for the movement of bird life" (Nparks [14]).

According to the *Straits Times* [15], the programme was envisaged to take up to 30 years to complete and will eventually cover approximately 300 km. Most of the existing linear parks are already completed, but plans are underway to upgrade them with additional recreational facilities. Figure 1 shows the completed park connector network as at September 2003.

The advantage of this park connector network is to help conserve biodiversity by working as a green corridor for bird life with minimal encroachment upon urban space. Drainage reserves, foreshore, and road reserves were converted to park connectors, linking existing national and regional parks, local neighbourhood parks and the coastal areas to maximize usage of precious land. The park connector network also provides additional recreational areas for residents. A pilot study based on Ulu Pandan Canal park connector by Clive



Briffett [16] showed that there was a wide diversity of wild life at the park connector. A bird behaviour study recorded feeding and singing and it was estimated that a reasonable number of nest sites could be present within the connector.

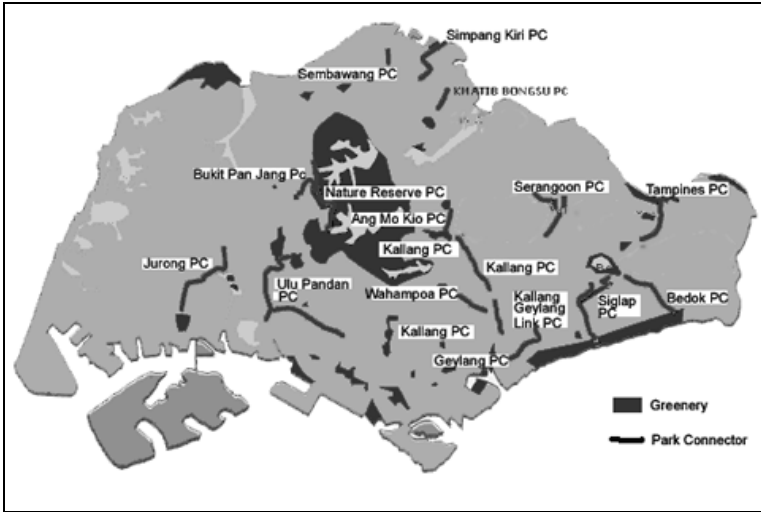


Figure 1: Map of completed park connector network as at September 2003 (Nparks [17]).

2.3.3 Restoration

Restoration programmes include replanting of threatened or declining plant species, reforestation, eradication of pest and alien species, and reintroduction of local animals.

Replanting of rare species and reforestation has proved to be effective in Singapore. One example is the replanting of rare coastal plants, such as Mentigi (*Pemphis aciula*), Lenggadai (*Bruguiera parviflora*), Berus-berus/pisang-pisang (*Kandelia candel*), and Nyireh (*Xylocarpus rumphii*). These plants were replanted along the river banks of Sungei Api Api and Sungei Tampines, and in Sungei Buloh Nature Park. Some new populations have been established (Nature Society of Singapore [18]). Reforestation was also carried out in Bukit Timah to rehabilitate degraded forested areas by removing aggressive weeds and planting native trees to ensure the continued survival of the forest (Nparks [19]).

To counter animal extinction, reintroduction is also taken into consideration, but whether it will benefit the rare animals in the small patches of forest is yet to be determined. Reintroduction is currently considered a last resort.

3 Conservation with development

Economic development often places a lot of pressure on the conservation of natural areas. In Singapore, particularly during the colonial period and the early

years of development, much natural landscape was sacrificed and biodiversity was lost. Today, this still happens around the world, especially in newly developing countries. Careful planning and management can enable the conservation of natural areas within development programs rather than lock development and conservation in lethal conflict. The experience of Singapore, particularly after the 1990s, shows the possibility of integrating nature conservation into development.

The pragmatic attitude to nature in Singapore makes conservation of nature habitats and biodiversity more than just an ecological project. Biodiversity in Singapore is viewed from within the lens of social value as well. The value of biodiversity is also packaged in terms of aesthetics, recreation, education and tourism. Pockets of natural landscape such as hills or shrubs near residential areas help create a counterpoint to the busy city. Nature reserves and national parks are protected not just for its ecological value but also for Singaporeans to enjoy their natural and wild beauty, and to help children learn about wildlife (URA [20]). The park connectors provide recreational opportunities for the residents, and work as corridors for bird life. In this way, the value of the natural habitat is appreciated by the public as well as by developers and government, and it helps make nature conservation easier.

However, this approach is not without its faults and problems. The design of the park connector network is one example. The park connector network is innovatively designed to prevent competition with other land uses, but by doing this, the route of the connectors may not follow existing ecological corridors. As a result, some currently important corridors for wildlife are neglected while new corridors may not meet ecological needs.

Another example of conflict between development and conservation is the Bukit Timah Nature Reserve. It is successful in preserving a tract of primary forest in a compact city, but some problems stemming from its usage and development has surfaced. Being very small (164 ha), its recreational usage may have a negative impact on biodiversity conservation. With the increased awareness of nature, there can also be an unacceptably large increase in visitor number leading to disturbance of the wildlife and other problems such as land erosion.

The experience of Singapore suggests that there can be some integration of the conservation of nature with economic development. But the integration of nature conservation into development asks for good design, planning and management.

4 Conclusion

From the history of nature conservation in Singapore, we can see that the political will of the government is crucial to the issue of nature conservation. Despite some drawbacks, the pragmatic approach to nature adopted by Singapore in balancing ecological and socio-economic objectives has succeeded in creating both a clean and attractive urban environment as well as go some way towards conserving biodiversity.



In the early years (60s and 70s), Singapore made the ecological mistake of replacing nature areas with artificial landscape for their ornamental and exotic values, but this cannot take the place of the ecological functions of nature areas and local species. With the increase of public awareness in the 80s and 90s, nature and biodiversity began to be greater valued. The increased public awareness of nature has affected government policy in Singapore and helped enhance nature conservation.

Development of nature areas may also have some negative impact on conservation. To achieve the original ecological objectives, the development of nature areas should be well designed and managed. Environmental Impact Assessments (EIA) should be made before development, a good management plan should be put in place, and regular counts and studies of biodiversity for every nature area are needed to ensure that the biodiversity of Singapore can be conserved for now and forever.

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