

FIRST NATIONAL REPORT
UNDER
THE CONVENTION ON BIOLOGICAL DIVERSITY

SINGAPORE
DECEMBER 1997

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UNDER
THE CONVENTION ON BIOLOGICAL DIVERSITY

PREPARED BY
THE NATIONAL PARKS BOARD
AND
THE REPORT DRAFTING COMMITTEE

SINGAPORE
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EXECUTIVE SUMMARY

Singapore is a small island republic with a physical land area of 647.5 square kilometre. With a total population of 3,612,00, Singapore's population density stands at 5578 persons per square kilometre, and inevitably, Singapore is highly urbanised.

Singapore signed and ratified the Convention on Biological Diversity (CBD) on 10 March 1993 and 21 December 1995, respectively. To honour the letter and spirit of the CBD, Singapore uses the Singapore Green Plan, a blueprint that describes the broad policy direction that the Government will take towards attaining a model green city, as the vehicle for its implementation. Designated as Singapore's scientific authority on nature conservation, the National Parks Board is thus delegated as the national focal point responsible for the co-ordination of activities related to the CBD.

Presented in Chapter 2 are details on the legal framework, policy guidelines and institutional capacity for conservation of biological diversity that currently exist in Singapore. Following logically are the broad goals and objectives for biological diversity conservation listed in Chapter 3 and the strategic approaches to biodiversity conservation in Chapter 4. The achievement of these goals necessitates a multi-sectoral approach from a diverse range of participants. These are identified in Chapter 5.

The action programmes that are currently implemented or are on the drawing board are discussed in Chapter 6 sequentially highlighting the articles most pertinent in the Singapore context. Chapter 7 notes the methods for monitoring and evaluating action programmes. The report ends with a write-up on the budget and institutional support committed to the implementation of the CBD.

CHAPTER 1

INTRODUCTION

1.1 Origins

General Introduction

1.1.1 The Republic of Singapore, with a total land area of 647.5 square kilometre (sq km), comprises the main island of Singapore and some 63 offshore islands (Ministry of Information and the Arts, 1997). With a total population of 3,612,000 (Department of Statistics, 1997), Singapore's density stands at 5578 persons per sq km, a density only surpassed by Monaco.

1.1.2 Despite a paucity of resources, nonetheless, Singapore experienced rapid development, expanding urbanisation, and economic development between 1970 and 1990. It became apparent to the Singapore Government that at that pace of change, the small island republic would have to plan carefully in its land use to achieve a pragmatic balance between the economic and social needs on one side and the preservation of the environment on the other. The environment, hence the quality of life, would deteriorate if the existing environmental management and control strategies were not reviewed and up-dated. To meet the environmental challenges of the 1990s and beyond, the Singapore Green Plan (SGP) was conceived (Ministry of the Environment, 1993).

Singapore Green Plan

1.1.3 The SGP is a blueprint that describes the broad policy direction (Ministry of the Environment, 1993) that the Government will take towards attaining a model green city. The vision of the model green city has three facets: "a city with high standards of public health, with clean air, land, water and a quiet living environment; a city conducive to gracious living, with people who are concerned about and take a personal interest in the care of both the local and the global environment; a city that will be a regional centre for environmental technology" (Ministry of the Environment, 1993).

1.1.4 Implementation programmes of the Convention on Biological Diversity (CBD) form a significant part of the action programmes on nature conservation, which is one of the areas of concern under the SGP. This will be elaborated on in greater detail in Chapter 6.

Convention on Biological Diversity

1.1.5 The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits. On signing and ratifying the CBD on 10 March 1993 and 21 December 1995, respectively, Singapore's commitment to CBD's provisions stands as threefold: administrative, legal, and action programmes. Representatives from Singapore attended all the three conferences of parties.

1.2 **Application**

National Focal Point

1.2.1 The National Parks Board (NParks) of Singapore is the national focal point for the CBD as it is the main government body entrusted with the conservation and management of nature in Singapore. The Nature Conservation Branch (NCB) within NParks has been assigned the responsibility of co-ordinating the concerns of the CBD.

Cross-sectoral Approach

1.2.2 The objectives of the CBD are broad ranging and the scope of the convention articles diverse. It, hence, necessitates the involvement and co-operation of several agencies, at the local, regional, and international levels. NParks has been consolidating the existing activities of its Nature Conservation Branch and has identified new action programmes to facilitate the fulfilment of the enlisted articles specified within the CBD document. Strengthening existing liaisons and forging new working partnerships are two of the important steps towards building up the network for implementing the CBD.

1.2.3 Since the concerns of the CBD are long-term, its implementation, inevitably, involves a multi-stage process strategy of a cross-sectoral nature. Different agencies will consecutively play a more prominent role as the implementation progresses.

Singapore's First National Report of the Convention on Biological Diversity

1.2.4 The objectives of this report are threefold: Firstly, it aims to reconcile the past with the present strategies and action programmes on biodiversity conservation. Secondly, in the light of past experience, the new strategies that are formulated and new action programmes that have been identified are presented here. Finally, it is a document on Singapore's efforts on biodiversity conservation and will be made available to the public.

1.2.5 This report is prepared by NParks and is submitted for review by the CBD Report Drafting Committee (Table 1.1). The comments of the members of the Committee are incorporated into the final report.

1.3 Presentation

The Arrangement of the Report

1.3.1 A brief introduction to Singapore and its nature conservation efforts are presented in Chapter 1. The next chapter focuses on the existing framework, including the laws, national policies, biotic assets, and institutional capabilities, on which Singapore can build its action plans on nature conservation. Chapters 3, 4 and 5 encapsulate the macro-approaches to nature conservation. Action programmes and proposed schedules are presented in Chapter 6. Mechanisms for monitoring and evaluation are proposed in Chapter 7. The key focus of Chapter 8 is the budget. An executive summary accompanies this report.

1.3.2 A list of references and a list of abbreviations and acronyms are grouped at the end of the report. Tables, maps and figures are placed at the end of each chapter. When an acronym is first used, it will be in parentheses following the full term immediately. Subsequently, the acronym will be used. Because several of the issues are inter-related, cross-referencing will be made. The cross-referred paragraphs are prefixed with a ‘#’ sign, and printed in **bold** within parenthesis.

TABLE 1.1

MEMBERS OF THE REPORT-DRAFTING COMMITTEE

The Committee comprises representatives from the following organisations:

- 1) Ministry of National Development
- 2) Ministry of the Environment
- 3) Attorney-General's Chambers
- 4) Centre for Natural Product Research
- 5) Institute of Molecular Agrobiolgy
- 6) National Science and Technology Board
- 7) Primary Production Department
- 8) Urban Redevelopment Authority
- 9) National Parks Board

CHAPTER 2 BACKGROUND

2.1 Legal Framework

Acts Directly Pertaining to Nature Conservation

2.1.1 The three acts that are directly relevant to the conservation of flora and fauna include the National Parks Act 1996, the Parks and Trees Act (Rev. ed. 1996), and the Wild Animals and Birds Act 1985. Table 2.1 lists the laws in Singapore that pertain to conservation of flora and fauna, directly or indirectly.

2.1.2 The objective of the National Parks Act is to “make provision for national parks and nature reserves and to establish a National Parks Board (NParks) and for matters connected therewith”. By this legislation, NParks has been given the mandate to manage national parks and nature reserves that are “dedicated, set aside and reserved for all or any of the following purposes: (a) the propagation, protection and preservation of the flora and fauna of Singapore; (b) the study, research and preservation of objects and places of aesthetic, historical or scientific interest; and (c) the study, research and dissemination of knowledge in botany, horticulture, biotechnology and natural and local history”.

2.1.3 Legislated with the objective of providing for “the development, protection and regulation of public parks and gardens and for the -preservation and growing of trees and plants and for matters connected therewith”, the Parks and Trees Act (PTA) is another effort to further facilitate the aim of making Singapore a model Garden City. This falls under the purview of NParks. The Parks and Tree Rules, 1983 (GN S 5/83) states that “No person shall in a public park without the permission of the Commissioner(h) capture, injure or destroy any animal, butterfly, or insect or spread, use or set any net, snare or other instrument for the capture, injury or destruction of any animal, bird, butterfly or insect. For the purpose of this sub-paragraph, “animal” includes the eggs and young thereof; (i) capture, injure or destroy or attempt to capture, injure or destroy a fish or water fowl in a lake, pond or stream”.

2.1.4 The Wild Animals and Birds Act prohibits the killing and trapping of wild animals in Singapore. An accompanying schedule lists the species that are excluded from protection and this includes the common pest species, e.g., House crow (*Corvus splendens*). The Primary Production Department (PPD) is responsible for implementing this act.

Other Acts Indirectly Relevant to Nature Conservation

2.1.5 The catchment area parks are governed by the Public Utilities (Central Water Catchment Area and Catchment Area Parks) Regulations [Rg 1 1] 1997 Ed., made under its parent act, the Public Utilities Act (Cap 261, 1996 Ed). Provisions for flora protection are also contained in this Act.

2.1.6 The Jurong Town Corporation (Parks) Regulations (GN S 285/88, Rg 4, 1990 Rev Ed, made pursuant to the Jurong Town Corporation Act, Cap 150, 1985 Rev Ed) also made provisions for the protection of animals similar to that stated in the PTA (# 2.1.3). The aims of the Fisheries Act (Cap 111, 1985 Rev Ed) are the protection and conservation of fisheries and the control of fishing.

2.2 Policy Framework

Policy-making

2.2.1 The Ministry of National Development (MND) includes national parks under its portfolio. Within the Singapore Government, NParks has been appointed as the Scientific Authority on Nature Conservation. MND and NParks, on consultation with relevant Ministries, agencies and organisations, formulate policies on the conservation of flora and fauna in Singapore.

Present Initiatives

2.2.2 The Ministry of the Environment (ENV) initiated the SGP in 1992 to address environmental challenges ahead. The constraints of limited land and manpower resources will grow more acute in future because of greater urbanisation and the rising expectations of citizens. The SGP is wide-ranging. It covers enhancements to environmental infrastructure, environmental management and public health and six other areas on environmental education, environmental technology, resource conservation, clean technology, nature conservation and environmental noise. ENV continues to lead in developing and implementing action programmes on environmental infrastructure, environmental management and public health. Six working groups were formed to develop action programmes for the other six areas. A Steering Committee spearheaded the formulation of the action programmes and directs, co-ordinates and endorses the recommendation of the six working groups. Both the SGP and the action programmes were formulated based on dialogues held with many public and private organisations and members of the public. During the implementation of the action programmes, regular reports were compiled by six working committees formed to monitor and up-date the progress of the implementation of the action programmes. The successful implementation of the action programmes requires the involvement of many agencies and a high degree of support from all Singaporeans.

2.3 Biotic Assets

General Background Information

2.3.1 Singapore has committed itself to set aside 5% of its total land area for nature conservation to promote appreciation of nature and interest in the country's natural resources. To enhance the conservation value of individual nature areas, they are or will be linked together by green connectors.

2.3.2 By virtue of its geographical location, spanning between latitude 1°09'N and 1°29'N, it experiences an equatorial climate of uniformly high temperature, abundant non-seasonal rainfall, and high humidity. Physiographically, the main island can be roughly divided into three regions: the central hilly region of igneous rock formation in Bukit Timah, Bukit Gombak, Bukit Panjang and Bukit Mandai; the western region of sedimentary rocks which form a succession of north-west-trending hills and valleys; and the relatively flat eastern region of sand and gravel deposits that extends from Katong to Changi. Singapore does not have any outstanding physical features. Its highest point, Bukit Timah, stands at 165 m above sea-level.

2.3.3 From a historical perspective, qualitative and quantitative data on the ecological changes that occurred in Singapore between 1819 and 1990, reflecting the land-use transformation, could be obtained from a wide range of official and unofficial publications, viz., books (Makepeace et al., 1921; Buckley, 1984), reports (Moniot, 1861; Cantley, 1883?), papers (Thomson, 1850; Jackson, 1965), etc. Some of these data were compiled by Corlett (1992) and presented in a Figure 2.1. The records indicated that the area under cultivation reached a maximum in 1935 and declined thereafter overtaken by urbanisation. Corlett (1992) made some general conclusions from the Singapore's experience, three of which will be mentioned below because of their management implications.

2.3.4 Firstly, deforestation is the most important step in the context of management of tropical forest ecosystems. Subsequent land-use changes are less significant in terms of conservation of flora and fauna. In the Singapore context, most of the primary vegetation had already been converted to other land-use by the early twentieth century. Secondly, the deforested tropical environment is dominated by exotic species as opposed to the traditional agricultural land of the temperate regions that support a diversity of native plant and animal species. This domination of exotic flora is further accentuated with increasing urbanisation. Finally, with the loss of primary forest under intensified human use, the loss of large vertebrates will, inevitably, ensue. Nonetheless, even small pockets of disturbed primary forests can support a large proportion of the original invertebrate biodiversity long after fragmentation. Hence, these remnants must be accorded top conservation priority.

2.3.5 The diverse range of ecosystems in Singapore includes lowland tropical rain forests, freshwater swamps, secondary forests, mangrove swamps, beach vegetation, and marine communities (Wee & Corlett, 1986). The urban niche is occupied by an interesting assemblage of trees, epiphytes and shrubs. Table 2.2 comprises a list of the 19 nature areas.

2.3.6 The separation of Singapore from the southern part of Peninsular Malaysia by the Straits of Johore is a relatively recent geological event (Thomas, 1991). Coupled with the narrowness of this channel of water and a lack of distinctive topographical features, suitable ecological conditions for the evolution of endemic species did not exist in Singapore. The native fauna is similar to that across the Johore Straits except for the notable absence of the gibbons, rhinoceroses and tapirs in Singapore. It is, thus not surprising that until recently, most of the books on natural history considered Peninsular Malaysia and Singapore as one geographical unit. The few earlier exceptions that focused on Singapore only include Johnson (1964) and Chuang (1973). For historical and biodiversity reasons, much has been written about Bukit Timah Nature Reserve (Corlett, 1988; Chin *et al.*, 1995; Lum & Sharp, 1996).

Indigenous Flora

2.3.7 Of the 2282 known vascular plant species in Singapore, 584 species are extinct while 241 species are classified as common (Tan, 1995). The rest are accorded a conservation status of one of the following categories: endangered, vulnerable or rare (Table 2.3). Some of the more recent general publications that deal with threatened plants in Singapore include Ng & Wee (1994), Wee & Ng (1994), and Tan (1995). A checklist of names used for Singapore plants since 1900 was compiled by Turner (1993).

Indigenous Fauna

2.3.8 Although there is a growing number of books on the indigenous fauna of Singapore, the information is biased towards some taxonomic groups. The mammals, birds and freshwater fish are better studied than the insects, arachnids, nematodes, and protozoa. Lists of animals sighted in Singapore have been compiled by Wee & Ng (1994). The bird list is updated periodically by the Bird Group of the Nature Society of Singapore. Published and unpublished records include papers (Ridley, 1898; Lim, 1985; Lee & Kang, 1990; Sodhi *et al.*, 1997) and books (Glenister, 1971; Briffett, 1986; Hails & Jarvis, 1987; Chew, 1989; Lim, 1992; Briffett & Supari, 1993; Strange & Jeyarajasingam, 1993; Lim & Gardner, 1997). Books on arthropods include Koh (1989), Neo (1996) and Seow-Choen (1997). The conservation status of the fauna of Singapore is available in Ng & Wee (1994) and Ng (1995). Figure 2.2 compares the numbers of extinct species with that of existing species of mammals, birds and freshwater fish (Ng, 1995) while Table 2.4 lists the number of selected taxonomic groups of indigenous animals.

2.4 Institutional Capacity

Singapore Civil Service

2.4.1 Singapore is a republic with a parliamentary system of government. All three organs of state - the executive, the legislature and the judiciary - are provided for under a written

constitution. The administration of the government is vested in the Cabinet headed by the Prime Minister. The Cabinet is responsible for all government policies and the day-to-day administration of the affairs of the state. It is responsible collectively to Parliament and comprises the Prime Minister, his deputies and the ministers in charge of the various ministries, i.e., Communications, Community Development, Defence, Education, the Environment, Finance, Foreign Affairs, Health, Home Affairs, Information and the Arts, Labour, Law, National Development, and Trade and Industry. MND, by virtue of being responsible for the physical development of Singapore, oversees the following: land-use planning, public housing, urban redevelopment and building conservation, public works, parks and greenery and primary production. The major departments and statutory boards under the umbrella of MND are the Construction Industry Development Board, Housing & Development Board (HDB), NParks, PPD, Public Works Department (PWD), and Urban Redevelopment Authority (URA).

2.4.2 NParks was inaugurated in 1990. In July 1996, NParks and the Parks and Recreation Department (PRD) merged with a shared mission: “We Make Singapore Our Garden”. With the combined resources, NParks now commands a staff of over 1000 employees. NParks, presently, manages more than 1,040 hectares of parks and open spaces and assists in maintaining more than 3,700 hectares of roadside greenery and state-land. Singapore Botanic Gardens and Fort Canning Park are also administered by NParks. NParks manages the Nature Reserves as Singapore’s most significant natural heritage and as the largest refuge for indigenous flora and fauna. Since NParks has been designated as the Scientific Authority on Nature Conservation, NParks advises the Ministries, in particular, MND, the Ministry of Foreign Affairs (MFA) and ENV, on policies pertaining to nature conservation. NParks is also the lead agency in the implementation of nature conservation action programmes, including the CBD. The wide scope and diversity of nature conservation projects, invariably, involve the participation of different departments within NParks and often numerous cross-sectoral agencies.

2.4.3 The historical record of biological diversity is an important component in the monitoring of biodiversity. The role of herbaria, zoological collections, natural history libraries, and archives in the conservation of biodiversity, hence, cannot be overemphasised. The key herbarium in Singapore is based at the Singapore Botanic Gardens (SBG). With its long-standing and extensive specimen collection, together with a fine library collection of botanical books and periodical, the SBG herbarium functions as an important reference and lending centre for taxonomic research on the region’s flora (Wee, 1991). The School of Biological Sciences (SBS) at the National University of Singapore (NUS) maintains a smaller herbarium and a “germplasm bank”. Of both scientific and historical value is the Zoological Reference Collection (ZRC) which is also housed at the SBS. This zoological collection originated as the Raffles Museum Collection, which dates back to the past century.

Other Institutions

2.4.4 Singapore has two universities, NUS and the Nanyang Technological University (NTU). In addition, four polytechnics, Nanyang Polytechnic (NYP), Ngee Ann Polytechnic,

Singapore Polytechnic and Temasek Polytechnic, provide diploma-level education and professional development programmes. The School of Horticulture (SOH) is part of the NParks and is appropriately located within the SBG. SOH provides training for the horticultural industry, environmental resource management, and plant research.

2.4.5 The National Science and Technology Board (NSTB) is a statutory board under the purview of the Ministry of Trade and Industry. Founded in 1991, the mission of NSTB is to develop Singapore's capabilities in science and technology to support selected industrial and service sectors, to enhance Singapore's national competitiveness. NSTB plays a crucial role in five key areas: supporting research and development in industry, strengthening the technology infrastructure, developing research and development (R & D) manpower, promoting technology innovation and entrepreneurship, and establishing international linkages. NSTB currently oversees 14 research institutes and centres in Singapore, namely, the Bioprocessing Technology Centre, Centre for Remote Imaging, Sensing and Processing, Centre for Signal Processing, Centre for Wireless Communications, Data Storage Institute, Environmental Technology Institute, Gintic Institute of Manufacturing Technology, Institute of Information Technology, Institute of Materials Research and Engineering, Institute of Microelectronics, Institute of Molecular Agrobiolgy (IMA), Institute of Molecular and Cell Biology (IMCB), Institute of Systems Science, and the National Supercomputing Research Centre.

2.4.6 The Singapore Science Centre (SSC) is under the purview of the Ministry of Education. It has an innovative exhibition programme, including the following exhibitions, Biotechnology Exhibition and the Dinosaur World Tour. SSC also conducts numerous non-formal educational programmes for both teachers and students, like the Coral Reef Education Programme and the Ecogarden. Publications such as the Singapore Scientist, the Science Centre News, natural history guide books and slide packs continue to play an integral part of SSC's efforts in the promotion and dissemination of knowledge of science and technology to the general public.

Non-governmental Organisations

2.4.7 The Nature Society of Singapore (NSS) is the major non-governmental organisation focusing on nature conservation. It actively partakes in initiating public awareness programmes by organising field trips and talks on nature conservation. Some of the members, albeit amateurs, carry out the important task of monitoring biodiversity, especially of birds, butterflies, and vertebrates.

2.4.8 Incorporated as a company on 2 November 1995, the Singapore Environment Council (SEC), is a non-profit organisation and an approved charity. Its major role is to nurture, facilitate and co-ordinate environmental causes and groups in Singapore. SEC, not only endorses the projects of non-governmental organisations but is also involved in arranging logistical and infrastructure assistance and financial backup.

TABLE 2.1

LAWS OF SINGAPORE
THAT HAVE IMPLICATIONS ON
NATURE CONSERVATION

The National Parks Act 1996

The Parks and Trees Act 1996

The Wild Animals and Birds Act 1985

The Endangered Species (Import and Export) (Amendment) Act 1992

The Public Utilities Act 1996

The Jurong Town Corporation Act 1985

The Fisheries Act 1985

TABLE 2.2

A LIST OF NATURE AREAS IN SINGAPORE

1. Bukit Timah Nature Reserve and Central Catchment Nature Reserve
2. Singapore Botanic Gardens' Jungle
3. Labrador Nature Park
4. Mt. Imbiah and Mt. Serapong on Sentosa Island
5. Bukit Batok Nature Park and Town Park
6. Mt. Faber Park
7. Telok Blangah Hill Park
8. Kent Ridge Park
9. Bukit Timah Nature Park
10. Pulau Tekong Mangroves
11. Pulau Semakau
12. Sungai Mandai Mangroves
13. Sungai Buloh Nature Park
14. Pulau Ubin
15. Pasir Ris Mangroves
16. Sungai Khatib Bongsu
17. Kranj i Mangroves
18. Kranj i Reservoir Mai &es
19. Western Catchment Live-Firing Area

TABLE 2.3

INDIGENOUS FLORA

OF SINGAPORE

Listed below are two sources that attempt to enumerate the number of indigenous plant species in Singapore:

- 1) No. of indigenous plant species: 2504 spp.
(Turner, 1993)

- 2) No. of indigenous plant species: 2282 spp.

The breakdown of the plant species according to conservation status in Singapore is as follows:

Extinct	584 spp.	25%
Endangered	153 spp.	7%
Vulnerable	403 spp.	18%
Rare	901 spp.	40%
Common	241 spp.	10%
TOTAL	2282 spp.	100.0%

(Tan, 1995)

In the last 5 years, 46 new plant species had been recorded. Twenty-two plant species that were considered extinct because they had not been seen for at least 50 years, were rediscovered between 1996 and 1997.

TABLE 2.4

INDIGENOUS FAUNA
OF SINGAPORE

Only one reference has been cited for each group of animals below. Data are missing or not comprehensive for a number of animal taxonomic groups, particularly the invertebrates. Some data on marine fishes and crustaceans are available but have not been included in this list.

1) Indigenous mammal species

No. of mammal species:	82	(Yang <i>et al.</i> , 1990; Sigurdsson & Yang, 1990)
	3	(new record - Biosurvey of the Nature Reserves)
	<hr style="width: 50px; margin: 0 auto;"/>	
	85 spp.	
	<hr style="width: 50px; margin: 0 auto;"/>	

Three mammals were newly discovered during the Biological Survey of the Nature Reserves:
 Red-cheeked Flying Squirrel, *Hylopetes spadiceus* (BTNR)
 Hollow-faced Bat, *Nycteris javanica* (Central Catchment)
 Glossy Horseshoe Bat, *Rhinolophus refulgens* (BTNR & Central Catchment)

2) Indigenous resident bird species

No. of bird species: 180 spp. of which 39 are extinct (22%)
 (Lim, 1992)

3) Indigenous freshwater fish species

No. of indigenous fish species:	39	(Kelvin Lim's unpublished list, 1997)
	2	(new record)
	<hr style="width: 50px; margin: 0 auto;"/>	
	41 spp.	
	<hr style="width: 50px; margin: 0 auto;"/>	

FIGURE 2.1

**LAND-USE TRANSFORMATION IN SINGAPORE BETWEEN
1819 - 1990**

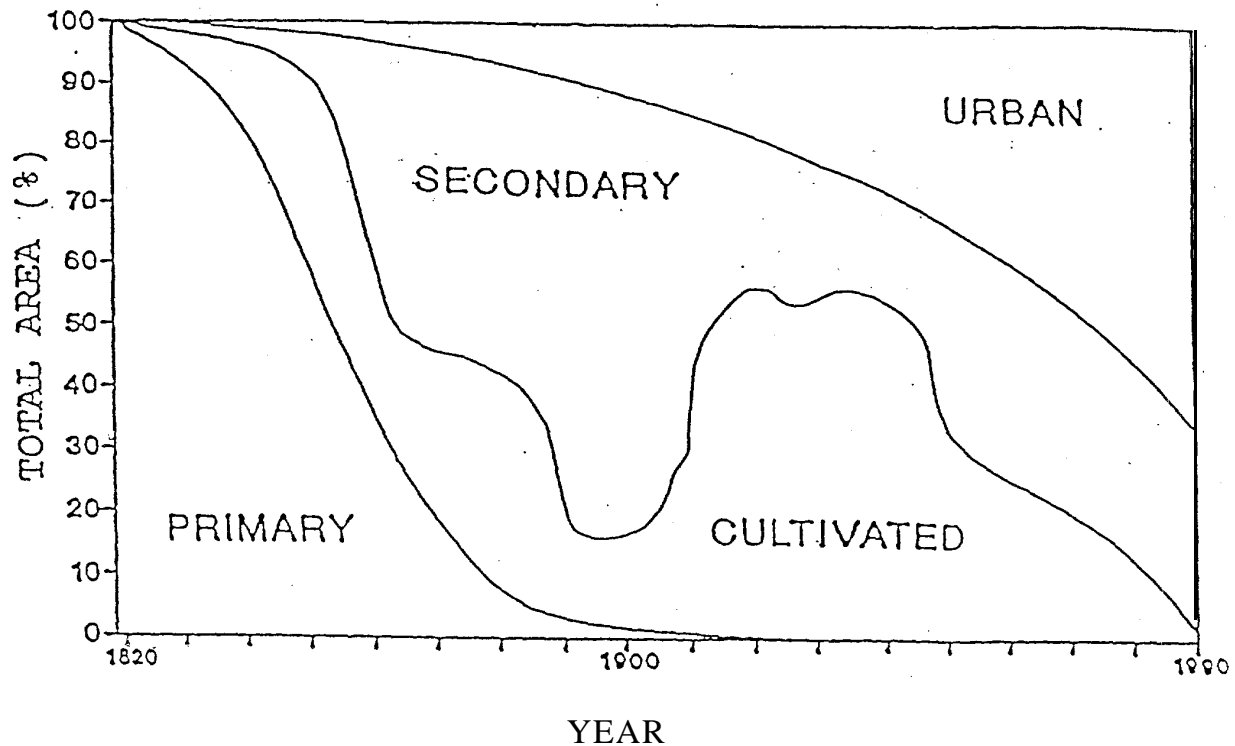


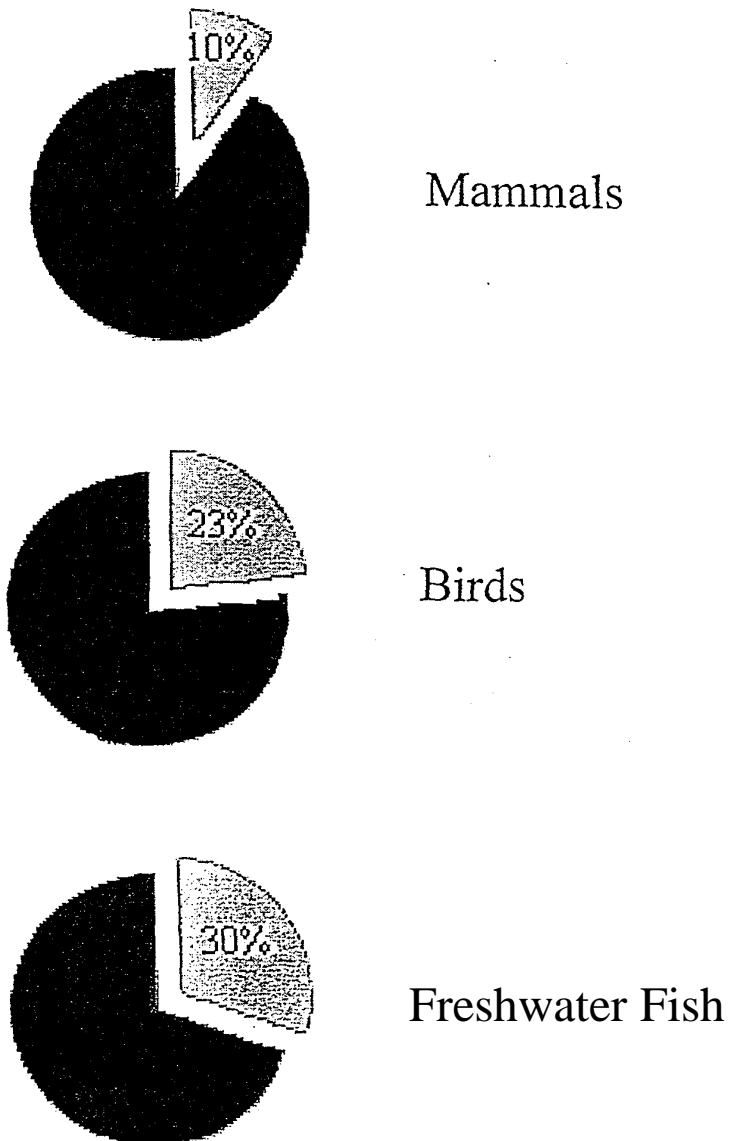
FIG. 2. Land Use changes in Singapore, 1819-1990. Excluding offshore islands and reclaimed land.

PRIMARY = primary forest, CULTIVATED = cultivated land, including tree crops;
SECONDARY = secondary grassland, scrub forest; URBAN = urban areas,
including parks and gardens.

Adapted from Corlett (1992)

FIGURE 2.2

A COMPARISON OF EXTANT AND EXTINCT FAUNAL SPECIES



Pie-charts for mammals, birds, and freshwater fish showing extinctions in Singapore.
Dark shade = extant species Light shade = extinct species Adapted from Ng (1995)

CHAPTER 3

GOALS AND OBJECTIVES

3.1 Vision for Biodiversity

3.1.1 On 9 August 1965, Singapore became a fully independent and sovereign nation. To survive economically without any natural resource base, Singapore embarked on an industrial revolution. The first phase, which started in the 1960s, concentrated on potentially pollutive industries. In the 1980s, the second phase shifted to the service-orientated and high technology industries. That the economy of Singapore is industry-based is illustrated by the following statistics: 58% of 1996's domestic exports is concentrated on electronics and related products while 55% of Singapore's total imports were consumed by the industrial sector (Ministry of Information and the Arts, 1997). Only after over 20 years of development can Singapore, now on a strong economic base focus on the quality of life. In spite of industrialisation underpinning Singapore's economy, an overview of the island from above gives an ambience of widespread greenery. Today, the well-travelled Singaporeans are increasingly appreciative of nature.

3.1.2 Singapore has been referred as the Garden City for over twenty years. As we approach the next millennium, NParks has been entrusted with the task of making Singapore a City in a Garden. NParks is responsible for not only maintaining but also developing Singapore's image as a Garden City. To achieve this, NParks provides quality parks greenery and related services to meet the needs of both residents and visitors. Through prudent regulation, parks and greenery will be developed and managed to fulfil Singaporeans' social and recreational needs.

3.1.3 Even more relevant to the conservation of biodiversity, NParks promotes responsible conservation and awareness of her natural heritage and actively provides educational programmes to share NParks' experience and expertise with the public. NParks aims to enhance its standing as a leading institution for tropical botany, horticulture and ecology, to fulfil NParks role as the Scientific Authority on Nature Conservation, and to manage nature areas directly under NParks to maintain or enhance their biological diversity.

3.2 National Goals

3.2.1 Prior to Singapore's signing of the CBD, nature conservation has already been incorporated into the SGP in 1992. Under the SGP, the government will set aside an area not less than 3,130 hectares, which is 5% of Singapore's total land area, for nature conservation (Ministry of the Environment, 1993). The concern on nature conservation is congruent with

the objectives of the CBD. Action programmes were formulated by a Workgroup on Nature Conservation in 1993 and adopted for implementation. The terms of reference of the Workgroup were a) to identify 5% of the land area of Singapore to be set aside as nature areas; b) to identify strategies to manage nature areas; c) identify green linkages to link parks and nature areas; d) to identify marine areas worthy of conservation and recommend measures for their protection; e) to identify measures to promote nature appreciation; and f) to identify the potential for and implications of ecotourism. A Working Committee on Nature Conservation has been formed to track and monitor progress in the implementation of the action programmes. NCB of NParks serves as the secretariat of the working committee. Some of the action programmes pertaining to nature conservation are dealt with in Chapter 6.

3.2.2 The forests of Singapore are not commercially exploited for timber or other non-timber products. There are no indigenous hunter-gatherers living in Singapore, hence, the forests are not foraged for subsistence. The natural areas of Singapore are, therefore, conserved solely for ecological, educational, recreational, and scientific purposes. With the identification of the nature areas completed, the next task is to ensure that 5% of the Singapore's land area is conserved for the above functions and managed appropriately. Since sound science should underpin environmental policy management, it is essential that Singapore be equipped with a reliable biodiversity database. The database on Singapore's biodiversity, a project that NParks initiated five years ago, could be modified to serve as the national clearing-house mechanism. This will be incorporated into the National Biodiversity Reference Centre (NBRC) based at NParks.

3.3 Regional Goals

3.3.1 Singapore participates in the various Association of South East Asian Nations (ASEAN) Environmental Programmes (ASEP) in its capacity as an ASEAN member nation. The ASEAN Senior Officials on the Environment (ASOEN) committee comprises 6 Working Groups: ASEAN Seas and Marine Environment, Environment Economics, Nature Conservation, Environmental Management, Transboundary Pollution, and Environmental Information, Public Awareness and Education.

3.3.2 ASEAN Meetings on Nature Conservation, the predecessor of the ASEAN Working Group on Nature Conservation (AWGNC), had been organised since 1978. The first AWGNC meeting was held in Malaysia in 1990. NParks represents Singapore at the meetings of the AWGNC who meets annually to up-date existing projects, as well as initiate new conservation programmes.

3.3.3 Since the indigenous plants and animals of Southeast Asian are quite similar, a regional effort at conserving biodiversity would, undoubtedly have a synergistic effect. AWGNC is the most appropriate forum to galvanise this regional initiative.

3.3.4 Singapore has excellent telecommunication facilities. With the setting-up of NBRC, Singapore can provide support to the proposed ASEAN Regional Biodiversity Reference Centre, to be based in the Philippines.

3.4 International Goals

3.4.1 Two of the international conventions that Singapore had acceded to that are relevant to nature conservation are:

- a) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which Singapore ratified on 28 February 1987; and
- b) Convention on Biological Diversity (CBD), ratified by Singapore on 21 December 1995.

3.4.2 In 1994, NCB of NParks was set-up to monitor and co-ordinate the measures to maintain the health of the designated nature areas. When Singapore ratified CBD, the administrative unit of NCB was suitably placed to serve the implementation of CBD in Singapore. NCB is currently building up a network of scientists working on the various aspects of biodiversity on a national, regional, as well as, an international level.

CHAPTER 4

STRATEGIC APPROACHES TO CONSERVATION OF BIODIVERSITY

4.1 General

4.1.1 The total land area of Singapore is only 647.5 square kilometres (sq. km). Its small area is further compounded by its island nature, and, hence, it is not surprising that it only houses a tiny proportion of all the extant plants, animals and microorganisms found on Earth. On the other hand, what is noteworthy is despite these handicaps and a long history of urbanisation, Singapore has as many indigenous flowering plants as New Zealand which is more than 400 times larger and extends over 1600 km from north to south (Davis *et al.*, 1995). It has more angiosperm species than Fiji, Hawaii, and Dominica (Davis *et al.*, 1997), islands all larger than Singapore. Figure 4.1 plots the number of angiosperm species against the area for some tropical islands.

4.1.2 Singapore has more resident higher vertebrate species than the islands of Fiji and Vanuatu, both over 20 times larger and with much lower population densities. Figure 4.2 charts a comparison of the number of higher vertebrate species for different island nations.

4.1.3 As a planning strategy, the government will attempt to conserve as much of our existing natural areas as possible to balance against the urbanisation needs of the country. However, future developments affecting some nature areas cannot be entirely precluded given that there could be other competing uses for such areas, particularly if they are of national or strategic interest, e.g., housing needs. As land is limited in Singapore, there is a need to take a more pragmatic approach in nature conservation.

4.1.4 Because Singapore is so small, it is inevitable that numerous users compete for the premium commodity, land. Multiple complementary land-uses for the same plot of land will be the strategy for the future, as land becomes more and more scarce. To weave the vision of biodiversity conservation into a tapestry of complex land-uses, three strategic approaches have been identified.

4.2 Strategies to achieve goals

Database, research, and capacity building

4.2.1 Sound science should underpin all environmental policy and conservation management. One of the prerequisites of sound science is good research. Results derived

from well-designed research projects contribute to a reliable database that will be the most important tool used by the stewards of biodiversity.

4.2.2 Continuing the documentation of indigenous flora and fauna of Singapore by credible field researchers will be an infinitely valuable exercise in the building-up of the database. A database that has been stringently vetted will facilitate the fine-tuning of conservation management. Use of the Geographic Information System (GIS) as a tool for the documentation and monitoring of biodiversity by NParks will be intensified.

4.2.3 Emphasis will be placed on applied research. Special attention will be placed on exploring land-uses and activities that are compatible with biodiversity conservation. Where possible, re-creations of original ecosystems and re-introductions will be attempted. However, these will be approached cautiously. These will only be implemented after careful studies have been carried to predict both the positive as well as the negative possible outcomes.

4.2.4 NParks' has been entrusted with the mission of making Singapore a City within a Garden. To achieve this end, it is necessary to augment its expertise in the fields of urban conservation, conservation management and tropical ecology.

Maintenance of the biodiversity and area of the designated Nature Areas

4.2.5 In the SGP, Singapore has committed itself to maintain 5% of the land area of Singapore as Nature Areas. The different governmental agencies will ensure that the aggregate area of the nature sites is not less than 5% of Singapore's land area.

4.2.6 The key thrust of NParks is to maintain biodiversity levels, not merely to protect the size of the nature areas. Hence, monitoring of the health status of the representative ecosystems is imperative so that action can be taken to arrest any preventable deterioration of the ecosystems. Management practices should also target towards counteracting the fragmentation of the natural ecosystems of Singapore.

Regional and International Networking

4.2.7 The strengthening of regional partnerships, particularly ASEAN, Asia-Pacific forum, and the CBD family, will continue. Singapore can gain immensely from these regional and international networking. Equally, Singapore can contribute its expertise to other countries that are part of the afore-mentioned organisations.

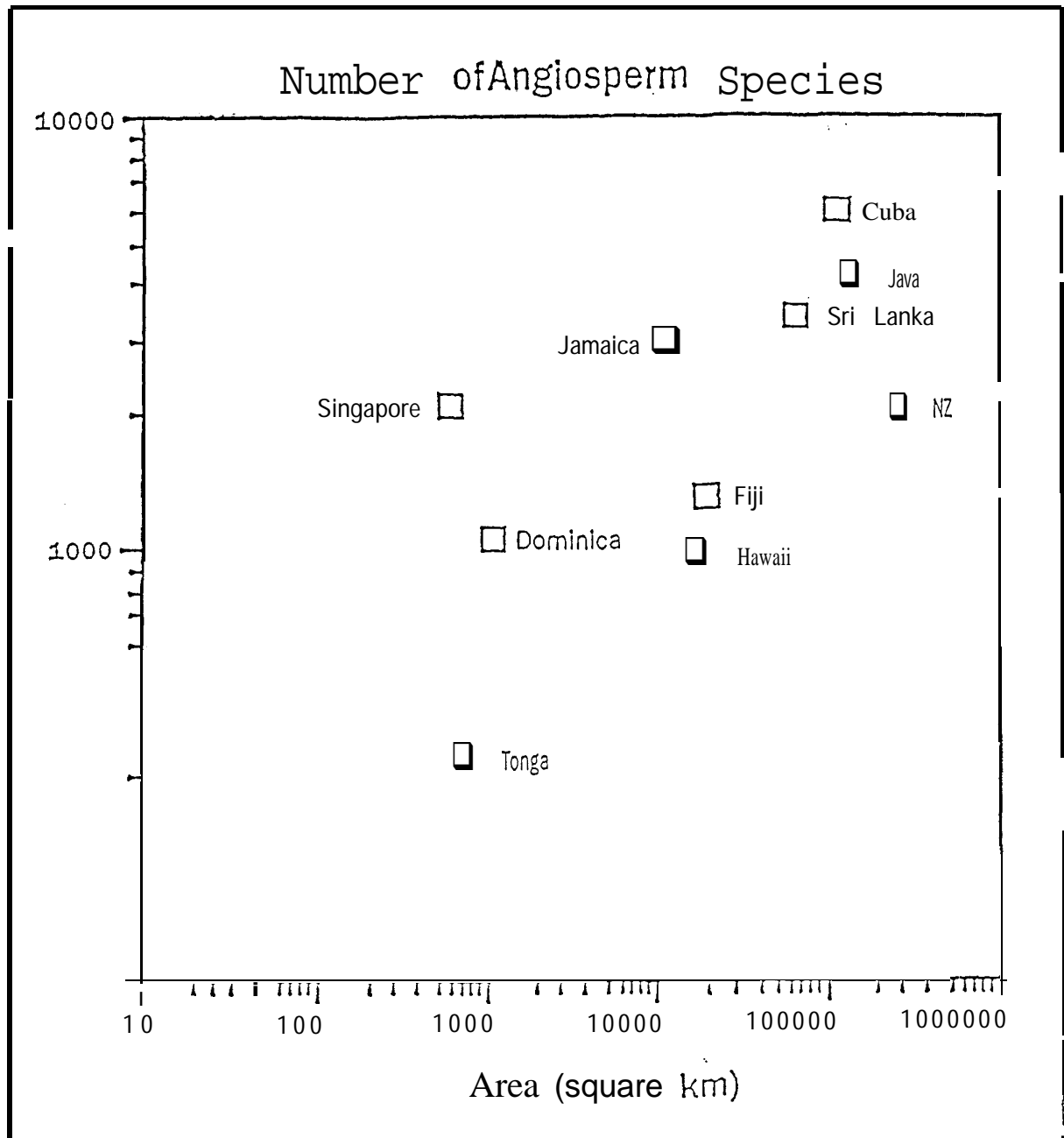
4.3 Priority Ranking

4.3.1 Joint top priority is accorded to increasing the database, research and capacity building as well as the maintenance of the 5% and the monitoring of the health of the representative ecosystems. These two activities are complementary and synergistic.

4.3.2 The next priority falls on networking with regional and international organisations, which will, indeed ramify with improving communication technology.

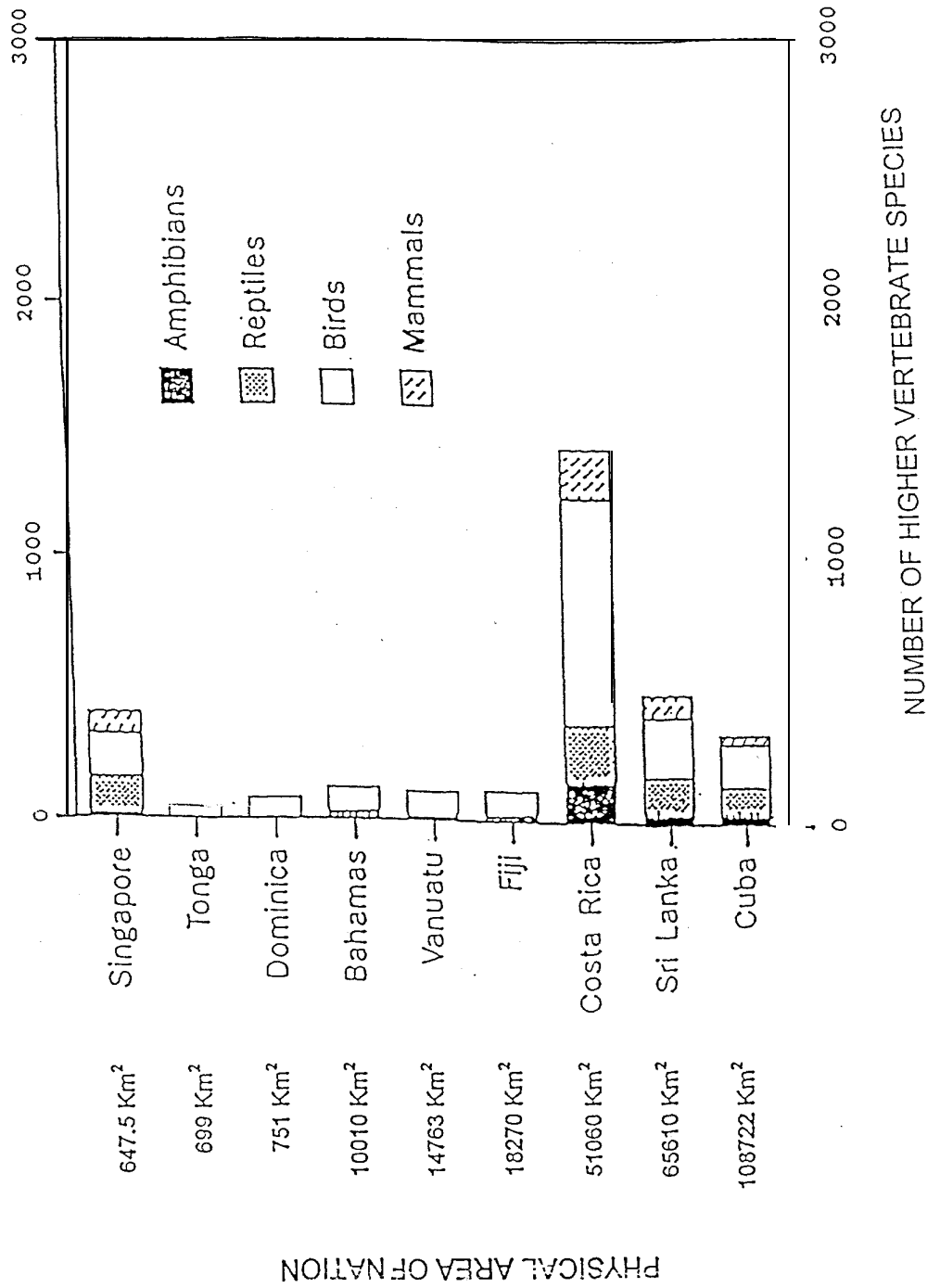
FIGURE 4.1

NUMBER OF ANGIOSPERM SPECIES AGAINST AREA OF COUNTRIES



Area against angiosperm flora size for some tropical island-s (after Turner 1994).
NZ = New Zealand.

FIGURE 4.2
A COMPARISON OF THE NUMBER OF RESIDENT HIGHER VERTEBRATE SPECIES FOR
DIFFERENT NATIONS. THE STATES ARE ORDERED IN INCREASING AREAL EXTENT FROM
TOP TO BOTTOM



CHAPTER 5 PARTNERS

5.1 Introduction

5.1.1 The coverage of the CBD is wide-ranging. Although NParks functions as the national agency, the implementation of the specific programmes, inevitably, involves an equally diverse pool of expertise. This chapter highlights some of the core partnerships that NParks has established to assist in the implementation of the CBD specific articles. From time to time, new partnerships will definitely be forged to meet fresh challenges and topical issues that surface with the ever-changing environment. The strengthening of existing liaisons will further enhance the implementation of long-term on-going action programmes. While this chapter focuses on the general purview of the key partners, Chapter 6 will define more explicitly their roles in the specific action programmes.

5.2 Public Sector

MND Umbrella

5.2.1 The mission of URA is “to plan and facilitate the physical development of Singapore into a tropical city of excellence.” To URA, planning means more than just safeguarding land for future needs. Developing blueprints to stimulate Singapore’s economic growth and improving the quality of life for all Singaporeans are also addressed by URA in the form of the Concept Plan, Development Guide Plans and the Conservation Master Plan. The Planning Department and the Parks and Trees Regulatory Section, both of NParks, work closely with URA and other agencies with regards to the implementation of these plans.

5.2.2 The main responsibility of PPD is to ensure that all imported and locally produced fresh foods are safe for human consumption. PPD is also responsible for the safeguarding of animal, fish and plant health. The development, management and promotion of agrotechnology or intensive high technology farming also fall under their purview. By virtue of this, PPD with NSTB are the lead agencies responsible for the preparation of the national guidelines for the release of genetically modified organisms used in agriculture. Details of Singapore’s initiatives on biosafety are given elsewhere in the report (# 6.11).

5.2.3 HDB is a statutory authority entrusted with the responsibility of providing affordable public housing of a high quality. Its scope of work includes the planning and development of new towns, the allocation and management of HDB properties, and the upgrading and re-

development of older estates. In the provision of a total living environment for its residents, parks have become an integral part of their urban design and landscape of HDB estates.

Other Relevant Ministries and Agencies

5.2.4 Through the SGP, ENV aims to develop Singapore into a city with high standards of public health and a quality living environment (# 1.1.3). NParks works closely with the Strategic Planning and Research Department and the International Environment & Policy Department.

5.2.5 The Ministry of Education (MOE) and NParks have collaborated on several projects. SOH has assisted the Science Unit of MOE in developing environmental education worksheets for the schools. Individual schools are also involved in ecological projects within the nature reserves in collaboration with the Nature Reserves Management Branch.

5.2.6 The International Affairs Division of AGC provides legal advice on international law and drafting of bilateral and multilateral legal instruments. These responsibilities of AGC are most pertinent to the implementation of CBD.

5.2.7 The Public Utilities Board (PUB) is the water authority in Singapore. Some clauses in the act that governs PUB are also relevant to nature conservation. All of Singapore's reservoirs are situated within the legally protected nature reserves or the designated nature areas. The management of water catchment areas involves close co-operation between PUB and NParks.

5.2.8 NSTB aims to develop and harness science and technology for Singapore's future economic success. NSTB actively partners both local and multinational companies to help them build up their R & D capabilities. In addition, the Board is developing the regulatory and technological infrastructure necessary for science and technology. In the life sciences area, one of the concerns is biosafety regulation. This is one common area of interest that NSTB is working in concert with NParks.

5.3 Academic and Research Institutions

5.3.1 NUS encourages research in a wide range of disciplines. NParks maintains good working relationships with the School of Biological Sciences, the Asia-Pacific Centre for Environmental Law (APCEL), Bioscience Centre, IMA, and IMCB.

5.3.2 The National Institute of Education (NIE) which is part of NTU works closely with SOH, particularly in environmental education. NIE also carries out research projects in various scientific fields.

5.4 Private Sector

Funding

5.4.1 Funding from the private sector could be solicited from private individuals or companies. Concerned individuals or private foundations have funded several projects on nature conservation. Some large companies have adopted long-term projects. Hongkong Bank has donated generously to finance several diverse projects under their “Care-for-Nature” environmental conservation and education programme. BP has been funding a series of guidebooks on natural history published by the SSC since 1981. These existing partnerships will be nurtured whilst seeking new partners.

Implementation

5.4.2 Non-governmental organisations such as the NSS, SEC, Singapore Institute of Biology, Singapore Reef & Marine Conservation Committee, Singapore Underwater Federation, and Royal Singapore Yacht Club, have contributed significantly to local biodiversity conservation efforts.

5.4.3 It is impossible for NParks to, single-handedly, document and monitor the indigenous flora and fauna of Singapore. It, hence, relies on a pool of dedicated professionals and amateurs to achieve its tasks. Volunteers, mostly from NSS, SBS, and some individuals, have unstintedly assisted in carrying out the biological survey of the nature reserves (# 6.4.1). The goodwill of these volunteers will be maintained as well as cultivating new converts.

CHAPTER 6

ACTION AND SCHEDULE

6.1 Introduction

Rationale for Priorities

6.1.1 Although the primary focus of the first national report is the implementation of Article 6, this chapter will also document Singapore's initiatives on the other articles. It begins with Singapore's existing national strategy on conservation and sustainable use of biological diversity. Articles that are relevant to Singapore and where efforts have been initiated to promote them are elaborated on subsequently.

6.1.2 Due to its small size and high level of urbanisation, there are some articles provided for in the CBD that are not relevant to Singapore. Of those that are pertinent, some are presently being addressed. Of those that have not been considered, some warrant immediate attention while others are less urgent or require greater efforts, hence there is a need to set a priority ranking. This exercise focuses on the issues that will be dealt with in the next 5 years. Nonetheless, this does not preclude actions that might at a later date surface to prominence.

6.1.3 Table 6.1 summarises the status of the action programmes for the articles of the CBD that are relevant to Singapore. The progress of the action programmes is monitored on an annual basis and, in some cases, on a quarterly cycle.

6.2 Article 6 - General Measures for Conservation and Sustainable Use

6.2.1 As nature conservation is a concern under the SGP (# 2.2.2), various aspects of conservation and sustainable use of biological diversity have been addressed by the action programmes. Issues relevant to the CBD, although they are not contained in the SGP, will be implemented separately by the appropriate agencies.

6.2.2 NParks as the Scientific Authority on Nature Conservation, logically, has been appointed as the national focal point for the CBD. Although many of the responsibilities of NParks are related to nature conservation, NCB is specifically tasked to maintain the floral and faunal species diversity of Singapore. In 1995, the **Research Management Plan: The Nature Reserves for Research and Education** was prepared and adopted. In the following year, the **Nature Reserves Recreational Masterplan** was approved and is presently being implemented. The wide-ranging scope of the CBD necessitates relevant sectoral, as well as,

cross-sectoral planning, programmes and policies. These are effected by the setting up of committees and taskforces.

6.3 Article 7 - Identification and Monitoring of Biological Diversity

6.3.1 Some 3000 hectares have been identified as nature areas when the SGP was published in 1993. The nature areas (Table 2.2) were selected based on the following criteria:

- a) “the site should have a natural environment in terms of its landscape and wildlife”;
- b) “the site should be ecologically stable and have the ability to support a large variety of wildlife. Presence of endangered or rare species, or wildlife unique to Singapore, will be an added merit”;
- c) “the site should have the potential for recreation, education and scientific research”;
- and
- d) “the site should be able to coexist with adjoining, or nearby developments.”

6.3.2 The different agencies of the Singapore Government will ensure that the aggregate area of the nature sites is not less than 5% of Singapore’s land area.

6.3.3 Owners or trustees of these nature areas are either the State or Statutory Boards. Most of the designated nature areas are nature reserves and Stateland, with the remaining pockets under the jurisdiction of NParks, PUB and Sentosa Development Corporation. As a planning strategy, the authorities will try to conserve as much of the existing natural areas in its present state as possible to balance against the urbanisation demands of the island. Therein lies the greater challenge for Singapore’s biodiversity conservation efforts.

6.4 Article 8 - In-situ Conservation

Nature Reserves

6.4.1 One of the projects proposed by the SGP was an inventory of flora and fauna of Singapore to be used as an important tool in the understanding of the biological diversity of Singapore. The field work of the 5 year Survey of the Nature Reserves which encompasses the physical, as well as the biological aspects, ended in May 1997. The data analysis and preparation of the report on the survey are in progress. The report is targeted to complete in early 1998.

6.4.2 Long-term monitoring of the health of the nature reserves will be continued when the Survey of the Nature Reserves is completed. The Division of Biology and the Center for Tropical Forest Science, both of the NIE, had recently completed a population dynamics study of a 2 ha plot within the Bukit Timah Nature Reserve (Ercelawn *et al.*, in prep.). Another census will be initiated soon to follow-up on this project.

Nature Areas and Nature Parks

6.4.3 A biological survey of Bukit Batok Nature Park, a nature area, was started in 11 August 1997. Involving NCB, Parks Management staff of Bukit Batok Nature Park and the Herbarium staff, this collaborative project will yield results that will increase the existing biodiversity data on the nature areas of Singapore. The survey data will also be adapted as teaching resource materials for environmental education (# 6.6.2 & # 6.6.3). Other nature areas are to be earmarked for future surveys.

Green Corridors

6.4.4 Being a small island and compounded by a long history of intensive land-use, natural areas of Singapore, inadvertently, suffer from fragmentation, isolation, and small size. To counter this as a drawback to nature conservation, NParks has embarked on an accelerated development programme of a network of park connectors. The park connectors function as green corridors facilitating fauna movement and plant dispersal.

6.5 Article 9 - Ex-situ Conservation

General Comments

6.5.1 Scattered all over Singapore are several small pockets of land where wild plants grow. Administratively, these areas could be state land that have yet to be gazetted for a specific land use or they could be privately owned land. Any threatened or rare species in these small refuges will not be able to survive on a long term basis. Salvage operations are carried out on these specimens that are subsequently translocated to SBG or to the most ecologically suitable nature area.

Singapore Botanic Gardens

6.5.2 The functions of SBG are many, including, inter *alia*, serving as museum of living plants; housing a herbarium; collecting, donating, and exchanging living plants; spear-heading research in the fields of horticulture and applied botany; breeding plants, in particular, orchids; acting as depository of endangered and threatened indigenous, as well as exotic, species; providing technical advice on horticulture. *Leea angulata* and *Dolichandrone spathacea*, *Uncaria calophylla*, and *Vanilla griffithii* are some rare and endangered plants that have been salvaged and are now surviving in SBG. The monitoring of the number of indigenous flora species in SBG is facilitated by the database, BG-Base.

Nature Areas

6.5.3 The nature areas represent a range of ecosystems found in Singapore. Since these nature areas represent a diverse range of ecosystems, they form an important pool of **ex-situ** refuges that can accommodate plants salvaged from different ecosystems.

Parks

6.5.4 The planting of indigenous species, particularly those species that are threatened, endangered or rare, in horticulturally landscaped parks is a method of promoting **ex-situ** conservation within an extensive park network within Singapore. The Computerised Horticultural Information System (CHIS) based at NParks serves as a tree database. The planting of indigenous species could be monitored using this database.

Tree Conservation Areas

6.5.5 The Parks and Trees Act (Cap 216, 1994 Rev Ed) is an act “to provide for the development, protection and regulation of public parks and gardens and for the preservation and growing of trees and plants and for matters connected therewith”. No person shall, without the written permission of the Commissioner of Parks and Recreation, fell or cut any tree, with a girth exceeding one metre, growing on any vacant land and those within the Tree Conservation Areas (First Schedule). Large trees are, hence, legally protected by this Act.

Ex-situ Conservation of Fauna

6.5.6 The **ex-situ** conservation efforts of the Singapore Zoological Gardens and the Jurong Bird Park cannot be overestimated. Some of their breeding programmes of faunal species, particularly primates and birds, have been quite successful.

6.6 Article 12 - Research and Training

Singapore Botanic Gardens

6.6.1 Active research is being carried out in the fields of tissue culture, plant pathology, orchid breeding, arboriculture, and entomology. **The Gardens' Bulletin**, a botanical and horticultural journal and the newsletter, **Gardenwise**, are regular publications of SBG. Books on various aspects of botany, horticulture and nature conservation, have also been published by SBG. These publications cater to the academia, as well as, the general public.

6.6.2 Established in 1972, the SOH offers formal training in horticulture and landscape design. By awarding diplomas in horticulture and landscape design and a trade certificate in

horticultural practice, the School serves as a provider of trained horticulturists and landscape designers, not only to Singapore but also to the region. A milestone in the development of landscape design education in Singapore was set in July 1997 when the SOH launched an Advanced Diploma in Landscape. Studies in collaboration with Lincoln University of New Zealand.

6.6.3 In addition to the diploma and trade certificate courses, the SOH also organises gardening courses, nature walks at SBG and Bukit Timah Nature Reserve, and workshops for children. Short technical courses are conducted periodically to impart new advancement and techniques in the fields of horticulture and landscape design. The School works closely with the Ministry of Education and contributes valuable input to the development of worksheets and curricula for nature conservation. The attachment programme for foreign visitors to SBG falls under the responsibility of the SOH. With the expanding horticultural and landscape service industries, it is envisaged that the role of the SOH will, inevitably, become increasingly important.

Universities and Polytechnics

6.6.4 Three polytechnics in Singapore, viz., Ngee Arm Polytechnic, Singapore Polytechnic and Temasek Polytechnic, offer a diploma in Biotechnology. Students in these polytechnics are encouraged to work on biotechnology projects. NParks will be launching a new diploma in 1998. NUS awards degrees in the sciences, including botany and zoology. Research on freshwater ecology, marine ecology and forest ecology is carried out by lecturers and students of the SBS of NUS, and the NIE of NTU. One of the relevant regular scientific publications published by NUS is the **Raffles Bulletin of Zoology**. The APCEL is based in the Law Faculty of NUS .

6.7 Article 13 - Public Education and Awareness

6.7.1 The Public Education arm of the SOH offers a range of recreational courses for hobbyists and diverse outreach programmes targeted at both children, adults and families. Bukit Timah Nature Reserve and Sungei Buloh Nature Park, too, run their own nature walks and public education programmes.

6.7.2 A biological survey of the biodiversity of Bukit Batok Nature Park was initiated in August 1997 (# 6.4.3). This project is a collaborative effort involving NParks' staff from the Parks Management Division, the Herbarium and the Nature Conservation Branch. Based on the information accrued during the biological survey, an ecological tour of Bukit Batok Nature Park will be tailored for a group of teachers soon. The guided educational walk programme will, subsequently, be extended to school children, teachers and the general public.

6.7.3 The Ministry of Education, with the assistance of the SOH, has been preparing and periodically revising environmental education source books for primary and secondary

schools. The “Adopt-A-Park” project is a joint effort between schools and NParks to promote nature awareness. Environmental education is also being carried out by ENV, NSS, and SEC. Activities organised by NSS include nature walks, talks, overseas nature trips, clean-up operations of nature areas, the annual bird race, compilation of check-lists of different taxonomic groups, etc. SEC’s public awareness programme covers a diverse gamut, ranging from heritage trail walks, talks, workshops, art exhibitions, etc. Some of the efforts jointly or independently organised by these organisations include activities during the Clean and Green Week, World Environment Day Observance, and Earth Day Observance. NSS celebrated its inaugural NSS Nature Day on 5 October this year.

6.8 Article 14 - Impact Assessment and Minimising Adverse Impacts

6.8.1 One of the main statutes governing land use planning and control is the Planning Act (Cap 232, 1990 Ed.). This Act makes provision for the Master Plan that will be reviewed at least once every five years. To complement the Master Plan, the non-statutory long-range Concept Plan was introduced in 1971 and subsequently revised in 1991. The Plan, by embodying the Green and Blue Plans, strives to make Singapore a city that harmonises urban development with its natural and landscaped environs. On the completion of the Concept Plan, URA proceeded to draw up detailed plans in the form of Development Guide Plans (DGP). Singapore is zoned into fifty five DGPs or planning areas. When completed in 1998, all the fifty five DGPs would be gazetted as the new Master Plan. This statutory Master Plan provides “a clear guide to landowners on what their land can be used for. It is the reference for development control at the operational level of the planning system” (URA, 1997).

6.8.2 Although there is no law legislating environmental impact assessment (EIA) in Singapore, there are a number of channels that function in that role. ENV, in consultation with URA, checks that all new developments are properly sited and are compatible with surrounding land use. ENV also imposes environmental pollution control requirements to be incorporated into the designs of the new development to minimise pollution and to mitigate pollution impact on surrounding developments. For more complex industrial developments, ENV may require the developer to carry out studies on the environmental effects of the project. The project could proceed only when ENV is satisfied that adequate mitigating and pollution prevention measures would be undertaken to ameliorate the environmental effects arising from the project. As an administrative procedure, NParks must be consulted on all developments falling within the nature areas, the Tree Conservation Areas, and vacant stateland.

6.9 Article 15 - Access to Genetic Resources

6.9.1 Singapore recognises the importance of formulating a policy on access to genetic resources for environmentally sound uses and is presently in the process of initiating the development of policy guidelines.

6.10 Article 17 (Exchange of Information) and Article 18 (Technical & Scientific Co-operation)

6.10.1 To facilitate the exchange of information and technical and scientific co-operation, a National Biodiversity Reference Centre (NBRC) has been set-up within NParks. One of the functions of the NBRC is to service as a repository of information on fauna and flora, published bibliographic data on fauna and flora of Singapore, a list of contact persons working on nature conservation (in particular, in Singapore and the region), a compilation of existing legislation in Singapore pertaining to nature conservation and policy guidelines on nature conservation, and a catalogue of NParks' slide collection on fauna, flora and ecosystems of Singapore. With the building up of its database, the NBRC can act as a one-stop information centre on fauna, flora and nature conservation, thus easing information exchange.

6.10.2 Because it is the depository of past and present data on fauna, flora and ecosystems, it is in an excellent position to identify information gaps. With its growing network of contacts, it is also in a pivotal position to match technical and scientific experts with the end-users. In this capacity, it can serve the function of a clearing-house mechanism to promote and facilitate technical and scientific co-operation.

6.10.3 Institutions like NSTB and the Economic Development Board (EDB) function in a similar capacity of promoting and facilitating technical and scientific co-operation for selected industrial and services sectors and for commercial purposes.

6.11 Article 19 - Handling of Biotechnology and Distribution of Its Benefits

6.11.1 The Biosafety Regulation Taskforce formulates the set of guidelines for the release of genetically modified organisms (GMOs) in the Singapore context. The taskforce comprises representatives from PPD, NSTB, ENV, EDB, IMA, Singapore Productivity and Standards Board (SPSB), Ministry of Health (MOH), MND, and NParks. The Director of PPD is the Chair while NSTB functions as the Secretariat. The taskforce proposed that two committees, that is, the Genetic Manipulation Advisory Committee (GMAC) and the Biosafety Monitoring and Auditing Committee (BMAC), be established to administer the safety in biotechnology guidelines. Organisations, including companies, research institutions, and academic institutions, involved in genetic manipulation work, may set up their own institutional biosafety committees (IBCs) that must be accredited by GMAC. When Singapore sent a representative to the Third Meeting of the CBD open-ended Ad Hoc Biosafety Working Group held in Montreal from 13 October to 17 October 1997, it had completed the first draft of the national guidelines with the proposed administrative and monitoring institutions. The national guidelines for the release of genetically modified organisms used in agriculture are being finalised and targeted to be completed by end 1997.

6.11.2 At the 19th meeting of the ASEAN Ministers on Agriculture and Forestry on 11-12 September 1997, Singapore obtained the ASEAN Ministerial mandate for its initiative to work towards harmonisation of regulations for agricultural products derived from biotechnology. This initiative will be launched with an ASEAN workshop on 1-3 April 1998.

The workshop will serve as a discussion platform for regional, international and industry views on the subject. The objective is to work towards regional harmonisation of regulations.

6.12 Article 22 - Relationship with Other International Conventions

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1975

6.12.1 Singapore ratified the Convention on 28 February 1987. Following its ratification, Singapore passed the Endangered Species (Import and Export) Act (Cap 92A, 1990 Ed) and implements CITES by controlling the importation and exportation of certain animals and plants or parts thereof. This Act is administered by the Director of PPD and provision is made for an Advisory Committee to assist the Director in the Administration of the Act. Export or re-export of endangered species must be accompanied by certificates from PPD. Reciprocally, all import of endangered species into Singapore must have CITES certificates from the exporting countries.

Convention for the Protection of the Ozone Layer, 1986 and the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987

6.12.2 Singapore acceded to both the 1985 Vienna Convention on the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substance that Deplete the Ozone Layer on 5 January 1989. In accordance with the phasing out schedule set out in these international agreements, Singapore has implemented control measures to phase out ozone depleting substances since October 1989. The Control of Import and Export (Montreal Protocol) Order 1989 (GN S 404/89) is the legislative tool used to control and subsequently ban the importation of halons, chlorofluorocarbons (CFCs) and other ozone depleting substances into Singapore. The latest control measure is the prohibition of the import of CFCs, carbon tetrachloride and methyl chloroform with effect from 1 January 1996.

TABLE 6.1: ACTION PROGRAMMES FOR CONSERVATION OF BIODIVERSITY

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 6 : GENERAL MEASURES FOR CONSERVATION AND SUSTAINABLE USE	1. SINGAPORE GREEN PLAN (SGP)	1. SPECIFIC ACTION PROGRAMMES WERE FORMULATED IN 1993. IMPLEMENTATION ON-GOING	1.6 COMMITTEES COMPILE QUARTERLY REPORTS UP-DATING THE PROGRESS OF ACTION PROGRAMMES
	2. RESEARCH MANAGEMENT PLAN : THE NATURE RESERVES FOR RESEARCH AND EDUCATION	2. COMPLETED IN 1995; BEING IMPLEMENTED	2. REGULAR REVIEW
	3. NATURE RESERVES RECREATIONAL MASTERPLAN	3. REPORT COMPLETED IN 1996; BEING IMPLEMENTED	3. REGULAR REVIEW
ARTICLE 7 : IDENTIFICATION AND MONITORING	1. IDENTIFICATION OF NATURE AREAS	1. IDENTIFICATION OF NATURE AREAS COMPLETED IN 1993	1. QUARTERLY REPORTS SUBMITTED BY URA ON THE STATUS OF THE NATURE AREAS
	2. MONITORING OF THE HEALTH STATUS OF NATURE AREAS	2. ON-GOING MONITORING CARRIED OUT BY NPARKS	2. MONITORING SURVEYS CARRIED OUT ON A PERIODIC BASIS TO ENSURE THAT THE HEALTH STATUS OF THE NATURE AREAS IS MAINTAINED OR ENHANCED

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 8 : IN-SITU CONSERVATION	1. SURVEY OF THE NATURE RESERVES	1. STARTED IN JANUARY 1992; WILL COMPLETE IN DECEMBER 1997	1. PERIODIC MONITORING OF FLORA AND FAUNA
	2. SURVEY OF NATURE AREAS, EXCLUDING THE NATURE RESERVES	2. SURVEY OF BUKIT BATOK NATURE PARK STARTED IN 11 AUGUST 1997, SCHEDULED TO COMPLETE IN DECEMBER 1997	2. PERIODIC FAUNAL SURVEYS AND MONITORING OF TAGGED FLORA SPECIMENS
	3. GREEN CORRIDORS INVOLVING A NETWORK OF PARK CONNECTORS	3. ON-GOING; 30-YEAR PLAN	3. PERIODIC MONITORING OF WILDLIFE USE OF CORRIDORS

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 9 : <i>EX-SITU</i> CONSERVATION	1. SINGAPORE BOTANIC GARDENS AS A SITE FOR <i>EX-SITU</i> CONSERVATION	1. ON-GOING	1. MONITORING FACILITATED BY THE DATABASE, BG-BASE
	2. NATURE AREAS AS SITES FOR <i>EX-SITU</i> CONSERVATION	2. ON-GOING	2. PERIODIC MONITORING BY FIELD SURVEYS
	3. PARKS AS SITES FOR <i>EX-SITU</i> CONSERVATION CONNECTORS	3. ON-GOING	3. MONITORING FACILITATED BY THE DATABASE, CHIS
	4. TREE CONSERVATION AREAS AS SITES FOR <i>EX-SITU</i> CONSERVATION	4. ON-GOING	4. PERIODIC MONITORING BY FIELD SURVEYS

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 12 : RESEARCH AND TRAINING	1. SOH'S DIPLOMA IN HORTICULTURE AND DIPLOMA IN LANDSCAPE DESIGN COURSES	1. ON-GOING	1. ATTENDANCE AND FEEDBACK AS MONITORING PROCEDURES; EVALUATION PROCEDURE INCLUDE AN ANNUAL REVIEW BY THE SOH COUNCIL
	2. DEGREE AND DIPLOMA COURSES OFFERED BY THE UNIVERSITIES AND POLYTECHNICS	2. ON-GOING	2. ATTENDANCE AND FEEDBACK AS MONITORING MECHANISMS; REVIEW BY THE UNIVERSITIES' AND POLYTECHNICS' COUNCILS

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 13 : PUBLIC EDUCATION	1. COURSES RUN BY SOH	1. ON-GOING	1. ATTENDANCE AND FEEDBACK; ANNUAL REVIEW
	2. NATURE WALKS AND PUBLIC EDUCATION PROGRAMMES RUN BY THE BTNR AND SBNP	2. ON-GOING	2. ATTENDANCE AND FEEDBACK; ANNUAL REVIEW
	3. ECOLOGICAL TOUR OF BBNP	3. FIRST TOUR TARGETTED FOR DECEMBER 1997; SUBSEQUENTLY PROCEED AS A LONG TERM PROJECT	3. ATTENDANCE AND FEEDBACK; ANNUAL REVIEW
	4. ENVIRONMENTAL EDUCATION SOURCEBOOK FOR PRIMARY SCHOOLS	4. SOURCEBOOK LAUNCHED ON 4 NOV 1997	4. DEMAND FOR SOURCEBOOK AND FEEDBACK; PERIODIC REVIEW
	5. ADOPT-A-PARK PROJECT SPEARHEADED BY NPARKS	5. ON-GOING	5. REQUEST FOR PARTICIPATION IN PROJECT AND FEEDBACK; PERIODIC REVIEW
	6. ACTIVITIES ORGANISED BY ENV, SEC, NSS INCLUDIGN WALKS, TALKS, BIRD RACE EXHIBITIONS, ETC	6. ON-GOING	6. PUBLIC PARTICIPATION AND FEEDBACK; PERIODIC REVIEW

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 14 : IMPACT ASSESSMENT AND MINIMISING ADVERSE IMPACTS	1. NPARKS IS CONSULTED ON DEVELOPMENT PROJECTS PROPOSED WITHIN NATURE AREAS AND THE TREE CONSERVATION AREAS	1. ON-GOING	1. THE CONSERVATION HEALTH STATUS OF THE NATURE AREAS IS THE INDICATOR
ARTICLE 15 : ACCESS TO GENETIC RESOURCES	1. FORMULATION OF A SET OF POLICY GUIDELINES PERTAINING TO ACCESS TO GENETIC RESOURCES	1. PREPARATORY STAGES	1. FINALISATION AND APPLICATION OF THE POLICY GUIDELINES AS MONITORING PROCEDURES; FEEDBACK AND PERIODIC REVIEW TO ENSURE EFFECTIVENESS AND RELEVANCE

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 17 : EXCHANGE OF INFORMATION	1. THE SETTING-UP OF A NATIONAL BIODIVERSITY REFERENCE CENTRE (NBRC)	1. ON-GOING	1. MONITORING DATABASE INPUT AND USERS' DEMAND AND FEEDBACK; MORE FREQUENT REVIEW OF PROGRESS DURING THE EARLY STAGES FO THE SETTING-UP AS AN EVALUATION PROCEDURE
	2. NETWORKING LOCALLY, REGIONALLY, AND INTERNATIONALLY	2. ON-GOING	2. REVIEW OF NETWORK DATABASE
ARTICLE 19 : HANDLING OF BIOTECHNOLOGY AND DISTRIBUTION OF ITS BENEFIT	1. IMPLEMENTATION OF THE NATIONAL GUIDELINES FOR THE RELEASE OF GMOs USED IN AGRICULTURE	1. THE NATIONAL GUIDELINES FOR SINGAPORE WILL BE FINALISED BY DECEMBER 1997	1. NUMBER OF BIOSAFETY APPLICATIONS AND FEEDBACK WILL BE USED AS MONITORING CRITERIA; PERIODIC REVIEW OF THE NATIONAL GUIDELINES WILL BE CARRIED OUT TO EVALUATE AND ENSURE EFFECTIVENESS

TABLE 6.1 : (cont.)

ARTICLE	ACTION PROGRAMME	SCHEDULE	MONITORING & EVALUATION
ARTICLE 22 : RELATIONSHIP WITH OTHER INTERNATIONAL CONVENTION	1. IMPLEMENTATION OF CITES	1. ON-GOING	1. NUMBERS OF CHARGED OFFENDERS AND FEEDBACK ARE USED AS MONITORING INDICATORS; THE LAW IS PERIODICALLY AMENDED TO ENSURE ITS RELEVANCE AND EFFECTIVENESS
	2. IMPLEMENTATION OF THE MONTREAL PROTOCOL	2. ON-GOING	2. NUMBER OF CHARGED OFFENDERS AND FEEDBACK ARE THE MONITORING INDICATORS USED

CHAPTER 7 MONITORING AND EVALUATION

7.1 Methods for Tracking Results of and Evaluating Action Programmes

Committees

7.1.1 There are numerous committees that monitor and evaluate action programmes on nature conservation. The following paragraphs highlight only a few of the committees that perform these tasks.

7.1.2 Action programmes on Nature Conservation under the SGP were formulated by a Workgroup in November 1993. They were designed to meet the five objectives of the Workgroup. The Workgroup had completed their assigned work and had been discontinued. In its place, a Working Committee on Nature Conservation has been set up to monitor and review the progress of implementation of the action programmes. The committee meets regularly to monitor, evaluate and review the progress of the action programmes. NCB, as the secretariat of the Working Committee, compiles quarterly updates of the progress of the action programmes.

7.1.3 NParks holds a corporate conference annually to review its past programmes and set new goals, including aspects of nature conservation. This exercise, inevitably, involves evaluation of planned projects and schedule targets.

7.1.4 On the pursuance of appropriate handling of biotechnology, the Biosafety Regulation Taskforce is entrusted with the responsibility of drafting a set of guidelines for the release of GMOs used in agriculture for Singapore. When the proposed national guidelines are officially accepted, the GMAC will monitor and oversee, *inter alia*, the release of GMOs into the environment at the policy level. The national BMAC acts, on the other hand, as the administrative arm, responsible for monitoring and ensuring compliance to relevant regulations. To promote responsibility within the research and industrial organisations partaking in biotechnological work, IBCs are encouraged to be established within their administrative framework. IBCs are the institutional liaisons linking the GMAC-BMAC complex with the project supervisors.

Ad hoc Committees

7.1.3 Periodically, problems or issues, e.g., oil spills and the long-term effect of the haze due to the burning of vegetation in the region, that does not fall under the purview of existing committees, arise. Ad **hoc** committees would be set up as and when necessary to contain the effects of the catastrophes and to monitor the long-term effects of the disasters on biodiversity.

7.1.4 An occasion that warranted the setting-up of an **ad hoc** committee was when a marine organisms' salvage exercise was organised for a number of purposes. The different objectives included collection for taxonomic identification, extraction of bioactive components, zoological reference specimens, and coral translocation. Another example is the **ad hoc** committee that co-ordinated the clean-up operations of the oil spill caused by the collision of Evoikos with Orapin Global on 15 October 1997.

CHAPTER 8

BUDGET

8.1 Budget

8.1.1 The CBD national agency for Singapore is NParks. The cost of maintaining a team to administer CBD matters is borne entirely by NParks. Other government agencies and statutory boards are involved to different degrees in the implementation of CBD concerns. If they are collaborative projects, the costs are shared by the participating agencies.

8.1.2 Some nature conservation projects are financed by sources other than governmental funding. The Nature Reserves Survey was initiated with government funding and subsequently matched by an equivalent amount donated by a private sponsor. Similarly, funding could be sought from individuals or companies, as and when required. The project could also be written up as a proposal for potential funding by the Singapore Government. Financing, too, could be solicited from international and regional organisations.

8.2 Personnel

8.2.1 NCB of NParks is the administrative hub for CBD. It comprises an assistant director (Nature Conservation), two research officers, and one assistant research officer. The assistant director reports directly to the Deputy Chief Executive Officer (Specialist Services) and the Director of the Singapore Botanic Gardens.

8.2.2 All the departments of NParks are, directly or indirectly, involved with nature conservation. In particular, the work carried by SBG, SOH, the Planning Department, Istana and Conservation Management, and sections of Parks Management that manage nature areas within the parks, is pertinent to nature conservation. These departments absorb the cost of maintaining the health of indigenous flora and fauna.

8.2.3 For each of the other CBD concerns, the appropriate agencies are juxtaposed: Biosafety (PPD and NSTB); CITES (PPD); Planning (URA); legislation (AGC & APCEL). Administrative costs have been borne by the respective agencies. The universities, polytechnics, and NSS carry out relevant research. These projects are funded by a diverse source of funding, e.g., the academic institutions themselves, international organisations, commercial companies or private individuals. The organising of f&d-raising events, e.g., concerts, banquets, activities, also raises funds.

8.2.4 The SEC to encourage and facilitate the financing of environmental projects has established the Central Environment Fund (CEF) Scheme by private donors or companies. This scheme provides a channel for green groups to register with the SEC so that the donations they receive are routed through the SEC's CEF in order to secure tax exemption for their donors. Among the projects that have benefited from this scheme are the NSS' Building Fund donation drive and the Singapore Underwater Federation mooring buoy project.

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LIST OF ABBREVIATIONS AND ACRONYMS

APCEL:	Asia-Pacific Centre for Environmental Law
ASEAN:	Association of South East Asian Nations
ASEP:	ASEAN Environmental Programmes
ASOEN:	ASEAN Senior Officials on the Environment
AWGNC:	ASEAN Working Group on Nature Conservation
BMAC:	Biosafety Monitoring and Advisory Committee
CBD:	Convention on Biological Diversity
CEF:	Central Environment Fund
CFC:	Chlorofluorocarbons
CHIS:	Computerised Horticultural Information System
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DGP:	Development Guide Plan
EDB:	Economic Development Board
ENV:	Ministry of the Environment
GIS:	Geographic Information System
GMAC:	Genetic Manipulation Advisory Committee
GMO:	Genetically Modified Organism
HDB:	Housing & Development Board

LIST OF ABBREVIATIONS AND ACRONYMS (cont.)

IBC:	Institutional Biosafety Committee
IMA:	Institute of Molecular Agrobiology
IMCB:	Institute of Molecular and Cellular Biology
MFA:	Ministry of Foreign Affairs
MITA:	Ministry of Information and the Arts
MND:	Ministry of National Development
MOE:	Ministry of Education
MOH:	Ministry of Health
NBRC:	National Biodiversity Reference Centre
NCB:	Nature Conservation Branch
NIE:	National Institute of Education
NParks:	National Parks Board
NSS:	Nature Society of Singapore
NSTB:	National Science and Technology Board
NTU:	Nanyang Technological University
NUS:	National University of Singapore
NYP:	Nanyang Polytechnic

LIST OF ABBREVIATIONS AND ACRONYMS (cont.)

PPD:	Primary Production Department
PRD:	Parks and Recreation Department (merged with NParks in 1996 to form the new NParks)
PTA:	Parks and Trees Act
PUB:	Public Utilities Board
PWD:	Public Works Department
R & D :	Research and Development
SBG:	Singapore Botanic Gardens
SBS:	School of Biological Sciences (NUS)
SEC:	Singapore Environment Council
SGP:	Singapore Green Plan
SOH:	School of Horticulture (SBG, NParks)
SPSB:	Singapore Productivity and Standards Board
sq. km:	square kilometre
s s c :	Singapore Science Centre
URA:	Urban Redevelopment Authority
ZRC:	Zoological Reference Collection