

PREFACE

When the Republic of Mauritius became the first country to sign and ratify the Convention on Biological Diversity in September 1992, we were making a clear statement that we would try to prevent any more of our unique biodiversity from following in the footsteps of the dodo.

Our biodiversity has been severely affected by humans, either directly through factors such as habitat destruction and conflict with individual species, or indirectly through pollution and the effect of introduced species. The remaining natural systems are now very fragile and degraded, and many species are known from only a handful of individuals, and the future of the biodiversity is dependent upon us for its survival.

With the socio-economic pressures affecting the Republic of Mauritius, it is easy to ignore biodiversity issues in the short term. However, biological conservation is not only about saving unique species from extinction. Ultimately the Country's future depends upon its natural resources – to ensure a reliable supply of water, to maintain productive agriculture and fisheries, to protect the island from cyclones and tsunamis, for sustainable tourism and ecotourism, and to preserve the intangible benefits that biodiversity gives to everyone.

Having signed the CBD, it is our duty to put the convention into practice and this document, the National Biodiversity Strategy and Action Plan for the Republic of Mauritius, sets out a ten-year strategy to ensure that we can achieve this. By integrating the conservation of biodiversity, its sustainable use and the fair and equitable sharing of its benefits into decision-making, and initiating active and clear ecosystem management for conservation, we can aspire to achieving a significant reduction in the rate of biodiversity loss by 2015.

The Government, through the National Parks and Conservation Service, must lead in helping to achieve this goal, but the successful implementation of the plan depends upon all of us. Together, we can ensure that the Republic of Mauritius remains a unique paradise island forever.

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Minister of Agro-Industry and Fisheries

LIST OF ABBREVIATIONS

African Eurasian Migratory Waterbird Agreement	AEWA
Agricultural Research and Extension Unit	AREU
Albion Fisheries Research Centre	AFRC
Association des Consommateurs de L'Ile Rodrigues	ACIR
Association des Pecheurs de L'ile Rodrigues	APIR
Association Rodriguaise des Tour Operateurs	ARTO
Bait Application Techniques	BAT
Biodiversity Strategy and Action Plan	BSAP
Black River Gorges National Park	BRGNP
Central Statistical Office	CSO
Central Water Authority	CWA
Centre de Documentation, de Recherches et de Formation Indianoceaniques	CEDREFI
Clearing House Mechanism	CHM
Community Based Organisation	CBO
Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South East Asia	IOSEA
Conservation Management Area	CMA
Conservatoire Botanique Nationale de Mascarin	CBNM
Convention on Biological Diversity	CBD
Convention on International Trade in Endangered Species of Wild Fauna and Flora	CITES
Department of Environment	DoE
Environment Impact Assessment	EIA
Environment Information System	EIS
Environment Investment Programme	EIP
Environment Resource Management	ERM
Environmental Protection Act	EPA
Environmentally Sensitive Area	ESA
European Union	EU
Exclusive Economic Zone	EEZ
Fauna and Flora International	FFI
Fish Aggregating Device	FAD
Fisheries Research and Training Unit	FRTU
Food & Agriculture Organisation	FAO
Food and Agricultural Research Council	FARC
Forestry Service	FS
Genetically Modified Organism	GMO
Geographical Positioning System	GPS
Global Environment Facility	GEF
Global Invasive Species Programme	GISP
Gross Domestic Product	GDP
Hectare	Ha
Human Resources Development Programme	HRDP
Indian Ocean Commission	IOC/ COI
Indian Ocean Tuna Fishing Cooperation	IOTFC
Information and Communication Technology	ICT
Integrated Coastal Zone Management	ICZM

Integrated Marine and Coastal Area management	IMCAM
International Consortium for Sugarcane Biotechnology	ICSB
International Plant Genetic Resource Institute	IPGRI
International Union for the Conservation of Nature/World Conservation Union	IUCN
Invasive Alien Species	IAS
Japan International Cooperation Agency	JICA
Limits of Acceptable Change	LAC
Male Annihilation Technique	MAT
Marine Oceanography Institute	MOI
Marine Protected Area	MPA
Mauritian Rupees	MRU
Mauritian Wildlife Foundation	MWF
Mauritius College of the Air	MCA
Mauritius Marine Conservation Society	MMCS
Mauritius Research Council	MRC
Mauritius Scuba Diving Association	MSDA
Mauritius Sugar Industry Research Institute	MSIRI
Mauritius Tourism Promotion Authority	MTPA
Mauritius Underwater Group	MUG
Maximum Sustainable Yield	MSY
Memorandum of Understanding	MOU
Ministry of Agriculture, Food Technology & Natural Resources	MoA*
Ministry of Agro-Industry & Fisheries	MoAIF*
	MoE &
Ministry of Environment & National Development Unit	NDU
Ministry of Finance and Economic Development	MOFED
Ministry of Fisheries	MoF*
Ministry of Housing & Lands	MOHL
Ministry of Local Government	MOLG
Ministry of Tourism	MOT
National Biodiversity Strategy and Action Plan	NBSAP
National Capacity Self Assessment	NCSA
National Coast Guard	NCG
National Conservation Strategy	NCS
National Development Strategy	NDS
National Environment Action Plan	NEAP
National Environment Fund	NEF
National Oceanography Data Centre	NODC
National Parks and Conservation Fund	NPCF
National Parks and Conservation Service	NPCS
National Physical and Development Plan	NPDP
National Remote Sensing Centre	NRSC
Non Governmental Organisation	NGO
Non Sugar Sector Strategic Plan	NSSSP
Objectively Verifiable Indicators	OVI
Organisation des Pecheurs Professionnelle des Rodrigues	OPPR
Outer Islands Development Corporation	OIDC
Plant Genetic Resource Centre	PGRC
Prime Minister's Office	PMO

Principal Research and Development Officer	PRDO
Protected Area Network	PAN
Rivulet Terre Rouge Estuary Bird Sanctuary	RTREBS
Rodrigues Regional Assembly	RRA
Rodrigues Underwater Group	RUG
SADC Plant Genetic Resource Centre	SPGRC
Small Grants Programme	SGP
Southern African Development Community	SADC
State Law Office	SLO
Un Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	MARPOL
United Kingdom	UK
United National Development Programme	UNDP
United Nations Convention on the Law of the Sea	UNCLOS
United Nations Convention to Combat Desertification	UNCCD
United Nations Educational, Scientific and Cultural Organisation	UNESCO
United Nations Framework Convention on Climate Change	UNFCCC
University of Mauritius	UoM
Wastewater Management Authority	WMA
Water Resources Unit	WRU

* The Ministry of Fisheries and the Ministry of Agriculture, Food Technology & Natural Resources were merged in 2005 to form Ministry of Agro-Industry and Fisheries, within which NPCS, Forestry Services and Fisheries Division are found

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Chapter 1. Introduction to the Republic of Mauritius

1.1 Introduction

The Republic of Mauritius is located in the Indian Ocean 800 km southeast of Madagascar. It consists of two main islands, Mauritius (1865 km²) and Rodrigues (109 km²) and two groups of outer islands, namely the St Brandon Archipelago (3 km²) and Agalega (c21 km²) (Figure 1.1). The total land area of the Republic of Mauritius is 2,040 km² with an Exclusive Economic Zone (EEZ) extending over more than 2 million square kilometres.

Figure 1.1: Map of the Western Indian Ocean Islands



Mauritius and Rodrigues form part of the Mascarene Archipelago, along with Réunion Island (France). All three are of volcanic origin and share many similarities in terms of their biodiversity. Mauritius was formed c8 million years ago and is encircled by fringing coral reefs that enclose coastal lagoons of varying widths. It has no proper continental shelf with seabed dropping off to a depth of 3000 meters within a few kilometres of the shore. Rodrigues is thought to be the oldest of the 3 islands at 8-10 million years (Giorgi & Borchiellini 1998) and is encircled by a large fringing reef.

1.2 Socio-economic background to Mauritius

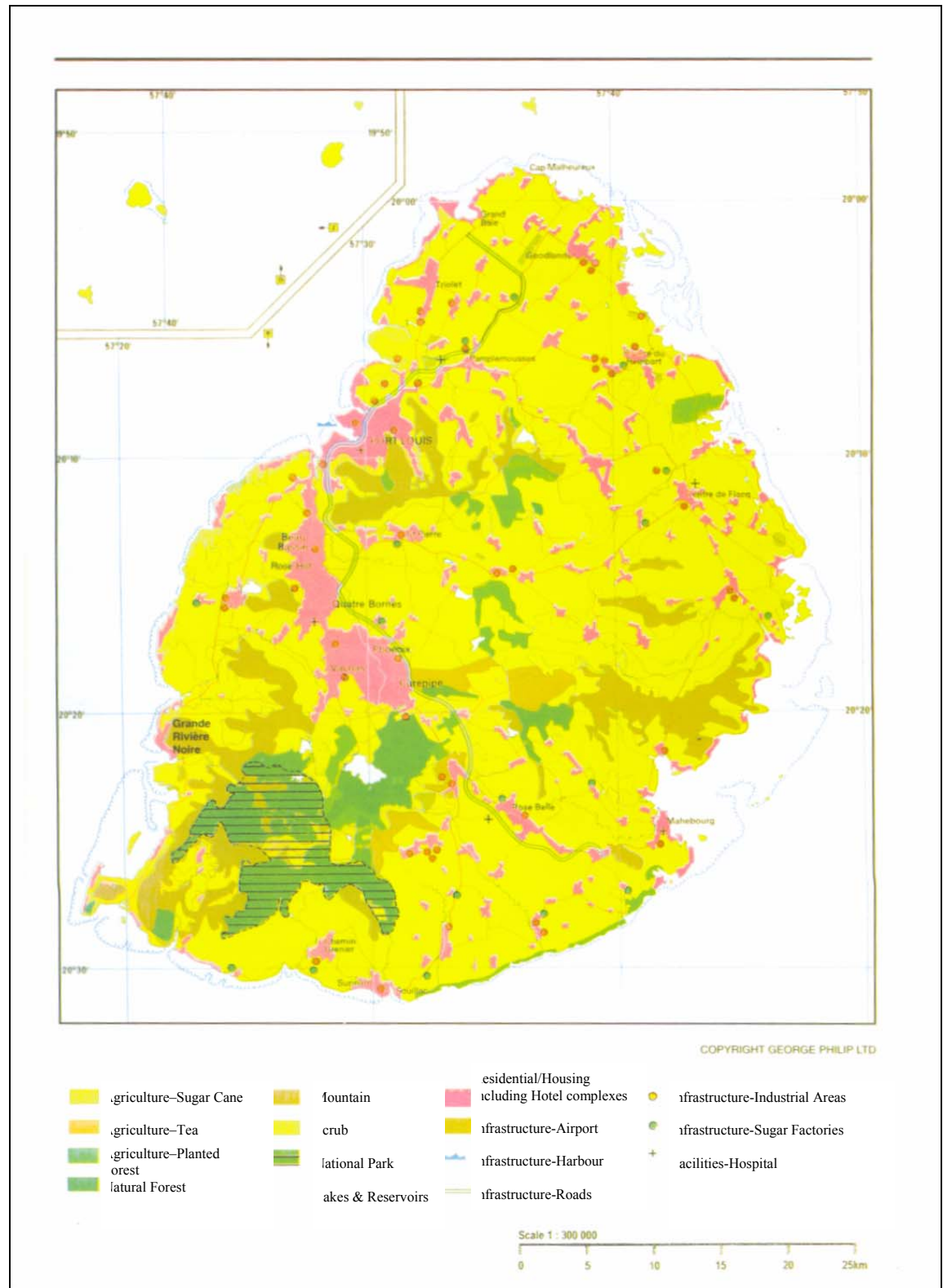
Mauritius gained its independence on the 12th March of 1968 and became a Republic in March 1992. It has a multi-cultural society, made up of descendants of immigrants from Africa, Asia and Europe. All the major religions are practiced. In 2004 the total population was 1.2 million with a growth rate of about 1.1% per year. Over the next twenty years population growth is expected to stabilise at replacement levels or less, but as population density in Mauritius is already high at 600 people per km², the predicted modest population growth (of 250,000 by 2010) will increase pressures on land use. Government policy is thus actively seeking to generate employment in rural areas.

Over the last three decades the Mauritian economy has been regarded as a success story, with annual growth rates of over 5 % and a per capita income of US\$ 5,000 in 2004. Mauritius is amongst the top group of upper middle-income countries and was listed fourth in the African Competitiveness Report of 2004. The country was ranked 65th on the Human Development Index in 2003, with life expectancy at birth of 72.2 years and an adult literacy rate of 84.3%. Mauritius has realised a fair degree of diversification in its economy with agriculture, manufacturing, tourism and financial services emerging as the main pillars. Mauritius has embarked on an ambitious strategy to find new drivers for economic growth. The Government is putting a lot emphasis on the development of the ICT sector and the promotion of Mauritius as a seafood hub in the region.

Gross tourism receipts grew from Rs 7.5 billion in 1995 to Rs 23.4 billion in 2004. The tourism industry has been one of the most dynamic sectors of the Mauritian economy, with its contribution to GDP increasing from 3.8 % in 1995 to 7.5 % in 2004. Expanded tourism has led to the rapid construction of hotels and other facilities along the shoreline, providing considerable direct and indirect employment, but also increasing stress on the environment. Many other sectors of the economy are benefiting from the success of tourism, including agriculture, fisheries, transport, and handicrafts.

Figure 1.2 shows the land use pattern in Mauritius. The tropical climate, topography and over a million of years of isolation have resulted in the evolution of a diverse biota with a high degree of endemism. However human settlement and interference has caused extensive habitat loss, degradation and high rates of species extinction.

Figure 1.2: Land use in Mauritius (Source: NEAP 1999)



Land in Mauritius is largely privately owned. State land is distributed throughout the island and the Pas Géométrique, a narrow belt of land (250 French feet) around the coast is Government-owned. Vacant land for development is limited since most of the useable land has already been put to productive use. As shown in Table 1, of a total land area of 186,500 ha, 45% is devoted to agriculture, 31% to forests or natural green areas and the remaining 24% is either built upon or unusable. In contrast, 90 % of the land in Rodrigues is state-owned.

Table 1: Land Use in Mauritius (1986 - 1996)

Land Use	1986 ²		1996 ¹		Change
	Area (ha)	%	Area	%	
<i>Agriculture</i>	91,574	49.1	84,424	45.3	-7,150
Sugar cane	83,289		76,814		-6,475
Tea	3,776		1,109		-2,667
Tobacco	600		611		11
Food crops	1,791		1,333		-458
Fresh vegetables	2,118		4,557		2,439
<i>Forestry</i>	65,400	35.6	56,639	30.4	-8,761
Planted forests ³	12,307		13,089		782
Natural forests ³	8,485		8,325		-160
Savannah, scrub, grazing and other forest lands	44,608		35,225		-9,383
<i>Community</i> ⁴	29,526	15.8	45,437	24.4	15,911
Reservoirs	1,180 ⁶		1,165 ⁵		
Swamps and rocks	1,430 ⁶				
Roads (including agricultural roads)	3,465 ⁶				
Built up areas	23,451 ⁷				
<i>TOTAL</i>	186,500	100	186,500	100	

Source: ¹ 1996 State of Agriculture (Mauritius).

² CSO and 1987 Annual Report of the Forestry Service of the Ministry of Agriculture.

Notes: ³ Includes mountain reserves (government and privately owned), excluding river reservoirs.

⁴ Including built-up areas, reservoirs, roads, including swamps. No figure available for 1996.

Figure provided = total land area - agriculture - forestry.

⁵ *Pers comm* CWA, 1998.

⁶ CSO. Breakdown based on aerial photographs taken in 1965.

⁷ CSO breakdown states 25,000ha for built up areas. Figure revised to retain consistency with total for community land.

1.3 Biodiversity in Mauritius

Terrestrial and Forest Biodiversity

Due to its volcanic origin, age, isolation and its unique terrain Mauritius is blessed with a diversity of flora and fauna not usually found in such a small area. Before its discovery by the Portuguese in 1507, there were no terrestrial mammals on the island. This allowed the evolution of a number of flightless birds and large reptile species. The arrival of man saw the introduction of invasive alien species and the rapid destruction of habitat and the loss of much of the endemic flora and fauna.

The Dutch visited the island after the Portuguese, and Van Warwick's report (1601) on the resources of the island stated:

"the island is uninhabited and very mountainous. The soil is extremely rocky but fertile as can be judged from the large number of trees which are so close to each other that one can hardly walk in the forest. The trees are mostly black ebony. There are also a large number of palms, the palms and the palmists are edible."

The Dutch East India Company first began to clear forest to exploit the ebony and palms in the lowlands. The process was accelerated markedly during the later French and the British administrations to make room primarily for agriculture as well as roads and settlements. The cleared forest areas were planted with sugar cane, tea, eucalyptus and pine.

The island, which once supported a rich diversity of wildlife, is now sadly famous as the former home of the flightless Dodo (*Raphus cuculatus*), the very symbol of extinction. Less than 2% of the native forest that once stretched from the mountain tops of the central plateau to the shore now remains, concentrated in the Black River Gorges National Park in the south west, the Bamboo Mountain Range in the south east and the Moka-Port Louis Ranges in the north west. There are also some isolated mountains which are important e.g. Corps de Garde, and Le Morne Brabant, and several offshore islands with remnants of coastal and mainland diversity.

Over 100 species of plants and animals have become extinct and many more are threatened. Conservation activities began some 25 years ago with the implementation of programmes for the reproduction of threatened bird and plant species as well as habitat restoration in the National Parks and Nature Reserves.

Coastal, Marine and Freshwater Biodiversity

The coastline of Mauritius is 322 km long and almost entirely surrounded by a fringing coral reef enclosing a lagoon area totalling 243 km². The reef complex of Rodrigues has an area of 200 km². The coral reef of St Brandon covers an area of 190 km², while Agalega has 100 km². The marine ecosystem is quite vulnerable with threats from both marine and land-based activities. In 1997 the Blue-Bay (353 ha) and Balaclava (485 ha) Marine Parks were proclaimed. Coral bleaching was observed in 1998.

Six Fishing Reserves have been proclaimed under the Fisheries and Marine Resources Act 1998, (Port Louis, Grand Port, Black River, Poudre d'Or, Poste La Fayette and Trou d'eau Douce). The main objective of the Reserves is to protect and conserve habitats that are nursery grounds for juvenile fish.

The freshwater bodies on the mainland of Mauritius comprise approximately 2000 ha of reservoirs, rivers and streams. There are three known endemic freshwater fish and many endemic crustacea. Introductions of exotic fish species including the Tilapia (*Oreochromis* spp.), have invaded almost every fresh water body and have resulted in significant changes in freshwater biodiversity.

Agrobiodiversity

Crops and livestock were introduced by the early settlers and have through a process of selection developed traits that suit them to their specific environments. There has also been regular introduction of new crop varieties and breeds by research institutions, commercial enterprises and farmers which are now cultivated by the farming community. These plant varieties and breeds also constitute the agricultural biodiversity of Mauritius. Only one native plant species is used nowadays for food, although some species of *Coffea* are found in the wild.

In the last decade Mauritius has been involved in new biotechnologies, and various institutions devoted to agricultural research, as well as human and animal health, are presently involved in biotechnology. Most of the research in biotechnology has been focused on the agricultural sector.

1.4 Rodrigues

Rodrigues is the smallest of the Mascarene Islands with an area of 109 km². Situated 570 km to the northeast of Mauritius, the island is hilly with a central spine culminating in the highest peak, Mont. Limon (393 m). Rodrigues is the only Mascarene Island with extensive limestone deposits and caves. A large fringing reef surrounds the island forming a lagoon within which lie eighteen small islets. Rodrigues is in the cyclone belt and has a warm wet season from November to April and a cool dry season from May to October; despite this some coastal areas are very dry and drought-prone.

The detailed accounts of Leguat from the early 18th century paint an idyllic picture of 'valleys covered with palm-trees, plantains (lataniers) and ebony's', with an important endemic biodiversity. Today, Rodrigues is one of the most degraded tropical islands in the world, and much of the terrestrial biodiversity is extinct, or highly threatened. In contrast, Rodrigues has the most substantial and best-developed reefs in the Mascarenes (Montaggioni and Faure, 1980), and the coral reefs are amongst the most preserved in the Western Indian Ocean.

The economy of Rodrigues is based on agriculture, fishing and tourism and use of native biodiversity for handicrafts is still quite widespread. Land use patterns are shown in Figure 1.3

Rodrigues gained autonomous status in 2001 and is governed by the Rodrigues Regional Assembly. Given its autonomy and specificity, a separate section is devoted to the island (refer to Part II).

1.5 National Conservation Policies and Strategies

The Government of Mauritius initiated conservation actions in the early 1970's, when at the invitation of the Government Sir Peter Scott wrote a report entitled "Conservation in Mauritius". This was the forerunner to IUCN's Conservation in Mauritius (1974) by John Proctor and Rod Salm which took into account the forest policy and the general environment laws that existed at the time, as well as the work in place to protect the terrestrial and marine environments.

The National Conservation Strategy

In 1985 the Government of Mauritius published a White Paper for a "National Conservation Strategy" (NCS), in which it defined the major objectives for the conservation of natural resources based on the same objectives as the World Conservation Strategy, namely,

- (i) to maintain essential ecological processes and life support systems on which human survival depend;
- (ii) to preserve genetic diversity, on which depend the breeding programmes necessary for the protection and improvement of cultivated plants and domesticated animals, as well as for scientific advancement;
- (iii) to ensure the sustainable utilisation of species and ecosystems, for example, fish and other wildlife, forests and grazing lands.

Priorities to attain the above aims and objectives included:-

- (a) Avoiding extinction of endangered and threatened species of flora and fauna by providing sound planning, allocation and management of land and water use, supported by an on-site preservation in protected areas and an off-site protection such as zoos and botanical gardens;
- (b) Preserving as wide a genetic diversity as possible of many varieties of the same plants and animals;
- (c) Preserving as many habitats as possible;
- (e) Expanding large conservation management areas to other key biodiversity hot spots areas, and
- (f) Encouraging the protection of wetlands and river reserves.

National Environmental Action Plan

In the wake of rapid economic growth and the growing concerns about the degradation of the environment, the Mauritian Government and the World Bank organised a technical seminar on the environment in 1988 to discuss the key environmental issues facing the country. The outcome was a comprehensive first National Environmental Action Plan (NEAP 1) supported by the first Environmental Investment Programme (EIP 1) to address key issues. EIP1 consisted of 32 projects covering institutional strengthening, the main economic sectors, land management, solid waste and marine and terrestrial conservation. The outputs included the establishment of the country's first National Park to conserve endangered species, integrated pest management research, management of nature reserves, offshore islets management, the proclamation of two marine parks, and the initiation of long term monitoring and research.

Vision 2020

In 1991 the Government published a White Paper for the National Environment Policy providing a commitment to attaining sustainable development. The White Paper placed great emphasis on the duties of the individual in environmental protection and the concomitant right to relevant information, while aiming to safeguard prosperity, health and heritage. The policy was reviewed in *Vision 2020* ("The National Long Term Perspective Study") creating the challenge of establishing a resource management approach that would involve the management of the entire ecosystem. This would be based on the modelling of interactions between the economy and the environment. The *Vision 2020* sets out a scenario for future development based on:

- ▣ gains in agricultural efficiency;
- ▣ high quality, high yield tourism;
- ▣ quality and specialised industrial production, and
- ▣ movement towards financial and value-added services.

National Environmental Strategy

In 1999 to reiterate its commitment to sustainable development the Government of Mauritius commissioned a National Environmental Strategy for the next decade comprising a second 10 year National Environment Action Plan (NEAP2) and its supportive Second Environmental Investment Programme (EIP2). Several stakeholder working groups were established to assist with the formulation and refinement of the strategies identified for the various priority sectors, including terrestrial biodiversity and conservation and integrated coastal zone management.

The goal of the National Environmental Strategy can be summarised as:

'To follow the principles of sustainable development by providing environmental services, encouraging responsible environmental practices and enforcing appropriate environmental standard in order to safeguard the health and welfare, conserve the heritage, and enhance the quality of life of all the people of Mauritius.'

National Development Strategy (2003)

The NDS provides a national-level strategy and policy framework within which a wide range of public and private sector infrastructure and development projects can be efficiently guided, implemented and managed within a sustainable environment. The strategy deals in detail with promoting sustainable development to protect the best quality agricultural land and environmentally sensitive areas.

Non-Sugar Sector Strategic Plan (2003-2007)

This strategy document contains sections on sustainable agriculture, forest and terrestrial biodiversity conservation.

National Biosafety Framework (1999)

A framework has been developed that sets out guidelines for the 'safe development and introduction of Genetically Modified Organisms in Mauritius'. It recommends practises and procedures for the safe use of biotechnology to protect the environment and human and animal health from the potential adverse effects of GMOs.

1.6 International Conventions, Agreements and Co-operation

Mauritius was the first country in the world to ratify the Convention on Biological Diversity in 1992. The Ministry of Environment is the focal point for the Convention and the National Parks & Conservation Service is the National Executing Agency for the preparation of the National Biodiversity Strategy and Action Plan (NBSAP) and the First National Report.

The Government of Mauritius is also signatory to a number of International Conventions relating to Article 1 of the CBD. These include:

- ☐ The International Convention for the Regulation of Whaling, (1946);
- ☐ The African Convention for the Protection of Nature and Natural Resources, (1968);
- ☐ The Convention on Fishing and Conservation of Living Resources of the High Seas, (1958);
- ☐ The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR), (1971);
- ☐ The Convention for the Protection of the World Cultural and Natural Heritage, (1972);
- ☐ The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), (1973);
- ☐ The UN Convention on the Law of the Sea (UNCLOS), (1982);
- ☐ The UN Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (MARPOL), (1989);
- ☐ The UN Framework Convention on Climate Change (UNFCCC) (1992);
- ☐ The Convention to Combat Drought and Desertification in Africa (UNCCD) (1995).
- ☐ The Convention on Migratory Species (1994)
- ☐ The African Eurasian Water Bird Agreement (1999)
- ☐ The Indian Ocean – South-East Asia Marine Turtle MOU (IOSEA) 2003.
- ☐ The Cartagena Protocol on Biosafety to the Convention on Biological Diversity (2000).

1.7 National Legislation for Biodiversity Conservation

A legal framework exists for the protection of key habitats, nature reserves and restoration of some of the unique ecosystems of Mauritius. Some of the most important ones are:

Primary Legislation

- ☐ The Environment Protection Act 1991, 2002;
- ☐ The Fisheries and Marine Resources Act 1998;
- ☐ The Wildlife and National Parks Act 1993,
- ☐ The National Coast Guard Act, 1988
- ☐ The Forests and Reserves Act, 1983 and subsequent amendment of 2003;
- ☐ The Plant Act, 1976;
- ☐ The Pas Geometriques Act, 1895;
- ☐ The Removal of Sand Act, 1975;
- ☐ The Shooting and Fishing Leases Act, 1966;

- ☐ The Town and Country Planning Act, 1954;
- ☐ The Maritime Zones Act, 2005
- ☐ The Continental Shelf Act, 1970
- ☐ The Central Water Authority Act 1981

Secondary Legislation

- ☐ The National Parks and Reserve Regulations of 1996, and the Wildlife Regulations of 1998;
- ☐ The Botanical Gardens (Pamplemousses) Regulations, 1945 and Botanical Gardens Regulations 1922;
- ☐ The Female Sea Turtles (Prohibition of Import) Regulations, 1950;
- ☐ The Plant (Importation and Exportation) Regulations, 1976, and
- ☐ The Plant (Pest and Disease Control) Regulations 1984.
- ☐ The Marine Protected Area Regulations 2001.

1.8 NBSAP Process in Mauritius

Mauritius has prepared its National Biodiversity Strategy & Action Plan (NBSAP) under project GF/1200-96-58, financed by the GEF through UNEP acting as the Implementing Agency. The NBSAP was prepared in order to meet the country's obligations under the Convention on Biological Diversity (article 6a) and provide a strategic approach for biodiversity management in Mauritius for the coming decade (2006–2015). The National Parks and Conservation Service (NPCS) of the Ministry of Agro-Industry and Fisheries implemented the NBSAP process in collaboration with all relevant partners and stakeholders.

The NBSAP process in Mauritius has been lengthy and gone through various stages and reviews. It commenced in 1998 with the recruitment of two national consultants to collate baseline data and information on terrestrial and aquatic biodiversity which resulted in a draft First National Report (FNR). In July 2000 a national consultant was recruited to prepare the NBSAP and finalise the FNR.

The first draft of the NBSAP was structured according to seven thematic areas, devised to reflect the important economic sectors of Mauritius and the institutional responsibilities of the organizations involved in the management of biodiversity resources.

Thematic consultants were recruited to prepare baseline papers on the status of biodiversity. These were presented and discussed during a First National Workshop held in September 2000. Following this national consultation exercise the First National Report was submitted to the Secretariat of the Convention on Biological Diversity in January 2001. Thematic workshops followed in January and February 2001 to identify gaps/pressing issues and proposed strategies/options. A separate process was pursued in Rodrigues, with one coordinator and five thematic consultants recruited from Rodrigues itself to prepare and present baseline papers. The Rodrigues workshop was organised in April 2001.

In February 2002 UNEP recommended to Mauritius that the existing draft be restructured. Agreement was reached with NPCS in 2003 and a contract was signed for a consultant to develop a Country Study report and provide guidance on how the strategy component of the NBSAP might be drafted. The country study was completed in 2003

and is precised in the following pages. The full document can be accessed through the offices of the NPCCS.

The strategy document was finalised through a series of local, thematic and national workshops in November 2005. The structure, with separate sections for Mauritius and Rodrigues, was refined to three thematic areas:

- 1) Forest and Terrestrial Biodiversity
- 2) Freshwater, Coastal and Marine Biodiversity
- 3) Agricultural Biodiversity, Biotechnology & Biosafety

with five strategic objectives:

- 1) Establish a Representative and Viable Protected Area Network (PAN)
- 2) Manage Key Components of Biodiversity
- 3) Enable Sustainable Use of Biodiversity
- 4) Maintain Ecosystem Services
- 5) Manage Biotechnology and its Products

set in the context of a Vision, Mission Statement and five working principles.

The process was at all times incorporative and stakeholder driven. The Strategy document lays out an agreed structure and process for the coordination and implementation of the BSAP designed to build and maintain stakeholder participation and implementation. The document is set out in a strategic and modified logical framework and incorporates consideration of ongoing initiatives such as the National Capacity Self-Assessment (NCSA) and Biosafety Framework. Provision is also made for the rapid utilisation of the enabling activities add-on facility and the elaboration of priority projects from the strategic framework to meet the formats and requirements of specific donor agencies.

Chapter 2. Forest and Terrestrial Biodiversity of Mauritius

2.1 Overview of Biodiversity

Mauritius has an area of 1,865 km², of which 30% is considered forested. The area of good quality native forest, (i.e. that with more than 50% native plant cover, Page & d'Argent 1997), is estimated to cover less than 2% of the island (NEAP 1999, MWF unpublished, Fig.2.1). The rest consists of plantation forestry, deer-ranches or highly degraded vegetation invaded by alien plant and animal species. As a result Mauritian biodiversity is amongst the most threatened in the world.

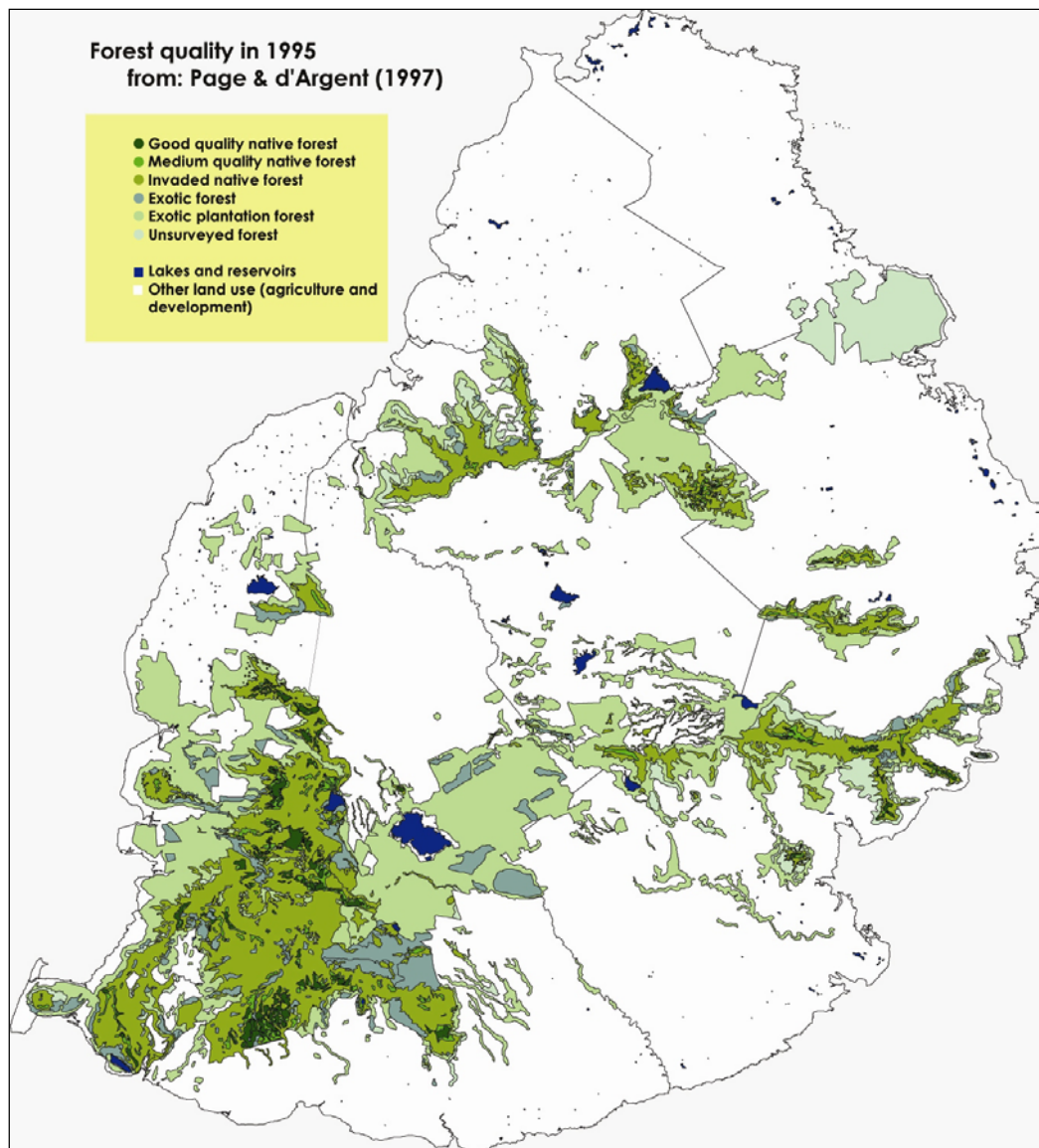


Figure 2.1 Forest cover in Mauritius (Page and d'Argent, 1997)

Fifteen vegetation types have been classified (Vaughan & Wiehe 1937), varying

in species composition and structure, and ranging from coastal sand dune vegetation to cloud forest. Remnants of some vegetation types are concentrated in the Black River Gorges National Park in the south west, the Bambous Mountain Range in the south east and the Moka-Port Louis Ranges in the North West. There are also some isolated mountains which are important e.g. Corps de Garde, Trois Mamelles and Le Morne Brabant, and several offshore islands with remnants of coastal and mainland diversity.

Table 2.1: Native diversity of selected groups in Mauritius, with respective total number of extinctions. Numbers in brackets indicate the number of endemic species.

	Number of native species	% species endemic	Number of extinct species	Number of extant species
Angiosperms¹	671 (311)	46%	77 (42)	594 (269)
Mammals²	5 (2)	40%	2 (1)	3 (1)
Birds²	30 (24)	80%	18 (15)	12 (9)
Reptiles²	17 (16)	94%	5 (5)	12 (11)
Butterflies³	37 (5)	14%	4 (1)	33 (4)
Snails⁴	125 (81)	65%	43 (36)	82 (45)

1. Page & D' Argent, 1997; 2. Cheke, A. S. & Hume, J. P. *in press*; 3. Williams, 1989; 4. Griffiths & Florens *in prep*.

2.1.1 Flora

There are 671 species of indigenous flowering plant recorded in Mauritius, of which 311 are endemic (Mauritius has eight endemic plant genera), and 150 are endemic to the Mascarene Archipelago (Page & d'Argent, 1997; Strahm, 1994). 77 of these indigenous species are classified as extinct. Of the extant flowering plant species, about 35% are already classified as threatened as per IUCN criteria (Bachraz & Tezoo, 1997).

The most recent study of lower plants estimates that there are 207 taxa consisting of 89 genera of mosses and 59 genera of hepatics (Tixier & Gueho, 1997). There are about 200 species, subspecies and varieties of pteridophytes, of which 13 species are endemic, and 40 are extinct (Bachraz, 2000).

2.1.2 Fauna

24 of the 52 native species of forest vertebrate that were known to have occurred on Mauritius and adjacent islets are now extinct, including the Dodo (*Raphus cucullatus*), a giant parrot (*Lophopsittacus mauritianus*) and two species of giant tortoise (*Cylindropsis* spp.). Many of the extant species are threatened.

Mammals – The only native mammals are bats. Of the three species of fruit bat (*Pteropus niger*, *P. subniger* and *P. rodricensis*) known to have occurred, only one (the Mauritian fruit bat *P. niger*) remains and is still locally common. *P. subniger* is extinct. *P. rodricensis* still occurs on Rodrigues. There are two native insectivorous bat species (*Taphosus mauritianus* & *Mormopterus acetabulosus*) that are also found on Reunion and mainland Africa (IUCN, 2003).

Birds - Twelve species of land bird have so far escaped extinction (Table 2.1). Of these,

nine are threatened according to the IUCN Red List (2003). Species recovery programmes have saved three of these species from probable extinction:

The Mauritius Kestrel (*Falco punctatus*) was once the rarest falcon in the world due to DDT poisoning with only four birds known in 1974. The kestrel population is now estimated to be 800 birds.

The Echo Parakeet (*Psittacula eques echo*) is the last surviving parrot in the Mascarenes. It was considered the rarest parrot in the world, with only about 12 individuals known in 1987 due to nest predation by invasive species and habitat loss. An intensive captive breeding and release programme, supplementary feeding, provision and monitoring of predator-proof nest boxes, and predator control have increased the population to about 270 birds (Malham, 2005).

The Pink Pigeon (*Columba mayeri*) now numbers around 400 birds, compared to a population of c25 birds in the 1970s. There are now five managed populations, four in the Black River Gorges National Park and one population on Ile aux Aigrettes.

Of the remaining forest bird species, the Mauritius grey white eye (*Zosterops mauritianus*) is common, the Mascarene cave swiflet (*Callocalia francica*) and the Mascarene Swallow (*Phedina borbonica*) are fairly common, while all the others are threatened. A recovery programme was initiated in 2003 to establish a population of the Mauritius Fody (*Foudia rubra*) on Ile aux Aigrettes (a rat-free islet). There are now about 50 birds on the island, and individuals began to breed in 2004.

None of the other species (Mauritius Cuckoo shrike (*Coracina typica*), Mauritius black bulbul (*Hypsipetes olivaceus*), Mauritius olive white eye (*Zosterops chloronothos*), or Mascarene paradise flycatcher (*Terpsiphone bourbonensis* subsp. *desolata*) receive any active management.

Reptiles - Of the 17 native reptile species, only 12 remain, 11 of which are endemic (Table 2.1). Seven of these are restricted to the northern offshore islets. These include five species found only on Round Island; the keel scaled boa (*Casarea dussumieri*), Telfair's skink (*Leiolopisma telfairii*), Gunther's gecko (*Phelsuma guentheri*) and a night gecko (*Nactus durrelli*). The burrowing boa (*Bolyeria multicarinata*) was last seen in 1975 and may already be extinct.

Invertebrates - Of the invertebrate fauna, only butterflies and land snails have been well studied. There are 39 native species of butterfly, of which five are endemic, and 125 known native species of land snail of which 43 are already extinct (Table 2.1).

2.1.3. The forest estate and protected areas

30% of Mauritius is forested consisting of exotic plantation, deer-ranching land and natural forest most of which is badly degraded. 47% of the forested land in Mauritius is state owned (Table 2.2).

State land - Plantations

Exotic plantations cover 11,816 ha. The most common species are *Pinus elliottii*

and *P. taeda*, (65 %), *Eucalyptus tereticornis* (16 %) and *Cryptomeria japonica* (13 %). In 2003, it was decided that half of the plantation area would be set aside for protection of ecosystem services (water catchments, soil protection etc.).

State land - Pas Géométriques

The *Pas Géométriques* forms a narrow belt of state-owned land all around the coast. This is 81.21 m (250 French feet) in width, although there are several cases where the width is less than this, or it does not exist at all. Much of the *Pas Géométriques* is leased for campments (seaside holiday homes) and hotels. Beaches occupy a fairly large area around the island, but a substantial portion, especially in the south, are leased to adjacent estates. Other areas have been granted long-term leases for grazing and tree planting in place of land that has been forcibly acquired from private estates.

There are 635 ha of forest on the *Pas Géométriques* managed by the Forestry Service. This includes exotic plantations (mostly filao - *Casuarina equisetifolia*), lands leased for grazing and tree planting, as well as un-plantable or “to be planted” lands.

State land - Protected areas

The mainland has one National Park, seven Nature Reserves and two Reserves covering an area of 7,246 ha. 16 of the 49 offshore islets are protected due to their conservation importance, seven as Nature Reserves, eight as National Parks and one as an Ancient Monument (Table 2.3).

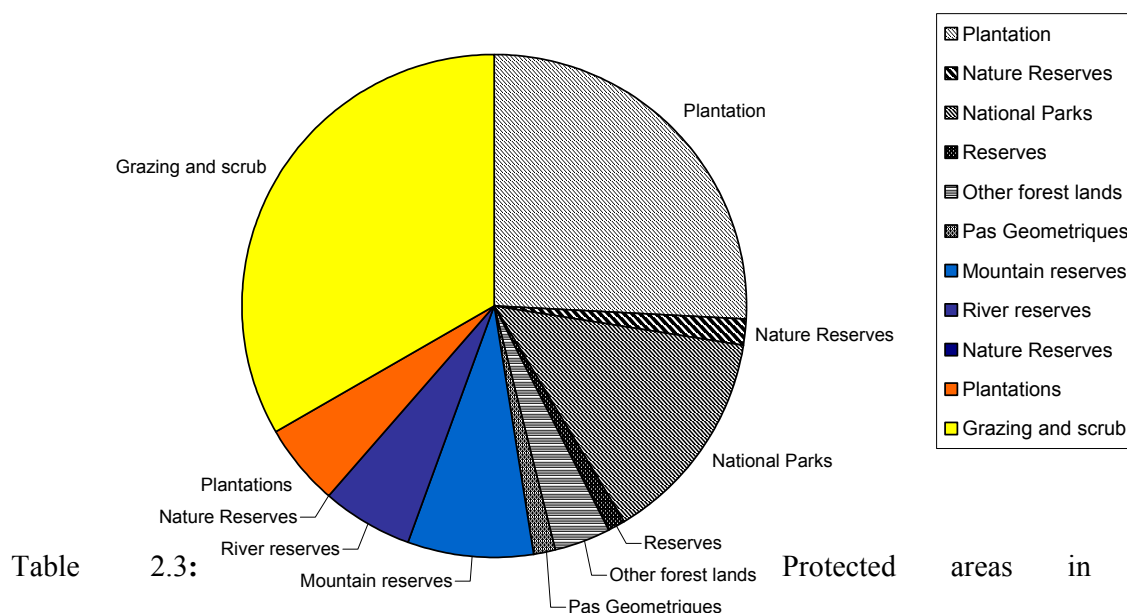
Mainland Nature Reserves are managed by the Forestry Services, while the National Parks and Conservation Service oversee the National Parks and most offshore islet Nature Reserves. Ile aux Aigrettes Nature Reserve is leased for conservation management to the Mauritian Wildlife Foundation.

Table 2.2: The area of different types of forest in Mauritius

Type of forest	Area (ha)
State	22,200
Plantations	11,816
Nature Reserves	799
<i>Mainland</i>	200
<i>Islets</i>	599
National Park	6,708
<i>Black River Gorges National Park</i>	6,574
<i>Islet National Parks</i>	134
Bras D'eau and Poste La Fayette Reserves	472
Unplanted, protective or to be planted	1,770
Pas Geometriques	635
<i>Plantations</i>	226
<i>Leased for grazing and tree planting</i>	230
<i>Unplanted, protective or to be planted</i>	179
Private (including leased land)	25,000
Reserves	6,553
<i>Mountain reserves</i>	3,800
<i>River reserves</i>	2,740
<i>Nature Reserves</i>	13
Plantations	2,600
Forest lands, incl. scrub, grazing lands (estimate)	15,847
TOTAL	47,200

*Updated from Forestry Service, Ministry of Agro-Industries and Fisheries (2004).

Figure 2.2: Area and land use of state (black shading) and private (coloured shading) lands



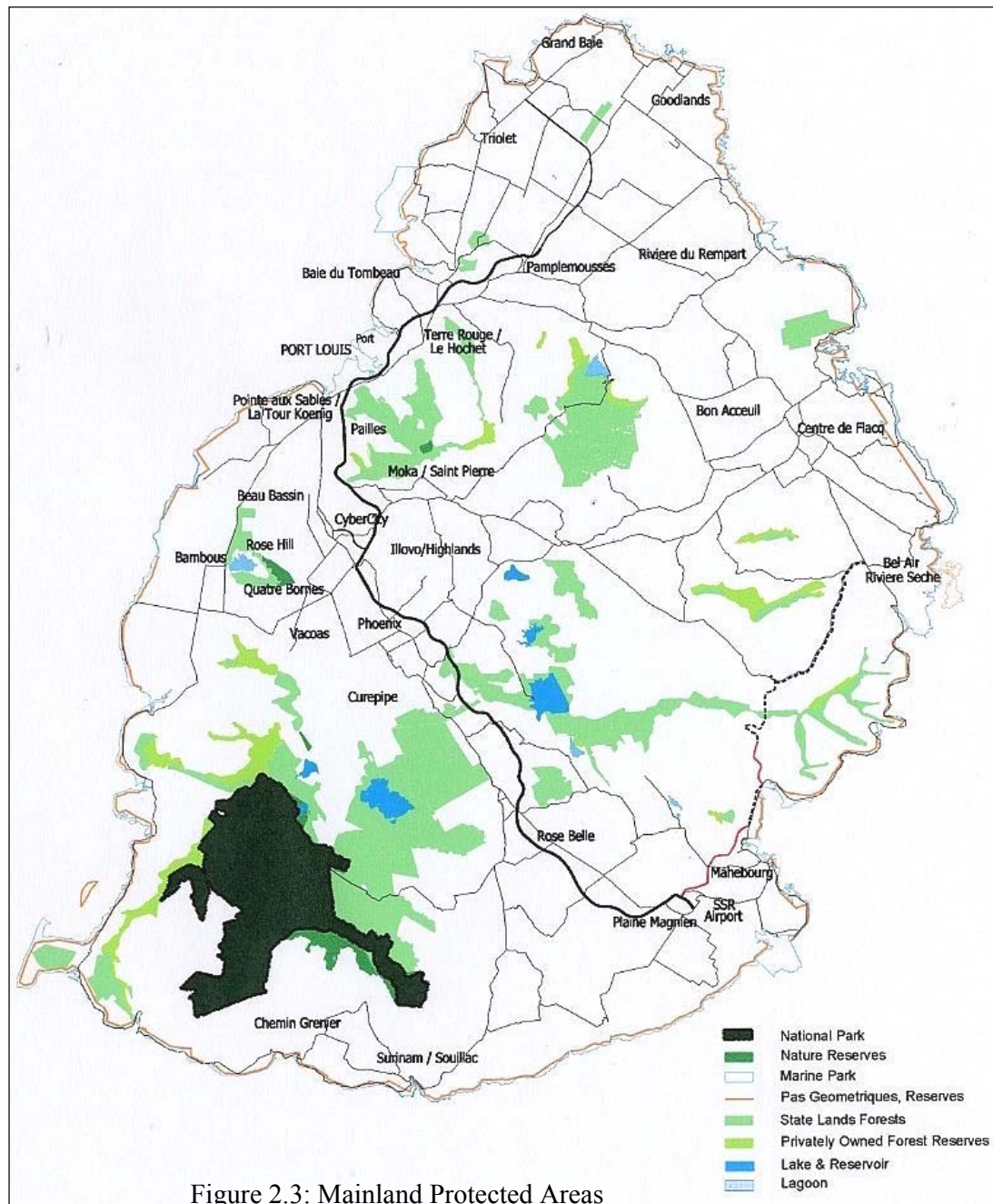
Mauritius with respective areas under active management.

AREA	AREA (HA)	AREA MANAGED (HA)*	AREA	AREA (HA)	AREA MANAGED (HA)*
Mainland – National Parks	6,574.00	39	Offshore islets - National Parks	134.38	0
<i>Black River Gorges</i>	<i>6,574.00</i>		<i>Pigeon Rock</i>	<i>0.63</i>	
Mainland – Nature Reserves	200.26	4.44	<i>Ile D'Ambre</i>	<i>128.00</i>	
<i>Perrier</i>	<i>1.44</i>	<i>1.44</i>	<i>Rocher des Oiseaux</i>	<i>0.10</i>	
<i>Les Mares</i>	<i>5.10</i>	<i>1.00</i>	<i>Ile aux Fous</i>	<i>0.30</i>	
<i>Gouly Pere</i>	<i>10.95</i>	<i>1.00</i>	<i>Ile aux Vacoas</i>	<i>1.36</i>	
<i>Cabinet</i>	<i>17.73</i>		<i>Ile aux Fouquets</i>	<i>2.49</i>	
<i>Bois Sec</i>	<i>5.91</i>		<i>Ilot Flamants</i>	<i>0.80</i>	
<i>Le Pouce</i>	<i>68.80</i>		<i>Ile aux Oiseaux</i>	<i>0.70</i>	
<i>Corps de Garde</i>	<i>90.33</i>	<i>1.00</i>	Offshore islets – Nature Reserves	598.62	194.8
Mainland - Reserves	497.00	25.00	<i>Round Island</i>	<i>168.84</i>	<i>168.84</i>
<i>Mare Sarcelles</i>	<i>20.00</i>		<i>Ile aux Serpents</i>	<i>31.66</i>	
<i>Bras d'Eau</i>	<i>452.00</i>		<i>Flat Island</i>	<i>253.00</i>	<i>1.00</i>
<i>Rivulet Terre Rouge Bird Sanctuary</i>	<i>25.00</i>				
Mainland – Private Reserves	13.00	5	<i>Gabriel Island</i>	<i>42.20</i>	
<i>Mondrain</i>	<i>5.00</i>	<i>5.00</i>	<i>Gunner's Quoin</i>	<i>75.98</i>	
<i>Emile Series</i>	<i>8.00</i>		<i>Ilot Mariannes</i>	<i>1.98</i>	
			<i>Ile aux Aigrettes</i>	<i>24.96</i>	<i>24.96</i>
			Offshore islets - Ancient Monument	2.19	0
			<i>Ile de la Passe</i>	<i>2.19</i>	
TOTAL – Mainland				7284.26	73.44
TOTAL – Offshore islets				735.19	194.8
GRAND TOTAL				8019.45	268.24

*Active management entails regular weeding of invasive alien plant species and restoration planting of native species. Trapping and poisoning of exotic animals is carried out on a small scale in some of these areas.

a) Mainland Protected Areas

The Black River Gorges National Park in the south west of Mauritius was proclaimed in 1994 and covers an area of 6,574 ha. The Park harbours many different forest vegetation types, ranging from dry lowland forest near to the west coast, to heath and mossy forest at high altitudes. It is home to all of the endemic birds of Mauritius, and many rare plant species. Although much of the forest is very degraded, areas of good quality vegetation remain. The National Park contains a visitor centre, an information centre and four field research stations. The mainland Nature Reserves and Reserves that



fall outside of the National Park, provide legal protection to some important areas of

plant biodiversity, in particular Corps de Garde, Le Pouce and Mare Sarcelles.

b) Offshore islets

The 16 protected islets harbour species, and habitats that have almost disappeared from the mainland. For example, seven of the remaining twelve species of reptile are restricted to islets, the last remaining areas of coastal ebony forest and palm-rich forest are found on Ile aux Aigrettes, and Round Island respectively and many of the northern islands have important seabird colonies.

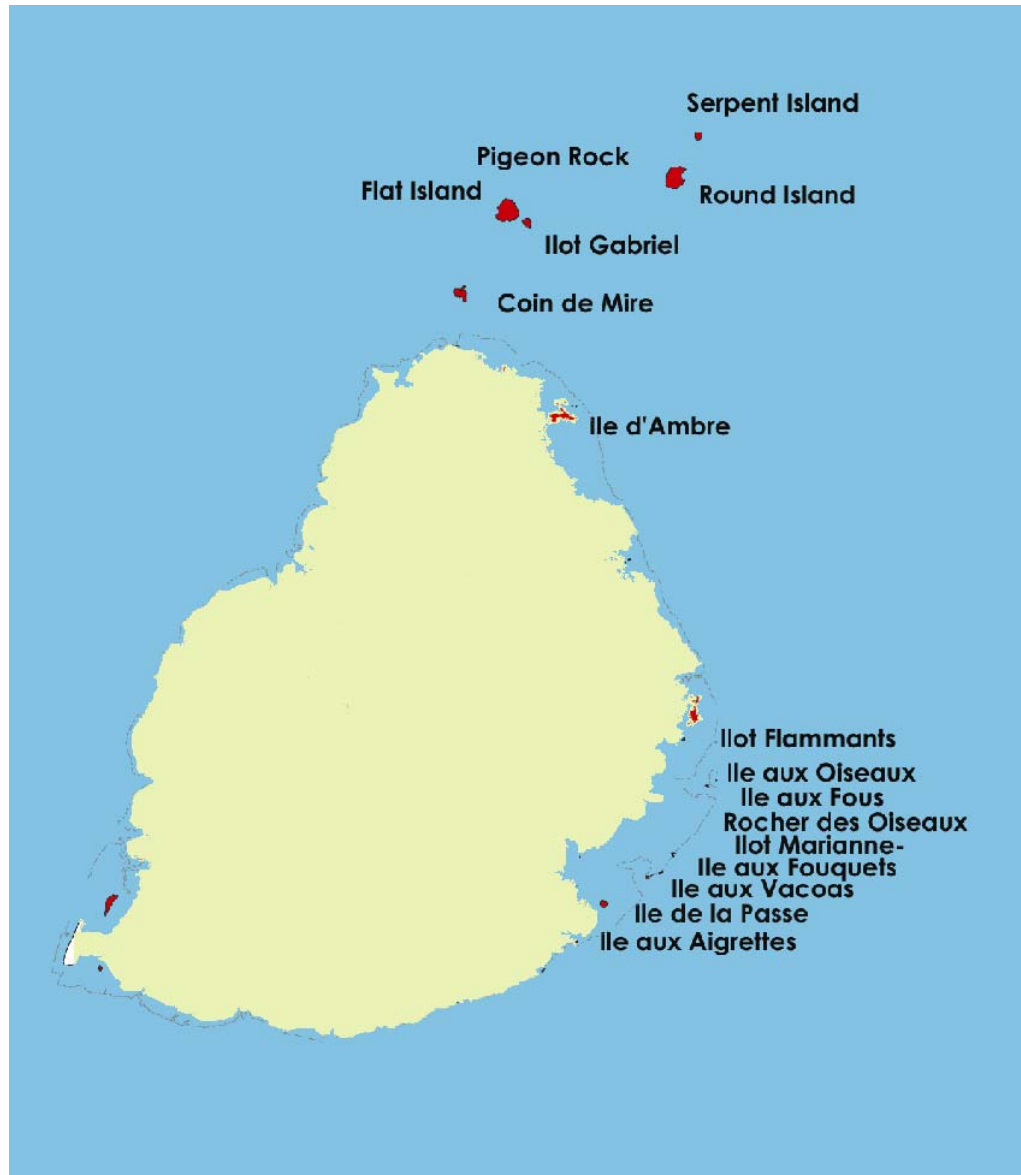


Figure 2.4: The protected offshore islets of Mauritius

Round Island is of exceptional biological importance because it is the largest area free of

introduced mammals and reptiles in the Mascarenes. It supports the last remnants of the palm rich forest once characteristic of the northern plains of Mauritius. It is home to at least ten threatened native plant species and possibly eight species of native reptiles including six that are endangered - five of which are now restricted to Round island. The island is also an important seabird breeding ground most notably for the rare Round Island petrel (*Pterodroma arminjoniana*).

Serpent Island is an important seabird colony. This otherwise barren rock is home to the sooty tern (*Sterna fuscata*), brown noddy (*Anous stolidus*), lesser noddy (*Anous tenuirostris*), and a tarantula that has yet to be described scientifically.

Flat Island, Ilôt Gabriel & Pigeon Rock lie to the north of Mauritius. Pigeon Rock is a volcanic plug, rising vertically out of the sea and is home to a seabird colony. Ilot Gabriel is a small island with coastal sand dune vegetation including the only known wild population of Baume de l'Ile Plate (*Psiadia arguta*). Flat Island is separated from Ilot Gabriel by a narrow lagoon and is the largest of the northern islets (253ha). In spite of its degraded nature, the islet is home to several species of reptile including the night gecko (*Nactus coindemirensis*) and the last refuge of the orange tailed skink (*Gongylomorphus* sp.). It harbours a seabird colony and has remnant populations of some plant species that once formed part of the palm-rich forest.

Although the palm-rich forest that used to cover Gunner's Quoin is much degraded, the island is important for several native species, including *Gagnebina pterocarpa* (*Acacia indigène*), *Lomatophyllum tomentorii* (mazambrou marron), *Dicliptera falcata* and *Cynanchum scopulosum*. The island is also used by seabirds for breeding and has an important population of *Nactus coindemirensis*.

Ile aux Aigrettes has the best-preserved native vegetation cover of all the coralline islands and contains the last remaining patch of ebony-rich forest. The island is also a refuge for many rare plants, such as *Gastonia mauritiana* (bois de boeuf), *Diospyros egrettarum* (bois d'ébène) and *Sideroxylon boutonianum* (bois fer). The island's vegetation has been restored over the last ten years, and now only requires periodic weeding. One population of pink pigeons and Mauritius fody have been established on the island.

The three islets Ile aux Vacoas, Ile aux Mariannes & Ile de la Passe are important historically due to their strategic position in defending the bay of Mahebourg, and the remaining buildings and ruins represent an important cultural heritage. Ile de la Passe has

been declared as Historical Monument and is under the management of the Ministry of Arts and Culture. The islets also contain some remnants of natural coastal vegetation, and Ile aux Mariannes is rich in insect life (AGRER 2004).

c) Private land

It is estimated that 25,000 ha of forested land are privately owned, or leased to private landowners. Much of this forest is managed for deer hunting with clearings for pasture. These forests are of high conservation importance because they include habitat types and gene pools not represented in state land protected areas.

Some of the private land is classified as Mountain Reserve or River Reserve and receives legal protection. Mountain Reserves occupy the upper third of mountains. River Reserves vary in width from 3 to 16 m on each side, depending the size of the river. Deforestation is not permitted in these reserves but enforcement is poor.

There is little active conservation management of privately-owned forests apart from one private reserve on the land of Medine Sugar Estate comprising 5 hectares and managed by the Royal Society of Arts and Sciences of Mauritius. There are also some innovative forest restoration projects being initiated by Bioculture Ltd. (Mauritius), and several private landowners are developing nature-based tourism on their land.

2.2 Consumptive and non-consumptive resource use

There is very little use of native forest resources because there is so little forest left and the components are in general very rare.

Creation and protection of forest resources

It is estimated that MRU 200 million is spent annually by the country as a whole, in addition to external funding, on the conservation of forests and terrestrial biodiversity.

Timber exploitation

In 2004 6,858 m³ of timber and poles were produced from state forestlands. There was also some extraction of waste wood, in the form of privet (*Ligustrum robustum* var. *walkeri*) and goyave de Chine (*Psidium cattleianum*) stakes. In 1995 the amount of wood used for cooking purposes was equivalent to 81,000 tons of petroleum products, meeting about 10.2% of local needs. By 2000 less than 5 % of fuel consumption was through firewood.

Deer ranching

The introduced rusa deer from Java (*Cervus timorensis*) is mainly reared on

extensive farms and estates for hunting purposes. The national herd is estimated to number about 70,000 heads. In 2004, 12,000 heads, representing 480 tonnes of carcass, were shot during the hunting season (1 June to 30 September). This was valued at MRU 53 million. (Mauritius Deer Farming Cooperative Society Ltd, 2005). The meat is exclusively for the local market.

Export of monkeys

Introduced long-tailed macaques (*Macaca fascicularis*) are highly invasive and have deleterious effects on both native flora and fauna. Monkeys are caught from the wild or bred in captivity and exported to laboratories and biomedical research institutions, mainly in Europe and America. In line with the CITES Convention, a voluntary annual export quota of 8000 wild-caught *Macaca fascicularis* has been fixed by the Ministry of Agro-Industry & Fisheries (MOAIF) to four companies. In addition, captive-bred monkeys are also exported. A contribution of 50 US\$ per head exported is credited into the National Parks and Conservation Fund (NPCF). This was increased to 70 USD in July 2004. Table 2.5 indicates the contribution to NPCF from 1995-2004. The trade provides an important incentive to control the pest in the wild and at the same time support various biodiversity conservation programmes.

Table 2.5: Number of monkeys exported from 1995 to 2004 and respective contribution to the National Park and Conservation Fund.

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Number of animals	5,410	6,084	5,998	5,578	7,263	7,870	7,050	5,731	7,740	7,621
Contribution to NPCF (million Rs.)	8.1	9.1	9.0	8.4	10.9	11.8	10.6	8.6	11.6	11.4

Wild fruit collection

Many introduced fruit tree species have naturalised, or become invasive in the forests of Mauritius e.g. *P. cattleianum* (goyave de Chine). This fruit is available for about four months of the year and guava picking is a popular Mauritian pastime. Fruit are also collected for sale but there are no reliable figures as to its economic significance.

Nature-based tourism

Guided visits on quad bikes or jeeps to admire the scenery and introduced animals, or canoeing trips down rivers, and abseiling down waterfalls are amongst the activities available.

One of the ecotourism destinations in Mauritius is the Nature Reserve of Ile aux Aigrettes. Proceeds from guided tours of the island are used for its restoration. 8,000

tourists visited the island in 2004.

Palm hearts

The endemic palmiste blanc (*Dictyosperma album* var. *album*) is cultivated in plantations on marginal lands for their cabbage. This local trade is estimated to be worth 20 million rupees MRU (Govinden, 2004). Although in the past the cabbages were exported (mainly to Reunion), this trade has stopped, as local demand from hotels and restaurants is greater than the supply. There is little harvesting of wild palms as the species are rare and hard to find in the wild.

Traditional use

A few families have earned their living for generations from the sale of traditional remedies using native species collected from the forest. However, this is a dying trade and much traditional knowledge passed down orally is being lost. In addition several of the plant species used are critically endangered, sometimes due to over harvesting.

A scientific survey funded by the European Union and carried out under the aegis of the Indian Ocean Commission estimated that there are about 100 native plant species with medicinal properties in Mauritius and Rodrigues in addition to 500 introduced species (Gurib-Fakim *et al.*, 1994-2000). Other species have been found to contain active ingredients for herbicides and pesticides (Dulloo, 1995).

Vacoas leaves (*Pandanus utilis*) are used by two communities for making baskets, mats and hats. Forest resources that are exploited illegally include ferns and orchids. The current market value of ferns is around MRU 150 per plant (NEAP, 1999). Data on the number of species collected and their potential value are not available.

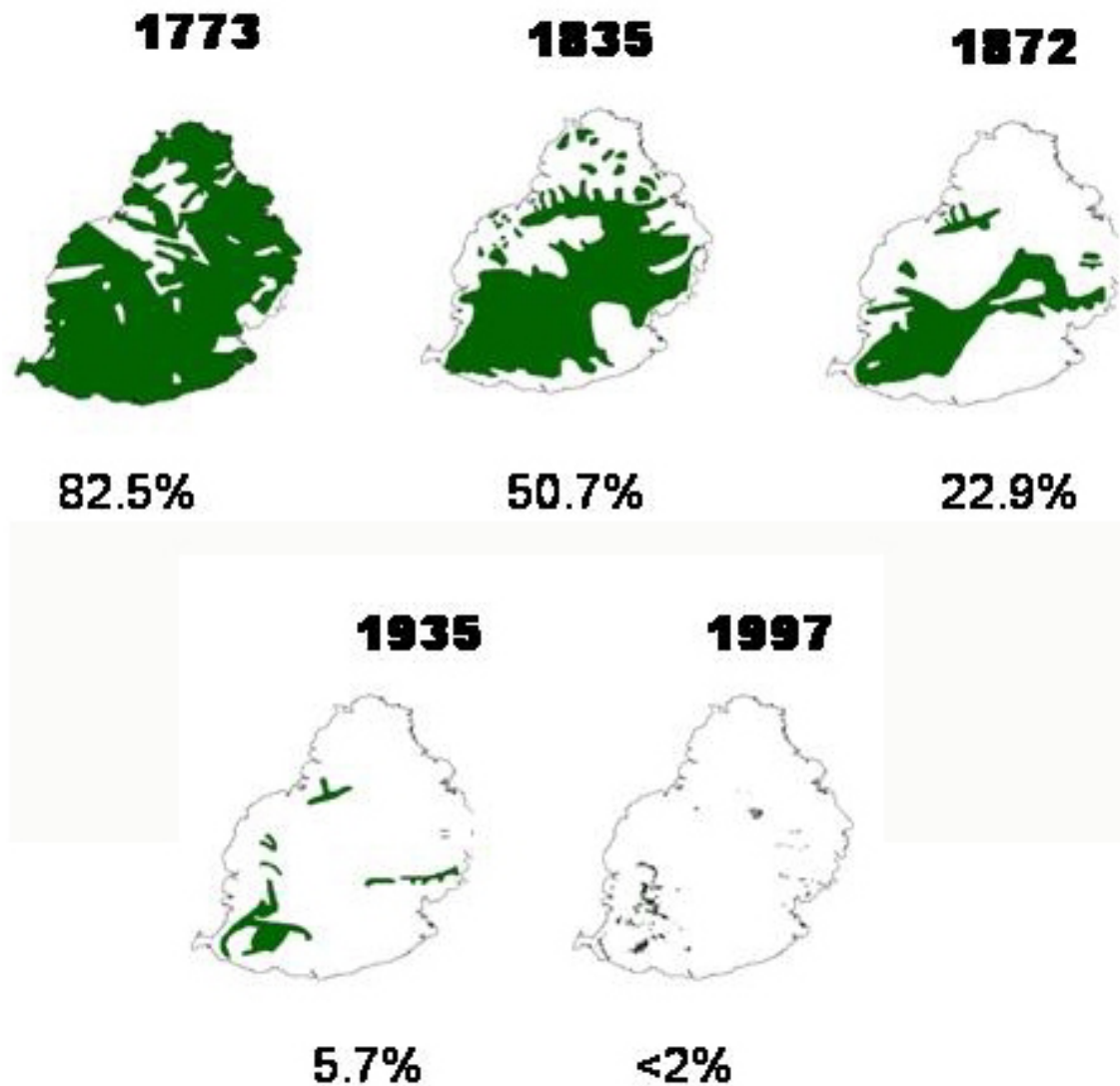
2.3 Causes of Biodiversity Loss

2.3.1 Loss of habitat

Forest clearance for agriculture and settlement began with the colonisation of the island in 1638 although selective logging for ebony (*Diospyros tessellaria*) started in 1598. Most of the forest cover had been lost by 1935, and the last major project of forest clearance occurred in the 1970s following a World Bank Funded scheme to replace native upland forest with plantation forestry based on pine (Figure 2.5). Despite these losses, habitat destruction and fragmentation continues to this day. There is a gradual conversion of forest to enlarge pasture areas for deer grazing. Development projects also

pose serious threats. A proposed road project that would have resulted in the loss of 9 ha of forest, the possible extinction of 2 species of plant and disturbance to one of the most important areas for the Mauritius kestrel (Ministry of Environment & NDU, 2004), was stopped recently after 1.5 years of pressure from conservation stakeholders and the general public.

Figure 2.5 Forest cover loss since colonisation (MWF unpublished)



2.3.2 Invasive alien species

Invasive alien species pose the most serious current threat to the remaining terrestrial biodiversity. At least 21 introduced species of mammal, reptile and mollusc are naturalised, more than 1,675 plant species have been introduced of which at least 20 plant species have been identified as particularly aggressive invaders (Mauremootoo *et al.*, 2003). Animals such as the rusa deer (*C. timorensis*), introduced in 1639, browse native shrubs, saplings and seedlings. Feral pigs (*Sus scrofa*), introduced in 1606, disturb the soil, disperse seeds of alien plants and have negative effects on native plant regeneration. Pig predation was also probably partly responsible for the extinction of several ground-nesting endemic species such as the dodo and the giant tortoises. They may also affect ground-dwelling invertebrates. Javanese macaques (*Macaca fascicularis*), introduced at the turn of the seventeenth century, damage unripe native fruits and eat the eggs and chicks of native birds (Carter and Bright, 2002). Rats (*Rattus rattus* and *R. norvegicus*), also predate on eggs and chicks (Safford and Jones 1998), reptiles and invertebrates and are notable seed predators (Cuddihy and Stone, 1990).

Predation by a range of alien species appears to pose a very serious threat to the survival of endemic snails, which are often taken by rats, toads and tenrecs (*Tenrec ecaudatus*) and the carnivorous rosy wolfsnail (*Euglandina rosea*) (Griffiths *et al.*, 1993).

A diverse suite of invasive alien weeds is threatening all the remaining native forests. The worst species include goyave de Chine (*Psidium cattleianum*) and privet (*Ligustrum robustum* subsp. *walkeri*). A recent arrival is liane cerf (*Hiptage benghalensis*), an aggressive invader of lowland dry forests. These species, and many more, out-compete native plants for space, light and nutrients and quickly come to dominate the forests throughout the island.

2.3.3 Hunting and harvesting

Direct exploitation of certain species has pushed them towards extinction. The Dutch colonised Mauritius for its ebony (*Diospyros tessellaria*), which was highly prized. Several other species were also exploited for their wood. Most species of Mauritian palms were exploited for their edible hearts and are all now highly threatened (Maunder *et al.*, 2002). The four endemic species of giant tortoise (two species each on Mauritius and Rodrigues) are all extinct having been exploited for their meat (Cheke, 1987a).

Direct exploitation of most native species has now largely ceased although certain plant species are still being taken from the wild for handicraft and medicinal purposes (Prosper, 1998), and endemic reptiles are occasionally caught for the international pet trade. Small quantities of endemic hardwoods are also still being exploited in certain areas.

2.3.4 Pests and Diseases

Very little information exists on the impact of insect pests and diseases on Mauritian biodiversity, but it is likely that their effect on ecosystem degradation has been under-estimated.

Insect introductions to Mauritius accelerated considerably in the late 20th century in line with increased international traffic (Williams and Ganeshan, 2001). Of the 22 significant pests to have entered Mauritius, fourteen arrived after 1975. No reliable information exists on the effect of such pest species on native biodiversity.

Pink pigeons (*Columba mayeri*) are known to be very prone to three serious pathogens: *Trichomonas*, a protozoan transmitted directly or via contaminated food or drinking water; *Leucocytozoon marchouxi* a protozoan transmitted by blackfly (Simuliids); and avian pox, a virus spread by contact, contaminated surfaces or insect vectors notably mosquitoes. Psittacine beak and feather disease is causing a problem for the recovery programme of the echo parakeet. It was first reported in 2004-2005, and has prevented intensive hand rearing for the 2005-2006 season.

2.4 Management of Biodiversity

2.4.1 Identification and monitoring (Article 7 CBD)

a) Identification.

Genetic level - There have been long-term studies at the genetic level of reptilian and avian species. Genetic studies of some native plant genera have also been carried out (*Coffea*, *Helichrysum*, *Psiadia*, *Gaertnera*, etc).

Species level - At the species level, some groups have been studied including angiosperms, ferns, terrestrial vertebrates and snails (Table 2.1). Forest surveys are

carried out regularly to help improve knowledge of the distribution of plant species, focusing in particular on locating individuals of critically rare plants. Several 'extinct' species have been rediscovered in the last decade, and the distribution of many species has been widened. The forest quality maps of Mauritius (Page & d'Argent, 1997) have been digitized, and GPS positions are collected for all rare plants.

The University of Mauritius has begun to study the micro fungi in native forest and has conducted a census of about 300 species, many of which are first records for Mauritius (pers. comm. R. Dullymamode).

A Darwin Initiative Grant (2003-2007) was awarded to the University of Plymouth and MWF to provide training to Mauritians in taxonomy and baseline research on insect species distribution and abundance.

Ecosystem level - Forest classifications were established by Vaughan & Wiehe (1937). Page & d'Argent (1997) classified forest quality and many studies have looked at the distribution of individual plant species (e.g. Strahm, 1994). Species distribution and composition of different associations are known by historical collections and by flora and fauna surveys over the last 30 years.

A detailed ecological survey has been carried out on Round Island every 7 years since 1975 (Bullock & North 1975, 1982; North & Bullock 1986, 1994).

b) Monitoring

A Darwin Initiative project grant to set up "An Information System for Biodiversity and Conservation Management in Mauritius" developed databases for threatened bird species and plant nursery management. Both are in use.

There is regular and detailed monitoring of four mainland bird species (Mauritius kestrel, Mauritius pink pigeon, Echo parakeet, Mauritius fody). Population estimates are carried out for four seabird species on Round Island. Five reptile species, three on Round Island and two on Flat Island, are also monitored to provide baseline information for future translocations.

All of the threatened plant species (c300) are monitored to some extent to aid in species recovery programmes. A database for threatened plants in line with IUCN criteria is being established.

Other species are monitored over the short term for higher degree projects (e.g Orange tailed skink (Ross, 2004), Telfair's skink (Pernetta, 2004).

Long-term monitoring systems have been put in place by the Ministry of Environment and NDU under the Environment Information System Project including monitoring the proportion of native species of birds and higher plants that are threatened.

2.4.2 In-situ conservation management (Article 8 CBD)

a) Mainland

In-situ conservation (or habitat restoration) involves control of invasive plants and animals. In the National Park, active management takes place in Conservation Management Areas (CMAs). These fenced and weeded plots of forest cover 39 hectares, five forest types, and range in size from 0.34 to 18 ha. The management involves the initial and maintenance weeding of invasive alien plants and fencing against deer and feral pigs. Where CMAs have been used for establishment of populations of pink pigeons and echo parakeets trapping of feral cats, mongooses and rats is also carried out. This network contains 57% of all native species (Strahm, 1992), but the small size of the protected areas may not allow the populations to be self-sustaining or representative. It is a recognized national policy that the area of forest being actively managed must be increased (NEAP, 1999; NSSSP, 2003-2007). This is being realized through establishment of new areas, and extension of existing CMAs. Three areas are already fenced (totaling 19 hectares), and one of these (4.9ha) will be weeded in 2005.

4.4ha of the Nature Reserve network is actively managed in a similar way to the CMAs. This area is spread over four reserves. The private nature reserve of Mondrain (5ha) is also under active management.

The weeding of two privately managed forests, each of 40 hectares has been started. These two areas are not fenced, and restoration involves the use of herbicides to control invasive plant species.

A programme of micromanagement has also begun in the National Park. Weeding is carried out around individuals of critically endangered plant species. The plants will be monitored to maximize seed collection for ex-situ species recovery.

b) Islets

Rats were removed from Ile aux Aigrettes, Flat Island, Pigeon Rock, Ilot Gabriel and Gunner's Quoin between 1995 & 1998 (Bell & Bell 1996, 1999).

Ile aux Aigrettes has now been to a large extent restored by the Mauritian Wildlife Foundation (MWF). Grants from the Global Environment Facility (1996-2000), enabled MWF to eradicate the rats and initiate full-scale restoration of the island's vegetation. A grant from the IUCN Sir Peter Scott Fund (2004-2005) is allowing the rest of the island to be weeded. Following this, only periodic maintenance weeding should be necessary.

Intense restoration of Round Island by MWF (in collaboration with the Government) with GEF funding began in 2000. The establishment of a field station on the island has allowed permanent presence, and active restoration to re-establish the palm-rich forest is taking place. Monitoring of birds and reptiles (the latter for future translocation projects) also takes place. There is a strict quarantine system to prevent rats, reptiles and weeds reaching the island.

NPCS has started some trials on Flat Island to establish methods for restoring this highly degraded island.

A 2001 Task Force on islets assessed the causes and extent of islet degradation and proposed remedial measures for their restoration and protection. An Islets National Park Strategic Plan has been produced for 16 islets of conservation importance (AGRER, 2004). Eight islets were proclaimed as Islet National Parks in 2004 (Section 2.1.4).

c) Alien species

UNDP/GEF–SGP funded the 'Development of predator-exclusion area for conservation of upland forest' (2001-2004), which involved the design and trial of a predator-exclusion fence by a consultant from New Zealand to determine if this technology could be of use in Mauritius. The grant also provided for the design of quarantine posters for the airport to inform people of the importance of not bringing invasive species into the country.

An Invasive Alien Species committee was created in 2003 in order to advise sectors on issues relating to invasive alien species. A grant of 1 million MRU has been allocated under the EIP2 to establish a national strategy and action plan on invasive alien species for Mauritius.

2.4.3 Ex-situ conservation (Article 9 CBD)

a) Propagation of endangered plant species ex-situ for reintroduction in-situ

Over 80% of the flowering plants of Mauritius are threatened, and 103 of these species are known from less than 50 individuals in the wild. To date, NPCS and Forestry Services have successfully propagated c40 of the species with less than 50 individuals in the wild.

There are five nurseries that only propagate native species (two Government, two for MWF, and one private). These nurseries concentrate on propagation of critically endangered species for species recovery programmes and also mass-produce native plants for restoration projects.

For many rare species, seed is not readily available and propagation involves techniques such as grafting and tissue culture.

In an attempt to save not only species but also the genetic diversity of the rarest plants species, a field gene bank has also been set up in the uplands in a collaborative project between the NPCS and the MWF. Targeting 20 species with less than 50 individuals in the wild, capturing all genetic diversity of these species by taking cuttings or seed from each known wild individual, and developing a duplicate collection. A field genebank for coastal plants is about to be established in Bras d'Eau Reserve.

The 'Mauritian Rare Fern project' in collaboration with the Royal Botanic Gardens (Edinburgh) has set up a fern propagation facility at the NPCS nursery. This includes a fern tunnel and a mist propagation unit. Some 50 species of ferns are being propagated at present.

Ex situ collections of Mauritian flora are held at Conservatoire de Brest (France), Royal Botanic Gardens, Kew (UK), and Edinburgh Botanic Gardens (UK).

b) Species recovery programmes for critically endangered bird species

Captive breeding programmes were established by the Durrell Wildlife Conservation Trust (Jersey) in 1976 to save the Mauritius pink pigeon, Mauritius kestrel and Echo parakeet from extinction. All three programmes have been successful, and populations of each of the three species have been re-established in the wild. In-situ management is still required for these species through provision of predator-proof nest boxes, predator control and supplementary feeding. This is carried out by MWF.

A population of the Mauritius fody, based on hand-reared birds, has also been established on the predator-free island of Ile aux Aigrettes.

2.4.4 Sustainable use of components of biological diversity (Article 10 CBD)

a) Biodiversity and tourism

The 2002 Tourism Development Plan considers biodiversity and tourism development through the protection of conservation areas, mountain areas, nature reserves and nature parks. The National Development Strategy (2003) also incorporates strategies to protect the natural environment. Tourism Action Area Plans, Tourism Zones and ‘campement’ sites have been earmarked so that development is confined to designated zones.

2.4.5 Research & training (Article 12 CBD)

a) Research

The University of Mauritius has carried out inventories of all medicinal plants through an Indian Ocean Commission Project (Inventory and Study of the Medicinal and Aromatic Plants of the States of the Indian Ocean). A computerized database on these plants now exists at the University.

The Mauritius Research Council (MRC) has funded several projects, submitted by the University of Mauritius. The aims are to validate traditional data and to test for the biological activity of indigenous/endemic plant extracts.

Biodiversity research by students for higher degrees is encouraged and supported. e.g. the effect of weeding IAS on native plant regeneration, the effect of introduced animals on native birds, detailed population and ecological studies of pink pigeons, Mauritius fody and Echo parakeet etc...

b) Training

The University of Mauritius degree in biology now incorporates four modules related to Ecology.

Five Mauritian students have received training at M.Sc. level in ecology and conservation in overseas Universities over the last 5 years.

Several PhD and Masters students are also being trained in the field of phytochemistry and ethnobotany at the University of Mauritius. Close collaboration

exists with many universities overseas and in the region.

2.4.6 Public education and awareness (Article 13 CBD)

Public education and awareness forms an integral part of the routine activities carried out by government and NGOs. Schools can request talks on forest biodiversity and guided tours of the forest. Plants are also available for an endemic corner in school grounds. Poster exhibitions, brochures, films and newspaper articles are produced regularly. A campaign of awareness against invasive species has been started with the launching of quarantine posters at the airport, and production of posters about IAS for schools. There are visitors' centres in the National Park, on Ile aux Aigrettes, at Mont Vert and at Bras d'Eau to inform the public about nature conservation.

Gurib-Fakim (2003, 2004 and 2005) has produced several T.V. programmes with the Mauritius College of the Air and books to address the issue of Public Education and awareness.

2.4.7 Impact assessment & minimizing adverse impacts (Article 14 CBD)

The Environment Protection Act (2002) specifies that an EIA is required for conversion of forest land to other land use and clearing and development in environmentally sensitive areas such as water catchments, mountain slopes, islets and wetlands.

National programmes and initiatives are usually set up, monitored and evaluated through national consultations and inter-ministerial committees where the relevant authorities and interested and affected stakeholders take care of the biodiversity issues. The policies are also usually mediated such that NGOs and the public can comment if the project is having adverse impacts on biodiversity.

2.4.8 Exchange of information (Article 17 CBD)

Mauritius received a grant in 1997 to develop a clearinghouse mechanism for biodiversity. The project is ongoing.

2.4.9 Financial resources (Article 20 CBD)

In addition to international and regional funds for biodiversity conservation, national funding mechanisms include:

- ☐ The National Parks and Conservation Fund, established under the Wildlife & National Park Act (1993). Contributions from exportation of monkeys, export and

import permits under CITES and native plant sales go into this fund for biodiversity conservation. Any project that falls under the remit of the Director of NPCS can receive funding. The projects can involve other stakeholders, but NPCS must be the lead agency.

- ☐ The National Environment Fund supports environmental projects and is accessible to any stakeholder.
- ☐ The Mauritius Research Council provides grants through five schemes on nine themes including biodiversity.

2.5 Legislation, policy and institutional framework

2.5.1 Legislation

Mauritius is signatory to 18 international treaties and conventions on the environment and was the first signatory country of the 1992 Rio Convention on Biodiversity. In addition, there are four national laws of relevance to terrestrial biodiversity conservation:

The Environment Protection Act (1999 and 2002)

This Act established the Ministry of Environment (MoE) as the body responsible for overall coordination of environmental management. Under the EPA five ministries are assigned the role of enforcement for implementation of environmental policies. The Act covers all aspects relating to EIA procedures.

The Forest and Reserves Act (1983, amended 2003)

This is the principal legislation governing the management of forests resources and designates the power to declare national forests, nature reserves, mountain reserves, river reserves and road reserves. Sixteen Nature Reserves have been selected (two of which now form part of the National Park, and 4 are in Rodrigues) for the purpose of maintaining vegetation cover and the provision of ecosystem services. The Act provides protection for designated areas of state land but is inadequate to safeguard against the loss of privately owned areas with rich biodiversity resources, as penalties are too weak to be an adequate deterrent.

The Wildlife and National Parks Act (1993)

This is the principal legislation for the protection of flora and fauna, with the Wildlife Regulations of 1998 giving effect to the CITES Convention in Mauritian law. In 1996, the National Parks and Reserves Regulations were made under the Act, laying down rules regarding activities on reserved land. The Act and its regulations are

currently being revised to make them fully compliant with the provisions of CITES. The opportunity is also being taken to increase legal protection of native biodiversity at national level.

The Plant Act (1976)

This Act is currently under revision to the Plant Protection Bill. A Black List of the worst invasive weeds to be prevented entry into Mauritius has been proposed to help protect native biodiversity.

2.5.2 Policy

Various documents lay down policy regarding conservation of terrestrial biodiversity including:

White Paper for a National Conservation Strategy (1985)

The NCS defines the major objectives for the conservation of natural resources but has been outdated and superseded by Mauritius' commitments under the CBD and the National Environmental Action Plan.

The National Environmental Action Plan for the next decade (1999)

The NEAP contains a programme on terrestrial biodiversity, with a strategic goal to 'ensure that native Mauritian biodiversity survives, flourishes and retains its genetic diversity and potential for evolutionary development'. The strategy focuses on rationalizing and strengthening the political, institutional, legislative and financial foundation by

- i) bringing management of all protected areas under the portfolio responsibility of NPCS;
- ii) increasing the capacity of NPCS to prioritise, plan, co-ordinate and report;
- iii) maximizing the role of NGOs to undertake specific projects;
- iv) increasing involvement of the private sector and the public in conservation activities; and
- v) identifying options to fund management activities.

National Development Strategy (2004)

The NDS includes the designation of a network of Environmentally Sensitive Areas to reinforce a 'general presumption' against development in these areas using the precautionary approach. The network includes coastal features, wetlands, mountain areas and other areas of high biodiversity (both private and state owned). A proposed network is given, although base line information is still being compiled (under EIP II projects).

The Non-Sugar Sector Strategic Plan (2003-2007)

The NSSSP is a sustained programme for agricultural diversification and includes the goal ‘to reverse the present tendency towards degradation of biodiversity, safeguard and manage in a sustainable manner the biotic wealth of the country, and arouse public awareness on the value and importance of biodiversity’.

Islets National Park Strategic Plan (2004)

The Plan covers 16 islets of conservation importance. Draft management plans for 9 of these islets were completed in 2004. The plans have been gazetted.

2.5.3 Institutional framework

The National Parks and Conservation Service (Ministry of Agro-Industry & Fisheries)

The NPCS is responsible for the Black River Gorges National Park, Islet National Parks and the Ramsar site at Terre Rouge. The Service was officially established on 9 May 1994 under Section 8 of the Wildlife and National Park Act 1993. The budget for 2005-2006 was 16.3 million rupees. It employs 86 staff and is headed by a Director who is responsible for monitoring all issues related to the conservation of terrestrial flora and fauna in Mauritius and provision of advice to the executive.

At present the NPCS has an equipped native plant propagation centre, a captive breeding centre, 4 field research stations, a shade house, information centres at Pétrin and Black River, a fernery and a green house at Curepipe. The Service runs various conservation programmes such as management of offshore islets, management of Conservation Management Areas, control of pests, management of wetlands and awareness raising.

Much of the active forest restoration and conservation is contracted out due to lack of staff. The National Parks and Conservation Fund (section 2.4.9) finances the work.

The Forestry Service (Ministry of Agro-Industry & Fisheries)

The Forestry Service, headed by the Conservator of Forests, has a staff of 1037 and a budget of 157 million MRU for 2005-2006. It is responsible for 15,300 ha of forest and an additional 1,938 ha of ‘native’ forest designated as mountain and river reserves for the protection of ecosystem services. The main activities of the Service are shifting

from timber production to soil, water and biodiversity protection. The Service is also responsible for 200 ha of Nature Reserves, although only 4.4 ha are actively managed. Some 25,000 indigenous plants, including several critically endangered native species, have been successfully propagated and reintroduced into Nature Reserves.

The Service also carries out awareness raising through a visitor centre, nature walks, school programmes and production of native plants for public places.

Ministry of Environment & National Development Unit

The Ministry of Environment is the national focal point for the CBD, UNCCD and UNFCCC. In practice CBD-related activities are implemented by the NPC. The vision of the MoE is to provide a better environment and quality of life for the present and future generations. The Ministry has sections specializing in information and education, pollution control, integrated coastal zone management, policy and planning, environmental law and environmental assessment. The National Environment Commission (chaired by the Prime Minister) functions to steer the work of the Ministry by setting national goals and objectives for the protection of the environment.

Mauritian Wildlife Foundation (NGO)

The largest terrestrial biodiversity NGO, it was created in 1984 to help save critically threatened birds from extinction. There are 54 full time Mauritian staff, 10 expatriates, and up to 16 volunteers. MWF is actively involved in islet restoration, ecotourism on Ile aux Aigrettes, species recovery management for rare birds, forest surveys, rare plant propagation, and public education and awareness. It also works with the private sector. The MWF has earned international renown for its pioneering work with endangered bird species.

Mauritius Herbarium (MSIRI).

Since 1960 the Mauritius Herbarium has been housed at the Mauritius Sugar Industry Research Institute and comprises some 25,000 sheet-mounted specimens and associated collections. It also houses a unique assemblage of publications, manuscripts, original sketches, paintings and maps. The Mauritius Herbarium is a regional herbarium dedicated to collection from the Mascarene Islands, and from islets including Agalega, St Brandon, the Chagos Archipelago and some other countries. The research for the publication of a modern regional flora, Flore des Mascareignes, is nearing completion with the main financial assistance from the European Union. The Mauritius Herbarium has a small living collection of native plants and also carries out research on ecology and conservation of native species. It has a staff of one technical officer and one technical

assistant

University of Mauritius.

Research is carried out through the University on ecological processes and the effectiveness of conservation management. The University also runs several courses containing modules on ecology and conservation at under and post-graduate levels. There is one lecturer specialising in terrestrial ecology. Modules like the Economic use of plants, biotechnology etc. are also being addressed.

2.6 Summary of gaps and existing needs

1. Limited area under protection and inadequate active conservation management of native ecosystems;
2. No strategy for invasive alien species (IAS) control;
3. Lack of training of Mauritians, limited human capacity at all levels;
4. Inadequate protection for biodiversity, especially on private land;
5. Incomplete inventory;
6. Habitat fragmentation;
7. Limited inter-institutional communication and collaboration;
8. Limited research or monitoring to support adaptive management;
9. Limited awareness of the population at large;
10. Limited development of conservation as a profitable venture;
11. Commitment to conservation not necessarily a priority for government.

3.1 Overview of the Freshwater, Coastal and Marine Biodiversity of Mauritius

Mauritius is surrounded by 49 offshore islets and has two groups of outer islands, Agalega and St Brandon. Agalega consists of two sandy cays covering c21 km² surrounded by 100 km² of coral reef. St Brandon Shoals has 55 low-lying islets and sand cays covering c3 km² within a 100 km long coral reef system (Figure 3.1). Mauritius has an extremely rich coastal zone of wetlands and mangroves, lagoon coral and fringing coral reefs.

Map of the coastal region of Mauritania, showing the Atlantic Ocean to the west and the Sahara Desert to the east. The map includes the coastline, major cities like Nouakchott, and various islands and reefs. A scale bar indicates 100 km. A legend box in the bottom right corner provides technical details:

- PROJECTION : Universal Transverse Mercator - Zone 40
- GEODETIC DATUM : World Geodetic System 1984 (WGS 84)
- SCALE : 1 : 160,000
- DATE : November 2003
- Ministry of Housing and Lands

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3.1.1 Fauna and Flora

Coastal & Marine

Mauritius has a diverse marine environment with five reef types: Fringing Reefs, Patch Reefs, Atolls, Reef flats and Barrier reefs. A total 159 species of scleractinian corals have so far been recorded (Pillay *et al.*, 2002). Out of 340 species of fish that have been identified (Terashima *et al.*, 2001), 42 within the lagoon area are of economic importance. Five species of Penaeid shrimps (*Penaeus monodon*, *P. latisulcatus*, *P. canaliculatus*, *P. indicus* and *Metapenaeus monoceros*) as well as two species found in deeper water have been identified. Other invertebrates include octopus, mussels, oysters (the endemic *Crassostrea cuculata*), barnacles and clams.

The effect of over-fishing of *Lethrinids* is apparent on the fringing reefs of Mauritius with a population explosion of sea urchins (*Diadema* and *Echinometra* spp). Several species of sea stars and echinoderms are reported in the Mauritian waters. The coral grazing Crown of Thorns Starfish (*Acanthaster planci*) is occasionally sighted on the fringing reefs.

Mauritius has a rich algal flora. Over 160 genera of marine algae have so far been identified from the coastal waters. Records on the marine flora date back to 1875 and the Mauritius Herbarium has a collection of more than three hundred marine algae.

Sea cows, once common in the lagoons of Mauritius are extinct, and marine turtles are rarely seen due intense hunting pressure. Turtles still use St Brandon Shoals and Agalega for nesting. Seventeen marine mammal species have been recorded in Mauritian waters – mostly during their migration to and Antarctica for calving. Some dolphins are resident in Mauritian waters.

Of the outer islets, the marine ecosystem around St. Brandon is still virtually ecologically intact with abundant large reef fish, corals and sea creatures. St. Brandon is an important seabird site with eight species breeding (Newlands, 1975). Seabird numbers appear to be in decline due to poaching and introduced rats. Nesting sea turtles though still common are in decline (Swinnerton *et al.*, 1996).

Wetlands

There are 44 recognised coastal wetlands in Mauritius (ICZM subcommittee unpublished report, 2005).

Two species of mangrove, *Rhizophora mucronata* and *Bruguiera gymnorhiza*, grow around Mauritius. Over the years the extent of mangrove cover around the island has decreased significantly through cutting for firewood, construction and to enable boat passage. Recently large-scale replanting programmes have reversed this trend.

There are important mudflats for migratory birds at river estuaries. Around 1,200 birds of 16 species visit the most important wetland at Terre Rouge Estuary (RTREBS) each year. (Bird survey count 1997, NPCS unpublished).

Freshwater

The freshwater vertebrate fauna of Mauritius is low in diversity and endemism. A survey carried out using electro-fishing in eight of the major rivers found 18 species of fish, of which 5 are introduced and the rest native. The same survey found ten species of macrocrustaceans belonging to two families; the Atyidae (six *Caridina* spp. and one *Atyoida* sp.) and the Palaemonidae (two *Macrobrachium* spp. and one *Palaemon* sp.). Three of these species are endemic to Mauritius (ARDA, 2003). Of 18 freshwater and one brackish water snail recorded (Griffiths & Florens in prep), only 10 are native, and perhaps one of these endemic. There has been no systematic survey of freshwater macro-invertebrates in Mauritius.

3.1.2 Protected Areas

Marine Protected Areas

The Fisheries and Marine Resources Act 1998, enables the designation of Marine Parks, Fishing Reserves and Marine Reserves. Two marine parks at Blue Bay (353 ha) and Balaclava (485 ha) were proclaimed in 1997 as National Parks under section 11 (1) of the Wildlife and National Parks Act 1993. Both were declared Marine Protected Areas (MPAs) and designated as Marine Parks in June 2000 under the Fisheries and Marine Resources Act 1998. The Balaclava Marine Park is as yet unmanaged.

Six Fishing Reserves were also proclaimed in June 2000 to protect and conserve marine habitats that are nursery grounds for juvenile fish (Figure 3.2)

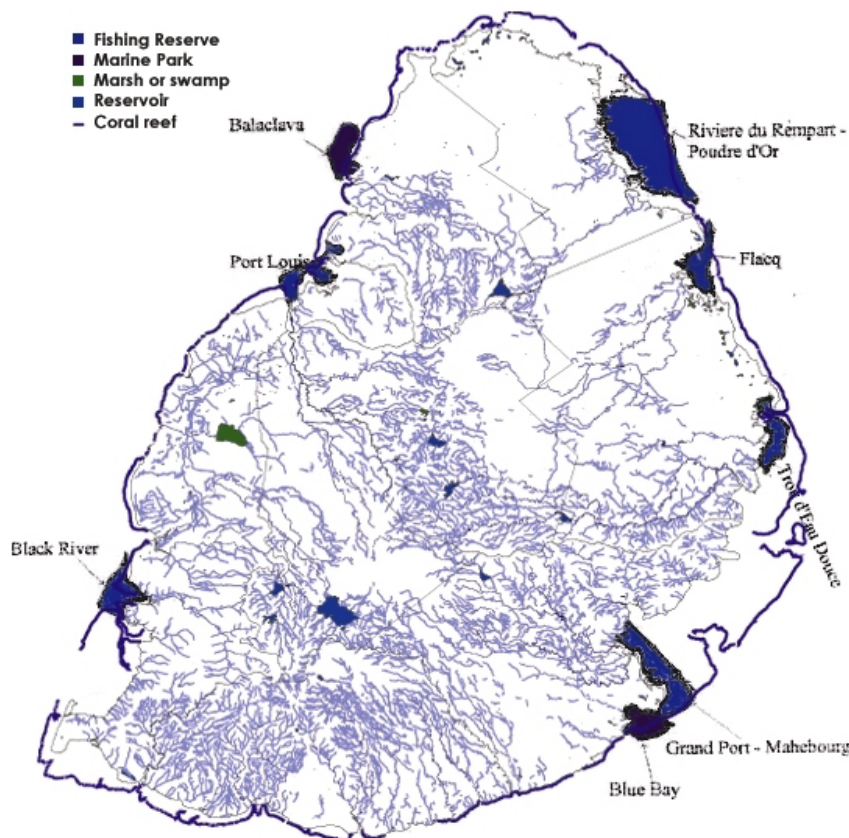


Fig. 3.2: Marine Protected Areas (Source: Fisheries Division).

Wetlands

The wetland at Rivulet Terre Rouge Estuary Bird Sanctuary (RTREBS) was declared a Ramsar Site in 2001. The wetland covers 26ha of mud flats and muddy sands. The estuary has abundant marine life, and forms a refuge and important feeding ground for migratory birds. Mare Sarcelles (20ha) at Bras D'Eau, has been declared a Reserve under the Wildlife and National Parks Act (1993).

Freshwater

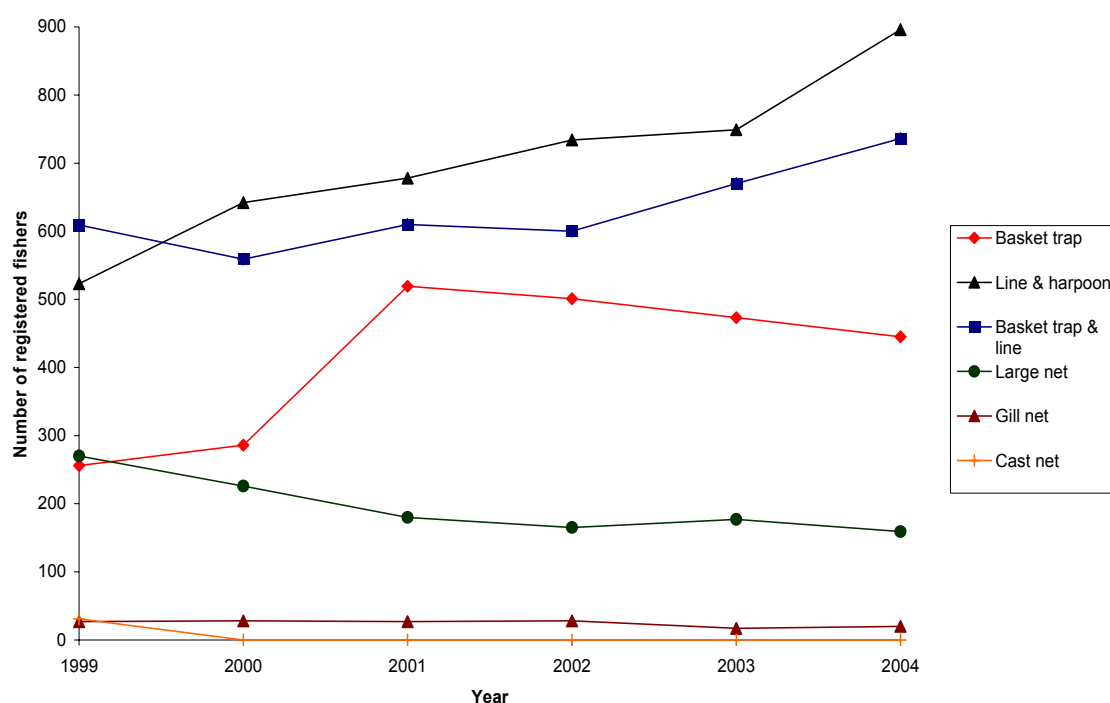
There are no areas of freshwater protected for biodiversity.

3.2 Use of Freshwater, Coastal and Marine Biodiversity

Coastal and Marine

Marine biodiversity is a valuable resource, generating income through tourism and fisheries, and is the focus of much of Mauritian leisure time. It is the source of direct and indirect employment for c45, 000 people (CSO, 2005). Lagoon fisheries account for 1% of GDP and provide a livelihood for 2,256 registered fishermen (Fisheries Division 2003) Fishing exports accounted for USD 139 million in 2003 (MoE & NDU, 2005).

Figure 3.3: Number of active fishermen by gear-type (Source: Fisheries Division)



Fishery resources are found in the lagoon and off-lagoon areas of Mauritius, Rodrigues, Agalega, St Brandon, the banks along the Mauritius-Seychelles ridge stretching from St Brandon to Saya de Malha, and the Chagos Archipelago, as well as in the open sea tuna fisheries. The total area of the fishery grounds is c52,000 km². The total fish production in fresh weight equivalent stood at 11,003 tonnes in 2004, compared to 12,116 tons in 1999 (Fisheries Division). The *per capita* consumption of fish in Mauritius is given in Table 3.1

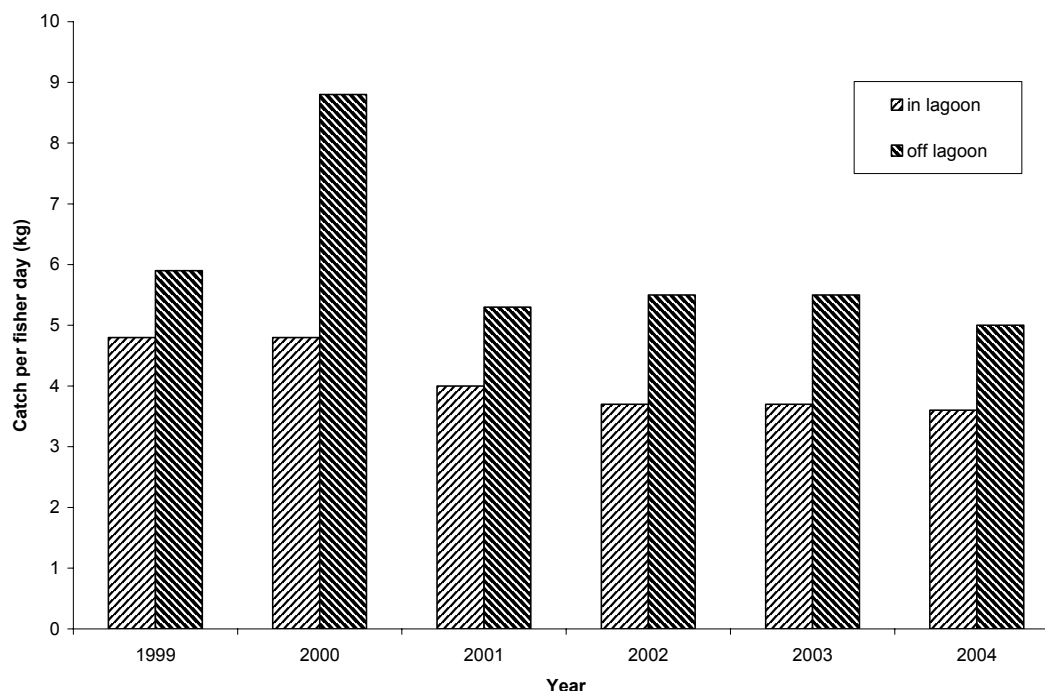
Table 3.1 Per capita consumption of fish (Fisheries Division)

Year	1999	2000	2001	2002	2003	2004
Quantity (kg)	20.6	23.3	19.9	20.0	18.7	19.8

There are five different classifications of fishery: artisanal, banks, pelagic, aquaculture and sport.

The Artisanal fishery includes in-lagoon and off-lagoon fishing for about 42 fish and 7 crustacean species. The catch from the artisanal fishery is marketed as fresh fish. The artisanal fishery of Agalega is exploited at a subsistence level. The Maximum Sustainable Yield (MSY) for the artisanal fishery has been estimated at 1,700 tonnes and the annual catch for 2004 was 1,043 tonnes (Fisheries Division).

Figure 3.4: Catch, fisher days and catch per fisher day in lagoon and off-lagoon (Source: Fisheries Division)



The Banks fishery is carried out in the shallow waters of the Saya de Malha, Nazareth, Albatross and Chagos banks. The catch is sold as frozen fish, with most fish coming from Saya de Malha (76%) and Nazareth (15%) (Table 3.2). About 90% of the catch consists of *Lethrinus* spp. such as Dame Berri, Caya and Capitaine (Fisheries Division). The annual catch for the year 2004 was 2,679 tonnes.

Table 3.2: Annual catch (tonnes) of frozen fish by bank (Source: Fisheries Division)

Year	No. of vessels	Saya de Malha	Nazareth	St. Brandon	Chagos	Albatross	Total catch
1999	13	2,107	1,121	341	127	226	3,922
2000	12	2,099	1,080	267	312	141	3,899
2001	11	1,283	1,366	332	228	202	3,411
2002	10	2,090	918	0	223	55	3,286
2003	9	2,354	468	0	235	37	3,094
2004	8	1,686	855	0	117	21	2,679

Table 3.3: Fishing effort and catch from the banks for 2004 (Fisheries Division)

Bank	Catch (t)	Fishing days	Bad weather days	Effort (Fisher days)	Catch per fisher day (kg)	% Total catch
Saya de Malha	1,686	474	183	23,729	71	62.9
Nazareth	855	206	65	10,154	84.2	31.9
Chagos	117	34	26	1,761	66.4	4.4
Albatross	21	11	2	541	39.9	0.8
Total	2,679	725	276	36,185	74.0	100

The Pelagic Fishery consisting of tuna (*Thunnus* spp.), skip jack (*Katsuwonus pelamis*) and other species (including swordfish, bill fish and shark) is exploited on an industrial scale. This is the most abundant fishery source in the EEZ of Mauritius. Canned tuna corresponds to more than 90% of fish exports— in 2004 33,625 tonnes were exported, and 1,236 tonnes were sold locally (Fisheries Division, 2005).

A joint public-private sector initiative to develop Mauritius as a seafood hub has been initiated. The hub aims to be an efficient and attractive environment for the supply of value-adding processes and services. (Fisheries Division, 2005).

Aquaculture has a long history Mauritius. Fish, crabs and oysters (including introduced species) are collected and placed in coastal ponds enclosed by stone walls (barachois). Fingerlings are collected from the open sea and are released in the "barachois" for growing after which they are harvested. There are about 13 "barachois" in Mauritius. However, at present many are not in use.

A major private aquaculture project began in 2002, farming an introduced

species, red drum (*Sciaenops ocellatus*) in floating cages. In 2004, this enterprise produced 330.8 tonnes of fish for local consumption and export (Fisheries Division).

The Sports Fishery is an important tourism activity. Professional anglers come to Mauritius for blue and black marlins, sail fishes and pelagic tuna. It is estimated that the industry produces c650 tonnes of fish per year (Fisheries Division estimate, 1988).

Recreation

Foreign tourists and locals exploit the marine and coastal ecosystem for recreational purposes, with tourism being one of the most vibrant industries in the Mauritian economy (Table 3.4). Tourists enjoy the beaches, water sports, sport fishing, dolphin watching, snorkelling and diving. For example, in 2004 109,000 people visited the Blue Bay Marine Park (Fisheries Division). The success of the industry is directly linked to the quality of the lagoon, its biodiversity and ecosystem services. There are plans to develop the outer islets of Agalega and St Brandon for tourism (Ministry of Shipping, Rodrigues and Outer Islets, 2004).

Table 3.4: Number of tourists and money spent (Source: CSO, 2003)

Year	2000	2003	2004
Number of tourist arrivals	656,500	712,000	718,900
Tourist receipts (million Rupees)	14,234	19,415	23,448

Freshwater

Fishing for introduced species such as *Tilapia* is a popular activity, especially in the reservoirs. Fishing for camaron and chevrettes still occurs for local use, and has resulted in the rarity of this macro-crustacea. There is some freshwater aquaculture – 16 tonnes of the introduced *Macrobrachium rosenbergi* were produced in 2004.

The demand for water for agricultural and municipal use is high and places pressure on river systems. In addition to extraction, the rivers receive pollution from industry and agriculture (NEAP, 1999).

Waterfalls and several rivers are popular tourist attractions used for nature-based tours through canoe trips and abseiling down cliffs. Water-based ceremonies are an integral part of the Hindu religion and the riverbanks and lakes in many areas have been developed to allow ceremonies to take place.

3.3 Causes of biodiversity loss

Unsustainable use of resources

Lagoon fishing currently exceeds sustainable levels of exploitation (MoE & NDU, 2005) with the size of fish and the total catch decreasing despite increased effort. Anchors, traps and boat poles are damaging corals. Corals and shells are protected and their removal prohibited without permit. Local species are still found on the market however. Turtle hunting is prohibited by law (Fisheries and Marine Resources Act, 1998).

Development:

Land-based human activities, including construction, pollution from sewage and agriculture and unsustainable use of coastal resources are having considerable impacts on the coastal zone, especially in terms of lagoon water quality (NDS, 2003). Much of this is a result of pressure for tourism and residential development, particularly in the north of the island. At present the development of infrastructure associated with tourism is not well coordinated. Non-compliance with established guidelines also occurs. A review of the existing planning norms focusing on development density, height of complexes and compulsory architectural designs is considered a priority.

Environmentally sensitive areas are being degraded or lost mainly due to construction for housing or tourist accommodation. Areas of particular concern are wetlands, including marshes and mangroves. Most of the wetlands at Grand Baie, Pereybere, Baie du Tombeau, and Flic en Flac have been reclaimed for hotel and residential development. The Ministry of Environment estimates that 20% of wetlands have been filled in the northern tourist zone of Mauritius and 50% in Flic en Flac.

Beach erosion

Whilst some beach erosion is natural, it is exacerbated by hard structures on the beach, such as sea walls and recreation jetties, which restrict the natural movement of sand. Many of these structures do not conform to existing planning guidelines. For example, the appropriate setback for hard structures has varied between 15m (NPDP, 1994) and 30 metres (EPA 2002) from the high water mark. A 1997 MOE survey of public beaches identified seven critical sites of beach erosion covering 5,300 m. A further study was commissioned in 2002 on coastal erosion, and the final report was submitted in 2003 by Baird and Associates. Its recommendations are being implemented.

Sand mining

Though now banned the former practice of sand mining in the lagoon has had negative impacts on the marine environment through destruction of habitats and the siltation of corals. Sand mining has also been linked to coastal erosion.

Pollution

In many coastal locations and some established settlements such as Grand Baie, rapid development of housing and commerce has outstripped the rate at which local authorities have been able to provide environmental services and community facilities, especially sewage systems. For example effluent is released through four short sea outfalls directly into the sea in the Port Louis region.

Industrial effluents and agricultural run off are issues of concern, causing degradation of water quality that can lead to eutrophication and algal blooms. At some locations on the eastern coast, high nutrient levels, from heavy use of inorganic fertilisers, have resulted in the growth of the nuisance algae (*Ulva* sp.) that can cover inshore corals and be washed ashore causing odour and aesthetic problems.

It is likely that pollution is the major cause of biodiversity loss for freshwater systems. Agricultural chemicals and discharge from textile industries are two key sources of pollution. (Seelarbokus, 1990; Geddedu, 1998).

Invasive alien species

IAS threaten biodiversity in all the aquatic zones. Ballast water from ships is a potential source of invasive marine species, but otherwise little is known about the IAS situation in marine systems. Many introduced species have been recorded in freshwater systems, including the western mosquito fish (*Gambusia affinis*) renowned for its damaging effect on freshwater fauna, the Nile perch (*Tilapia* sp), and the golden apple snail (*Pomacea bridgesi*). The water hyacinth (*Eichornia crassipes*), and many other waterweeds are also present, and river banks tend to be highly invaded by alien species (Page & d'Argent 1997).

Shell extraction

While the extraction of shells and corals from the lagoon is illegal, the importation of shells and corals into Mauritius is permitted (32,570 units were imported in 2004 from Madagascar and Philippines). As a consequence it is likely that there is still a high incidence of illegal collection of corals from the lagoon in Mauritius. There is some local artisanal trade, although much of the jewellery is also imported.

Improper beach management

Proper beach management has not yet been optimised in Mauritius. The use of prime beach areas for parking, cooking and an increasing number of commercial activities, has deprived these zones of much of their appeal. The cleaning up of beaches and a move towards professional beach management is required.

Climate change

Climate change is a major concern to Mauritius as an island state. Coral bleaching was observed in late February 1998, which coincided with the abnormally high temperatures and heavy rainfall. Bleaching was studied within the Balaclava and Blue Bay Marine Parks and the results that 39% and 31% of the live corals had been affected in the two parks respectively. Mauritius suffered further sporadic bleaching in 2003 and 2004. Surveys at four sites recorded bleaching levels between 16 and 85%.

3.4 Management of Biodiversity

This section deals almost exclusively with coastal and marine (including wetland) biodiversity as there is no management of freshwater systems for biodiversity.

3.4.1. Identification and monitoring (Article 7 CBD)

a) Identification

Species level

The Marine Oceanography Institute (MOI) is developing a taxon-based biogeographic database of marine organisms of Mauritian maritime zone. It will store literature based on taxonomic and geographical data for species reported from Mauritian Waters. The end product will be made available online and on CD-ROM.

Ecosystem level

The Albion Fisheries Research Centre (AFRC) has recently prepared thematic maps of the coastal area around Mauritius and Rodrigues. These maps depict the different coastal habitat up to the reef and will be used for monitoring changes in the coastline and habitats.

A preliminary survey has been carried out to identify all the coastal wetlands of Mauritius (ICZM, MoE). NPCS is in the process of recruiting a consultancy team to carry out a comprehensive survey of all wetlands.

b) Monitoring

The AFRC monitors coral at 12 selected sites around Mauritius. Since the early nineties observations on coral spawning, growth and recruitment have been carried out between October and December.

A long-term monitoring programme has been established for the Blue-Bay and Balaclava Marine Parks. Data is collected on coral, benthos and fish populations. Physical, chemical and bacteriological properties of water are also monitored.

3.4.2 In-situ conservation management (Article 8 CBD)

a) Wetlands

A mangrove propagation programme was initiated in 1995. The public has been sensitised to the importance of mangroves and is being urged to protect them. To date 17 sites with a total area of about 12.8 ha have been re-established.

The Ministry of Environment commissioned a study in 2002 to advise and recommend remedial measures for the protection of the wetlands in the Grand Bay area. An Implementation Committee has been set up to follow up on the recommendations. The study has earmarked all the wetlands that need protection and actions are being initiated to declare these sites as reserves. NPCS, in collaboration with the Fisheries division, has submitted documents to Ramsar Bureau to proclaim a second site, Blue Bay Marine Park, as a Ramsar site. The NPCS is working to fulfill national obligations under the Ramsar Convention. A National Ramsar Committee has been formed and a wetlands bill drafted.

b) Invasive Alien Species

There is no active management against aquatic alien species although stakeholders from the aquatic sectors are represented on the National Invasive Alien Species Committee. A task force on the Monitoring of Ballast Water, consisting of representatives from various institutions, has been established. There is an urgent need to undertake a baseline survey to identify exotic marine species.

3.4.3 Sustainable use of components of biological diversity (Article 10 CBD)

a) Artisanal fishery

Since 1996 management measures have been taken to relieve the fishing pressure in the lagoon. These include:

- A buy-back policy for large nets and gill nets, and compensation of fishermen who relinquish their net licences.
- A closed season of five months for net fishing (October to February).
- A control on the number and type of nets in the fishery.
- A minimum size for harvest of oysters; crustaceans in the berried state are prohibited for capture.
- Placement of 21 Fish Aggregating Devices (FADs) 1.67-12.3 nautical miles outside the lagoon.
- Training of fishers in modern off-lagoon fishing techniques with a stipend of 250 rupees per day.
- Soft loan facilities for cooperatives to purchase equipment for off-lagoon fishing.

Efforts are being made to restock the lagoon with experimental seed productions for the mangrove crab (*Scylla serrata*), giant tiger prawn (*Penaeus monodon*), and the gueule pavée (*Rhabdosargus sarba*) while culture of berri rouge (*Oreochromis* sp.) and crayfish (*Cherax quadricarinatus*) are on-going.

b) Banks fishery

Statistics collected over the years indicate that fish size has decreased. Entry to the fishery has subsequently been limited with only nine vessels licensed to operate in 2003.

c) Pelagic fishery

Studies are being carried out in collaboration with IOTC to estimate the stock size.

d) Aquaculture

The Ministry of Fisheries five-year plan sets out to rehabilitate unused barachois for projects that combine fish farming with public leisure and eco-tourism.

e) Outer islets

The marine environment of the outer Islets of St. Brandon and Agalega is relatively undisturbed. The islands were once important nesting sites for the green turtle *Chelonia mydas* and the Hawksbill turtle, *Eretmochelys imbricata*. These species were declared protected in 1983.

- A project to place permanent mooring sites in the ocean to prevent anchor damage to coral reefs is carried out by the NGOs Reef Mauritius and the Mauritian Marine Conservation Society (MMCS).

3.4.4 Incentive measures (Article 11 CBD)

A bad weather allowance to registered fishers has proved controversial and is considered a perverse incentive by encouraging people to become registered fishers, and thus increasing the pressure on the lagoon fish stocks. Research and work is required to develop a structured system of incentives that foster the conservation and sustainable use of biodiversity.

3.4.5 Research & training (Article 12 CBD)

Coral reef monitoring

An IOC funded project (2003-2005) collected regional data on coral reefs. The programme included training of more than 25 people (from government and NGOs) in monitoring techniques, data processing and logistical support (including equipment and dive training). The data is used in the Global Coral Reef Monitoring Network.

Aquaculture

Research is being undertaken by AFRC for the development of aquaculture, especially seed and fingerling production of species used for restocking the lagoon.

Continental Shelf Project

The MOI has been entrusted with the task of formulating the claim for the extended continental shelf for Mauritius. This claim must be submitted to the UN Commission on Limits of the Continental Shelf by 2009.

Bioprospecting in Mauritian Waters

This project aims to assess the biological properties of certain classes of marine organisms.

3.4.6 Public education and awareness (Article 13 CBD)

Wetlands

NPCS celebrates the World Wetland Day every year in February with a series of activities to sensitise school children and the public on the importance of wetlands. An NGO was recently awarded a small grant from Ramsar to carry out a project related to public awareness and training of wetland leaders.

Fisheries

AFRC produces regular publications and there is an annual open day to the sensitise public on the fisheries sector. There are two dedicated education officers who give talks to visitors at AFRC and Blue Bay Marine Park and visit schools and hotels. There is also a sensitisation campaign for fishermen. Some NGOs are involved in awareness-raising activities e.g. CEDREFI carried out a 2 year project to sensitise villagers of the importance of a sustainable way of living; EcoSud carries out awareness raising in schools in the Mahebourg area; Reef Mauritius and MMCS produce posters, games and leaflets, and carry out sensitisation in key areas (e.g. dolphin watching at Tamarin).

3.4.7 Impact assessment & minimizing adverse impacts (Article 14 CBD)

Pollution

1.2-1.4 billion MRU have been invested since 2000 in a sewage masterplan. This includes wastewater projects, including tertiary level treatment, a long sea outfall and the cessation of use of the short outfalls at Pointe aux Sables and Bain des Dames.

Erosion

The Ministry of Environment commissioned a study in 2002 on coastal erosion around Mauritius. The final report was submitted in 2003 by Baird and Associates. A committee has been set up to implement the recommendations made by the consultants.

Public beaches

A Beach Authority has been established (2002) to provide for the management and control of the public beaches.

Development

The Ministry of Environment has commissioned a technical report for the preparation of a strategic EIA to identify potential sites for marinas, ski lanes and bathing areas. The final report is expected by the end of 2005.

3.4.8 Access to genetic resources (Article 15 CBD)

Any requests for material are sent to the Ministry of Fisheries. They must be fully justified and are sent to the Prime Minister's Office for approval.

3.4.9 Exchange of information (Article 17 CBD)

The Ministry of Fisheries has a detailed website which lists all publications. The Ministry also produces annual and research reports. Information on fisheries is used in the National Environment Indicator System.

3.4.10 Technical & scientific cooperation (Article 18 CBD)

The Ministry of Fisheries has received significant technical and scientific cooperation from the Government of Japan to finance the construction of facilities including: ARFC, a marine conservation centre, a fishing port at Trou Fanfaron and a marine shrimp culture station. Technical assistance and exchange programmes have been provided through the Japan International Cooperation Agency (JICA) and the Overseas Fisheries Cooperation Foundation has implemented an outer lagoon fisheries development programme. More recently, five experts have been attached to the AFRC for five years in a 'Coastal Fisheries Resources and Environment Conservation Project'. There is also an exchange programme with India to provide observers on vessels through the Indian Ocean Tuna Commission (IOTC).

3.4.11 Financial resources (Article 20 CBD)

A Marine Park Fund is being set up by the Ministry of Fisheries, which will consist of revenue from donations and permits. The money will be used for conservation within the Marine Parks.

The National Parks and Conservation Fund can also support biodiversity conservation projects relating to wetlands.

3.5 Legislation, Policy and Institutional Framework.

3.5.1 Legislation

Legislation is fragmented and dispersed across a number of different acts and regulations, with powers conferred to several ministerial portfolios resulting in an apparent lack of co-ordination and co-operation between them. The existing legislations are also inconsistent in several respects. Where possible legislation needs to be strengthened and harmonised in order to provide adequate protection. The main acts relevant to marine, coastal and freshwater biodiversity protection include:

Environment Protection Act (EPA), 2002

The Environment Protection Act (2002) specifies that an EIA is required for land clearing and development in environmentally sensitive areas such as water catchments, mountain slopes, islets, and wetlands.

The Act provides for the creation of an Integrated Coastal Zone Management Unit within the Ministry of Environment to coordinate the various actors. A multi-stakeholder ICZM Committee was set up in 2003. The Act vests powers in the Minister to make regulations for the prevention of pollution in the coastal and maritime zones, this mandate however is yet to be used to any substantial degree, and decisions for individual items are largely taken independently by the agencies concerned.

Mauritius Oceanography Institute Act, 1999

The Mauritius Oceanography Institute (MOI) was established under the MOI Act (Act No. 24 of 1999) to rationalise and co-ordinate research and development activities related to Oceanography. The MOI monitors the marine environment around Mauritius, Rodrigues and the Outer Islands, and advises the Government on appropriate policies and strategies for the management of resources under its jurisdiction.

Wildlife and National Parks Act 1993, the National Parks and Reserve Regulations of 1996, and the Wildlife Regulations of 1998

The Act specifies that camarons (*Macrobrachium lar*) less than 8.5cm and berried females cannot be caught or sold, and that camarons and shrimps cannot be fished for with explosives, poisons or using artificial light. It also specifies that unless the watercourse is on private land, a permit is required for fishing.

The Fisheries and Marine Resources Act 1998 & MPA regulations 2001

The Act provides for the management, conservation and protection of fisheries and marine resources, and the protection of marine ecosystems. In addition to providing for general enforcement and compliance measures, it also deals with protection of the aquatic ecosystem against pollution, exploitation of mangroves and construction activities. The Act also enables proclamation of marine protected areas in Mauritian

waters. The Regulations include specifying associated land areas for the MPA, setting up of an MPA Fund and conservation measures.

National Coast Guard Act, 1988

The National Coast Guard has the responsibility for enforcement of any law relating to the protection of maritime zones. In addition, they have the powers to prevent any activity which is likely to constitute a threat to maritime zones including pollution.

Maritime Zones Act, 1997 (amended 2005)

This provides for the Prime Minister to make regulations for the preservation and protection of the marine environment and the prevention and control of marine pollution.

Central Water Authority Act (1981)

This act, lays down the responsibilities of the CWA. These include the study and formulation of policy in relation to the control and use of water resources including the protection of wildlife, afforestation and control of soil erosion, disposal of industrial waste, abatement and prevention of water pollution. The CWA also has the power to stock rivers and watercourses with fish undertake measures for the prevention of diseases and discontinue supply of water of any consumer that discharges polluted water.

River, Reserves and Canals Act (1863)

This act specifies actions, buildings and livestock activities that are prohibited within a given distance from the water body as they can cause water pollution.

Public Health Act (1925)

This act empowers the authority to remove any nuisance that pollutes a water body.

3.5.2 Policy

The present institutional, policy and legislative framework for managing the coastal zone is fragmented. The 1991 *State of the Environment Report* recommended that the control, custody and management of a coastal zone should be vested in one authority. However, as yet there is no government body with overall responsibility for the coastal zone and many Ministries and organisations have inter-related responsibilities.

The main policies for controlling development of coastal zone are the NDS (2003) and NEAP (1999). According to the NDS, the coastal area is the most sensitive environmental area given its vulnerability to irreversible damage and the importance of this zone for the Mauritian economy.

An Integrated Coastal Zone Management Unit (ICZM unit) has been established under the EPA (2002) within the MoE. Its role is to develop appropriate policy and legislation for coastal resources and identify research priorities.

The tourism policy for the Government of Mauritius is to promote high class tourism, in line with a development strategy which is focused on quality at all operational levels. The *Vision 2020* tourism strategic plan anticipates a continued growth in net tourist receipts, although with a restriction on the extent of tourism development, and therefore on the numbers of arrivals. A ceiling of 700,000 visitors per year and 9,000

hotel rooms was proposed in the Tourism Carrying Capacity study commissioned by the Ministry of Tourism (KPMG, 1998). However this limit has been reached and the Government has already expressed its intention to further develop the industry in the near future. As a powerhouse of economic growth, tourism takes on an added dimension in the medium and long-term national policy and development framework of the island.

3.5.3 Institutional framework

The following governmental institutions are involved in coastal, marine and freshwater issues:

<i>Institution</i>	<i>Responsibility</i>
Department of Environment	EIA, environmental quality
Ministry of Agro-Industry & Fisheries	Fisheries and lagoon eco-system
Department of Local Government	Shore development, beaches
Ministry of Housing and Lands	Physical planning policy
Ministry of Land Transport, Shipping and Ports	Marine pollution from vessels
Mauritius Ports Authority	Port functions, shipping
Ministry of Tourism and Leisure	Coastal hotels and recreation
Prime Minister's Office	Meteorological services, National Coast guard/police
Beach Authority	Shore development and beach management
Central Water Authority, Ministry of Public Utilities	Freshwater distribution
Water Resources Unit, Ministry of Public Utilities	Assessment of freshwater resources
Waste Water Authority; Ministry of Public Utilities	Wastewater management
Outer Islands Development Corporation	Outer islands management

The Division of Fisheries is the enforcement agency for waters, under the Environment Protection Act (2002) and has two sections:

- *The Albion Fisheries Research Centre* (AFRC) has a staff of about 60. There are eight technical divisions: Coastal Zone Management, Marine Parks, Fisheries Management, Fisheries Planning, Marine Science, Fisheries Research, Aquaculture and Fisheries Training Extension and Development.
- *The Protection Service* is responsible for the enforcement of the Fisheries Act and regulations and has a staff of about 230. Protection personnel work with the National Coast Guard at sea to carry out enforcement.

Mauritius Oceanography Institute (MOI) and National Oceanographic Data Centre (NODC)

These agencies have an important role in managing data on the coastal zone. MOI carries out scientific research on oceanic processes and facilitates sustainable use of resources. It is the hub of regional collaboration and global cooperation for the Indian Ocean Studies, and the National Coordinating body for oceanographic activities in the country.

Non-Governmental Organisations

There are a large number of non-governmental organisations specifically focused on the coastal zone, many of which are associated with diving. The Mauritius Marine Conservation Society (MMCS), the Mauritius Scuba Diving Association (MSDA), the

Mauritius Underwater Group (MUG) and Reef Mauritius continue to sink ships to form artificial reefs, set up permanent mooring sites and have organised an underwater film festival to raise awareness of the value of the coastal zone. The NGO Grand Baie Watch works to improve the environment of the important tourist resort of Grand Baie.

3.6 Identification of Gaps and Existing Needs

Review of the existing documentation and consultations with stakeholders have identified a number of priority concerns. There is a need for holistic management of the coastal zone so as to optimise the balance of socioeconomic and environmental benefits. Key issues associated with the coastal zone include:

- Control of shoreline development
- Management of beaches
- Waste and pollution management
- Soil and agrochemical management
- Control of lagoon usage
- EIA as a tool for mitigating adverse effects of development
- Strengthening resource stewardship
- Protection of waters around offshore islets
- Increased monitoring of ecosystem health

Management is currently constrained by:

Lack of Data

Data are inadequate and difficult to access. There is a general lack of information on fresh water biodiversity. A comprehensive survey is required to enable the conservation and sustainable use of freshwater biodiversity.

There is inadequate information on marine resources in the EEZ and information on IAS is lacking.

Lack of Consistent Guidelines

Planning guidelines and procedures for the coastal zone do not successfully harmonise the built environment with the natural environment. In some cases existing guidelines are contradictory.

Public awareness and sensitization

Public education and sensitization of school children, local communities and decision makers needs to be an on-going process. Stakeholder interaction needs to be enhanced to enable their contribution towards biodiversity conservation.

Protected areas

The existing protected areas are not representative of marine habitats or large enough to enable sustainable use.

Ecotourism

The ecotourism component of the tourism sector remains small and under exploited. There is a need to further develop ecotourism as a means of advancing the conservation and sustainable use of biodiversity. A Code of Ethics and a National Environment Pledge should be elaborated and marketed for a countrywide adoption to ensure tourism developments are established and maintained sustainably.

Chapter 4. Agricultural Biodiversity, Biotechnology & Biosafety

4.1 Overview of the Agricultural Sector

Crops and animals have been introduced to Mauritius since the first settlements

in the seventeenth century. Many of the current crops grown and animals reared have thus formed the basis of agriculture for a long time and it is these varieties and breeds, which are seen as constituting the agricultural biodiversity of Mauritius. One species from the native flora is exploited (*Dictyosperma album*), and there are three members of one genus that has yielded economically important crops elsewhere (*Coffea* sp.).

It is still unknown how many local cultivars and varieties of crops, fruit, vegetables and breeds of livestock there are in Mauritius. Today's agriculture depends increasingly on new introduced varieties of crops to increase yields per unit area and quality of produce (e.g. the Crop Research Department of AREU introduced 325 varieties of 22 crops in 2004 (AREU 2005)). Consequently local types and related traditional knowledge are being lost. Crop conservation relies on efficient and well-maintained seed and genebank programmes.

Up until the 1970's the Mauritian economy was predominantly agricultural and based on sugar cane production. Since the 1980's there has been an increase in industrialization and economic diversification. The agricultural sector's contribution to GDP has declined from 23% in 1970 to 6.2% in 2004 with sugar cane, tea and tobacco contributing 66% of this total, food crops 20%, and livestock and poultry 10% (Central Statistical Office 2004).

46% of the island is under agricultural cultivation, of which 82% is sugar cane (CSO 2004). Mauritius is normally self-sufficient in vegetables but not fruit (NDS 2003), and imports some potatoes, onions, garlic and maize and all of its wheat and rice (NSSSP 2003). There is some export of tropical fruits, notably litchis and pineapples. Mauritius is self-sufficient in chicken meat and eggs although 80% of the ingredients for feed is imported. Most other meat is imported -for example 90% of beef and 40% of goat meat consumed comes from abroad (Mauritius Meat Authority, 2003).

4.2 Plant genetic resources

Sugar cane

The cultivated *Saccharum* species, *S. officinarum*, *S. sinense*, *S. barberi*, and the wild *Saccharum* species *S. spontaneum*, *S. robustum* as well as associated genera, *Erianthus*, *Miscanthus*, *Narenga*, *Sclerostachya* constitute the basic genetic resources of sugar cane. The history of the introduction of sugar cane dates back to the colonisation of Mauritius, but it was during British rule that many varieties were introduced and later there were more systematic introductions by the Chamber of Agriculture (Ramdoyal & Domaingue, 1995). The varietal situation witnessed a major change towards the turn of the twentieth century and the advent of interspecific hybridization. When the Agricultural Department was established in 1913, variety introduction from abroad was further promoted. The Sugar Research Station established in 1930 continued to introduce commercial hybrids and wild species and to carry out breeding activities. With the creation of the Mauritius Sugar Industry Research Institute (MSIRI) in 1953, breeding work was intensified and a dynamic varietal exchange policy was maintained. New varieties are regularly developed to meet the requirements of the sugar industry.

Maize

Maize (*Zea mays*) was an economically important crop at the beginning of the

French colonization in the 18th century. There were subsequent periodic introductions from several sources including America, Europe and Africa. Introductions were restricted when quarantine laws were enacted in 1940, and it was then that farmers started selecting on the basis of their own taste and requirements. By saving seeds from one generation to the next, farmers created a number of ecotypes suited to their production systems. The preference for these ecotypes was more accentuated in Rodrigues, where farmers continue to cultivate modern versions in the form of composites. In Mauritius maize is no longer grown to a significant extent.

Vegetables

The number of local crop varieties, races and cultivars is still unknown. Local varieties of 35 crop species are still used regularly (PRDO, Div. Horticulture 2005). These include 'local red' bean, 'yard long' asparagus bean (*Vigna unguiculata* cv *sesquipedalis*), local red onion (*Allium* spp.), tomato 'var. quatre carres'; groundnut 'var. cabri'; garlic 'var. local'; cucumber 'var. local white', local cauliflower and pumpkin 'var. local'.

Other crops (root, tuber and fruit)

Many old cultivars of cassava (*Manihot esculenta*) and sweet potato (*Ipomoea batatas*) still exist as they were important staple foods as recently as the Second World War.

The pineapple (*Ananas comosus*) is an important export commodity. 437 tonnes were exported in 2003, with a value of MRU15.9 million. Litchi (*Litchi chinensis*) was introduced in the early 19th century from China, and has been grown extensively for local consumption and as a commercial crop. 150 tonnes of litchi were exported in 2004, mostly to Europe (223 tonnes were exported in 2005). There are three cultivars in Mauritius, one of which constitutes 98% of the commercial business. Between 1989 and 1992 eleven new varieties were introduced to develop high yielding varieties. Many of the 62 mango cultivars (*Mangifera indica*) are grown extensively for local consumption. There are 18 cultivars of banana (*Musa* sp.) and many local varieties of citrus.

In addition some species that yield fruit or vegetables are grown in backyards e.g. *Ziziphus mauritiana* (maçon or Indian jujube), *Elaeocarpus serratus* (Ceylon olive or sweet olive), *Artocarpus heterophyllus* (jack fruit) *Artocarpus altilis* (bread fruit). Others have become naturalised or even invasive in Mauritius including *Psidium cattleianum* (goyave de chine) and *Syzygium jambos* (jamrosa).

Wild relatives of food crops

The native flora contains one species that is exploited (*Dictyosperma album*) and three members of one genus (*Coffea* spp.) that has yielded economically important crops elsewhere. Two of these *Coffea* species (*Coffea macrocarpa* and *C. myrtifolia*) are endemic to Mauritius, while the third, *C. mauritiana*, is also found in Réunion. These species are known to be naturally caffeine-free and could thus be of great importance in developing low caffeine cultivars (Dulloo, 1998).

The endemic palmiste blanc (*Dictyosperma album* var. *album*) is cultivated in plantations on marginal lands for its palm cabbage. This local trade is estimated to be worth 20 million rupees (Govinden, 2004). In the past the cabbages were exported, but

the trade has stopped as local demand from hotels and restaurants is greater than the supply.

Although they are not native, several wild relatives of important crops have become naturalised in Mauritius. These include tomato (*Lycopersicon esculentum* var *tallerelli*), pigeon pea (*Cajanus cajan*), potato (*Solanum commersoni*), *Solanum torvum* (white flowers) and *Solanum indicum* (violet flowers).

An interesting species, lentille créole (*Vigna glabreus*), is believed to be unique. It was found in the Pamplémousses Garden and is extensively used in the development of fusarium-wilt resistant beans. Seeds are stored in the *Vigna* collection at Gembloux, Université Agricole, Belgium.

Mauritius has a lot of lesser known and under-utilized crops to which value needs to be added and their utilization encouraged (Gurib-Fakim, 2005).

Forestry

Commercial forestry relies on introduced tree species. This is dealt with in the section on terrestrial and forest biodiversity.

Medicinal plants

These are discussed in the section on terrestrial and forest biodiversity.

4.3 Animal genetic resources

All farm animal genetic resources were introduced to Mauritius during the period of colonisation. The 'local' breeds found in Mauritius originate from these introductions. However indiscriminate crossing of exotic breeds with local breeds has led to the genetic erosion of this resource.

Cattle

The Creole breed of cattle is a medium sized cow, characterized by its white colour, an absence of hump and lack of horns. The breed originated from Northern Europe and most probably came through France if not from France. According to Bennie (1956), it is possible that this breed was introduced in the eighteenth century while the first introductions of cattle date back to 1511. New germplasm in the form of live animals has been introduced over time, namely the Jersey, Friesian, Sahiwal, Ongole, Boran and Brahman breeds. Presently artificial insemination is carried out using imported semen from the Friesian breed. In 2001 there were 8,690 cattle in Mauritius, of which 273 were the Creole breed. (AREU 2003)

Goats

There were some 21,450 goats in Mauritius in 2001 (AREU, 2003), the majority belonging to the local breed – the Barbari. This is a mixture of different breeds that were introduced over time. As recently as 1980's and 1990's several breeds such as the Jamna Pari, the Anglo-Nubian and the Boer were imported to try and boost the goat sector. These introductions have not been successful although the Boer still exists in its pure state due to its recent introduction.

Sheep

The local breed has been heavily diluted by introductions of breeds such as the Dorper, Black Head Persian, Romanov, Vendeen, Causse du Lot and the Blanc du Massif Central.

Pigs

In 2001 there were some 12,100 pigs (AREU, 2003) comprising Large White and landrace breeds. A few farmers still possess the local breed - the mongoose pig- although exotic breeds have almost completely displaced it due to their higher productivity.

Poultry

The local chicken still exists in rural areas. The commercial production of poultry meat and eggs relies on imported breeds suited for intensive production.

Ducks

Manille and Peking ducks are still found in rural areas.

Apiculture

In 2000 Mauritius produced 35 tonnes of honey and imported 103 tonnes (NSSP, 2003).

4.4 Ex-situ conservation

4.4.1 Plant genetic resources

Separate *ex situ* programmes exist for the different agricultural crops.

Sugar cane

The MSIRI holds a collection of clones, which have either directly or indirectly contributed to produce varieties that increase productivity. Details of this collection are shown in Table 4.1. It should be noted that these clones are conserved exclusively by vegetative means.

Maize: MSIRI used to hold forty-one accessions of ecotypes (2001). These were transferred to PGR Unit at Curepipe which now holds twenty-eight accessions in the seed bank.

Vegetables: Seeds have been collected and stored in a seed genebank since 1985 through collaboration between the MoA and IPGRI, and latterly the SPGRC. To date there are 381 accessions in the collection (pers comm. PRDO Horticulture, 2005), stored at Curepipe with a replicate collection at the SPGRC, Zambia (Table 4.2). This compares to 220 accessions in 1985. Characterisation and multiplication of these accessions has yet to begin.

Table 4.1: Status of *Saccharum* germplasm and allied genera in the MSIRI collection
(Source: K. Ramdoyal, 2005)

Species	Number of accessions
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<i>S.officinarum</i>	151
<i>S.spontaneum</i> ¹	30
<i>S.robustum</i>	9
<i>S.sinense</i>	6
<i>S.barberi</i>	1
<i>Eranthus</i> sect <i>Ripidium</i>	21
<i>Saccharum</i> hybrids ²	429
<i>Erianthus</i> hybrids	3
<i>Miscanthus</i> hybrids	2
Commercial hybrids	
Mauritian	800
Foreign	710
Others ³	38
TOTAL	2200

¹ An additional 40 clones are available in quarantine; ² Early generation nobilisation, F1, BC1, BC2; ³ Advanced generation backcrosses

Table 4.2: List of Accessions at the Seed Gene Bank, Curepipe

Scientific name	Common name	No. of Accessions (2005)
<i>Abelmoschus esculentus</i>	Okra	28
<i>Allium cepa</i>	Onion	18
<i>Amaranthus</i> spp.	Greens	8
<i>Anettum</i> spp	Annett (wild)	1
<i>Arachis hypogea</i>	Ground nut	6
<i>Benincasa hispida</i>	Wax gourd	1
<i>Brassica oleracea</i>	Cabbage	2
<i>Brassica oleracea</i> var. <i>oleracea</i>	Cauliflower	9
<i>Brassica</i> spp.	Greens	10
<i>Cajanus cajan</i>	Pigeon Pea	2
<i>Capsicum</i> spp	Chilli pepper	39
<i>Carica papaya</i>	Pawpaw	2
<i>Cavanalia gladiata</i>	Sword bean	1
<i>Citrillus lanatus</i>	Watermelon	7
<i>Coriandrum sativum</i>	Coriander	3
<i>Cucumis melo</i>	Melon	1
<i>Cucumis sativus</i>	Cucumber	23
<i>Cucurbita maxima</i>	Butternut	1
<i>Cucurbita maxima</i>	Pumpkin	11
<i>Cucurbita pepo</i> var 3	Squash	1
<i>Daucus carota</i>	Carrot	3
<i>Glycine max</i>	Soya bean	3
<i>Lablab purpureas</i>	Hyacinth bean	1
<i>Lactuca sativa</i>	Lettuce	7
<i>Lagenaria siceraria</i>	Bottle gourd	18

<i>Luffa acutangula</i>	Ridge gourd	11
<i>Lycopersicum esculentum</i>	Tomato	23
<i>Momordica charantia</i>	Bitter gourd	6
<i>Morinda citrifolia</i>	Noni	2
<i>Moringa oleifera</i>	Drum stick	1
<i>Nicotiana tabaccum</i>	Tobacco	3
<i>Petroelinum crispum</i>	Parsley	2
<i>Phaseolus spp</i>	Beans	34
<i>Pisum sativum</i>	Pea	1
<i>Raphanus sativus</i>	Radish	5
<i>Ricinus communis</i>	Castor (wild)	2
<i>Solanum nigrum</i>	Nightshade	5
<i>Solanum spp.</i>	Aubergine	33
<i>Tetragonia tetragonioides</i>	Spinach	1
<i>Tricosanthes cucumerina</i>	Snakegourd	4
<i>Vicia faba</i>	Faba bean	1
<i>Vigna mungo</i>	Mung bean	5
<i>Vigna unguiculata</i>	Cowpea	7
<i>Zea mays</i>	Maize	28
<i>Ipomoea obscura</i>	Liane latic	1
TOTAL		381

Other crops - Roots, tubers and fruits:

Roots, tubers and fruits are kept in field genebanks. The PGR unit (Division of Horticulture) has two ex-situ field genebanks, one in the dry zone (Roches Brunes) and one in the humid zone (Nouvelle Decouverte). There is also a collection at AREU. For several crops, such as mango, all of the old varieties are represented in the collection, for some the collection is still being established, and for one species (cassava) the collection set up containing 18 local varieties has been lost, and is being rebuilt. The *ex situ* coffee collection has also been removed. The accessions at these stations are given in Table 4.3

Table 4.3: List of Accessions of roots, tubers and fruit. (updated 2005 Horticulture Division and AREU)

Scientific Name	Common Name	Location of collection	Number of Accessions in 2005 (in
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			brackets 1995)
<i>Allium cepa</i>	Chives	Nouvelle Decouverte PGRC	1
<i>Allium sativum</i>	Garlic	AREU	31
		Nouvelle Decouverte PGRC	37
<i>Amorphophallus campanulatus</i>	elephant yam	Nouvelle Decouverte PGRC	2
<i>Ananas comosus</i>	Pineapple	AREU	5 (3)
<i>Ananas bracteatus</i>	wild pineapple	Nouvelle Decouverte PGRC	1
<i>Bactris gasipaes</i>	peach palm	Nouvelle Decouverte PGRC	1*
		Curepipe E.S	1
		Richelieu E.S	1*
<i>Canna edulis</i>	arrow root	Nouvelle Decouverte PGRC	1
<i>Colosia esculenta</i>	songe	AREU	5
<i>Colocasia esculenta</i> var. <i>antiquorum</i>	Taro(arouille cari)	Nouvelle Decouverte PGRC	1
<i>Colocasia esculenta</i> var. <i>antiquorum</i>		AREU	3
<i>Colocasia esculenta</i> var. <i>esculenta</i>	Taro(arouille violette)	Nouvelle Decouverte PGRC	1
<i>Colocasia esculenta</i> var. <i>esculenta</i>		AREU	2
<i>Curcuma amada</i>	mango ginger	Nouvelle Decouverte PGRC	1
<i>Dioscorea spp.</i>	Igname	Nouvelle Decouverte PGRC	3
<i>Fragaria ananassa</i>	Strawberry	Nouvelle Decouverte PGRC	3
		AREU	6
<i>Ipomea batatas</i>	sweet potato	Nouvelle Decouverte PGRC	58*
		AREU	6 (39)
<i>Litchi chinensis</i>	Litchi	AREU	14 (3)
<i>Mangifera indica</i>	Mango	AREU	40 (62)
<i>Manihot esculenta</i>	Cassava	Nouvelle Decouverte PGRC	4
		AREU	3 (18)
<i>Musa sp.</i>	Banana	AREU	40(8)
<i>Palm</i>		AREU	10
		Nouvelle Decouverte PGRC	17
<i>Psidium guajava</i>	Guava	AREU	6
<i>Sechium edule</i>	chou chou	Nouvelle Decouverte PGRC	3
<i>Zingiber officinale</i>	ginger	AREU	2
		Nouvelle Decouverte PGRC	2
	corn flour	Nouvelle Decouverte PGRC	1
<i>Cocos nucifera</i>	Coconut	AREU	2
<i>Coffea sp.</i>	Coffee	AREU	0 (13)

* Accessions contain duplicates

4.4.2 Animal genetic resources:

Under a project funded by SADC 'Management of farm animal genetic resources in the SADC region (1999-2003) a census of cattle, goats, pigs and sheep was carried out. However, the local breed was only considered separately for cattle. The survey recorded 273 créole cows (AREU 2003).

The only germplasm conservation that is carried out for animals has been the creation of a nucleus of Creole cattle at Curepipe Livestock Research Station.

4.5 Sustainable farming practises

Market gardening in Mauritius is heavily dependent on pesticides and fertilisers. Sugar-cane production relies on integrated pest management for pest control, but requires intensive use of fertilizers (500-700 kg per hectare). In 2004 Mauritius used 61,000 tonnes of fertiliser (Central Statistical Office, 2004).

Potential negative environmental impacts of the sustained use of agrochemicals include water pollution, loss of freshwater biological diversity, declining soil fertility and falling crop yields. At present little is known about the link between the concentration of agrochemicals in hydrological, estuarine and marine environments and on-going agricultural practices (CBD First National Report, 2000). There is also little awareness or monitoring of the impact on the health of employees and the general public (ERM, 1999; NDS 2003). Strict controls over the use of these chemicals near sensitive areas (residential areas, schools etc) should be established. (NDS, 2003).

Projects aimed at developing a more environmentally sustainable agriculture include:

Organic farming

At present organic farming is not carried out commercially and a regulatory framework pertaining to organic farming needs to be developed in order to meet stringent regulations. Research is being carried out by both AREU and the Agricultural Services (MoA) on the applicability of organic farming to a wide range of cultivated crops. Two recent experiments with cauliflower and cucumber indicate that both crops produce good yields using compost and organic pesticides (Agronomy Division, Agricultural Services 2005).

The trial production of organic sugar by three sugar estates for a niche market in Europe amounted to 649 tonnes in 1995. By 2003 only 50 tonnes were exported, and production has now stopped.

Organic fertilizer by composting

With the support of the University of Mauritius (UoM), and the UNDP GEF-SGP, an aggressive campaign of composting was launched following the successful implementation of a pilot/ demonstration compost plant in Belle Mare. Means to convert municipal waste into organic materials are also being explored – a tender has been launched to carry out a feasibility study for a National Composting Plant (Ministry of Local Government 2005).

Biological control - Several trials of biological control are ongoing. These include:

- ☐ Cyprus aphids (*Cinera cupressivora*) using the parasite *Panesia juniperorum* imported from the Kenya Forest Research Institute.
- ☐ *Aleurodicus dispersus* (spiraling white fly), first recorded in Mauritius in July 2000 and a source of severe problems on ornamentals and fruit trees. A predator *Nephaspis bicolor*, from the Republic of Trinidad and Tobago has been released

in both Mauritius and Rodrigues to control the insect.

- ☐ The rhinoceros beetle (*Oryctes rhinoceros*) using the virus *Baculovirus oryctes*. The virus has become firmly established since 1970 and keeps the insect in check.

Fruit flies pose an economic problem for fruit production. Bait Application Techniques (BAT) and Male Annihilation Technique (MAT) have been adopted to control fruit flies. A sterile insect technique is also used for the control of both fruit flies and melon flies. The success of these projects is not known.

4.6 Traditional knowledge, access and benefit sharing

With the increased use of modern agriculture and adoption of novel improved varieties, traditional genetic resources are in rapid decline along with the associated traditional knowledge. Traditional knowledge represents centuries of accumulated experiences and skills of farmers who often sustained yields under adverse farming conditions. This knowledge is as important to conserve as the varieties themselves.

So far no inventory of traditional knowledge within the farming community has been documented and immediate steps should be initiated to gather and preserve traditional knowledge before it is lost forever.

4.7 Ongoing strategies and activities towards conserving agricultural diversity

Ongoing activities in this sector include:

- ☐ Monitoring of viability of accessions in the crop seed gene bank.
- ☐ Establishment of field gene banks for fruit species and tuber crops.
- ☐ Maintenance, management and evaluation of sugar cane accessions in the field;
- ☐ Collaboration and training through SADC Plant Genetic Resources Centre. To date 3 Mauritians have received funding for M.Sc. programme, 11 have received a certificate in Plant Genetic Resources.
- ☐ SADC project for the management of farm animal genetic resources.
- ☐ Characterisation of Creole cattle and creation of a nucleus population at Curepipe.
- ☐ Compilation of literature review on Farm Animal Genetic Resources in Mauritius.
- ☐ Characterization of the local goats.

4.8 Biotechnology in Mauritius

Biotechnology has many traditional applications in agriculture and has been applied in Mauritius for a number of years in the processing of dairy products, in brewing and in the transformation of sugarcane co-products for the production of alcohol and animal feed. The application of modern biotechnological tools began to take on importance in the late 1980s in the agricultural sector.

The application of biotechnology to crop breeding is being increasingly emphasized. For apart from sugarcane, where genome mapping, marker-assisted selection and genetic transformation are being developed, it is expected that in the next

decade biotechnology will be integrated into the classical plant breeding programme to enhance the production of new cultivars. The introduction of new traits, for disease and drought resistance, for nitrogen fixing, and for the production of bioplastics in sugarcane are being contemplated. These techniques may also be applied to other crops such as potato for the production of pest and virus resistant clones.

In the last decade Mauritius has become more involved in new biotechnologies and now has several institutions devoted to agricultural research. The leading institute is the MSIRI, with trained scientists and specialised laboratories. Since the early 1990s it has focused on three main research areas - marker-assisted selection, molecular diagnostic tools and genetic engineering for improving sugarcane cultivars with new traits. The University of Mauritius has a Research and Development (R&D) programme in biotechnology and provides training in this field to undergraduate and postgraduate students. There is a strong government will to promote biotechnology. In the Non-Sugar Sector Strategic Plan (2003-2007), the government proposed to set up a National Biotechnology Institute at the cost of MRU 360 Million. A Memorandum of Understanding in Biotechnology was signed between India and Mauritius in 2002 to allow exchange of personnel between the two countries.

Research in biotechnology in the non-sugar sector is predominantly Government funded. Sugarcane biotechnology is mainly financed by a cess (or tax) on sugar produced. International funding by the European Union (EU) has partly contributed to the setting up of the FARC tissue culture laboratory, but inadequate funding is a major constraint towards the progress of many of the existing laboratories. In 1997 the overall funds allocated to biotechnology in the country was estimated to be less than MRU 12 million.

Most of the research activities in biotechnology have been in the agricultural sector with a comprehensive programme in the sugar sector, which includes projects in plant tissue culture, molecular diagnostics, genetic transformation, and molecular mapping for breeding purposes.

Tissue culture

Plant tissue culture is of particular interest because it requires low biotechnological techniques. In 2004, six plant tissue culture laboratories were operational on the island. Some of the laboratories carry out multiplication of imported starter cultures using commercial protocols, while others are involved in all steps required for propagating tissue cultured plants. Plants propagated include ornamentals (orchids, anthurium, carnation, syngonium, caladium, gerbera, chrysanthemum, begonia, roses), fruits (banana, pineapple, strawberry), vegetable crops (asparagus, potato, ginger) and sugarcane varieties.

The laboratories have a potential *in vitro* annual production capacity of over 1.5 million plantlets. *In vitro* culture is also being used to eliminate diseases from sugarcane cultivars infected with pathogens of viral and bacterial origin (Parmessur *et al.*, 2002).

Diagnostics

For the diagnosis of plant, animal and human diseases, molecular techniques

based on serological tests using monoclonal and recombinant antibodies, and nucleic acid sequence-based techniques, are being applied. These new techniques provide a higher sensitivity, specificity and accuracy and thus enhance diagnosis of diseases. These techniques are also proving to be useful for the study of genetic variability amongst strains of pathogens present in Mauritius. In the veterinary sector, a small volume of vaccines against Newcastle disease and Fowl pox are produced using imported seed vaccines.

Genome mapping

Molecular techniques are being applied to plant breeding as an aid to conventional methods. Research in molecular mapping and genetic transformation was initiated in 1994 to improve the sugarcane crop. A molecular genetic map for a local commercial sugarcane cultivar has been produced using AFLP and microsatellite markers and markers linked to the yellow spot disease resistance gene have been identified (Aljanabi *et al.*, 2005). The aim is also to identify molecular markers for resistance to yellow spot and leaf scald diseases, sucrose content and other agronomic traits.

Collaborative links of the MSIRI to various foreign institutions as a member of the International Consortium for Sugarcane Biotechnology (ICSB), has allowed the Mauritian sugar industry to benefit from the results of several biotechnology projects being undertaken in well-known research centres abroad.

Genetic transformation

Research in the field of genetic transformation was initiated in Mauritius in 1995. In May 1999, the MSIRI produced its first transgenic sugarcane plants. Scientists at the MSIRI introduced the *bar* gene that confers resistance to the herbicide Basta® into the embryogenic callus of two commercial sugar cane varieties. The transgenic plants have been multiplied *in vitro* for further testing, and evaluated under glasshouse conditions. Field-testing will only be carried out after appropriate legislation governing biosafety is enacted.

Environmental management

The use of biotechnology for the treatment of wastewater is being investigated at the University of Mauritius.

4.9 Legislation, policy and institutional framework

4.9.1 Legislation:

The Genetically Modified Organisms Act (2004)

This law provides for measures ‘to regulate the responsible planning, development, use, marketing and application of genetically modified organisms’ in the food and agricultural sector. It also ensures that all activities involving the use of GMOs and products thereof are carried out in such a way to limit damage to the environment and risk to human health. Only part of this Act has been enacted, namely entry, transit and labelling of GMOs.

A National Biosafety Committee has been set up under the Act to advise on all aspects concerning the importation, exportation, transit, development, research, production and use of GMOs.

The Environment Protection Act (2002)

Part A of the First Schedule of the Act stipulates that the development, production, release, use, marketing and application of GMOs warrant an EIA Licence.

The Plant Genetic Resources and Plant Breeder's Right Bill (in development)

The object of this bill is to provide for the protection of plant breeder's rights on new varieties.

Memorandum of Agreement for the supply of biological material

A Memorandum of Agreement for the supply of biological material by the Government of Mauritius is in place. This agreement is in accord with the CBD and specifies that the property remains with Mauritius and that use is for non-commercial purposes only. A new agreement must be signed for commercial use, specifying that any benefits will be shared with the Government of Mauritius.

4.9.2 Policy

- ☐ The Non-Sugar Sector Strategic Plan (2003-2007) – a sustained programme for agricultural diversification includes a policy on plant genetic resources. The policy includes establishing a legal and institutional framework to address Plant Genetic Resources and GMOs, consolidation of germplasm collections by increasing facilities and training staff, promotion of long-term conservation of PGR, establishment of an information system, evaluation of genetic drift in local varieties, and development of relevant research programmes.
- ☐ National Biosafety Framework (1999) An Institutional Biosafety Committee was constituted at the MSIRI in 1996 to review all projects regarding GM technology. In 1999, with the assistance of UNEP/GEF, National Biosafety Guidelines for the 'Safe Development and Introduction of Genetically Modified Organisms in Mauritius' were prepared (Dookun *et al.*, 1999).

4.9.3 Institutional framework

Some of the institutions that are actively involved with Agricultural Biodiversity at the national level are:

- ☐ PGR Unit of the MoA (*ex situ* conservation of food crop, fruit, root and tuber genetic resources);
- ☐ Mauritius Sugar Industry Research Institute (Conservation and utilization of sugar cane and potato);
- ☐ University of Mauritius provides training in biodiversity and sustainable agriculture for students studying Agriculture at degree level. There is also a crop museum which is maintained at the University farm;
- ☐ Agricultural Services including the Veterinary Service, Animal Production Division of the MoA;

- ☐ Agricultural Research and Extension Unit (AREU);
- ☐ Mauritius Chamber of Agriculture (MCA);
- ☐ Farmers Service Centre;
- ☐ Food and Agricultural Research Council (FARC).

Research in biotechnology is carried out in several centres in Mauritius namely:

- ☐ Agricultural Services - Ministry of Agriculture, Food Technology & Natural Resources
- ☐ Food and Agricultural Research Council (FARC)
- ☐ Agricultural Research and Extension Unit (AREU)
- ☐ University of Mauritius
- ☐ Mauritius Sugar Industry Research Institute (MSIRI)
- ☐ Private firms

The Faculty of Agriculture at the University of Mauritius has run B.Sc. (Hons.) Food & Agricultural Biotechnology in the past and at present is running a B.Sc. (Hons.) in Agricultural Biotechnology (24 students in 2005) and M.Sc. in Plant Biotechnology (10 students in 2005). Other biotech related programmes at the University include M.Sc. in Bioinformatics and a M.Sc. in cell & molecular biology. There is also a Certificate/Diploma in Biotechnology for Small and Medium Enterprises, and a number of MPhil/PhD students working on Biotech projects. Recently 2 PhDs and 1 MPhil in Plant Biotechnology have been awarded, and there are at present 7 students doing their MPhil/PhD in Plant Biotechnology at the Faculty of Agriculture.

4.10 Identification of Gaps and Existing Needs

The consultations undertaken for the NBSAP have revealed a number of shortcomings, gaps and issues:

Institutional framework and integrated policy

At present there is no coordination body for activities in the agricultural biodiversity sector and genetic resources available in the country. The inadequate coordination of activities can lead to inefficient use of resources, duplication of work, and restricted information flow among others.

Biological data

Data on farm animal genetic resources has yet to be collected. In the crops sector data on ecotypes of varieties of crops and under-utilised species is not available. The lack of basic biological data will hinder the formulation of conservation policies.

Conservation activities

The MSIRI has an on-going programme for the exchange, conservation, evaluation, characterisation and utilisation of sugar cane germplasm for breeding purposes. For other crops, the characterisation of accessions in the genebank, the regeneration and multiplication of accessions, the management of genebank accessions, and the establishment of field genebank are not being undertaken due to lack of equipment, shortage of land and facilities available to the PGR Unit. In the livestock sector, there have not been any conservation activities except for the fact that a nucleus of Creole cattle is being kept at Curepipe Livestock Research Station (AREU) since

2000.

Shortage of personnel in specialized fields

Many activities concerning agricultural biodiversity are very specific and therefore require trained personnel to tackle specific duties. At present such personnel are limited.

Public awareness and sensitisation

Conservation and utilisation programmes require the cooperation and support of the public but activities on public awareness are practically non-existent in this sector. In particular there has been little public education and consultation with regard to the handling, transfer and use of GMOs.

Legal framework

Complete enactment of the bills in progress needs to be carried out, as well as development of new bills in line with international obligations.

In order to develop a CBD-compliant discipline of biotechnology several constraints need to be overcome.

Lack of appropriate and modern laboratories

A number of institutions do not have adequate infrastructures to carry out high-tech biotechnology projects.

Poor development of biosafety guidelines

Biosafety standards and procedures as identified in the National Biosafety Guidelines must be implemented in the various institutions. So far only one institution, the MSIRI, has prepared its Institutional Biosafety Guidelines and set up its Institutional Biosafety Committee to review all projects in relation to the development of Genetically Modified Organisms (GMOs).

Trained personnel

There is a need for more qualified personnel in biotechnology as it is a specialized field. The National Biotechnology Committee has already identified training as a major issue towards the development and implementation of biotechnology projects in the country.

Chapter 5 Mauritius Framework Strategy

Vision

“That people in Mauritius enjoy a healthy environment and an enhanced quality of life, through the effective conservation and sustainable use of biodiversity in line with national and international commitments, while respecting local values.”

Mission Statement

“Mauritius will continue to work towards achieving a significant reduction in the rate of biodiversity loss by 2015.”

Strategic Objectives

- 1). Establish a Representative and Viable Protected Area Network (PAN)
- 2). Manage Key Components of Biodiversity
- 3). Enable Sustainable Use of Biodiversity
- 4). Maintain Ecosystem Services
- 5). Manage Biotechnology and its Products

Working Principles¹

The Interdependence of Humans and Biodiversity
Intrinsic Value
The Precautionary Principle
The Priority of In-situ Conservation
The Ecosystem Approach

Plan Duration and Review

The strategy is intended to have a 10-year duration 2006-2015 with an independent review during year five, which will provide the basis for a consultative revision of the BSAP so as to enable an adaptive management approach and the optimal attainment of goals and objectives.

¹ The working principles are stated in full overleaf.

5.1 Working Principles

The Interdependence of Humans and Biodiversity:

“Ultimately all Mauritians depend upon biological diversity and have a responsibility to contribute to its conservation and sustainable use.”

Intrinsic Value:

“All forms of life have intrinsic value”

The Precautionary Principle:

“Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimise such a threat”

The Priority of In-situ Conservation:

“The fundamental requirement for the conservation of biological diversity is the in-situ conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings.”

The Ecosystem Approach:

“An ecosystem approach to the management of biodiversity is central to achieving its conservation and sustainable use.”

5.2 Mainstreaming Biodiversity

The consultative development of Biodiversity Strategies and Action Plans (BSAPs) empowers stakeholders, by incorporating their capacities and priorities into the communal effort to manage biodiversity. The thematic areas and objectives in this document therefore reflect stakeholder priorities. However, for the NBSAP to function effectively and meets its obligations under the CBD other issues need to be addressed and incorporated into the overall document.

These issues were compiled and put to the final stakeholder workshop and approved as follows under the overarching title of Mainstreaming Biodiversity.

5.2.1 Implementation and Coordination:

- A Steering committee will fulfil an executive role, oversee, guide and monitor the implementation of the BSAP. The committee will have representative stakeholder

membership², be equitable in mode of function³ and should be chaired by the Permanent Secretary of Environment. It was recognised that the mandate of the Steering Committee was of vital importance to its effective function. The Steering Committee will require Cabinet endorsement and Chairmanship by the Permanent Secretary for Environment to ensure its sufficient prominence. This authority will enable it to influence the day-to-day workings of sectoral Government portfolios and fulfil its role of coordination, outreach and partnership building.

- A coordinating unit consisting of 2-3 dedicated staff will be formed and fall under the administrative responsibility of the Ministry of Environment⁴. The Unit will serve as secretariat to the Steering Committee with its broader terms of reference to be determined by the Steering Committee.

5.2.2 Integrating Biodiversity Concerns

- The steering committee and coordinating unit will also function to integrate the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies (CBD Article 6b). This will be achieved through:
 - the representative nature of the committee's stakeholder membership, and
 - the targeted and timely dissemination of information by the coordinating unit to appropriate agencies and partners.
- Biodiversity valuation: an economic analysis of the value of biodiversity, in its various forms and provision of services, to the economy is a vital element in incorporating biodiversity concerns into other sectoral activities.

5.2.3 Administrative and Legislative Review

The administrative structure for environmental management in Mauritius is fragmented with responsibility for policy (MOE) and implementation (MOAIF) residing in separate ministerial portfolios. Furthermore the agency responsible for conservation of biodiversity falls under a Ministry with a development oriented portfolio (MOAIF), which leads to the perception, if not the reality, of a clash of interests.

Environmental legislation is fragmented and lacks the appropriate cross-referencing to enable the necessary checks and balances of portfolios (e.g. development and environmental management) to function smoothly.

A review of the administrative and legislative structures is necessary to streamline the management process and harmonise legislation. Work programme 1a explicitly addresses the issue of updating protected area categories and legislation, but other issues noted include:

- the creation of a framework Biodiversity Act to bring together all existing relevant legislation,

² The national workshop identified certain key members for inclusion: MOE, MOAIF, Environmental NGOs/Force Vives, MOHL, Academia, Local Community Leaders, Outer Island Development Coordinator (PMO), Private Landowners, GEF Operational Focal Point (MOFED), MOT.

³ Equitable function should empower civil society and build partnership in the BSAP implementation.

⁴ The Coordinating Unit need not necessarily be physically based in the MOE.

- the incorporation of the sensitive area atlas, being developed as part of the National Development Strategy, as a legislative tool under the Environment Protection Act.

These shortcomings were universally recognised by stakeholders in the national workshop but the general consensus was that no action would be taken to address it as similar observations and recommendations made in previous analogous processes had not resulted in any substantive change. Clearly this is a matter that, though recognised by technical staff, needs the political will to follow through and instigate positive change.

5.2.4 Information Management

Information management is essential for the effective implementation of CBD objectives and the adaptive management of the BSAP; and specifically with regard to Identification and Monitoring and Exchange of Information (CBD Articles 7 and 17 respectively). An Environment Information System (EIS) is being developed by the Ministry of Environment. It was agreed that the CHM should be incorporated into this broader database, with the appropriate modifications made to meet specific biodiversity information requirements, so as to reap cost and efficiency benefits.

5.2.5 Partnership Building

Successful biodiversity management requires broad stakeholder participation where society's capacities and resources are effectively harnessed towards the attainment of goals and objectives. The following activities were identified by stakeholders as central to harnessing the full support of civil society:

- Develop a Biodiversity Policy: Legislation provides a basic framework but it is policy that determines how legislation is implemented. The development of a National Biodiversity Policy would provide stakeholders with the stable and predictable working environment they need to invest time and resources into the conservation and sustainable use of biodiversity. The Policy, developed through a process of consultation and widely promoted and circulated, would also make Government accountable to stakeholders for its implementation of the BSAP and related initiatives creating an ideal scenario for partnership building and optimal stakeholder implementation of the BSAP.
- Review Incentive Measures: An economic analysis of current taxes, levies and incentives that relate to biodiversity management should be undertaken with a view to removing perverse incentives and optimising the economic environment to encourage private sector investment in the sound conservation and sustainable use of biodiversity.
- The Protection of Land Rights: Specific reference to the concerns of landowners was raised in the National and the forest and terrestrial thematic workshops. The concerns of private landowners are, in part addressed, by the forum to be established in Work Programme 1a. Due care and attention, however, should be paid in the development of the Biodiversity Policy and in the review of incentive measures to foster biodiversity protection on private property.

5.2.6 Capacity Building

The National Capacity Self Assessment (NCSA) was ongoing at the time of the development of this document and will provide a substantive capacity building requirements baseline for the effective implementation of the CBD in Mauritius. The NCSA however looks primarily at core-capacity issues as they also relate to the Conventions on climate change (FCCC) and desertification (CCD). Whereas this BSAP elaborates Mauritian biodiversity priorities as identified by stakeholders. A gap analysis of the final NCSA should be undertaken to ensure that the full capacity building requirements of the BSAP are addressed and a Human Resources Development Programme (HRDP) designed accordingly.

5.2.7 Education and Awareness

This is a crosscutting issue that should be incorporated as standard practice into all project developments and is hence not explicitly mentioned in all projects within the BSAP. All E&A campaigns need however to be designed with their own logical frameworks so that they can be effectively targeted, monitored and adaptively managed.

5.3 Enabling Activities

Following the completion and approval of the NBSAP document Mauritius will be able to apply for GEF funding under the “enabling activities add-on” programme. This money is typically not disbursed for implementation of NBSAP programmes but rather for additional activities that will facilitate the implementation of the NBSAP.

These funds and their application were discussed at length at The National Workshop and stakeholders identified the following as priority enabling activities:

- The Biodiversity Valuation cited under “Integrating Biodiversity Concerns”.
- The Rapid Assessment of Inland Waters, in line with CBD criteria, as an essential precursor to work Programme 1b on Inland Waters.
- The development of the Biodiversity Policy cited in the section on Partnership Building.
- Development of the Clearing House Mechanism so as to ensure that it has the appropriate characteristics and functionality to fulfil its CBD role of information storage and exchange, within the broader structure of the national Environmental Information System. This project was launched in March 2002 and is expected to be completed by April 2002. In particular means should be investigated to ensure its utility and accessibility to all stakeholders (national and international) including active targeted dissemination where appropriate.
- Project elaboration: this BSAP due to the circumstances of its development and finalisation represents a strategic framework where priority areas are identified and outlined. Once the Steering Committee is formed however, the projects described in the BSAP will require elaboration and formulation for submission to potential donors. The National Workshop recommended that funds be set aside under the enabling activities add-on to fund consultancies for project development specialists to develop donor submissions as required by the Steering Committee.

5.4 Work Programmes

Each strategic objective is divided up into work programmes:

1). Establish a Representative and Viable Protected Area Network (PAN).

- a) Terrestrial Protected Area Network
- b) Inland Waters Programme
- c) Marine Protected Area Network
- d) Adaptive Management of Protected Area Network

2). Manage Key Components of Biodiversity.

- a) Invasive Alien Species
- b) Flowering Plants and Ferns
- c) Birds
- d) Bats
- e) Reptiles
- f) Research Priorities
- g) Agrobiodiversity

3). Enable Sustainable Use of Biodiversity

- a) Ecotourism Development
- b) Review the Environment Protection Act
- c) Fishing
 - i) Offshore Fishery
 - ii) Lagoon fishery
 - iii) Freshwater Fishery
 - iv) Aquaculture/ Mariculture
 - v) Sports Fishery
- d) Agrobiodiversity

4). Maintain Ecosystem Services

- a) Forest Management
- b) Water Quality
- c) Integrated Coastal Zone Management

5). Manage Biotechnology and its Products.

- a) The Cartagena Protocol on Biosafety

Mauritius Biodiversity Action Plan			
Strategic Objective 1: Establish a representative and viable Protected Area Network (PAN)			
	Description	OVI s	Partners
Work Programme	1a) Terrestrial Protected Area Network		
Objective	To place 10% of Mauritian terrestrial area within a PAN by 2015 ¹ .		
Results	<p>New paradigm for Protected Area (PA) management which fosters (including incentives) private sector involvement in the ownership and/or management of protected areas (PAs).</p> <p>Viable and representative PAN consisting of at least 10% of land mass established.</p> <p>Protected area law and categories provide for a comprehensive and graded range of protective and usage regimes.</p> <p>At least 1000 Ha of priority areas are under intensive management by 2015.</p>	<p>Policy on private ownership and/or management of PAs. PAs owned and managed by private sector.</p> <p>Maps, reports etc...</p> <p>Official gazette</p> <p>Reports, maps, site verification.</p>	
Activities	<p>Define major habitat types using available models (e.g. Reunion island model).</p> <p>Identify biodiversity hotspots and other priority areas (e.g. caves).</p> <p>Re-evaluate status of forestlands (private & state) using best available sources²</p> <p>Establish a forum involving all stakeholders to discuss implementation of the objective³.</p> <p>To identify incentives where appropriate⁴.</p> <p>Select areas for inclusion in PAN based on findings of above activities^{5&6}.</p> <p>Designate and demarcate</p>	<p>Definitions and habitat models available for field application.</p> <p>Gap assessment Survey of existing knowledge Survey of habitats with limited knowledge</p> <p>Report documents.</p> <p>Minutes of forum meetings.</p> <p>Incentives measures proposed for approval.</p> <p>Proposed areas. Minutes of forum meetings.</p> <p>Official Gazette and site verification.</p>	<p>Lead agencies: NPCS, Forestry Services.</p> <p>Partners: MWF, MOE, NRSC, MCAgri, Ministry of Housing and Lands, University of Mauritius, MSIRI Universite de la Reunion (UR), Conservatoire Botanique Nationale de Mascarin(CBNM) SLO International organisations.</p>

<i>Activities (cont).</i>	<p>Amend existing legislation with reference to IUCN categories⁷.</p> <p>Select priority areas for implementation of intensive management⁸</p> <p>Improve methods of restoration through adaptive management.</p> <p>Actively manage 1000 ha of forest</p>	<p>Official Gazette.</p> <p>Maps, management plans.</p> <p>Monitoring assessments and recommendations.</p>	
<i>Notes and Guidance</i>	<p>1: The area will be designed to be representative of terrestrial habitats (including as appropriate islets) and will incorporate an area of 1,000 ha under intensive management (i.e. IAS management and restoration).</p> <p>2: e.g. (Page and D'Argent, 1997), ongoing MOAIF survey project and landowners surveys.</p> <p>3: A large proportion of lands in Mauritius are privately owned. Any representative PAN will need to incorporate private lands. It is essential therefore that a proper and equitable forum be established to negotiate a new paradigm for protected area management in Mauritius, such that it is in the interest of private landowners to manage their lands in ways beneficial to the conservation and sustainable use of biodiversity (including restoration and ecotourism projects) without concern that their land may be removed from their effective ownership either by Governmental acquisition or designation as a high level protected area. The review of protected area categories can also contribute to this see later activity and footnote 7.</p> <p>4: Incentives to encourage private landowners to manage estates in ways beneficial to the conservation and sustainable use of biodiversity.</p> <p>5: where possible consideration should be given to the interconnectivity and linkage of PAs.</p> <p>6: x-ref with WPs 1b, 2b-e incl.</p> <p>7: Current protected area classifications are limited and do not offer the necessary scope for protection or usage regimes as merited by the diverse range of areas. A review and reclassification of PA categories in line with IUCN criteria would offer much better scope for diverse management regimes and the inclusion of the private sector in PA management. This review would apply to all categories of protected area including those under WP 1c.</p> <p>8: Intensive management includes the management of IAS and restoration of habitat.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	1b) Inland Waters Programme		
Objective	Identify key areas of inland water ecosystems for management and incorporation into PAN.		
Results	<p>Hot spot areas identified.</p> <p>Priority areas incorporated into PAN.</p> <p>Detailed research programme targeting management priorities on inland water biodiversity initiated.</p> <p>Single agency identified/established and administering inland water biodiversity management.</p>	<p>Survey reports, sensitive area reports</p> <p>Official gazette,</p> <p>Research reports.</p> <p>MoUs with research institutions.</p> <p>Administrative and legislative structure.</p>	
Activities	<p>Undertake a rapid assessment of inland waters to identify biodiversity hotspot areas¹.</p> <p>Identify priority areas for management and/or incorporation into the PAN</p> <p>Enable/facilitate/undertake comprehensive baseline survey of biodiversity².</p> <p>Identify / establish the responsible agency for the management of freshwater systems</p>	<p>Survey reports and maps.</p> <p>Survey reports and maps.</p> <p>Correspondence with potential research partners.</p> <p>Proposal for single agency submitted to executive.</p>	<p>CWA, MOE, NGOs, M/Agro Industry and Fisheries, Local Communities, Customary users, Irrigation Authority.</p>
Notes and Guidance	<p>Inland water ecosystems were identified as having been significantly under-represented in previous research and protection measures. Inland waters have also been extensively modified and utilised by agricultural development, which was and continues to be a major sector in the country's economy.</p> <p>1: The CBD has recognised the particular case of SIDS with regard to inland waters and has developed a rapid assessment protocol to assist the informed conservation and sustainable use of their biodiversity.</p> <p>2: Detailed research of inland waters biodiversity would be best undertaken by research institutions/ universities facilitated by Government and assisted by local partners.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	1c) Marine Protected Area Network		
Objective	To develop and maintain a representative marine protected area network.		
Results	<p>Habitat types lacking from PAN identified.</p> <p>Key habitat areas identified and incorporated into sensitive area atlas¹.</p> <p>Representative PAN established and under operation (x-ref WP1d).</p> <p>Permanent buoys demarcate marine areas.</p>	<p>Gap analysis.</p> <p>Atlas.</p> <p>Official gazette, site verification</p> <p>Site verification.</p>	
Activities	<p>Undertake gap analysis of habitats in existing marine protected areas².</p> <p>Identify priority representative habitat areas for inclusion in PAN.</p> <p>Establish a sensitive areas atlas of marine areas.</p> <p>Identify sites that can be declared and managed as marine PAs^{3, 4&5}.</p> <p>Declare and demarcate PAN.</p>	<p>Analysis document and findings.</p> <p>Hotspot and core areas identified.</p> <p>Atlas available.</p> <p>Proposal for extended PAN.</p> <p>Official gazette, site verification.</p>	<p>M/Agro Industry and Fisheries, Fisherman's assoc. NGOs, Tourism operators Local communities, OI DC, MOI.</p>
Notes and Guidance	<p>1: The sensitive area atlas can then form the basis for coastal development planning for application under the Environment Protection Act and physical planning processes.</p> <p>2: Including:</p> <ul style="list-style-type: none"> • Identification of seagrass beds and mangrove ecosystems. • A gap analysis of coral communities. • A prioritisation of coastal wetlands. <p>3: Consider:</p> <ul style="list-style-type: none"> • Outer islands (Agalega and St Brandon). • Waters surrounding the Northern islets and Mahebourg islets. <p>4: Logistical and pragmatic considerations must be incorporated including cost benefit analyses, management and enforcement feasibility and customary access and use.</p> <p>5: Consideration should be given to connectivity and synergistic interaction of PAs.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	1d) Adaptive Management of Protected Area Network		
Objective	To develop costed and scheduled management plans, for each PA, that enables adaptive management.		
Results	Each Protected Area has a structured, time bound and targeted management plan that enables adaptive management.	Management plans. Budgets. Usage regimes including multiple-use and zoning of activities as appropriate. Monitoring of impact using criteria such as Limits of Acceptable Change (LAC) and Quality of Visitor Experience (QVE) indicators.	
Activities	Develop management plans for each area through stakeholder consultation utilising a logical framework approach ^{1&2} . Investigate usage potential in particular modes of non-consumptive use.	Stakeholder analyses Situation analyses Risk assessments Meeting minutes Situation analyses reports including Potential usage assessments. Such as Recreation Opportunity Spectrum analyses etc...	Lead agencies: NPCS, Forestry Service Partners: MWF, NRSC, University of Mauritius, MSIRI, MOE, MHL D, WMA, MoT, CWA, Local Authorities, NGOs, NCG, MOI.
Notes and Guidance	1: Stakeholders identified the assessment and mitigation of impacts on Marine Protected Areas as an issue of particular concern e.g. sources of pollution and the establishment of treatment facilities where appropriate, water sports, diverse usage regimes and the impact of incentive programmes such as the bad weather allowance were highlighted. 2: Stakeholders also identified and stressed the importance of the effective and efficient functioning of the Integrated Coastal Zone Management Committee in enabling harmonisation between the various administrative portfolios concerned with coastal development and management (w-ref WP 4c).		

Mauritius Biodiversity Action Plan			
Strategic Objective 2: Manage Key Components of Biodiversity			
	Description	OVI	Partners
Work Programme	2a) Invasive Alien Species		
Objective	To develop and implement a comprehensive national IAS Strategy and Action Plan		
Results	Balanced, comprehensive IAS strategy developed in line with GISP guidance. Action plan under implementation	National strategy and action plan document. Minutes of meetings Implementation reports.	
Activities	Develop a national strategy and action plan through stakeholder consultation utilising the GISP model and other relevant strategies ^{1&2} . Review and modify, as appropriate, national IAS committee membership.	Draft strategy and action plan for approval. Committee membership.	National IAS Committee MOI Ministry of Shipping (task force on ballast water) MAIF Customs dept, Traders; Public, Farming community, Air and sea carriers, NGOs MSIRI
Notes and Guidance	<p>IAS poses the greatest ongoing threat to native terrestrial biodiversity. The situation with regard to freshwater (x-ref WP 1b) and marine environments needs further assessment.</p> <p>1: The GISP model offers a comprehensive approach to IAS management addressing, vectors, pathways and issues of prevention, control, mitigation and eradication. The sectoral stakeholder workshops did however highlight certain issues which are consequently itemised below:</p> <ul style="list-style-type: none"> a) Forests & terrestrial biodiversity: harmonisation of legislation and administrative structure. b) Aquatic biodiversity: take into account the Convention of ballast water. c) Agricultural biodiversity: develop a priority list of IAS, including pathogens that pose a risk to native agrobiodiversity. <p>All sectors noted the need to consider:</p> <ul style="list-style-type: none"> • a system of inter-island quarantine (x-ref with Rodrigues BSAP WP 2a), and • the impacts of IAS on ecosystem services. <p>2: Funding has already been obtained to undertake this project during 2006.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2b) Flowering Plants and Ferns		
Objective	To enhance conservation of native flowering plants and ferns		
Results	<p>Conservation status of species reviewed and identified.</p> <p>All endangered species incorporated into ex-situ collections and in-situ management areas.</p> <p>All threatened species protected by law and incorporated into conservation initiatives (x-ref with WP 1a).</p> <p>Use of exotic species reduced.</p>	<p>New red data list</p> <p>Reports and site verification.</p> <p>Official gazette and regulations</p> <p>Policy documents and guidelines etc.</p>	
Activities	<p>Assess the conservation status of species and identify threatened and endangered species as per IUCN criteria¹.</p> <p>To secure all endangered species in ex-situ collections and in-situ managed areas^{2&3}.</p> <p>To protect all threatened species at a national level and under the Wildlife and National Parks Act.</p> <p>To encourage public awareness and use of native plants (instead of exotics) in landscaping.</p>	<p>Assessment report.</p> <p>Reports, site verification etc...</p> <p>Official gazette and regulations National conservation initiatives.</p> <p>Public information.</p>	<p>National Threatened Plants Technical Committee; Indian Ocean Plant Specialist Group (IUCN); Nature Reserves Board; Wildlife and National Park Advisory Council; MSIRI Relevant public and private bodies; (including private landowners); Media</p>
Notes and Guidance	<p>1: Initial assessment made by review of best current information. Where critical information is found to be lacking field surveys and research should be instigated/facilitated on a priority basis.</p> <p>2: assumes all plants can be propagated by traditional or available biotechnological methods.</p> <p>3: Knowledge of past distribution in addition to present occurrence and abundance is an important tool in conservation management and may require targeted research programmes.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2c) Birds		
Objective	i) To review and enhance the conservation of endemic birds. ii) To protect seabird colonies. iii) To protect migratory birds		
Results	Conservation status of species determined and protected species list modified as appropriate. Species databases established. Recovery programmes under implementation for priority species. St Brandon rat free. Priorities for IAS management on outer islands determined. Implement AEWA action plan. Implement Ramsar action plan	Species data list Official gazette. Database accessible. Conservation plans. Implementation reports Rat free status. Proposals for action. Progress reports. National reports to CMS and AEWA National reports to Ramsar.	
Activities	Assess conservation status of endemic birds. Establish monitoring programmes as appropriate. Determine conservation priorities. Develop and implement conservation plans for threatened species ¹ (habitat emphasis) Carry out rat eradication on St Brandon. Identify introduced predators on outer islands and consider control measures (x-ref WP 2a). Review protected species listings modify as appropriate. Review obligations under the African-Eurasian Waterbird Agreement (AEWA) ² and develop and commence implementation of an action plan. Review obligations under the Ramsar Convention ³ and develop and commence implementation of an action plan.	Reports. Population databases periodically updated. Proposed actions. Approved plans Implementation reports. Rat monitoring. Predator assessment and actions proposed for approval. Population assessments. Official gazette. Assessment of obligations and action plan for approval. Assessment of obligations and action plan for approval.	MOAIF NGOs (MWF), Private sector (landowners) Tour operators Local community including fishers MOI OIDC Convention secretariats.
Notes and Guidance	1: Conservation plans should place an emphasis on habitat management (x-ref WP 1a-c and 4c). 2: Mauritius is a party to the Convention on Migratory Species (CMS) and its Agreement on African and Eurasian Waterbirds (AEWA). 3: Mauritius is party to the Ramsar (International wetlands) Convention.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2d) Bats		
Objective	To enhance the conservation of bat species.		
Results	<p>Conservation status and priorities of bat species determined.</p> <p>Population databases established and trends through time elaborated.</p> <p>Fruit bat ecology including range and feeding niche understood.</p> <p>Impact of Fruit bats on fruit production quantified.</p> <p>Impact reduction techniques tested and viable options under implementation.</p> <p>Feasibility and practicality of re-introduction of Rodrigues fruit bat determined and decision made.</p>	<p>Action plans. Implementation reports.</p> <p>Databases.</p> <p>Reports, publications.</p> <p>Reports and valuations.</p> <p>Pilot projects, assessments.</p> <p>Plan of Action.</p>	
Activities	<p>Assess abundance and distribution of fruit bats and micro-bats.</p> <p>Establish and implement population-monitoring protocols.</p> <p>Carry out research on the ecology of fruit bats, including movement and feeding habits¹.</p> <p>Quantify the economic loss to crops by fruit bat through time (2 year study).</p> <p>Investigate ways to reduce conflict between fruit farmers and fruit bats².</p> <p>Assess that possibility of reintroduction of the Rodrigues fruit bat.</p>	<p>Reports and recommendations.</p> <p>Monitoring reports and data.</p> <p>Reports, range maps.</p> <p>Impact report and valuation.</p> <p>Recommendations and pilot projects.</p> <p>Feasibility and pragmatic assessment with recommendations.</p>	Farming community, MOAIF, NGOs, Research partners.
Notes and Guidance	<p>1: several stakeholders spoke to the necessity of controlling fruit bat populations to limit the losses to fruit farmers. However it was felt that the known vulnerability of bat populations to cyclones and the lack of knowledge as to: fruit bat populations, actual quantified economic losses and viable deterrent mechanisms should all be addressed before population control (culling) options were considered.⁴</p> <p>2: Including identifying international models for control</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2e) Reptiles		
Objective	To review and enhance the conservation of reptiles.		
Results	<p>Occurrence of and distribution of key populations mapped and priorities determined.</p> <p>Ecology requirements of priority species understood.</p> <p>New populations of key species established.</p> <p>IOSEA Action Plan under effective implementation</p>	<p>Maps, action plans.</p> <p>Reports, publications.</p> <p>Site verification, reports.</p> <p>National reports.</p>	
Activities	<p>Assess abundance and distribution of native reptiles (x-ref WP 1a);</p> <p>Carry out research on the ecology of the species as appropriate.</p> <p>Maintain key islets free of alien predators (x-ref WP2a).</p> <p>Implement a reptile translocation in line, as appropriate, with IUCN guidelines</p> <p>Implement IOSEA action plan as appropriate in Mauritian circumstances¹.</p>	<p>Reports and maps.</p> <p>Requirements of priority species understood.</p> <p>Suitable habitats available for translocation.</p> <p>Implementation reports.</p>	<p>Enforcement bodies, relevant ministries and organisations (including researchers)</p> <p>Local communities MOAIF MOI OIDC</p>
Notes and Guidance	1: Mauritius is a signatory to the MoU on the Conservation and Management of the Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA). The IOSEA has developed a comprehensive action plan for the conservation of sea turtles.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2f) Research Priorities		
Objective	To identify additional research priorities.		
Results	Additional priorities for research and/or conservation identified. Conservation/research projects determined.	Reports. Project proposals.	
Activities	Undertake gap assessment of existing knowledge of native biodiversity. Identify key species and groups of particular importance to the conservation and sustainable use of biodiversity. Carry out inventories of these groups ¹ . Identify topics of priority for conservation research ² . Determine suitable conservation measures.	Assessment. Reports. Reports and species listings. Priority topics proposed. Project proposals.	MOAIF MOI Universities. MSIRI International organisations
Notes and Guidance	1: The stakeholder workshop highlighted the need for an inventory of marine algae to be established. 2: Marine fish or invertebrates considered endangered were identified as a priority by stakeholders e.g. seahorses.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2g) Agrobiodiversity		
Objective	To have 70% of local agro-biodiversity under ex-situ protection and document knowledge on native agro-biodiversity (including cultivated medicinal plants).		
Results	<p>Listing and detailed characterisation of breeds and varieties¹.</p> <p>National strategy under implementation.</p> <p>At least 70% of agrobiodiversity represented in ex-situ collections.</p> <p>Traditional knowledge relating to local agrobiodiversity documented.</p>	<p>Reports available.</p> <p>Strategy document and implementation reports.</p> <p>Reports and site verification.</p> <p>Publication.</p>	
Activities	<p>Undertake stocktaking and characterisation of local plant and animal agro-biodiversity.</p> <p>Develop a national strategy for conservation of agrobiodiversity² and medicinal plants.</p> <p>Develop ex-situ livestock facilities.</p> <p>Carry out survey of literature & grey literature.</p> <p>Interview traditional farmers and herbalists.</p> <p>Document and make available traditional knowledge.</p>	<p>Listings and descriptions.</p> <p>Strategy document submitted for approval.</p> <p>Site verification</p> <p>Survey available</p> <p>Records of interviews.</p> <p>Publications.</p>	MOAIF, University of Mauritius, Farmers, MSIRI.
Notes and Guidance	<p>1: Detailed description of morphological and agronomic potential and economic traits.</p> <p>2: x-ref with NSSSP and SADC survey.</p>		

Mauritius Biodiversity Action Plan			
<i>Strategic Objective 3: Enable Sustainable Use of Biodiversity</i>			
	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3a) Ecotourism Development		
Objective	Develop an ecotourism strategy ¹		
Results	<p>Ecotourism committee established and operating.</p> <p>Basis for ecotourism strategy determined by review of existing initiatives.</p> <p>Ecotourism strategy under implementation and administered by ecotourism bureau.</p>	<p>Minutes of meetings. Reports.</p> <p>Review and recommendations.</p> <p>Strategy Document approved. Implementation reports.</p>	
Activities	<p>Establish a representative and equitable stakeholder committee</p> <p>Review progress to date in the elaboration of an enabling framework for the development of sound ecotourism².</p> <p>Develop a comprehensive ecotourism strategy, building upon existing sound initiatives, through stakeholder consultation utilising a logical framework approach.</p> <p>Establish ecotourism bureau to oversee coordination and implementation of national strategy.</p>	<p>Committee membership and minutes of meetings.</p> <p>Examples of best practice identified.</p> <p>Situation and stakeholder analyses. Draft Strategy for approval.</p> <p>Bureau and budget.</p>	<p>MOT, MTPA, MOE, SLO, Association of Tour operators, Ministry of Finance MOAIF Min. of Education Tourism industry, relevant NGOs, Local communities, University and research institutions.</p>
Notes and Guidance	<p>1: Stakeholders noted that ecotourism offers considerable potential to enhance the conservation and sustainable use of biodiversity and that there is great scope for expansion of such activities in Mauritius.</p> <p>2: During the sectoral workshops numerous aspects were highlighted³, which served to underline the need for a comprehensive stakeholder driven strategic approach. This is not to ignore however progress that has already been made and as such the review of existing measures is explicitly stated in the activities under this programme in order to form a basis for the development of a national strategy.</p> <p>3: Issues raised included:</p> <ul style="list-style-type: none"> • The need for a national definition of ecotourism based on that developed by SIDS in 2002. • To develop guidelines for specific ecotourism activities such as rare species watching (incl. sea mammal watching); • The key importance of facilitating private sector investment. (X-ref with WP1a) • The importance of adaptive management of ecotourism activities. • That ecotourism should have administrative oversight by clearly identified authorities. • The potential of agrobiodiversity in local and international tourism should be investigated. 		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3b) Review the Environment Protection Act.		
Objective	To better integrate issues of biodiversity concern into the functioning of the EPA.		
Results	<p>Public involvement and input to EIA process is enhanced.</p> <p>Process, legislation and implementation of EIAs reviewed and amended to enhance function.</p> <p>Biodiversity and sensitive area considerations are better incorporated into EIA and development planning approaches.</p>	<p>Number of public comments etc...</p> <p>Number of complaints and appeals etc.</p> <p>EIA documents and decisions.</p>	
Activities	<p>Investigate and implement methods to enhance public involvement in the EIA process¹.</p> <p>Investigate and implement means to ensure the impartiality of the EIA document.</p> <p>To set legal guidelines for the preparation of EIA².</p> <p>Consider additional activities for inclusion of list of activities that require an EIA.</p>	<p>Recommendations.</p> <p>Recommendations and pilot projects.</p> <p>Official gazette.</p> <p>Recommendations.</p>	MOE, SLO, Developers, promoters. Government agencies as appropriate.
Notes and Guidance	<p>1: Suggestions included: increasing accessibility of EIA documents and requiring presentation of major projects to the public at large.</p> <p>2: Including/relevant experience of consultants, contents of the document (note: the DoE is preparing sectoral guidelines which highlight the level of expertise required).</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3c) Fishing		
Objective	Enable sustainable utilisation of fishery resources.		
Sub-work programme	3c (i) Offshore fishery		
Results	Fishing controls are enhanced. Fishery stocks and by-catch are better managed.	Log books and reports. Log books and reports.	
Activities	Implement an obligatory independent observer system. Monitor by-catch and quota. Increase deployment of FADs for local fishing fleet.	Legislation. Official gazette. Log books and reports.	Government, fishing operators, IOTC.
Notes and Guidance			
Sub-work programme	3c (ii) Lagoon fishery		
Results	Fishing effort in the lagoon reduced. Fish populations show recovery. New management regimes have community support. Shells and coral receive are better managed.	Number of fishermen etc... Catch and population monitoring statistics. Number of complaints and cases of illegal activities. Survey reports.	
Activities	Reduce fishing pressure ¹ . Restock the lagoon with native species ² . Investigate means of developing community stewardship of lagoon resources ³ . Review legislation pertaining to shell and coral collection ⁴ . Ban import of corals, shells and shells products.	Fishery statistics. Reports, stock releases. Consultations, workshops etc... Assessment and recommendations. Official Gazette.	MOAIF, Fisherman's associations. Local communities.
Notes and Guidance	1: various means were proposed including: <ul style="list-style-type: none"> • review of the bad weather allowance, • review of protected area measures (x-ref WP 1c), • promote sustainable mariculture (x-ref WP 3c (iv)), • facilitate transition to offshore fishery (provision of loans and incentives, increase deployment of FADs etc...) 2: utilising only wild stock larvae etc... 3: e.g. rights fisheries, licensing schemes etc... 4: with a view to the banning of shell and coral collection (dead or alive).		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Sub-work Programme	3c (iii) Freshwater fishery		
Results	Recommendations for management of freshwater fishery stocks ¹ .	Report document.	
Activities	Investigate scope for sustainable use of camaron la rivière, chevrettes etc... Assess the present stocks (x-ref WP 1b) Improve water quality in marginal freshwater systems (x-ref WP 4b) Investigate potential for sustainable aquaculture (x-ref WP 3c (iv))	Assessment report and recommendations. Distribution mapped and stocks assessed.	Freshwater biodiversity agency (x-ref WP 1b), MOAIF, Fishers, Local communities, Landowners.
Notes and Guidance			
Sub-work Programme	3c (iv) Aquaculture/Mariculture		
Results	Sustainable profitable small enterprises are developed in the fields of aquaculture and mariculture. Activities have minimal negative environmental impacts.	Revenue and employment. Environmental monitoring.	
Activities	Promote sustainable mari/aquaculture ¹ . Mari/aquaculture developed in line with international guidelines and best practice ^{2&3} .	Feasibility studies. Incentives. Site verification. Guidelines.	NGOs, MOAIF MOI Local fishermen SLO
Notes and Guidance	1: Attention to focus on high revenue species such as giant clam, oysters, prawns and sea cucumber. 2: e.g. CBD guidelines - especially regarding IAS and pollution. 3: Stakeholders noted that native species should be used, that small-scale farming should be encouraged and that methods to reduce pollution should be developed.		
Sub-work Programme	3c (v) Sports Fishing¹		
Results	Sports fishery activities are sustainable and optimised.	Revenues No. of operators.	
Activities	Investigate the sustainability and scope for expansion of sport fishing. Consider feasibility of and incentives for catch and release programmes	Management recommendations. Management recommendations	MOAIF, MOT, Sports fishing operators.
Notes and Guidance	1: Stakeholders identified this programme as being of lower priority than WP 3c I – iv incl. Above.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3d) Agrobiodiversity		
Objective	To increase sustainable agriculture and encourage the use of local varieties and breeds		
Results	<p>Demand for and supply of organic produce increased, particularly that of local varieties and breeds.</p> <p>Incentive system in place to encourage organic and beneficial traditional farming practices and varieties/breeds.</p> <p>Biodiversity considerations incorporated into permit system for water access.</p>	<p>Revenue, number of organic farmers and area farmed etc...</p> <p>Incentive packages available and effective.</p> <p>New policy,</p>	
Activities	<p>Determine the potential market for and production of organic produce.</p> <p>Encourage organic farming practises and the use of local varieties and breeds.</p> <p>Use of ex-situ and in-situ genepool in breeding programme</p> <p>Raise awareness of health implications of excess use of agrochemicals.</p> <p>Rationalise the production and use of compost – (x-ref to Solid Waste Plan / Local Government).</p> <p>Facilitate utilisation of the ex-situ genepool to maintain in-situ populations.</p> <p>Develop mechanisms to harmonise freshwater conservation and agriculture (x-ref with 1b).</p>	<p>Review and recommendations.</p> <p>Recommendations for incentive packages.</p> <p>New varieties and breeds available to the farming community</p> <p>Media campaign, leaflets etc...</p> <p>Seeds and stock available and sufficient to demand.</p> <p>Recommendations.</p>	<p>MOAIF, Farmers, Public, Central Water Authority. Freshwater biodiversity agency (x-ref WP 1b). MSIRI</p>
Notes and Guidance	Good agricultural practices are being promoted among local farming community in order to develop sustainable agriculture and to ensure food safety, worker's welfare and environment protection.		

<u>Mauritius Biodiversity Action Plan</u>			
<i>Strategic Objective 4: Maintain Ecosystem Services</i>			
	<i>Description</i>	<i>OVI</i>	<i>Partners</i>
<i>Work Programme</i>	<i>4a) Forest management</i>		
<i>Objective</i>	Protect watersheds and soils by increasing forest cover.		
<i>Results</i>	Existing core areas are protected. Nursery capacity adapted to new planting needs. Forest cover increased and optimised by incorporating new priority areas. Area of native woodland cover progressively increased to up to 50% of total area.	Maps, aerial photos etc... Policy statements. Nursery production. Sensitive area maps, aerial photos, GIS. Maps and aerial photos. Site verification.	
<i>Activities</i>	Maintain forests with regard to existing catchments and areas at high risk of erosion. Increase capacity to produce saplings of appropriate species. Extend forest cover by reforestation of strategically selected areas ^{1&2} . Replace exotic plantations used for ecosystem service protection with native species – up to 50% ³ .	Maps, aerial photos, GIS. Reports, site verification. Reafforestation acreage each year. Total acreage under forest. Maps, aerial photos etc... Reports, site verification	Lead agency: Forestry Services Partners: MWF, NPCS, MOE, Private sector.
<i>Notes and Guidance</i>	1: Selection of areas will relate to priorities such as catchments, river reserves, erosion and biodiversity hotspot areas (x-ref WP 1a & 1b). 2: Extension of forest cover depends upon the establishment and effective functioning of the stakeholder forum described in WP 1a. 3: Some 50% of current forest cover has been designated as permanent for the protection of ecosystem services. A programme should be developed to progressively convert these exotic plantations to stands of native tree species.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	4b) Water Quality		
Objective	To reduce water pollution		
Results	<p>Database of ambient water quality.</p> <p>Law enforced more effectively and efficiently.</p> <p>Cases of point source and general water pollution reduced.</p> <p>Wetlands receive higher protection¹.</p>	<p>Database.</p> <p>Number of cases and general water quality figures.</p> <p>Number of cases and general water quality figures.</p> <p>Official Gazette.</p>	
Activities	<p>Monitor water quality in freshwater and marine systems.</p> <p>Enforce environmental standards as they pertain to pollution and water quality.</p> <p>Investigate and implement means to reduce and mitigate impacts of water pollution².</p> <p>Protect wetlands (x-ref WP 1b).</p>	<p>Monitoring reports and trends analyses.</p> <p>Number of cases.</p> <p>Ambient water quality.</p> <p>Pilot projects.</p> <p>Official Gazette.</p>	<p>MOE, MOAIF, M/Local Government, WMA, Local Authorities, Industry, Tourism Sector, Planters.</p>
Notes and Guidance	<p>1: Either through inclusion in the PAN or the formulation of a sensitive areas atlas for use under the EPA.</p> <p>2: Options suggested by stakeholders include:</p> <ul style="list-style-type: none"> • mitigate direct discharge of storm water drainage and red soil pollution. • promote use of traditional ways to control soil erosion (e.g. use of vetiver /muguet alongside sugar cane fields) • Encourage organic farming practices, including incentives (x-ref WP 3d). • Promote the collection, treatment, reduction, recycling and reuse of solid and liquid wastes. 		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	4c) Integrated Coastal Zone Management¹		
Objective	To increase coastal protection.		
Results	<p>Impacts and costs of coastal erosion reduced.</p> <p>Dispute mechanism functioning providing stakeholders with recourse to appeal against development decisions.</p> <p>Coastal habitats receive greater protection under the law.</p> <p>ICZM policy and guidelines under implementation.</p>	<p>State of environment reports.</p> <p>Number of cases etc...</p> <p>Official Gazette.</p> <p>Policy document.</p>	
Activities	<p>Implementation of Baird Report recommendations on coastal erosion study around Mauritius².</p> <p>Establish a dispute resolution mechanism³.</p> <p>Increase the area of coastal wetlands, mangroves, seagrasses and fringing coral reefs as protected areas (x-ref WP 1a & 1c).</p> <p>Identify sensitive areas and develop atlas for implementation under the Environment Protection Act.</p> <p>Review function of the ICZM Committee.</p> <p>Develop an ICZM plan for Mauritius and the outer islands</p>	<p>Implementation reports. Site verification</p> <p>Records of meetings.</p> <p>Official Gazette, Maps.</p> <p>Official Gazette. Sensitive areas atlas.</p> <p>Review and recommendations.</p> <p>Draft plan for approval.</p>	<p>MOHL, MOLG, MOT MOAIF Local communities, Tourism industry, NGOs, Developers. MSIRI</p>
Notes and Guidance	<p>Coastal development was identified by stakeholders as posing the greatest threat to coastal ecosystems due to the rate of development and the inability of existing administrative structures to control and monitor developments.</p> <p>1: CBD language and decisions refer to Integrated Marine and Coastal Area Management (IMCAM) and this broader concept should be incorporated into this programme.</p> <p>2: Implementation is ongoing by the MOE.</p> <p>3: The conflict of coastal protection and coastal development interests is increasingly intense as development escalates due to the importance of coastal tourism to the economy. Stakeholders consequently felt that a dispute resolution mechanism was needed in addition to enhanced policy, administrative and legal measures in order for management of this sector to function efficiently and equitably.</p>		

<u>Mauritius Biodiversity Action Plan</u>			
<i>Strategic Objective 5: Manage Biotechnology and its Products</i>			
	<i>Description</i>	<i>OVI</i>	<i>Partners</i>
<i>Work Programme</i>	<i>5) The Cartagena Protocol on Biosafety</i>		
<i>Objective</i>	To implement the Cartagena Protocol on Biosafety.		
<i>Results</i>	The legislative and administrative structure established to enable the effective implementation of the Cartagena Protocol on Biosafety.	Official Gazette. National Policy.	
	International commitments under the Cartagena Protocol are met.	National reports to the Cartagena Protocol.	
<i>Activities</i>	To implement the national biosafety framework ¹ .	Implementation reports.	
<i>Notes and Guidance</i>	1: The National Biosafety Framework project was under implementation at the time of the stakeholder workshops and it was agreed by consensus that it would cater entirely for the attainment of this strategic objective.		

Chapter 6. Rodrigues

6.1 Overview of the Biodiversity of Rodrigues

Rodrigues is the smallest of the Mascarene Islands with an area of 109 km² and probably the oldest with an estimated age of 8-10 million years (Giorgi & Borchellini, 1998). Situated 570 km to the northeast of Mauritius, the island is hilly with a central spine culminating in the highest peak, Mont. Limon (393 m). Rodrigues is the only Mascarene Island with extensive limestone deposits and caves. A large fringing reef surrounds the island forming a lagoon within which lie eighteen small islets. Rodrigues is in the cyclone belt and has a warm wet season from November to April and a cool dry season from May to October; despite this some coastal areas are very dry and drought-prone (Figure 6.1).

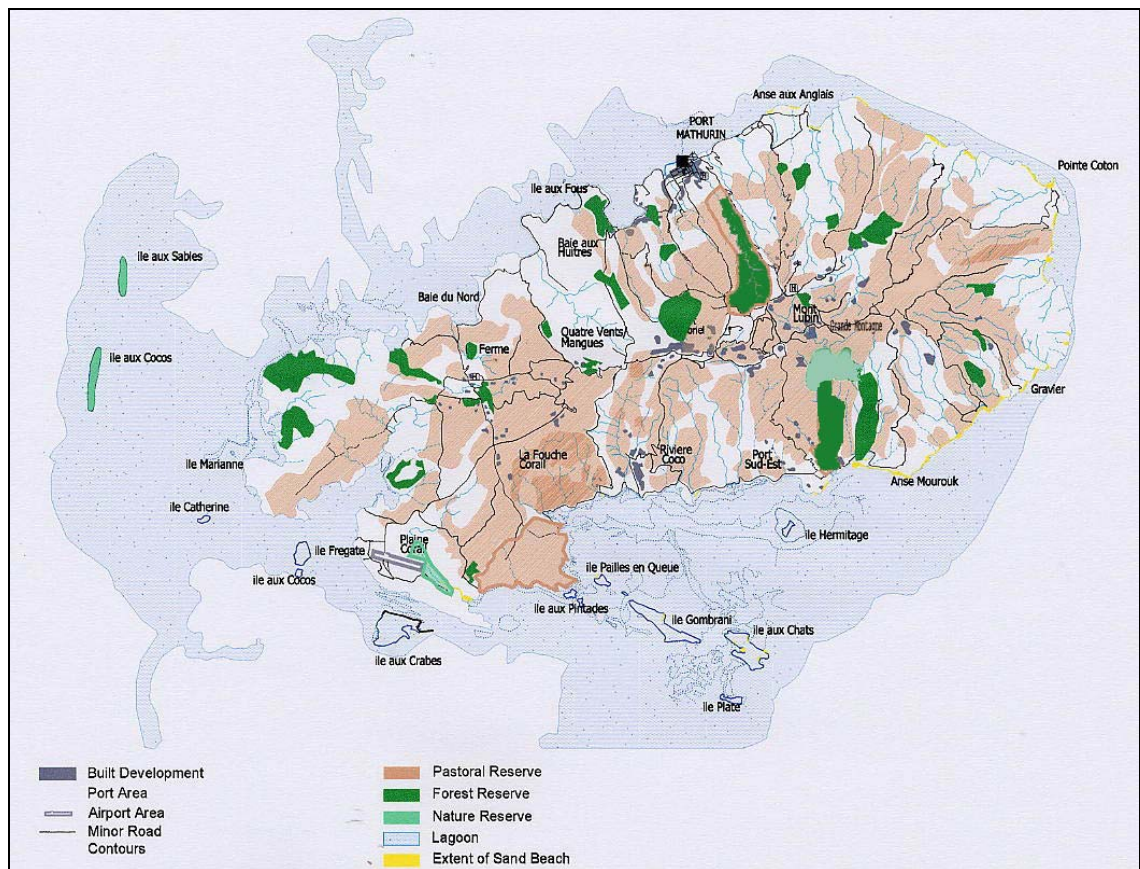


Figure 6.1: Rodrigues land use map (adapted from NDS, 2003)

6.1.1. Forest and Terrestrial Biodiversity

The detailed accounts of Leguat from the early 18th century paint an idyllic picture of 'valleys covered with palm-trees, plantains (lataniers) and ebonys'. Human activity, however, changed Rodrigues significantly such that in 1874 Balfour referred to the island as "a dry and comparatively barren spot, clothed with a vegetation mainly of social weeds". Today no primary forest remains and Rodrigues is considered one of the most degraded tropical islands in the world.

Rodrigues has five endemic genera of plants, and 133 indigenous plant species have been recorded (Wiehe 1949; Cadet 1975). Today 123 species remain, including 37 endemics (Strahm, 1989). Nine of the endemic species populations are comprised of less than 10 mature individuals in the wild, including three species, which are known from just a single individual (*Ramosmania rodriguesii*, *Dombeya rodriguesiana* and *Gouania leguatii*).

Rodrigues formerly contained at least twelve species of endemic bird, including the flightless solitaire (*Pezophaps solitaria*), two species of giant tortoise, two species of giant gecko, two species of night gecko, an unidentified lizard and one endemic fruit bat. Of these vertebrates, only four species remain, the Rodrigues warbler (*Acrocephalus rodricanus*), the Rodrigues fody (*Foudia flavicans*), the Rodrigues fruit bat (*Pteropus rodricensis*), and the native morning gecko (*Lepidodactylus lugubris*).

Little is known about the native invertebrates, although there is a study in progress to document the diversity through a Darwin Initiative Project.

On mainland Rodrigues the remaining plants and animals are scattered across the landscape. For example: Cascade Mourouk (which contains the last remaining individual of *Gouania leguatii* and 2 individuals of *Hibiscus liliflorus*). The valley of Anse Quitor is equally important for lowland plants. Some plant species are restricted to single islets (e.g. *Myoporum mauritianum* on Ile aux Gombрани). The two islets of Ile aux Sables (8 ha) and Ile aux Cocos (14.4 ha) harbour breeding sites for many sea birds (especially the fairy tern (*Gygis alba*) brown noddy (*Anous stolidus*), lesser noddy (*A. tenuirostris*) and sooty tern (*Sterna fuscata*)). Ile aux Cocos is home to the native morning gecko, a population of *Pisonia grandis* (bois mapou) and the endemic beetle (*Cratopus inormatus*).

6.1.2 Marine and Freshwater Biodiversity

Rodrigues has the most substantial and best-developed reefs in the Mascarenes (Montaggioni and Faure, 1980). The coral reef platform forms an almost continuous rim, 90 km long and from 50 to 10,000 metres wide which encloses a lagoon of 240 km². The lagoon bed is dominated by sand (40% of the area), and vegetation (28%), with coral covering 20.5%. Some 160 species of coral have been identified to date. Vegetation within the lagoon is dominated by macro-algae (139 species recorded - Coppejans *et al.* 2004, De Clerck *et al.* 2004) and seagrass (*Halophila ovalis* and *H. stipulacea*) which forms dense beds in the east and south.

The bulk of fishing pressure falls within the lagoon. There are five fishing reserves within this area but they serve only to prohibit fishing by seine nets. The site at

Mourouk in the southeast lagoon has been approved for the establishment of a Marine Protected Area. The project has been funded by the UNDP jointly with the Government of Mauritius and the Rodrigues Regional Assembly.

In addition, 4 no-take zones (Rivière Banane, Anse aux Anglais, Grand Bassin and Passe Demi) in the north of the island have been approved by the RRA, and Rivière Banane Reserve has now been delimited and a management plan has been drafted and is awaiting approval.

A Marine Biodiversity Workshop held in 2001, organised by the Shoals of Capricorn Programme resulted in the identification of 130 species of coral (which increases the total number of species recorded to 160), including an endemic species, *Acropora rodriguensis* (Fenner *et al.*, 2004). 494 fish species were recorded (Heemstra *et al.*, 2004) including two endemic species: the damselfish *Pomacentrus rodriguensis* and the dottyback, *Chlidichthys foudioides*. 109 species of bivalve (Oliver *et al.*, 2004) and 74 species of echinoderms were also recorded (Rowe and Richmond, 2004). In addition, 3 new species of isopod (*Bemlos pustulatus*, *Globosolembos rodriguensis* and *Neomegamphopus malabarensis*) (Svavarsson and Jorundsdottir, 2004; Bruce, 2004; Myers, 2004), one new species of polyplacophora (*Cryptoconchus oliveri*) (Scwabe, 2004) and 15 new species of bivalve were identified (Oliver and Holmes, 2004).

There are three permanent rivers (Mourouk, Cascade Pigeon, Cascade Victoire) and the only standing fresh water is found in caves and wells. There has never been an assessment of freshwater biodiversity.

6.1.3 Agricultural Biodiversity

Some 2,500 hectares of land are suitable for systematic agriculture and pasture (FAO/MSIRI 1974). The genetic diversity of all cultivated crop species and reared livestock originates from past introductions. Some of the cultivated crops, however, have naturalised wild relatives (e.g. *Ananas bracteatus* - ananas marron - and *Solanum indicum* - bringelle marron). Local varieties have also been developed through local practices and, although most have been displaced by introduced modern high yielding varieties, some are still used. These include two landraces of bean (*Phaseolus vulgaris*) - the 'local red' and the 'navy bean'. Rodrigues is also known for its petit piment (chilli pepper), the local onion (toupie), and the Rodriguan lime.

Maize (*Zea mays*) has been an economically important crop since the 18th century and there have been periodic introductions from several sources including America, Europe and Africa. Following quarantine laws in 1940, introductions were restricted and farmers started selecting on the basis of their own requirements. These ecotypes are still cultivated even after the recent introduction of hybrids.

Local breeds of cow, pig, goat, sheep and poultry used to exist, although high levels of outcrossing with introduced breeds make it difficult to find the pure Rodriguan forms anymore.

Native grass species can still be found in pasture e.g. *Cynodon dactylon* (chiendent), *Paspalum commersonii* (herbe à épée), *Stenophratum dimidiatum* (herbe bourrique) (Strahm, 1987), although species introduced accidentally and deliberately, for erosion control, now dominate.

6.2 Use of Biodiversity

6.2.1 Forest and Terrestrial Biodiversity

Terrestrial biodiversity plays a key part in the livelihoods of many people. The collection of leaves of the endemic vacoas (*Pandanus heterocarpus* and *P. tenuifolius*) for mats, hats, baskets and handicrafts is an important, though as yet unquantified, economic activity. Several endemic species are noted for their medicinal properties and those that are common (e.g. bois gandine (*Mathurina pendulifera*) and Affouche à petites feuilles (*Ficus reflexa*) are still used regularly (Gurib-Fakim *et al.*, 1994). Of the remaining endemic plant species there is one particular example of possible agronomic importance, the latanier jaune (*Latania verscaffeltii*). The fruits of the latanier are edible and the leaves are used in thatching and handicrafts.

The 4,000 ha of forest in Rodrigues provide various services and products e.g. soil conservation, windbreaks, timber and aesthetic benefits. There is some nature-based tourism on the mainland including guided walks and visits to nature reserves. Almost all of the forest cover, however, consists of exotic plantations that generally have a high water requirement and may impact on water availability.

6.2.2 Marine and Freshwater Biodiversity

There are about 2,000 registered fishermen, fishing mainly in the lagoon areas. Offshore fishing is limited because of the investment required for the acquisition of specialized fishing vessels. The most common fishing methods are nets (legal minimum mesh size of 9 cm), basket traps (made of bamboo or iron mesh), reef gleaning (primarily for octopus) and line fishing. Table 6.1 lists the most common fish species caught for consumption. Surveys carried out between 2002 and 2005 suggest that there has been a decline in Catch per Unit Effort in recent years and that the majority of cordonnier, capitaine, carangue and corne are being caught before they reach maturity, indicating serious recruitment overfishing.

Table 6.1: The common species of fish caught in and outside the lagoon (Information from Min of Fisheries, 2001)

Fish commonly caught in the lagoon		Fish commonly caught off-lagoon	
Scientific name	Common name	Scientific name	Common name
<i>Caranx melampygus</i>	carangue	<i>Thunnus albacares</i>	thon jaune
<i>Epinephelus morrhua</i>	vieille la boue	<i>Istiophorus platypterus</i>	voilier
<i>Lethrinus harak</i>	batardet (now rare)	<i>Acanthocybium solandri</i>	becune
<i>Lethrinus nebulosus</i>	capitaine	<i>Katsuwonus pelamis</i>	bonite
<i>Valamugii seheli</i>	mulet	<i>Coryphaena hippurus</i>	dorate
<i>Naso unicornis</i>	corne	<i>Egalatis bipinnulata</i>	galaté
<i>Siganus spp.</i>	cordonnier	<i>Pristipomoides filamentosus</i>	sacrechien
<i>Parupeneus rubescens</i>	rouget	<i>Pristipomoides zonatus</i>	vivaneau
<i>Mulloidichthys sp.</i>			
<i>Gerres longirostris</i>	breton		
<i>Epinephelus spilotoceps</i>	bengue		

Octopus fishing is very important, especially for women fishers, although the maximum sustainable yield for octopus has already been exceeded Genave (2000). The majority of octopi, particularly females, are being caught before they reach maturity, which takes place when they reach 700-800g.

Gleaning for crabs in the lagoon is a popular pastime, but there are no data on the effect that this has on the populations of targeted species such as *Portunus* (swimming crabs) and *Grapsus* crabs. Despite regulations, over exploitation has resulted in falling populations of species such as the Portunids, the mud crab (*Scylla serrata*) and the spiny lobsters (*Palinura sp.*) (Ian Watt *pers. obs*). Large quantities of these animals are now being imported from Madagascar because of continuing demand and dwindling local supplies.

The coral reefs of Rodrigues are amongst the best in the western Indian Ocean, and diving and snorkelling provides an important source of revenue. There are three registered dive companies. There is also some sport fishing in the lagoon, and big-game fishing offshore.

6.2.3 Agro-biodiversity

There is an ongoing decline in the use of traditional varieties, however, some remain important including: the local onion (toupie), chilli “petit piment”, red bean variety, and the Rodriguan lime. The local onion and the petit piment are under threat given their tendency to cross-hybridise with introduced varieties.

6.3 Causes of Biodiversity Loss.

6.3.1 Forest and Terrestrial Biodiversity

Change in Land Use

The historical clearance of land has resulted in the loss of all primary forest cover and the extensive modification of terrestrial ecosystems. This has resulted in extensive degradation of habitats and continues to restrict the range and abundance of native species today.

Invasive Alien Species

IAS represents the major current threat to terrestrial biodiversity. IAS have been introduced in an ongoing process ever since the initial human colonisation. The native vegetation can now only be seen in restricted areas on mountaintops (such as Grande Montagne, Mont Cimetière, Cascade Mourouk, and Mont Malartic) and in steep valleys and cliff faces. The few remaining areas of native vegetation are badly degraded through the invasion by exotic plants such as “piquant loulou” (*Acacia nilotica*), jamrosa (*Syzygium jambos*), bois d'oiseaux (*Litsea glutinosa*), aloes (*Furcraea foetida*), vieille fille (*Lantana camara*) and ravenale (*Ravenala madagascariensis*). A number of other plants potentially threaten native vegetation, including poivre marron (*Schinus terebinthifolius*), roussaillier (*Eugenia uniflora*) and Chinese guava (*Psidium cattleianum*). Even recent well-intended management measures such as extensive reafforestation programmes, to protect watersheds and prevent soil erosion, have almost exclusively planted non-native species, some of which have become highly invasive.

Introduced animals are a problem too (e.g. rats), including recent introductions of the shrew and house gecko from mainland Mauritius. Deer, monkeys and the red-whiskered bulbul, which are common pests in Mauritius are still absent from Rodrigues.

Unsustainable Use

Overgrazing by cattle, goats and sheep left to roam freely constitutes an ongoing threat to native vegetation not only through the direct impact of grazing and browsing but also by facilitating the spread of IAS. There is also some collection of plants for handicrafts and medicinal use remains a threat to certain naïve species.

6.3.2 Marine and Freshwater Biodiversity

Overfishing

Over-fishing in the lagoon is apparent from the lack of large predatory fish and triggerfish. Numbers of large molluscs, such as giant clams (*Tridacna maxima*) and conocono (*Pleuroploca trapezium*), are also very low. Invertebrate populations are dominated by sea cucumbers and the bio-eroding sea urchin, (*Echinometra mathaei*, and octopus catches fell by 50% from 1994 to 2004 (FRTU unpublished data, 2004). Surveys conducted by *Shoals Rodrigues* at 9 reef sites around the island between 2002 and 2005 indicate that coral reefs on the reef flat are impacted by trampling from octopus fishing and anchor damage.

Although not affected by the mass coral bleaching event of 1997/1998, bleaching occurred in 2002 and 2005, resulting in mortality of coral colonies on the reef flat down to 5-6m depth, particularly at sites in the north of the island. Recent cyclones have also

been found to cause damage to coral colonies and inshore sites are affected by sedimentation particularly following periods of heavy rainfall.

An allowance, introduced by the government in the early 1990s, to compensate registered fishers for non-fishing days due to bad weather has resulted in an increase in the number of registered fishers (especially gleaners). Bad weather days are calculated one month after the event from measurements taken outside of the lagoon. In 2004 212 bad-weather days occurred, costing the government MRU 52 million (Min of Fisheries 2005).

Sand Mining

This activity is still legal in the lagoon. Extraction is controlled through a permit system but the quantity extracted is not monitored effectively. It is likely that this activity has a substantive negative impact upon the lagoon ecosystem.

6.3.3 Agricultural Biodiversity

Apart from a few products of important cultural heritage, the increasing globalisation of consumption patterns is leading to the gradual replacement of diverse crop varieties with a few that are perceived as having commercial value.

6.4 Biodiversity Management

6.4.1 Forest and Terrestrial Biodiversity

In-situ conservation

Many of the developments in terrestrial conservation in recent years have been positive. The reforestation programme (albeit with exotics) has resulted in an increase in the populations of Rodrigues fruit bats: from 70-100 individuals in 1974 to >5000 individuals in 2003 (Cheke, 1974; Powell *pers comm.* 2005), fodies: from 5-6 pairs in 1968 to more than 900 birds in 1999 (Cheke 1987, Impey *et al.*, 2002), and warblers: from 23 birds in 1974 to >150 birds in 1999 (Cheke 1987; Showler *et al.*, 2002)).

Grande Montagne (14 ha), Anse Quitor (10 ha) and two islets to the west of the island, Ile aux Sables (8 ha) and Ile aux Cocos (14.4 ha) have all been declared Nature Reserves (under the Forest and Reserves Act 1983). Management plans have been prepared for Ile aux Sables, Ile aux Cocos as well as Gombrani Island and Crab Island (which are also of potential conservation importance) through a consultancy by AGRER (2004). The Forestry Service and the Mauritian Wildlife Foundation (MWF) have undertaken significant work in the restoration of Grande Montagne and Anse Quitor reserves where about 80,000 native and endemic plants have been planted to date (2005). There is a private project by Francois Leguat Ltd to recreate 20 hectares of original forest at Anse Quitor. So far 35,000 native and endemic plants have been planted (2004).

Ex-situ conservation

Wild individuals of endemic plant species (and critically endangered indigenous species) are monitored to allow collection of seeds or cuttings for propagation. Almost all of the rare species have been successfully propagated. There has been collaboration with Kew Gardens (UK) to rescue Café Marron (*Ramosmania rodriguesi*) by

propagation from cuttings. Eleven plants were returned to Mauritius, eight of which went to Rodrigues.

Management of livestock

Ninety percent of the island is state land, and although legislation states that no animal can graze on this land, overgrazing is a severe problem. In order to address this, the cattle walk legislation is under review. There has also been a de-stocking exercise to remove cows over 4 years in age. This exercise has reduced the number of cattle from 13,000 to 5,500 (2004).

Using native species to protect ecosystem services

MWF carried out a project funded by the Whitley Award 'Community Participation in Restoration of Endangered Native Forests of Rodrigues' to restore village nurseries in five areas across Rodrigues for the production of native plants that could be used as windbreaks, in erosion control and as watershed protection. There has also been an anti-erosion project funded by the EU utilising native species to prevent coastal erosion. Two trial plots have been established (one on the wind-ward and one on the lee-ward side of the island) and the results are promising.

Propagation of medicinal and artisanal plants

A UNDP/GEF SGP was awarded for a project on the sustainable use of endemic plants. This project involved developing an ex-situ area with plants used by villagers for medicinal and artisanal purposes.

Education and awareness

There is a visitor's centre at Grand Montagne Nature Reserve and plans for a botanic garden in Mourouk, and a visitor's centre at Anse Quitor.

MWF has a full time educator who visits all the primary schools on the island once a month to work with teachers and pupils on an environmental awareness programme, both in the classroom, and through site visits. The NGO Shoals (Rodrigues) has a similar programme, focussing on the marine environment. It has 3 educators and has produced a treasure chest of education materials for each school.

There is active community involvement in forest restoration projects. Volunteer groups help with weeding and replanting of Grande Montagne Nature Reserve during the weekends.

6.4.2 Marine and Freshwater Biodiversity

Reducing fishing pressure in the lagoon

Due to a significant decrease in seine net catches, a net buy-back scheme was introduced in 1997. As a result the number of seine net fishers has decreased by more than 75% and catches have improved. The seine net fishery also has a number of management measures in place, including a minimum mesh size of 9cm, a closed season (30th September to 1st March) and 5 closed areas where seine net fishing is permanently prohibited.

There are five fish aggregating devices (FAD) outside the lagoon, and a loan system to assist fishermen to buy the boats and equipment needed to convert to offshore fishing.

The NGO Shoals Rodrigues exists to help protect the marine ecosystem and sensitise stakeholders on the importance of this work. A number of activities are being carried out including studies of the coral reef ecosystem and its components, mapping of the lagoon, studies of the octopus fishery, and training and awareness raising.

Zooplankton research

A project to investigate the diversity of zooplankton in Rodrigues and to provide training in collection and identification of zooplankton was funded by the UK Darwin Initiative and implemented by the Shoals of Capricorn Programme (and latterly Shoals Rodrigues) as part of a regional study.

Monitoring and Data collection

A biotope map of the whole lagoon has been produced and incorporated into a GIS system. There are 10 permanent monitoring sites within the lagoon and 13 coral reefs sites that have been monitored every 6 months since 2002. The data is collected by Shoals, Rodrigues and is given to RRA and FRTU and anyone interested. These data are used to advise on management decisions.

6.4.3 Agricultural Biodiversity

Activities undertaken by Agricultural Services for the preservation of local biodiversity include:

- ▣ Improvement of the local red onion variety through high selection pressure (ongoing since 1986). The activity intends to eliminate undesirable characteristics such as splitting and bolting.
- ▣ Propagation of the local red bean variety at seed-production stations and maintenance of disease-free seed stock;
- ▣ Production of planting materials for the Rodriguan lime;
- ▣ Protection of the purity of the local 'petit piment' from hybridisation with introduced varieties.
- ▣ Collaboration with PGR Mauritius in the development of an ex-situ collection of crop varieties

6.5 Institutional Framework

a) Governmental Organisations

Rodrigues Regional Assembly

Rodrigues is autonomous from Mauritius and is governed by the Rodrigues Regional Assembly (RRA), established under the Rodrigues Regional Assembly Act (2001). An executive council is responsible for carrying out the functions of the assembly, and comprises the Chief Commissioner, Deputy Chief Commissioner and up to five other members. Each is given the responsibility of various departments. The agencies involved in biodiversity conservation fall under the Chief Commissioner's Office (Environment Unit, Fisheries Protection Service, Fisheries Research & Training

Unit, Forestry Division and Marine Parks) and Deputy Chief Commissioner's Office (Water Resources Unit, Agriculture, Food Production and Quarantine Services). Apart from Environmental Impact Assessments (EIA), all decisions relating to these divisions can be made independently of Mauritius.

Forestry Division

The Forestry Division is under the day-to-day management of a Forest Ranger. There are three area-based Sections (Mt Lubin, Latanier and La Ferme) with a staff of 157. The Division is responsible for forestry plantations and four nature reserves. Decisions relating to the management of Nature Reserves are governed by the Nature Reserves Board (Forest and Reserves Act 1983), which meets in Mauritius. The SLO has recently ruled out that Mainland Nature Reserves are under the responsibility of the RRA, while islets Nature Reserves are under the responsibility of the Nature Reserves Board.

Environment Unit

The Environment Unit advises on policy matters relating to the management and protection of the coastal zone. It plays a coordinating role for environmental protection and oversees the preparation and dissemination of EIA reports.

Fisheries Division

The Fisheries Division addresses issues pertaining to the conservation and sustainable use of marine biological resources. A Fisheries Committee chaired by the Chief Commissioner and consisting of Departments under the RRA and NGOs has been established to advise the RRA on policy development in this domain.

Agricultural Unit

The Agricultural Unit addresses issues of agricultural biodiversity. It provides support to the farming community through the provision of technical and extension services. Sporadic efforts have been made to conserve local crop varieties.

b) Non-Governmental Organisations

Mauritian Wildlife Foundation

The Mauritian Wildlife Foundation (MWF) has been active in conservation in Rodrigues since 1985. MWF has signed a Memorandum of Understanding the RRA to carry out collaborative projects on biodiversity conservation. MWF has six full-time staff and is involved in the restoration of Grande Montagne and Anse Quitor nature reserves. It has a native plant nursery, for the propagation of critically endangered species. It operates effective volunteer schemes with the local community and has carried out many projects involving plant conservation and restoration.

There are two NGOs working on the conservation and sustainable use of marine biodiversity, Shoals (Rodrigues) and the Rodrigues Underwater Group.

Shoals Rodrigues

Shoals Rodrigues was founded in 2001, following on from the Shoals of Capricorn Programme, and has 9 permanent staff. It uses three complementary approaches - research, education and training to raise the level of understanding about the marine environment in Rodrigues. This is achieved through long-term habitat and

fisheries monitoring, visiting international scientists, the involvement of local trainees and youth educators.

Rodrigues Underwater Group

Rodrigues Underwater Group is primarily a dive group that also carries out some conservation work in collaboration with Shoals Rodrigues.

6.6. Identification of Gaps and Existing Needs

6.6.1 Terrestrial and forest biodiversity

Management of the forest and terrestrial biodiversity of Rodrigues is currently constrained by:

- *Absence of a strategic approach to biodiversity management.*
- *Weaknesses in legislation and its enforcement.*

There are gaps in the national legislation with no protection for individual plant species. Plants are classified as forest produce under the Forest and Reserves Act so there are penalties for the removal and damage of plants in areas under the jurisdiction of forestry; however no distinction is made between critically endangered endemic species and invasive weeds. Capacity needs to be built in the relevant agencies to facilitate the implementation of legislation.

- *Absence of biosecurity planning and controls for Rodrigues*

Politically Mauritius and Rodrigues are one entity but biogeographically they are quite separate. There are many non-native organisms found in Mauritius that could cause environmental and economic problems if they were introduced into Rodrigues e.g. monkeys, red-whiskered bulbuls, tenrecs and plants such as Brazilian pepper (*Schinus terebenthinus*) and liane cerf (*Hiptage benghalensis*). A comprehensive approach to biosecurity is required that such as that set out in the Global Invasive Species Programme (GISP) guidelines.

- *Inadequate capacity in the executing agencies*

Conservation management is an increasingly technical task demanding specific skills such as horticulture, animal handling and specimen preparation, the use of taxonomic keys, humane animal trapping and census techniques. Training is an on-going requirement for all staff involved in conservation.

6.6.2 Marine and Freshwater Biodiversity

Management of marine and freshwater biodiversity is currently constrained by:

- *Inadequate staff in the lead organisation and lack of coordination between different agencies*

The coastal and marine resources are managed in a fragmented manner with a lack of communication between the different departments responsible for management, leaving room for duplication and conflict. This is further complicated by a general lack of human resources that impedes the implementation of necessary day-to-day marine management activities including management of, and enforcement of regulations in,

marine reserves. Patrols on the high seas surrounding Rodrigues fall under the responsibilities of the National Coast Guard, which unfortunately does not have the appropriate vessels to fulfil this role.

There is no agency responsible for the management of freshwater biodiversity.

6.6.3 Agricultural Biodiversity

There is a need to define a strategy for the conservation of existing genetic resources for the benefit of the agricultural sector, and the community at large. The following gaps have been identified as being of particular concern:

- ☐ Absence of policy with regard to the conservation and improvement of local cultivars of crops and local breeds/cross-breeds of animals.
- ☐ Lack of data of the traits and characteristics of local varieties and breeds.
- ☐ Lack of human resources and capacity to conduct the necessary research activities.
- ☐ Lack of necessary infrastructure and equipment.

Chapter 7. Rodrigues Framework Strategy

Vision

“That the people of Rodrigues Island enjoy a healthy environment and an enhanced quality of life due to the effective conservation and sustainable use of biodiversity in line with local, national and international commitments.”

Mission Statement

“That the rate of biodiversity loss in Rodrigues is significantly reduced by the year 2015.”

Strategic Objectives

- 1). Establish a Representative and Viable Protected Area Network (PAN)
- 2). Manage Key Components of Biodiversity
- 3). Enable Sustainable Use of Biodiversity
- 4). Maintain Ecosystem Services
- 5). Manage Biotechnology and its Products

Working Principles

The working principles for the implementation of the Rodriguan BSAP match those for the overall national approach namely:

The Interdependence of Humans and Biodiversity
Intrinsic Value
The Precautionary Principle
The Priority of In-situ Conservation
The Ecosystem Approach

Plan Duration and Review

The strategy is intended to have 10-year duration 2006-2015 with an independent review during year five which will provide the basis for a consultative revision of the BSAP so as to enable an adaptive management approach and the optimal attainment of goals and objectives.

7.1 Mainstreaming Biodiversity

The consultative development of Biodiversity Strategies and Action Plans (BSAPs) empowers stakeholders, by incorporating their capacities and priorities into the communal effort to manage biodiversity. The thematic areas and objectives in this document therefore reflect stakeholder priorities. However, for the NBSAP to function effectively and meets its obligations under the CBD other issues need to be addressed and incorporated into the overall document.

These issues were compiled and put to the final stakeholder workshop and approved as follows under the overarching title of Mainstreaming Biodiversity.

7.1.1 Implementation and coordination

- A Steering committee will fulfil an executive role, oversee, guide and monitor the implementation of the BSAP. The committee will have representative stakeholders membership, be equitable in mode of function and will be chaired by the Chief Commissioner's Office.
- A coordinating unit that will serve as secretariat to the Steering Committee will be established in the Chief Commissioner's office. The unit will fulfil the administrative role in coordinating the implementation of the Rodriguan BSAP.

7.1.2 Integrating biodiversity concerns

The steering committee and coordinating unit will also function to integrate the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies (CBD Article 6b). This will be achieved through:

- the representative nature of the committee's stakeholder membership, and
- the targeted and timely dissemination of information by the coordinating unit to appropriate agencies and partners.

The Biodiversity evaluation proposed under the national BSAP will also play an important integrating role by giving value to aspects of biodiversity and environmental services that are not traditionally incorporated into environmental and developmental planning.

7.2 Enabling activities

- Capacity Building: the National Capacity Self Assessment (NCSA) was ongoing at the time of the development of this document and will provide a substantive capacity building requirements baseline for the effective implementation of the CBD in Rodrigues. The NCSA however looks primarily at core-capacity issues as they also relate to the Conventions on climate change (FCCC) and desertification (CCD). This BSAP, however, elaborates specific areas of Rodriguan biodiversity priorities as identified by stakeholders. A gap analysis of the final NCSA should be undertaken to ensure that the full capacity building requirements of the BSAP are addressed.

- Education and Awareness: is a cross-cutting issue which should be incorporated as standard practice into all project developments and is hence not explicitly mentioned in all projects within the BSAP. All E&A campaigns need however to be designed with their own logical frameworks so that they can be effectively targeted, monitored and adaptively managed.
- Administrative and Legislative Review: the review proposed under the national BSAP will also have pertinence in the Rodriguan scenario and potentially offers scope for enhanced conservation and sustainable use of biodiversity.

7.3 Work Programmes

Each strategic objective is divided up into work programmes:

1). Establish a Representative and Viable Protected Area Network (PAN)

- a) Terrestrial Protected Area Network
- b) Inland Waters Programme
- c) Marine Protected Area Network
- d) Management Plans

2). Manage Key Components of Biodiversity

- a) Invasive Alien Species.
- b) Flowering Plants
- c) Birds
- d) Fruit Bats
- e) Reptiles
- f) Invertebrates
- g) Agrobiodiversity
- h) Repatriation of Information and Genetic Materials.

3). Enable Sustainable Use of Biodiversity

- a) Ecotourism
- b) Environment Protection Act
- c) The Aquatic Environment
- d) Traditional Use
- e) Fishing
- f) Agrobiodiversity and Sustainable Agriculture

4). Maintain Ecosystem Services

- a) Forest Management
- b) Water Quality

5). Manage Biotechnology and its Products.

- a) Implement the Cartagena Protocol on Biosafety

Rodrigues Biodiversity Action Plan			
Strategic Objective 1: Establish a Representative and Viable Protected Area Network (PAN)			
	Description	OVI s	Partners
Work Programme	1a) Terrestrial Protected Area Network		
Objective	To place 10% of Rodrigues terrestrial environment within a PAN by 2015.		
Results	<p>Priority areas of terrestrial habitat for inclusion in PAN identified.</p> <p>PAN incorporates viable and representative components of Rodrigues' terrestrial environment.</p> <p>PAN is designated under the law and demarcated on the ground¹.</p> <p>At least 10% of landmass is incorporated into PAN².</p> <p>500 Ha of priority habitat under intensive management³.</p>	<p>Draft proposal for PAN incorporating all ecosystem and habitat types.</p> <p>Management plans, sensitive area/biodiversity maps.</p> <p>Official gazette. PA boundaries demarcated.</p> <p>Maps. Gazette. Management Plans (x-ref WP 1d)</p> <p>Management reports. Maps, photos, site verification.</p>	
Activities	<p>Review existing literature and knowledge of terrestrial ecosystems.</p> <p>Survey habitat types where baseline information is lacking e.g. cave ecosystems (x-ref WP 1b).</p> <p>Identify key representative areas and biodiversity hotspots and design PAN to incorporate these areas. (x-ref WPs 2b-f).</p> <p>Designate and demarcate PAN.</p> <p>Identify priority areas within PAN for intensive management with regard to control/mitigation/eradication of IAS and rehabilitation.</p> <p>Commence intensive management of targeted areas</p>	<p>Priority areas identified. Gaps in knowledge of ecosystem and habitat types identified.</p> <p>Survey reports and maps.</p> <p>Sensitive areas and biodiversity hotspots map.</p> <p>Proposed PAN is representative of biodiversity as per best current information. Gazette. Maps. Site verification.</p> <p>Management proposals.</p> <p>Reports. Site verification.</p>	
Notes and Guidance	<p>1: The implementation of this WP should be undertaken with due reference to the national programme to review PA classifications based upon IUCN criteria</p> <p>2: Some 90% of the land in Rodrigues is owned by the state and as such the stakeholder workshop felt the 10% target could be obtained without encroaching on private property. If this should prove not to be the case an equitable mechanism of land negotiation should be followed in line with that set out in the national BSAP.</p> <p>3: The ongoing threat posed IAS in Rodrigues requires that priority areas of the PAN be intensively managed in order to ensure the future viability and representative nature of the PAN</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	1b) Inland Waters Programme		
Objective	Identify key areas of inland water ecosystems for management and incorporation into PAN		
Results	<p>Priority areas for management and/or inclusion into the PAN identified.</p> <p>Capacity for ongoing monitored localised.</p> <p>Inland waters biodiversity under enhanced and effective management regime.</p>	<p>PAN incorporates viable and representative inland water ecosystems.</p> <p>Trained staff</p> <p>Single agency mandated by RRA and implementing management recommendations for Inland water ecosystems.</p>	
Activities	<p>Undertake (rapid assessment¹) baseline survey of inland water biodiversity.</p> <p>Train local staff in basic rapid assessment and monitoring techniques.</p> <p>Determine priority areas for management and protection².</p> <p>Review administrative structure for management of inland water biodiversity</p> <p>Recommend structure for inland waters biodiversity.</p> <p>Prepare a management plan for rivers, canals, springs and streams.</p>	<p>Survey reports with comprehensive management recommendations.</p> <p>Appropriate personnel from govt, NGO and private sector agencies trained.</p> <p>Biodiversity hotspots and sensitive areas identified.</p> <p>Minutes of stakeholder consultations</p> <p>Proposal for single agency submitted to RRA.</p> <p>Draft document for approval.</p>	<p>Environment unit, NGOs, Local expertise, Local communities, NPCS, International expertise e.g. Ramsar convention and CBD secretariats.</p>
Notes and Guidance	<p>Stakeholder consultations revealed that inland waters are a priority for attention. This is due to:</p> <ul style="list-style-type: none"> • The extensive historical deforestation of the island has lead to the loss and severe degradation of many watercourses. Consequently in contrast to early historical accounts of the island there are now very few permanent watercourses on the island. • Very little work has been undertaken in surveying and assessing biodiversity interest in freshwater systems. • The geographic and evolutionary isolation of these systems makes it likely that they will harbour high biodiversity interest. <p>The optimal implementation of PAN (WP 1a-d) and forestry (WP 4a) initiatives set out in this document is dependent upon an effective assessment of inland waters that identifies biodiversity hotspots, sensitive areas and priority areas for management and restoration.</p> <p>1: The CBD has recognised the particular circumstances of inland waters in SIDS and has developed a rapid assessment programme to address this.</p> <p>2: The main workshop identified a preliminary list of priority areas for survey: Cascade Pigeon, Cascade Victoire, Riviere Banane, Mourouk.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	1c) Marine Protected Area Network		
Objective	To develop and maintain a representative marine protected area network		
Results	<p>PAN network is expanded to include representative components of marine habitats in and around the lagoon.</p> <p>Mourouk marine park, incorporating Gombrani Island and Mourouk Valley, is designated and demarcated</p> <p>PAN is managed within the context of Integrated Marine and Coastal Area Management (IMCAM).</p> <p>Status of fishery reserves reviewed and altered as appropriate.</p> <p>Conservation status of mangrove systems determined.</p>	<p>Gazette Site verification Management plans and reports</p> <p>Gazette and site verification.</p> <p>Management Plans address the PAN in the broader land and seascape.</p> <p>National Gazette</p> <p>Criteria for mangrove management agreed.</p>	
Activities	<p>Undertake gap assessment of marine protected areas and the proposed Port Mourouk marine park to identify under-represented habitat types.</p> <p>Designate and demarcate the proposed Mourouk marine Park modified so as to incorporate Gombrani island and Mourouk Valley.</p> <p>Review protection criteria of fishery reserve status^{1&2} i.e. consider options for no-take and multiple use zones.</p> <p>Determine management approach to mangrove areas³.</p>	<p>Report documents.</p> <p>Gazette</p> <p>Recommendations.</p> <p>Scientific reports and minutes of stakeholder meetings.</p>	FTRU RUG Shoals
Notes and Guidance	<p>1: The implementation of this WP should be undertaken with due reference to the national programme to review PA classifications based upon IUCN criteria.</p> <p>2: The stakeholder workshop felt that existing fishing reserves were not fulfilling their purpose and should be reviewed. Fishery reserves currently only legislate against large seine netting practices. It was felt that the location, efficacy and need for other protective measures all required investigation.</p> <p>3: Historical accounts indicate that mangroves did not naturally occur in Rodrigues and as such those created in recent times as a coastal protection measure are controversial. It was agreed that the status of mangroves in Rodrigues should be determined and agreed through a consultative process before they be considered for inclusion in the PAN.</p>		

	<i>Description</i>	<i>OVI</i>	<i>Partners</i>
<i>Work Programme</i>	<i>1d) Adaptive Management of Protected Area Network</i>		
<i>Objective</i>	To develop costed and scheduled management plans for each area that enable adaptive management.		
<i>Results</i>	Each Protected Area has a structured, time bound and targeted management plan that enables adaptive management.	Management plans. Budgets. Usage regimes including multiple-use and zoning of activities as appropriate. Monitoring of impact using criteria such as Limits of acceptable change and Quality of visitor experience indicators.	
<i>Activities</i>	Develop management plans for each area through stakeholder consultation utilising a logical framework approach. Investigate usage potential in particular modes of non-consumptive use.	Stakeholder analyses Situation analyses Risk assessments Usage potential Meeting minutes Situation analyses reports including risk assessments. Such as Recreation Opportunity Spectrum analyses etc...	FTRU, RUG, Shoals, Fishermen's assoc, WRU, Environment Unit, ARTO.
<i>Notes and Guidance</i>	Stakeholders identified the assessment and mitigation of impacts on Marine Protected Areas as an issue of particular concern. Issues such as terrestrial sources of pollution, different categories of water sports, diverse usage regimes and the impact of incentive programmes (perverse or otherwise) such as the bad weather allowance were highlighted.		

Rodrigues Biodiversity Action Plan			
Strategic Objective 2: Manage Key Components of Biodiversity			
	Description	OVI s	Partners
Work Programme	2a) Invasive Alien Species		
Objective	To develop and implement a national IAS Strategy and Action Plan		
Results	<p>Balanced, comprehensive IAS strategy developed in line with GISP guidance¹.</p> <p>National IAS strategy and Action Plan recognises the distinct biogeographical context of Rodrigues and the need to exert internal controls to ensure the Biosecurity of Rodrigues².</p> <p>IAS impact on ecosystem services addressed³.</p> <p>Action plan under implementation</p>	<p>National strategy document.</p> <p>National strategy document</p> <p>National strategy document</p> <p>Minutes of meetings Implementation reports.</p>	
Activities	<p>Establish a representative Rodriguan stakeholder IAS committee.</p> <p>Ensure effective and equitable involvement of Rodriguan committee in national undertaking to develop a IAS strategy and Action Plan.</p> <p>Identify a coordination mechanism to streamline the activities of the Health, Agriculture and Biodiversity sectors.</p> <p>Develop and implement a comprehensive strategy and action plan for Rodrigues⁴, in line with GISP criteria, that interacts effectively within the broader national approach.</p> <p>Investigate need for establishment of a Biodiversity Unit within the Environment Division.</p>	<p>Minutes of meetings</p> <p>National approach recognises and incorporates the particular biogeographic and administrative circumstances.</p> <p>Mechanism established, functioning and adaptively managed.</p> <p>Rodrigues strategy addresses local priorities and circumstances whilst an effective mechanism for the integration of activities within the broader national approach.</p> <p>Recommendations.</p>	<p>Forestry, MWF, Shoals, RUG, FRTU, Customs, Environment Unit, Agricultural services, CBO, NCG, GISP.</p>
Notes and Guidance	<p>1: Invasive Alien Species are the primary factor currently threatening terrestrial biodiversity on Rodrigues.</p> <p>2: The specific biogeographical context of Rodrigues must be recognised within the plan and dealt with appropriately. In particular the establishment of biosecurity controls between Rodrigues and mainland Mauritius. The establishment of direct links with Reunion island must also be considered.</p> <p>3: Stakeholders identified IAS as a key threat to the maintenance of ecosystem services.</p> <p>4: Funds for the development for a Mauritian IAS strategy have been identified.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2b) Flowering Plants		
Objective	To effectively conserve and manage the endangered and threatened flowering plants of Rodrigues.		
Results	<p>Status of flowering plants reviewed and threatened and endangered species identified¹.</p> <p>Electronic database (GIS) of threatened plant species established.</p> <p>All critically endangered species and 60% of threatened species in ex-situ collections.</p> <p>60% of threatened species represented in-situ management areas.</p> <p>1 coastal and 1 “uplands” in-situ gene bank(arboretum) established.</p> <p>All threatened species protected under the Wildlife and National Parks Act.</p>	<p>Updated list of threatened flowering plants of Rodrigues.</p> <p>Database and distribution maps.</p> <p>Ex-situ collection reports Site verification.</p> <p>In-situ management reports. Site visits of restoration areas and in-situ gene banks.</p> <p>Site visit. Management reports.</p> <p>Gazette.</p>	
Activities	<p>Establish a Rodrigues threatened plants technical committee.</p> <p>Establish partnership with mainland threatened plant technical committee and IUCN.</p> <p>Review the status of flowering plants utilising the Rodrigues’ red data document as a baseline.</p> <p>Undertake field surveys to establish distribution and abundance of threatened species.</p> <p>Establish and commence implementation of a prioritised programme of ex-situ and in-situ plant conservation.</p> <p>Investigate scope for artificial propagation techniques where necessary.</p> <p>Identify suitable areas for in-situ gene banks(arboretum) and initiate establishment.</p> <p>Protect, as appropriate (x-ref WP 3c), all threatened species under the Wildlife and National Parks Act.</p>	<p>Minutes of meetings.</p> <p>Correspondence with Mauritian committee and IUCN.</p> <p>Minutes of meetings. Updated list.</p> <p>Survey reports</p> <p>Action Plan. Implementation reports.</p> <p>Research reports and correspondence with international agencies and donors. Coastal and “upland” sites proposed</p> <p>Regulations gazetted.</p>	<p>MWF, FS, NPCS, IUCN, MSIRI, RBG Kew. CBO, SLO, CEHDA, Friends of Wildlife.</p>
Notes and Guidance	1: The updating of the threatened species list has two components: i) the review of current information in light of IUCN red data criteria, ii) field surveys to establish the distribution and abundance of threatened plant species. Action on conservation must not wait for the completion of the field survey but should initiate on priority basis (i.e. commencing with critically endangered species) as soon as the initial review of best current information has been completed.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2c) Birds		
Objective	To monitor and manage key bird species		
Results	<p>Status of Rodriguan warbler, Rodriguan Fody and other priority species known.</p> <p>Bird species database established.</p> <p>Bird species adaptively managed</p>	<p>Database Monitoring reports.</p> <p>Conservation plans...</p> <p>Limits of acceptable change (LAC) determined for priority species. Management plans and reports.</p>	
Activities	<p>Identify species that require monitoring, this will include the Rodriguan Fody and Rodriguan Warbler.</p> <p>Develop monitoring protocols for identified species in partnership with appropriate agencies.</p> <p>Develop monitoring for key sea bird colonies on Ile aux Cocos & Sables.</p> <p>Implement monitoring protocols and report on population trends.</p> <p>Establish electronic databases.</p> <p>Develop management plans as appropriate.</p>	<p>Preliminary survey reports. Minutes of stakeholder consultations.</p> <p>Monitoring protocol documents. Correspondence and collaboration with appropriate agencies.</p> <p>Monitoring protocol documents. Correspondence and collaboration with appropriate agencies.</p> <p>Monitoring reports</p> <p>Database printouts and reports. Site verification.</p> <p>Criteria for management plans e.g. Limits of acceptable change defined. Recommendations for management plans/management plans.</p>	FS, MWF, BirdLife International.
Notes and Guidance			

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2d) Fruit Bats		
Objective	Monitor and adaptively manage the Rodriguan bat population		
Results	<p>Status of bat population known Ecology of the species better understood.</p> <p>Criteria for active management established¹.</p>	<p>Database Scientific reports/papers.</p> <p>LAC determined Management Plan drafted.</p>	
Activities	<p>Monitoring of population continued and modified as appropriate.</p> <p>Study of ecology undertaken.</p> <p>Management/contingency plan drafted</p> <p>Options for enhancing conservation status investigated</p>	<p>Monitoring reports Database.</p> <p>Scientific reports/papers</p> <p>Plan available</p> <p>Feasibility report.</p>	<p>FS, MWF, International Partners e.g. IUCN.</p>
Notes and Guidance	<p>1: The population has undergone a significant recovery in recent years thought to be as a result of forestry development and as such it may be deemed unnecessary to undertake active management. The species however remains vulnerable due to its restricted range and the threat of cyclones as such a contingency plan for the conservation of the species is required and options for improving its conservation status should be considered e.g. the practicalities of re-introducing to the species to mainland Mauritius.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2e) Reptiles		
Objective	To enhance the conservation status of reptiles.		
Results	<p>Strategy and Action plan for terrestrial reptiles developed and under implementation.</p> <p>IOSEA action plan under implementation in Rodrigues</p>	<p>Implementation and progress reports.</p> <p>Implementation reports incorporated into national reports.</p>	
Activities	<p>Undertake surveys of the native gecko on Coco and Sable islands, Anse Quitor, Grand Montagne.</p> <p>Develop and implement, as appropriate, a reptile species strategy.</p> <p>Review IOSEA¹ Action Plan and identify aspects pertinent for implementation in Rodrigues.</p> <p>Implement Rodriguan commitments under the IOSEA.</p>	<p>Survey reports.</p> <p>Strategy available Implementation/progress reports.</p> <p>Rodriguan action plan drawn from the IOSEA</p> <p>Annual reports</p>	<p>FS MWF International partners. Environment unit.</p>
Notes and Guidance	<p>The stakeholder workshop identified baseline data as being critically deficient for both terrestrial reptiles and marine turtles.</p> <p>1: Mauritius is a signatory to the MoU on the Conservation and management of the marine turtles and their habitats of the Indian Ocean and South-East Asia (IOSEA). The IOSEA has developed a comprehensive action plan for the conservation of sea turtles.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2f) Invertebrates		
Objective	To develop and implement strategies for native insects and snails respectively.		
Results	<p>Insect Strategy with targeted species action plans, as appropriate, developed and under implementation.</p> <p>Snail Strategy with targeted species action plans, as appropriate, developed and under implementation.</p>	<p>Strategy and Action Plan documents. Conservation status of species.</p> <p>Strategy and Action Plan documents. Conservation status of species.</p>	
Activities	<p>To carry out invertebrate surveys¹ building upon ongoing MWF activities.</p> <p>Develop and implement a native insect strategy.</p> <p>Carry out a survey of native snail species¹.</p> <p>Develop and implement species recovery plans where necessary within the framework of an overall snail strategy.</p>	<p>Survey reports.</p> <p>Strategy document. Implementation reports.</p> <p>Survey reports.</p> <p>Strategy document. Implementation reports.</p>	<p>FS, MWF, University of Sussex.</p> <p>FS, MWF, Leguat Ltd.</p>
Notes and Guidance	<p>1: The stakeholder workshop identified lack of data as the key factor inhibiting effective action on invertebrates and targeted insects and snails of being of priority. If areas/habitats of key significance for invertebrate biodiversity are identified this information should be fed into WP 1a-c.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2g) Agrobiodiversity		
Objective	To have 70% of local agrobiodiversity in ex-situ collections		
Results	<p>Local varieties and breeds documented.</p> <p>At least 70% of local varieties and breeds of agrobiodiversity are conserved in ex-situ collections.</p> <p>Traditional knowledge on each accession in ex-situ collection documented.</p>	<p>Survey report</p> <p>Management reports, Site verification</p> <p>Documentation/publication.</p>	
Activities	<p>Undertake survey of local plant and animal agrobiodiversity and characterise local breeds.</p> <p>Develop a priority list of local agrobiodiversity¹.</p> <p>Implement priority actions through initiation/expansion of ex-situ collections.</p> <p>Research and document traditional knowledge associated with each accession under ex-situ protection.</p>	<p>Survey reports</p> <p>Comprehensive listing and description of local varieties and breeds.</p> <p>Priority list for action available.</p> <p>Ex-situ collections, site verification.</p> <p>Reports and documentation/publication.</p>	AREU, AS, FASER, Traditional farmers.
Notes and Guidance	<p>1: The stakeholder workshop identified a preliminary priority list for investigation:</p> <ul style="list-style-type: none"> - Lime, petit piment, haricot rouge, café local. - Poultry, sheep, pig, vache creole. 		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	2h) Repatriation of Genetic Material		
Objective	Identify/assess overseas holdings of Rodriguan genetic resources and specimens and secure access as required.		
Results	International ex-situ holdings of specimens and genetic material identified and access secured.	Correspondence. Repatriation as appropriate. Evidence of access.	
Activities	<p>Liaise with international ex-situ centres (Botanical gardens, museums etc...)</p> <p>Identify holdings of Rodriguan genetic material and specimens.</p> <p>Negotiate access to information and resources.</p>	<p>Correspondence</p> <p>Correspondence. Documentation of holdings.</p> <p>Correspondence MoUs.</p>	<p>FS MWF Uof Mauritius. International agencies. RRA Ministry of Foreign Affairs.</p>
Notes and Guidance			

Rodrigues Biodiversity Action Plan			
Strategic Objective 3: Enable Sustainable Use of Biodiversity			
	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3a) Ecotourism Development		
Objective	To develop an ecotourism strategy		
Results	Ecotourism strategy finalised, approved and under implementation.	Strategy document. Implementation/progress reports. Budget committed.	
Activities	<p>Develop strategy through stakeholder consultation utilising a logical framework approach.</p> <p>Set up a coordinating tourism office</p> <p>Develop regulations for ecotourism as identified in the Island Development Strategy and the Tourism Development Plan 2001.</p> <p>Implement a permit/tax system, with a portion of revenue going to environmental protection.</p>	<p>Draft Strategy for approval by RRA</p> <p>Office mandated and operational.</p> <p>Regulations gazetted.</p> <p>Regulations gazetted.</p>	<p>RRA, AGTH, Vive Rodrigues, ACIR, APIR, OPPR, Compagnie de pecheurs, Association de tourism vert de Rodrigues, ARTO.</p>
Notes and Guidance			

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3b) Review Environment Protection Act		
Objective	To better integrate issues of biodiversity concern into the functioning of the EPA		
Results	<p>Biodiversity issues are better represented in final EIA documents.</p> <p>Public input EIAs on large developments enhanced and maintained.</p> <p>New process for the selection of EIA consultants that ensures independence from developers.</p> <p>Activities requiring EIAs updated</p>	<p>EIA documents</p> <p>Public comments</p> <p>Regulations.</p> <p>Regulations.</p>	
Activities	<p>Investigate and test ways of enhancing public input to the EIA process¹.</p> <p>Investigate means of ensuring impartiality of EIA consultants².</p> <p>Review activities which require an EIA/PER through stakeholder consultation giving particular consideration to adding:</p> <ul style="list-style-type: none"> - Road construction and upgrading in the coastal zone. - Ecotourism projects. 	<p>Proposals of enhanced public participation reviewed and as appropriate applied for assessment/refinement on trial basis.</p> <p>Proposals for executive consideration.</p> <p>Recommendations for activities to require EIA submitted for Executive decision.</p>	<p>Environment Unit State Law Office</p> <p>EIA/PER Review Committee</p>
Notes and Guidance	<p>1: The workshop discussed this subject at length and felt strongly that means should be developed to invalidate "implicit consent" suggestions included:</p> <ul style="list-style-type: none"> - Compulsory presentation of EIAs for large developments to key stakeholders (including local communities). - Stream lining procedures for public comments to facilitate public input. <p>2: Concerns were also expressed regarding the impartiality of EIA documents due to relationships being established between developers and EIA consultants.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3c) Traditional Use of Plants		
Objective	To manage species of plant harvested for traditional use		
Results	Public awareness on protected plant species enhanced. Sustainable use of key plant species subject to traditional use enabled	Species conservation status, Questionnaire/survey results. Traditional practices maintained without detriment to conservation status of species.	
Activities	Assess effectiveness of village nursery pilot projects. Identify aspects of best practice and expand programme as appropriate. Create awareness of legal status of plants as per WP 2b ¹ . Develop programmes as appropriate to enable sustainable use of key species.	Reports and recommendations. Proposal for enhanced programme. Media campaigns, workshops etc... Project Documents. Site visits etc...	MWF, FS, NPCS, CBO, SLO, CEHDA, Friends of Wildlife.
Notes and Guidance	1: WP 2b moves to protect all threatened flowering plants. Several of these species are however subject to traditional use in terms of artisanal crafts and medicinal purposes. It is necessary therefore to address these species in terms of both conservation and sustainable use.		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	3d) Fishing		
Sub work programme	3di) Lagoon fishing and gleaning		
Objective	Enable sustainable utilisation of lagoon fishery resources		
Results	Protected area network strengthened and expanded (x-ref WP 1c). Stakeholders effectively involved in beneficial management regimes. Lagoon resources better managed and providing improved sustainable yields.	Gazette. Maps, site verification. Management approaches generated through stakeholder consultation. Catch statistics.	
Activities	To investigate and identify means of reducing fishing pressure in the lagoon ¹ . Increase scope of protected areas and introduce no-take zones ² . Strengthen legislation on collection and ban trade (import and export) in marine shells. Establish shell reference collection and train enforcement officers in species identification. Investigate means of developing community stewardship of the lagoon resources. Assess the ecological impact of sand mining in the lagoon environment.	Recommendations for enhanced management of lagoon fishery resources. Gazette. Gazette. Collection accessible. Trained staff. Minutes of consultations. Recommendations. Report and recommendations.	Environmental Unit, RRA, Shoals, RUG, Fisherman's assoc.
Notes and Guidance	1: e.g. Review mesh size regulations for Seine netting review the bad weather allowance develop programmes to reduce numbers of in lagoon fishers (i.e. transition to pelagic fishing). Investigate scope for development of rights fisheries in the lagoon. 2: The implementation of this WP should be undertaken with due reference to the national programme to review PA classifications based upon IUCN criteria.		

Sub work programme	3dii) Game fishing		
Objective	Develop strategy for game fishing development		
Results	<p>Strategy developed, approved and under implementation.</p> <p>Game fishing industry continues to develop in sustainable manner.</p> <p>Negative interactions between game fishers and artisanal fishers reduced.</p>	<p>Implementation reports.</p> <p>No. of operators. Revenues.</p> <p>Fishing authority records. No. of complaints.</p>	
Activities	<p>Work to mitigate conflict between sports fishing and artisanal fishing operations.</p> <p>Investigate feasibility of zoning sports and artisanal fishing activities.</p> <p>Review game fishing industry and develop strategy for its optimisation and sustainability.</p>	<p>Minutes of stakeholder meetings.</p> <p>Report and recommendations.</p> <p>Situation analysis Stakeholder workshop reports. Draft Strategy.</p>	<p>RRA Environment Unit Fisherman assoc. Game fishing operators.</p>
Notes and Guidance			

	Description	OVI	Partners
Work Programme	3e) Agrobiodiversity and Sustainable Agriculture.		
Objective	Encourage the utilisation of native agrobiodiversity and increase the sustainability of agricultural practices.		
Results	<p>Usage of traditional varieties is increased and economically viable.</p> <p>Organic farming practices more widely utilised.</p>	<p>No. of producers. Volume of trade.</p> <p>Site verification</p>	
Activities	<p>Develop a niche and labelling for traditional local products.</p> <p>Increase the availability of seed stock from local varieties¹.</p> <p>Maintain livestock gene pool (x-ref WP 2g).</p> <p>Investigate the potential for the expansion of organic farming practices².</p>	<p>Certified labelling regime.</p> <p>Breeding centres and ex-situ collections.</p> <p>Ex-situ collections.</p> <p>Assessment and recommendations.</p>	<p>AREU, AS, FASER, Traditional farmers.</p>
Notes and Guidance	<p>1: Improved phytosanitary controls are important to protect local varieties from disease, whilst improved biosecurity can lower the risk of loss local varieties through hybridisation with commercial varieties (x-ref with WP 2a).</p> <p>2: This should include the increased composting of biodegradable solid waste under the Solid Waste Strategy.</p>		

Rodrigues Biodiversity Action Plan			
Strategic Objective 4: Maintain Ecosystem Services			
	Description	OVI s	Partners
Work Programme	4a) Forest management		
Objective	Protect watersheds and soils by increasing forest cover		
Results	<p>Equitable consultation mechanism between grazing and forestry interests established.</p> <p>Forestry policy and current livestock grazing practices harmonised enabling an extension of forestry cover in priority areas.</p> <p>Priority areas for erosion, catchments and biodiversity management (re)planted as appropriate.</p>	<p>Minutes of meetings Modus operandi etc...</p> <p>Approved Policy document</p> <p>Site verification, maps, etc...</p>	
Activities	<p>Establish a consultation mechanism</p> <p>Determine priority areas for reforestation (e.g. key water catchment, erosion or biodiversity areas) (x-ref WPs 1a-b and WPs 2b-f).</p> <p>Negotiate equitable terms for the extension of forested areas and the mitigation of impacts on grazing practices¹.</p> <p>Investigate feasibility of conversion of permanent catchment forestry to native species².</p> <p>Increase native components of watershed forestry cover.</p>	<p>Minutes of meetings</p> <p>Recommendations for priority areas for reforestation.</p> <p>Draft policy or agreement document.</p> <p>Pragmatic targets established for the conversion of exotic plantation into stands of native species.</p> <p>Records, maps aerial photos, site verification etc...</p>	FS, Agriculture, Federation of Associations of livestock Owners
Notes and Guidance	<p>1: Rodrigues has historically undergone near complete deforestation resulting in severe impact to or loss of many freshwater sources. One of the primary difficulties today preventing extensive reforestation is ongoing customary grazing practice. In order to enable an expansion of forestry cover it is essential that an equitable arrangement be reached between grazing and forestry interests.</p> <p>2: 50% of current forestry coverage has been designated as permanent for water catchment maintenance. The workshop agreed that it would be desirable to convert exotic plantation forestry to stands of native species.</p>		

	<i>Description</i>	<i>OVI</i> s	<i>Partners</i>
Work Programme	4b) Water quality		
Objective	To reduce water pollution		
Results	<p>Baseline established for water quality in freshwater sources and lagoon.</p> <p>Point sources for pollution identified and mitigated.</p> <p>Adaptive management improves ambient water quality.</p>	<p>Reports and database.</p> <p>Reports, management activities, legal actions,</p> <p>Results of ongoing water quality monitoring.</p>	
Activities	<p>Monitor water quality in main rivers and water sources (incl. Wells and boreholes). (x-ref WP 1b)</p> <p>Monitor ground water quality around Petit Gabriel for impacts of pit latrines and soak aways¹.</p> <p>Enforce regulations and improve management practices.</p>	<p>Results of monitoring, database.</p> <p>Monitoring results</p> <p>Reports, warning notices, legal actions etc...</p>	<p>Water Resources Unit, Environment Unit, FRTU, Public Health Office.</p>
Notes and Guidance	1: Petit Gabriel was selected as a pilot project to investigate the impact of population centres on water quality.		

Rodrigues Biodiversity Action Plan			
Strategic Objective 5: Manage Biotechnology and its Products			
	Description	OVI s	Partners
Work Programme	5) The Cartagena Protocol on Biosafety		
Objective	To implement the Cartagena Protocol on Biosafety		
Results	<p>Public receives balanced information on the use of biotechnology.</p> <p>Societal choice with regard to the handling transfer and use of LMOs and their products in Rodrigues is determined.</p> <p>Administrative and legislative framework is put in place in line with requirements specified under the National Biosafety Framework document and local circumstances.</p>	<p>Media Campaigns. Brochures. Pamphlets. Posters. Public meetings etc...</p> <p>Stakeholder consultation or form of referendum as appropriate.</p> <p>Mandated agencies. Regulations approved by the RRA.</p>	
Activities	<p>Initiate public education and awareness programme on the potential benefits and risks of the handling, transfer and use of Living Modified Organisms (LMOs).</p> <p>Undertake broad consultations to determine the public's attitude to the introduction and use of LMOs and their products.</p> <p>Implement the National Biosafety Framework¹ as appropriate in the context of Rodrigues.</p> <p>Develop Bill to address Biosafety, bioethics and Intellectual Property Rights as applied to biotechnology.</p>	<p>Media Campaigns. Brochures. Pamphlets. Posters. Public meetings etc...</p> <p>Public meetings Stakeholder consultations etc...</p> <p>Focal point agencies and personnel identified. Correspondence with National Biosafety Committee.</p> <p>Draft bill to RRA for consideration.</p>	<p>Environment Unit Agriculture Civil Society, ACIR.</p>
Notes and Guidance	1: The National Biosafety Framework was near to completion at the time of the workshop		

References

- AGRER (2004) Islets National Park Strategic Plan, p. 70. Government of Mauritius.
- Aljanabi S, Parmessur Y, Kross H, *et al.* (2005) Characterization of quantitative trait loci (QTLs) contributing to field resistance to yellow spot disease in sugarcane. *Proceedings of the International Society of Sugar Cane Technology XXV*, 550-557.
- ARDA (2003) Premier inventaire des poisons et des macrocrustacés d'eau douce des principales rivières pérennes de l'île Maurice. Rapport de resultats., p. 53. Ministère de l'Amenagement du Territoire et de l'Environnement, France.
- Bachraz V, Tezoo V. (1997) A review of ex-situ conservation activities in Mauritius. In: *Proceedings of the workshop on restoration of highly degraded and threatened native forests in Mauritius* (ed. Y. Mungroo JRM, V. Bachraz), pp. 12-19. National Parks and Conservation Service.
- Bachraz V. (2001). *Fern Conservation in Mauritius*, unpublished paper presented at the International Fern Conservation Symposium, University of Surrey, UK
- Baird W.F. & Associates, Reef Watch Consultancy, Risk M (2003) Study on coastal erosion in Mauritius, final technical report. Ministry of Environment.
- Bell BD, Bell EA (1996) Wildlife management international limited: part one "Mauritius offshore islands project Phase II implementation of management recommandations"; part two "Mauritius offshore islands survey report and management plan".
- Bell P, Lomax K (1999) Habitat restoration: Flat Island, Mauritius. Eradication of rats, mice and feral cats, September to November 1998.
- Bennie J (1956) The Mauritius creole breed of Milch cattle. *Empire Journal of Experimental Agriculture* **24**, 1-15.
- Bruce NL (2004) *Hadromastax dinamoraze* sp. nov., the first occurrence of the family Hadromasacidae Bruce and Müller, 1991 (Isopoda, Crustacea, Limnoriidea) in the Indian Ocean. *Journal of Natural History* **38**, 3113-3122.
- Bullock DJ, North S (1975) Report of the Edinburgh University expedition to

Round Island, Mauritius, July and August 1975.

- Bullock DJ, North S, Greig S (1982) Round Island Expedition 1982: final report.
- Cadet T (1975) Contribution d'une etude de la vegetation de l'Ile Rodrigues. *Cahier du centre Univ. de Reunion* **6**, 29.
- Carter SP, Bright PW (2002) Habitat refuges as alternatives to predator control: experimental and modelling approaches to the consevation of endangered Mauritian birds.
- Cheke AS (1974) British Ornithologist's Union Mascarene Islands expedition.
- Cheke AS (1987) An ecological history of the Mascarene Islands, with particular reference to extinctions and introductions of land vertebrates. In: *Studies of Mascarene Island Birds* (ed. Diamond AW), pp. 5-89. Cambridge University Press, London.
- Cheke AS (1987) Observations on the surviving endemic birds of Rodrigues. In: *Studies of Mascarene islands Birds*, pp. 364-402. Cambridge University press, UK.
- Coppejans E, Leliaert F, Verbruggen H, *et al.* (2004) The marine green and brown algae of Rodrigues (Mauritius, Indian Ocean). *Journal of Natural History* **38**, 2959-3020.
- Cuddihy LW, Stone CP (1990) Alteration of Native Hawaiian Vegetation: Effects of Humans, Their Activities and Introductions. University of Hawaii, Department of Botany, Cooperative National Park Resources Studies Unit., Honolulu.
- De Clerck O, Coppejans E, Schils T, *et al.* (2004) The marine red algae of Rodrigues (Mauritius, Indian Ocean). *Journal of Natural History* **38**, 3021-3057.
- Dookun A, Autrey L, Koch M (1999) Preparation of a National Biosafety Framework in Mauritius. National Biosafety Guidelines for the Safe Development and Introduction of Genetically Modified Organisms in Mauritius., p. 93. UNEP/GEF Pilot Biosafety Enabling Activity Project.
- Dulloo ME (1995) International conference and programme for plant genetic resources.
- Dulloo M.E.(1998) Diversity and conservation of wild Coffea germplasm in the Mascarene Islands, PhD Thesis, University of Birmingham, U.K

- Fenner D, Clark TH, Turner JR, Chapman B (2004) A checklist of the corals of the island state of Rodrigues, Mauritius. *Journal of Natural History* **38**, 3091-3102.
- Geddedu JR (1998) *Water quality assessment of Mauritian rivers using invertebrate bioindicator species*. BSc (Hons) thesis, University of Mauritius.
- Genave,T.(2003) Abundance and distribution of *Octopus cyanae* in Rodrigues lagoon,MSc Dissertation, University of Wales, Bangor, U.K
- Giorgi L, Borchellini S (1998) Carte geologique de l'Ile Rodrigues. Le schema hydrogeologique. La notice explicative., p. 28+ 22 maps. Ministere Delege a la Cooperation et de la Francophonie & Geolab., Paris.
- Govinden N (2004) Guide de la productions de coeurs de palmiers a Maurice. *Advisory Bulletin, Mauritius Sugar Industry Research Institute* **8**.
- Griffiths OL, Cook A, Wells SM (1993) The diet of the introduced carnivorous snail *Euglandina rosea* in Mauritius and its implications for threatened gastropod faunas. *Journal of Zoology, London* **229**, 79-89.
- Griffiths OL, Florens. FBV (in prep) Field guide to the non-marine molluscs of the Mascarene island and northern dependencies of Mauritius.
- Gurib-Fakim A, Guého J, Sewraj MD, Dulloo E (1994) *Plantes Médicinales de L'Ile Rodrigues* Editions de l'Océan Indien, Rose Hill, Mauritius.
- Gurib-Fakim A, Gueho J, Bissoondoyal MD (1995-1997). *Planntes Medicinales de Maurice* Tomes 1, 2, 3, Editions de l' Ocean Indiens, Rose Hill, Mauritius.
- Gurib-Fakim A, Gueho J (1999-2000). CD-ROM on 'Inventaire et Etudes des Plantes Aromatiques et Medicinales des Etats de l' Ocean Indien'. MNO Nouveaux Territoires, St. Denis, Reunion(France)
- Gurib-Fakim A (20003-2004). *Illustrated Guide to the Flora of Mauritius and the Indian Ocean Islands*. Gurib-Fakim Ed, Mauritius.
- Gurib-Fakim A (2005). *Lesser-known and Under-utilized Plant Resources*. Gurib-Fakim Ed, Mairitius
- Heemstra E, Heemstra P, Smale M, Hooper T, Pelicier D (2004) Preliminary checklist of coastal fishes from the Mauritian island of Rodrigues. *Journal of Natural History* **38**.

- Impey AJ, Cote IM, Jones CG (2002) Population recovery of the threatened endemic Rodrigues fody (*Foudia flavicans*) (Aves, Ploceidae) following reforestation. *Biological Conservation* **107**, 299-305.
- IUCN (2003) IUCN red list of threatened species.
- Malham J (2005) Echo parakeet management report. Mauritian Wildlife Foundation.
- Maunder M, Page W, Mauremootoo JR, *et al.* (2002) The decline and conservation management of the threatened endemic palms of the Mascarene islands. *Oryx* **36 (1)**, 56-65.
- Mauremootoo JR, Leckraz NR, Puttoo M, *et al.* (2003) Mauritius. In: *Invasive alien species in southern Africa: national reports and directory of resources* (eds. Macdonald I, Reaser C, Bright C, *et al.*). Global Invasive Species Programme, Cape Town, South Africa.
- Ministry of Agriculture Food Technology and Natural Resources (2003) Non Sugar Sector Strategic Plan 2003-2007. Government of Mauritius.
- Ministry of Agriculture FTaNR (2003) Non Sugar Sector Strategic Plan 2003-2007. Government of Mauritius.
- Ministry of Economic Development and Regional Cooperation (1998) Management plan for St Brandon, p. 61. Government of Mauritius, Mauritius.
- Ministry of Environment and NDU (1999) National Environmental Strategies for the Republic of Mauritius: Environmental Investment Programme., p. 200. Government of Mauritius.
- Ministry of Environment and NDU (1999) National environmental strategies for the Republic of Mauritius: National Environment Action Plan for the next decade.
- Ministry of Environment and NDU (2004) South Eastern Highway Project Environmental Monitoring Committee Report of the Chairperson, p. 18pp. Ministry of Environment and NDU, Government of Mauritius., Port Louis.
- Ministry of Housing and Lands (2004) National Development Strategy. Government of Mauritius.
- Ministry of Shipping, Rodrigues and Outer Islets (2004) Blue Print on Cardagos Carajos Group of Islands (St Brandon), p. 23. Government of Mauritius.

- Ministry of Environment and NDU (1999) National environmental strategies of the Republic of Mauritius: Environmental Investment Programme.
- Ministry of Environment and NDU (2005) Mauritius - Staking out the future. Government of Mauritius, Port Louis. Mauritius.
- Ministry of Fisheries (2005) Ministry of Fisheries Annual Report 2003. Republic of Mauritius.
- Montaggioni L, Faure G (1980) Les récifs coralliens des Mascareignes (Océan Indien). Centre Universitaire de la Réunion. Université Française de l'Océan Indien., Réunion.
- Myers A (2004a) Amphipoda (Crustacea) of the family Aoridae (Corophiidea) from Rodrigues, Indian Ocean. *Journal of Natural History* **38**, 3123-3135.
- Myers A (2004b) A new species of amphipod of the genus *Neomegamphopus* (Crustacea, Amphipoda, Neomegamphopidae) from Rodrigues, Indian Ocean. *Journal of Natural History* **38**, 3137-3142.
- National Parks and Conservation Service (2000) First national report for the Republic of Mauritius on the Convention of Biological Diversity. Ministry of Agriculture FT & NR, Port Louis, Mauritius.
- National Parks and Conservation Service (2002) Second national report for the Republic of Mauritius on the Convention of Biological Diversity, p. 99. National Parks and Conservation Service, Port Louis, Mauritius.
- Newlands W (1975) St. Brandon: Fauna conservation and management. Minister of Agriculture and the Environment, Mauritius.
- North SG, Bullock DJ (1986) Changes in the vegetation and populations of introduced mammals of Round Island and Gunner's Quoin, Mauritius. *Biological Conservation* **37**, 99-117.
- North SG, Bullock DJ, Dulloo ME (1994) Changes in the vegetation and reptile populations on Round Island, Mauritius, following the eradication of rabbits. *Biological Conservation* **67**, 21-28.
- Oliver PG, Holmes AM (2004) Cryptic bivalves with descriptions of new species from the Rodrigues lagoon. *Journal of Natural History* **38**, 3175-3227.
- Page WS, D'Argent G (1997) A vegetation survey of Mauritius. Report

- Commissioned by IUCN, Basel. Mauritian Wildlife Foundation, Port Louis, Mauritius.
- Parmessur Y, Aljanabi S, Saumtally S, Dookun-Saumtally A (2002) Sugarcane yellow leaf virus and sugarcane yellows phytoplasma: elimination by tissue culture. *Plant Pathology* **51**, 561-566.
 - Pernetta AP (2004) *Microhabitat and dietary preferences of Telfair's skinks (Leiolopisma telfairi)* Masters, University of East Anglia.
 - Pillay R, Terashima H, Venkatasami A, Uchida H (2002) *Field guide to corals of Mauritius* Albion Fisheries Research Centre, Albion, Mauritius.
 - Prosper A (1998) *An ethnobotanical survey of the indigenous plant resources of Rodrigues* Thesis, University of Mauritius.
 - Puchooa D (2004) Biotechnology in Mauritius: current status and constraints. *Electronic Journal of Biotechnology* **7**.
 - Ramdoyal K, Domaingue R (1993) Conservation, evaluation and utilisation of sugar cane germplasm in Mauritius.
 - Ross T (2004) *The ecology of a new endemic skink from Flat Island* Masters Thesis, University of East Anglia, UK.
 - Rowe, F.W.E and Richmond, M.D. (2004) A preliminary account of the shallow-water echinoderms of Rodrigues, Mauritius, Western Indian Ocean. *Journal of Natural History* **38**:3273-3314.
 - Safford RJ, Jones CG (1998) Strategies for land-bird conservation on Mauritius. *Conservation Biology* **12**(1), 169-176.
 - Scwabe E (2004) The Polyplacophora (Mollusca) collected during the First International Marine Biodiversity Workshop for Rodrigues (western Indian Ocean), with the description of a new species. *Journal of Natural History* . **38**, 3143-3173.
 - Seelarbokus B (1990) *Hydrobiological survey of River St Martin and its influence on groundwater quality*. BSc (Hons.) thesis, University of Mauritius.
 - Showler DA, Cote IM, Jones CG (2002) Population census and habitat use of Rodrigues warbler *Acrocephalus rodericanus*. *Bird Conservation International* **12**, 223-243.

- Strahm W (1989) *Plant Red Data Book for Rodrigues* Koeltz Scientific books, Koennigstein, West Germany.
- Strahm WA (1994) *The conservation and restoration of the flora of Mauritius and Rodrigues* PhD Dissertation, University of Reading, UK.
- Svavarsson J, Jorundsdottir K (2004) A new gnathiid species (Crustacea, Isopoda, Cymthoidea) from Rodrigues, Mauritius, Indian Ocean. *Journal of Natural History* **38**, 3103-3111.
- Swinnerton KJ, Chapman R, Vardapanaikan B (1996) A report on a visit to St. Brandon by the Mauritian Wildlife Foundation 22/1 - 7/2/1996. Part 1 - Turtles. Mauritian Wildlife Foundation, Port Louis, Mauritius.
- Terashima H, Mosaheb JI, Paupiah CN, Chineah V (2001) *Field Guide to Coastal Fishes of Mauritius* Albion Fisheries Research Centre, Albion, Mauritius.
- Tixier P, Gu,ho J (1997) *Introduction to Mauritian bryology :a checklist of mosses and liverworts* Mauritius Sugar Industry Research Institute, Reduit, Mauritius.
- Vaughan RE, Wiehe PO (1937) Studies on the vegetation of Mauritius I, A preliminary survey of the plant communities. *Journal of Ecology* **25**, 289-343.
- Wiehe PO (1949) The vegetation of Rodrigues Island. *Bull. Mauritius Inst.* **2**, 279-305.
- Williams JR (1989) *Butterflies of Mauritius* Pedigraph Ltd, Mauritius.
- Williams JR, Ganeshan S (2001) Insects introduced into Mauritius during the 20th century: Natural, accidental and deliberate introductions. *Revue Agricole et Sucrière de l'Ile Maurice* **78**, 33-50.