THE COMMONWEALTH of THE BAHAMAS
National Biodiversity Strategy and Action Plan

Coordination

Bahamas Environment, Science and Technology Commission
G. Carleton Ray, University of Virginia
Alan Bolten, University of Florida

Contributors

Ambassador Lynn P. Holowesko
Bahamas Environment, Science and Technology Commission
Karen Bjorndal, University of Tourism
Donald Cooper Department, of Environmental Health Services
John Hammerton, Department of Agriculture
Colin Higgs, Department of Fisheries
Susan Larson, Bahamas National Trust
Gerry McCormick-Ray, University of Virginia
Melonie McKenzie, Department of Environmental Health Services
Archie Nairn, Department of Local Government
Tex Turnquest, Department of Lands and Surveys
Philip Weech, Water and Sewerage Corporation
Simon Wilson, Ministry of Finance

Acknowledgments

Bahamas Environment, Science and Technology Commission
Deputy Permanent Secretary, the late Catherine Benjamin
Lorca Bowe, Maria Hield, Tia Sawyer, Cindy Smith
Bahamas National Trust
Department of Agriculture

Editing and Additional Material

John Hammerton, Susan Larson

Production

Susan Larson
Bahamas National Trust
Bahamas Environment, Science and Technology Commission

Partially funded under Grant GF/1200-96-40

Submitted to
The United Nations Environment Programme

June 30, 1999

CONTENTS

Foreword

Lynn P. Holowesko, Ambassador for the Environment
Chair, Bahamas Environment Science and Technology Commission
June 30, 1999

This strategy and action plan had its formal beginning in September 1996. A broadly representative task force was called together at the invitation of The Bahamas Environment Science and Technology (BEST) Commission to discuss the generous offer of the United Nations Environment Programme to fund a project for a National Biodiversity Strategy for The Bahamas.

Earlier beginnings of this undertaking date back to the 1980s when national consciousness began to warm to environmental concerns, and Bahamians publicly acknowledged the value of their environment, that it was fragile, and not to be taken for granted.

Then in 1990, The Bahamas National Trust planned a week-long observance and celebration of Earth Day. Those activities attracted high-level public sector involvement and set the stage for enthusiastic Bahamian participation at the United Nations Convention on Environment and Development (UNCED) in Rio de Janeiro, Brazil, in 1992.

Following the Rio Conference, the Bahamas National Trust developed a comprehensive document outlining a National Conservation Strategy for The Bahamas. This was adopted by The Bahamas delegation to the Small Island Developing States Conference in Barbados in 1994, and promoted, as this country's initial response to Agenda 21, the Rio Declaration.

Later in the year, The Bahamas ratified the Convention on Biological Diversity and hosted the First Conference of the Parties in Nassau in November, 1994. At the opening of the Nassau Conference, the Prime Minister of The Commonwealth of The Bahamas announced the creation of the Bahamas Environment, Science and Technology Commission and appointed a Bahamian Ambassador for the Environment as its Chair.

Many members of the task force, including the consultants, had travelled much of that long road together, from early 1980 to 1994. Several had walked it in even earlier days, when the road was no more than a dirt path through the bush. Each task force member brought, in varying manifestation, a passionate devotion to the task at hand. It is, after all, what each has worked towards throughout long or short careers, directly or indirectly related to the environment — a national policy for conservation and a plan of action to implement it.

Bahamians, perhaps like many other island people, have historically had a close personal relationship with the land and the sea. The remarkable clarity of the water, the incredible colours embracing the full spectrum of blues and greens, speaks to us about who we are, and where we come from.

From our earliest days ("since I knew myself", a Bahamian would say) we have enjoyed the bountiful harvest of our islands. What could be better than Nassau Grouper, Bahamian crawfish, passin' jacks, goggle-eye and conch! As children, we could stand on a rocky shore and catch shads. The older generation was able to walk on sand flats and pick up conchs.

We grew the sweetest pineapples, bananas and melons. Childhood was spent setting our teeth on edge eating guineps, hog plums, cocoplums, gooseberries and tamarinds. The fields of the islands were planted with native corn, tomatoes, pigeon peas, cassava and sweet potato. Rainwater filled our cisterns, and we drank and bathed in God's "sweet water".

Slowly, imperceptibly, "things" began to change. The colour of the water still takes one's breath away, but the harbours and bays of the islands are laden with the refuse and rubbish of a thoughtless society. From sail boats, motor craft, picnic crowds and cruise ship passengers, the ugly discards of a society mad for convenience float in our waters, layer the once-clear, sandy or grassy bottom, and disfigure the beaches, poking out from among the sea-oats and bay cedar which frame the shores.

Grouper and crawfish are among the most expensive items on a menu in the best restaurants. The demand from 280,000 Bahamians and three and a half million tourists, and the international market, has put severe pressure on marine resources. Fishermen dive thirty feet or more, and far away from shore, to find conch.

We no longer cultivate hog-plums and gooseberries; we import peaches, grapes and plums from other lands. The new generation hardly knows what cassava is, and most have never seen a breadfruit.

The diminishment of Bahamian biodiversity in the lifetimes of those who have written this report is distressing. But it is staggering to remind ourselves what the country has lost since its "discovery" in 1492. Historians describe waters then teeming with seals, porpoises and whales. Ships' captains reported harbours where turtle were so abundant they were a menace to anchored vessels. Skies were "darkened" at times by parrots, and other birds of brightest hue.

And the indigenous people, the Lucayans, lived in peace and harmony in a virtual paradise.

Four hundred years later, all the seals and many whales had disappeared, having been slaughtered for their oil and skins. Five hundred years later, a national park was created in the northern Bahamas on Abaco island, for one of the two last breeding flocks of Bahamian parrots. Parrots and turtles both are on the endangered species list.

And there are no Lucayans left with whom to share a culture and history; they had been wiped out in The Bahamas long before the turn of the 17th Century.

The authors of this report hope that a lesson can be learned, a national commitment made to lose no more. They want their children, and grandchildren, to have an opportunity to enjoy, and to cherish, the rich variety of life that was special to their childhood, and to pass on to new generations a respect and appreciation for the natural world.

Against this background, merely a sampling of the depth of caring that produced so much thought, planning, and work, a national strategy for the conservation and wise use of our natural resources, has been forged.

At the outset, we declared that our efforts were, first of all, for our people, for a quality of life that ensured each person had a healthy environment in which to be born, to grow, to learn and to thrive. For that reason, every effort has been made to convey the message of this strategy and action plan in popular, rather than scientific language, so that it can be widely shared and broadly understood.

We also recognised that our biodiversity is the basis of our national wealth. We have neither gold nor silver, coal nor oil to mine. Instead, we have what the world yearns for: a beautiful land, scattered like 700 pearls in an emerald sea, capped with startlingly clear, blue skies, bathed in sunshine and moonlight year-round. The natural environment is "relatively" clean, "relatively" unspoiled.

We have an undetermined variety of marine and terrestrial flora and fauna. Part of the action plan to this Strategy must be to catalogue that wealth, to evaluate its potential for the well-being of our people, and to give it the protection it requires if it is to continue to enrich our society. The task force resolved to see that this work is done, to ensure that this inheritance is passed on.

A national commitment is needed if we are to succeed. The strategy devised needs to be implemented. This is a task that cannot be done by a small group, or by government, or by one constituency, or by one island. It must be a

national programme, driven by a less-selfish society, carried out by committed citizens.

Toward that end we have chosen a theme for this National Biodiversity Strategy and Action Plan for The Bahamas, a vision for the future - “A Strong Nation Rooted in a Healthy Environment". It is up to Bahamians everywhere to make the vision a reality.

1 Chapter One
Biodiversity: Purpose and Potential

"In the economic sense biodiversity represents unimaginable wealth, in the ethical sense it is simply priceless."

(Birdlife International. Putting Biodiversity on the Map, 1992)

The world community's growing commitment to sustainable development inspired the Convention on Biological Diversity. The Convention represents a dramatic step forward in the conservation of biological diversity, the sustainable use of its components, and the fair and adequate sharing of benefits arising from the use of biological resources.

The Convention was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). The Commonwealth of The Bahamas (The Bahamas) was among the first of the Small Island Developing States to become a signatory State, ratifying the Convention in September, 1994. At June 30, 1999 176 States had signed the Convention, making it one of the world's most widely-supported international Conventions. The first Conference of the Parties of the CBD was held in Nassau, The Bahamas, in November, 1994.

The Convention is unique among environmental conventions as it takes a comprehensive, rather than a sectoral, approach to conservation and sustainable use of all the Earth's biological resources. The Convention is hailed as a landmark for another important reason as it is the first time that the conservation of biodiversity is recognised as the common concern of humankind.

The Articles of the Convention cover a wide range of topics, including general measures for conservation and sustainable use, identification and monitoring, *in-situ* and *ex-situ* conservation, sustainable use of biodiversity components, research and training, impact assessment, and access to genetic resources.

The Bahamas is committed to the principles of the Convention. With far-reaching obligations for conservation and for sustainable use of resources the Convention also obligates the signatories to develop national strategies and action plans. This Strategy and Action Plan is intended to help The Bahamas meet these obligations.

1.1 Biodiversity Purpose

Biological diversity, or biodiversity, encompasses the complex mosaic of all life. It includes all genes, species and ecosystems and the ecological processes of which

they are a part. It has been noted that "there is no shortage of examples of wild animals and plants being put into service for the benefit and economic development of mankind: new drugs, new fibers, new foods, new genetic capabilities — all such things derive from often unexpected sources in nature, sources that have survived more by chance than by human design or management" (ICBP, 1992). Biodiversity is the life-support system of the planet and yet it is being lost at an alarming rate.

1.1.1 Biodiversity of The Bahamas.

The Bahamas Country Study Report (1995) is The Bahamas' most recent attempt to provide an overview of the country's biodiversity. Even so, its accounting of the taxonomic and ecological status of biodiversity in The Bahamas is considered preliminary. As the Report states, "knowledge of Bahamian species diversity is fragmentary. An estimate based upon the survey of scientists and literature reported here suggests that possibly only 5% of all species present in the country are reported to date. This would mean that a full 95% remains unreported or undescribed."

However, many aspects of Bahamian biodiversity have been studied and are noteworthy. The Lucayan Caverns on Grand Bahama, reputably one of the largest submarine cavern systems in the world, are known to possess a number of endemic species. Research on some of the blue holes of Andros on *Gambusia hubbsi* , a species of mosquitofish found only in The Bahamas, shows that populations between blue holes differ greatly in body size and sex ratios. These differences may reflect differences in predators, and research is continuing on these extremely complex ecosystems. The lakes of San Salvador contain four species of sympatric pupfish (*Cyprinodon*), a situation known to exist in only one other place in the world.

Insularity and a extensive shelf with productive coral reefs and other habitats, plus a large area of coastal wetlands, especially managrove forests, contribute to the abundance and diversity of fish. In this regard, The Bahamas has greater biodiversity abundance and diversty than the entire insular Caribbean.

Correll and Correll (1982) report that nearly nine percent (121 taxa) of plant species found in The Bahamas are endemic, but concludes that the Bahamian "flora has been derived mainly from that to the south and west, especially Cuba." Over 1350 species of flowering plants and ferns have been described, representing approximately 660 genera and 144 families.

Box 1.1
Some Rare Animal and Plant Species of The Bahamas

Rare species are those that have dwindled in numbers and distribution until there are only small populations dispersed over a large area. If the decline in numbers or in the number of populations continues, the species is said to be *vulnerable*. Further decline leads to population numbers falling below a critical level, and the species is then said to be *endangered*. The next stage is total decline and *extinction*.

The Bahamas has a number of animal and plant *rare* species, some of which are described below. In most instances these species have become rare because of habitat destruction as a result of land-clearing or direct exploitation for food or other uses.

The Bahamian Hutia (*Geocapromys ingrahamii*) is the only endemic land mammal in The Bahamas. It is a tail-less rodent somewhat larger than a rat. The hutia was considered at one time to be extinct within The Bahamas, but a colony was found on East Plana Cay, and small colonies have now been established on a number of Cays in the Exuma Land and Sea Park, where they have successfully multiplied. It remains rare because of the small number of colonies.

During the 1940s, numbers of the West Indian Flamingo (*Phoenicopterus ruber ruber)* in the Wider Caribbean declined sharply, probably as a result of habitat destruction. A Reserve to protect this bird was first established in 1951, in Inagua: this became a National Park in 1963. A breeding colony, estimated to number some 60,000, is now to be found in Inagua, and flamingoes from Inagua are now beginning to recolonize other islands in The Bahamas. The Great Barn Owl or Chickcharnie (*Tyto pollens*) has declined in numbers as its habitat, and probably its food supply also, have dwindled as a result of land-clearing.

The Osprey or Fish Hawk (*Pandion halietus*) has also declined in numbers, probably as a result of coastal zone developments destroying nesting sites, and possibly also because of reductions in food supply as a result of commercial fishing. It is now found in only a few areas of The Bahamas.

The Inagua Turtle (*Pseudemys malonei*) and the Cat Island Turtle (*Pseudemys felis*) are found only near these two islands and are distinct species native to The Bahamas. Exploitation has probably led to their declines in numbers.

Three species of Ground Iguana are found in The Bahamas: *Cyclura cychlura, C. carinata* and *C. rileyi.* Each of these species has one or more sub-species, which are found only in certain islands or cays. *C. cychlura cyclura* is found only in Andros*, C. cychlura inorta* is found only on the Allen Cays, and *C. cychlura figginsi* is found only in Exuma. *C. carinata bartschi* is found only in Mayaguana, while *C. rileyi nuchalis* is found only in Acklins and *C. rileyi cristata* only on White Cay. While the decline in numbers of all these species and sub-species is, no doubt, partly due to development, it is also due to poaching of live iguana for sale overseas as pets.

The Bimini Boa (*Epicrates striatus fosteri*), native to Bimini, has declined in numbers in part because of loss of habitat, but many have been, and continue to be, killed by people who find them in their houses or gardens, though the snake is non-venomous and not dangerous. Some are also poached and sold for the pet trade.

Agave species are related to the sisal plant—and known locally as “bamboo”. Several distinct and native species of *Agave* are found in Acklins, Exuma, Inagua and San Salvador. It is not clear why these species should be in decline but, no doubt, land-clearing is an important factor.

Ernodea gigantea is a shrub of coppice thickets on Acklins, Crooked Island and Mayaguana. It has no generally-recognized local name. It has become rare presumably as a result of land clearing. *Erythoxylum reticulatum* is a rare shrub of both coppice and pineland habitats on Andros and Exuma. Again, it is not clear why it has become rare*. Psidium androsianum* is related to the common guava and, as the name suggests, is native to Andros but is now rare.

Euphorbia brittonii is a low-growing perennial herb, rarely more than 7 cm high, is native to The Bahamas but now found only in Eleuthera and New Providence. Land-clearing may well be responsible for its rarity in New Providence, but it is less clear why it appears to have declined in Eleuthera.

There are a number of plant and animal species that are rare in The Bahamas (Box 1.1). The fauna include the country's only endemic mammal (*Geocapromys ingrahamii)*, a variety of birds endemic and migratory, including the Kirtland's Warbler (*Dendroica kirtlandii*), and a number of reptiles. The Monk seal (*Monachus tropicalis*) and the Great Barn Owl (*Tyto pollens*) are two Bahamas species known to be extinct. The Bahamas is by far the largest, small-island archipelago in the tropical Atlantic, similar in size and complexity to some Pacific Island groups and to the entire Lesser Antilles (Table 1.1). It is important to recognise that the majority of The Bahamas' space (more than 96%), and most of its diversity (both higher taxa of organisms and habitat types), is in coastal, marine and deep waters, the vast majority of which remains unexplored. Much of the biodiversity of Bahamian waters comprises migratory fish and mammal species. Many of its ecological relationships are unique in the Wider Caribbean Region.

The Bahamas, together with the ecologically similar Turks and Caicos Islands, comprise three biogeographical regions. The size, complexity, and ecological isolation of The Bahamas has important implications for biodiversity. Each species and life-form in an ecosystem plays a unique but significant role, which contributes to the resilience and robustness of the ecosystem. In small island states, maintaining these ecosystem characteristics is a challenge: small islands are much more prone to loss and extinction of species than are larger land masses. Removal or alteration of one or more components, invariably leads to ecosystem change or even loss. For example, tree loss may not only lead to the loss of food supply, shelter and nesting sites for birds and many small animals, but also to the loss of shade. Many under-storey plant species may not survive the loss of shade. The loss of ground cover may then lead to soil erosion, and the ecosystem has been significantly altered, even destroyed.

Table 1.1
Characteristics of The Bahamas

Land 700 cays 2,400 rocks	35 major islands
North-South Extent[1]	720 km (448 mi)
Northwest-Southeast Extent[2]	937 km (528 mi)
Greatest Width	812 km (505 mi)
Land Area[3]	13,933 km ^{2} (5382 mi^2)
Total Area	325,000km^2 (124,000 mi^2)
Estimated Reef Area	10,000 km^2 (3,800 mi^2)
Protected Areas[4]	1,230 km^2 (~500 mi^2)

[1] Measured latitudinally.
[2] Measured from northwest Little Bahamas Bank to Inagua Southeast Bank.
[3] This figure is accepted by the Department of Lands and Survey.
[4] This is the total area of the twelve areas designated to date (See Table 2.1).

In marine ecosystems, destruction of coral reefs and sea-grass beds removes food and shelter for many life-forms, and leads to declines in commercial fish populations. Mangrove swamps provide nurseries for many fish of commercial

Box 1.2
Examples of Bahamian Ecosystems

In spite of its relatively small land area, The Bahamas has many terrestrial ecosystems and, with its large expanse of ocean, a high diversity of marine ecosystems. Important, and easily-recognized, Bahamian ecosystems include — but are not limited to — the following:

Pine Forests. Most pine forests (*Pinus caribaea*) are self-sustaining secondary growths. They protect the soil and the fresh water lens and provide habitats for many plants and animals--including the Bahama parrot in Abaco. This ecosystem is also known as "pineyards", "pinelands" or "pine barrens", and they may be "wet barrens" or "dry barrens". The pine forests of Abaco, Andros and Grand Bahama occupy about 6,185 km^2 (2,416 mi^2).

Coppice. This comprises the dense, upright and narrow-stemmed, regrowth of mixed hardwood tree species (*Bursera, Metopium* and *Swietenia*). It provides habitats for many orchids and bromeliads--both terrestrial and epiphytic--and for birds, snakes and crabs. Coastal coppice may occasionally flood, and on windward coasts receives salt spray which may lead to sculpting and wind-shaping.

Inland ponds. Plant life may be restricted to micro-algae either dispersed or in mats along the edges. Salinity can vary widely, with some ponds hypersaline. Animal life in the latter include crabs, insects, brine shrimps and wading birds. Anaerobic decomposition may release sulphides with unpleasant smells. Heavy rainfall or flooding with freshwater seriously disturbs hypersaline ecosystems.

Mangrove Forests. These are dominated by one or more species of mangrove (*Avicennia, Laguncularia* and *Rhizophora,)* with other plant species in drier areas. They encourage sedimentation, hold the sediments in place, and help build land. They also provide nursery habitats for many marine animals, including commercial fishery species, and habitat for water fowl and other fauna. Mangrove forests minimise flooding and erosion. They occur mainly in protected locations on leeward coasts. The Bahamas has about 4,286 km^2 (1,674 mi^2) of mangrove forest and other wetlands.

Blue holes. Ocean blue holes provide habitats for many marine animals, including commercially-important fish. Inland blue holes comprise photo-synthesising cyanobacteria (often called blue-green algae) around the edges, and several different bacterial species at specific depths and levels of salinity. They are also home to several unusual species of fish. The inland blue hole ecosystem is easily disrupted.

Coastal rock. These ecosystems occur close to the sea, and comprise several low-growing and salt-tolerant shrubs, including *Strumfia*, many of which are most attractive. Iguanas may be found in this ecosystem.

Coastal sand. These communities include beaches and strips among coastal rock ecosystems. Above the high water mark, the plants are typically vines and low-growing spreading perennial species and shrubs. Sea oats (*Uniola*) are often conspicuous.

Tidal flats and salt marshes. These have saline soils which may be high in silt content, and are typically covered with rather succulent low-growing plants tolerant of salinity. Typical is *Salicornia*.

Seagrass beds. These stabilise the sea-bed, are a primary source of food for many grazing marine reptiles, and provide nursery habitats for many commercial fisheries.

Coral reefs. These protect low-lying coast-lines from wave action, provide habitat for numerous fish species and for other sea creatures, and have aesthetic value for Bahamians and tourists. They are the most diverse ecosystems in The Bahamas. The Bahamas may have as much as 4 to 5% of the world's coral reef biodiversity.

Open ocean. This ecosystem abounds with numerous species of fish, marine mammals (such as whales and dolphins), jelly fish, octopus and aquid, as well as with seaweeds and an abundance of other creatures that provide food for the larger animals.

importance, as well as for crabs, and provide nesting sites for many birds. Coral

reefs and swamps protect coastal areas from ocean storms and surges, and, swamps also reduce flooding — all important stabilising functions, especially in small island nations.

Humans must also be considered an integral component of most ecosystems. Few, if any, ecosystems world-wide have not experienced some perturbation as a result of human use of plant, animal and physical natural resources. The complexity of ecosystems, and our uncertain knowledge of their workings, are compelling reasons for treating ecosystems as the units for conservation and management. Conservation of any ecosystem component species requires conservation of the ecosystem as a whole.

Unless action is taken to protect some of these species at least, they may all be headed for extinction.

1.1.2 The Services of Biodiversity

From both ecological and socio-economic points of view, biodiversity is the life-support system that provides many imperative services directly to human society, usually at little or no direct cost (Box 1.3). Many of these services are "hidden" in that humankind is often unaware of these services — at least until they are no longer provided. A myriad of organisms, large and small, acting together and meeting their own reproductive and physiological needs, provide these services.

In The Bahamas these services are woven into the country's culture, history and future. Over the centuries they have provided the people of The Bahamas with medicines, building materials, food, protection, transportation, recreation, and aesthetics, to name a few. One of the earliest contributions to the country's economy was derived from biodiversity. Centuries of home-concocted remedies are rooted in the Bahamian "bush." The widely-promoted Bahamian resources of sun, sand and sea provide the foundation on which tourism, the country's number one industry, is built.

The repair or replacement costs for the loss of any biodiversity service can be socially and economically catastrophic. For example, the costs of restoring water quality, eliminating chemical or microbiological pollution, managing wastes, and making up for resource losses have been known to economically cripple nations large and small, developed and developing, around the world. These mitigation costs also bear additional human-health costs.

1.1.3 Biodiversity as Natural Capital.

Biodiversity is the natural capital of a country. Biodiversity provides the components of the various ecosystems of a country. Loss of biodiversity disrupts the functioning of ecosystems, their stability and their capacity to deliver services (Box 1.3). Biodiversity maintains the productivity of agriculture and fisheries and its conservation is a vital component of "sustainable development". The World Commission on Environment and Development has defined the latter as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Box 1.3
Some Services of Biodiversity

Apparent services

- plants for shelter, boat-building, fuel, baskets
- plants for decoration, dyes, fragrances and aesthetic pleasure
- plants for food and drink, medicine and honey
- plants for forage for livestock, manure and mulch
- plants for fibre for cloth, twines and ropes
- control of pests and disease
- support of diverse human activities, such as recreation, relaxation, and financial gain
- provision of aesthetic beauty and a sense of well-being for humans
- intellectual stimulation in knowing about the diverse ways in which organisms have evolved and survived on Planet Earth for billions of years

Hidden services

- maintenance of abundant populations of valued species that provide economic benefits to Bahamians;
- maintenance of ecosystem function, and productive habitat diversity;
- purification of air and water and detoxification and decomposition of wastes and pollutants;
- benefits to agriculture and forest growth by generation and renewal of soils and soil fertility
- moderation of climate by plants and forests, which transpire and cycle water through the soil and atmosphere
- animals and birds for scavenging services
- animals and birds for insect pest control services
- bacteria and fungi for nutrient recycling services; bacteria and fungi for decomposition services; bacteria and fungi for nitrogen-fixing services
- birds and small animals for seed dispersal services
- insects for pollination services
- insect parasites and predators for pest control services
- plants for soil generation and maintenance services
- plants for atmospheric carbon dioxide mediation services
- plants for water transpiration services
- landscapes for aesthetic pleasure, recreation, and windbreaks

"Apparent services" are those that may require the user to harvest wild plants or animals in order to obtain the service. "Hidden services" are those

Two primary stated goals of the Government of The Bahamas are sustainability and the elimination of poverty. Both are intertwined with the conservation and sustainable use of biodiversity, and both these goals are inextricably tied to the country's natural capital. Sustainable development is almost totally dependent on biodiversity and the services it provides. Yet, all nations, especially small island nations such as The Bahamas, are vulnerable to losing

their natural capital and its associated services. If biodiversity is depleted or lost, financial and social impacts can be significant, either through the need for direct subsidies or replacement costs. Sustainability becomes increasingly difficult and the impoverished are the first to be impacted by the loss of services and the cost of mitigation.

The beneficiaries of biodiversity con-servation are the whole of humankind (Box 1.4). In The Bahamas fishermen, crabbers, hunters, farmers, straw vendors, and wood carvers derive their livelihoods directly from biodiversity but the benefits go far beyond these primary users. Plants affect climate change, a critical issue for Small Island Developing States. Coral reefs act as carbon sinks and help regulate the level of carbon dioxide in the atmosphere, and other ecosystems play integral roles in life-supporting natural cycles and processes such as water and food chains - both directly supporting human life. Biodiversity IS the country's natural capital held in trust by the present generation for the benefit and well-being of future generations.

1.1.4 Policy.

The Government of The Bahamas has endorsed biodiversity conservation. It has recognised that the environment is critically important to the economy and well-being of all generations of Bahamians. As a consequence of this policy, the Government has begun to incorporate the protection and enhancement of the environment and biodiversity into the national planning process. To facilitate this process, the Government created the Bahamas Environment, Science and Technology (BEST) Commission in 1995, passed important environmental legislation, and is actively reviewing international agreements on environment and natural resources.

Government is further committed to the development and implementation of a review and approval process for development through the finalization of environmental impact assessment processes and procedures. It has committed itself to develop policies that will ensure regular monitoring, quality control and enforcement of laws for the protection of environmental resources, including fresh water, marine resources, agricultural lands and general environ mental quality. Government has committed itself to work with the Bahamas National Trust in evaluating the country's National Park System with a view to determine what gaps exist in biodiversity *in-situ* conservation.

The Government has also committed itself to the principle of "sustainable development", and believes economic expansion, job creation, and financial investment are important constituents of such development. However, in order to resolve conflicts, it is essential

that the relationships among conservation of biological diversity, national economic well being, and sustainability are recognised and addressed.

Box 1.4
Beneficiaries of Biodiversity Conservation

Biodiversity is recognised at the gene level, at the species level, and at the ecosystem level. At the ecosystem level it is the life-support system of Planet Earth

Conservation of the diversity of plants is fundamental to the future of humankind. Plants, and a few other organisms, transform solar energy into the foods and food chains that feed other organisms. Plants affect climate change by photosynthesis: they act as carbon sinks and to a degree regulate atmospheric levels. Coral reefs also act as carbon sinks because of their symbiotic relationship with photosynthetic organisms. Plants are also an integral part of the hydrological cycle. Loss of plant cover interferes with the hydrological cycle, contributing to erosion and desertification. Plants also build and protect the soils that must be conserved if plant life and food production is to continue sustainably.

Ecosystems also contain animals, from minute arthropods to birds and mammals in terrestrial ecosystems, and from aquatic arthropods to fish and aquatic mammals in marine and freshwater ecosystems. These animals rely directly (for food) and indirectly (for shelter) on the plants of the ecosystem and also interact with one another. Herbivores large and small occupy lower levels of food chains and are preyed upon by omnivores and carnivores. Small carnivores may, in turn, be prey for larger carnivores. Insects and birds may be needed by the plants for pollination or the distribution of seeds.

These intricate relationships occur in all ecosystems. All the life-forms of an ecosystem therefore play some role, great or small, in ecosystem function, thereby contributing to the sustainability and integrity of ecosystems.

Humankind must be also considered an integral component of ecosystems. However, humans have taken ecosystem services for granted and have benefited from ecosystem “outputs”, rather than on maintaining their “inputs”. Therefore, few if any ecosystems, world-wide, have not experienced some perturbation as a result of human use and/or abuse of plant, animal and physical resources.

Because of inter-connections among ecosystem elements, over-harvesting by humans of only one or two species may deleteriously affect many other elements. Many of these interactions are well understood, but most are not; for example, the unknown potential of plants and animals as sources of biomedical compounds which stand to benefit humankind. There are also the aesthetic benefits of animal and plant diversity to residents and tourists alike. Loss of ecosystems will directly impact ecotourism.

For these, and many other reasons, the beneficiaries of biodiversity conservation is the whole of humankind, including the primary users of biodiversity — the fishermen, crabbers, hunters and farmers — as well as city-dwellers who value the recreational benefits of a vibrant and alive countryside. Beneficiaries also include native people who are gatherers of food and medicinal plants, and the bioprospectors who seek new drug and food plants. And by extension, all those who will benefit economically are also beneficiaries.

1.2 Biodiversity Potential

The long-term goal for The Bahamas is to conserve biodiversity and to create a sustainable Bahamian society within a sustainable Bahamian

environment. The overall objective of this Strategy and Action Plan is to provide an overview of the role that biodiversity plays in the social and economic well-being of the Nation, and to recommend the steps that need to be taken to ensure that biodiversity is conserved as economic development continues.

To highlight biodiversity potential, Vision and Mission Statements, responsive to the long-term goal, was formulated by the National Biodiversity Strategy and Action Plan Task Force (Box 1.5). The Vision expresses the connection between human and environmental well being. The foremost goal is to ensure environmental sustainability, while promoting human well-being and addressing socio-economic needs. The Mission directs efforts toward integrated, bioregional planning and management for the Nation and suggests mechanisms for capitalizing on institutional assets now in place as well as improving capacities across the board. It considers the true cost and benefits of development, environmental trade-offs, needs for environmental impact assessments, and further acquisition of knowledge. The Mission directs planning for conservation of biological resources by several means:

- ☐ A comprehensive system of protected areas
- ☐ Regulatory and enforcement mechanisms
- ☐ Special protection for genetic resources
- ☐ Control of alien and invasive species

The Mission Statement also urges development of increased public awareness and education. Finally, it recognises that only through securing consistent and long-term financial

Box 1.5
A Vision and Mission for The Bahamas

VISION
A strong Nation rooted in a healthy environment

MISSION
The quality of life in The Bahamas depends on sustaining biological diversity and incorporating the needs of all peoples throughout the islands of The Commonwealth.

GOALS
Enhance the quality of life in The Bahamas
Ensure environmental sustainability
Promote human well-being
Address socio-economic needs
Develop integrated, comprehensive planning
Share information systems
Incorporate cost-benefit analysis and EIA/EIS processes
Provide for community participation
Support research and monitoring
Conserve biological resources and diversity
Develop a more comprehensive system of protected areas
Enhance regulatory and enforcement mechanisms
Provide for the protection of genetic resources
Control alien and invasive species
Promote public awareness and education
Secure financial support for implementation of our Mission

support will implementation proceed successfully.

Realizing the Vision, and achieving the Mission and Goals are challenging tasks. At the center is the conservation of biological diversity, recognizing that this is basic to ensuring the continued functioning of the ecosystems that underpin human well being in the Commonwealth of The Bahamas.

The challenging tasks will require and information base on biodiversity and its distribution throughout The Bahamas, on the functioning of ecosystems and the vulnerability of biodiversity to human activities and to environmental change. First steps have already been taken to providing this information base with the compilation of the Bahamas Country Study (1995) and with the development of a bibliographic database under the Bahamas Data Management Project (1997).

2 Chapter Two
National Perspective

"We must see the larger task — stewardship of all of the species on all of the landscapes with every activity we undertake as human beings — a task without spatial or temporal boundaries."

(Jerry F. Franklin. Ecological Applications, 3 (2), 1993)

The above quote suggests two important concepts: first, that all of the natural world is interconnected, and second, those social systems must treat natural systems comprehensively and sustainability.

The National Perspective reviews the on-going activities and needs of Bahamian institutions, relevant to the conservation and management of natural resources. Not all activities, agencies, and organizations concerned with this subject or with biodiversity have been included here, a task that would virtually be without boundaries. The summaries in this section are based on Resource Papers prepared by members of the National Biodiversity Strategy and Action Plan Task Force.

Present agency mandates and activities relative to biodiversity issues and actions originated well before The Bahamas became a signatory to, and ratified, the Convention on Biological Diversity, in September, 1994.

2.1 The Bahamas Environment, Science and Technology Commission (Box 2.1)

2.1.1 Context

The Commonwealth of The Bahamas is among the leaders in the Wider Caribbean Region in environmental legislation. The Wild Bird Protection Act, The Bahamas National Trust Act, the Fisheries Resources (Jurisdiction an Conservation) Act, Amendment No. 2 of 1993 (for the prohibition of long-line fishing), and the creation of The Bahamas Environment, Science and Technology (BEST) Commission in 1994, were each milestone achievements in their time.

Through such activities as the enactment of legislation, The Commonwealth of The Bahamas set itself apart in the forefront of innovative environmental legislation.

The Government if The Bahamas has recognized the need to strengthen the Commission so as to make it more effective in developing environmental policy and enhance its capacity in the area of assessment and environmental management. The Inter-American Development Bank has agreed to provide technical assistance through a two-year "institutional strenghtening" project scheduled to begin in 2000 (Enabling Expanded Private Sector Investment Component II: Strengthening of Environmental Management). This has a number of activities, including the drafting of legislation and regulations and recommendations for implementation of a sustainable development policy, recommendations for staffing and funding of the Commission, and updated and improved environmental impact assessment guidelines. It is anticipated that the recommendations from this project will address some current concerns expressed in Box 2.1 and will profoundly affect the capabilities of the Commission to undertake its international commitments and to effectively manage biodiversity throughout the Commonwealth of The Bahamas.

Among the many significant mandates of the Commission is a review of environmental law and policy in The Bahamas. The Commission is to determine whether legislation is in place, whether existing legislation needs amendment, or needs drafting, to enable The Bahamas adequately to protect its natural resources and meet its commitments under the various international treaties to which it has become a signatory.

Even before signing the Convention on Biological Diversity, The Bahamas reaffirmed that biodiversity is fundamental to the success of the development process. It is the role of the BEST Commission to advise Government on policies and activities that will ensure that development takes place in harmony with

sustainable use and conservation of biodiversity. The Commission is also to ensure that The Bahamas meets its obligations under that Convention.

2.1.2 Mandate

Box 2.1
Bahamas Environment, Science and Technology Commission
The highest environmental authority in The Bahamas

Mandate

- Co-ordinate policies and programmes for protectionof the environment
- Develop science and technology awareness among all sectors of Bahamian society
- Develop a national conservation strategy and action plan
- Advise and assist Government in meeting terms, conditions and obligations of international legal convention, treaties, protocols and agreements relating to the environment
- Identify suitable scientific and technological advances which can contribute to the development of The Bahamas
- Propose legislation for enforcement of the provisions of a natural conservation plan and for Government's environmental and sustainable development policies
- Advise Government on the environmental impact of development proposals submitted for Government's consideration
- Prepare papers on various issues to assist in national policy formation
- Explain and publicise the policies and activities of Government in the areas of environment, science and technology

Concerns

- Distances between major islands and populated communities within The Bahamas hinders contact and communication among partners and stakeholders
- Inadequate knowledge base of Bahamian biodiversity impedes strategic planning
- Lack of available natural resource data on which to base sound judgement
- Insufficient human and financial resources within BEST to carry out mandate
- Policy restraint and costs hamper the development of technology
- Overlaps with other institutions in areas of responsibility create confusion

Needs

- Establishment of BEST as a statutory institution
- Institutional strengthening of BEST
- Implement National Biodiversity Strategy and Action Plan
- Implement Bahamas Biodiversity Data Management Plan
- Review of Bahamian law to reveal overlaps and address gaps and to make the EIA/EIS process mandatory
- Development of biodiversity inventory for The Bahamas
- Compile catalogue of national obligations under international treaties

The BEST Commission is the central policy and coordinating body for environmental affairs in The Bahamas. Its goals and objectives include the development of The Bahamas Biodiversity Strategy and Action Plan in accordance with Article 6 of the Convention on Biological Diversity, to assure that national planning is based on all environmental considerations. This entails, among other things, the development of a Geographic Information System (GIS) to enable the BEST Commission to access geographical information related to

the Bahamian natural resources and to allow it to more effectively evaluate development proposals. This is being addressed by a Bahamas National Geographic Information System Project, which is described in more detail in Section 2.4. It is expected that when finally concluded the Bahamas National Geographic Information System will be invaluable in assisting the Commission and other agencies concerned with biodiversity in planning the management of biodiversity of the country.

Critical to the goals of the Bahamas Environment, Science and Technology Commission is the establishment of the legal mandate of the Commission and of the structure and legal basis of the Environmental Impact Assessment procedure. The Inter-American Development Bank institutional strengthening project already referred to will address this.

Another goal is the production of a national inventory of natural resources, including species, habitats, and ecosystems, along with a national system of parks, protected areas and reserves, to ensure adequate resources for *in situ* conservation. The Commission is already preparing a comprehensive report to Government on Bahamian obligations under all the International Conventions, Treaties and Protocols, and other legally and non-legally binding agreements to which the country is a signatory.

Another important goal is to establish an integrated system for information flow and communication between government agencies and other interested entities, so as to ensure that development decisions are based on the best available information on environmental policies, science and technology, and international decisions that relate to Bahamian environmental policies. The strengthening of enforcement capacity in regard to environmental laws is also a necessary goal, and ensuring that environmental legislation, now in draft or conceptual form, is approved by Parliament.

These tasks will be greatly facilitated by existing and pending legislation and regional and international commitments (Box 2.1). These policies, laws, and agreements are not yet coordinated on a national level, and at times may seem to be conflicting. However, current legislative policies have the potential to form the basis for the sustainable use of biodiversity in The Bahamas, facilitated by the institutional strengthening project and the geographic information system project already underway.

2.1.3 Concerns

Fresh water, oceans, forests, fisheries, conservation, and food security are "common goods" of national and international concern. The greatest challenge for policy and law will be to address environmental problems without imposing

needless or harmful regulations on other sectors. However, Bahamian environmental issues are complex and interdependent, and social needs, current environmental approaches to problem definition, and decision making, are presently fragmented.

Sea level rise, as a result of global warming, has potentially serious and far-reaching impacts for biodiversity throughout the islands of The Bahamas. The Commonwealth of The Bahamas is actively participating in the Caribbean Planning for Adaptation to Global Climate Change Project which is funded by the Global Environment Facility. Of particular concern to the Bahamas Environment, Science and Technology Commission is the vulnerability of the coral reefs to damage and destruction. Also of concern are the potential negative impacts of sea level on ground water and on human health. These are shared with several other agencies, so the role of the Commission in coordinating policy on these issues will be a critical one.

Obligations set out in the Convention on Biological Diversity are not being sufficiently addressed in The Bahamas at present, neither in policy nor in provisions of the law. There are no programmes to identify components neither of biological diversity nor for monitoring their well being. Theer is no legislation in place, nor has any been drafted, to provide protection for Bahamian genetic resources so that at present, exploitation of such genetic resources could be pursued with impunity. A case in point is that a soft coral that occurs in abundance in some Bahamian waters (*Pseudopterogorgia elisabethae*), which has been found to contain a pharmacologically active substance. The right to access and the question of compensation need to be negotiated.

Environmental issues have recently come to fore as a consequence of the enactment in 1997 of the Local Government Act. While this has had many advantages it has raised uncertainties concerning the approvals of land use and exploitation of natural resources. District Councils, as established under the Act, naturally seek to achieve economic development within their Districts but are sometimes confused by the constraints of the environmental rules and regulations of Central Government.

Some problems, such as marine pollution and waste management, are multilateral and require joint action by two or more sectors; others such as water quality are regional and require several sectors. Furthermore, public and private sectors are too often at odds. An important role of Bahamas Environment Science and Technology Commission is to coordinate sector programmes in order to diminish confusion, duplication and conflict, and to identify and fill gaps in national environmental issues.

National approaches to policy and law assume decision processes in which goals are clear and agreed upon, policy options and criteria for evaluating them are defined, and information about the consequences of alternative options is adequate. Policy makers need a steady flow of information to enable them to set priorities, design strategies, and make policy choices. They need "indicators" to define acceptable measures of progress or to signal concern. However, not only is current policy on the environment vague and fragmented, but loopholes in procedures allow approvals for development to be given without reference to the Commission, or to an environmental impact assessment process. The Commission needs to be clearly mandated.

There has, in the past, been some confusion among agencies over their different legislative mandates and responsibilities and in the sharing of information. Fortunately, much of this confusion has disappeared, in part through regular meetings of the Board of Directors of the Commission. The Commission also has established a National Biodiversity Committee, a National Biosafety Committee, a National Climate Change Committee, and a National Ramsar Committee. These also provide for exchange of information and more details on some of these committees are given below. It is expected that the Inter-American Development Bank project will make recommendations for improving information flow.

Another area of uncertainty is that of national parks and protected areas. The Bahamas National Trust is mandated by an Act of Parliament to manage national parks and has put forward proposals for a system of representative parks. However, the Department of Fisheries is moving toward the designation of certain marine areas as protected "no-take" zones for the conservation of fish stocks. and how a national system of protected areas might be approached for the greatest good for all. Present and proposed protected areas must be re-evaluated to determine their effectiveness in contributing to in situ conservation, as well as for replenishment, restoration, and resource enhancement.

The National Biodiversity Committee was formed in 1997 to provide, *inter alia*, a forum for exchange of information among those agencies with responsibilities for conservation and biodiversity. In particular, the committee provides a means of disbursing information from Conferences of the Parties of the Convention on Biological Diversity, from meetings of the Subsidiary Body for Science, Technical and Technological Advice, and from other meetings concerned with biodiversity. It responds by consensus to matters that come to the Commission from the Convention Secretariat and is also charged with drafting reports and public awareness.

The National Ramsar Committee was established in early 199 following accession to the (Ramasr) Convention on Wetlands of International Importance Especially as Waterfowl Habitat in 1997: this is in accordance with a resolution of the 7th

Conference of the Parties. Much of Bahamian biodiversity is wetland biodiversity and wetlands are of considerable economic importance providing nursery areas for commercial species of fish and wild bird habitat. As part of the accession process for The Bahamas, Inaqua national Park was designated as a wetland of international importance. The goal of the committee is "use of the Ramsar Convention to provide protection for all wetlands of significance within The Bahamas". It is intended that the National Ramsar Committee and the National Biodiversity Committee work closely together: this accords with the memorandum of Understanding between the Ramsar Convention and the Convention on Biological Diversity. A task to be undertaken jointly is preparation of a descriptive inventory of wetlands in The Bahamas, including ecological characteristics, biodiversity, risk assessment and restorative actions needed, if any. The National Creeks and Wetlands Restoration Initiative, a recent initiative of the Ministry of Agriculture and Fisheries, seeks to restore wetlands which have been corrupted, generally by closure from the sea. The initiative is to come under the aegis of the Bahamas Environment, Science and Technology Commission and the two entities will collaborate in the selection of sites for restoration.

The National Biosafety Committee was formed in December 1998 to inform the Bahamas, Science and Technology Commission on all matters pertaining to the safe handling and use of living modified organisms (LMOs). A particularly important role is to provide advice to Ambassador Holowesko in her role as Chair of the Legal Drafting Committee for the Biodiversity Protocol under the Convention on Biological Diversity. This reflects the concerns of the Government of The Bahamas with the question of biosafety, the potential impacts of LMOs on the environment and on biodiversity, and on the matter of trade in LMOs.

The National Climate Change Committee is responsible for implementing two projects. The first is the Caribbean Planning for Adaptation to Global Climate Change Project (CPACC), which is concerned, *inter alia*, with coral reef monitoring and vulnerability and adaptation studies. The second is funded by the United Nations Development Programme and the Global Environmental Facility and provides assistance in undertaking an inventory of greenhouse gases and in preparing the first national communication to the Conference of the Parties of the Framework Convention on Climate Change.

A further committee, set up under the aegis of the Department of Agriculture and the Commission, is the Land Conservation Committee, which is preparing an inventory of sites to be considered for conservation throughout the country. The Committee has so far reported on New Providence, the most developed island and the most critical in terms of conservation needs, identifying 135 sites for consideration. Many of these sites are notable for their vegetation and ecosystems but also include beaches, cays, blue holes and ocean holes.

2.1.4 Needs

The Commission is within the portfolio of the Office of the Prime Minister, which ensures that it receives the highest political support and lends the Commission authority from the public point of view. However, the Commission's legal status should be resolved if it is to make the contribution its planners envisioned and to avoid confusion about its role as development expands and conflicts magnify.

Environmental legislation has neither kept pace with environmental awareness nor has the existing body of laws been coordinated to support the Government's national and international commitments. A comprehensive legislative review of Bahamian environmental law is required, including those governing environmental management and conservation, to determine where over-laps, gaps and conflicts exist. It is expected that the Inter-American Development Bank Project will address these issues.

Currently, proposals are under consideration for ways and means of achieving these reviews, particularly for achieving protection of biodiversity and environmental sustainability.

National obligations under the various international environmental treaties to which The Bahamas is a signatory, are not catalogued, but an *ad hoc* Committee is currently undertaking such a review.

2.2 Ministry of Agriculture and Fisheries

The Ministry of Agriculture and Fisheries comprises three Departments, two of which – Agriculture and Fisheries – are directly concerned with biodiversity. However, the Ministry has two assigned portfolios, namely natural history collections, and reefs and blue holes. Currently, there is only one national history collection, the National Herbarium, managed by the Department of Agriculture. The Herbarium consists primarily of the Correll and Correll collection [which was used in compiling "Flora of the Bahama Archipelago" (Correll and Correll, 1996)], with some smaller additional collections. There are also "satellite" collections at the Bahamas National Trust and at the College of The Bahamas, jointly managed by each. There are several private natural history collection including birds, butterflies, and shells.

Inland blue holes contain unique and complex ecosystems that are easily disrupted or damaged by uncontrolled or inappropriate access or development as well as other means. There is presently no legislative protection of blue holes. The draft Forestry Act would provide protection *de facto* to many blue holes on

Andros through the declaration of large areas of pine lands on which blue holes are found as "conservation" or "protected" forest.

The coral reef portfolio is delegated to the Department of Fisheries. A sea-bed stratification exercise, undertaken in 1984, showed that some 2% of the shallow sea bed was reef, 14.6% was rock, 68.5% was seagrass, and the remaining 14.9% was sand. These strata often grade imperceptibly into each other, resulting in complex admixtures of rocky, vegetated, and unvegetated types. The rich fishery resources of The Bahamas are directly related to the extensive coral reef habitat and the large expanses of seagrass beds, which are important nursery areas for many fish, spiny lobster, and conch. The sand-coral beaches scattered throughout the islands are key components of the Bahamian tourist package of "sun, sand, and sea". The health of these beaches is directly related to the near shore barrier and fringing coral reefs that act as natural breakwaters, thereby limiting beach erosion. They also contribute to the production of sand for beach replenishment, and coral rock and sand are used extensively as building materials in The Bahamas. Furthermore, corals are increasingly being recognized as sources of biomedical chemicals and are the sources of new chemicals currently being tested for anticancer, antimicrobial, and anticoagulant properties.

2.2.1 Department of Agriculture (Box 2.2)

2.2.1.1 Context

Agriculture accounts for between 1 and 2% of Gross Domestic Product. However, agriculture impacts on biodiversity in many ways. It impacts directly on terrestrial biodiversity by imposing agro-ecosystems on large tracts of land, and indirectly on wetlands and near-shore systems through run-offs of chemicals and nutrients. Agriculture, including forestry, is a traditional economic activity that provides employment, income, and food, and contributes to national security and culture. The agricultural sector provides fresh local fruits and vegetables to the important tourism sector, and it enables communities, especially in the Family Islands, to continue to exist, in many instances with a greater income than would be derived from alternative land uses. Traditional skills and practices suitable to the local conditions, allow Family Islanders to produce crops under relatively harsh conditions, such as low rainfall and limited water supply, low soil nutrients, and a hot, marine climate.

Livestock are not abundant, but production of pigs, poultry (eggs and broilers) and small ruminants is being encouraged. The Ministry of Agriculture has stated that the strategy for the agricultural sector was the stimulation of the production of key short-term crops and livestock to increase farm incomes: potatoes, onions

and swine are targeted. A second objective is to diversify production to include medium-term crops and livestock such as bananas, papaya, pineapples and poultry. A third objective is to encourage investment in long-term crops such as coconuts, avacados, mangos, other tropical fruits and sheep and goats.

Box 2.2
Department of Agriculture

Mandate

Hold, lease, manage, and dispose of agriculture land
Encourage agricultural development to reduce dependence on imports
Create employment opportunities
Establish cooperative linkages among Government agencies
Provide extension services and scientific research
Conserve biodiversity
Enhance range and quality of wildlife habitats and ecosystems
Strengthen forestry development and conservation

Concerns

Vague Government policies for conservation and development
Intra- and inter-agency duplication and conflicts with regard to agricultural expansion and conservation
Conservation and agriculture conflicts
Loss of farming skills because of aging population and emigration from Family Islands
Impacts of alien and invasive organisms, application of chemicals, use of bio-control agents, introduction of genetically-modified species, monoculture maintenance, pollution and contaminants on native forests and wildlife
Global climate change
Effects of agricultural expansion on water supplies, coastal and inshore waters, and natural habitats

Needs

Legislation to clarify relations between Forestry and Agriculture, to regulate products derived from native plants for pharmaceuticals, and to control the use of pesticides, the importation of alien species, and the introduction and use of genetically modified organisms
Conduct environmental impact assessments and statements
Expand Bahamian agriculture; e.g., establishment of credit, access to lands, modernize farm methods, and education and training in traditional Bahamian farming
Preserve diverse, small farms
Strengthen institutional capacity; e.g., agricultural and forest management practices, human resources, public participation, information dissemination, and funding
Meet the obligations of international conventions
Enhance the range and quality of wildlife habitats and ecosystems
Preserve landraces of crop plants and animal breeds
Establish *ex-situ* conservation of agricultural biodiversity through the Nassau Botanical Garden
Expand research, monitoring, and *ex situ* facilities
Designate protected areas as wild plant or bird reserves and strengthen protected-area management

Local conditions for agriculture vary widely within The Commonwealth of The Bahamas and this has an impact on crop production. The wetter, northern islands support large-scale mechanized commercial agriculture, wheras the dries, southern islands are characterized by small-scale subsistence agriculture. Abaco and Grand Bahamas in the north are major producers and exporters of citrus and vegetables. Grand Bahama, Eleuthera, Long Island and North Andros are major producers of bananas for the local market

Agriculture has recently declined in The Bahamas. Since 1978, the area of farmland and the number of farmers have diminished. According to the 1994 Census, the area occupied by farm holdings had fallen from 36,261 ha. (89,565 ac.) in 1978 to 20,344 ha. (50,250 ac.) in 1994. This is about 1.5% of the total land area of The Bahamas. Over the same period the number of farmers declined from 4,246 to 1,760. The average age of farmers in 1994 was nearly 60 years. The majority of farms (about 79%) are small, less than 4.1 ha. (10 ac.), and only 6% of holdings are larger than 20.2 ha. (50 ac.), but these latter farm holdings now account for nearly 82% of the total agricultural area.

Bahamian agriculture has evolved unique methods and cultures, and has extremely important implications for biodiversity. Agriculture seeks to replace, in whole or in part, natural and often diverse ecosystems with simpler agroecosystems. In fact, a measure of success for agriculture is continued simplicity of the agroecosystem. Furthermore, a number of agricultural practices have dramatic effects on species and ecosystems; contrary to fisheries, these are well documented. Impacts include pollution from chemical applications, over-use of limited water supply, reduced water quality, encouragement of pests and invasive species, introductions of alien species and genetically-engineered varieties, and many other impacts.

2.2.1.2 Mandate.

The Ministry of Agriculture (Incorporation) Act of 1993 declares the Minister "a corporation sole" with the power to hold, lease, and dispose of agricultural lands.

The goal of the Department of Agriculture is long-term sustainable development of agricultural land and water resources. The Department's objectives are to: produce an adequate supply of nutritious food for the domestic market; reduce dependence on imported food; create employment opportunities; encourage investment; expand linkages between Agriculture, Fisheries, Tourism and other sectors; provide agricultural research and extension services; develop and evaluate low-input sustainable agriculture and agroforestry systems, and; encourage integrated pest management. The Department works to conserve fauna, flora and ecosystems. Additionally, along with the Department of

Fisheries, the Department of Agriculture administers the Convention on International Trade in Endangered Species.

The Department conducts research at the Gladstone Road Agricultural Complex in New Providence. This is adaptive research and focuses on vegetable crop variety selection, the improvement of small ruminant production through genetic improvement and management, and the improvement of pig production and distribution to farmers of quality breeding stock and finishers. The Complex also houses a Plant Propagation Unit and is establishing a Food Safety and Technology Laboratory to comply, *inter alia*, with Hazard Analysis at Critical Control Points.

The Inter-American Institute for Cooperation on Agriculture has provided assistance with training in plant protection system throughout The Commonwealth of The Bahamas. The Food and Agriculture Organization of the United Nations (FAO) is providing assistance to the Department of Agriculture through a Technical Cooperation Protect entitled "Assistance to Review Agricultural Policies and Legislation." This is scheduled to be completed before the end of 1999 and will include a review of environmental and conservation legislation that falls within the mandate of the Department. The Food and Agricultural Organization will shortly also be providing assistance to the Department of Agriculture through another Technical Cooperation Project entitled "Assistance to Strengthen Plant Quarantine Capabilities." This is expected, *inter alia*, to develop new plant protection legislation.

2.2.1.3 Concerns

The Department of Agriculture works with a wide variety of other departments on common concerns. With the Ministry of Tourism, it is concerned with ecotourism; with the Department of Environmental Health Services, about water pollution, the risk of introduced alien pests and waste disposal; and with the Bahamas National Trust, about conservation. The Department also seeks to expand and formalize collaboration with the College of the Bahamas on education and training and to encourage young people to take up farming as a livelihood.

There is also concern that agricultural expansion may conflict with conservation objectives, and that the aging population of farmers will result in lost knowledge of native plants, which are often of medicinal or other value. Great concern is placed also on the introduction of invasive plants and insect pests, diseases, and the effect of climatic change on agriculture, and subsequent loss of cultivable land.

The Department of Agriculture is responsible for the protection of wild animals and birds. All wild animals, including feral cats, dogs and pigs are protected. Several areas throughout The Bahamas are declared wild bird reserves, ranging

in size from 708 ha. (1750 ac.) to less than 1 ha. (2.5 ac.): many of them are entire cays. Some of these are major nesting sites for the white-crown pigeon. The hunting seasons for game birds is regulated. Currently there is no legislation to protect the habitat of the reserves. There is a corps of volunteer game wardens.

Finally, increase in agriculture depends on several assumptions: that credit is available and accessible to allow for land development and for the modernization of farming methods; that a cadre of trained young farmers will be forthcoming; that extension services are available to make farmers aware of new technologies; and that a structured private sector marketing system develops. The past net migration from the Family Islands has been followed by abandonment of cropland. The areas are rapidly colonized by weeds and revert to scrub land as woody species invade. This may contribute to increased diversity of habitat.

2.2.1.4 Needs

Environmentally sensitive management of agricultural lands, the conservation of biodiversity, and the sustainable development of agriculture and forestry have been hampered in the past by lack of guidelines or clearly enunciated policies. Government has now issued a statement on forest policy and the Department of Agriculture has a procedure manual for "conservation farming". Paramount to sustained agricultural development is public participation, information dissemination, and inter-sector coordination. However, social and environmental factors are not the same for agriculture throughout the islands. The Bahamas contains numerous small farms with strong regional differences, which require strikingly different management practices. In addition, the vulnerability of small islands to pollution, introduced species, and feral animals, compounds problems of sustainable agricultural development.

Wild "crop" plants are of great interest for biodiversity. These include guavas (*Psidium guajava*) and grapes (*Vitis vinifera*). The Commonwealth of The Bahamas hosts wild relatives of sweet potatoes and yams (*Dioscorea* spp.), and landraces (i.e., locally-adapted crop varieties) of maize, sorghum (*Sorghum bicolor*), pigeon pea (*Cajanus cajun*), okra (*Abelmoschus esculentus*), hot pepper (*Capsicum annuum*), sesame (*Sesamum indicum*), cassava, sweet potato, eddoes (*Colocasia esculenta* var. *antiquorum*), pineapple (*Ananas comosus*), lima beans (*Phaseolus lunatus*), and dry beans (*P. vulgaris*). These are of interest for biodiversity and their germplasm may contribute at some future date to crop improvement. They may, however, be lost as the custodians diminish in number as older farmers retire or die. There is a need for the collection and inventory of these landraces and the establishment of ex situ storage facilities for their preservation.

There are also unique animal genetic resource, primarily of sheep on Cat Island and Long Island and North Eleuthera. These landraces are amalgams of several breeds, and goats also have been so bred. Selection over time has resulted in these being especially hardy and adapted to the relatively poor forage and browse of the islands of the Central Bahamas. The Gladstone Road Agricultural Complex maintains flocks of both sheep and goats of these land races for sale to farmers.

2.2.2 Department of Fisheries (Box 2.3)

2.2.2.1 Context

The fishing industry plays an important role in the Bahamian economy and way of life. It is a net contributor to the economy, contributing some 3-4% annually to the Gross Domestic Product. A sustainable fishery is crucial to the Government's policy of economic diversification and of creating opportunities for its people. The Department of Fisheries considers Bahamian fisheries healthy and able to sustain increased fishing effort. This places special demands on The Bahamas to avoid over-exploitation and to be increasingly certain that its fisheries remain in a healthy state.

In The Bahamas, the most important commercial species all depend on the extensive shallow water banks. The spiny lobster (*Panuluris argus*); various groupers (*Epinephelus* spp. and *Mycteroperca* spp.); snappers (*Lutjanus* spp. and *Ocyurus chrysurus*); and conch (*Strombus gigas*), all depend on healthy shallow waters and supplies of juveniles that may be recruited back into the fishery. Fisheries management is especially complex, as it involves international, regional, national and local co-operation and must address concerns about endangered species, marine mammals and foreign markets, and conflicts with aquaculture and mariculture, and with coastal development.

Mariculture also depends on a healthy inshore environment, but can pose conflicts with fisheries for supplies of wild stocks. The same may be said for sport fishing, but mariculture has the added impacts of habitat alteration and pollution. Therefore, resolution of conflicts must accompany any plans for sustainable use of the coastal and marine environment and fishery resources.

It is important to note that The Bahamas is overwhelmingly marine country, both in space and in regard to biological diversity. This has two important repercussions. First, fisheries policy and management bear responsibilities out of proportion to its logistical capabilities, personnel, and funding. Second, the effects of fisheries on biodiversity are very poorly known, due both to the physical nature of marine ecosystems and to the remoteness and difficulty of

Box 2.3
Department of Fisheries

Mandate

Development of fisheries through sustainable use and integrated management
Management of marine ecosystems consistent with sustainable-use principles, and protection of national marine assets
Optimizing employment in the fisheries sector
Diversifying the fisheries industry
Optimizing linkages with the tourism sector
Research, training, and public education
Mariculture development
Statistics, enforcement, and administration
Meeting obligations of international agreements and protocols, including the Convention on Biological Diversity.

Concerns

Impacts of mariculture development
Cross-agency conflicts and duplication
Threats to sustained use: e.g., open access, over-fishing, over-capitalization, poaching, competition with recreational fishing and ecotourism, alteration of coastal zone and wetlands, pollution and waste disposal
Introduced species, diseases and pests
Lack of habitat mapping and identification of priority sites for conservation
Public awareness of fishery conflicts and problems
Deficiencies in fishery science and data-bases

Needs

Develop a Fisheries Master Development Plan with provisions for mariculture
Strengthen institutional capacity for all aspects of the mandate, especially up-graded communication technology, technological skills, specialized training, and professionally trained staff
Establish mechanisms for cross-sector coordination and communication
Strengthen regulatory and enforcement capacity
Expand extension arm, with special attention to training and community-based fisheries management programmes
Provide new legislation to meet emerging needs (e.g., for new fisheries regulations, controlled access to fishery resources, and marine mammals)
Reduce impacts and conflicts of fishery enhancement programmes
Encourage fishery investments by identifying options and opportunities
Prepare environmental impact assessments and statements
Expand capacity for data acquisition, research and monitoring
Establish a system of fisheries reserves for restoration and enhancement, experimental use, recovery of endangered and depleted species, and research and monitoring
Examine methods of traditional fishing
Create national information and collection centers (e.g., National Library, National Museum, GIS facility for habitat analysis)
Increase funding and logistic support
Promote public understanding

studying these ecosystems. Recent reviews have concluded that fisheries are the most important cause of coastal and marine biodiversity loss. The US National Research Council has assessed the impact of fishing and concludes that the fishing sector is responsible for major impacts such as habitat destruction and changes in genetics, demography, and food webs. Empirical and theoretical

studies show major impacts on the composition and abundance of non-target species and to the overall function of marine ecosystems. One major cause of many of these effects is the selective removal of the largest and oldest components of the community; a cause for concern about the declines of groupers world wide.

2.2.2.2 Mandate

The Department of Fisheries follows Government policy for sustainable growth and economic expansion. Fisheries are to grow under principles of sustainable use and integrated management through creation of employment opportunities, investment and revenue building, diversification, exports, benefits to the socioeconomic environments of the Family Islands, improved seafood safety, and other means.

National legislation and international agreements to which The Bahamas is a signatory ensure the Government's commitment to sustainable fisheries. The Fisheries Resources (Jurisdiction and Conservation) Act of 1977 makes provision for conservation and management of the fishing industry and fishery resource. The Fisheries Resources (Jurisdiction and Conservation) (Amendment) Act of 1993 gives the Minister of Finance responsibility for the disposal of forfeited articles from fisheries, and the Fisheries Resources (Jurisdiction and Conservation) (Amendment) (No. 2) Act of 1993 prohibits long-line fishing. Furthermore, The Bahamas is a party to the United Nations Convention on the Law of the Sea, which establishes a comprehensive framework for the regulation of ocean space and fishery resources.

The Bahamas seeks to comply with the United Nations Food and Agricultural Organization's Code of Conduct for Responsible Fisheries. This voluntary Code sets out principles and international standards of behaviour for responsible conservation, management and development of fisheries.

2.2.2.3 Concerns

Despite an optimistic forecast for Bahamian fisheries, there are concerns that challenge sustainability. Enforcement of fishery regulations is a serious problem and fisheries management is challenged by open access policies that encourage over-exploitation and over-capitalization. Management must make decisions without the benefit of reliable and timely scientific data and the resources allocated by the Government for administration and development of the Department of Fisheries are far from sufficient.

Enforcement of fisheries regulations presents a serious challenge. Poaching by foreign vessels and violations by domestic fishermen are common, especially

illegal use of chemicals and air compressors, abandonment of traps, illegal harvesting of protected juveniles and illegal harvesting of species during their respective closed seasons.

Increased fishing effort on grouper spawning aggregations leads to serious depletion of stocks. In order to meet the increased demand for grouper, some fishermen have increased their efforts, including the use of illegal fishing methods and apparatus. Increasing competition for the high valued spiny lobster is leading to widespread theft from lobster traps and conflicts among fishermen.

Mechanisms to facilitate cross-sector communication and coordination are of special concern. The Department of Fisheries shares conservation concerns with The Bahamas National Trust, health concerns with the Department of Environmental Health Services, investment opportunities with the Bahamas Agriculture and Industrial Corporation, fisheries development funding with the Bahamas Development Bank, and sport-fishing and tourism interests with the Ministry of Tourism. The Department of Fisheries also interacts with the Ministry of Education, the Royal Bahamas Defense Force, Customs and Immigration, the Water and Sewerage Corporation, the Department of Lands and Surveys, Department of Physical Planning, and the Bahamas Investment Authority.

The threat of the introduction of undesirable alien species is of concern to fisheries. Mariculture development is promoted. There is a major transshipment terminal operating in Freeport, Grand Bahama. There is a large open aquarium facility on Paradise Island. The cruise ship sector is a significant component of the tourism industry and these ships call into ports where there are no facilities for shore-based sewerage disposal. Therefore there is a high risk for the introduction of undesirable alien species that could pose problems for fisheries and that have the potential to pose serious health risk through introduction of undesirable viruses or bacteria e.g. Cholera.

Among the greatest concerns is that for increased public support, public relations, and public education. Education must be directed toward policy makers and the local communities throughout the islands. From a fisheries prospective, the message should be geared towards an understanding of the complexities of tropical-inshore fisheries management, recognition and resolution of conflicts, and allocation of fishery resources within the framework of national development and in the context of the relationship among fishes and their ecological support system.

Last, but by no means least, are major gaps in fisheries science that need urgent addressing. In the absence of improved and better-coordinated fisheries research, both applied and strategic, fisheries will neither be able to monitor success or attain sustainable use. A greater information base is needed at all

levels, from species biology to the behaviour of whole ecosystems, from local to national, regional, and international levels.

2.2.2.4 Needs

The Department is vastly under-supported at all levels; e.g., lack of adequately qualified technical manpower; lack of adequate funding; lack of a national library and national museum as instruments of public education and scientific information; and lack of an adequate scientific-research capability. It is hampered further by the high costs of effective monitoring, surveillance, and enforcement throughout The Bahamian Archipelago.

Finding a solution to the difficult problem of open-access fisheries presents perhaps the greatest need of all. Many regulatory and economic problems associated with over-fishing result from government policies that encourage over-investment and over-capitalization in the marine commons. Actions in the future should be directed toward establishing some form of fishery-resource property rights in order to control access, perhaps through licensing, quotas, special use taxes, and zoning use rights.

It is clear that fisheries development must be strategically integrated into a National Plan that integrates fisheries management with biological diversity and environment, and with other Government and non-Government sectors. This will especially involve addressing coastal development, protected areas, fisheries protected areas, "no take zones" and spawning aggregations, liquid waste disposal, habitat restoration, and conservation of coastal wetlands, risk assessment, and a host of other requirements. It may be an understatement to say that among the greatest of concerns for Bahamian biodiversity conservation is the conduct of fisheries conservation and management.

2.3 The Bahamas National Trust (Box 2.4)

2.3.1 Context

Species conservation and protected areas, for which The Bahamas National Trust (BNT) is mainly responsible, are central elements of any national biodiversity strategy and action plan. For almost four decades the Trust has managed parks and protected areas in The Bahamas, with demonstrable success (Boxes 2.5, 2.6). Currently, there are 12 national parks and protected areas within The Bahamas, comprising a total of more than 1230 km^2 (~500 mi^2) (Table 2.1).

Collectively, these protected areas house an impressive representation of island ecosystems and resources. Within them are the world's first land-and-sea national park under a single agency's jurisdiction; one of the longest known

underwater cave-cavern systems and the site of the original discovery of *Speleonectes*, representing a new order of crustacean; one of the world's foremost marine turtle research facilities; the world's largest breeding colony of West Indian flamingos (*Phoenicopterus ruber*); one of the few known wintering habitats of the Kirtland's Warbler, (*Dendroica kirtlandii*); and the only habitat of the Bahama parrot, (*Amazona leucocephala bahamensis*). The flamingo, warbler and parrot are all listed in Appendix I (endangered species) of the Convention on the International Trade of Endangered Species.

In 1997 The Bahamas acceded to the Convention on Wetlands of International Importance (the Ramsar Convention) and designated the Inagua National Park as the country's first Ramsar site. The Convention provides the framework for international co-operation in the conservation and sustainable use of wetlands. Sites are designated to the Ramsar list on the basis of their international importance in terms of ecology, botany zoology, limnology or hydrology.

However, the biodiversity of The Bahamas is far from being fully represented in national park and protected areas. Thus, the Trust's highest priority is to establish an integrated system of parks and protected areas, representative of Bahamian biodiversity, thereby helping the nation to achieve natural resource sustainability. With respect to obligations of the Convention on Biological Diversity, strategies and actions are being developed in a National Park and Protected Area System Master Plan with a view to ensuring full integration and "representativeness".

2.3.2 Mandate

The Bahamas National Trust was established by a special Act of Parliament. Operating under the official mandate of the Bahamas National Trust Act of 1959, the Trust has the responsibility and authority to develop and manage the National Park System of The Bahamas. The Act also authorizes the Trust to advise Government on policy relative to parks and protected areas, on candidates for inclusion in the park and protected area system, and on matters relating to wildlife conservation in general. The Government of The Bahamas has reasserted its support of this mandate by agreeing to determine what gaps exist in habitat conservation, in order to ensure better protection of natural resources and biodiversity.

The Bahamas National Trust is a non-governmental organization with quasi-governmental characteristics. The Trust benefits from a diverse network of expertise via a Council comprising representatives of: the Office of the Governor-General; the Ministries of Agriculture and Fisheries, Education and Culture,

Box 2.4
The Bahamas National Trust

Mandate

Develop a system of national parks and protected areas
Identify important areas for protected-area designation
Enforce regulations and bye-laws
Advise Government on conservation and wildlife
Help Government carry out national and international commitments on the environment

Concerns

Lack of comprehensive environmental legislation and enforcement
Lack of operational funds
Low national priority for environmental issues
Too few protected areas to conserve natural resources
Lack of protection for ecosystems (i.e., for ecosystem management)
Conflict among Government policies for promotion of economic development, environmental conservation, and sustainable use.
Lack of cross-agency cooperation in biodiversity conservation, sustainable development, and environmental decision-making
Insufficient impact assessments prior to development and monitoring of impacts after development occurs
Introduction of alien species from pet and ornamental trade, ship ballast, horticulture and plant nurseries, etc.

Needs

Create a protected-area system, based on scientific environmental classification and a resource inventory, that represents Bahamian biodiversity
Create new legislation: to enable The Bahamas National Trust Act more effectively to protect critical habitats and species; to control alien species; to control risks associated with development
Rehabilitate and restore degraded habitats and ecosystems
Strengthen institutional capacity, particularly for improved enforcement and management
Improve research and monitoring better to evaluate management efforts
Promote public awareness and understanding of important environmental issues and the role and value of protected areas, with outreach and educational programmes in all sectors of Bahamian society
Ensure adequate funding
Address cross-sector needs for biodiversity conservation and management

Health, and Tourism; the American Museum of Natural History; the National Audubon Society; the Smithsonian Institution; the University of Miami (Florida); the US National Parks Service; the Wildlife Conservation Society; and nine elected members from within the Trust's general membership. Special Advisors to Council are also appointed to provide further expertise in thematic activities. The Trust's structure has proven to be a viable alternative to government-run national park systems and is receiving much international attention as a successful model.

Table 2.1
National Parks and Protected Areas

Name	Statistics	Features
Abaco National Park	1994. 82 km^2 (32 mi^2). 99 year lease.	Prime pine forest, habitat for Bahama Parrot.
Black Sound Cay National Reserve	1988. 0.5 ha. (1.3 ac.). 99 year lease.	Mangoves, habitat for waterfowl amd oher wintering avifauna.
Conception Island National Park	1973. 8.7 km^2 (3.4 $mi^2$2). 2 year lease.	Sanctuary for migratory birds, seabirds and sea turtles, especially Green turtles.
Exuma Cays Land & Sea Park .	1958. 451 km^2 (176 mi^2). 99 year lease.	First land and sea park in the world. Pristine beauty. First marine fishery reserve in Wider Caribbean.
Inagua National Park	1965. 735 km^2 (287 mi^2). 99 year lease.	World's largest breeding colony of West Indian flamingos (approx 60,000). Many other avifauna.
Lucayan National Park	1982. 16.2 ha. (40 ac.). Conveyance.	Extensive underwater cave and cavern system. Every Bahamian vegetative zone found terrestrially.
Pelican Cays Land & Sea Park	1981. 8.4 km^2 (3.3 mi^2). 99 year lease.	Sister park to ECLSP. Underwater caves, extensive coral reefs.
Peterson Cay National Park	1971. 0.6 ha. (1.5 ac.). 99 year lease.	Scenic spot..
Rand Nature Center	1992. 40.5 ha. (100 ac.). Conveyance.	Native coppice, barrens. Administrative HQ for BNT on Grand Bahama.
The Retreat	1985. 4.5 ha. (11 ac.). Conveyance.	200+ species of rare, exotic palms. Many native trees and tropical plants. National HQ for BNT
Tilloo Cay National Reserve	1990. 4.3 ha. (10.7 ac.). Conveyance.	Wild and pristine environment. Nesting site for Tropicbirds, other seabirds
Union Creek Reserve	1965. 19.8 km^2 (7.7 mi^2). 99 year lease.	Enclosed tidal creek, important sea turtle research site.

2.3.3 Concerns

The issues associated with biodiversity and parks and protected areas are many, crossing economic, legislative, social, educational, institutional, scientific and financial parameters. With regards to *in-situ* biodiversity conservation, paramount concerns include:

- Gaps in biodiversity representativeness
- Effective conservation management as it relates to biodiversity within and outside parks and protected areas
- Pressure from tourism and fisheries
- Personnel, infrastructure, financial capacities for management and enforcement of existing and expanded system
- The range of values and economic implications of parks and protected areas
- Appropriate and effective enforcement as a primary management tool
- Research and monitoring capacities and priorities
- Ways and means for outreach and education

These are all cross-agency concerns that require co-operation. Improved communication between relevant agencies in recent years has led to the building of beneficial partnerships.

Box 2.5
Exuma Cays Land and Sea Park:
Potential as a Fisheries Reserve

The Exuma Cays Land-and-Sea Park was established in 1959 as a result of the passage by Parliament of The Bahamas National Trust Act. The Park is located in the central Bahamas and covers 458 km^2 (176 square miles). It was among the first marine parks in the world, and the first with land-and-sea jurisdiction under a single agency. Its establishment occurred during the early serendipitous, opportunistic, "protectionist" days of parks and protected areas, even before the First World Conference on Parks and Protected Areas in 1962. The beauty and wilderness qualities of this Park are widely known and to this day the Park is managed primarily for these qualities and for ecotourism.

During the 1980s, new global concerns arose for protected areas — for biodiversity, resource enhancement and sustainability. Declines in fish stocks were being reported around the world, including those in the Exuma Cays Land-and-Sea Park. Use of the park had also increased dramatically. In an effort to protect the Park's fishery resources, the Trust established new bylaws in 1986, making the entire Park an area of "no consumptive use", thus establishing the first marine fishery reserve in the tropical western Atlantic.

The last decade has seen a growing interest in marine fishery reserves as an alternative management approach to protectionism. The benefits include: protection for spawning stocks, increased spawning densities, reduced over-fishing of vulnerable species, reduced user conflicts, and facilitated stakeholder and user involvement in management. Marine parks also hold potential to provide ecological benefits, such as protection of ecological processes and keystone species, and can serve as research and monitoring sites.

Several studies in the Exuma Park now indicate its potential as a marine fishery reserve. A recent study by The Nature Conservancy has obtained preliminary information that the size and abundance of groupers is greater inside the Park than outside. Another study by the Virginia Institute of Marine Science has shown that the Park is an important link in Nassau Grouper life history, even though total protection of this species' local population would require management of the entirety of the Exuma Sound, throughout which the Sound's population of larval, recruiting, and adult groupers occur. In addition, studies by the Caribbean Marine Research Center indicate that densities of Queen conch larvae in the Exuma Park were the highest ever recorded, being several thousand times the concentrations measured in the Florida Keys and Wider Caribbean Region during the time of the study.

Although these results are preliminary and remain to be verified, scientific studies in the Exumas and several other areas are beginning to show that marine protected areas may be essential for replenishment of fisheries stocks both within and outside reserve boundaries.

The Trust shares concerns with the Department of Fisheries about the need to declare additional marine fishery reserves for commercially valuable species, which emulate the emerging replenishment value of the Exuma Cays Land and Sea Park, the wider Caribbean's first marine fishery reserve. With the Forestry Section of the Department of Lands and Surveys, the Trust has lobbied for the establishment of protected forest areas. The BNT also provided the springboard for the Ministry of Tourism to develop a National Ecotourism Strategy which lists sustainable development and ecotourism among its top ten priorities.

Cooperation and support from the Ministry of National Security has resulted in more effective enforcement and visitor safety in parks and protected areas.

The role of parks and protected areas and in-situ conservation in the country's sustainable development is not widely understood in policy-setting and decision-making circles. As a result the potential for beneficial partnerships between development and conservation is not appreciated. The Trust views biodiversity as a national asset, but an asset that is nonetheless threatened on all fronts. National legislation lags behind conservation needs. An example: the lack of guidelines and a comprehensive legislative framework for the institution of Local

Box 2.6
The Great Inagua Story: Nature and Industry

Great Inagua provides an excellent example of a sustainable industry co-existing with the natural environment and with the agency mandated to protect it. Inagua is the southernmost and third largest island in the Bahamian Archipelago. Rainfall is minimal, averaging only 28 inches per year — the lowest for any populated island in The Bahamas. Low rainfall and wind-swept wetland areas combine to produce what has been described as a "natural salt factory".

Salt production on Inagua is a two-year process. As sea water slowly circulates through the wetland areas, algae begin to grow, darkening the salty soup and hastening evaporation. Brine shrimp feed on the algae, filtering the water in the process. As evaporation continues, salt crystals form. Birds find food abundant; their droppings further enhance the algae, and as algae grow, so too do brine shrimp, a favorite food for some birds, especially flamingos.

Concern for the rapidly declining population of West Indian flamingos *(Pheonicopterus ruber*) led the National Audubon Society in 1952 to send its renowned Research Director Robert Porter Allen to Inagua to locate what might have been the last breeding colony in the Bahamas and to find a solution on how to save it. The Society for the Protection of Flamingoes in The Bahamas was formed, wardens were appointed, and the flamingoes began to multiply. The Trust assumed responsibility for the flock in the early 1960s, at about the same time that Morton Salt Company took over Inagua's salt works. The four decades since have been a story of growing success for both the birds and the salt, and for the island's economy as well. The Inagua National Park was established in 1965, a 183,740-acre sanctuary for flamingos and a myriad of other water birds and wildlife. At that time, the flamingo population was estimated at less than 3,000. Today, the Park boasts more than 60,000 flamingos, the largest breeding population of this endangered species in the world. There is evidence that the population is spreading to other islands off the Bahamas, and possibly elsewhere.

What lies behind this success? The enhanced food cycle of algae, to brine shrimp, and to flamingos depends in large part on production of salt and the expansion of the salt works. Before the salty reservoir was enlarged by Morton Salt, Lake Rosa would dry up in dry years, leaving a layer of salt, but no food for birds. With limited salt production, employment opportunities were also few. The reservoir system provides year-round algal production, supporting more brine shrimp and feeding more flamingos. This success story extends beyond biology; Morton (Bahamas) Limited, makes annual donations and provides logistical and infra-structure support to The Bahamas National Trust on an on-going basis. The Company provides an excellent example of an appropriate and sustainable industry co-existing with the natural environment and the agency mandated to protect it.

Government, has created the potential for this most positive institution to become one of the greatest threats to the country's biodiversity in recent years. The lack of a formal environmental impact assessment process, coupled with the country's accelerated development agenda, has left the nation and its biodiversity prone to myriad consequences from inappropriate development. Additionally, international agreements to which the Bahamas is party, are not sufficiently reflected in legislation. These concerns are particularly relevant to meeting conditions of the Convention on Biological Diversity, which obligates signatories to conserve biological diversity, recognizing that in situ conservation is an important approach. Parks and protected areas have been directly impacted by the country's short-comings in these regards.

The Trust is committed to helping The Bahamas carry out its obligations under the Cartegena Convention, the Convention on the International Trade of Endangered Species (CITES), the Convention on Wetlands of International Importance (Ramsar Convention), and the International Coral Reef Initiative.

An especially serious concern for biodiversity conservation and management is that knowledge of Bahamian resources, both species and ecosystems, remains poor. For only a very few Bahamian species can success or failure be stated with any degree of certainty, and all of these are terrestrial; e.g., hutia, iguana, and flamingo. Sustainability of supporting ecosystems is a particular concern; at present, this can not even be measured, much less assured.

2.3.4 Needs

The Trust is committed to fulfilling the obligations of the Convention on Biological Diversity, but is seriously constrained by lack of resources and expertise. Although the Trust operates under an Act of Parliament, less than 5% of its annual budget comes from Government. The remainder is generated mostly from private sources, fees, and sales. The Bahamas Government receives funds from inter-governmental bodies, yet Government commitment to fund conservation is marginal. For example, biodiversity conservation, and parks and protected areas, involve many agencies and sectors, each of which should recognize its need to commit to support an integrated program.

Although the successes of The Bahamas National Trust are demonstrable in having achieved an outstanding protected-area system (Table 2.1). The Prime Minister's recent Environmental Address (May 1999) heralds exciting additions to the system. Further expansion needs to occur as a matter of priority. The Trust's 1983 document "The Development of a National Park System for the Commonwealth of The Bahamas", while under-going review, continues to provide guidance to site selection. Selection criteria have been developed based

on best international examples to further aid appropriate site selection and help ensure an integrated system is developed.

Conservation throughout The Bahamas is especially constrained by the need for information and its transfer to the public. The degree to which protected areas represent Bahamian biodiversity is not known. Lack of adequate research and monitoring threatens environmental protection, biodiversity conservation, and possibilities for sustainability. These can not be attained unless an informed public becomes supportive of the roles and value of protected areas, and of the value of sustainable use. Thus, a major need is for public outreach and education programs that reach all sectors of the Bahamian society.

Institutional strengthening, particularly for improved management, interpretation and enforcement and infra-structure, must also be also be addressed – for existing as well as expanded protected areas. Capacity building is an integral part to successfully meeting all other needs.

2.4 Department of Lands and Survey (Box 2.7)

2.4.1 Context

The Department provides a mechanism for conditional purchase after leasing. Its mandate covers Crown and Government land, including seaward of the high water mark to the limit of The Bahamas' Territorial Seas. The Department is required to confirm whether Crown or Government interest is adversely affected by private claims (Quieting of Titles Act, 1959). It prepares diagrams and legal descriptions of subject land. It surveys Crown Lands for creation of residential, commercial, industrial and agricultural subdivisions, and advises government on the value of leasehold and freehold interests in accordance with the Acquisition of Lands Act, of 1913, as amended. Inspections are conducted on all land previous to any recommendation for disposal and for renewal of a leases or grant of a freehold.

Land area is becoming limiting in The Bahamas, and the demand for land is a source of conflict among government agencies, users, and values. These conflicts result in confrontation, increased costs, degradation of the environment, and loss of biodiversity. The conflicts also threaten national economic and societal goals. A recently concluded pre-feasibility study on Land Policy and Administration has been completed as part of the Bahamas National Geographic Information System Project and should provide guidelines for the administration of lands.

2.4.2 Mandate

The Department of Lands and Surveys is responsible for all Crown Lands, including marine lands, within the Commonwealth of The Bahamas. The primary objective is to encourage, via management, an equilibrium between the intentions of the Government and the preservation and protection of Bahamian rights to Crown Land, through orderly distribution and development. Crown Land is land held in trust on behalf of the Bahamian people. Crown Land is disposed of by the Minister responsible for Crown Lands (presently in the Office of the Prime Minister) with the advice of the Department. About 70% (10,400 km^2 (4,062 mi^2)) of the total land area of The Bahamas is Crown Land. About 15 to 20% of this area is under lease for agricultural, residential, light industrial, and commercial uses.

The Bahamas National Geographic Information System Unit, which is still beign developed, is housed in the Department of Lands and Surveys. The Unit is being established with technical assistance from the Inter-American Development Bank and funds and technical assistance provided by the Government of Japan. The objectives include the development of a national geographic information system policy for The Bahamas, the establishment of the Unit policy, and the installation of a network of geographic information system along some thirteen agencies.

Box 2.7
Department of Lands and Survey:
Land-Use Policy

Mandate

- Disposal and lease of Crown Lands, including marine areas, while protecting Crown and Government interests and encouraging a balance between use and preservation
- Advise the Prime Minister on land leasehold and freehold interests
- Provide land surveys for residential, commercial, industrial, and agricultural uses
- Conduct inspections prior to disposal of land or renewal of land leases
- Manage a geographic information system (GIS) on lands

Concerns

- Lack of national land-use policy and a national land-use plan
- Conflicts in land-use and threats to sensitive areas by urbanization and development
- Increasing population and intensity of land use
- Worsening water quality
- Flooding in some low-lying areas, including on New Providence
- GIS over-committed and Government policy on its use confused

Needs

- Re-examine land-use policies and practices throughout The Bahamas
- Develop National Land- and Water-Use Plans to provide for environmental sensitive zoning and to help resolve future conflicts that may result from development

There will also be a programme of training in the uses and applications of geographic information systems.

Additionally, the Department has responsibilities for the sustainable management and conservation of the natural forest resources of The Bahamas that are located on Crown Land. The forest resource comprises pine forest in the most northerly larger islands, comprising approximately 2000 km^2 (780 mi^2), and the hardwood coppice forest of the Central and Southern Bahamas. Drier areas of scrub forest are located in the drier southerly islands, in addition to extensive areas of mangrove forests--usually regarded as swamp. In the undertaking of this responsibility, four components of forestry development have been identified (Box 2.8).

Box 2.8
Forestry Development

Institutional

- Enactment of comprehensive forestry legislation
- Human resource development and training
- Capacity building for the Department of Forestry

Resource Management

- Establishment of a permanent forest estate comprising forest reserves, protected forests and conservation forests
- Establishment and implementation of a forest fire protection programme
- Public education on all aspects of forestry development and conservation
- Forestry research programme
- Pine seed collection programme
- Urban forestry programme
- Agro-forestry programme
- Forestry recreational and amenity programme
- Conservation of forestry biodiversity

Sustainable Utilization

- Promotion of small-scale environmentally-friendly forest-based industries
- Adherence to protocols, agreements and conventions relating to forestry

Assessment and Monitoring

- Inventories of forest resources
- Land capability and suitability studies
- Harvest potential assessments
- Assessment of non-wood resources and uses of forests
- Assessment of non-market functions of forests: carbon sequestration, hydrology, climate change
- Establishment of permanent plots for resources monitoring and assessment
- Stand modeling and forest regeneration studies

2.4.3 Concerns

The Department of Lands and Surveys, presently in the Office of the Prime Minister, is associated with various government departments, including the Departments of Agriculture and Fisheries, the Department of Public Works, and the Department of Physical Planning. Being concerned with land utilization throughout the entire Bahamas, zoning is a major concern. This falls officially under the mandate of the Department of Physical Planning, which is also in the Office of the Prime Minister. All agencies and sectors of society share the same environment, the same water, the same products of forests and land, as well as sharing the common problems of pollution, generation of waste, and degradation of the environment. The latter reduces the capacity to effectively manage the land for economic development and detracts from societal well being.

In New Providence there are competing demands for a limited, finite, supply of land. Unfortunately, New Providence, inclusive of available Crown Lands, has no land use plan and many sensitive areas are therefore under threat from urbanization.

The situation continually worsens as the population rises and the demand for land increases. Furthermore, many areas of New Providence are subject prone to flooding and this must be taken into account when considering the use of Crown Land.

2.4.4 Needs

The need to develop zoning plans for lands, inclusive of Crown Lands and the seabed, is critical. Many land uses are conflicting: for example, habitat conservation and mariculture; livestock farming and residential development; industrial development and tourism, and so on. The Bahamas should plan for expected growth in population, industrial and urban development, tourism development, and fisheries and mariculture development, under conditions of finite space and shared resources.

The Government of The Bahamas has recently formulated a Forest Policy. This recognizes the importance of forestry as a component of land use and commits to its conservation, management and development. In keeping with this commitment the Government has established a Forestry Unit in the Department of Lands and Surveys. The Unit answers to the Minister responsible for the management of the forest estate of The Bahamas and for the stewardship of the legally constituted forest estate. Specifically the Unit is responsible for the following:

- Supervision of the forest estate to increase yields of sawlogs and other forest products sustainably

- Provision of fire protection and development of management systems compatible with the conservation and protection of fresh ground water resources
- Developing sustained wood resources for the promotion of local forest industries
- Managing designated forest conservation areas for amenity use and for the protection of rare, fragile, or threatened ecological associations
- Making recommendations to Government for the licensing and promotion of sound forest development proposals
- Making recommendations for the development and implementation of a comprehensive sustainable forest research programme
- Making recommendations for the definition and revision of forest royalty of stumpage rates to ensure that Government derives reasonable returns from licensed rights

A Forestry Act has been drafted and should be presented to Parliament in the near future. It provides for the designation of protected and conservation forests that would include mangrove forests.

2.5 Department of Environmental Health Services (Box 2.9)

2.5.1 Context

The Department of Environmental Health Services (DEHS) was established in 1972 within the Ministry of Health as the primary regulatory agency within The Bahamas for environmental matters affecting human health. In 1997 Environmental Health Services portfolio was assigned to the Ministry of Consumer Welfare and Aviation.

In recent years the Department of Environmental Health Services has focused its attention on issues related to freshwater and marine pollution, air emissions and pollution, and the management of waste oils and solid waste. The urbanization of New Providence, coupled with the dramatic increase in development, has severely impacted the environment. Population growth and development have increased resource use and the volume of waste generated, but without strengthening the national infrastructure or enacting legislation to properly address waste generation and management. Public Health Environmental impacts include ocean pollution by garbage, waste oils and chemicals, air quality changes resulting from vehicular and industrial emissions, and effluent discharges into coastal waters and swamps.

The health of the environment not only affects human health and well being, but pollution also disrupts species' life support systems, damages wildlife, and produces nuisance effects. An Environmental Court was re-established in the late-1980s and hears violation of regulations concerning the burning of solid waste in residential areas, improper waste disposal, and pollution of water sources.

2.5.2 Mandate

The Department of Environmental Health Services is mandated by the Environmental Health Act of 1987 to promote the conservation and sustainable use and maintenance of the environment and the management of its impact on public health. It has responsibility for the investigation of environmental problems and the institution of preventative and corrective measures in respect of environmental pollution, the management and disposal of solid, liquid and gaseous waste, and general sanitation. The Environmental Monitoring and Rsik Assessment Division is responsible for monitoring food, water, and air for the presence of contaminants and for research related to environmental pollution. It is based in Grand Bahama and New Providence.

Box 2.9
Department of Environmental Health Services

Mandate

- Promotion of the conservation and maintenance of the environment in the interests of health
- Promotion of proper sanitation in matters of food and drinks
- Provision and control of services and activities incidental to the above
- Investigation of problems, and the institution of preventive and remedial measures, in respect of environmental pollution, management and disposal of solid, liquid and gaseous wastes, the management of food and drink, rodents and insect pests, and general sanitation
- The conduct of research and monitoring programmes related to environmental pollution, management and disposal of solid, liquid and gaseous wastes, and rodent and insect pests
- Promotion and implementation of measures designed to ensure the wise and safe use of the environment
- Operation of the necessary laboratory, analytical and inspection facilities
- Provision of advice in the area of environmental health to government agencies in The Bahamas
- Initiation or revision of legislation, standards and procedures in keeping with technological and advances in environmental health

Concerns

- Public ignorance concerning community responsibility for maintenance of the environment
- Microbial and chemical contamination of water.
- Inadequate disposal of wastes and their impact on human health and the environent.
- Inadequate regulations to address air pollution, water pollution, and effluents
- Inter-agency duplication and conflicts with regard to marine pollution
- Lack of manpower and other resources
- Improper disposal of waste oils and the impact on soil and water

Needs

- More comprehensive regulations to cover all aspects of environmental health
- Institutional strengthening to provide a more integrated approach to environmental issues
- Enhancement of public education and awareness programmes
- Increased fines for improper disposal of wastes
- Development of treatment or disposal facility for waste oils

The Department of Environmental Health Services is the scientific focal point for a number of international agreements concerning the environment. The Bahamas signed the Montreal Amendment and has already gone a long way in reducing CFCs and other ozone depleting substances and has organized a number of training workshops. There is an Ozone Unit within the Department. Similarly, The Bahamas has signed the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Other Wastes and Their Disposal and allows no importation into the country of hazardous or other wastes. There is some export of hazardous wastes, under bilateral agreements, for recycling.

The Department is also responsible for the control of insect vectors throughout The Commonwealth of The Bahamas and this activity has been expanded in the last year or so with the employment of new staff. Vector control is undertaken using larvicides, biological control (the Department distributes guppies for use in ponds and water storage facilities), and by ground fogging with insecticide as necessary. A laboratory has been established for the identification of mosquitoes and for testing for immunity to pesticides.

2.5.3 Concerns

The management of waste, particularly of waste oils and solid waste, are of extreme concern to the Department. Improper disposal of waste oils and oil spills impact both soil and water. A considerable amount of waste oil is generated as a result of commercial and personal activities. At present Texaco Bahamas Limited has a number of sites for the collection of small quantities of used oil. This is then delivered to a government-licensed contractor for storage and used in slow-running diesel engines, but there are no clean-up facilities for recycling.

There is intentional and accidental disposal of waste oils on land and in the marine environment, but the extent of this is largely unknown. Although areas affected may be limited, this improper disposal of waste oil poses significant threats to biodiversity by corrupting terrestrial and marine ecosystems.

In the event of major oil spills in the marine environment there is a National Oil Spill Contingency Plan. The Plan is primarily the responsibility of the Ministry of Transport but its development in collaboration with other agencies, including the Departments of Environmental Health Services and Fisheries. The plan is also revised periodically, the latest review occurring in 1999.

A present concern is the recent industrial expansion and the lack of adequate legislation for its regulation. Industrial activities and their effluent discharges often pose threats to marine ecosystems. Gaseous emissions adversely affect air

quality and human health and may have unrecognized impacts on terrestrial ecosystems. Environmental regulations have been drafted but not yet passed into law on motor vehicle emission, collection and disposal of solid waste, ozone depleting substances, and on environmental levies and penalties. These regulations will facilitate the monitoring of industry and the enforcement of environmental standards. This will materially assist in the protection and conservation of the Bahamian environment and biodiversity.

There are a number of environmental issues that are addressed by multiple agencies. This duplication often results in conflicts with regards to environmental management. For example, the Department of Environmental Health Services has the responsibility for pollution, including marine pollution. This is a shared responsibility with the Ministry of Transport and the Department of Fisheries is also concerned because of the potential impact to marine life and habitats.

The archipelagic nature of The Commonwealth of The Bahamas requires the replication of regulatory infrastructure for all Family Island communities if the environment of the entire country is to be adequately protected. The Department has recently appointed qualified officers on the islands of Eleuthera, Exuma, and Abaco. It is projected that officers will be appointed to the islands of Bimini and Andros in early 200 and to Inagua, Cat Island and Long Island, Acklins and Crooked Island, and San Salvador sometime in 2001. This will significantly improve delivery of environmental health service throughout the Commonwealth of The Bahamas.

The Department is increasingly aware of the need for formal and informal education of the public of the importance of community involvement and responsibility in maintaining a healthy environment and protecting and conserving biodiversity. Environmental habits need to be changed to ensure this.

The Department of Environmental Health Services is also responsible for the care and maintenance of public areas in New Providence through its Grounds Beautification Division. Its mandate includes public areas, historic sites, most Government schools, streets, and public beaches. The work of the Division has repercussions for birdlife.

2.5.4 Needs

Protection and conservation of the environment is hampered by lack of comprehensive environmental regulations with appropriate penalties for infractions. To provide a more integrated approach to environmental issues there must be appropriate institutional strengthening.

Waste reduction and management should be addressed by a National Waste Management Programme and by the inclusion of an improved school curriculum on environment and waste management. Additionally, there should be enhancement of public education and awareness programs.

The management of waste has become an increasingly urgent matter that is of concern to several sectors, and to tourism in particular. A detailed study has been completed for the entire Bahamas and a Solid Waste Management Project, to be funded by a loan of $23.5 million from the Inter-American Development Bank, will begin in early 2000. It will provide for the construction of several new landfills in New Providence and the Family Islands, including a hazardous waste storage facility in New Providence, and will improve solid waste management practices. Improved landfills have already been constructed in some islands. The Department of Environmental Health Services collaborates closely with the Departments of Agriculture and Fisheries, the Ministries of Public Works and Tourism, the Port Authority, the Bahamas National Trust, and the Bahamas National Pride Association. The Bahamas Environment, Science and Technology Commission provides an important forum for exchange of information between agencies. It is important to maintain this collaboration and to involve the private sector communities.

2.6 Water and Sewerage Corporation (Box 2.10)

2.6.1 Context

Water sustains all, including human life, and its quality and quantity determine the ecosystems and the biodiversity of an area. The water used by human society eventually feeds back into the hydrological cycle. A multitude of living organisms –micro-organisms, plants and animals – impact upon water cycles and the water fluxes that affect, inter alia, infiltration, percolation, water quality, erosion, nutrient input and uptake, evapo-transpiration. This is true of hyper saline, marine, brackish, and fresh waters. Fresh water, so essential to human society, has clear economic value and depends for its quantity and quality on biodiversity and ecological interactions, while in turn affecting biodiversity and ecosystem diversity.

Water availability limits human activities, but water is not evenly distributed across the Commonwealth of The Bahamas. This in part explains the distribution of bioregions and, on a smaller scale, the distribution ecosystems, agroecosystems, and human settlements. Availability of adequate freshwater from aquifers is no longer the determining factor for settlements of tourism development, thanks to technology, but technology has also led to the depletion of supplies.

Freshwater lenses underlie some 20% of The Bahamas' land area, or 1% of the archipelagic area of The Bahamas, and these resources have always been easy both to exploit and contaminate. In less-developed areas, water is obtained by bucket from shallow hand-dug wells and from mechanically cut trenches, pits, seasonal freshwater marshes, and rain water catchments. Alternatively, water is obtained by flash desalination, reverse osmosis, and by the shipment of ground water from North Andros to New Providence. The latter method provides up to 50% of the water presently supplied by the Water and Sewerage Corporation to New Providence. Table 2.1 summarizes the water resources of thirteen Bahamian islands.

Box 2.10
Water and Sewerage Corporation

Mandate

Administer and manage water resources throughout The Bahamas
Coordinate water use with Government agencies and use sectors
Advise on potable water quality and distributions of fresh and saline waters
Provide public awareness and education programmes on water
Oversee waste disposal, water treatment, water quality, and their effects on human health

Concerns

Vague government policies that contribute to fragmented water management and user conflicts
Growing demands for water by expanding industries *vs*. limits of supply
Microbial and chemical contamination of water supplies
Inadequate disposal of wastes and the effects of water pollution on public health
Influence of biodiversity on water quality, micro-climate, and water sourcing, espeially on arid islands
Understanding of physical and biological relationships among fresh, brackish, saline, and hyper-saline water
Effects of water supply on fisheries, agriculture, tourism, and other human uses
Public ignorance about critical water problems and decreasing availability of quality water

Needs

Passage of the Water Resources Act to cover all aspects of water management, inluding water supply and waste management, as national priorities
A Water Resources Management Strategy Plan that will indicate the true costs of development and impact on all uses of water, expand water management practices to all living organisms, and create predictive models of future growth and water needs
Institutional strengthening to provide an integrated management framework, including consideration of biodiversity
Adequate support for management and administration
Adequate abilities to monitor the effects of development and urban impacts on water supply and salt intrusion
Regular monitoring of water quality and supplies, including saline waters
Enhancement of public education and awareness programmes
Expansion of the knowledge base and creation of research facilities to better undertand the physical and biological dynamics of Bahamian hydrogeology

2.6.2 Mandate

"Water" has traditionally been thought of as freshwater and management and infrastructure has been directed toward obtaining and delivering potable water to meet the needs of Bahamian citizens, residents and tourists. The water resources of The Bahamas, however, include hyper-saline, marine, brackish, and fresh waters and these resources need to be considered holistically. Management of water lies principally with the Water and Sewerage Corporation, whose major concern is the quantity and quality of potable water and the provision of wastewater disposal services. The Corporation administers the water resources sector with the co-operation of the Ministry of Public Works, Department of Lands and Surveys, Physical Planning, Environmental Health Services, and with non-governmental agencies such as the Bahamas National Trust and the Grand Bahama Port Authority. Another responsibility lies with private and public utility companies that provide water and sewerage services.

The Water and Sewerage Corporation has primary responsibility over land defined as water reserves or developed well-field areas. These areas are highly vulnerable to pollution, with consequences for both human health and biodiversity. It is important to recognize that water quality and quantity similarly affect both plants and animals, and thus biodiversity. The draft Water and Sewerage Corporation Act, 1997, section 3.1 proposes that the development and use of water resources of The Bahamas:

> Be orderly and coordinated development and use of the water resources of The Bahamas in order to conserve and protect such resources for the benefit of present and future generations of The Bahamas, and to provide the Bahamian public with a safe, wholesome, adequate and reliable supply of water and to provide for the safe treatment and disposal of sewerage and other effluent and associated other services.

2.6.3 Concerns

Globally, water is an essential commodity in households and municipalities, and a critical factor in agriculture and industrial production. Thus, providing water, especially high-quality fresh water, is a serious challenge to users and providers. The provision of services for the safe treatment and disposal of sewage and other effluent also presents special challenges in small island states characterized by local water scarcity, high-localized demand and a high potential threat from pollution.

Although there is no absolute shortage of freshwater in The Bahamas the availability of water is a concern (Table 2.2). In New Providence, a resident population of over 171,000 can be provided, from local freshwater sources, a long term sustainable supply of approximately 56 Imperial gallons (254 litres)

per person per day, or a total of 9.63 million Imperial gallons (43.7 million litres) per day. However, this sustainable supply ignores the tourism sector, which is expanding and is the largest user of potable water. For other islands, growing populations and their need for freshwater (which in some cases fall below the available sustainable freshwater supply) will present difficulties. Decisions will need to be taken concerning the allocation of freshwater resources to residential communities, tourism, agriculture and industrial development. Reverse osmosis is already being used to provide potable water for tourism development in some of the Family Islands and its adoption may need to be extended so as to release freshwater from aquifers for agricultural and industrial development.

Water management is also a public health concern. Providing water to drink and for the removal of waste have been concerns of civilizations since ancient times. Today there are two major water quality concerns: microbial contamination that cause diseases, and chemical contamination that poses health risks for both humans and aquatic ecosystems. The microbial threats to human health through the transmission of water-borne diseases have been well studied globally. Water pollutants from trace levels of chemical pollutants have, by comparison, not been adequately studied and the long-term effects on public health from chemical pollutants in water, is not well understood.

Table 2.2
Freshwater Resources of Thirteen Bahamian Islands

Island	Freshwater Lens Acreage	Max. Volume M gal day-1	Availability gal day -1	Population 1990 Census
Abaco	116280	79.1	7859	10061
Acklins	15783	4.36	10178	428
Andros	338585	209.92	25742	815
Bimini	395	0.17	75	2272
Cat Island	149774	6.80	4050	1678
Crooked Island	5923	1.74	4104	423
Eleuthera	16599	8.13	773	10524
Exumas	6586	2.90	819	3539
Grand Bahama	147884	93.17	2270	41035
Great Inagua	3571	0.86	870	985
Long Island	9301	2.88	928	3107
Mayaguana	2340	0.65	2096	308
New Providence	17503	9.63	56	171542

NOTES: Maximum volume is million Imperial gallons per day.
Availability is Imperial gallons per day per person.

Ground water contamination affects agriculture, industry, tourism, fisheries, and other human activities. Improper waste removal and disposal, agricultural chemicals, accidents, urbanization, and ignorance, largely cause contamination. Ground water contaminants include disease agents, nitrates, pesticides, and toxic chemicals delivered by runoff, floods, and seepage from areas with improper waste disposal, domestic uses, and land alterations. Coastal waters are also becoming contaminated; marshes and wetlands are being used for dumpsites and turbidity is changing the colour of water, both of which affect tourism, recreation, development, aesthetics, and impact human health. In The Bahamas, water needs and uses are fraught with conflict and exacerbated by a fragmented government policy that lacks Cabinet-level mechanisms to resolve conflict. For example, brackish and marine waters have potential for desalination, and hyper-saline waters can

be used for salt production. However, these resources are poorly understood, although their neglect can have serious economic consequences.

There are many conflicts over water needs and uses that need to be resolved. Government currently has neither unified policy nor high-level mechanisms for conflict resolution. The Draft Water and Sewerage Corporation Act is expected to resolve some of the deficiencies. Marine and brackish waters can be used for the production of potable water by reverse osmosis and hyper-saline waters have potential for the production of salt. These resources need to be better understood and valued.

Agriculture conflicts with its own water-conservation efforts, and tourism, economic expansion, and jobs are being promoted without adequate attention to water concerns. Finally, water quality, species distributions, and ecosystem processes important to water cycling, water quality, and water retention, are being altered faster than either water sourcing or purification can be studied, resulting in future potential conflicts in the sector.

Public education about water resources is presently rudimentary. Many of the problems associated with water require social and institutional solutions. The public and decision-makers need better understanding of the constraints on quality water supplies and how human activities can diminish its availability.

The availability of cheap energy has made it possible to transport water long distances, and desalination is another technological alternative, but one which requires intensive energy use in order to expand water supply services. The destruction of local supplies, and the extra costs and dependency on energy and foreign technology to sustain water supply from alternative sources at high cost places The Bahamas in a vulnerable position.

Waste and sewage disposal is also a growing concern for public education. Sewer systems that treat waste water serve approximately one fifth of Nassau, and are limited to a few small subdivisions and some private developments and hotels on the other islands. Studies show that ground water under urbanized areas has been polluted from sewage discharge from domestic waste water facilities. There is also evidence that run-off contributes to seawater pollution, particularly in some enclosed harbours, which creates conflicts between tourist development, aesthetics and, in some cases the commercial fisheries and seafood industry.

2.6.4 Needs

Water management in The Bahamas is faced with unique challenges. Foremost, the Water and Sewerage Corporation has, at present, a conflict of interest in

being the primary supplier of potable water and also the regulatory authority for matters concerning water, The Corporation needs to be strengthened and provided with adequate funds and the facilities for research and monitoring and the control and administration of the water sector spanning the archipelagic extent of The Bahamas.

The existing Water Resources Act (1976) is to be replaced with the Water and Sewerage Corporation Act that is still in draft form. This is expected to correct many of the deficiencies under the present Act. Still, an Integrated Water Resource Management Strategy needs to be developed to include a regulatory and institutional framework that considers all uses and has the capacity to anticipate and resolve conflicts. The concept of water as a service to the

Box 2.11
Ministry of Tourism

Mandate

Marketing and promotion of the Tourism Industry
Integration of resource protection into land-use planning
Creation of economic values from resource conservation
Provision of incentives and means for environmental enhancement
Promotion of sustainable development

Concerns

Uncontrolled development that destroys environmental assets for visitors
Ineffective waste management and litter
Stray dogs and cats and their plight
Lack of implementation and enforcement of the Environmental Health Services Act (1987), which has contributed to dumping of waste at sea
Depleted and degraded once-abundant marine resources
Under-funded and under-staffed National Parks and Protected Areas
Lack of awareness in island communities and among hoteliers
Domination of tourism by the mass market
Sectoral interests that drive duplication of effort and that creates gaps, overlaps, and ineffective management

Needs

Greening of the Tourism Industry, especially by means of ecotourism development
National planning to guide development, reduce impacts, protect environmental features, and encourage incentives for cost-effective, sustainable practices
National legislation to prevent marine pollution, to ensure Government's commitment to sustainability, and to preserve Bahamian heritage and culture (Antiquities, Monuments, and Museums Act)
Promotion of environmental awareness and the
Reduction of non-renewable resource consumption
Designation of more protected areas to attract tourists and to control visitor impact, over-exploitation, poaching, and destruction of coral reefs
Safe-guarding of water supplies
Improved waste and pollution management , including by the Tourism Industry
Promotion of Bahamian culture and local products
Protection of the quality and attractiveness of shorelines
Control of pests (rats and mice) and stray dogs and cats
Implementation of better processes for environmental impact assessments

economy, needs to go beyond meeting the potable water needs and waste water management to include uses and needs of all living organisms, in a healthy environment.

There also needs to be mechanisms for assessing the true value of water in all aspects. Presently, our knowledge of freshwater resources is relatively good. However, freshwater cannot be adequately understood without the knowledge of its complex interactions with brackish, saline, and hyper-saline waters. Knowledge of these interactions is, at best, rudimentary, and the resources necessary to expand the knowledge base are practically non-existent. This means that the biodiversity that fresh, saline, and hyper-saline waters support can only be inferred. The premise that subsurface waters contain no significant biodiversity is a false assumption. An adequately funded research and monitoring programme is needed.

2.7 Ministry of Tourism (Box 2.11)

2.7.1 Context

International tourism is an example of advanced capitalist development and has become the third largest item in world trade, accounting for 12% of the world's GNP and 100 million jobs by the early 1990s. By early in the next century, the industry is expected to generate trillions of dollars, employ millions of people, invest in billions of dollars in new facilities, and contribute billions in tax revenue.

Tourism, especially ecotourism, depends on the viability of natural resources and the diversity of life. Furthermore, although tourism development can impact the fragile natural resource base of island nations, the industry can make significant contributions to sustainable development.

In general, the more diversified the economy, the less economic weight tourism will carry. In economies that depend heavily on tourism there is generally heavy leakage or repatriation of profits overseas with relatively little money remaining in the host economy. On the other hand, large, resource-rich economies generally have multiplier effects and considerable earnings from tourism-dependent trades and activities remain in the host economy. Also, large multi-national hotels or resorts tend create leakage, whereas small locally owned hotels or resorts tend to have multiplier effects. The Bahamas is a case in point generally and specifically. Generally there is a heavy leakage of tourism profits overseas although much has been done and is being done to address this. At a more specific level, tourist development on New Providence is predominantly of the multi-national kind and is considered quite "leaky". Tourist development on

the Family Islands is predominantly of the "homegrown" kind and inherently has more multiplier effects.

It is said truthfully that: "In The Bahamas, tourism is the engine that drives the economy," and tourism has experienced unprecedented growth and expansion. In fact, the tourism leader in the Caribbean region is The Bahamas.

The environment of The Bahamas is relatively unspoiled and has a diversity of flora and fauna that, though not unusually diverse, is readily accessible and observed.

Ecotourism is a direct user of biological diversity and is an appropriate economic development incentive for The Bahamas. The Government is keenly interested in promoting ecotourism, especially to promote employment opportunities in the Family Islands. Illustrations of tourism development and concern for the environment operating in tandem can be found around the world. However, a common feature in each case is a regulatory framework that ensures coexistence. The ecotourism market and perhaps the entire tourism market in general, can expand significantly only if there is an environmentally and socially responsible travel industry with an emphasis on sustainability.

2.7.2 Mandate

The statutory mandate of the Ministry of Tourism is the Promotion of Tourism Act of 1964. The Act gives the Ministry responsibility for tourism marketing, with responsibilities for advertising, public relations, sales and promotions, research and public awareness, reception services, and hotel licensing.
One major goal of the Ministry of Tourism is to integrate resource protection into all planning and decision-making, in order to preserve the environment on which this industry depends for its very existence. This involves creation of economic value for resource conservation; provision of incentives and means for environmental enhancement; establishment of essential infrastructure; research on environmentally sound technology; communication of principles of sustainable development to receptive audiences; provision of growth alternatives; and leadership for sustainable development in business practices. In sum, the mission of the Ministry is: "to make it increasingly easier to create, sell, and deliver a satisfying vacation product — satisfying to investors, employees and tourists." This reflects a commitment toward placing a value on ecotourism and sustainable development among its top priorities.

2.7.3 Concerns

Tourism is concerned with at least 11 major environmental issues (Box 2.12). This means that an effective programme of sustainable tourism development

requires partnerships between public and private sectors. Government must provide the climate, strengthen relationships where necessary, introduce

Box 2.12
Major Environmental Concerns for Tourism

Ecotourism. This the fastest growing segment of the travel industry, but only represents 5-10% of global tourism. The Ministry of Tourism and The Bahamas National Trust, with the private sector, have drafted a National Ecotourism Strategy. Ecotourism development is impeded by an image of The Bahamas equated mainly with Nassau and Freeport, an image made popular by the mass-market selling of sun, sand, sea, gambling casinos, and cabaret-style entertainment. However, congestion, waste, and the unsustainable activities that tourists readily observe, all obscure the potential of ecotourism.

Planning. Uncontrolled growth can disrupt unique features that interest tourists, destroy natural resources, contaminate water supplies, over-extend the capacity of waste treatment and disposal systems, and destroy shorelines that lack safeguards against storms and ocean surges.

Marine pollution. No facilities are in place to allow water craft to comply with the existing Environmental Health Services Act of l987 for the prevention of environmental pollution or contamination. This affects Tourism marketing and the concept of the "pristine waters" of The Bahamas.

Depleted marine resources. Most of the popular tourism activities are centered around the sea. Once-abundant fishes have become depleted and bonefish guides have expressed concern about visitor use and exploitation, calling for more protected area designations. Poaching, over-fishing, and damage to coral reefs by boat anchors are problems.

National parks and protected areas. These are important to the tourism industry, but are seriously under-funded. An expanded, integrated park system, education and public relations, membership development, policy and advocacy, and research and monitoring are required.

Litter and waste management. The waste management system now in place is ineffective, and there is no system for disposal of hazardous materials that may enter ground water. The travel industry itself generates about a third of all commercial garbage in New Providence. An incentive-based system of "reduce, re-use, and recycle" needs to be put in place.

Accommodation. This issue relates to the need for freshwater, energy management, building codes, use of environmentally friendly materials, landscape management, and use and disposal of chemicals. However, hoteliers and potential tourism developers feel they are asked to spend large sums of money to introduce sustainable tourism while the country itself is operating unsustainably. Thus, few efforts are being made to implement sustainable practices nationally, even though sustainable measures have been shown to be cost-effective.

Heritage, archeological and cultural resources. A significant selling point for tourism is a mixture of environmental and cultural elements. However, there is insufficient effort to preserve the national heritage. Implementation of The Antiquities, Monuments, and Museums Act is needed to preserve Bahamian heritage and culture.

Awareness, education and training. Island communities and some hoteliers are generally unaware of "greening" practices or the impact of their activities on natural resources, or even of the cost-effectiveness of sustainable practices.

Partnerships, and meaningful involvement of local communities. The integration of Government, tour operators, NGOs, the hospitality industry, and local communities is essential.

incentives, and embark on an massive education and awareness programme.

The Government has responded to environmental needs through legislation and enabling the different government sectors to address their environmental-sector needs. However, enforcement is weak. Tourism's dependence on environmental quality demands close working relationships with Government departments and ministries responsible for the environment, natural resources, and education.

2.7.4 Needs

The prominence and potential of tourism in general and ecotourism in particular, constitute both a challenge and an opportunity. Tourism facilities and services consume large quantities of land, water, and energy, and produce significant volumes of waste and effluent. The environmental impacts of tourism, especially mass tourism, are no longer purely local in their impacts. They can have regional impacts, as in the case of marine pollution and oil spills, and contribute to ozone depletion and global warming. Without a Government committed to an integrated, sustainable, environmental strategy, tourism is at long-term risk.

There has long been a need for a national waste management system and a solid waste project is shortly to be undertaken by the Department of Environmental Health Services. There is also a need to develop recycling programmes and to ensure the proper disposal of hazardous wastes. Ecotourism sites need to be protected and properly managed. Such sites include blue holes, wetlands (particularly as waterfowl habitat), trails and coastal lands, including beaches.

Finally, the Tourism Industry itself needs to become "greener". It needs to participate as diligently in protecting the product as it does in promoting it.

2.8 Department of Local Government (Box 2.13)

2.8.1 Context

Prior to the introduction of Local Government in the Family Islands, the effectiveness of Government services was dependent upon policies, procedures, and practices developed and decided by Central Government. With the introduction and implementation of Local Government, much authority has devolved from Central Government to elected District Councils and Town Committees. This is intended to protect the interests and well being of the local communities.

The Commonwealth of The Bahamas is divided into 31 local government districts. These are distributed as follows: six in Abaco, five in Andros (including the Berry Islands), five in Eleuthera, three in Grand Bahama, three in Acklins and

Crooked Island, and three in Exuma and Ragged Island. Bimini and Cat Cay form a single district. Each district has an administrator, though some administrators are responsible for two or more district. The Department of Local Government provides the linkage between districts and administrators and Central Government.

2.8.2 Mandate

Local Government is an actual transfer of authority, not just a delegation of functions and powers. This authority is governed by the Local Government Act of l996. The elected District Councils and Town Committees are the means through which Local Government provides services to Family Island communities. This system allows action to be taken promptly and efficiently, and has the capacity to ensure effective utilization of resources.

The functions of Town Committees are limited to conformity with national standards as per the following reference from the Local Government Act: "…general health and sanitation, collections and removal of refuse from public places, the maintenance of cleanliness, upkeep, maintenance, and establishment of recreational areas, parks, open spaces, beaches, public wells and water tanks, roadways, issuance of guidelines for the upkeep, restoration, design or alteration of any building visible from a street, including types of lighting and materials, advertisements and shop fronts, postal facilities and upkeep of local port, docks, harbours, wharves and jetties."

The Councils hold wide powers and duties for the purpose of carrying out their functions. By virtue of various sections of the Act, the scope of responsibility towards the overall goal of protecting the Nation's biodiversity is immeasurable.

2.8.3 Concerns

Tourism development is a leading activity in the Family Islands but some degree of over-development has come with tourism, particularly in the northern islands. Councils will be need to balance the desire and need for economic development with the need to protect and conserve the environment. Tourism development should not be allowed to outweigh environmental considerations.
Long-range planning must strive to achieve this balance between protection of the environment and promotion of the economy. Local Government therefore must work interactively with Central Government. Zoning in the Family Islands is the responsibility of the Minister of Public Works who can prescribe by Zoning Order where development may or may not take place. In addition, the Town Planning Act allows for restrictions on the type and scale of development. The Town Planning Committee and/or Council is empowered by the Act to assist with the formulation, implementation and review of zoning plans. This review takes

into account projected community needs, including clinics, schools, social and recreational facilities, and residential lots.

The Conservation and Protection of the Physical Landscape of the Bahamas, both the Act and the Order, were passed after consultation with the Bahamas Environment Science and Technology Commission. Town Committees/Councils have the responsibility to regulate and control use of all lands in conjunction with the proper Central Government authorities, and to ensure that development in their districts is consistent with conservation needs and development plans. The Town Planning Act, however, defines development in terms of buildings and does not include control of mining, deforestation, or protection of wetlands or other

Box 2.13
Department of Local Government

Mandate

Determination and performance of community functions of Local Government Districts, including development issues

Provision of community services, such as water, health, sanitation, roads, and waste removal

Creation of recreational parks and areas, and other forms of open space

Ensure effective use of resources.

Concerns

Serious threats of unplanned development

Destruction of land and sea resources and water pollution

Dilemmas among changes brought by development and the tourists' desires for pristine natural settings

Balancing needs of local communities for economic development *vs*. "green" toursm

Needs for jobs *vs*. vigilance for natural areas

Lack of knowledge among decision makers on linkages among environmental factors and the impacts of development, particularly solid waste and sewage disposal, water shortages and water supply, harbor development and dredging, beach erosion and siltation, impacts of increased cruise ship traffic, and threats of urbanization to native wildlife and fisheries

Needs

Develop greater inter-agency and cross-sector interactions

Improve local understanding of the trade-offs of development

Identify options and alternatives for benign development and growth, emphasizing ecotourism

Emphasize local culture, for example: how locals conserve and use water; how local tradition has permitted long-term survival; ways of using the environment without modern technology

Encourage local pride through local historical events, traditional ways of life, and local museums with artifacts, art, and natural history items for tourist information and enjoyment

Create environmental awareness among local residents and visitors

Implement land use plans in order to: minimise development impacts; avoid conflicts among users and developers; avoid failed development and abandonments; and identify sensitive areas that need protection

Collect fines for environmental damage to finance conservation efforts

Coordinate and implement adequate health and waste management systems

Encourage scientific studies in which local people are involved

natural areas. While recognizing that excavation and removal of trees and landfills must take place in the ordinary course of development, Local Government legislation was drafted and passed to ensure that damage to the environment is minimized.

Additionally, the Conservation and Protection of the Physical Landscape of The Bahamas Act, passed in mid-1997, provides for control of excavation and requires a permit for the felling of certain protected trees. Town Councils have the responsibility for regulating and controlling the use of all lands within their district, in consultation within the appropriate Central Government authorities and ensuring that environmental needs are met.

2.8.4 Needs

Economic Development in many of the Family Island has resulted in damage to and contamination of freshwater aquifers, pollution of surface waters and wetlands, and destruction of terrestrial ecosystems, especially on Grand Bahama, Abaco, Spanish Wells, Eleuthera and Exuma. On the other hand Central Government has, in past, issued permits for the construction of docks, canals, and marinas, for the dredging harbours, and for the reclamation of the seabed without adequate consideration of the environmental impacts or the wishes of local communities. Machinery must be put in place to avoid these errors happening in the future.

In many or even most cases, methods of disposal of human, solid, and liquid wastes in the Family Islands must be modernized and made more environmentally friendly. The Solid Waste Management Project described earlier is much needed and long overdue.

Unplanned development for inland, coastal zones, and wetland environments poses the most serious threat to biodiversity. The Councils, in meeting the needs of the Family Island communities, have to be vigilant in protecting natural areas, while ensuring sustainable use of the environment and addressing human needs. An example is the expansion of cruise ship traffic. Such vessels require dredging of harbours and dock construction, which have devastating effects on the seabed and inshore ecosystems, fisheries, and even some endangered species, such as sea turtles.

Councils and Town Committees urgently need monitoring capabilities for a host of items: e.g., dump sites, environmental contamination, coastal waters, and impacts of tourism. Concomitant needs include timely and relevant information on which to make decisions and management and enforcement capacities to ensure that development is sustainable and orderly. Elected Local Government officials must fully understand the need to protect biodiversity and should be

aware that a primary mechanism for biodiversity conservation is proper planning, management, and public education. Concurrently, Central Government must continue to recognize the significance of involving local communities and their long-term needs and desires in the planning process.

2.9 Ministry of Finance (Box 14)

2.9.1 Context

The Ministry has shown concern for the environment. However, an unresolved issue concerns the extent to which The Bahamas' environment can support increased living standards, population growth, and employment opportunities over the long term, given its limited resources.

The Bahamas has a relatively high per capita Gross Domestic Product (GDP) of about US $12,000, making it among the most prosperous countries in the Caribbean Region. Fiscal policy, that is the creation of investment through tax incentives, is of paramount importance to the country's development policy. In The Bahamas this development policy has largely been centered on mass-market tourism. Lately, ecotourism has come into vogue, but the traditional fiscal incentives, i.e. tax breaks, have not been geared to encouraging this form of tourism.

Two factors are of special importance to The Bahamas. First, the Government sector in The Bahamas is large, accounting for about 20% of the nation's GDP. Second, as the Government seeks to spur economic growth, expenditures have largely been in infrastructure, limiting expenditure increases for other programmes.

Recent revenue growth has been through the expansion of the existing tax base. New taxes have been introduced nor have any substantial rate increases taken place. Nor does it appear to be the policy of the present Government to institute any type of pollution or environmental-use tax. Depletion taxes have historically been limited to sand and other minerals, not to fisheries resources or to fauna, flora, and the environment in general.

Presently, there are few fiscal incentives to protect biodiversity or conserve natural resources. There is some interest in introducing the concept of true environmental costs for development. There is also some interest in creating incentives that facilitate or constrain local exploitative actions.

Yet profits based on unsustainable use or environmental depletion will burden the Government in the future with high social costs and costly environmental consequences.

Box 2.14
Ministry of Finance

Mandate

- Collection of Government revenue
- Control of Government expenditure
- Implementation of Government fiscal policy
- Coordination of financial administration of different Government departments

Concerns

- Allocation of department budgets as a measure of development costs omits social and environmental costs
- Lack of attention paid to true costs of development, including discounts in cases of resource depletion
- Allocation of department budgets is a measure of development costs, but operations are constrained by financial, economic, and social costs

Needs

- New budgetary methods for assessment of environmental and social costs of development
- Redirect the budget process toward better services for citizens
- Implementation of a monitoring program for environmental and social costs of development
- Increase financial incentives for inclusion of conservation of biodiversity into department budget considerations

2.9.2 Mandate

The Ministry of Finance is mandated by the Financial Administration and Audit Act with responsibility for the collection of Government revenue and control of Government expenditure. It is the agency specifically charged with implementing the Government's fiscal policy, and is directly responsible for financing 65 different agencies and all major utility companies. This support is either through direct cash contributions or duty exemptions, as in the case of the communications and electricity industries.

2.9.3 Concerns

Allocation of department and agency budgets is a shared concern. The Government provides training programmes to introduce different departments to extra-budgetary impacts to the economy and to the environment, making them aware that their operations are constrained by environmental, as well as financial costs. However, no means yet exist for measuring the costs of environmental degradation over the long or short term.

With regard to protecting the country's biodiversity, the budgeting method is an area that needs strengthening. A department is allocated funds in accordance with the Financial Administration and Audit Act, which is simple and transparent

but unsuited for assessing intangible costs. In cases where an environmental impact assessment is necessary, requests are passed to the agency involved, yet individual projects are budgeted according to a process that excludes social and environmental costs. Also, there is presently no policy on bonding for nonperformance or for environmental impacts.

Because development decisions undoubtedly affect every citizen, as well as future generations, informed citizens have a responsibility to help guide the decision-making process.

2.9.4 Needs

Social and environmental cost/benefit analyses are needed for projects under both the capital and recurrent budgets. Recent advances in technology and the Government's intention to be at the vanguard of a more advanced project-budgeting process bode well for environmental protection.

Government and the nation need to become increasingly aware of the social and environmental costs of any project. Fiscal incentives that lure developers to The Bahamas may lower investor cost and produce higher profits but they may also have social and environmental impacts that need to be fully considered and factored into the "cost" equation.

There is also an urgent need to monitor development costs in terms of environmental and social impact of projects. This requires that new indicators be identified for measuring social and environmental costs as well as fiscal.

2.10 Public Education and Awareness

2.10.1 Context

It is a poorly understood concept that human well-being depends on biodiversity and ecosystem well-being. Public education and awareness programmes can make this link apparent and give people the environmental and ethical awareness, the values and attitudes, and the skills and behaviour needed for improved biodiversity conservation and sustainable development. To do this, education must explain not only the biological environment, but the socioeconomic and human development environment as well.

In The Bahamas a number of agencies contribute formally and informally to public education and awareness. The Department of Education is responsible for the management and development of the Government Schools of The Bahamas. The Department operates centrally and maintains control over all Government Schools. District Education Officers who represent the Department on Family

Islands facilitate this mechanism. There are 171 Government schools in the country; 43 in New Providence and 128 on the Family Islands. There are also 38 independent schools, 19 on New Providence and 19 in the Family Islands. In 1996 the student population in all schools was approximately 59,300.

The Department requires all students to sit national secondary exams. These include environment sections with specific topics addressing endangered species, ecosystems and native flora and fauna. Government Schools have traditionally focused almost exclusively on formal education programs, that is, those associated with the classroom, but recently this has been changing. For example, a number of schools at the secondary level offer agricultural science (formal education), and as a result have begun organizing 4-H Clubs (informal education). The Department's Science and Technology Unit regularly organizes workshops for teachers to acquaint them with new concepts, introduce materials and curriculum changes, and to promote consistency in classroom content. In 1996 the Unit also organized its first Youth Environmental Summit.

The Department also manages the Learning Resources Unit, situated in New Providence. This depository of teaching materials, aids, references, etc. is available to all teachers throughout the country. The Exuma Education Resource Centre was established by the Department of Education to provide support for teachers in the field, and is an extension of the Exuma District Education Office. The Resource Centre houses a vocational training centre to meet the specific needs of Exuma and neighboring islands. The Centre has established a mobile library for the surrounding communities and, in 1996, organized a highly successful environmental workshop for local educators.

The College of The Bahamas (COB) is the only broadly based institution of higher (tertiary) education in The Bahamas. In 1995 the Government of The Bahamas granted the College autonomy and directed it achieve financial independence as soon as possible without sacrificing quality of education or denying the right to study to any deserving Bahamian. Enrollment in 1995 was approximately 3,500 with 400 faculty and staff. The Library houses 72,000 volumes. The College maintains campuses in Grand Bahama and Exuma.

For most of its history the College of The Bahamas has been a two-year institution awarding Associate of Arts degrees. In 1997 the College conferred its first Bachelor of Arts degrees upon Business Administration graduates. More than 200 Colleges and Universities in North America, the United Kingdom, and the West Indies accept the Colleges credits. The College is actively involved in scientific research through its Research Unit, which fosters national and international partnerships in research. The College has two field stations: the Bahamian Field Station in San Salvador and the Bahamas Environmental Research Center in Andros.

Twenty percent (20%) of the student population attend the 38 independent schools in the country. The primary focus of these independent schools has obviously been formal education but they have always had a diverse range of informal education activities as well. Generally, independent schools are better funded and equipped than Government Schools and this has led to more varied approaches to education.

A number of agencies make substantial contributions to public education and awareness through informal programs. These include: The Ministry of Tourism and its Bahamahost programme. Bahamahost serves as a basic foundation to all other tourism industry training, and is used to promote service excellence in The Bahamas. The programme provides participants with information on Bahamian history, geography, civics, economics and places of interest. Over the past several years, the course has included information on the natural history of The Bahamas, as well as on ecotourism and the National Parks.

The Bahamas National Trust's educational activities are varied. Formal education focuses on the development of materials and activities that supplement curricula needs. The Trust also produces a full range of printed and visual materials, posters, fact sheets, and teaching guides, conducts field trips and school visitation programs, and manages a Reference Library used increasingly by students, teachers, and researchers. Informal educational efforts include the highly successful Discovery Club (for young Trust members), Earth Weeks, the Adelaide Creek Restoration Project, the Bahama Parrot Conservation Project, the Green Pledge Program, Birdlife International's annual World Bird Watch, and the Center for Marine Conservation's annual International Coastal Clean-up.

A great deal of scientific research is conducted in The Bahamas and Bahamian Field Stations are valuable educational resources in themselves. There are presently five: Caribbean Marine Research Center, Lee Stocking Island, Exuma; Forfar Field Station, Andros; Bimini Biological Field Station; Bahamian Field Station, San Salvador; and, Bahamas Environmental Research Center, Andros — the latter two now formally part of COB. These facilities have in the past existed in isolation from national academics. In recent years Bahamian institutions have become increasingly involved in Field Station programs and benefited from the resources within them.

A small number of non-governmental organizations are involved in environmental education to varying degrees. These include, among others, the Bahamas National Pride Association, Friends of the Environment, Ocean Watch and the Bahamas Reef Environment Educational Foundation, which is concerned primarily with coral reef education and with fund-raising for the protection of Bahamian marine resources through education. The Foundation has funded teachers participating in professional development courses in The Bahamas and abroad, conducted workshops, produced fisheries reports and distributed a variety of educational materials to Bahamian schools.

2.10.2 Concerns

Efforts to conserve biodiversity cannot succeed without the general public's understanding and support. To be successful education, awareness and communication must open up and capitalize on opportunities for linkages and partnerships. Within the formal environment, a simple ecology course requirement will not lend itself to a full understanding of the many facets, issues and values of biodiversity. In the wider community, efforts must target and emerge out of religious groups, citizen-based programmes, professional bodies, industry, youth and much more.

There are many issues to be addressed in biodiversity education, including social, political, economic and institutional. Key among them are:

- Development Agenda and Awareness Levels. The Government's development agenda is high-paced. Many decision-makers are not fully aware of the implications of decisions on biodiversiity, nor of the inter-relation between human well being and biodiversity well being. Lack of awareness and "quick fix" approaches to strengthening the economy can lead to accelerated loss of biodiversity.

- Family Island Development. Within the Family Islands is the wilderness and natural capital of the country. Largely undisturbed, the Family Islands are now the focus of development. While the institution of Local Government is a great advance for the country, the lack of resources and guidelines for Local Councilors creates the potential for this institution to become one of the major threats to Bahamian biodiversity conservation and sustainable use.

- Information and Communication. The availability of information, and effective communication, are critical to public education and awareness. Communication capacity in the country is a major constraint. The lack of ability to research, share and retrieve information and network in a timely fashion, will hamper education and conservation efforts.

- Formal Education. Eighty percent of the student population in The Bahamas attends government schools. Yet it is these schools that suffer most from lack of capacity to effectively address and carry out all their educational responsibilities. Many schools do not have basic supplies for teaching traditional subjects. Most government schools do not have any access to computer technology.

- Youth Involvement. It is known that childhood experience of the outdoors is the single most important factor in developing personal concern for the

environment. Studies have highlighted the fact that youthful experiences of the outdoors and of pristine environments was a dominant influence in producing adults informed and environmentally active. There is a critical lack of activities that immerse Bahamian youth in conservation and related issues. One consequence of this is a lack of connectivity between their future well being and the well being of the environment. The 1990 United Nations Convention on Child Rights gave legal strength to youth participation. In that same year the World Summit for Children declared, "among the partnerships we seek, we turn especially to children." Agenda 21 devotes an entire chapter to children and youth, stating, "Governments should establish procedures allowing for participation of youth in decision-making processes… (and)…incorporate children's concerns into policies for environment and development at the local, regional and national levels." Little progress in these regards has been made in The Bahamas.

- Perception of Biodiversity Conservation Education. The pervading attitude towards conservation and biodiversity education is that it is an extra-curricular activity, not really connected to required courses, and something to be fitted-in only if there is time and/or room. This undermines the very purpose of the discipline. Conservation education and, by extension, biodiversity education, seeks to heighten awareness of inter-relations. The goal is not simply to integrate but to make conservation a way of life.

- Financing Conservation and Biodiversity Public Education and Awareness. If biodiversity well being ensures the well being of the Bahamian people. Government must lead the way in meeting financial needs and creating financial mechanisms on which education and awareness depend. However, the private sector, the tourism industry, developers and investors, to name a few, also have financial responsibilities to bear in this regard.

2.10.3 Needs

The current losses of biodiversity have both direct and indirect causes. The direct causes include habitat loss and fragmentation, invasion by alien species, the over-exploitation of living resources, pollution, and global climate change. These diverse problems have a common root: biological impoverishment and its consequences are in almost every case a result of the way in which people use, misuse and abuse biological resources. No public education and awareness programme can hope for success unless it addresses this fundamental factor.

The Bahamas is committed to ensuring that all public education and awareness obligations of the Convention on Biological Diversity are met successfully. Yet it is seriously constrained by lack of resources and a lack of national priority setting for education and awareness in all sectors of the community. Strategies and

mechanisms for their implementation should be developed for a national biodiversity public education and awareness programme. This should provide for the promotion and increased understanding of the importance of and the measures required for the conservation of biological diversity.

National circumstances require that decision-makers be considered a priority target group. Information and guidelines should be made available as a matter of urgency to local government officials. Technical and financial assistance is required to develop and implement a mechanism to evaluate Government policies, with a view to identifying and resolving potential conflict between development and biodiversity conservation.

Especially important is the need to improve information and communication capacity, within the formal and informal education community and within decision-making circles. A desired result of this will be the ability to identify biodiversity education gaps and opportunities and increased biodiversity education capacity and content within the formal and informal education community.

Bahamian youth should be a target audience as well as makers and shapers of programmes and activities. Mechanisms to ensure both need to be clearly articulated and supported by all sectors of the community.

3 Chapter Three
The Road to Integrated Ecosystem Management

I suggest that as biological knowledge grows the ethic will shift fundamentally so that everywhere… the fauna and flora of a country will be thought part of the national heritage, as important as its art, its language…

Edward O. Wilson, *Biophillia, 1984.*

Until recently the conservation was interpreted as the preservation or protection of individual species, especially those that were endangered species, or of protection of what were assumed to be pristine areas, natural environments unspoiled by man. Neither is the case any longer.

It is now recognized that species within an ecosystem not independent of one another. Interdependency exists at the species and ecosystem level. The concept of ecosystems is that of an interrelated and functioning entity that provides

essential services to its component parts, including humankind, and is in turned interrelated with another ecosystem or other ecosystems, functions and services.

Accordingly, conservation of biodiversity is no longer species driven or focused on "great natural spots". It has been extended to include whole habitats and entire ecosystems – pristine or not. As awareness and understanding of this concept has increased, the complexion of effective conservation measures has changed. It is now recognized that the issues and themes associated with biodiversity conservation are almost as diverse and as interrelated as nature itself. Consequently, a management approach has evolved that better facilitates the conservation of biodiversity – and that approach is integrated ecosystem management.

3.1 The Ecosystem

An ecosystem can be defined as a dynamic complex of animal, plant and microbial communities that interacts with each other and with components of the non-living environment as an integrated functional unit. While emphasis is on function, it is important to recognize that maintenance and functioning of the whole. Ecosystem integrity is important.
Units of size or scale do not clarify this definition. An ecosystem may be a small patch of land, a single coral head, or a pond. Equally, it may encompass an island, a forest, or a complex interconnected system of wetlands.

Interdependency is a key characteristic. It not only exists within the ecosystem at the species level it exists at the ecosystem level itself. These linkages and interactions between different ecosystems may seemingly complicate the concept, but they also clearly illustrate the depth and breadth of the nature of interdependency. An example relative to the Bahamian context is the functional relationship and interdependency between a mangrove forest, an offshore reef and the deep ocean.

Ecosystems can evolve with time in response to perturbations, such as after hurricane or following the introduction of an alien species such as perturbations may be dramatic and long lasting and lead to permanent change, or slight and

Box 3.1
User Conflicts

Biological diversity and its components are a finite natural resource. As a result, the continued growth and development of the economic sectors of The Bahamas will lead to conflicts arising out of the competitive use of natural resources, which will give rise to severe pressure on The Bahamas' regulatory agencies.

Increasing user conflict is now evident in the competitive use of the marine resources by the tourism and commercial fishing sectors, for example in the commercial fishery for the spiny lobster (*Panulirus argus*). With increasing competition for this very high value resource, one can expect an increasing incidence of user conflict and confrontation over time. Further, recreational diving and sports fishing are important components of this sector of the economy. The growth of these industries, along with the growth of the commercial fishing industry, has also led to user conflicts which will escalate as these industries continue to grow. Also, conflict between sports fishermen (in particular bonefishermen) and commercial fishermen, competing for what many consider gamefish resources, is on the increase. The question of how to resolve this conflict, which requires good-will between the interested parties — which is often not present — is a challenging task.

The causes of conflict pertaining to the use of common property issues are imbedded in the social, economic and political environment. For conflict resolution to be successful, policy and management solutions must address that same environment. Thus, conservation of biological diversity and its components is key to the sustainability of fisheries, mariculture, tourism, and other sectors of the Bahamian economy. It hinges on the Bahamian society being able to deal with a very complex problem, and being able to reconcile market forces with the conservation of natural ecosystems.

Solutions lie in development of cross-sector management and research models for testing new concepts, approaches and methods. They also depend on:

Extraction of realistic rent from users of biological resources
The collection of fees for use of biological resources
Realistic penalties for infringements that affect resource sustainability
Establishment of codes of conduct and/or protocols for responsible development and management of living recourses and the environment
Development of contingency plans to deal with potential natural or man-made environmental disasters, and elaboration of mechanisms to resolve conflicts among users of biological resources and the environment
Development of relevant public education and awareness programmes

short-lived, so that the ecosystem soon regains its integrity and functions as before.

Box 3.2
Priority Issues Relevant to Resource Management

The following issues have the potential for serious inter-related conflicts over the allocation and use of natural resources.

Tourism. Very high priority is given by Government to the expansion of tourism, especially in the Family Islands. A clear and transparent strategy and action plan for tourism development is required, including a comprehensive EIA process, monitoring capability, and policies that encourage small-scale, local enterprises.

Land Use. Land is most often allocated according to the principle of "highest and best use". Given the policy for sustainability, there is need to recognize that public benefits — that is, the "common good" — often outweighs private development and profit.

Fisheries And Mariculture. It is clear that the future for fisheries is highly uncertain in view of growing demand for fishery products, and current legislation and enforcement capabilities. Mariculture is being promoted to meet a portion of the demand. A Fisheries and Mariculture Development Plan is needed to address possible conflicts.

Agriculture. Government seeks to accelerate the growth and development of agriculture for import substitution and generation of foreign exchange. Priorities include the control of agricultural imports; protocols for the importation of alien plants and the importation of live plants; land and water use policy; pesticide legislation; plant and animal quarantine facilities; and integrated pest management.

Biomedical Resources. There continue to be significant collections of marine specimens from Bahamian waters by outside institutions seeking bio-medical compounds. Assessment of such resources is required to determine the viability of harvest, and protocols are needed to regulate this bioprospecting.

Housing. Government priority is presently on low-cost housing and other developments in the Family Islands. Guidelines need to be established for land classification and zoning, waste water facilities, and a comprehensive EIA process.

Foreign Investment. It is Government's priority to foster foreign investment aggressively and to reduce the "red-tape" for considering investment proposals. This requires equally accelerated capacity to deal with environmental concerns, especially EIAs, so as to fully address both foreign and domestic investments. In addition an enhanced monitoring capability is needed.

Dredging. Government is promoting investment in marinas and cruising facilities for residents and tourists. The capacity to evaluate and monitor potential impacts of such activities is required, in order to mitigate serious environmental and health problems resulting from habitat alteration and pollution.

Rock and Sand Mining. There will be increasing pressure, in the years ahead, from the Eastern Seaboard States of the United States, for Bahamian sand. Considering this, the Government should seek to determine "sand cells" where commercial extraction is economically viable and environmentally sound.

Flood Control. The Government is currently developing a system of deep-wells to control flooding in low areas of New Providence. Should this prove effective it is likely that this flood control method will be expanded throughout The Bahamas. The long-term effects of deep-well disposal are unknown.

In a few instances, ecosystems are man-dominated. These are socio-economic systems such as agricultural and industrial ecosystems, rural and urban ecosystems, and artificial, transformed and semi-natural ecosystems. Humans are a component part of natural ecosystems and are essential to their function and integriy. The history, culture and well being of The Bahamas are tied, in so many ways, to ecosystems. For centuries Bahamian have benefited from a range of ecological services that have connected the people to biodiversity and biodiversity to the people. Examples are briefly described in Box 1.3.

3.2 Consideration for an Integrated Ecosystem Approach

The integrated ecosystem approach is a strategy based on integrated management of land, water, and living resources so as to promote conservation and sustainable use in an equitable manner. This approach therefore meets three major objectives of the Convention on Biological Diversity.

Perhaps foremost, integrated ecosystem management aims to conserve ecosystem structure, function and the services provided. These are intimately connected. Loss of structure can lead to loss of function and services and can directly impact society. An example is the well-documented service the pine forest ecosystem makes to freshwater quality. Loss of this service would certainly directly impact society. The service could be replaced – by reverse osmosis for example – but at a capital and recurrent cost.

Integrated ecosystem management is based on the application of appropriate scientific methods that recognize and encompass the importance of ecosystem processes and functions and the interactions between organisms. Because of the dynamic nature of ecosystems integrated ecosystem management is adaptive, recognizing that many ecosystem processes are non-linear in their response to interventions and that time lags in responses often occur. This can lead to a seemingly lack of logical sequencing in events or responses, and to uncertainties. Therefore, the precautionary principle – that measures may need to be taken though cause and effect relationships may be poorly understood or not established scientifically – is also an integral part of integrated ecosystem management.

Ecosystems must be managed within their limits of function and not stressed beyond the limits imposed by the environment, or by artificially imposed conditions. The exploitation of one service may impact on other services and adversely affect ecosystem integrity and biodiversity well being, In this regard integrated ecosystem management can be preemptive.

Management objectives often reflect societal choices. However, different societies or sectors of a single society may have different expectations of an ecosystem. Integrated ecosystem management is therefore proactive recognizing there will be user conflicts that must be reconciled. Box 3.1 identifies some of the more obvious user conflicts in The Bahamas, Equally there will be policy conflicts and issues of priority concerning land use and the use of other natural resources. Box 3.2 highlights some of these.

Management activities of one ecosystem may impact adjacent ecosystems. For example, mangrove forest ecosystems function as nurseries for many juvenile scale fish and interact with coral reef ecosystems, which in turn provide habitat for the adult fish. Without a healthy reef ecosystem the adult fish may not reproduce and the mangrove forest's role as a nursery is lost. Agro-ecosystems may rely on the adjacent ecosystems as *refugia* for the parasites and predators of crop pests. An integrated approach brings all these factors into play.

Integrated ecosystem management recognizes that all biodiversity has intrinsic value – value in its own right that is apart from any economic value. All components of an ecosystem have value, both those with a recognized economic value and those with no (apparent) economic value. Mosquitoes may appear to have only nuisance value, but the adults provide food for birds and the larvae food for fish.

Change in ecosystems is inevitable over time. Often the challenge is to distinguish those changes which are inevitable from those which result from man-made perturbations and which may be reversed. Integrated management therefore changes with changes.

In the past there has been a tendency to manage the components of biodiversity as either protected or non-protected, as either "closed" or "open" for consumption. The integrated approach seeks to strike a balance between biodiversity conservation and biodiversity use.

All forms of information are important to integrated ecosystem management, including scientific data and research findings, indigenous and local knowledge, and practical experience. All relevant scientific disciplines are involved and the use of local knowledge in developing plans of action is seen as particularly relevant. Research and monitoring are also essential to integrated management, and accordingly the integrated approach is adaptive and responsive to resulting feedback.

Finally, while a central authority provides information, structure and guidance, and is a major partner in the planning process, integrated ecosystem

management is more effective when local communities and stakeholders are equally involved in the planning and actually take a lead role in implementation.

3.3 Issues

The facets of biodiversity conservation are many and issues cross themes, socio-economic factors, and political boundaries to name a few. Management matters are often made more complex due to the diffused arrangement of environmental portfolios throughout various agencies, and this has been particularly true in The Bahamas. Biodiversity conservation is a cross-sectoral issue and integrated ecosystem management a cross-sectoral strategy. Closer looks at several issues make both apparent.

3.3.1 Natural Resources

Many government agencies share responsibility for the management and/or the development of natural resources, including water, fisheries, coral reefs, forests, biodiversity, game birds, protected areas, agricultural crops and livestock. Lead agencies for each include the Water and Sewerage Corporation, the Departments of Agriculture, Environmental Health Services, and Fisheries, the Bahamas National Trust, the Ministry of Tourism, the Port Department, the Ministry of Public Works and others.

Initiatives to develop partnerships for information acquisition and management have been undertaken individually and largely in an ad hoc manner. At present, no government-wide policy or mechanism for integrated resource management exists. Nor have specific priorities been set to determine which particular resources should take precedence. This has hampered capacity building, resource monitoring, administration, and the filling of widening gaps in knowledge, and forced managers to make decisions under conditions of uncertainty and without an adequate information base on which to act, monitor, and adapt.

3.3.2 The Coastal Zone

It can be effectively argued that the entire Bahamas is coastal zone, that no part of any island is sufficiently distant from the sea as to be totally free of its influence. The need for integrated coastal zone management is therefore especially important, but because of the conflicting demands on the coastal zone it poses particular problems from the viewpoint of conservation. Two examples: managing to avoid degradation while promoting use of beaches, reefs and inshore waters by an increasing number of citizens and tourists; and managing to preserve “windows to the sea” and the storm surge protection service of

dunes in the face of sky-rocketing demands for beachfront property development.

The Land Use Committee formed this year is the first multi-sectoral initiative to address the coastal zone. This issue is so important yet the exemplary work of the Committee has only scratched the surface. A comprehensive land use plan for The Bahamas is needed. Legislation may also be required to provide desired levels of protection and reconcile conflicting uses.

3.4 Parks and Protected Areas

In situ conservation is considered the "pinnacle" of a country's efforts to protect its biodiversity. The existing system of national parks (Table 2.1) encompasses over 321,000 acres, a small fraction of the land and sea area of the Commonwealth of The Bahamas. A 1958 Act of Parliament mandates park and protected area system management and development to the Bahamas National Trust. The Trust's accomplishments in establishing and managing these areas over 40 years have been considerable.

Parks and protected areas can serve several inter-related functions including the conservation of biodiversity, the sustainability of resource use, the maintenance of ecosystem integrity, support for education and training, research on ecosystem functioning, research on repair, capacity building in research and monitoring, and recreation.

Several other agencies are concerned with protected areas. There are several wild bird reserves, under the jurisdiction of the Department of Agriculture. These only provide sanctuary for birds and prohibit hunting; they do not protect the habitat. The latter could easily be remedied by declaring all wild bird reserves "protected areas' under the Agriculture and Fisheries Act.

The Department of Fisheries is exploring the possibility of declaring a number of marine areas "no-take zones", following the example of the Exuma Cays Land and Sea Park. Investigations in the park have suggested that groupers have increased in numbers and are replenishing stocks outside of the park boundaries as a result. Such "no-take" zones can serve as fisheries reserves. The Department of Fisheries is also interested in protecting grouper spawning aggregations.

The Water and Sewerage Corporation are interested in the protection of their well fields, which are primarily forested areas but also serve as conservation areas. Draft Forestry legislation would create large areas of "conservation forest", including areas of mangrove forest, and would also protect a number of blue holes in Andros.

3.3.4 Invasive and Alien Species

Alien species pose a real threat to biodiversity (Box 3.3). While deliberate introductions have a long history, and most of the world's food crops and domestic livestock are introductions, there are now many examples from around the world of introduced species that have wreaked havoc with ecosystems. Both the terrestrial and the marine environments are under threat and small island states are considered most vulnerable.

Living modified organisms (LMOs) are a special category of alien species. Discussions are underway, under the Convention on Biological Diversity, for a Biosafety Protocol to address the matter of the transboundary movement of LMOs.

Ports offer great opportunities for introduction of many alien marine species in ballast water. The demand for exotic pets, and the smuggling of such pets, poses its own particular problems. Similarly, the desire for exotic ornamental plants and the ease with which seeds or cuttings can be smuggled, increase the chances that invasive alien plants will be introduced.

3.3.5 The Bioregional Context

Three broad bioregions exist in The Bahamas and can be defined, based on climate and vegetation. The presence and different characteristics of the bioregions have enormous implications for biodiversity conservation and integrated ecosystem management plans – certainly a case where one size does not fit all.

- The Northern Bioregion: North Andros, New Providence, Grand Bahama and the Abacos from a distinct group, with *Pinus caribea* as the dominant species. These are the so-called pine islands. Rainfall is about 1300 to 1400 mm per year, with May to October the wettest months. Mean temperature rarely exceed 29ºC, usually in July and August, and seldom fall below 20ºC in January and February.

  Large Areas of Abaco, North Andros and Grand Bahama were clear-felled in the 1950's and most pine forests in those islands are now self-sustaining secondary growths. They are largely unmanaged at present. Soils are stony, free draining and alkaline, and by world standards infertile but because of their relatively high rainfall, and the availability of water for irrigation, these islands have been developed for large-scale agriculture. The pine forests of Abaco, Andros and Grand Bahama, cover about 6, 185km^2.

- The Central Bioregion: Cat Island, Eleuthera, Exuma, Long Island and San Salvador are known as the coppice islands, the term coppice referring to the

dense thicket of hardwood vegetation, the result of many decades of harvesting these trees. Rainfall is of the order of 1000 m or less per year with perhaps a bimodal distribution, July and August being a little drier than June or September. Mean temperatures are a little higher than are those in the northern islands. From the perspective of climate South Andros might be considered to fall within this group.

Farming in the Central Bioregion is relatively small-scale, and pothole farming – planting crops, both annuals and perennials, in the pockets of soil large and small that occur in the limestone rock – is commonly practiced. Slash and burn subsistence farming still occurs.

☐ The Southern Region: Acklins, Crooked Island, Great Inagua and Mayaguana are also coppice islands, but the vegetation is often xerophytic and, on the smaller cays, consists of low canopy shrubs. Rainfall is generally not more that 750 mm per year, and may be considerably lower. Hogsty Reef, which lies between Acklins and Great Inagua, receives only about 250 mm of rain per year, which means that two small cays on the reef are essentially desert ecosystems.

In the marine environment, the concept of bioregions, as defined above, does not apply. Much more is known of the biodiversity of the shallow water banks than about the deep ocean. Four important categories of biotype or habitat on shallow banks can be delineated.

☐ Reef Habitat: This includes a variety of reef morphologies, such as barrier, fringing, and patch, but these categories represent a continuum in which each grades almost imperceptibly into the next. These reefs typically include the large massive coral of the genera *Acropora*, *Montastrea*, *Diploria*, and *Meandrina*, and are largely dominated by the stony (scleractinian) corals, though soft corals do occur.

☐ Rock Habitat: This habitat is variously colonized by small, solitary stony corals, soft corals, sponges, and assorted benthic invertebrates and macro algae (particularly *Sargassum*). The rocky substrate locally be covered with a veneer of sediment (giving the false impression of sandy bottom) and occasional patches of the sea-grass *Thalassia*. In certain areas, the rock may be elevated relative to surrounding bottoms, but the lack of large boulder or plate-forming stony corals, the predominance of soft corals or sponges in certain areas, and the low relief most noticeably identify this biotype. Dead, eroded coral reefs are classified as rocky bottom.

☐ Vegetated Habitat: These bottoms are covered with turtle grass (*Thalassia*) on sediments of varying texture and thickness. Other sea-grasses are also

locally abundant and may include shoal grass (*Haludole*) and manatee grass (*Syringodium*). Green macro-algae may also be of local importance. Soft corals and an occasional stony coral may occur spottily throughout the area, especially where small rocky patches interrupt the sediment.

- Unvegetated Habitat: This biotype consists of barren sediments varying in texture and thickness, from calcareous rubble near reef, to calcareous sand or mud. These are rather unstable, shifting bottoms, which inhibit the growth of vegetation.

Two fundamental exercises are important in developing integrated ecosystem management plans that accommodate the bioregional character of The Bahamas. The first if a resource inventory of Bahamian species and ecosystems, including present conditions and functions. The second is a land-use study and plan that would result in a system of allocation for all resources, land and marine.

With respect to inventory, the Land Resources Survey (Little et al., 1997) provided a useful starting point. It covers biogeography, vegetation, rocks, and landforms, shorelines, groundwater, and pine forests. The potential contributions of the National Geographic Information System Unit to the development of an inventory and a land-use study and plan cannot be overstated.

Bioregional planning for integrated ecosystem management requires that partnerships be developed among various components of Central and Local Government and the agencies involved in resource management. This partnership might just be the most important to biodiversity in The Bahamas.

3.4 Global and Regional Issues of National Significance

A number of global and regional issues also bring weight to bear on planning for biodiversity conservation. They further serve to illustrate the cross-sectoral nature of both the issues themselves and integrated management plans to address such.

Global issues that will impact on all countries, including the Commonwealth of The Bahamas, include, *inter alia*, the following:

- World Trade Organization: access to markets and rules of trade, sanitary and phytosanitary regulations.

- Global Climate Change: sea-level rise, temperature rise (global shift of agriculture towards the poles and increase incidences of coral bleaching),

increasing carbon dioxide levels (affect the competitive balance within plant communities).

Regional issues that will impact on all countries of the Wider Caribbean include the following:

- Free Trade Area of The Americas: access to markets.
- Caribbean Environmental Programme: regional initiatives to environmental concerns.
- Small Island Developing States Action Plan: there are multi-sector plans for broad array of environmental issues.
- Immigrants: illegal immigrants and refugees landing on remote and uninhabited cays pose threats to biodiversity.

3.5 Information and Data Management

Decision-making and the development of integrated ecosystem management plans are dependent on information and data management. However, information is not always available in advance of decisions that need to be made. Because of this it is important to recognize that decisions can and often have to be made based on incomplete information, so there can be an element of uncertainty. A system of information acquisition and data management can minimize the uncertainty and ensure a standard of quality in the information it delivers.

There are two sources of biodiversity information under the terms of the Convention on Biological Diversity that have been produced in The Bahamas.

The Bahamas Biodiversity Country Study was undertaken initially in 1992, and was the first compilation of the available knowledge of Bahamian biodiversity ever attempted. It was revised in 1995 (Bahamas Environment, Science, and Technology Commission, 1995), to confirm guidelines issued by the Convention on Biological Diversity Secretariat. The Study contains sections on Bahamian geography, climate, socioeconomic factors, taxa and ecosystems, agency responsibilities, legislation and agreements, major biodiversity issues, and proposed measures for conservation.

The second initiative was the Bahamas Data Management Project. The Project's Final Report (1997) sets out the objective – all of which were met – as follows:

- ☐ To prepare a data management plan to provide for the efficient management of data and information in support of policy development for natural resources, biodiversity, and implementation of the Convention on Biological Diversity.

- ☐ To undertake an institutional survey of existing capacity for effective biodiversity data and information management and to assess needs to enhance institutional capacity.

- ☐ To develop a comprehensive computerized bibliographic database to facilitate access to the scientific literature.

- ☐ To develop a database to identify individual authorities on the natural resources of the Commonwealth of The Bahamas.

- ☐ To develop a metadatabase (= directory) to provide access to sources of data and information on the natural resources of the Commonwealth of The Bahamas

- ☐ To develop an electronic communications system to facilitate biodiversity data flow among Bahamian institutions.

Monitoring is a critical component of data acquisition and management. Properly conducted monitoring provides new information that can assist in designing mitigating actions to correct mistakes and to devise new strategies and actions.

Box 3.3
Alien and Invasive Species

Aliens are non-native organisms. ***Invasives*** may or may not be native, but are aggressive species that "take over" ecosystems, especially following an environmental disturbance. The consequences can be far-reaching and expensive--and difficult--to correct.

Deliberate introduction of plants and animals from one country to another has a long history. Most major food crops are introductions. However, many deliberate introductions have become "nuisances" in their new country. In other instances introductions have been accidental. Rats and mice, snakes and mongooses, many insects and many plants, are examples of "accidental" aliens that have become rodent or insect pests, weeds, or vectors of human disease, or that have displaced native animals and plants.

In The Bahamas, alien plants have been introduced with little control — and a few by accident — mainly by gardeners and horticulturists. Several are now recognised as serious threats to natural ecosystems and to biodiversity. Tree species, such as *Casuarina, Melaleuca* and *Schinus*, are aggressive invaders of forests, wetlands and disturbed or open sites, displacing native plant species.

Domestic animals — horses, donkeys, pigs, dogs and cats — were introduced to The Bahamas many years ago. These all have major impacts on native species of both plants and animals, particularly if they are allowed to roam free, or where they become feral (go wild).

Alien insects may have an important role to play as biocontrol agents. Should the hibiscus mealy bug *(Maconellicoccus hirsutus*), formerly known as the pink mealy bug, invade The Bahamas, it is likely that a parasitic wasp from China (*Anagyrus kamali*), and two alien coccinelids (*Cryptolaemus montrouzieri* and *Scymnus coccivora*), will be introduced for its control. Biocontrol agents may also be needed to control the brown citrus aphid (*Toxoptera citricidus*) and the root weevil (*Diaprepes abbreviatus*) — currently causing great concern in Florida — should the latter reach The Bahamas.

Introduced ornamentals have perhaps the greatest potential for the invasion of natural habitats — as evident from the large number of invasive alien plants in Florida. Alien animals are restrained in enclosures, whereas plants are generally grown in the open where seeds or fruits can be wind-blown or carried by birds or animals to new habitats.

The introduction of alien aquatic species — especially of fish — to aquaria, can also pose problems. Water is taken from the open sea, passed through the various holding facilities, and pumped back to the sea. This poses high risks for the introduction of alien species to the wild, particularly of species producing large numbers of pelagic eggs. If there is an extended planktonic larval stage, the escapees could well become distributed over a large area, to compete with (or feed on) native fish and other marine species. Similarly there are risks of the escape to the sea of introduced fish and shrimp species from mariculture facilities. Although the hatchery facility may be a closed system, there are still high risks of accidental introduction to the wild.

The Grand Bahama container port is a high risk area for the accidental introduction of alien marine species from vessel fouling and ballast water, which may introduce predators or parasites of native marine species, or which may compete with commercial fish species for food.

Not only does ballast water pose problems for fisheries, but it can also pose human health risks through the introduction of bacteria and viruses. This, in turn, creates risks for the dive industry and for tourism. The containers themselves may also carry "hitch-hiker" insects, spiders, snails, and possibly snakes and other animals, that may escape and become established on-shore. This may pose a threat to native biodiversity and to agriculture.

Living modified organisms also pose a threat to native species and to ecosystems in the same way as do alien organisms, and they can therefore be regarded as a class of aliens. Examples of genetically modified plants are crop varieties that have genes for resistance to a specific herbicide, or that incorporate the *Bacillus thuringiensis* (Bt) genes to manufacture an insect toxin. The widespread cultivation of crops with Bt genes could lead to the development of insect resistance to the toxin. This would require farmers to revert to chemical sprays — with consequent damage to non-target insects, water supplies and other resources.

In addition, there is the risk of gene escape into native plant populations by horizontal transfer, possibly leading to the creation of novel "transgenics" with undesirable characteristics. Of particular concern is the transfer of genes for herbicide resistance to wild —and possibly weedy — relatives of crop plants. These transgenics could become serious weeds. There is much less experience with the release of genetically modified animals.

The question of "biosafety" — the safe handling and testing of genetically modified organisms--is currently an important issue. It is clear that internationally agreed protocols and codes of conduct, supported by national legislation, are needed to regulate the introduction and testing of alien plants, animals and micro-organism into countries, in order to protect native species and ecosystems.

The United Nations Food and Agriculture Organization has already developed guidelines for the introduction of alien biocontrol agents. The Conference of the Parties to the Convention on Biological Diversity recommend a precautionary approach to the introduction of all aliens and genetically modified organisms, but discussions on a legally binding biosafety agreement continue. Risk assessments should be mandatory for all deliberate introductions.

4 Chapter Four
Recommendations

In short, for every kind of organism that we lose because of our indifference or lack of attention, we deny our children the ability to enrich and improve their lives by using those organisms as elements in their management of the global ecosystem.

Peter H. Raven, National Audubon Society, Washington, 1987.

The Recommendations of National Biodiversity Strategy and Action Plan follow the integrated ecosystem management approach to biodiversity conservation. The Recommendations also address other pressing national needs, most specifically the need for bioregiional planning and biodiversity education and communication.
What emerges therefore are Recommendations that pave the way for integrated bioregional planning and management, as well as education and communication initiatives that are key to success.

Integrated bioregional planning and management ensure both appropriate conservation measures for sustainable use and appropriate development, properly regulated. What is "good" and "appropriate" for the northern Bahamas might not be "good" or "appropriate" for the Central and Southern Bahamas. The bioregional context in planning and management is critical.

Education and communication are cornerstones in successful strategic plans. Inherent in each recommendation is the need for education and communication. Efforts must target decision-makers, government officials, the business community, the tourism industry, the general public and the country's youth. Education and communication are aimed not only at increasing awareness and understanding but also at promoting involvement in the process and creating the conditions for natural "buy-in"

The Recommendations help the Nation to define the following:

- ☐ What comprises Bahamian biological diversity?
- ☐ Is biodiversity important to the financial and social well being of the Nation?
- ☐ Does biodiversity contribute towards economic and social sustainability?
- ☐ What must the Nation do to achieve its goal of sustainability?

4.2 Conservation of Natural Resources

The Convention of Biological Diversity stresses conservation of the total portfolio of biological diversity and the maintenance of the structure and function of ecosystems. Therefore it is recommended that:

4.2.1 An inventory be taken and a determination be made of which Bahamian ecosystems and species are most at risk in order to determine priorities for conservation and protection, utilizing appropriate technologies (such as satellite imagery, GIS and others).

4.2.2 A comprehensive national system of parks, protected areas and reserves be developed for the conservation of biodiversity, including:

- ☐ further development of guidelines for the selection of areas
- ☐ further development of management plans for all protected areas
- ☐ strengthening of legislation of Bahamas National Trust Act to more effectively protect national parks and protected areas
- ☐ strengthening institutional capacities of Bahamas National Trust

4.2.3. Regulatory and enforcement measures be developed to ensure continued and sustained management of natural resources biodiversity and to safeguard critical ecosystems.

4.2.4 Breeding aggregations of species of commercial, recreational, sport, and aesthetic value, be effectively managed to ensure sustainability.

4.2.5 Protocols controlling the importation and evaluation of alien and invasive species, and of genetically modified organisms be developed, to include:

- ☐ risk analysis of alien species and of living modified organisms
- ☐ management of useful alien and genetically modified organisms
- ☐ contingency plans for the control and eradication of invasive alien and genetically modified organisms

4.2.6 Plant and animal genetic resources for food and agriculture be conserved, using *in-situ* and *ex-situ* methods, based on modern technologies.

4.2.7 The National Herbarium be properly housed and curated, and other national natural history collections be established.

4.3 Sustainable Use of Natural Resources

The Convention on Biological Diversity stresses the sustainability of resource use. It is important to determine which Bahamian resources are in danger of depletion, and which ecosystems are under threat of degradation. It is recommended that:

4.3.1 Sustainable use of natural resources be fully integrated with national policy planning, to ensure the most effective use of these resources.

4.3.2 A comprehensive plan for sustainable agriculture be developed including:

☐ conservation and improvement of agricultural soils
☐ programmes of integrated pest management
☐ agricultural systems that are environmentally-friendly
☐ evaluation and adoption of new product technologies

4.3.3 A National Fisheries Development Plan be implemented to maintain and enhance the productivity and biodiversity of Bahamian fisheries, through:

☐ allocation of fishery resources according to limited entry, property rights and zoning
☐ establishment of appropriate fisheries protected areas
☐ conservation and restoration of coastal habitats and wetlands important to fisheries recruitment and to the health of fringing reefs
☐ evaluation and adoption of appropriate new fisheries resources and technologies, including mariculture

4.3.4 A National Forestry Development Programme for sustainable management of all forest resources be developed and implemented including:

☐ establishment of a permanent forest estate
☐ design and implementation of appropriate management strategies
☐ development of sustainable resource utilization plans
☐ forest resource assessment and continuous monitoring
☐ an inventory of mangrove forest and their resources

4.3.5 A comprehensive Integrated Water Resources Management Plan, that includes all forms and uses of water, be developed, including:

☐ consideration of the needs of all living organisms in a healthy environment
☐ discouraging wasteful practices
☐ management of water resources for agriculture
☐ strengthening of regulatory and institutional arrangements
☐ expansion of waste water and waste disposal facilities for ecosystem preservation and prevention of water pollution

4.3.6 The use of native trees and shrubs in landscaping be encouraged, and the importation of alien plant species be discouraged.

4.3.7 A national plan for sustainable tourism and ecotourism be implemented.

4.4 Science and Technology

A comprehensive policy and programme for science and teechnology are essential to the future of The Bahamas in many respects , especially in regard to assessing and monitoring natural resources and their sustainable use. Therefore, it is recommended that:

4.4.1 A Science and Technology Council be appointed, under the aegis of The Bahamas Environment, Science and Technology Commission, to define a National Science and Technology Policy and to develop research goals and objectives.

4.4.2 A research and monitoring programme, aimed primarily at the conservation and sustainable use of biodiversity, be designed and implemented.

4.4.3 A natural resource inventory for The Bahamas be compiled, to form the basis for on-going monitoring.

4.4.4 Training programmes to enhance national science and technology capability be developed.

4.4.5 The Bahamas Natural Resource Bibliography, developed by the Biodiversity Data Management Project, be maintained and managed by the Bahamas Environment, Science and Technology Commission as a primary resource for research and training in The Bahamas as well as world-wide.

4.4.6 The Bahamas National Geographic Information System Project incorporates natural resource assessment and planning.

4.4.7 The Bahamas Government develops co-operative agreements with other nations, particularly in the Caribbean, for capacity building and information exchange in the area of biodiversity.

4.5 Public Education and Awareness

The acquisition and dissemination of information is critical to the development of public awareness and sensitivity to the fragility of Bahamian ecosystems and the repercussions and/or losses to biodiversity experiences when ecosystem are disrupted, damaged or destroyed. It is important that all forms of media and educational tools be employed to inform the Bahamian public. Therefore, it is recommended that:

4.5.1 Appropriate emphasis on environmental issues is placed in the curricula of primary, secondary and tertiary level educational institutions. This would include:

- ☐ designation of a lead agency to spearhead and coordinate the programme
- ☐ identification of partners to assist with development and implementation

- ☐ participation and recognition of the concerns of youth
- ☐ development and implementation of mechanisms to improve information exchange and communication capacity, especially within the formal education and decision-making communities.

4.5.2 Teacher training in key areas of environmental studies be supported and facilitated.

4.5.3 Appropriate use of print and electronic media in the dissemination of environmental information is developed.

4.5.4 A system to address the concerns of key sectors of the community through the sponsoring of workshops, seminars, and public lectures be developed and implemented.

4.6 Social Issues

Sustainability of the environment and of its resources cannot be achieved without a sustainable and healthy society, as the Vision of "Strong Nation Rooted in a Healthy Environment" makes clear. Society at large must be integrated into the planning and management process. Therefore it is recommended that:

4.6.1 Youth be provided with opportunities for participation in the planning and implementation of biodiversity conservation programmes.

4.6.2 The question of solid waste management is being addressed by an Inter-American Development Bank loan but attention needs to be given to other forms of waste and pollution, and minimizing littering.

4.7 Financial Resources and Mechanisms

Bahamian society, its economy and standard of living depend on the environment and its resources, but there are few mechanisms to ensure that the necessary financial resources to maintain the environment are assured. Therefore, it is recommended that:

4.7.1 A National Conservation Fund be established for biodiversity conservation.

4.7.2 A user-pays policy be defined, legislated and introduced.

4.7.3 Appropriate national resources for the implementation of this Strategy and Action Plan be determined and committed as appropriate.

4.7.4 External multi-lateral, bi-lateral and private sector sources of financial and other support for the implementation of this Strategy and Action Plan be identified and secured.

4.7.5 National decision-making procedures that incorporate environmental accounting and cost-benefit analysis be developed and adopted.

4.8 National Consultative Process

The archipelagic nature of The Bahamas, the dispersed human settlements, and the diversity of ecosystems, present enormous challenges for full participation in the development of detailed actions plans for conservation and sustainable use of biodiversity. Therefore, it is recommended that:

4.8.1 A series of workshops be convened with stakeholders to define priorities for biodiversity conservation and sustainable use, and to further develop specific actions. In recognizing that implementation of this recommendation comprises preparation, presentation and follow-up the following are included:

- ☐ preparation of multimedia presentations on the "state of knowledge" of Bahamian biodiversity
- ☐ employment and introduction of Geographic Information Systems technology
- ☐ preparation and circulation of position papers on biodiversity and biodiversity issues.

4.8.3 Public participation and support for this Strategy and Action Plan be nurtured and encouraged by means of radio, television, newspapers, town meetings and other appropriate mechanisms.

4.8.4 The full participation of Local Government be assured by means of a series of workshops and other appropriate mechanisms.

5 Chapter Five
The Action Plan

Biological conservation, if it is to be successful, has to be spread effectively over the entire landscape.

D. H. M. Cumming, speech, Conservation 2100 Symposium, 1986.

5.1 The Action Plan

At the national level the Action Plan begins with a National Consultative Process. A series of consultations or workshops will be held at locations throughout the country — in the Family Islands as well as in New Providence — with representatives of all the major stakeholders and other interested parties. The archipelagic and bioregional nature of The Bahamas makes such a process essential if the protection of species and ecosystems is to receive the support of the community at large and of local communities in particular.

Participants in the National Consultative Process will include, *inter alia*, farmers, fishermen, handicraft workers, residents, local government officials, non-governmental organizations, ecotourism operators, relevant Government Ministries, the business and commercial sector, and other concerned and interested parties.

Two actions, however, must precede the National Consultative Process. The first is the Bahamas Environment Science and Technology Commission as a legal entity. The Commission is currently mandated to be the coordinating hub and focal point for all environmental activities within The Bahamas and for international agreements and conventions concerning the environment. Its establishment as a legal entity, fully-mandated and strengthened, are seen as critical to continued success and, in the present context, essential to the country's ability to fulfill its obligations under the Convention on Biological Diversity and to execute the National Biodiversity Strategy and Action Plan.

A second action, also essential to the success of the Action Plan, is the formation, within the Commission, of a National Biodiversity Task Force to, *inter alia*, prepare for and conduct the National Consultative Process and the follow-up that will be required.

The Action Plan was prepared following four particular principles. The first is flexibility. This allows for the Action Plan to be modified and adapted as appropriate, and can be sensitive to the needs of critical species and ecosystems. Secondly, it is intended that the Action Plan be consultative at all times, so that concerned parties and stakeholders are full participants not only in the planning process, but also in the implementation of specific actions and activities. The third principle is coordination. The National Biodiversity Task Force should be charged with preparing for and conducting the consultative process; collating the results; developing procedures; setting targets; assigning responsibilities; monitoring progress in implementation; and modifying Actions as appropriate. The fourth principle speaks for itself: the Action Plan must be a living document.

The following five actions have been developed, with indicative budgets, and are regarded is prerequisites to the development of specific Actions designed to conserve the biodiversity of The Bahamas. Some are already underway and, though Action 1 is a priority, others Actions can commence, or continue, pending completion of Action 1. Start dates are given in quarters (3-month blocks) beginning from the formal start-up time of implementation.

5.1 Action One: Establishment of the Bahamas Environment, Science and Technology Commission as a legal entity.

Lead Agency: The Bahamas Environment, Science, and Technology Commission.
Start Date: 1st quarter, 1999[1]
Duration: 24 months
Budget: $798,400
Funding sources: Government of The Bahamas; Inter-American Development Bank

5.1.1 Objectives:

- ☐ To establish the Bahamas Environment, Science and Technology Commission as a legal entity charged with the coordination of environmental protection in The Bahamas.
- ☐ To determine the staffing needs of the Commission to enable it to carry out its mandate responsibilities.
- ☐ To ensure, through a Cabinet Decision, that Government Departments are fully supportive of the work of the Commission, and that they contribute to its work through the assignment of staff as required.

Table 5.1
Action One Indicative Budget

Categories[2]	**Phase 1**[3]	**Phase 2**
Environmental policy review		
Review of Information Management Systems		
Design of EIA guidelines and procedures		
Review of staffing requirements and training		
Institutional assessment and recommendations		
Refinement of EIA guidelines and procedures		
Preparaton of quality control programme		
Totals	**102, 700**	**686,700**

[2]It is impossible to de-aggregate budget costs for individual categories or the Inter-American Development Bank funding. The toatl for Phase 1 is the amount budgeted by the IDB. The total for Phase 2 is made up of $565,2000 provided by IDM and $123,500 counterpart funding from the Government of The Bahamas.

[3] Phase 1 is scheduled to last 6 months and complete the first four activity categories. Phase 2 is scheduled to last 18 months and complete the remaining activity categories.

[1] This marks the date of the signing of the contract and the start of the process of selection of consultants. Implementation is expected to begin in the 1st quarter, 2000

5.1.2 Activities:

- ☐ A review of current national environmental policies and the drafting of new policies where necessary, including an overall Sustainable Development Policy for The Bahamas
- ☐ A review of existing information management systems for environmental matters, with recommendations for the hardware and software needed, and the framework for the improvement of the system.
- ☐ Design of interim Environmental Impact Assessment guidelines and procedures.
- ☐ A review of the staffing requirements of the Best Commission to enable it to fulfil its mandate, with draft job descriptions for environmental specialists and project officers.
- ☐ An institutional assessment of the BEST Commission and of other agencies involved in environmental management.
- ☐ Refinement of Environmental Impact Assessment guidelines and procedures, their review by private and public sector entities, and their adoption
- ☐ The development of a long-term financial plan for the Commission
- ☐ Preparation of a quality control programme for the Commission and other agencies with environmental responsibilities.

5.1.3 Comments

Implementation will be organized into two work phases over a 18-month period.

5.2 Action Two: Establishment of the National Biodiversity Task Force and Preparation for National Consultative Process.

Lead Agency: The Bahamas Environment, Science and Technology Commission
Start Date: To follow approval of the National Biodiversity Strategy and Action Plan
Duration: 18 months
Estimated Cost: $217,250
Funding sources: To be determined.

Table 5.2
Action Two Indicative Budget

Categories	0-12[1] months	12-18 months
Appointment of Chief Scientific Officer[2]	40,000	20,000
Appointment of Support Staff[3]	65,000	32,500
Appointment of Consultant(s)	40,000	
Contingencies (10%)	14, 500	5,250
Totals	**159,500**	**57, 750**

1 Indicates months into project.
2 This is inteded to be a permanent appointment and it could be one of the appointments made under Action One.
3 These could be made under Action One.
4 These consultants would be expected to complete their assignments in no more than six months.

5.2.1 Justification

A National Biodiversity Strategy and Action Plan can be implemented in The Bahamas only with the full understanding, support and participation of local communities and stakeholders. A National Consultative Process is therefore critical to the ultimate development and implementation of the Action Plan, and will determine the specifics of which species, ecosystems and locations are targeted for conservation activities.

To be successful, the National Consultative Process must be properly planned, with island-specific information available to stakeholders in order that they may make informed decisions. Thorough preparatory work is essential to ensure the recommendations arising from the process are based on sound information.

5.2.2 Objectives

- ☐ To establish a multidisciplinary National Biodiversity Task Force of professionals from relevant governmental and non-governmental agencies, with adequate support.
- ☐ To prepare for, and to conduct, the National Consultative Process.
- ☐ To compile, based on the outputs of the National Consultative Process, a detailed Action Plan, focussed on species and ecosystems.

5.2.3 Activities

- ☐ Appointment of adequate qualified staff to the Commission, with support staff and facilities. One or more of these appointments may have been made under Action One.
- ☐ Appointment of consultants to guide the Task Force on communications, on the preparation of materials, on the format of the consultations, and the process of consultation.

5.2.4 Partners

Department of Local Government, Department of Agriculture, Department of Fisheries, Department of Lands and Surveys, Department of Local Government, Department of Education, College of The Bahamas, Bahamas National Trust, Ministry of Finance, Water and Sewerage Corporation, other non-governmental organizations, and relevant regional and international organizations.

5.3 Action Three: The National Consultative Process

Lead Agency: BEST Commission
Start Date: Six months after the start of Action Two
Duration: 21 months
Estimated Cost: $639,100
Funding sources: To be determined.

5.3.1 Objectives

- ☐ To create an awareness among citizens and residents of The Bahamas of the value of biodiversity to the economy and to societal well-being, and of their individual and collective responsibilities under the Convention on Biological Diversity.
- ☐ To integrate and involve local communities and stakeholders in the planning process and in the implementation of Action Plan Activities at the species and ecosystem levels.

Table 5.3
Action Three Indicative Budget

Categories	**0-12**	**12-24**[1]
Consultancies	90,000	45,000
Public awareness materials	100,000	80,000
Educational materials for schools	20,000	70,000
Equipment	4,500	1,500
Conduct of national consultations[2]	40,000	100,000
Preparation of national action plan		30,000
Contingencies (10%)	21,450	36,650
Totals	**235,950**	**403,150**

[1] Indicates months into project.

[2] Assumes 160 person-days (10 consultations; 4 facilitators per consultation; 4 days per consultation) plus travel and per diem for some participants, and refreshments)

5.3.2 Justification

The informed participation of the all sectors of the community is essential if the Action Plan is to be implemented successfully. Activities must be implemented at the community level, and must involve the local communities as stakeholders: this can be done only if there is awareness and participation in the planning process through the National Consultative Process, but there must be a continuing process of consultation.

5.3.3 Activities

- ☐ Development, by the Coordinating Group, of a structured public awareness and education campaign: this will require media consultants.
- ☐ Preparation and production of materials for the above. This requires media consultants.
- ☐ Preparation and production of teaching materials for primary and secondary schools: the Department of Education to the lead agency.
- ☐ The preparation of materials for the National Consultative Process in communities throughout The Bahamas.
- ☐ The conduct of the National Consultations, and analysis and collation of the outputs as the basis for an Action Plan.

5.3.4 Partners

Department of Local Government, Department of Agriculture, Department of Fisheries, Department of Lands and Surveys, Department of Local Government, Department of Education, College of The Bahamas, Bahamas National Trust, Ministry of Finance, Water and Sewerage Corporation, other non-governmental organizations, and relevant international and regional organizations.

5.3.5 Comments

The National Consultations are intended, *inter alia*, to develop consensus on:

- ☐ Vision and Mission Statements
- ☐ Conservation and management of biodiversity
- ☐ Guidelines and criteria for prioritizing, and consensus on priorities at local, regional and national levels
- ☐ Monitoring and operational endpoints
- ☐ Time schedules and partnerships

The Consultations are not intended to address technical matters. Conflict resolution will be needed to address disagreements between communities and between local and central government.

It is envisaged that the public awareness component will begin in the first quarter and preparatory work for the consultative process will require at least six months. Therefore, the National Consultations Process will not begin until the last quarter of the first year. It will continue in full throughout the second year. Final compilation of the Action Plan to conserve species and ecosystems should be completed by the mid-way mark. However, it is intended that activities at the local level can begin as soon as outline plans and partnerships have been agreed upon.

5.4 Action Four: Implementation of the Recommendations of the Biodiversity Data Management Project

Lead Agency: The Bahamas Environment, Science, and Technology Commission
Start Date: Six months after the start of Action Two
Duration: 24 month
Estimated Cost: $639, 100
Funding sources: To be determined

5.4.1 Objectives

To "operationalize" the Bahamas National Biodiversity Management Project, according to the proposed plan of action, by:

- ☐ Putting the bibliographic database and the metadatabase (which are already extant as outputs of the completed BDM Project) "on-line".
- ☐ Producing the bibliographic database and metadatabase on CD-ROMs.
- ☐ Effectively managing and up-dating these databases on a continuing basis.

☐ Improving inter-agency communication within The Bahamas.

Box 5.4
Action Four Indicative Budget

Categories	0-12	12-24[1]
Creation of Home Page	8,000	3,000
Procurement of equipment[2]	20,000	5,000
Communication charges	2,500	5,000
Appointment of Information Manager[3]	17,500	35,000
Materials	10,000	7,500
Contingencies (10%)	5,800	5,550
Totals	**63,800**	**61,050**

[1] Indicates months into project.

[2] Includes a server and CD-ROM Reader/Writer: some of the necessary equipment is already in place.

[3] Appointment expected before the end of 1999. It is assumed that data managers within agencies (partners) will be appointed from within those agencies and are not therfore a charge to the project.

5.4.2 Justification:

The Bahamas was one of ten countries that participated in a UNEP Project, funded by the Global Environmental Facility on Biodiversity Data Management Capacitation in Developing Countries and Networking Biodiversity Information.

This project was completed in late-1997, and as outputs produced a bibliographic database and a metadatabase. Now, these need both to be made available to individuals and institutions within and outside The Bahamas and be properly managed. This action will also improve communications within The Bahamas and facilitate access to information by decision- and policy-makers.

This project complies with the Convention on Biological Diversity which requires that scientific information relating to biodiversity be made freely available, subject only to protocols on data access.

5.4.3 Activities

☐ Creation of a Home Page on the World Wide Web.
☐ Procurement of the necessary computer equipment to provide an on-line service and of equipment to produce CD-ROMs.
☐ Appointment of an Information Manager to manage and update the bibliographic and metadatabases.
☐ Appointment of data managers within partner agencies to liaise with the Information Manager.

5.4.4 Partners

Department of Local Government, Department of Agriculture, Department of Fisheries, Department of Lands and Surveys, Department of Local Government, Department of Education, College of The Bahamas, Bahamas National Trust, Ministry of Finance, Water and Sewerage Corporation, other non-governmental organizations. and relevant international and regional organizations.

5.5 Action Five: Preparation of Bioregional Guidelines, Position Papers and Policy Statements

Lead Agency: The Bahamas Environment, Science and Technology Commission
Start Date: Late 2000
Duration: 24 months
Estimated Cost: $363,000
Funding sources: Inter-American Development Bank and to be determined.

5.5.1 Objectives

- ☐ To prepare statements on bioregions, on major ecosystems, and on critical species in The Bahamas.
- ☐ To prepare statements on the role of the agriculture, fisheries and forestry sectors in conservation biodiversity.
- ☐ To prepare guidelines for Environmental Impact Assessments (EIAs).

Table 5.5
Action Five Indicative Budget

Categories	**0-12**	**12-24**[1]
Preparation of outlines[2]	40,000	40,000
Consultancies[3]	100,000	50,000
Travel costs[4]	70,000	5,000
Publication costs[5]	20,000	10,000
Contingencies (10%)	23,000	10,000
Totals	**253,000**	**110,000**

[1] Indicates months into projects

[2] Assumes consultancy costs plus interactive workshop with lead and collaborating authors.

[3] The number of consultancies and their cost cannot be reliably determined until further details are available.

[4] Assumes 15 trips (2 weeks duration, for 2 persons).

[5] Assumes a limited number of copies, well illustrate, in-house publishing.

5.5.2 Justification

Whilst much is known about the biodiversity of The Bahamas, the information needs to be systematically and uniformly analyzed and summarized, with sustainable management options clearly defined. Such documents will provide the scientific baselines to determine, *inter alia*, priorities for monitoring, keystone species and habitats, threats and constraints to sustainable use, and management policy options. They are viewed as living documents, to be revised as information becomes available. These documents will also enable gaps in the protected area coverage of ecosystems and species to be filled, and provide a basis for a NPPA System and for land use planning.

5.5.3 Activities

- ☐ Preparation of outlines of statements: a consultant will be required.
- ☐ Appointment of lead authors for bioregions, ecosystems and groups of ecosystems, and selecting of collaborating and contributing authors.
- ☐ Publication of statements.

5.5.4 Comments

It is assumed that some field work may be necessary and provision has been made in the indicative budget for limited field work. It is also assumed that staff from partners agencies will be assigned to work on these guidelines, statements and position papers. It is assumed that the direct costs for preparation of the EIA guidelines will be borne by the IDB Project, but that the Commission and staff of relevant agencies will make inputs into the process of developing the EIA guidelines.

5.5.5 Partners

Department of Local Government, Department of Agriculture, Department of Fisheries, Department of Lands and Surveys, Department of Local Government, Department of Education, College of The Bahamas, Bahamas National Trust, Ministry of Finance, Water and Sewerage Corporation, other non-governmental organizations, and relevant regional and international organizations.

While the above specific activities have been planned in some details, including indicative budgets, other actions in the Action Plan must await the outputs of the National Consultative Process before detailed planning can be completed. The following are seen as possible future activities. No specific order of implementation is implied.

5.6 Action Six: Planning for a System of National Parks and Protected Areas

Lead Agency: Office of the Prime Minster

5.6.1 Objectives

☐ To expand the system of National Parks to include representative areas of ecosystems and habitats that are either unique to The Bahamas, or threatened, and not presently represented.
☐ To prepare management plans for all proposed National parks, including projected budgets.
☐ To use where appropriate other legal instruments to provide protection to species or ecosystems.
☐ To strengthen legislation for the Bahamas National Trust to more effectively protect parks and protected areas
☐ To strengthen institutional capabilities of the Bahamas National Trust to meet responsibilities with existing and expanded parks and protected areas.

5.6.2 Justification

The present system of National Parks is recognized as incomplete, with important Bahamian ecosystems under-represented or not represented. This needs to be corrected, and the system extended.

The draft Forestry Act would provide protection for many areas of forest, including mangrove forest and blue holes. In addition wild bird reserves can be declared, and protected areas (for plants) can be designated.

5.6.2 Activities

☐ Review and updating of existing documents and information on proposed National Parks with additions as appropriate.
☐ Review existing wild bird reserves with a view to amending and the designation of new reserves.
☐ Designate some or all existing wild bird reserves as protected areas to provide protection for the habitat.

5.6.3 Comments

The Bahamas National Trust has already prepared as document proposing a number of additional National Parks, with map grid references, descriptions and justification.

5.7 Action Seven: Development of Monitoring and Evaluation Methodologies

Lead Agency: The Bahamas Environment, Science and Technology Commission

5.7.1 Objectives

- ☐ To develop scientifically sound methods for monitoring and evaluating ecosystems and species abundance.
- ☐ To develop methods of data handling, storage and transfer to be used by all agencies working in the area of biodiversity.
- ☐ To train Bahamians in monitoring and evaluation.

5.7.2 Justification

Monitoring becomes important whenever there is any degree of uncertainty — which is nearly always the case in the environmental sciences. Data need to be comparable over time, and spatially, if it is to used for long-term monitoring and to determine choice of sites. Methodologies must conform to international standards. The College of The Bahamas will be an important collaborator.

5.7.3 Activities

- ☐ Review of methods of monitoring the status of species and ecosystems
- ☐ Field testing of monitoring methods and of data collection and storage procedures.
- ☐ Training of Bahamians.

5.7.4 Comments

Global Biodiversity Assessment, Edited by V. H. Heywood, Cambridge University Press (0 521 56481 6) provides a useful starting point.

5.8 Action Eight: Protection or Rehabilitation of Threatened or Degraded Ecosystems and of Threatened Species

5.8.1 Objectives

- ☐ To identify specific ecosystems and species that are threatened or already degraded.
- ☐ To determine the possibility of rehabilitating or restoring such ecosystems location by location.

- ☐ To prepare develop methodologies and action plans for the rehabilitation and restoration of specific high priority sites and species
- ☐ To protect designated species of plant or animal, presently considered threatened, from further declines in number
- ☐ To increase numbers by enhancing populations in existing habitats, or by stocking new habitats.

5.8.2 Justification

Ecosystems can be degraded in many ways as a result of human activity, with the total or partial loss of ecosystem function or ecosystem integrity, and of component species. At least some degraded ecosystems can be restored by removal of the causes of degradation and by positive restorative actions. At present there are instances of eutrophication of surface waters as a result of farming or other human activities.

Declines in the population of species (and sub-species) of plants and animals has occurred as a result of habitat fragmentation, pollution, encroachment into habitats, and poaching and smuggling for sale as pets or as potted plants. Protection of the most threatened species therefore becomes necessary.

5.8.3 Activities

- ☐ Literature searches on restorative methodologies for threatened or degraded ecosystems, and evaluation of appropriate methodologies.
- ☐ Literature searches for experiences with the protection and rehabilitation of the same species or related species, to those threatened in The Bahamas
- ☐ Enactment of legislation and enforcement or regulations to prevent further destruction of degradation of threatened or endangered ecosystems and species.

5.8.4 Comments

Selection of appropriate methodologies for restoration of population numbers of threatened species might include: the captive breeding and release of animals and birds; the *ex situ* raising of seedlings or cuttings or of tissue culture plantlets) for transplanting into suitable habitats; control of predators and parasites of animals and plants; relocation of animals and birds to "new" sites. The control of rats has already been evaluated on a Bahamian cay in order to protect a unique and endemic sub-species of rock iguana. The introduction o improved environmental impact assessment guidelines should contribute to better protection of threatened ecosystems.

5.9 Action Nine: Improvement of the Botanic Gardens to Enhance its Capacity for *Ex Situ* Conservation.

Lead Agency: The Department of Agriculture

5.9.1 Objectives

- To establish and maintain living collections of the Bahamian flora, especially of endemic and rare species.
- To establish a seed bank for plant species to include landraces of crops from all agro-ecological zones of The Bahamas.
- To develop the capacity to propagate and maintain by tissue culture, those species which do not produce seed or that have recalcitrant seed.
- In collaboration with the Bahamas National Trust and the College of The Bahamas, to continue to add to the National Herbarium which is located in the Botanic Gardens

5.9.2 Justification

While the Botanic Gardens does have many Bahamian plants in its collection, a more systematic collection is needed including representatives of the rarer species. Seed and tissue culture collections will provide a valuable back-up resources and provide materials for research.

5.9.3 Activities

- The collection and maintenance of Bahamian plants not presently represented in the Botanic Gardens.
- The installation and management of (cold) seed storage facilities.
- The establishment of a tissue culture laboratory, and the training of staff

6 Chapter Six
Conclusion

This National Biodiversity Strategy and Action Plan has stressed that biodiversity is an essential part of the nation's well being. Biodiversity constitutes the "natural capital" that provides "services" that are costly at best, and impossible at worst, to replace. It recognizes that biodiversity and sustainability demand conservation and management on a very large scale.

This requires a shift from the piecemeal, sectoral approaches of the past. It requires a retreat from exploitative management, to sustainable management so as to conserve the ecological services that biodiversity provides. It requires a shift also from sector-based management to system-based management. It requires a shift away from the tendency to address small-scale, local problems as simply a number of small-scale problems, to taking a holistic, bioregional or national perspective.

Questions of perception and method arise. The matter of public expectations and the values placed, by members of the public, on natural resources and on biodiversity in particular, needs to be fully explored. Following this is the matter of how to integrate and reconcile local, regional, and national needs, and how to achieve a consensus, and resolve conflicts, among the various stakeholders.

6.1 The Central Role of the Bahamas Environment, Science and Technology Commission

The Government of the Bahamas has had the foresight to create the Bahamas Environment, Science and Technology Commission and to place it in the Office of the Prime Minister. This emphasizes the government's commitment to the environment and its leadership role in national and regional environmental affairs.

The primary role of the Commission is to coordinate the work of the various governmental and non-governmental agencies with responsibilities or concerns for the environment to avoid conflicts of interest and to ensure the most effective use of resources. The Commission is also acting as a focal point for all international environmental conventions and protocols, and with ensuring compliance with the obligations arising from these conventions and protocols. The Commission is not intended to be an operational agency, but to serve as

the hub, and to perform a clearing-house function, for environmental information pertinent to The Bahamas.

In its role as hub and coordinator, The Bahamas Environment, Science and Technology Commission must undertake a number of activities:

□ Provide guidance and information to policy-and decision-makers on the conservation and management of biodiversity.

□ Educate the public in order to develop an "environmental conscience."

□ Oversee the passing of legislation to ensure comprehensive protection of the environment.

□ Maintain a database of up-to-date information on biodiversity and other environmental concerns in The Bahamas so as to facilitate policy-and decision-makers, as well as researchers and other interested parties both nationally and worldwide.

6.2 Biodiversity Issues

Two issues that need to be discussed are the biodiversity portfolio and the question of well being.

6.2.1 The Biodiversity Portfolio

In the past, the conservation of biodiversity focused on species protection, especially of endangered species. Most ecologists and conservationists now recognize that a piece-meal, single-species approach is both inappropriate and ineffective. Focusing on a single species is an approach that has been readily understood by the public, particularly when the species in question had some endearing characteristics. Past experiences with the approach, however, have included large expenditures without the basic problem of ecosystem protection and maintenance of the integrity of the ecosystem having been solved. Notwithstanding emergencies, a multidisciplinary-and multi-species or ecosystem-approach is essential if conservation is to be effective.

6.2.2 National Well Being

The concept of national well being can be viewed from various perspectives. The most familiar is the economist's Gross Domestic Product. This however counts only money transactions, treats them as all positive, and treats natural resources as income. Gross Domestic Product simply measures market activity: it ignores human health and happiness and environmental quality.

A more realistic measure of well being would factor in the "live-ability" of communities; the goodness of local services such as education, health, and transport; the availability of leisure activities and the provision of open space;

the level of crime; the amount of air pollution and its health and other impacts; loss of biodiversity; degradation of ecosystem; and so on. Many of these are qualitative and subjective and not easily expressed in monetary terms.

Human well being and ecosystem well being are inextricably bound together. Well being can be assessed using a variety of criteria:

□ Ecosystem well being - quality of water and air, degree of land degradation, status of biodiversity, use of natural resources and the quality of their management and conservation.
□ Human well being - health, distribution of wealth, access to information, educational opportunities, freedom and civil order.

Given that, in The Bahamas, "tourism is the engine that drives the economy", sustainability and environmental protection have a special meaning. The maintenance of biodiversity and of a healthy and clean environment becomes mandatory in order to ensure growth in the tourism sector. It then becomes important to regulate and plan the development of the tourism sector so as to preserve the environment on which it depends. This poses an unusual challenge to policy-makers: to economic growth in the tourism sector with societal well being and a healthy environment, and the sustainable use of resources.

6.3 Achieving the Goal

The direct beneficiaries of adopting and implementing a National Biodiversity Strategy and Action Plan are the people of The Bahamas, the Government, and all sectors of the country.

Implementation of this strategy and plan in support of biodiversity, with the objective of sustainability and well being, would achieve the national goals highlighted in Box 1.5. Further, implementation could provide a model for other countries worldwide, especially small island developing states. Benefits would then extend well beyond Bahamian waters.

For centuries the people of The Bahamas have relied on, and benefited from, the country's natural resources. These resources are also magnets for visitors, investors, and developers alike. There is an inherent connection between these resources and the well being of the Bahamas. They are our security and our future. We must not just be mindful of that connection. We must insist that connection shape the way forward. Environmental protection and security is essential to The Commonwealth of The Bahamas. Biodiversity conservation is central to that security.