



## Protection of the marine resources of Central Andros, Bahamas

The article below is taken from a proposal prepared by the Central Andros Conservancy and Trust (CANCAT), a community organisation in Central Andros, with support from MEP and the Bahamas Reef Environment Educational Foundation (BREEF) ([Click here](#) to also see the article on this website about lobster fisheries in the Bahamas).

Andros is the largest island in the Bahamas, and is very sparsely inhabited. Much of the island is one large wetland or "coastal zone", characterised by grassy or mangrove swamp and large tidal inlets ("bights"). It also has sinkholes and tidal cave systems something like the cenotes of Yucatan ("blue holes") and the third longest barrier reef in the world (after Australia and Central America) down its east side.

The proposal is for a system of protected areas to be established in Central Andros, to protect some of that island's unique resources. It was presented by the Minister of Agriculture and Fisheries to the Bahamian Government, and is currently under discussion. We are trying to help CANCAT and BREEF in their search for funding to get the reserve system up and running.

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## EXECUTIVE SUMMARY

Andros has many natural resources that are important i) to the development of the economy of the island, ii) to the continued development of The Bahamas as a whole and iii) from a global perspective for conservation:

- The largest resource of fresh water in the country
- One of the world's longest and best preserved reef systems, with other associated marine habitats
- The extensive wetlands of the Bights and the West Side
- The highest density of blue holes anywhere in the world
- Some of the best bonefishing areas in the world
- Endangered species of birds, orchids and iguanas
- Some of the best land crab habitat left in the Caribbean
- At least two Nassau grouper spawning aggregations

While there has not been much scientific work done on many of these areas, it is clear to Androsians and scientists alike that there has been a gradual deterioration in some of these areas over the last few decades: fewer fish, conch and lobster, fewer land crabs, the reef in worse condition, some blue holes and other areas damaged by pollution etc.

Many organisations in the Bahamas, including the Ministry of Agriculture and Fisheries, the Bahamas National Trust and several NGOs, support the idea of a network of protected areas in the Bahamas to protect the environment, particularly the marine and coastal environment which is so critical to the Bahamian economy and way of life. The people of Central Andros are hoping to take a lead in this process by developing a system of protected areas to safeguard their unique resources.

A park system in Central Andros would have several objectives:

- Protect the ecosystems of Central Andros as a unique environment and an internationally important centre of biodiversity.
- Protect resources such as lobster, conch, fin fish and land crabs in the park areas for future generations of Androsians and Bahamians.
- Protect the freshwater resource in Central Andros for the future of The Bahamas
- Protect the quality of the environment for ecotourism activities such as bonefishing, diving and birdwatching
- Reduce conflict between different resource users by ensuring that further development is compatible with existing uses
- Promote Andros as an environmentally responsible and sustainable tourism destination and provide a focus for the expansion of ecotourism
- Provide a place for scientific research into the ecosystems of The Bahamas

A key element in the protection of all the areas will be the concept of compatible development. While development is encouraged, it needs to be designed so that it is i) compatible with maintaining the environment in its existing undamaged state (i.e. it must not cause pollution or habitat loss) and ii) compatible with existing activities such as ecotourism. In practice this means that developments should not be on a large scale, must be ecologically well designed to minimise habitat loss, pollution and water and energy use and must maintain the character of Central Andros as an unspoiled wilderness area. Preferably they should be close to existing development or urban sites rather than in the wilderness. From an economic point of view, this kind of development (ecotourism) is likely to bring the best value for money to Andros in any case.

It is hoped that the park system will be run largely in Andros, by Androsians, for the future of Andros. Evidence from elsewhere shows that parks are always more successful if they have a high degree of community management. Options for financing and operating the park are being explored, and several ecotourism operators are prepared to contribute to park management when their guests use the park.

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## 1. INTRODUCTION

This proposal has been prepared by the Central Andros Conservancy and Trust (CANCAT), which has been formed from the Central Andros Ad Hoc Committee on Conservation. It was prepared in response to an initiative by the Government of the Bahamas (Ministry of Agriculture and Fisheries).

Support, advice and encouragement has been given by the Ministry of Agriculture and Fisheries and the Bahamas National Trust (BNT), who have both recognised the importance of marine and coastal protected areas for fisheries management and for the development of ecotourism in the Out Islands, as well as for conservation of a unique and important ecosystem. The Bahamas Reef Environment Educational Foundation (BREEF) has also provide extensive technical and financial support. The proposal as it stands follows a process of public meetings and discussion in Central Andros, started by BNT, continued and developed by the Ad Hoc Committee with support from BREEF and to be further continued by CANCAT with continuing support from BNT and BREEF.

CANCAT hopes that the implementation of this proposal will be the beginning, rather than the end of a process of conservation in Andros. Depending on the success of particular areas and the results of scientific monitoring, the park areas could be extended or amended. In addition, it is very much hoped that CANCAT will be able to extend its geographical range, supporting North and South Andros to develop a similar park network, so that eventually conservation is covered across the entire island.

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## 2. THE ENVIRONMENT OF CENTRAL ANDROS

The environment of Andros is of international importance for several reasons. Its reef system is in the world's top five in length and is exceptional in the Caribbean for its unspoiled environment in a region where reefs have suffered appalling degradation in the last few decades. Andros is also fascinating for its wetland character and the difficulty of drawing a precise boundary between land and sea, and is famous for its density of blue holes, most of which are deep and unexplored.

The environment can be divided into broad zones from east to west, from the deep water of the Tongue of the Ocean, to the reef slope and crest, to the inshore lagoon area with patch reefs, turtle grass beds and bonefish flats, to the beach, mangroves and creeks in the intertidal, to the coppice and pineyards on the highest ground, and from there back to the vast expanse of creeks, Bights, mangroves and shallow flats of the West Side, over to the Great Bahama Bank and the deep water of the Florida Channel.

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### 2.1 The Andros barrier reef

Of these habitats, the coral reef areas are the most diverse and species rich. As part of the Atlantic and Gulf Reef Assessment Program, an ongoing study by a team from the University of Miami, with the assistance of Dr. Tim Turnbull, an Andros-based marine biologist, is looking at the "vitality" of the reefs, a parameter that includes elements such as coral biodiversity and abundance, fish abundance, relative algae abundance and recent versus historical coral mortality and causes. The team surveyed 26 sites in three groups (Northern: Joulter's Cays to Conch Sound, Central: Staniard Rock to Long Rock and Southern: North Rock to Washerwoman Cut). A total of 18 species of major reef building corals were identified throughout all sites, with elkhorn coral *Acropora palmata* the most abundant in shallow areas (3m / 10 feet) and boulder star coral *Montastrea annularis* most abundant in deeper waters (10m / 35 feet).

Early results of the study indicate:

- Coral colony frequency and coral cover is generally high at both depth zones surveyed
- Coral mortality is low to moderate
- Macroalgae are abundant, probably due to i) the time of year during which the survey was conducted (August) and ii) the Caribbean wide die-off of the urchin *Diadema antillarum* resulting in less grazing of algae
- Fish abundance and diversity is higher in northern areas of the reef, either because of patterns of larvae supply and/or because of greater fishing pressure in the south
- The most species rich area for corals is China Point, off Fresh Creek.

And overall:

- The reef is considered to be in good condition overall, probably because of low human impacts, and despite the major coral bleaching events of 1987 and 1998 and the die-off of the long spined sea urchin *Diadema antillarum* in the early 1980s.
- Sites in North and Central Andros seem to be healthiest based on lower coral mortality, lower abundance of macroalgae and higher abundance and diversity of fish.
- The Andros barrier reef is unique in the region because of its large spatial extent of coral cover, luxuriant coral growth, low levels of recent coral mortality, low incidence of coral disease and low level of identifiable anthropogenic impacts.

The study recommends that a system of protected areas be established along the Andros reef, to protect this unique and important marine ecosystem.

There are few historical scientific studies which can be used to show how the overall condition of the Andros barrier reef has changed over the last few decades. However anecdotal evidence suggestion that the condition of the reef has deteriorated over the last 30 years. The causes of the decline can probably be ascribed partially to "natural" events described above, but probably also partially to fishing pressure on the reef, which is the main cause of human induced stress at present.

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## 2.2 Lagoon and shore areas

Inshore and intertidal areas of Andros, on both sides of the island, are a mosaic of habitats, including patch reefs, seagrass beds, sand flats, creeks, bights and swash/mangroves. These habitats support important species such as queen conch (*Strombus gigas*), sponges, bonefish (*Albula vulpes*) and land crabs (*Cardiosoma guanahani*). Many important coral reef species, including grouper (various species, with Nassau grouper *Epinephalus striatus* particularly important), Caribbean spiny lobster (*Panulirus argus*, called "crawfish" in the Bahamas), conch and many others, use these habitats during parts of their lifecycle. They are particularly important as nursery areas. The exchange of energy, nutrients and sediment as well as animals means that the various marine and coastal habitats interact with each other and are mutually dependent for their diversity and vitality. This means that to protect the reef, we must protect these areas as well.

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## 2.3 Coppice, pineyards and the fresh water resource

The higher ground of Andros is mainly taken up coppice and pineyards which grow on the highly porous limestone rock of Andros. The vegetation community immediately behind the beach ridge has been defined as "coastal coppice", and is broadly a mixture of coppice plants (e.g. *Cocoplum Chrysobalanus icaco*, poisonwood *Metopium toxiferum* and love vine *Cassytha filiformis*) and seashore plants (e.g. railroad vine *Ipomea pes-caprae*, sea grape *Cocoloba uvifera* and sea oats *Uniola paniculata*). On higher ground, "high coppice" grows in pockets of thicker soil throughout the pineyards, usually on ridges or rises. This community is dominated by large trees of poisonwood, horseflesh *Lysiloma sabicu*, mahogany *Swietenia* mahogany and others, often with large banana holes.

The pineyards are large tracts of a Bahamian variety of Caribbean pine (*Pinus caribea* var. *Bahamensis*). Unlike in the coppice, the canopy is open and lets in a lot of light for an understory of bracken fern (*Pteridium aquilinum*), poisonwood, thatch palm (*Thrinax morrisii*) and orchids of several species. The soil in these areas is thin and rocky.

The pineyard areas are particularly important for rare species, including the Bahamian boa, Andros rock iguana, Atala hairstreak butterfly and several rare orchids. Other important species includes frogs, birds (the bird population of Andros doubles in winter due to migrants from North America), wild pigs and wild cows. There is potential for developing ecotourism activities such as birdwatching and nature walks which is at present largely unexploited.

However, the critical importance of the higher ground of Andros for the economic wellbeing of The Bahamas is in the thick porous limestone and its ability to store fresh water as groundwater. Andros supplies 51% of the water used by Nassau from wellfields in the North, and the freshwater lens is actually thicker in Central Andros than in the north. It is vital for The Bahamas that human activities do not damage or pollute this critical resource. Unmanaged or inappropriate forest clearance can affect run-off, and some alternative land uses such as agriculture or industrial, urban or large-scale tourism development could cause pollutants to filter into the ground and contaminate the freshwater

lens. Therefore forestry and development needs to be managed with care in this area.

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#### **2.4 Creeks, Bights and the West Side**

The whole of the West Side of Andros, along with the creeks and the Bights, is essentially a wetland and intertidal environment which is made up of salt water creeks, small sand or limestone islands, mangroves, bonefish flats and an oolitic limestone bank with patch reefs, sand shoals and turtle grass which extends several miles off the coast to the Gulf Stream channel. The main vegetation communities are savannah and swash. The savannah areas are on the edge of the pineyards but are high enough to remain unaffected by tidal flows of salt water. However the soil is calcareous, muddy, somewhat saline and very nutrient poor, meaning that the community is dominated by sawgrass (*Cladium jamaicensis*), as well as salt tolerant species such as white mangrove (*Laguncularia racemosa*). The swash areas are intertidal salt marshes, mainly dominated by red mangrove (*Rhizophora mangle*).

This type and extent of wetland environment is unusual worldwide and is highly productive and important for many marine species. These areas are also critically important as nursery areas for many species, including lobster, conch and many reef fish species. It also includes some of the best bonefishing grounds in the world.

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#### **2.5 Blue holes**

Blue holes are a very unusual geological feature which also connect the land and sea environments of Andros. They were formed through the erosive power of freshwater, and mixed fresh and salt water in fault lines during the repeated changes in sea level of the glacial and interglacial periods. Andros has the highest density of blue holes anywhere in the world, and compared to other areas with similar structures (e.g. cenotes in Yucatan), they are deeper, form more complex webs of tunnels and connections and are far more mysterious. They are one of the last environments on earth outside the deep ocean which are almost completely unexplored. Rare species of cave fish and cave shrimps and Lucayan artefacts have been found in some blue holes.

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#### **2.6 Links between terrestrial and marine habitats**

A key feature of the Andros environment is the close linkages between terrestrial and marine habitats: much of the island is one large wetland or transition zone (the creeks and bights drain the coppice and pineyards and support mangroves, which support juveniles of species that subsequently move offshore to the reef...). Not only are habitats linked above ground, but also underground because of groundwater filtration through the porous limestone rock and the extensive system of interconnected inland and marine blue holes. This means that impacts on one kind of habitat can have repercussions elsewhere.

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### **3. USES OF THE ENVIRONMENT OF CENTRAL ANDROS**

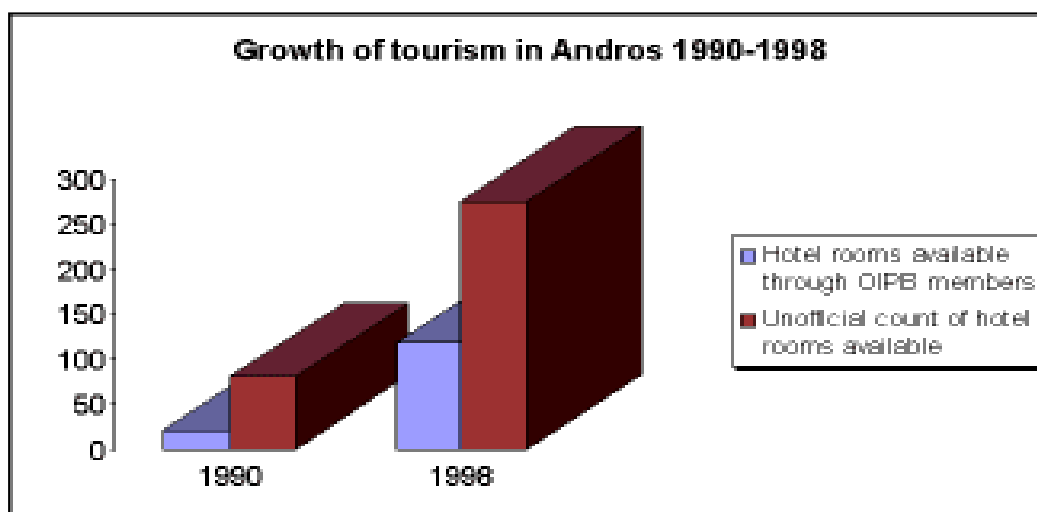
#### **3.1 Tourism and ecotourism**

The Bahamas is a sparsely populated country and has therefore always considered itself at less danger of overexploiting its natural resources than its more densely populated neighbours. However, The Bahamas receives over 3 million visitors a year, many of which fish, dive or otherwise make use of Bahamian resources, and nearly all of which require extensive infrastructure. These visitors have a disproportionate effect on the environment despite their short stays.

At present, tourism in central Andros is based around small, family run hotels, resorts and bonefish lodges; there are no large resorts and hotels or cruise ship destinations. This type of tourism gains more value per visitor while having less impact on both the environment and the Bahamian way of life.

Tourism in Andros is growing quickly. In 1990 there were unofficially about 80 rooms available on Andros, and now there are around 275: an increase of about 350% or 40% per year. The number of hotels which are members of the Out Island Promotion Board (licensed hotels with more than 4

rooms and a restaurant) has grown from one in 1990 (with 21 rooms) to 8 in 1998 (with a total of 117 rooms). Occupancy averages around 26% for the licensed hotels and is also growing.



Andros has been identified by the Government as the island with the biggest unexploited potential for ecotourism. At present, promotion of Bahamian destinations concentrates on Nassau, Freeport, Eleuthera, the Abacos and the Exumas. If Andros becomes the next island to be promoted as a destination in its own right, this should mean that visitor numbers increase even more rapidly. By looking at small hotels and developments currently in the planning stage, it is estimated that at least another 80 rooms will become available over the next 5 years (without including new developments which not yet planned).

Andros attracts tourists that are particularly "desirable" from both the economic and the ecological point of view. They are usually well off, with average incomes of more than \$100,000. They are often concerned about the natural environment and are looking for a "wilderness" experience rather than hotel luxury. Andros, like the other Family Islands, has a repeat and referrals business in excess of 70%.

Of the total visitors to Andros, it is estimated that about 35% are fishermen (mainly bonefishing) and 50% are divers and snorkellers. It is estimated that the average fishermen contributes \$275 per day to the local economy, a diver \$180 per day and a non-diving non-fishing tourist \$100. This gives a rough estimate of the direct contribution to the economy of Andros from tourists of about \$ 8-12 million per year (or \$ 1-1,500 per head of population per year). [Back to top](#)

### 3.2 Fishing

#### 3.2.1 Andros-based fishing boats

Fishing is traditionally the most important industry for the people of Central Andros. The majority of Androsian fishermen have small day boats and fish on the reef or on inshore patch for spiny lobster, conch, grouper, snapper and other fin fish. They fish using hook and line, fish pots (traps) and by diving, with or without compressors. Many Andros residents who are not professional fishermen will fish during weekends and holidays. Some fishing, such as casting for pilchards, lining for bonefish and conching is done from shore without a boat.

There are also some larger commercial boats based in Andros, mainly in Mangrove Cay and South Andros. Some of these boats fish the east coast and the Bights for lobster, grouper, snapper and conch.

Sponge fishing is a growing industry in Andros, particularly in North Bight and Middle Bight.

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#### 3.2.2 Commercial trapping

Commercial fishing boats from Nassau, Grand Bahama and the Abacos set fin fish traps both in shallow and deep water (down the drop-off) on the reef system. The traps can be set singly or in lines, and are usually larger and of a more solid construction than those used by local fishermen.

Many commercial boats set artificial habitats ("casitas" or "condos") for lobster on the Great Bahama Bank off the West Side. Usually this is quite a long way offshore.

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### 3.2.3 Other fishing

Until this year, many boats from Andros and elsewhere came to High Cay to fish the grouper spawning aggregation, however the aggregation was closed to fishing this year. There is some fishing by tourists in yachts, but not extensive.

The Great Bahama Bank off the West Side is probably used by poachers from other countries.

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### 3.3 Fresh water

From the point of view of the development of The Bahamas as a whole, the most critical resource in Andros is not its reefs, blues holes or mangroves but its fresh water lens, stored in the porous limestone, mainly under the coppice and pineyard areas. The main wellfields at the moment are in North Andros, but the lens is actually thicker under Central Andros. 51% of the water consumed in Nassau is extracted from the wellfields of North Andros, and as the capital continues to grow, the need for fresh water is bound to increase. Water can only be pumped from the lens at a given point at a certain rate (less than the recharge rate at that point), otherwise there will be saline intrusion into the lens.

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### 3.4 Land crabs

Land crabs (*Cardiosoma guanahani*) swarm in June and July to feed and mate in the coppice and pine areas, spending the rest of the year in the wetlands. They are an important resource for the people of Central Andros at this time of year, and it is estimated that about 715 households make around \$2,000 each selling land crabs in Nassau. Anecdotal evidence suggests that there are less than there used to be. Their continuing abundance depends on protecting the wetland habitat where they spend most of the year.

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### 3.5 Forestry

The Department of Lands and Surveys has divided crown land on Andros into different forest zones which are earmarked for different uses. This includes "Forest Reserves" which are areas which the Department would like to see protected for conservation of forest resources, animals and fresh water. The area with the highest incidence of blue holes, between Fresh Creek and Stafford Creek, has been included in the "Staniard Creek Forest Reserve".

At present, little forestry is taking place on Andros on crown land. The development of forestry, as well as the formal designation of the zoning plan and the forest reserves, awaits the ratification of the new forestry legislation, which is currently under discussion by the Government.

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## 4. ENVIRONMENTAL ISSUES AND CONFLICTS BETWEEN USERS

### 4.1 Issues and causes

The main issue that this park proposal addresses is that the quality and vitality of the marine environment of Andros has been gradually but progressively deteriorating, particularly on the reef and in the marine environment. While few scientific studies of environmental vitality have been done until recently, the perception of deterioration is shared by almost everyone who has known the marine environment well over the last few decades, including scientists, divers, fishermen and crabbers. Specifically, the main perception is that there has been a decline in the numbers and size of adult fish, particularly grouper, as well as reduced numbers of conch, lobster and helmet shells which are or were exploited commercially. Given that all the habitats are closely linked, if Central Andros continues without any form of protection, the losses are likely to get progressively worse, with economic as well as ecological consequences.

It is likely that the progressive deterioration of the marine environment has been at least partially induced by users, specifically due to i) overfishing and ii) the use of destructive techniques. Among the key fishing related issues in Andros are:

- Commercial trapping: commercial trapping can clean out in one go an area that could have been sustainably fished using lines or spears. It also targets the largest adult fish.
- Leaving fish traps too long in the water, so that the fish die.
- Dumping or losing fish traps, particularly when they are not provided with a biodegradable panel.
- Traps with small mesh sizes cause unnecessary mortality of juveniles and non-commercial species (e.g. angelfish).
- Fishing with bleach, gas, detergent or other toxic chemicals
- Catching or taking juveniles (mainly conch, lobster, grouper) before they have the opportunity to reproduce (violating the minimum size regulations)
- Disrupting spawning (fishing grouper spawning aggregations, violating the lobster closed season).
- Netting bonefish for human consumption (they are far more valuable if left for sport fishing).
- Non-Bahamian recreational fishermen who do not conform to the Bahamian regulations and bag limits.

Other issues giving cause for concern are:

- Reduction in the numbers of land crabs
- Pollution of some blue holes and damage to their water quality and setting through changes in land use and development nearby.

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## 4.2 Concerns for the future

### 4.2.1 Uncontrolled fishing

Despite a lack of scientific evidence, it seems likely that existing fishing pressure, even though it is not great, is gradually reducing the quality and vitality of the reef environment. It has been difficult to control fishing in The Bahamas, due to the large area of fishing grounds, the numerous fishing communities and landing sites and the limited number of enforcement personnel. If no conservation measure are put in place in important areas, the reef will have no opportunity to regenerate, and if practices such as commercial fin fish trapping continue to increase, more damage will be caused and stocks will be reduced, causing economic problems for Androsians. Across the rest of the Caribbean, stocks of species such as lobster, Nassau grouper and conch have been greatly reduced by overfishing, and conch is now protected by CITES as a threatened species. See Annex 1 for more information on lobster and Nassau grouper in the Caribbean.

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### 4.2.2 Tourism development

The main environmental risks from tourism come from large scale tourism developments, rather than the smaller developments that currently exist in Andros. Large construction projects inevitably mean that a large area of habitat is lost and more is disturbed and fragmented. They also cause pollution associated with the creation of large amounts of silt and sediment and disturbance of the environment around the site. Large hotels require extensive infrastructure for sewage and waste disposal if they are not to cause major pollution of the marine and coastal environment and groundwater. The sheer pressure of large numbers of visitors on the environment can cause damage, so it is better to get more value per visitor by targeting a high value market (the ecotourism market).

In addition to possible pollution and damage to the reef, such developments risk causing conflict with existing activities; for example reducing access to beaches for Bahamas, taking large number of divers to existing dive sites, disrupting fishing grounds and dive sites with jetskis and watersports and reducing the ecotourism experience by reducing the perception of Andros as unspoiled wilderness.

That is not to say that further tourism development is not be possible in Andros without environmental damage. The solution is for development to be compatible with preserving the environment and with activities that already exist (fishing, ecotourism).

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#### 4.2.3 Groundwater contamination

Unmanaged development and changes in land use have the potential to contaminate the freshwater lens under Andros. Once contaminated it may take years to recover. This is a critical resource for The Bahamas. Land use needs to continue to be carefully planned and managed to ensure that it is sustainable.

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#### 4.2.4 Land crab habitat loss

Land crabs are a useful source of income to Androsians during the period when the females migrate to lay their eggs. They spend most of the year in wetland / coppice habitat (moving between higher and lower ground depending on rainfall). In order to retain this resource their habitat needs to be protected. Land crabs were formerly common throughout the Caribbean, Florida and Central America, but they have been much reduced throughout much of their range by overexploitation and particularly by habitat loss.

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#### 4.2.5 Potential future issues and conflicts

- Further damage to the reef and fish stocks from gradually increasing fishing pressure
- Loss or deterioration of marine habitat, mangroves and nursery areas to development and pollution
- Contamination or reduction of the groundwater lens from development or uncontrolled land use changes
- Damage to blue holes from development and pollution
- Loss of habitat for land crabs
- Loss of access to beaches
- Loss of perception of "wilderness" reducing the opportunities for ecotourism
- Much larger numbers of visitors may overload environmental resources and reduce the quality of the environment, the quality of the visitors' experience and the quality of life for Androsians.

These conflicts can be avoided and existing conflicts mitigated as long as some basis for the protection of the whole Central Andros ecosystem and the control of future development is put in place now. That is the key objective of this proposal.

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### 5. OBJECTIVES OF THE PROPOSED MARINE PARK SYSTEM

From the above analysis of issues and conflicts, the following objectives emerge for the marine park system:

*Protect the ecosystems of Central Andros as a unique environment and an internationally important centre of biodiversity. Protect the quality and vitality of the environment as a resource for future generations.*

Biodiversity (the variety of different species of animals and plants) has to be conserved by conserving habitats, not just by conserving individual species. What is more, the high biodiversity of the coral reef also depends on the linkages between different terrestrial, coastal and marine habitats. So for maximum conservation effect a park system will include a variety of different habitats from land to deep water.

The Bahamas has signed the Convention on Biodiversity and has therefore pledged to support and promote the conservation of biodiversity in The Bahamas.

#### ***Protect resources such as lobster, conch, fin fish and land crabs in the park areas for the people of Andros***

It is scientifically well documented that fisheries replenishment zones are successful in maintaining populations of fished species, not only in the replenishment zone but in surrounding areas which can be fished. Fisheries replenishment zones are known to have the following benefits for commercially and locally fished species:

- Protection of important habitats.
- Protection against disturbance, particularly during spawning or migrating periods when they can otherwise be easy to catch.
- Protection against overfishing. Protection against destructive fishing techniques.
- Protection of large individuals which produce more eggs and are more successful at spawning
- Restocking of surrounding fished areas through supply of larvae and the movement of adult fish across the boundaries of the replenishment zone.
- Insurance against unpredictable events like El Niño, hurricanes, climate change, disease outbreaks etc. which might reduce stocks or damage habitat.
- Easier enforcement.

Many scientific studies have shown that marine parks and replenishment zones are successful in increasing the numbers and size of important species such as grouper, conch and lobster, not only in the park but also outside its borders. Recent studies on grouper and conch in the Exuma Land and Sea Park showed that there were more and larger Nassau grouper and conch inside the park and around its borders than further away from the park. Studies have shown similar effects throughout the world for lots of species including reef fish and lobster. Annex 2 describes these studies in more detail.

Land crabs have a number of de facto replenishment zones because the dense coppice and rocky, potholed wetlands in the main areas where they live prevents people from crabbing except right next to the road. Therefore the protection of land crabs in Central Andros depends critically on protecting these habitats.

***Protect the freshwater resource in Central Andros for the future of The Bahamas***

The freshwater lens is probably the single most economically important resource in Andros, and it is thickest in Central Andros. A park would provide a measure of protection for the critical coppice and pineyard areas which help to maintain the lens, and would help ensure that future development is compatible with maintaining the lens in an unpolluted condition.

***Protect the quality of the environment for ecotourism activities such as bonefishing, diving and birdwatching***

A rough estimate is that diving brings in \$3-4 million per year to Andros, (not including non-diving visitors that come with divers) while bonefishing brings in at least \$4-5 million, and this looks set to increase. The reputation of Andros for these activities depends on an unspoiled environment and the perception of an undeveloped wilderness, so environmental protection and control of development is an economic necessity if ecotourism is to continue to grow and thrive.

***Reduce conflict between different resource users by ensuring that further development is compatible with existing uses*** A park provides a framework for the control and management of development in the park area. It would also ensure that baseline data was available so the impacts of any development could be carefully assessed and monitored, and mitigation measures put in place as necessary.

***Promote Andros as an environmentally responsible and sustainable tourism destination and provide a focus for the expansion of ecotourism***

A park would provide a focus for marketing Andros as a tourism and ecotourism destination.

***Provide a place for scientific research into the marine ecosystem of the Bahamas***

Parks and replenishment zones provide natural laboratories where scientists can monitor biodiversity and the impacts of human induced change (through comparison with unprotected areas) and natural change (by looking at changes over time).

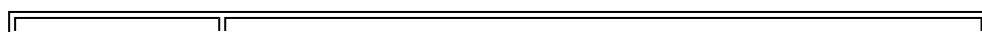
***Provide a conservation example for the other islands of The Bahamas***

If the park system is seen to be a success, other islands will be encouraged to follow Andros' lead. The park system has the potential to be a starting point for the enlargement and reinforcement of the nationwide park system, which has provided the basis for conservation and a highly successful ecotourism industry in other countries (Costa Rica, USA).

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**6. ANNEX 1 : DEPLETION OF FISHERIES IN THE CARIBBEAN AS A WHOLE**

**6.1 Caribbean spiny lobster (*Panulirus argus*) (1998)**



Country	Stock status
Brazil	Lobster being fished at unsafe levels. Recommended by FAO that the amount of fishing be reduced to a quarter of present levels.
Venezuela	Lobster are probably being overexploited. Numbers of fishermen increasing but total amount of catch staying the same (so each fishermen gets less for more effort).
Honduras / Nicaragua / Colombia	These three countries fish the same stock of lobster. They are considered to be fully exploited but the number of fishermen in all three countries continues to increase, because each is trying to get a bigger share of the common stock.
Jamaica	Catches have started to declined despite continuing increases in the number of fishermen.
Belize	Not enough information available
Cuba	25% decline in juvenile and adult lobster 1982.
Mexico	Fine in some areas, in others numbers of adult and juvenile lobster have been declining since 1990.
Florida	Their lobster fishery probably depends on getting larvae from other places such as the Bahamas, Mexico and the Dry Tortuga, otherwise it would collapse.
Turks and Caicos	Fishing at the maximum safe level according to scientists.
Antigua and Anguilla	Catches have decreased to 20% of levels 20 years ago.

## 6.2 Nassau grouper in the Caribbean

Location	Status
Belize	6 aggregation sites known, one has disappeared and one very much reduced. Landings in early 90s one quarter of those in early 80s.
Bermuda	In 1975 Nassau grouper was 16% of grouper catch, In 1989 it was <1% despite increased fishing. Three aggregations have all disappeared. Protected species.
Cayman Islands	Only handlining by residents permitted on the 5 known aggregations.
Cuba	Landing decreased to one fifth of those in 1960.
Dominican Republic	One aggregation is known to have disappeared, no information on the others. Grouper fishing banned during the spawning season.
Florida	In 1979 Nassau grouper was 10% of grouper catch, in the late 1980s it was 1-2% in the Keys and Biscayne National Park. All capture of Nassau grouper prohibited in 1992, and it is a protected species.
Honduras	Aggregation discovered in 1988 has been fished heavily. Estimated that 10,000 fish spawned there in 1989 but only 500 in 1991. Mature Nassau grouper are rarely seen by divers or fishermen.
Jamaica	All grouper species rare in catches due to over-fishing.
Martinique	All grouper now rare due to use of traps.
Mexico	No information.
Netherlands Antilles	Nassau grouper used to be very common but now rare around all the islands due to spear fishing.
	In 1900 the Nassau grouper was the most common food fish

Puerto Rico	which often reached a weight of more than 50lbs. Nassau grouper is now extinct for fisheries purposes. Four aggregations have disappeared. Since 1990 it has been a protected species.
St. Vincent / Grenadines	No information.
Virgin Islands	Several aggregations around St. Thomas and St. Croix used to yield catches of 2,200lbs per day from handlining but all have now disappeared due to trapping.
Venezuela	No information.

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## 7. ANNEX 2 : DO MARINE REPLENISHMENT ZONES WORK?

### 7.1 Worldwide research into marine replenishment zones

The table below summarises the results of a few of the studies that have been undertaken in and around marine protected areas.

Location of study	Result
Exuma Land and Sea Park, The Bahamas	Increased abundance, size and reproductive output of Nassau grouper in the park compared to areas north and south . See below.
Saba Marine Reserve, Netherlands Antilles	220% increase in biomass of snapper in two years since closed to fishing.
Sumilon Island Reserve, Philippines	Average weight of groupers twice as great as outside the protected area. Grouper density up to 25 times greater than outside. Overall fish density up to 31 times greater. When the area stopped being protected, snappers decreased by 94%, jacks 60%, groupers and hinds 45% and all other species 55-214%. Fish numbers also declined around the formerly protected area as well as inside.
Southern Great Barrier Reef, Australia	Most common grouper species average 10cm longer in replenishment zones, with 78% of mature size compared to 46% in areas open to fishing
Malindi Marine Reserve, Kenya	Mean size of all fishes greater in the lagoon near a reef replenishment zone than in the lagoon near a fished reef.
Boult Reef, Australia	Main grouper species average 13cm longer after 3.5 years protection than on nearby reefs. When Boult Reef reopened to fishing, average grouper size fell by 5cm in 18 months.
Looe Key Reef, Florida	After two years protection from spear fishing snapper abundance increased 93% and grunt abundance 439%. 13 other species also increased in density.
Dry Tortugas Marine Reserve, Florida	Breeding by large female spiny lobsters in this area probably sustains the lobster fishery over the lower Florida Keys.

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### 7.2 Grouper and conch in the Exuma Cays Land and Sea Park

The Nature Conservancy has published a scientific study investigating the status of various grouper species in and around the Exuma Cays Land and Sea Park.

The study clearly demonstrated that there are more Nassau grouper, black grouper, tiger grouper and yellowfin grouper inside the Exuma Park, compared to areas both north and south of the park. In addition, Nassau grouper inside the park were found to be on average larger than those outside, and females in the park were estimated to be producing 4.6-7.1 times more eggs than those outside, due to their larger size.

The study also showed that there are more Nassau grouper in areas adjacent to the park, in that the density of Nassau grouper was seen to decrease gradually with distance from the park boundary.

This study clearly demonstrates i) that fishing pressure is having an effect on the grouper population structure and reef ecosystems of the Bahamas, even in lightly populated areas like the Exuma Cays, ii) that marine parks closed to fishing can work in The Bahamas to increase numbers, size and reproductive output of species such as grouper both in and around the park.

Another study in 1993 by the Caribbean Marine Research Centre at Lee Stocking Island showed that numbers of conch larvae in the water were about 15 times higher in the Exuma Park than in the Exumas south of the Park. In fact the concentration of conch larvae in the water of the Park during the study period was the highest ever recorded anywhere in the Caribbean. Concentrations of conch juveniles and adults were also higher than at comparable sites around Lee Stocking Island and Cat Island. It is thought that high conch densities in the Park are partially related to the pattern of water circulation in the Exuma Sound, but the distribution of adult conch at shallower depths than outside the Park implies that the differences are also related to fishing pressure outside the Park.

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### 7.3 Conclusion

Where parks prevent fishing within their boundaries ("replenishment zone") they result in far higher densities of adult animals and larvae within the park. These in turn can increase the number of fish, conch, lobster etc. in the fished area around the park. The difference is seen not only in heavily damaged areas but also in areas where fishing pressure is not that great (e.g. the Exuma Cays).

Also, all these studies show the importance of parks and replenishment zones as control areas in scientific research. It would be impossible to assess the impact of fishing on the coral reefs of the Bahamas without this control area where fishing is not permitted.

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## 8. ANNEX 3 : GLOSSARY OF TERMS

A large number of words are used for different kinds of protected areas, which can cause confusion. Below is a definition of the most common terms:

### **Consumptive use, non-consumptive use**

Consumptive use of an area means that activities take place there which involves removing living or non-living things from the area. This would include all kinds of fishing except catch-and-release, collecting conch, land crabbing, hunting, forestry etc. Non-consumptive use involves activities that do not remove anything from the area, such as diving and snorkelling, catch-and-release fishing, birdwatching and most forms of ecotourism.

### **Park, Protected area, Reserve**

These three terms are used interchangeably for any area set aside for conservation of the natural environment. Levels of protection, use and management can vary. In this proposal, the terms "park", "park system" (for a park with several discrete areas) or "protected area system" are used to cover all the areas proposed for some kind of protection.

### **Replenishment zone, No-take zone**

These terms usually apply to marine areas and are used for protected areas in which no fishing or other consumptive uses are permitted. They are intended as areas where stocks of exploited species such as grouper and lobster can be allowed to recover and hence increase numbers in surrounding areas. An entire marine park may be a replenishment zone, or it may be a smaller area within a park.

### **Scientific monitoring zone**

In this proposal, this is used to mean an area set aside for scientific work, where no consumptive OR

non-consumptive uses are permitted.

**Compatible development**

This is a critical element of protection within any park. It means that any development within OR near the park boundaries must be compatible with the objectives of the park (i.e. compatible with conserving the environment in a pristine condition). It must also be compatible with existing uses of the park (ecotourism, bonefishing, crabbing etc.). This means not only ensuring that development keeps to the highest environmental standards, but also (critical for ecotourism) that the perception of Andros as an unspoiled island can be maintained. It also depends on the location of the proposed development, for example new development close by areas that are already developed is preferable to development in untouched areas.

The environmental compatibility of a proposed development will depend on a variety of factors:

- Site of development: near existing developments or urban areas or in the wilderness, near critical habitat areas or particularly sensitive areas, inside or near the boundaries of a park or protected area
- Size and scale of development
- Size and scale of associated infrastructure such as access roads, powerlines, freshwater supply, docks and jetties etc.
- Habitat lost, fragmented or changed
- Construction related issues (pollution, siltation, land clearance, noise, fumes etc.)
- Operation related issues (waste water treatment, waste disposal, disturbance of natural areas)
- Resources consumed both during construction and during operation (water, power etc.)
- Activities associated with the development (watersports, fishing etc.)
- Visual impact of development
- Disruption to existing activities such as ecotourism and fishing

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