# CAYMAN ISLANDS

## National Biodiversity Action Plan 2009

*…a just world values and conserves nature…*



Department of Environment

"A society is defined not only by what it creates, but by what it refuses to destroy."

John Sawhill, former president/CEO of The Nature Conservancy.

I am I plus my surroundings and if I do not preserve the latter, I do not preserve myself.

Jose Ortega Y Gasset (1883-1955), Meditations on Quixote, 1961.

Before it's too late, we need to make courageous choices that will recreate a strong alliance between man and Earth. We need a decisive 'yes' to care for creation and a strong commitment to reverse those trends that risk making the situation of decay irreversible.

Pope Benedict XVI, cited in Nicole Winfield, "Pope Urges Young to Care for Planet". *Associated Press*, 2007.

It is our task in our time and in our generation to hand down undiminished to those who come after us, as was handed down to us by those who went before, the natural wealth and beauty which is ours.

John F. Kennedy, speech dedicating the National Wildlife Federation Building, 1961.

If future generations are to remember us with gratitude rather than contempt, we must leave them more than the miracles of technology. We must leave them a glimpse of the world as it was in the beginning, not just after we got through with it.

Lyndon B. Johnson (1908-1973), at the signing of the *Wilderness Act*, 1964.

The earth we abuse and the living things we kill will, in the end, take their revenge; for in exploiting their presence we are diminishing our future.

Marya Mannes.

Ethical and moral questions and how we answer them may determine whether primal scenes will continue to be a source of joy and comfort to future generations. The decisions are ours and we have to search our minds and souls for the right answers… We must be eternally vigilant, embrace the broad concept of an environmental ethic to survive.

Sigurd F. Olson.

There is a growing consensus amongst scientists and economists that the planet is in peril. But the solutions to our problems depend less on technological advances and economic growth than on human will guided by a "moral compass" requiring a change of heart about how we live and work, how we produce things and how we treat other people and other species.

Charles Birch in the scientific magazine *21C*.

A more balanced environmental protection policy and ecologically sound development are needed to achieve a sustainable natural and built environment for the Cayman Islands.

CH2M Hill "Study on the Provision of Construction Aggregate and Fill Material for the Cayman Islands", 2001.

Unless someone like you, cares a whole awful lot. Nothing is going to get better, it's simply not.

The Lorax, Dr. Seuss, 1971.

## FOR REFERENCE and ACKNOWLEDGEMENT

DaCosta-Cottam, M., Olynik, J., Blumenthal, J., Godbeer, K.D., Gibb, J., Bothwell, J., Burton, F.J., Bradley, P.E., Band, A., Austin, T., Bush, P., Johnson, B.J., Hurlston, L., Bishop, L., McCoy, C., Parsons, G., Kirkconnell, J., Halford, S. and Ebanks-Petrie, G. (2009). Cayman Islands National Biodiversity Action Plan 2009. Cayman Islands Government. Department of Environment.

With special thanks to:

All Darwin Partners, contributors and volunteers, local and international
DoE Enforcement, Operations and Administrative staff, Cayman Islands
Brendan and Annette Godley, University of Exeter, UK
The Darwin Initiative, Department of Environment, Food and Rural Affairs, UK

Final formatting and production by John Binns, International Reptile Conservation Foundation.

# CONTENTS

# HABITAT ACTION PLANS

**xx**

*Link to marine habitats map: Grand Cayman*
*Link to marine habitats map: Cayman Brac*
*Link to marine habitats map: Little Cayman*

*Link to coastal and terrestrial habitats map: Grand Cayman*
*Link to coastal and terrestrial habitats map: Cayman Brac*
*Link to coastal and terrestrial habitats map: Little Cayman*

**MARINE HABITATS**

1. Open sea
2. Coral reefs
3. Lagoons
4. Seagrass beds
5. Dredged seabed
6. Artificial installations

**COASTAL HABITATS**

7. Maritime cliffs and ironshore
8. Sandy beach and cobble
9. Mangrove
10. Invasive coastal plants (INVASIVE)
11. Coastal shrubland

**TERRESTRIAL HABITATS**

12. Salt-tolerant succulents
13. Pools, ponds and mangrove lagoons
14. Dry shrubland
15. Forest and woodland
16. Caves
17. Farm and grassland
18. Urban and man-modified areas
19. Roads

# SPECIES ACTION PLANS

## MARINE SPECIES

### INVERTEBRATES

| | |
|---|---|
| *Cittarium pica & Coenobita clypeatus* | Whelks & Soldier crab |
| *Strombus gigas* | Queen conch |
| *Panulirus argus* | Spiny lobster |

### FISH

| | |
|---|---|
| *Dasyatis americana* | Southern stingrays |
| *Epinephelus striatus* | Nassau grouper |
| *Pterois volitans* (INVASIVE) | Red lionfish |

### REPTILES

| | |
|---|---|
| *Cheloniidae* | Marine turtles |

## COASTAL SPECIES

### PLANTS

| | |
|---|---|
| *Turnera triglandulosa* | |
| *Chrysobalanus icaco* | Cocoplum |
| *Cordia sebestena caymanensis* | Broadleaf |
| *Scaevola plumieri* | Inkberry |
| *Pectis caymanensis caymanensis* | Tea banker |

### INVERTEBRATES

| | |
|---|---|
| *Cardisoma guanhumi* | White Land crab |

## TERRESTRIAL SPECIES

### PLANTS

| | |
|---|---|
| *Hohenbergia caymanensis* | Old George |
| *Coccothrinax proctorii* | Silver Thatch palm |
| *Agave caymanensis* | Century plant / Agave |
| *Myrmecophila thomsoniana* | Banana orchid |
| *Dendrophylax fawcettii* | Ghost orchid |
| *Pisonia margaretae* | |
| *Epiphyllum phyllanthus plattsii* | |
| *Consolea millspaughii caymanensis* | |
| *Banara caymanensis* | |
| *Dendropemon caymanensis* | |
| *Cedrela odorata* | Cedar |
| *Drypetes* sp. | |
| *Aegiphila caymanensis* | |
| *Salvia caymanensis* | Cayman sage |
| *Chionanthus caymanensis* | Ironwood |
| *Verbesina caymanensis* | |

| | |
|---|---|
| INVERTEBRATES | |
| *Cerion nanus* | Little Cayman snail |
| *Brephidium exilis thompsoni* | Cayman Pygmy Blue butterfly |
| FRESHWATER FISH | |
| *Limia caymanensis &* *Gambusia xanthosoma* | Mosquito fish |
| REPTILES | |
| *Anolis maynardi* | Green anole |
| *Cyclura nublia caymanensis* | Sister Islands Rock iguana |
| *Cyclura lewisi* | Grand Cayman Blue iguana |
| BIRDS | |
| *Phaethon lepturus* | White-tailed tropicbird |
| *Sula sula* | Red-footed booby |
| *Sula leucogaster* | Brown booby |
| *Dendrocygna arborea* | West Indian Whistling-duck |
| *Amazona leucocephala* | Cayman parrot |
| *Dendroica vitellina* | Vitelline warbler |
| MAMMALS | |
| *Chiroptera* | Bats |

**ABBREVIATIONS AND ACRONYMS**

| | |
|---|---|
| **AAC** | Aggregate Advisory Committee |
| **AS** | Agricultural Society, Cayman Islands |
| **BC** | Bird Club, Cayman Islands |
| **BCI** | Bat Conservation International |
| **BIRP** | Blue Iguana Recovery Programme |
| **CA** | Culinary Association |
| **CARICOMP** | Caribbean Coastal Marine Productivity Program |
| **CBD** | Convention on Biological Diversity |
| **CC** | Conservation Council |
| **CCMA** | Centre for Coastal Monitoring and Assessment, NOAA |
| **CCMI** | Central Caribbean Marine Institute |
| **CH2MHILL** | A provider of engineering, construction, and operations services. |
| **CICTA** | Cayman Islands Council of Traditional Arts |
| **CIG** | Cayman Islands Government |
| **CITA** | Cayman Islands Tourism Association |
| **CITES** | Convention on International Trade in Endangered Species |
| **CIJ** | Cayman Islands Judiciary |
| **CN** | Cayman Nature, Cayman Islands |
| **COP** | Conference of the Parties, governing body of the CBD |
| **CPA** | Central Planning Authority, Grand Cayman, Cayman Islands |
| **CPN** | Commercial plant nurseries |
| **CSL** | Central Science Laboratory, UK |
| **CTF** | Cayman Turtle Farm, Cayman Islands |
| **CUC** | Caribbean Utilities Company |
| **DCB** | Development Control Board, Little Cayman and Cayman Brac, Cayman Islands |
| **DE** | Department of Education, Cayman Islands |
| **DEFRA** | Department of Environment, Food and Rural Affairs, UK |
| **DEH** | Department of Environmental Health, Cayman Islands |
| **DGSA** | Designated Grouper Spawning Areas |
| **DoC** | Department of Customs |
| **DoA** | Department of Agriculture, Cayman Islands |
| **DoE** | Department of Environment, Cayman Islands |
| **DoP** | Department of Planning, Cayman Islands |
| **DoRPC** | Department of Recreation, Parks and Cemeteries, Cayman Islands |
| **DoT** | Department of Tourism, Cayman Islands |
| **DWCT** | Durrell Wildlife Conservation Trust |
| **EAC** | Environmental Advisory Committee |
| **EEZ** | Exclusive Economic Zone |
| **EIA** | Environmental Impact Assessment |
| **ENSO** | El Niño Southern Oscillation |
| **ESO** | Economics and Statistics Office, Cayman Islands |
| **GC** | Garden Club, Cayman Islands |
| **GIS** | Government Information Services, Cayman Islands |
| **HAP** | Habitat Action Plan |
| **HMC** | Her Majesty's Customs, Cayman Islands |
| **HS** | Humane Society, Cayman Islands |
| **IBAs** | Important Bird Areas, Birdlife International designation |
| **IRCF** | International Reptile Conservation Foundation |
| **ISG** | Iguana Specialist Group |
| **IBA** | Important Bird Area, Birdlife International designation |
| **IntC** | International Collaborators (scientific and management expertise, funding and resources). |
| **IUCN** | International Union for Conservation of Nature |
| **LCN** | Local Commercial Nurseries |
| **LD** | Legal Department, Cayman Islands |
| **LPP** | Land for Public Purposes (Planning designation), Cayman Islands |
| **LS** | Lands and Survey Department, Cayman Islands |
| **LSCo** | Land and Sea Cooperative |
| **MCB** | Marine Conservation Board |
| **ME** | Ministry for Environment, Cayman Islands |
| **MEA** | Multilateral Environmental Agreements |

| | |
|---|---|
| **MP** | Members of the Public, particularly Private Landowners and Farmers |
| **MSB** | Millennium Seedbank, conservation seed storage programme of Royal Botanic Gardens Kew, UK |
| **MTRG** | Marine Turtle Research Group, University of Exeter |
| **MMU** | Minimum Mapping Unit |
| **NBAP** | National Biodiversity Action Plan |
| **NCCA** | National Climate Change Adaptation Working Group, Cayman Islands |
| **NCL** | National Conservation Law, Cayman Islands |
| **NMBCA** | Neotropical Migratory Bird Conservation Act, USFWS, USA |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **NRA** | National Roads Authority |
| **NT** | National Trust for the Cayman Islands |
| **OS** | Orchid Society, Cayman Islands |
| **OTEP** | Overseas Territories Conservation Programme, UK |
| **PCRU** | Parks Cemeteries and Recreation Unit, Cayman Islands |
| **QEIIBP** | Queen Elizabeth II Botanic Park, Cayman Islands |
| **Ramsar** | Ramsar Convention on Wetlands |
| **RBGK** | Royal Botanic Gardens Kew, UK |
| **RCIP** | Royal Cayman Islands Police (including Marine Police) |
| **REEF** | Reef Environmental Education Foundation |
| **RSPB** | Royal Society for the Protection of Birds |
| **SB** | Shade Brigade, Cayman Islands |
| **SAP** | Species Action Plan |
| **SBSTTA** | Subsidiary Body on Scientific, Technical and Technological Advice to the CBD |
| **SCSCB** | Society for the Conservation and Study of Caribbean Birds |
| **SDZ** | San Diego Zoo, USA |
| **SIDA** | Sister Islands Development Agency |
| **SITA** | Sister Islands Tourism Association |
| **SPAW** | Specially Protected Areas and Wildlife in the Wider Caribbean Region Programme |
| **UKHO** | United Kingdom Hydrographic Office |
| **UICN** | see IUCN (French and Spanish) |
| **USDA** | United States Department of Agriculture |
| **USFWS** | United States Fish and Wildlife Service, USA |
| **USGS** | United States Geological Survey |
| **VOL** | Volunteers from the local and international community |
| **WA** | Water Authority |
| **WIZ** | Wildlife Interaction Zones |

## BIODIVERSITY: THE VARIETY OF LIFE

### What is Biodiversity?

Biological diversity or "biodiversity" is the variety of life – *all creatures, great and small*.

Biodiversity includes all plants and animals… even fungi.

Biodiversity is all the species in the world today, irrespective of their size, distribution, economic value, scientific interest, or rarity.

Biodiversity encompasses the genetic diversity within species and extends beyond species, to encompass the habitats on which they depend.

### Why is Biodiversity Important?

We are a part of biodiversity - an integral part.

Like every species, ours depends upon other species for survival. While man has adapted to survive in an extreme range of habitats and environmental conditions, we remain ever-dependent upon the fundamental elements of adequate nutrition, fresh water and breathable air. The provision of these necessities for life is wholly reliant upon the functioning of the natural ecosystems of this planet.

All ecosystems are subject to the diversity and balance of their component species to maintain their natural function. Loss of species can result in temporary perturbation of ecosystems, or in far-reaching and permanent consequences.

In the minds of some, biodiversity equates to large *"charismatic"* species, critically endangered species, or those of special conservation concern: bizarre and exotic animals glimpsed from expeditionary records, or the windows of submersibles. For others, biodiversity is the species which we depend on most immediately: those of economic importance - those which keep us clothed and fed. Non-the-less, the fact of the matter is that *"keystone"* species, those most critical to the foundation and function of ecosystems, are most often the super-abundant and the small: mundane as they are essential.

It could be argued that all animals have a right to existence, regardless of their value to humankind, however, from a purely selfish perspective, the preservation biodiversity is to preserve our quality of life, and indeed, to preserve ourselves.

### History of Biodiversity Conservation

Around the globe, national histories of biodiversity conversation are usually unique, but often share common themes. With the advent of global communications, conservation efforts became increasingly linked through the global network. It soon became apparent that the irrepressible trend in global diversity was one of decline, and that this decline was rapid and large scale. Comparison with the fossil record indicates that we are currently loosing species at a rate comparable to the mass extinction which saw the end of the dinosaurs (Wilson and Peter 1988).

In recognition of the global trend of decline in biodiversity, world leaders assembled in April 1992, at the Rio Earth Summit. One hundred and fifty countries, including the UK, signed the *Convention on Biological Diversity* (CBD), undertaking to develop and implement conservation management plans to ensure the preservation of species and habitats, towards halting the global decline in biodiversity.

The CBD was extended at the Cayman Islands in 1992, at the request of the Cayman Islands Government.

**Understanding the Convention on Biological Diversity (CBD)**

The *Convention on Biological Diversity* was the first global agreement to cover all aspects of biodiversity.

The Convention has three main goals:

1. to conserve biodiversity;
2. to sustainably use the components of biodiversity; and
3. to share the benefits arising from the commercial and other use of genetic resources in a fair and equitable way.

Under *Article 8* of the CBD all member nations agreed to establish a *system of protected areas* or areas where special measures need to be taken to conserve biodiversity.

The CBD is a legally binding global treaty and the *Conference of the Parties* (COP) is the governing body of the Convention which advances its implementation through the decisions it makes at its periodic meetings.

**Strategic plan**

In 2002, ten years after the CBD was opened for signature, the COP developed a strategic plan with the mission *"to achieve by 2010, a significant reduction of the current rate of biodiversity loss at the global, regional and national level, as a contribution to poverty alleviation and to the benefit of all life on Earth."*

This 2010 target was then endorsed by the Heads of State and Government at the World Summit on Sustainable Development in Johannesburg, South Africa, in 2002.

**2010 Biodiversity Target**

In November 2003 the *Subsidiary Body on Scientific, Technical and Technological Advice* SBSTTA to the Convention recommended a global target to *"provide effective protection for at least 10% of each habitat type globally."*

It also recommended establishing *"at least 10 marine and coastal protected areas in areas outside of national jurisdiction, as a step towards a longer term target of including 20-30% of each habitat type in effectively managed marine and coastal protected areas."* *

According to the SBSTTA, marine and coastal protected areas are essential for the conservation and sustainable use of marine and coastal biodiversity.

SOURCE: www.epa.qld.gov.au

* Worldwide, the more progressive countries have already attained their 2010 targets of 10% habitat protection. Many, especially those with a significant reliance on their natural environment for tourism, are already progressing towards the 2020 targets of 20-30% protection. The new bar for environmental protection, however, is being set higher still. World-leading destinations are now opting for 100% protection of key habitats.

## IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

### The Darwin Initiative

The Darwin Initiative was announced by the UK Government at the Rio Earth Summit in 1992.

The aim of the Darwin Initiative is to assist those countries which are rich in biodiversity but poor in financial resources to implement the Convention on Biological Diversity (CBD), through the funding of collaborative projects which draw on UK biodiversity expertise.

Darwin projects are diverse. Typically, they address issues in the following areas:

* institutional capacity building
* training
* research
* work to implement the Biodiversity Convention
* environmental education or awareness

The Darwin Initiative is operated by the Department of Environment, Food and Rural Affairs (DEFRA), UK.

(SOURCE: http://darwin.defra.gov.uk/)

### Biodiversity in the Cayman Islands

The CBD was extended at the Cayman Islands in 1992, at the request of the Cayman Islands Government. In the Cayman Islands, conservation legislation exists in the form of the Marine Conservation Law (1978) and the Animals Law (1976). The former addresses conservation of the Marine Environment, and the latter conservation in the Terrestrial Environment.

Because the concept of biodiversity conservation has only really come to the fore since 1992, neither of these local laws represents a suitable legislative framework for the implementation of the Convention on Biological Diversity (CBD).

In September 2001, the *Environment Charter* was signed – a broad agreement between the Governments of the UK and the Cayman Islands, towards implementing the CBD.

*Link to Environmental Charter for the Cayman Islands*

**Fig. 1** *The Cayman Islands Environment Charter*.

Government commitments under the *Cayman Islands Environment Charter* require that new legislation be drafted, towards providing a framework for the conservation of our national biodiversity, and the implementation of MEAs, such as Ramsar, SPAW and the CBD, to which the Cayman Islands is signatory.

This new legislation is called the *National Conservation Law.* At the present time, this legislation has been pending approval for over seven years.

In the wake of Hurricane Ivan, the requirement for establishing baseline information on the status and distribution of habitats and species in the islands became critical. In 2005, towards implementing the species and habitat preservation requirements of the *National Conservation Law,* and funded by a matched contribution from the Darwin Initiative, the Cayman Islands Department of Environment commenced production of the *Biodiversity Action Plan for the Cayman Islands*.

**Evaluating the Biodiversity of the Cayman Islands**

The first step in the development of the *National Biodiversity Action Plan* (NBAP) for the Cayman Islands was the gathering together of existing information on the island's species and habitats, towards establishing baseline information on the status of the country's biodiversity, and determining key areas requiring action.

While all species form part of biodiversity, it is impractical to develop and implement conservation action plans for every species. So, towards achieving the goal of *"no net loss of biodiversity"*, a practical two-pronged approach is taken:

1. preservation of key habitats, through *Habitat Action Plans* (HAPs) and
2. preservation of key individual species, through *Species Action Plans* (SAPs).

Habitat preservation is the backbone of the NBAP, and carries with it the greatest potential for the preservation of the widest variety of species and functioning ecosystems. Preservation of a functioning habitat enables the preservation of many tens, hundreds, or even thousands of individual species.

In additional the *Habitat Action Plans*, some individual *Species Action Plans* have been developed, towards preserving species of special interest. Species selected for individual attention, are generally:

- of special local significance
- of economic value
- of particular conservation concern
- subject to pressures unlikely to be adequately addressed through a general *Habitat Action Plan*
- likely to benefit from a dedicated *Species Action Plan*

From baseline assessments, broad habitat categories were developed, each comprising a variety of related habitat types. Nineteen habitat categories were agreed - six marine, five coastal, and eight terrestrial, and a *Habitat Action Plan* (HAP) was developed for each. Forty one key species (or groups of species) were singled out for development and implementation of individual *Species Action Plans* (SAPs).

To enable progress to be assessed, both HAPs and SAPs incorporate a number of requisite targets, and proposed actions. Both are accompanied by timescales, and a list of potential stakeholders and deliverers.

Natural habitats range from open water, coral reefs and lagoons, to mangrove, shrubland and forest. Habitat categories also include man-modified systems, such as agricultural land, parkland, urban and suburban developments, and roads. With the population of the Islands almost doubling every ten years, protected areas will become increasingly isolated ecologically, unless a concerted effort is made to maintain the biodiversity value of the built surrounds. As urban sprawl expands, the necessity to maintain ecological function within the built environment will become increasingly important, if environmental function and quality of life if to be maintained in the Islands.

**No net loss of Biodiversity**

The goal for the NBAP is simple:

*Zero extinction in the Cayman Islands*

It is a fundamental right of future generations that they be afforded the opportunity to enjoy and benefit from the same variety of life and ecosystem services which we take for granted.

It is not for ourselves to decide what constitutes a "reasonable rate of decline", or an "acceptable loss".

**What will the National Biodiversity Action Plan do?**

The *National Biodiversity Action Plan* (NBAP) is not intended to replace existing conservation initiatives, indeed existing plans and processes are crucial to the success of the NBAP.

The objective of the NBAP is to bring together the accumulated information and resources, individuals and organizations, with a stake in Cayman Islands biodiversity - in order that their stake be recognized, and that conservation funds, resources and expertise may be utilized most effectively, and most equitably.

It is intended that, once enacted, the NBAP will serve as a resource and information hub, informed by, and to inform, all with a stake in the environment of the Cayman Islands, with a view to ensuring that full consideration of the value of an ecologically sound environment be taken into consideration in all decisions pertaining to the future of the country.

The NBAP is a living document. It will neither exist as a draft form, nor as a completed document. The NBAP will be subject to continuous update and revision as targets are reached. As such, the NBAP will evolve as a constantly developing complement of targets and objectives, backed up by practical, implemented, conservation management activity.

The NBAP will serve as a resource towards informing integrated planning and design, sustainable development, extractive industry, residential development, and local business and tourism, towards maintaining a functional and attractive natural environment in the Cayman Islands, maintaining common resources and ecosystem services, and maximizing the quality of life for all residents.

The NBAP will bring together information on Governmental and non-Governmental protected areas and conservation strategies, and highlight the potential of other stakeholders to actively contribute to the preservation process. Through these mechanisms, the NBAP will seek to establish and maintain a diverse system of national protected areas, to protected areas for wildlife, develop and improve sustainable recreational opportunities, and where feasible, restore aspects of the environment, towards recovering some of the natural value which has been lost from these islands in recent years.

**Taking Action**

"Action", rather than "Planning" underpins the NBAP. For this reason, many individual action plans have already commenced.

Significant achievements under the Cayman Islands Darwin Initiative project "*In Ivan's Wake*":

- Establishment of a *Native Tree Nursery*, at the Queen Elizabeth II Botanic Park. An integral component of several SAPs, the *Native Tree Nursery* is currently growing over 6,000 trees from thirty target species. The stock is specially selected on the basis of landscaping value, hardiness for local conditions, cultural significance, wildlife value, endemism, and conservation status. Targeting members of the public, commercial landscapers, and public and private sector development, the *Native Tree Nursery* aims to reintroduce ecological, aesthetic and cultural value into the built environment of the Cayman Islands.

- Rediscovery of the Cayman sage *Salvia caymanensis*. Considered extinct in 2005, the SAP for Cayman sage basically aimed to establish whether this endemic plant, not seen for almost 50 years, still existed. Three years later, the SAP can report the rediscovery of the Cayman sage, seedbanking of 10,000 seeds, successful propagation at the *Native Tree Nursery*, and sale to members of the public - eager to plant and preserve this attractive and unique little flower in their own gardens.

- Initiation of feral cat control in Little Cayman, towards eradication of the feral population and protection of the significant birdlife and reptile interest of the island. In 2008, all pet cats on the island were micro-chipped, and some 29 feral cats were captured, in a pilot study.

- Initiation of feral Monk parakeet *Myiopsitta monachus* control in Grand Cayman, towards eradication of the feral population. During 2007-2008, some 80% of feral birds were captured.

- Establishment of a Shade House for the Cayman Islands Orchid Society, at the Queen Elizabeth II Botanic Park. This shade house will facilitate the Conservation Propagation Team to grow-on local orchids cultured in their propagation facility, for habitat restoration around the Islands.

- Commencement of seedbanking of endemic flora, with banking of ca. 10,000 seeds each of Cayman sage *Salvia caymanensis* and Tea banker *Pectis caymanensis* lodged with Royal Botanic Gardens, Kew.

- Establishment of informational website www.CaymanBiodiversity.com, incorporating a *Virtual Bird Guide* to the Cayman Islands.

- Supporting complimentary projects, including OTEP, in the production of the *Red List for the Cayman Islands*, and USFWS NMBCA, in the establishment of a nursery for mangroves.

- Initiation of public education programmes, beginning with the launch of a Darwin Initiative stamp issue, featuring local wildlife and the habitats on which they depend.

INSERT STAMPS IMAGES

**National Biodiversity Action Plan Partners**

The National Biodiversity Action Plan requires that governmental and non-governmental organizations work together to attain mutual environmental goals. To these ends, the Cayman Islands Darwin Initiative has relied heavily on the expertise and support of a host of local and international organizations and individuals:

*Lead Partners:*

- *Darwin Initiative*: is a UK grant scheme administered by the Department of Environment, Food and Rural Affairs (DEFRA), promoting biodiversity conservation and the sustainable use of resources. Website: http://darwin.defra.gov.uk

- *Department of Environment* (DoE): under the Cayman Islands Ministry for Tourism, Environment, Investment and Commerce (TEIC), the DoE is the main Government agency responsible for the management and conservation of the environment and natural resources. The DoE works to facilitate responsible management and sustainable use of the natural environment and resources of the Cayman Islands through various environmental protection and conservation programmes and strategies. Websites: www.CaymanBiodiversity.com and www.DoE.ky

- *University of Exeter*: the University of Exeter Cornwall Campus offers excellent facilities for teaching and research near Falmouth in Cornwall. Set in 70 acres of countryside, but close to the waterside towns of Penryn and Falmouth, the campus offers peace and tranquillity as well as a lively student community. Exeter is one of the UK's leading universities with 13,500 students at our campuses in Exeter and Cornwall, research income of £30m a year, and a network of 55,000 alumni across 150 countries. Website: www.exeter.ac.uk/cornwall

*Local and International Partners:*

- *Blue Iguana Recovery Programme* (BIRP): the National Trust for the Cayman Islands began captive breeding Blue Iguanas in 1990, in response to a government sponsored survey in 1988 which found wild iguanas to be so scarce that extinction seemed imminent. Since then the Blue Iguana Recovery Programme has developed to integrate Field Research, Habitat Protection, Captive Breeding, Population Restoration, and Public Education and Awareness. Website: www.BlueIguana.ky

- *Caymana Bay Nursery* (CBN): a private nursery enterprise, which incorporates significant native vegetation into formal landscaping schemes.

- *Cayman Islands Bird Club* (BC): the Bird Club is small a group of individuals with a common interest in birds. While the Bird Club is, for the most part, a recreational group, members conduct annual bird counts on Grand Cayman, and have assisted in the past in a variety of bird-related projects.

- *Cayman Islands Humane Society* (HS): the Humane Society takes in many abused dogs and cats that need a loving home. Website: www.caymanhumanesociety.com

- *CaymanNature* (CN): CaymanNature works with local and international groups to promote the natural history of the Cayman Islands, particularly butterflies and flora.

- *Cayman Islands Orchid Society* (OS): the Orchid Society is dedicated to the preservation of Cayman's native orchids and educating its members and the public on orchid conservation and orchid culture. The Orchid Society is co-sponsor, with the Queen Elizabeth II Botanic Park, of the annual Orchid Show and Sale. Website: http://dir.gardenweb.com/directory/cios/

- *Cayman Wildlife Connection* (CWC): CWC is a network of interested people who hope to conserve the Cayman Islands' unique flora & fauna by encouraging individuals to landscape with native plants. By promoting the understanding that it is economically feasible to retain original vegetation during development and by connecting with existing organizations to highlight native flora and fauna as a part of the Cayman Islands' national identity. Website: www.caymanwildlife.org

- *Department of Agriculture* (DoA): DoA is the main Government agency responsible for agriculture in the Cayman Islands. The remit of DoA extends to include issues related to Animal Welfare, Veterinary support, and Animal Health Screening and Phytosanitary Regulation for imports and exports. DoA works closely with HMC and DoE. Telephone: (345) 947-3090. Fax: (345) 947-2634. Address: 181 Lottery Rd, Lower Valley, Grand Cayman, Cayman Islands. Mailing Address: PO Box 459, KY1-1106, Grand Cayman, Cayman Islands. Email: Brian.Crichlow@gov.ky

- *Garden Club of Grand Cayman* (GC): founded in 1957, the aim and purpose of the Garden Club is to promote interest in and knowledge of gardening and of all things related to the enjoyment of the natural beauty of the Cayman Islands; to undertake projects, either by ourselves or in concert with others, to beautify our community; to encourage the promotion of friendship and understanding among persons of all nationalities who share our interest in gardening. Our theme is "Keep Cayman Clean and Beautiful". Contact: PO Box 1617, Cayman Islands KY1-1109.

- *International Reptile Conservation Foundation* (IRCF): IRCF works to conserve reptiles and the natural habitats and ecosystems that support them. The International Reptile Conservation Foundation, Inc. is a non-profit 501c(3) California Corporation. All monetary and material donations are tax deductible to the extent allowed by federal, state and local tax codes. Website: www.ircf.org

- *Marine Turtle Research Group* (MTRG): MTRG is a group of professional scientists and student volunteers dedicated to undertaking fundamental and applied research on marine turtles whilst supporting local capacity building and environmental awareness efforts necessary for successful conservation. The Group are now permanently based at the School of Biological Sciences, University of Exeter. Website: www.seaturtle.org/mtrg

- *National Trust for the Cayman Islands* (NT): the National Trust is a non-profit, statutory body with a mission: "To preserve natural environments and places of historic significance in the Cayman Islands for present and future generations." With the exception of Animal Sanctuaries, which were first designated under the Animals Law (1976), the National Trust for the Cayman Islands Law (1987) currently represents the only mechanism for the designation of terrestrial protected areas in perpetuity, in the Cayman Islands. Key Trust reserves on Grand Cayman include the Mastic Reserve (*forest and woodland*), Salina Reserve (*dry shrubland* and *grassland*), and parcels in the Central Mangrove Wetland (*mangrove*). On Cayman Brac, key reserves are The Splits (*dry shrubland* and *Pools, ponds and mangrove lagoons*) and the Brac Parrot Reserve (*forest and woodland*); and on Little Cayman, the Booby Pond Reserve (*dry shrubland*, *mangrove*, and *pools, ponds and mangrove lagoons*). The National Trust is located at: 588A South Church St., George Town, Grand Cayman. Website: www.nationaltrust.org.ky

- *Queen Elizabeth II Botanic Park* (QEIIBP): Forty acres of the acres of the 65 acre Botanic Park is preserved in its natural state with a 0.8 mile walking trail. It is estimated that 40% of Grand Cayman's native flora is growing in the Woodland Preserve and the Woodland Trail passes through a wide variety of habitats and plant communities. The Botanic Park also houses a captive breeding and reintroduction facility for the endemic and critically endangered Blue Iguana *Cyclura lewisi*, offering a unique opportunity to see these unique lizards close up. The main focus of the Park's plant collections, aside from native flora, is the lowland seasonal flora of the West Indies (especially the Greater Antilles). Website: www.botanic-park.ky

- *Royal Botanic Gardens, Kew* (RBGK): The mission of the Royal Botanic Gardens, Kew is "To enable better management of the Earth's environment by increasing knowledge and understanding of the plant and fungal kingdoms - the basis of life on earth". Website: www.rbgkew.org.uk

- *Royal Society for the Protection of Birds* (RSPB): The RSPB is the UK charity working to secure a healthy environment for birds and wildlife, helping to create a better world for us all. Website: www.rspb.org.uk/

INSERT PARTNER LOGOS

**Who Pays for Biodiversity Conservation?**

We are all eager to benefit from a functional environment, however, as the pressures upon our environment grow, so does the financial cost of managing and maintaining our environment.

Fortunately, in the Cayman Islands, we have a long-established mechanism designed to raise money for the preservation of our environment. This mechanism is called the *Environmental Protection Fund*.

The *Environmental Protection Fund* was established in the Hansards of 23rd December 1997, Government Motion No. 14/97. For the purposes of:

*… defraying expenditure incurred in protecting and preserving the environment of the Islands.*

The *Environmental Protection Fund* raises money each time a resident or a visitor to the Cayman Islands leaves our shores, according to the Miscellaneous Provisions (Fees and Duties) (Temporary) (Amendment) (Environmental Protection Fees) Law, 1998, the fees charged are about CI$3.20 for air departures and CI$1.60 cruise ship departures.

Given the millions of journeys undertaken by local residents and tourists annually, the *Environmental Protection Fund* raises about $5 million each year.

One could be forgiven for thinking that, with $5 million to spend on the environment each year, the Cayman Islands should be able to boast a National System of Protected Areas which was the envy of the world; attracting tourists from afar as a *Green Globe* destination, and delivering to residents a quality of life which was second to none…

… the Cayman Islands conservation effort was kick-started in 1986, with the establishment of the first Marine Parks. Revolutionary (and controversial) in their time, the Marine Parks helped establish the Cayman Islands as an international dive destination. They remain the cornerstone of Cayman's conservation portfolio. Unfortunately, little has been done to improve our system of protected areas since this time. Not has the Cayman Islands failed to establish *any* national terrestrial protected areas since the Animal Sanctuaries of 1976, the country even lacks the basic legislation required to enable the creation of a new national terrestrial protected area, such as Wildlife Preserve or a National Park.

So, what is the *Environmental Protection Fund* spent on?

Unfortunately, during the ten years since it came into operation, the *Environmental Protection Fund* has rarely been spent on the purposes for which it was established. In the past, *Environmental Protection Fund* money has been spent on disparate projects, including roads and infrastructure development. In 2004, over $10 million was spent on clean-up operations following Hurricane Ivan. Since then, little of the revenue generated from the *Environmental Protection Fund* has been spent on the environment. As a result, over the last four years, the *Environmental Protection Fund* has swollen to over $20 million. Currently, this money is used to balance the Government's budget.

Given the current rate of development in the Cayman Islands, in the event that the *Environmental Protection Fund* continues not to be spent on the environment, the Cayman Islands will *never* be in a position to implement the targets of the NBAP.

*Without the support of the Environmental Protection Fund,*
*to preserve and protect the environment of the Islands,*
*the extinction of unique Caymanian species is guaranteed.*

Under the draft *National Conservation Law*, there is provision for the establishment of a Conservation Fund to be managed by a *Conservation Council* comprising both Government and non-Governmental representatives. With the passage of this law, it is hoped that the current Environmental Protection Fund

will be incorporated into the Conservation Fund, thereby ensuring that future spending is in line with the reasons for which the *Environmental Protection Fund* was originally established.

We all pay for conservation. We all pay when conservation does not happen.

Invariably, it is more cost effective and socially beneficial to preserve a healthy resource, than defer spending until ecological issues become critical and acute.

**Involving People**

The Cayman Islands is host to species which are found nowhere else in the world. Our natural environment underpins the quality of life for our residents, and our tourism industry.

Preservation of local biodiversity, towards maintaining the global diversity of life, falls to the stewardship and responsibility of the people of the Cayman Islands. It is the involvement and support of local Government, non-Governmental organizations, and members of the public which will determine whether the *National Biodiversity Action Plan* is a success. For this reason, from inception, the development of the NBAP has aimed to establish and improve communications, working in partnership with special interest groups, and the local community.

The presence of appropriate legislation, such as the *National Conservation Law*, will not, of itself, ensure the preservation of species or habitats. Those with the greatest stake in the environment, and those with the most to loose from its decline, should be afforded the opportunity and recourse to assist in its preservation. It is important that we all remain cognizant of our personal holdings in a functional environment, and that we not allow the influences and pressures of powerful individuals to undermine, belittle or devalue our common stake in a functional environment.

First published in the journal *Science*, in 1968, *The Tragedy of the Commons*, written by Garrett Hardin, describes the process whereby individuals acting independently, and in their own self-interest, destroy a shared resource, even where it is clear that no one's best interest is ultimately served by this end. *The Tragedy of the Commons* is echoed across the world, and throughout history.

With respect to the natural environment, and the ecosystems services it provides, *The Tragedy of the Commons* is already well-advanced in the Cayman Islands. Super-abundant fisheries, pristine reefs, unrestricted beach access, uncontaminated ground water, and clean air are just some of the lost common resources of the Cayman Islands.

**Climate and Climate Change**

The climate of the Cayman Islands is influenced by their location in the western Caribbean Basin. The islands have a tropical marine climate with two distinct seasons: a wet season from May to November and a relatively dry season from December to April.

Air temperatures (recorded on Grand Cayman) range from a low of 11.20 °C to a high of 36.50 °C, but the mean monthly air temperatures only range from 24.75 °C (February) to 28.40 °C (July). North-easterly trade winds predominate for most of the year, with hurricanes occurring mainly between August and November. Direct hits from hurricanes strike the islands about once every ten years, however the islands are brushed by tropical storms or hurricanes every 2.21 years (http://www.hurricanecity.com/city/caymanislands.htm).

Small islands are often economically, socially and physically vulnerable by their very nature – small size, narrow economic base, geographical and socio-economic isolation, susceptibility to external shocks and limited human capacity. Because they are unable to produce all the goods and services to meet domestic needs, they are often import-dependent. Many rely on tourism to generate foreign exchange to balance this demand for imported goods and services. Due to their small land masses, small islands are typically land-resource constrained and highly vulnerable to climate change because of their dependence on the natural resource base for livelihoods and tourism activities. This means that there are limited places for people to live, space for infrastructure, areas for waste disposal, agricultural production, industrial development, and areas of natural resource and biodiversity preservation.

Many small islands are already at risk from several environmental hazards, such as storm surge-related coastal inundation rain-induced inland flooding, and wind and rain associated tropical cyclone impacts . Climate change is expected to exacerbate these hazards making already vulnerable islands more prone to changing conditions and creating particular challenges for the resiliency of biological systems. Knowing the existing risks and how they are changing should help those on small islands prepare for future hazards. In particular it is important to understand how existing vulnerabilities could exacerbate the impacts of other climate-related hazards and what can be done to reduce the threat of disaster.

Most biological systems are already under pressure from land use changes and other anthropogenic stressors such as over-exploitation and pollution. Storm events with more intense wind and rain regimes, combined with past decades of habitat destruction and biological invasions, are likely to drive several species such as endemic birds to extinction. Other anticipated impacts on biodiversity include inundation of coastal mangroves, and possible increase in marine and terrestrial pathogens, notably coral diseases.

Increases in extreme events and the cumulative impacts of storms will likely affect the adaptation responses of forests on tropical islands in the short term, where regeneration is often slow (UN 2007 SIDS Report). The very nature of island biogeography constrains natural adaptation in the spatial context as the ability of terrestrial species to migrate has very clear physical limitations. The capacity of mangroves and other coastal systems to keep pace with rising sea levels is of particular concern, as is the erosion rate of remaining turtle nesting beaches. Soil and aquifer salinization will adversely affect the health of specific habitats as well as disrupt critical ecosystem services upon which agriculture and water sectors depend.

During 2004-2005, the Department of Environment worked in conjunction with the Tyndall Centre for Climate Change Research to produce A Guidebook: *Surviving Climate Change in Small Islands.* The guidebook offers a wealth of information on Climate Change, and practical advice on how to adapt to Climate Change.

SOURCE: http://www.caymanbiodiversity.com/downloads/Tyndall_Centre_surviving_climate_change.pdf

## GLOBAL CONSERVATION: THE IUCN

### What is the International Union for Conservation of Nature (IUCN)?

The *International Union for Conservation of Nature* IUCN is an international organization which helps the world find pragmatic solutions to our most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings Governments, non-Government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice.

IUCN is the world's oldest and largest global environmental network: a democratic membership union with more than 1,000 Government and NGO member organizations, and almost 11,000 volunteer scientists in more than 160 countries.

IUCN's work is supported by over 1,000 professional staff in 60 offices and hundreds of partners in public, NGO and private sectors around the world. The Union's headquarters are located in Gland, near Geneva, in Switzerland.

### Vision and mission

Vision: *a just world that values and conserves nature.*

Mission: *to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.*

### History

The IUCN was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France.

The organization changed its name to the International Union for Conservation of Nature and Natural Resources in 1956 with the acronym IUCN (or UICN in French and Spanish).

Use of the name "World Conservation Union", in conjunction with IUCN, began in 1990. From March 2008 this name is no longer commonly used.

SOURCE: www.iucn.org

**IUCN Protected Area Management Categories**

The *International Union for Conservation of Nature* IUCN has defined a series of six protected area management categories, based on primary management objectives. A national system of protected areas might be expected to include one of more of the following:

CATEGORY Ia: *Strict Nature Reserve: protected area managed mainly for science*

An area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

CATEGORY Ib: *Wilderness Area: protected area managed mainly for wilderness protection*

An area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

CATEGORY II: *National Park: protected area managed mainly for ecosystem protection and recreation*

A natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

CATEGORY III: *Natural Monument: protected area managed mainly for conservation of specific natural features*

An area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

CATEGORY IV: *Habitat/Species Management Area: protected area managed mainly for conservation through management intervention*

An area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

CATEGORY V: *Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation*

An area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

CATEGORY VI: *Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems*

Area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

SOURCE: www.iucn.org

**IUCN Red List Categories**

The *IUCN Red List of Threatened Species* provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction (i.e. those listed as **Critically Endangered**, **Endangered** and **Vulnerable**). The IUCN Red List also includes information on taxa that are categorized as **Extinct** or **Extinct in the Wild**; on taxa that cannot be evaluated because of insufficient information (i.e. are **Data Deficient**); and on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme (i.e. are **Near Threatened**).

Taxa that have been evaluated to have a low risk of extinction are classified as **Least Concern**. The Least Concern assessments did not appear on IUCN Red Lists produced before 2003 (except for 225 cases in 1996) because the main focus has been on threatened species. However, for the sake of transparency and to place threatened assessments in context, all Least Concern assessments are now included. Unfortunately, there has not been a formal reporting process in place to capture all Least Concern assessments; hence the list provided is incomplete. A process to capture the Least Concern listings has begun (at the species level only), but this is likely to take several years to complete.

The list of threatened taxa is maintained in a searchable database by the Red List Unit of the IUCN Species Programme as part of the SSCs Species Information Service (SIS). The records for all taxa listed in the Red List Categories described above are provided here and they can be viewed by using the Search and Expert Search functions on the home page. (Note that the default search parameters are set to look for species only and include Least Concern listings).

Taxa not included on the IUCN Red List are those that went extinct before 1500 AD, Least Concern species that have not yet been data based, and species that have not yet been assessed (i.e., they are in the **Not Evaluated** category). The only taxonomic groups, that have been comprehensively assessed, are the amphibians, birds, mammals, conifers and cycads. The vast majority of plant taxa listed in the 1997 IUCN Red List of Threatened Plants have not yet been evaluated against the revised Red List Criteria and are therefore not included here.

In-depth analyses of the data contained in the IUCN Red List are conducted periodically and the results are published once every four years.

SOURCE: www.iucnredlist.org

In 2008, *The Red List of the Flora of the Cayman Islands* was published, listing the conservation status of all 415 species and varieties considered native to the Cayman Islands, (Burton, 2008a). This publication was jointly funded by the Overseas Territories Conservation Programme (OTEP) and the Cayman Islands Government, through the Department of Environment, with support from the Darwin Initiate.

## HABITAT MAPPING

Habitat mapping objectives were defined as follows:

- create a baseline marine and terrestrial habitat inventory for the Cayman Islands,
- create a practical and repeatable mapping methodology,
- emphasise delineation of primary areas, especially delineation of dynamic habitats, such as *seagrass* in the marine environment, and *invasive coastal plants* on land,
- produce maps that would be at a level of detail of maximum benefit to the end user,
- utilise the abundance of existing supporting data.

Marine habitats (benthic, lagoons and shoreline habitats) were delineated using 2004 true colour aerial photography, supplied by the Cayman Islands Department of Lands and Survey, LS. The imagery was provided as both orthorectified and georectified to the local grid, in MrSID compressed format (scale 1:7,000, 0.12m resolution) in a projected UTM Nad27 datum based local coordinate grid, referred to as "CaymanLIS".

Terrestrial habitats were defined using 2006 Quickbird imagery, purchased by the Department of Environment DoE. Quickbird is multi-spectral (4 band) satellite imagery, with a resolution of 2.4m. Eight individual Quickbird satellite images comprised the necessary data coverage for the classification; four for Grand Cayman, two for Little Cayman, and two for Cayman Brac. All images were collected on different dates over the course of 2006. Images taken at different times of the year are subject to spectral variation, due to seasonal factors such as leaf growth and fall. As such, the composite image could not be classified using the automatic method, and each component had to be classified separately.

### Marine Habitat Mapping

Marine habitats within and outwith lagoons were categorized separately, towards improving specificity for key features, such as seagrass beds and patch reefs, respectively.

Outwith lagoons, a hierarchical classification structure was used (following the example of a similar project, *Benthic Habitats of Puerto Rico and the U.S. Virgin Islands*, completed by NOAA's Centre for Coastal Monitoring and Assessment (CCMA)). The hierarchical structure allowed for expanding or collapsing the classification to suit specific mapping goals.

Development of the local classification scheme included extensive input from resource managers, experts on the Cayman Islands marine ecosystem, and the map producer, towards developing and adapting the hierarchical classification to suit local biogeographical conditions, and conservation management objectives. The end result of this evolving exercise was a scheme that was scientifically sound, practical and repeatable.

Habitat delineation outwith lagoons utilized the habitat digitizer extension for ESRI's ArcGIS desktop v9.x, developed for similar projects by NOAA's CCMA. It was important to determine a suitable scale when digitising; balancing the need to maximize the quality of the imagery, avoid becoming unnecessarily detailed or too generalized, and ensuring consistency in the finished product. For the current project a digitising scale of 1:2,000 was chosen for the majority of habitats. A scale of 1:500 was used when working with fine features which were difficult to map at the larger scale (such as beach rock and manmade docks). A minimum mapping unit (MMU) of 150 $m^2$ was selected, based on a combination of image quality, and the small size of some key habitats.

Approximately 1125 field validation points covering all three Cayman Islands were utilised in the mapping exercise. Generally a field crew of three was required to complete field validations which were undertaken prior to mapping (towards scoping and determination of mapping feasibility) and periodically throughout the project (to assess the quality of the mapped product). Additional field validations were undertaken in

response to specific problem areas within the imagery, such as cloud cover. This was generally done using a "look-bucket" to determine habitat category at differentially corrected GPS coordinates.

Delineation of these habitats consisted of digitizing a polygon around unique areas visible in the 2004 aerial photography at a scale of 1:2,000 (when possible), selecting the associated habitat from the category scheme, and then finishing the polygon sketch. Adjacent areas of this polygon were then digitised in the same way until all of the imagery was assigned to the appropriate habitat category. Complimentary imagery was referenced where necessary, particularly for areas missing or unclear in the 2004 aerials. When this failed to provide the necessary level of detail areas were visited and validated in the field.

In order to estimate and report the reliability of mapped results, an estimate of thematic accuracy was completed. This involved using 170 points distributed using a stratified random sampling approach based on habitat type and coverage (ha). An error matrix was then created and accuracy by category, as well as overall accuracy, was calculated. At the detailed level, thematic accuracy was determined to be ca. 77%, while at the general level accuracy was ca. 90%.

For habitats within lagoons, benthic habitat maps were created using a hybrid supervised classification / manual delineation technique. GeoTIFF files were used because, being uncompressed, they were able to be manipulated.

A habitat classification scheme was developed which met the benthic habitat mapping objectives and also complemented the scheme for non-lagoon areas. The classification consisted of; Sand, Vegetated Sand, Vegetated Mud, Seagrass, Uncolonised Hardbottom, Colonized Hardbottom, and Hard Corals.

ArcGIS polygon shapefiles were created to delineate all lagoon areas. These polygons were then imported into Idrisi 15.0, and used to 'clip' the imagery so that only lagoons were included in each classification. A 7x7 minimum filter was then applied to each image, to reduce the high incidence of sun glint and reflectance.

Due to the very high image quality, file sizes were too large for Idrisi to effectively render an automatic classification. To overcome this issue, the images were prepared for automatic classification using an aggregation (factor 10), so that the resulting pixels represented an average of 40 original pixels. This had the added benefit of 'smoothing' the appearance of the imagery. A supervised classification (maximum likelihood) was used for each lagoon. This was made possible by a combination of extensive local knowledge, copious habitat data from previous projects, and field verification data. Training areas were developed for each lagoon habitat. A maximum likelihood classification was completed for each lagoon and results were checked using field validation data.

A number of iterations of the classification were completed until a satisfactory image was created for each lagoon. It was not possible to include coral or rubble in the automatic classification due to the high incidence of spectral mixing. Manual image-interpretation of 2004 aerial photography was used to delineate coral and rubble.

Cloud shadow and sun-glint presented issues. These areas were minimal, but where present, extensive field validation and cross-referencing with other available imagery were used to obtain a complete mapped product.

**Shoreline Habitat Mapping**

A detailed shoreline classification was completed as an value-added exercise, to assist in coastal zone management and complement the existing National Oil-spill Response plan. Shorelines will be ranked in order of their sensitivity to oiling, and it is planned that this information will be used in combination with environmental and recreational-use data to create an Environmental Sensitivity Index (ESI) map. The ESI will assist coastal zone managers in identifying vulnerable locations, establish protection priorities, and identify cleanup strategies in the event of an offshore oil or chemical spill.

A classification scheme was developed based mainly on substrate size and permeability, presence (or absence) of a natural vegetation line, and dominance of substrates in a given area. The individual substrate types were ironshore, rock, sand, cobble, vegetation, and man-modified installations.

The shoreline, for the purposes of this project, was defined and delineated as the area between the high water mark and the natural vegetation line (where present). The best example of a natural vegetation line in recent years came from the 2004 pre-Ivan imagery, taken in April of that year, largely due to the impact that Hurricane Ivan had on shoreline vegetation in September of that year. Also, the excellent quality of the imagery allowed for a classification through image interpretation. An extensive field validation exercise was completed to ensure the validity of this approach.

The shoreline was divided into sections with distinct substrate qualities. In each section there was the possibility of having up to three substrate types. In areas where 'mosaic' substrates occurred and were oriented parallel to shore, the seaward substrate was mentioned first and up to two more substrates were then mentioned, based on proximity to the water. In areas where the substrates were oriented perpendicular to the water line, the most dominant feature was mentioned first and then remaining substrates were mentioned in order of dominance. In areas where the natural vegetation line occurred at or beyond the high-water mark (i.e. mangrove), no shoreline was given and this area was mapped within the terrestrial habitat mapping project.

**Terrestrial Habitat Mapping**

Terrestrial land cover / land use maps were created using a hybrid automatic classification / manual delineation technique.

A hierarchical classification system was developed for the terrestrial habitat maps (see following section). Each mapping objective was first analyzed and the appropriate method was considered. After running an automated unsupervised classification (cluster), areas of spectral mixing were highlighted and analyzed using field validation data and local knowledge. This information was used to determine which methods would achieve the mapping objectives most effectively.

The first step was to determine which data would be masked in a supervised classification. Masked data were as follows:

- offshore areas and shoreline (for which separate classifications were already completed),
- nearshore vegetation (coastal shrubland was too similar in spectral reflectance to other habitats and inclusion of these data would obscure patterns in the remaining data),
- invasive Weeping willow *Casuarina equisetifolia* and Beach naupaka *Scaevola sericea* (for which a manual delineation was completed because of their particular importance as invasive species),
- cloud and cloud shadow,
- buildings (for which there are up-to-date polygon shapefiles that accurately reflect position and coverage better than possible using an automatic approach),
- roads (because of the availability of accurate data in shapefile format), and
- obviously built up areas (of which it was decided to use an object-oriented approach as it unnecessarily obscured patterns in remaining data).

Once suitably masked images were prepared, a supervised classification (maximum likelihood) was completed for each image. Requisite validation data were acquired through field observations, and aerial photo interpretation using very-high resolution aerial photography from a similar time frame. Approximately 125 field validation points were visited, each with a habitat category assignation, photos, and comments recorded.

Some observations were completed before the first attempt at the classification and some were taken at areas that were difficult to accurately classify due to cloud and cloud shadow, excessive spectral mixing, and obvious errors based on personal experience. It was not always possible to physically visit a location where problem areas occurred due to their inaccessibility, and in these cases all attempts were made to use a 'best guest' by local ecologists using aerial photography interpretation and personal experience.

Areas where feature discrimination and spectral mixing were an issue were noted. One main area of difficulty was between wetland and dry forest habitats. In order to attain the highest possible accuracy in boundaries between wetland and forest areas, all wetland area boundaries were delineated using aerial photo interpretation with reference to previously compiled detailed Swamps and Shallow Marine Substrates Maps, prepared by Overseas Development Natural Resources Institute, 1987. These maps accompanied the publication *Biogeography and Ecology of the Cayman Islands (D.R. Stoddard, M.A. Brunt and J.E. Davies* All previously mapped wetlands were compared to current data and this information assisted the delineation of boundaries. All new or previously unmapped wetlands were then delineated.

Nearshore vegetation was simply masked, and built-up areas were delineated. The majority of vegetation fell within one of the following classes: coastal shrubland, dwarf shrubland, Casuarina, or Scaevola categories. These were generally easier to delineate manually, rather than classify automatically.

Areas of cloud and cloud shadow within the imagery were manually digitised using photo-interpretation (multiple images), and information gathered from the surrounding automatic classification data.

*Casuarina equisetifolia* was identified as a species of key significance, due to its invasive nature. The ability of the 2004 imagery to very accurately distinguish this tree species enabled their mapping using photo interpretation and digitization. The same was true for the invasive *Scaevola sericea*. The same method was used to delineate this species. Aside from being included in the terrestrial habitat maps, this information will be used independently of the project to inform management decisions.

A mosaic of all data layers was compiled to form a single complete classification image for each island. This method proved to be robust in its added accuracy, its ability to meet mapping goals, and the marginal increase in time necessary to complete. It also made it possible to focus more on accurately classifying natural areas and less on unnecessary variability within the images.

These maps are considered dynamic documents and, as such, will be regularly updated (with all originals saved for reference and comparison), focusing on specific areas as necessary, in response to specific projects, as well as tracking development of natural and successional areas. The terrestrial habitat maps will serve as a detailed baseline land cover / land use resource for the Cayman Islands, providing decision makers and managers with accurate baseline and trends information (for)towards better informing land use planning and management and implementation of effective strategies for biodiversity protection.

**HABITAT CATEGORIES:**

An integral component of the *National Biodiversity Action Plan* is the mapping of the diversity of habitats of the Cayman Islands. This ambitious project was undertaken by staff of the Department of Environment, with the assistance of Frederic J. Burton.

At the highest level, habitat categories are broadly divided into Marine, Coastal and Terrestrial.

Marine habitats were subdivided, and categorized in part, based on a similar project: *Benthic Habitats of Puerto Rico and the U.S. Virgin Islands*, completed by NOAA's Centre for Coastal Monitoring and Assessment (CCMA).

Coastal and terrestrial habitats were subdivided, and categorized according to the *Vegetation Classification* formations of Burton (2008b), with supplementary categories for man-modified environments.

Habitat distinctions are made by way of facilitating a logical treatment of the habitats of the Cayman Islands, and should not be taken as indicative of isolation of ecological function or independence. To some extent, all elements of biodiversity are fundamentally interlinked.

## MARINE HABITATS

CATEGORY

***1. Open sea*** defined as all *marine habitats*, including the seabed and benthos, the water column and pelagic zone, and the water surface, which extend beyond the fringing reefs which surround the Cayman Islands, and which fall within the Cayman Islands EEZ. *Open sea* incorporates the deep sea, offshore waters, and *"nearshore waters"*, defined as those within a twelve-mile radius of the fringing reefs around the islands.

***2. Coral Reefs*** defined as limestone formations produced by living organisms. Corals are found both in temperate and tropical waters; however, shallow-water reefs are formed mostly within the zone between 30° north and 30° south of the equator. Incorporates, the following formations:

- Aggregate reef: defined as areas where hard coral cover (alive & dead) exceeds 70% substrate coverage. Usually found in the bank / shelf area, and / or the escarpment. Some soft corals / sponges may also be present.
- Spur and groove: defined as feature, typically hard coral cover (alive & dead), exhibiting a high vertical relief relative to the surrounding pavement / sand channels. "Spurs" are usually formed by accreting hard corals. "Grooves" usually comprise sand and / or hardbottom. Spur and groove features are usually associated with the seaward edge of the reef crest, and with the edge of the fore reef, near the escarpment, orientated perpendicular to shore and escarpment. Some soft corals / sponges may also be present.
- Individual patch reef: defined as isolated coral formations. Hard corals generally dominate, although some soft corals and sponges may be present. Only patch reefs greater than the MMU feature in habitat maps.
- Aggregated patch reef: defined as aggregated coral colonies, where colonies exhibit > 70% substrate coverage. Hard corals generally dominate, although some soft corals and sponges may be present. Confined areas of bare sand or hardbottom are present within the matrix of the reef aggregation, and are incorporated into the mapping delineation
- Reef rubble: defined as dead, unstable coral rubble and rocks. Usually found on the back reef portions of the reef crest. Reef rubble is often colonised with filamentous or other macroalgae.
- Fringing reef: defined as reef roughly parallel to the shoreline, and separating lagoonal inshore waters from nearshore waters. Fringing reef usually incorporates a semi-emergent high point. This area is called the "reef crest".

- Sand plain: defined as an expanse of uncolonised sediment (ranging from course sand to silt) located between the shallow and deep terrace reefs.
- Colonised hardbottom: defined as pavement exhibiting coral cover within the range of 10-70% of the substrate. Dominant features are low-relief pavement or rubble, or low-relief rock and sand grooves, colonised by algae, soft corals, and sparse hard corals, which are dense enough to partially obscure the underlying rock. Where coral cover >70%, areas fall within the *aggregate reef* category.
- Uncolonised hardbottom: defined as pavement, often dominated by algae but exhibiting a hard coral, soft coral, and sponge cover of <10%.
- Wall: near-vertical or vertical slope extending from the shelf-margin to abyssal depths and characterised by abundant coral and sponge colonisation from the drop-off to 120 m.
- Beachrock: defined as cemented sand. Beachrock is derived from calcite precipitating out of seawater; resulting in the formation a flat rock-like substrate.

***3. Lagoons*** defined as nearshore reaches of shallow salt or brackish water, separated from the *open sea* by a shallow or exposed *coral reef*, banks, or similar feature. Incorporates, the following formations:

- Seagrass beds: defined as areas where seagrass species represent the dominant substrate coverage. In cases where algae and seagrass co-exist, coverage is designated as *seagrass beds* if seagrass is dominant, and to the *vegetated sand* category if algae is dominant. *See also separate Seagrass beds HAP*.
- Sediment: unvegetated mud and sand.
- Hardbottom: low-relief pavement or rubble, or low-relief rock, often colonised by algae.
- Vegetated sand: vegetated sediment >=1 mm in diameter.
- Vegetated mud: vegetated sediment <1 mm in diameter.
- Lagoonal coral

***4. Seagrass beds*** defined as areas where seagrass species represent the dominant substrate coverage. In cases where algae and seagrass co-exist, coverage is designated as *seagrass beds* if seagrass is dominant, and to the *lagoons, vegetated sand* category if algae is dominant.

***5. Dredged seabed*** defined as any area of lagoon, inshore waters, reef or shallows, which has been modified as a result of channelisation, coastal development or dredging for fill.

**6. *Artificial installations*** defined as maritime constructions, including docks, large piers, and groynes. This category also includes underwater structures such as shipwrecks, underwater sculptures, and artificial reef structures.

## COASTAL HABITAT CLASSIFICATIONS:

***7. Maritime Cliffs and Ironshore*** defined as consolidated rocky coastal areas, between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside. Incorporates the VII.A.1.N.a vegetation formation, as *per* Burton (2008b):

- Cliffs with sparse vascular vegetation VII.A.1.N.a – vegetation of shaded cliffs, supports *Verbesina caymanensis*, restricted to north-facing section of bluff near Peter's Cave, Cayman Brac
- Maritime cliffs
- Ironshore
- Ironshore mosaic – shoreline comprising mostly ironshore, with one or more other substrates
- Beach rock
- Beach rock mosaic – shoreline comprising mostly beach rock, with one or more other substrates

***8. Sandy beach and cobble*** defined as all unconsolidated coastal sediments, between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside.

- Sandy beach
- Sandy beach mosaic – shoreline comprising mostly sandy beach, with one or more other substrates
- Cobble
- Cobble mosaic – shoreline comprising mostly cobble, with one or more other substrates

***9. Mangrove*** defined as habitat and plant assemblages associated with Black mangrove *Avicennia germinans*, White mangrove *Laguncularia racemosa*, Red mangrove *Rhizophora mangle*, and Buttonwood *Conocarpus erectus*. Incorporates the following vegetation formations, as *per* Burton (2008b):

- Seasonally flooded evergreen sclerophyllous forest I.A.5.N.c
- Tidally flooded mangrove forest I.A.5.N.e
- Seasonally flooded / saturated sclerophyllous evergreen woodland II.A.1.N.i
- Tidally flooded evergreen woodland II.A.1.N.e
- Seasonally flooded / saturated evergreen shrubland III.A.1.N.f
- Saturated sclerophyllous evergreen shrubland III.A.1.N.h
- Tidally flooded evergreen shrubland III.A.1.N.i

***10. Invasive coastal plants*** defined as the species / monoculture habitats of Weeping willow (Casuarina, Beefwood, Whistling pine, Australian pine) *Casuarina equisetifolia* and Beach naupaka (Sea lettuce, Scaevola) *Scaevola sericea*. Incorporates the following vegetation formations, as *per* Burton (2008b):

- Needle-leaved evergreen woodland II.A.3.C.a

***11. Coastal shrubland*** defined as a class of vegetation dominated by flora which ranges in height between 0.5m and 5m. Shrubs tend to grow as separate individuals or clumps of individuals. In *shrubland*, the canopy cover of shrubs constitutes greater than 25% of the total canopy cover. Larger trees may be present in *shrubland;* however, tree canopy cover should constitute less than 25% of the total cover to distinguish the area from "woodland". Incorporates the following vegetation formations, as *per* Burton (2008b):

- Hemi-sclerophyllous evergreen shrubland III.A.1.N.b
- Sclerophyllous evergreen shrubland III.A.1.N.c
- Mixed evergreen / drought-deciduous dwarf-shrubland IV.C.1.N.a
- Low tropical / subtropical perennial forb vegetation V.B.1.N.b

**TERRESTRIAL HABITAT CLASSIFICATIONS:**

***12. Salt-tolerant succulents*** defined as areas of succulent-dominated forb vegetation (non-woody plants other than grasses, sedges and rushes) influenced by regimes typically of high salt, and temporary or occasional water immersion. In coastal areas, this may include tidal areas, or those influenced by the tide. Further inland, this habitat forms in association with temporarily flooded pastures, and moderately elevated rocky cays, often at the edges of wetlands and *mangroves*. Incorporates the following vegetation formations, as *per* Burton (2008b):

- Tidally flooded perennial forb vegetation V.B.1.N.e
- Tidal tropical or subtropical annual forb vegetation V.D.1.N.d

***13. Pools, ponds and mangrove lagoons*** defined as natural and man-modified areas of standing permanent and temporary water and associated vegetation, including pools, ponds, ditches and flooded marl pits. This habitat category incorporates both natural areas, and manmade ditches and flooded marl pits. Natural freshwater pools are a rarity in the Cayman Islands, and of key conservation interest. With appropriate management, the ecological value of man-modified water features can be greatly increased.

- Semi-permanently flooded grasslands V.A.1.N.h

- Aquatic vegetation V.C.1.N.a
- Mangrove pools and ponds
- Mangrove lagoons
- Flooded marl pits

***14. Dry shrubland*** defined as a class of vegetation dominated by flora which ranges in height between 0.5m and 5m. Shrubs tend to grow as separate individuals or clumps of individuals. In *shrubland*, the canopy cover of shrubs constitutes greater than 25% of the total canopy cover. Larger trees may be present in *shrubland*, however, tree canopy cover should constitute less than 25% of the total cover to distinguish the area from "woodland". Incorporates the following vegetation formations, as *per* Burton (2008b):

- Tropical or subtropical broad-leaved evergreen shrubland III.A.1.N.a
- Mixed evergreen-drought deciduous shrubland with succulents III.C.1.N.a

***15. Forest and woodland*** defined as a class of vegetation characterized by a closed tree canopy, with interlocking crowns generally providing 60-100% cover. "Woodland", by comparison, is characterized by an open canopy, with tree crowns constituting just 25-60% cover. The canopy height of *forest and woodland* ranges from about 16m, down to about 4.5m in height, below which *shrubland* species dominate. Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Lowland semi-deciduous forest I.C.1.N.a
- Seasonally flooded / saturated semi-deciduous forest I.C.1.N.c
- Xeromorphic semi-deciduous forest I.C.4.N.b
- Lowland / submontane drought-deciduous woodland II.B1.N.a
- Tropical or subtropical semi-deciduous woodland II.C.1.N.a

***16. Caves*** defined as erosional landforms, including pot holes and fissures, which form as a result of wave action, or the action of rain and underground water courses.

***17. Farm and grassland*** defined as any land which is activity managed for agricultural purposes, or comes under the influence of agricultural practice, specifically, the growing of fruits, crops or the keeping of livestock. Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Seasonally flooded grasslands V.A.1.N.g
- Medium tall tropical/subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs V.A.3.N.c
- Short tropical or subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs V.A.3.N.f
- Saturated tropical or subtropical perennial forb vegetation V.B.1.N.d
- Agricultural plantation

***18. Urban and man-modified areas*** defined as the populated areas of the Cayman Island, and those areas of land subject to direct modification by man.

- commercial and residential areas on the islands, incorporating town centres, industrial sites, hotels and condominiums, and private homes and residential developments
- public and private green-space, such as parking lots, landscaped areas, parks and recreation grounds, cemeteries, and private gardens
- land cleared for development
- actively farmed land
- historically cleared areas, now reverting to nature, and exhibiting secondary growth
- roads are a component of this landscape, and are also assigned an individual *Roads* HAP.

***19. Roads*** defined as the public and private roads network. *Roads* incorporates surfaced and unsurfaced roads and associated landscaping and infrastructure, including roundabouts, mediums, sidewalks, drainage conduits, roadside verges and pathways.

## REFERENCES and FURTHER READING

### PUBLICATIONS:


Burton, F.J. (2008a) *Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b) *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Giglioni, M.E.C. (1976). The boom years, environmental deterioration, planning and administration. In: J.H. Wickstead (ed.) Cayman Islands Natural Resources. Study Part II, 42 pp. ODM, London AND In Brunt, M.A. & Davies J.E. (1994). (eds.) The Cayman Islands Natural History and Biogeography. Kluwer Academic Publishers. p13-49. ISBN 0-7923-2462-5.

Hardin, G. (1968) The Tragedy of the Commons, *Science*, Vol. 162, No. 3859, pp. 1243-1248.

Wilson, E.O. and Peter, F. M. (1988) *Biodiversity*. Papers from the National Forum on Biodiversity, Sept. 21-25, 1986 in Washington, D.C. Published by National Academies Press, 1988, ISBN 0309037395, 9780309037396, 521 pages.


### WEB RESOURCES:

| | |
|---|---|
| Convention on Biological Diversity | www.cbd.int |
| Tyndall Centre for Climate Change Research | www.tyndall.ac.uk |
| The Cayman Islands Darwin Initiative | www.caymanbiodiversity.com |
| International Union for Conservation of Nature | www.iucn.org |
| IUCN Redlist | www.iucnredlist.org |
| Darwin Initiative | http://darwin.defra.gov.uk |
| Queensland Government - *Understanding the Convention on Biological Diversity Fact sheet* | www.epa.qld.gov.au |

# CAYMAN ISLANDS

## Habitat Action Plans 2009

*…a just world values and conserves nature…*


Department of Environment

## MARINE HABITATS

### *1. Open sea*

### Definition

*Open Sea* describes all *marine habitats*, including the seabed and benthos, the water column and pelagic zone, and the water surface, which extend beyond the drop-off (200ft (61m) contour) which surround the Cayman Islands, and which would fall within Cayman territorial waters (extending to 12 miles from shore of each island).

### Local outline

The *open sea* incorporates a range of marine habitats, which vary most significantly according to nutrient availability, and the physical characteristics of depth, substrate, light attenuation and current. Many individual nearshore habitats support unique associations of life, and so are subject to consideration under individual *Habitat Action Plans*. Despite this individuality, however, the *open sea* represents an affecting and modifying constant throughout the marine environment, and so holistic consideration of the *open sea* environment is pertinent to the conservation management of any and all components.

Perturbation of the *open sea* through large-scale events, both natural and man-made, may have far-reaching ramifications. Under the influence of prevailing weather conditions and ocean currents, distant coastal environments high in biodiversity, such as *mangrove* and *coral reefs*, and those important for tourism and recreation, such as *sandy beaches*, come under the influence of the *open sea.* Given the varying sensitivities of different habitats and species to specific impacts, perturbations of the *open sea* may have the greatest impact far from the source.

Despite their diminutive size, plankton forms the foundation of the marine food web, and thus plays a seminal role in the functioning of the marine environment. Biotic factors, such as oceanic migration, and the reliance of many species on dispersal through a planktonic phase, contribute to the integrated dynamic of life in the *open sea*. While, for the purposes of this action plan, the *open sea* includes only Cayman waters, it remains a significant consideration that the quality of our marine environment is to an extent dependent on the activities of distant neighbours. Similarly, under the influence of the *open sea*, our stewardship of the Cayman Islands' marine environment is reflected throughout the region.

### Key Habitat Categories for *Open sea*

This category applies to all *marine habitats.*

### Key Species for *Open Sea*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

**KEY SPECIES for OPEN SEAS**

**PART 1**

| Category | Detail | Scientific Reference | NBAP |
|---|---|---|---|
| Mammals (marine) | Whales, Dolphins, etc. | Cetacea all species | |
| Mammals (marine) | Manatees | Sirenia all species | |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat: | Aves | |
| | Brown booby | *Sula leucogaster* | SAP |
| | Red-footed booby | *Sula sula* | SAP |
| | White-tailed tropic bird (Boatswain bird) | *Phaethon lepturus* | SAP |
| | Magnificent frigatebirds (Man O' War) | *Fregata magnificens* | |

| | | | |
|---|---|---|---|
| Turtle (marine) | Loggerhead turtle | *Caretta caretta* | SAP |
| Turtle (marine) | Green turtle | *Chelonia mydas* | SAP |
| Turtle (marine) | Leatherback turtle | *Dermochelys coriacea* | SAP |
| Turtle (marine) | Hawksbill turtle | *Eretmochelys imbricata* | SAP |
| Turtle (marine) | Kemp's Ridley turtle | *Lepidochelys kempii* | SAP |
| Fish (marine, bony) | Tilefish | *Malacanthus plumieri* | |
| Fish (marine, bony) | Filefish | Monacanthidae species | |
| Fish (marine, bony) | Angelfish | Pomacanthidae species | |
| Fish (marine, bony) | Jewfish, Goliath grouper | *Epinephelius itijara* | |
| Fish (marine, cartilaginous) | Sharks and rays - e*xcept those specifically listed in Part 2* | Elasmobranchii all species | |
| Corals | All soft corals (including Gorgonians & Telestaceans) | Anthozoa all species | |
| Corals | Black coral | Antipatharia all species | |
| Corals | Gorgonians | Gorgoniacea all species | |
| Corals | Fire corals | Milleporidae all species | |
| Corals | Hard corals | Scleractinia all species | |
| Corals | Lace corals | Stylasteridae all species | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Sponges | Porifera all species | |
| Invertebrates | Conch - e*xcept those listed in Part 2* | Strombidae all species | |
| Invertebrates | Tritons | Tritonidae all species | |
| Invertebrates | Tuns | Tonnidae all species | |
| Invertebrates | Cassidae | Cassis tuberosa | |
| Invertebrates | Cassidae | Cassis madagascariensis | |
| Invertebrates | Cassidae | Cassis flammea | |
| Invertebrates | Cassidae | Phalium granulatum (all varieties) | |
| Invertebrates | Cassidae | Cypraeacassis testiculus | |
| **PART 2** | | | |
| Invertebrates | White Land crab | *Cardisoma guanhumi* | SAP |
| Invertebrates | Soldier crab (Hermit crab) | *Coenobita clypeatus* | |
| Fishes (marine, bony) | Fry, Silversides | Atherinidae species | |
| Fishes (marine, bony) | Herrings | Clupeidae species | |
| Fishes (marine, bony) | Anchovies | Engraulidae species | |
| Fish (marine, bony) | Nassau grouper | *Epinephelus striatus* | SAP |
| Fish (marine, bony) | Goggle eyes | *Selar crumenophthalmus* | |
| Fish (marine, bony) | Y-Lined blenny | *Starksia y-lineata* | |
| Fish (marine, bony) | All bony fish - e*xcept those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Fish (marine, cartilaginous) | Southern stingray | *Dasyatis americana* | SAP |
| Invertebrates | Lobsters | Palinura species | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |
| Invertebrates | Queen conch | *Strombus gigas* | SAP |
| Invertebrates | Whelk | *Cittarium pica* | SAP |
| Plants (marine) | Green algae | Chlorophyta species | |
| Plants (marine) | Brown algae | Phaeophyta species | |
| Plants (marine) | Red algae | Rhodophyta species | |
| **INVASIVE** | | | |
| Fishes (marine, bony) | Red lionfish | *Pterois volitans* | SAP |

## Current Status of the *Open sea*

*Link to habitat map: Cayman 12-mile Territorial Waters and Exclusive Economic Zone*

| Habitat Status 2006 Open Sea | Total area (km²) | Area within protected areas (km²) | Area outside protected areas (km²) | % Habitat protected |
|---|---|---|---|---|
| | Cayman Islands | Cayman Islands | Cayman Islands | Cayman Islands |
| Exclusive Economic Zone | 119023 | 91.08 | 118931.92 | 0.076 |
| Cayman Territorial Waters | 5875 | 91.08 | 5783.92 | 1.55 |

Marine Protected Areas in the Cayman Islands include Marine Parks, Replenishment Zones, Environmental Zones, No Dive Zones and Wildlife Interaction Zones: totalling 19,311 acres for Grand Cayman, 2,281 acres for Little Cayman, and 914 acres for Cayman Brac. Total for the Cayman Islands: 22,506 acres (91.08 $km^2$).

## Key Sites for *Open sea*

Twelve Mile Bank.
Designated Spawning Aggregations (for Nassau grouper and other fish species).

## Nature Conservation Importance of *Open sea*

- *Keystone species:* plankton, drifting organisms which inhabit the water column of the *open sea*, represent the foundation of the marine food chains, incorporating commercially important fisheries and marine mega fauna.
- *Biodiversity:* the richness and quality of the *open sea* environment affects all associated marine habitats, including biodiverse communities such as *coral reefs* and *seagrass beds*.
- *Fish stocks:* the *open sea* supports significant fish stocks, including species of recreational and commercial significance. Distribution of fish stocks is highly specific: subject to temporal factors and physical influences, including currents, upwellings and underwater topography. Fish stocks may also be subject to biotic factors, Nassau grouper *Epinephelus striatus*, for example spawning in aggregations dependent on maintaining a critical number of fish, in order sustain behavioural queues to breed.
- *Marine mega fauna:* the *open sea* supports many large creatures which are rarely seen. Cayman Islands waters support occasional Killer whale *Orcinus orca*, Bottlenose dolphin *Tursiops truncatus*, Sperm whale *Physeter macrocephalus* (or *Physeter catodon*), Gervais' Beaked whale *Mesoplodon europaeus*, Great White shark *Carcharodon carcharias*, Whale shark *Rhincodon typus*, and Manta ray *Manta birostris*. The migratory nature of many marine mega-fauna underpins the importance of international responsibility and co-operation in biodiversity preservation.
- *Turtles*: a traditional mainstay of the Cayman Islands economy, the local turtle industry collapsed around the early 1800s. Despite the establishment of the Cayman Islands Turtle Farm as a supplier of captive-raised meat, the international designation of all Marine turtles found locally as endangered and critically endangered (IUCN Red List), and the precariously low-level of local breeding populations, protective measures still fall short of banning the local wild turtle fishery.
- *Birdlife: open seas* are of importance to a variety of seabirds and shorebirds. Breeding Red-footed booby *Sula sula*, and Brown booby *Sula leucogaster*, for example, range widely offshore on feeding expeditions. The summer breeding visitor, White-tailed tropic bird *Phaethon lepturus*, is similarly dependent on off-shore stocks of fish and squid.
- *Unknown species:* the *open sea* remains largely unstudied, and little is known about many of the species found there.

*Other:*

- *Carbon cycle and reservoir:* the photosynthetic activity of phytoplankton fixes carbon from dissolved carbon dioxide. Through grazing of phytoplankton, primarily by zooplankton, this carbon is introduced to the marine foodweb. Here component carbon is either respired, or

accumulates as biomass. Because organic material is typically denser than seawater, on death, organisms tend to sink. In the *open sea* ocean, away from coastal influence, this results in a "rain" or organic matter, transporting carbon from the sea surface, to the deep. This process is known as the "biological pump", and contributes to the oceans being the largest (active) pool of carbon on Earth.

- *Cultural:* Caymanians are traditionally a seafaring people. With little by way of a living to be made from a land impoverished by way of good soil and freshwater, the bounty of the oceans was comparatively plentiful.
- *Recreation*: the *open sea* is valued for recreation, particularly fishing and sailing.
- *Tourism*: the *open sea* is an influencing factor in the quality of nearshore waters, influencing activities such as diving, sailing and fishing, and the associated coastal environment, including *beaches.*
- *Economic:* shipping.

### Current Factors Affecting *Open seas*

- *Pollution:* primary sources of pollution of the *open sea* include oil-spill, dumping of effluent, marine litter, and toxic chemicals such as tributyltin, (an ingredient in anti-fowling paint). Tributyltin has been shown to accumulate in the tissues of marine mammals, fish, coral, seabirds and invertebrates Under the influence of prevailing weather conditions and ocean currents, localized pollution events may have far-reaching impacts on the marine environment. Land-based sources also contribute significant pollution to the *open sea*.
- *Operational discharge:* discharge into coastal waters from industrial and commercial developments in the form of treated effluent, heated-water etc, is addressed under the Marine Conservation Law (2007 Revision): "Whoever directly or indirectly causes or permits to flow or to be put into Cayman waters any harmful effluents or raw sewage, unless specifically permitted in that behalf … is guilty of an offence."
- *Over exploitation:* many fisheries of the *open sea* are under-researched, unregulated and beyond effective enforcement, making them prone to over exploitation. Many pelagic species, such as tuna and billfish, are governed only by international fisheries regulations e.g. the International Commission for the Conservation of Atlantic Tunas (ICCAT), giving them no effective protection from local fishing pressure. For others, such as Dolphin *Coryphaena hippurus* and Queen fish *Acanthocybium solandri* there is no regulation. The Marine Conservation Law (2007) provides protection to some species, including Nassau grouper *Epinephelus striatus*, (protected spawning areas). These Laws are actively enforced in nearshore waters. Offshore, however, the practicalities of effective enforcement become increasingly limited..
- *Marine litter:* littering of the seabed, water column and sea-surface results in the death of marine species by smothering, entanglement and ingestion. Sea birds in particular are susceptible to entanglement in discarded fishing gear. Discarded nets and pots continue to trap fish and marine mammals. Ingestion of floating plastics is a significant cause of mortality in marine turtles.
- *Invasive species:* cargo ships may transfer non-native species to new bio-geographic areas through discharge of seawater ballast. Marine invasive species recently reported in the Cayman Islands include the Red lionfish *Pterois volitans*, first reported in February 2008 in Little Cayman, since reported from Cayman Brac in September 2008.
- *Laying of cable and pipelines:* emplacement of utilities supplies incurs a modest and generally localized impact on the marine environment.

### Opportunities and Current Local Action for *Open sea*

- In 2004, amid concerns for the collapse of the Nassau grouper *Epinephelus striatus* population, the Marine Conservation board introduced an eight-year moratorium on fishing.

- All IMO conventions addressing marine oil pollution have been extended to the Cayman Islands . These include OPRC, MARPOL, CLC and Fund conventions, and Intervention and Salvage conventions. Local legislation implementing these conventions include the Merchant Shipping

(Marine Pollution) Law, Port Authority Law, and the Marine Conservation Law. Passage of the draft National Conservation Law will serve to increase preventative as well as response measures to spill incidents.

- Dumping of solid waste in the sea is addressed under sections of MARPOL and the London Convention which are locally enacted under the Merchant Shipping (Marine Pollution) Law as well as the Public Health and Port Authority laws. The proposed National Conservation Law will greatly improve the enforcement of marine pollution from solid waste within territorial waters.

- The Protocol Concerning Pollution from Land-Based Sources and Activities in the Wider Caribbean Region (LBS) of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention) attempts to address many pollution issues. While Cayman is party to the Convention it has not ratified the Protocol.

- Under the *Marine Conservation Law* (2007 Revision) "Whoever directly or indirectly causes or permits to flow or to be put into Cayman waters any harmful effluents or raw sewage, unless specifically permitted in that behalf … is guilty of an offence."

**HABITAT ACTION PLAN for *Open sea***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *open sea* and regularize all EEZ boundaries. | 2015 |
| **2.** Maintain and enhance the richness and quality of the *open sea*. | 2015 |
| **3.** Maintain and manage the variety of habitats, communities and species of *open sea* and seek improvement of areas which have been degraded. | 2015 |
| **4.** Extend protected area status to key areas of the *open sea*, including year-round protection of fish spawning aggregation sites. | 2012 |

| Open Sea<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4,5,6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3,4,5,6 |
| **PL3.** Continue to work to minimize the environmental impacts of shipping. | DoE | MACI | ongoing | 2,3 |
| **PL4.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,4 |
| **PL5.** Oppose developments or other proposed activities which threaten to damage the marine environment of the *open sea*. | DoE | CIG | ongoing | 2,3 |
| **PL6.** No dumping of ballast in Cayman waters. | DoE | MACI | 2010 | 2,3 |
| **PL7.** No dumping of effluent in Cayman waters | DoE | WA PA | 2010 | 2,3 |
| **PL8.** Establish and implement ban on use of tributyltin TBT in the Cayman Islands. | DoE | CIG<br>MCB | 2015 | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Increase enforcement presence on Twelve Mile Bank. | DoE | RCIP | 2010 | 2,3,4 |
| **SM2.** Implement associated SAPs. | DoE | | 2015 | 2,3 |
| **Advisory** | | | | |
| **A1.** Improve co-ordination between relevant authorities | DoE | MACI | ongoing | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| operating in the marine environment in the management of activities and resources of the *open sea*. | | RCIP PA WA | | |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4,5,6 |
| **Research & Monitoring** | | | | |
| **RM1.** Map EEZ for the Cayman Islands. | DoE | CIG UKHO | 2009 | 1 |
| **RM2.** Identify and prioritise most significant *open sea* areas. | DoE | | 2009 | 3,4 |
| **RM3.** Investigate potential and feasibility of extending the system of marine protected areas to key sites in the *open sea*. | DoE | RCIP | 2009 | 2,3,4 |
| **RM4.** Use data on hydrographic features of known spawning aggregations to predict locations of multi species spawning aggregations and implement appropriate management. | DoE | REEF | 2013 | 2,3,4 |
| **RM5.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM6.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,3 |
| **RM7.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value of, and threats to, the *open sea*. | DoE | | ongoing | 3 |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 5 |

## REFERENCES and FURTHER READING for *Open sea*


**The situation in the environment after the partial ban of TBT:**

Michael A. Champ, (2000). A review of organotin regulatory strategies, pending actions, related costs and benefits, Sci. Total Environ., 258 21-71.

**Accumulation of TBT in aquatic organisms:**

Berge, John Arthur, Einar M. Brevik, Arne Bjorge, Norunn Folsvik, Geir Wing Gabrielsen, Hans Wolkers, (2004). Organotins in marine mammals and seabirds from Norwegian territory, J. Environ. Monit., 6/2 108.

Folsvik, N., J.A. Berge, E.M. Brevik, M. Walday, (1999). Quantification of organotin compounds and determination of imposex in populations of dogwhelks (Nucella lapillus) from Norway, Chemosphere, 38/3 681-691.

Guruge, K.S., H. Iwata, H. Tanaka, S. Tanabe, (1997). Butyltin accumulation in the liver and kidney of seabirds, Mar. Environ. Res., 44 191-199.

Inoue, M., A. Suzuki, M. Nohara, H. Kan, A. Edward, H. Kawahata, (2004). Coral skeletal tin and copper concentrations at Pohnpei, Micronesia: possible index for marine pollution by toxic anti-biofouling paints, Environ. Pollut., 129/3 399-407.

Iwata, H., S. Tanabe, R. Tatsukawa, (1997). Bioaccumulation of butyltin compounds in marine mammals: the specific tissue distribution and composition, Appl. Organomet. Chem., 11/4 257-264. DOI: 10.1002/(SICI)1099-0739(199704)11:4<257::AID-AOC575>3.0.CO;2-2

Kannan, K., K. Senthilkumar, B.G. Loganathan, S. Takahashi, D.K. Odell, S. Tanabe, (1997).Elevated accumulation of tributyltin and its breakdown products in bottlenose dolphins (Tursiops truncatus) found stranded along the U.S. Atlantic and Gulf coasts, Environ. Sci. Technol., 31 296-301.

Le Thi Hai Le, Shin Takahashi, Kazutoshi Saeki, Nobutake Nakatani, Shinsuke Tanabe, Nobuyuki Miyazaki, Yoshihiro Fujise, (1999). High Percentage of Butyltin Residues in Total Tin in the Livers of Cetaceans from Japanese Coastal Waters, Environ. Sci. Technol., 33/11 1781-1786.

Lee, C.C. T. Wang, C.Y. Hsieh, C.J. Tien, (2005). Organotin contamination in fishes with different living patterns and its implications for human health risk in Taiwan, Environ. Pollut., 137/2 198-208. doi:10.1016/j.envpol.2005.02.011

Negri, Andrew P., Luke D. Smith, Nicole S. Webster, Andrew J. Heyward, (2002). Understanding ship-grounding impacts on a coral reef: potential effects of anti-foulant paint contamination on coral recruitment, Mar. Pollut. Bull., 44 111-117.

Shinsuke Tanabe, Maricar Prudente, Takahiko Mizuno, Jun Hasegawa, Hisato Iwata, Nobuyuki Miyazaki, (1998). Butyltin Contamination in Marine Mammals from North Pacific and Asian Coastal Waters, Environ. Sci. Technol., 32/2 193-198.

## MARINE HABITATS

### *2. Coral Reefs*

#### Definition

*Coral reefs* are limestone formations produced by living organisms. Corals are found both in temperate and tropical waters; however, shallow-water reefs are formed mostly within the zone between 30° north and 30° south of the equator. Tropical corals are rarely found in waters much below 18 °C.

*Coral reefs* are estimated to cover 284,300 $km^2$ worldwide. Caribbean *coral reefs* account for about 7.6% of the world total (Spalding *et al.* 2001). Though found in nutrient-poor tropical waters, coral reefs support extraordinary biodiversity. Corals absorb nutrients, including inorganic nitrogen and phosphorus directly from the water, and filter microscopic zooplankton from the current. However, coral polyps derive the majority (up to 95%) of their energy from sunlight. The coral polyps themselves do not photosynthesize, but maintain a symbiotic relationship with single-celled algae called *zooxanthellae*, incorporated within their tissues. It is these algal cells which, through the process of photosynthesis, provide the majority of the organic nutrients which sustain the coral polyps. As a result, the primary productivity of healthy coral reefs is very high.

The reef super-structure is composed of calcium carbonate, $CaCO_3$ (aragonite): the combined skeletons of countless tiny, individual coral polyps. Reef-building (*hermatypic*) corals are only found in the photic zone: the depth to which sufficient sunlight penetrates the water column for photosynthesis to occur.

#### Local outline

The Cayman Islands are mostly surrounded by fringing reefs enclosing shallow lagoons. The reefs are dominated by submarine topography, much the same as other western Caribbean islands (Fenner, 1993). Their narrow insular shelves host a variety of reef structures, including 'spur-and-groove' formations, fringing reefs and patch reefs. There is a shallow terrace reef located at a depth of 5-10 m, and a deep terrace at 15-20 m, culminating in a deep fore-reef with a precipitous drop-off at an average depth of 22 meters. The islands' shelf widths average 500 m, with some locations <300 m. However, the shelf extends to >500m at the east and west ends of each island.

The coral reef community is dominated by massive Montastraea and Diploria corals on the deep and shallow terrace reefs: most especially *Montastraea annularis*, *M. faveolata, M. cavernosa, M. franksi* and *Diploria strigosa*. Other relatively abundant species include *Siderastrea siderea* and *Colpophyllia natans*. Octocoral communities are composed of large colonies of *Pseudoplexaura porosa* and *Pseudoterogorgia americana* and *Eunicea* spp., among others. Sponges are also common, varying in size and form depending on depth and wave exposure. Mean live coral cover for the Cayman Islands was 25% in 1997 and declined to 18% by 1999. Mean coral cover was stable between 1999 and 2004 but declined to 14% in 2006. Most recent surveys, in 2008, showed negligible change - a national average of 15% live cover.

#### Key Habitat Categories for *Coral reefs*

- Aggregate reef: defined as areas where hard coral cover (alive & dead) exceeds 70% substrate coverage. Usually found in the bank / shelf area, and / or the escarpment. Soft corals and sponges are also present.
- Spur and groove: defined as feature, typically hard coral cover (alive & dead), exhibiting a high vertical relief relative to the surrounding pavement / sand channels. "Spurs" are usually formed by accreting hard corals. "Grooves" usually comprise sand and / or hardbottom. Spur and groove features are usually associated with the seaward edge of the reef crest, and with the edge of the fore reef, near the escarpment, orientated perpendicular to shore and escarpment. Soft corals and sponges are also present.
- Individual patch reef: defined as isolated coral formations. Hard corals generally dominate, although some soft corals and sponges may be present. Only patch reefs greater than the MMU feature in habitat maps.

- Aggregated patch reef: defined as aggregated coral colonies, where colonies (alive & dead) exhibit > 70% substrate coverage. Hard corals generally dominate, although some soft corals and sponges may be present. Confined areas of bare sand or hardbottom are present within the matrix of the reef aggregation, and are incorporated into the mapping delineation.
- Reef rubble: defined as dead, unstable coral rubble and rocks. Usually found on the back reef portions of the reef crest. Reef rubble is often colonised with filamentous or other macroalgae.
- Fringing reef: defined as reef roughly parallel to the shoreline, and separating lagoonal inshore waters from nearshore waters. Fringing reef usually incorporates a semi-emergent high point. This area is called the "reef crest".
- Sand plain: defined as an expanse of uncolonised sediment (ranging from course sand to silt) located between the shallow and deep terrace reefs.
- Colonised hardbottom: defined as pavement exhibiting coral cover within the range of 10-70% of the substrate. Dominant features are low-relief pavement or rubble, or low-relief rock and sand grooves, colonised by algae, soft corals, and sparse hard corals, which are dense enough to partially obscure the underlying rock. Where coral cover >70%, areas fall within the *aggregate reef* category.
- Uncolonised hardbottom: defined as pavement, often dominated by algae but exhibiting a hard coral, soft coral, and sponge cover of <10%.
- Wall: near-vertical or vertical slope extending from the shelf-margin to abyssal depths and characterised by abundant coral and sponge colonisation from the drop-off to 120 m.
- Beachrock: defined as cemented sand. Beachrock is derived from calcite precipitating out of seawater; resulting in the formation a flat rock-like substrate.

### Key Species for *Coral reefs*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

**KEY SPECIES for CORAL REEFS**

**PART 1**

| Category | Detail | Scientific Reference | NBAP |
|---|---|---|---|
| Mammals (marine) | Manatees | Sirenia all species | |
| Turtle (marine) | Loggerhead turtle | *Caretta caretta* | SAP |
| Turtle (marine) | Green turtle | *Chelonia mydas* | SAP |
| Turtle (marine) | Hawksbill turtle | *Eretmochelys imbricata* | SAP |
| Fish (marine, bony) | Tilefish | *Malacanthus plumieri* | |
| Fish (marine, bony) | Filefish | Monacanthidae species | |
| Fish (marine, bony) | Angelfish | Pomacanthidae species | |
| Fish (marine, bony) | Jewfish, Goliath grouper | *Epinephelius itijara* | |
| Fish (marine, cartilaginous) | Sharks and rays - e*xcept those specifically listed in Part 2* | Elasmobranchii all species | |
| Corals | All soft corals (including Gorgonians & Telestaceans) | Anthozoa all species | |
| Corals | Black coral | Antipatharia all species | |
| Corals | Gorgonians | Gorgoniacea all species | |
| Corals | Fire corals | Milleporidae all species | |
| Corals | Hard corals | Scleractinia all species | |
| Corals | Lace corals | Stylasteridae all species | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Sponges | Porifera all species | |
| Invertebrates | Conch - e*xcept those listed in Part 2* | Strombidae all species | |

| | | | |
|---|---|---|---|
| Invertebrates | Tritons | Tritonidae all species | |
| Invertebrates | Tuns | Tonnidae all species | |
| Invertebrates | Cassidae | *Cassis tuberosa* | |
| Invertebrates | Cassidae | *Cassis madagascariensis* | |
| Invertebrates | Cassidae | *Cassis flammea* | |
| Invertebrates | Cassidae | *Phalium granulatum* (all varieties) | |
| Invertebrates | Cassidae | *Cypraeacassis testiculus* | |
| **PART 2** | | | |
| Fishes (marine, bony) | Fry, Silversides | Atherinidae species | |
| Fishes (marine, bony) | Herrings | Clupeidae species | |
| Fishes (marine, bony) | Anchovies | Engraulidae species | |
| Fish (marine, bony) | Nassau grouper | *Epinephelus striatus* | SAP |
| Fish (marine, bony) | Goggle eyes | *Selar crumenophthalmus* | |
| Fish (marine, bony) | Y-Lined blenny | *Starksia y-lineata* | |
| Fish (marine, bony) | All bony fish - *except those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Fish (marine, cartilaginous) | Southern stingray | *Dasyatis americana* | SAP |
| Invertebrates | Tulip mussel | *Cosa caribbaea* | |
| Invertebrates | Commissioner Gerrard's clam | *Transenella gerrardi* | |
| Invertebrates | Whelk | *Cittarium pica* | SAP |
| Invertebrates | Lobsters | Palinura species | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |
| Invertebrates | Alfred's turbonille | *Turbonilla alfredi* | |
| Plants (marine) | Green algae | Chlorophyta species | |
| Plants (marine) | Brown algae | Phaeophyta species | |
| Plants (marine) | Red algae | Rhodophyta species | |
| **INVASIVE** | | | |
| Fishes (marine, bony) | Red lionfish | *Pterois volitans* | SAP |

**Current Status of *Coral reefs***
***Locally, Regionally & Globally Threatened.***

*Link to habitat map: Coral reefs Grand Cayman*
*Link to habitat map: Coral reefs Cayman Brac*
*Link to habitat map: Coral reefs Little Cayman*

| Habitat Status 2006 Coral reefs | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Aggregate reef | 123 | 0 | 8 | 62 | x | 8 | 61 | x | 0 | 50.4 | x | 100.0 |
| Spur and groove | 5153 | 2940 | 2045 | 969 | 442 | 302 | 4184 | 2498 | 1743 | 18.8 | 15.0 | 14.8 |
| Individual patch reef | 1 | 0 | 0 | 0 | x | x | 1 | x | x | 0.0 | x | x |
| Aggregate patch reef | 37 | 68 | 10 | 34 | 52 | 0 | 3 | 16 | 10 | 91.9 | 76.1 | 0.0 |
| Reef rubble | 846 | 66 | 271 | 317 | 28 | 145 | 529 | 38 | 126 | 37.5 | 42.3 | 53.5 |
| Fringing reef | 496 | 39 | 264 | 193 | 19 | 148 | 303 | 20 | 116 | 38.9 | 49.2 | 56.1 |
| Sand plains | 217 | 15 | 9 | 145 | 2 | 9 | 72 | 13 | 0 | 66.9 | 13.5 | 98.4 |
| Colonised hardbottom | 1191 | 481 | 612 | 384 | 68 | 131 | 807 | 413 | 481 | 32.2 | 14.1 | 21.4 |
| Uncolonised hardbottom | 4134 | 1511 | 1398 | 1309 | 285 | 389 | 2825 | 1226 | 1009 | 31.7 | 18.9 | 27.8 |
| Deep wall | *vertical feature, does not appear on map* | | | | | | | | | | | |
| Beachrock | 6 | 0 | 0 | 6 | x | x | 0 | x | x | 100.0 | x | x |
| **TOTAL** | **12204** | **5120** | **4617** | **3419** | **896** | **1132** | **8785** | **4224** | **3485** | **28** | **17.5** | **24.5** |

Marine Protected Areas in the Cayman Islands include Marine Parks, Replenishment Zones, Environmental Zones, No Dive Zones and Wildlife Interaction Zones: totalling 19,311 acres for Grand Cayman, 2,281 acres for Little Cayman, and 914 acres for Cayman Brac. Total for the Cayman Islands: 22,506 acres (91.08 $km^2$).

### Key Sites for *Coral reefs*

| | |
|---|---|
| GRAND CAYMAN: | Seven Mile Beach marine park<br>Southwest Point (Sand Cay High Heads)<br>North Side Reefs |
| CAYMAN BRAC: | White Bay marine park |
| LITTLE CAYMAN: | Bloody Bay marine park |

*Coral reefs* are protected through the Marine Conservation Law and Regulations; coral reefs within Marine Parks have an additional level of protection. However the Marine Park Regulations do not afford outright protection against activities related to construction and development.

### Nature Conservation Importance of *Coral reefs*

- *Biodiversity:* in addition to the many species of fish associated with *coral reefs*, numerous invertebrates inhabit the structure of the reef. These creatures include sponges, molluscs, crustaceans, echinoderms and polychaete worms.
- *Fish stocks:* worldwide, over 4,000 species of fish have been recorded inhabiting *coral reefs.* Over 500 species of fish inhabit Caribbean reefs. Locally, *coral reefs* are home to numerous species of significance; including Parrotfish, Angelfish, Damselfish, Butterfly fish, Groupers, Snappers, Grunts and Wrasses. Some fish migrate to *coral reefs* from local nursery habitats such as *seagrass* and coastal *mangrove*. Others may be carried great distances across the ocean in planktonic form, to settle in unoccupied niches.
- *Productivity: coral reefs* are highly productive habitats, with extremely efficient nutrient-cycling regimes, allowing them to thrive in very nutrient poor waters.
- *Turtles*: Cayman's *coral reefs* are habitat to juvenile Hawksbill and Green turtles, which feed on sponges and reef-associated algae.

*Other:*

- *Tourism*: diving is a significant component of the Cayman Islands tourism industry.
- *Fishing*: *coral reefs* support a variety of commercially significant species.
- *Coastline protection*: intact fringing *coral reefs* protect the coastline from the full force of oceanic waves, particularly during severe weather.
- *Unknown properties:* the diversity of species associated with *coral reefs* has resulted in a number of them being investigated for medical properties and used in commercial applications.
- *Beach formation:* protection of beaches and source of beach sand.

### Current Factors Affecting *Coral reefs*

Many environmental factors influence the health and function of *coral reefs*. Some factors operate on a regional or even global scale, such as changes in Earth's atmosphere, ocean acidification, and dust storms. Other factors, such as marine pollution and nutrification, are generally more localized, and often directly linked to issues of coastal management.

- *Bleaching:* a potential manifestation of climate change, anomalously high sea surface temperature (SSTs) coupled with high irradiance (light intensity), triggers the expulsion of the symbiotic zooxanthellae from coral polyps, resulting in a loss of pigmentation. Some corals derive 95% of their energy from zooxanthellae associations, and their loss results in a reduction in reef productivity, growth and capacity for repair. In the Cayman Islands, the first observance of a coral

bleaching event occurred in 1983. Bleaching also occurred in 1987, 1991, 1994, 1998, 2003 and 2005. The acute global coral bleaching event of 1998 resulting in the highest mortality measured to date. The 2005 bleaching event, which affected coral reefs throughout the Caribbean, also affected coral reefs in Cayman Islands, but with little mortality.

- During the 1997-1998 El Niño weather event, local sea surface temperatures rose above 30ºC for 25 days, from August 9th through to September 3rd. Surveys indicated approximately 90% of all corals in Grand Cayman to be affected, and an observed mortality of 10%. at two 9m-deep reef sites on the North Side of the island (Bush & McCoy *unpub*.). A near 1°C increase in SSTs in the tropics has been observed over the past century. Some corals are already living at or very near to their upper thermal tolerances. A regional temperature increase of +1ºC relative to the 1961-1990 mean is expected by the end of 2100 which will likely result in coral bleaching across the entire Caribbean (McWilliams *et al.* 2005). More alarming projections of +1ºC by 2015 and about 2ºC have been made for the 2050s for the Caribbean Sea (Sear *et al.* 2001; Nurse *et al.* 2001).
- *Climate change:* predictions of continued elevated sea surface temperatures (SSTs), in combination with an elevation in sea-level, and more severe storms could represent a critical combination of factors detrimental to the health and function of *coral reefs.* It is anticipated that these stresses would be concomitant with a reduction in the capacity of *coral reefs* for self-repair and regeneration, due to the compounding effects of ocean acidification bleaching and disease, with the two latter being identified as the drivers of coral reef decline in the region.
- *Disease:* the reefs of Grand Cayman have similar or lower levels of prevalence of coral diseases at the community level when compared with other countries around the Caribbean basin (Weil, Cróquer & McCoy, *unpub.*). The most common and perhaps most severe diseases affecting reefs of Cayman Islands are yellow band, white plague and black band diseases. Yellow band disease affects the three species of *Montastraea* (*M. faveolata, M. franksi* and *M. annularis*) and normally persists, producing extensive mortality on individual colonies. White plague affects a wide range of hosts, including the major reef builders, and may relatively quickly kill extensive areas of living tissue. This disease tends to be seasonal but not persistent, with higher levels of prevalence during warmer months. Black band disease presents as a dark red or black microbial mat, which migrates over the surface of the coral, resulting in tissue degradation, and exposure of the coral skeleton.
- *Sediments:* the active dredging of nearshore *lagoons* for fill and access generates particulate matter. The fine nature of this residue enables it to remain suspended in the water column for long periods, during which time it may be carried some distance from the activity footprint. In suspension, this residue contributes to increased turbidity, reduced clarity and increased light attenuation through the water column, compromising the productive capacity of photosynthetic organisms, and associations including *seagrasses* and *corals*. On settlement, these sediments have the capacity to smother *seagrass beds* and damage the fragile feeding mechanisms of *coral* polyps. Due to their fine nature, these sediments are prone to resuspension as a result of modest wave action, or currents generated by passing water craft. Due to the confined, reef-protected nature of much dredged *seabed*, residue has a tendency to remain captive, repeatedly cycling between suspension and sedimentation, migrating within, and impacting, the nearshore system.
- *Coastal development:* nutrient and sediment-rich runoff from the terrestrial environment, exacerbated by land clearance, roads construction and emplacement of impervious surfaces, combined with the removal of buffering coastal vegetation, contribute to an increased incidence of stressors on *coral reefs*, in combination with an erosion of natural filtration mechanisms.
- *Dredging / channelling:* for fill and access impacts *coral reefs* within the footprint of activity, and beyond through increased sediment loading.
- *Antiquation of legislation:* though progressive in their time, the current protective measures for *coral reefs* (outside of Marine Park areas) in the Cayman Islands have remained unchanged since 1978. Since the *Marine Parks Regulations* were established in 1986, the population of the Cayman Islands has risen from 21,545 to 53,888 in 2007, and annual visitor numbers to the Islands have increased to nearly two million; placing *coral reefs* under increasing pressure. Protection measures for *coral reefs* should be dynamic and responsive to change if they are to effectively address the evolving complement of pressures to which they are subjected, and the expectations of a tourism industry increasingly savvy with regard to environmental provision. With other destinations setting the current benchmark by protecting their entire *coral reef* system, the Cayman Islands can

no longer be regarded as ecologically forward-thinking with less than 10% of its *coral reefs* included within marine protected areas.

- *Anchor damage:* physical destruction of *coral reefs* due to commercial and recreational boating has contributed significantly to the degradation of reefs in the Cayman Islands. *Coral reefs* in areas exposed to heavy marine traffic, for example, in the vicinity of George Town harbour, have been almost completely destroyed.
- *Nutrification:* addition of nutrients into coastal waters promotes a shift in the natural complement of reef species, encouraging the rapid growth of algae, which has the potential to smother corals and compete for space. Sewage effluent and fertilizer runoff are the most common sources of coastal nutrification. In the Cayman Islands, examples of nutrification and algal domination of degraded reefs may be seen adjacent the effluent outlet for *Boatswain's Beach* (previously *Cayman Turtle Farm*).
- *Ocean acidification:* a manifestation of climate change - the net effect of ocean acidification is the dissolving of the *coral reef* structure. Carbon dioxide $CO_2$ is soluble in water, in which it interconverts between $CO_2$ and carbonic acid $H_2CO_3$. As atmospheric $CO_2$ increases, the amount of $CO_2$ dissolved in the oceans increases, decreasing ocean surface pH and increasing acidity. Ocean acidification is of major long-term concern for *coral reefs*. Ocean surface pH is estimated to have decreased from approximately 8.25 to 8.14 since the beginning of the industrial era, (Jacobson 2005) and it is estimated that it will drop by a further 0.3-0.4 units by 2100 as the ocean absorbs more anthropogenic $CO_2$. (Orr *et al.* 2005). As ocean pH falls, so does the concentration of calcium carbonate, which is normally present at supersaturating concentrations. When carbonate becomes under-saturated, structures made of calcium carbonate are vulnerable to dissolution. Research has already found that corals experience reduced calcification or enhanced dissolution when exposed to elevated $CO_2$. (Gattuso 1998).
- *Spearfishing*: this popular recreational sport has the potential to target top-predators and remove large adult breeding stock from the reef environment.
- *Diver damage:* the living tissue of coral polyps is sensitive to physical pressure and abrasion. Permanent death of polyps can result from divers touching the surface of corals, either deliberately with their hands, or accidental through trailing equipment or fins. The modern diving community is generally better educated regarding the sensitivity of *coral reefs*, resulting in a much reduced impact from individual divers; however, this reduction in impact is largely offset by the extent of historical degradation and the current high levels of usage of remnant *coral reefs.*
- *Invasive species:* Red lionfish *Pterois volitans* were first reported on Cayman reefs in 2008.
- *Accidental grounding:* grounding events of recreational and commercial vessels are a regular occurrence. Grounding may result from boats slipping moorings during severe weather, or poor navigation.
- *Storm damage:* there is evidence that modest storm action may be beneficial to reef-health, cleaning corals surfaces of excessive epifauna and epiflora, especially marine algae. However, wave action, strong currents, abrasion and scour arising from severe storms can significantly impact reef structure. Studies throughout the Caribbean show that hurricanes on average cause a 17% decline in coral cover in the year following the storm (Gardner *et al.* 2005). Climate change predictions are for more intense storms.
- *Pollution:* poor water quality encourages the establishment and the spread of infectious diseases among corals. Industrial pollutants, such as copper, can impact the natural development of corals. There is also evidence that tributyltin (TBT), a key ingredient in anti-fowling paints, significantly impacts coral growth and recruitment. Vessel grounding events thus have the potential not only to inflict immediate physically damage on coral heads, but also impact recovery through TBT contamination (Negri *et al*. 2002, Smith *et al.* 2003). The impact of these factors on Cayman *coral reefs* is largely unstudied.
- *Oil-spill*: pollution events arising from large scale wrecking and small-scale accidental and deliberate release of oil into the marine environment have significant potential to impact *coral reefs* and associated flora and fauna.
- *Dust:* Global air currents link the Caribbean with Africa, carrying dust to the Cayman Islands from the Sahara. This process is most pronounced during positive phases of the North Atlantic Oscillation (Prospero 1986), and over time is believed to have supplied the Cayman Islands with

the characteristic "red mold" earth which supports some of our best *farm and grassland*. Dust events have been linked to a decline in the health of coral reefs across the Caribbean and Florida, primarily since the 1970s (*U. S. Geological Survey*).

- *Marine litter:* while coral skeletons appear rocky and fairly impervious to physical damage, the living polyps are delicate, and highly sensitive to even slight physical pressure or abrasion.
- *Artificial installations:* a significant decline in the quality of Cayman's *coral reefs* in recent years has resulted in increasing attempts to diversify the "attractiveness" of diving sites through augmentation of natural features with artificial installations. Examples include the *Shipwreck City* project, which aims to deliberately wreck ships as a dive feature off Grand Cayman, and a concrete *"Lost City of Atlantis"* off Cayman Brac.

### Opportunities and Current Local Action for *Coral reefs*

- To better understand the dynamics of the Cayman Islands reefs, the *Department of Environment* has commenced a long-term *Coral Reef Monitoring Programme*, encompassing all three islands, towards determining the scale of the problems facing *coral reefs*, and to provide conservation manager with data to foster better management practice of local reefs.
- In 1988, the *Marine Conservation Regulations* made it illegal to damage coral by anchoring in the Cayman Islands. The Department of Environment maintains a network of over 300 permanent moorings around the islands, towards minimizing anchor damage. The maximum fine imposed to-date is CI$150,000 for 130$m^2$ of damaged reef.
- In 2007, the Cayman Islands Government strengthened protective regulations on the legal harvest of marine turtles.
- The establishment of the proposed Barkers National Park would represent the first protected area in Cayman to incorporate a full continuum of habitats, from *coastal shrubland* and *mangrove*, to *beach*, *lagoon* and *coral reef*.
- Dive tour operators work in cooperation with the *Department of Environment* - educating divers towards minimising impact on *coral reefs*, including participation in the annual *Reef Watch* survey.
- Since the mid 1980s:
    - Under the *Regulations of the Marine Conservation Law* "whoever anchors any vessel exceeding twenty feet in length or a commercial vessel … in such a manner that damage is caused to the coral by an anchor, chain or any similar contrivance, is guilty of an offence."
    - Under the *Marine Conservation Law* "Whoever, unless licensed … intentionally cuts, carves, injures, mutilates, removes, displaces or breaks any underwater coral or plant growth or formation in Cayman waters is guilty of an offence."
    - Under the *Marine Conservation Law* "any person who, while equipped with any kind of underwater breathing apparatus, takes any marine life in Cayman waters is guilty of an offence."

  While these clauses effectively protect all corals in the Cayman Islands from a variety of threats, this protection is incomplete. Unforeseen events such as boat groundings, land-based stresses, people walking on shallow coral reefs, etc remain unaddressed.
- In 1986 *Marine Conservation Regulations* created strict licensing procedures for spear fishing. Importation of new spear guns and parts into the country is illegal under these regulations. Though this was envisioned as slowly phasing out this activity, it has been only partially successful.
- *Coral reef* monitoring is undertaken by DoE biannually, as part of CARICOMP.

### HABITAT ACTION PLAN for *Coral reefs*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *coral reefs*. | 2008 |
| **2.** Maintain *coral reefs* in a natural state, by eliminating and managing local anthropogenic stressors. | 2015 |
| **3.** Maintain and manage the variety of habitats, communities and species on *coral* | 2015 |

| | |
|---|---|
| *reefs*. | |
| **4.** Seek improvement of *coral reefs* which have been degraded. | 2015 |
| **5.** No net loss or reduction in quality of habitat due to local anthropogenic activity. | 2015 |
| **6.** Fully protect all *coral reefs* in the Cayman Islands through legislation, and include a minimum of 50% of currently remaining reef habitats within marine protected areas, ensuring that key species and habitats are incorporated within the MPA system. | 2015 |

| Coral reefs<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4,5,6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3,4,5,6 |
| **PL3.** Agree and implement water sports codes of practice with operators which will minimize impacts on biodiversity and promote sustainability of water sports activities. | DoE | CITA<br>DoT<br>SITA<br>MCB | 2010 | 2,3,4,5 |
| **PL4.** Ensure that developments do not adversely affect *coral reefs*. | DoE | DoP CIG | ongoing | 2,3,5 |
| **PL5.** Establish a policy of "no channelling" through any *coral reefs.* | DoE | CIG<br>MCB | 2010 | 2,3,5 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,5,6 |
| **PL7.** Expand marine protected areas to incorporate 30% of *coral reefs*. | DoE | CIG<br>MCB | 2015 | 2,3,5,6 |
| **PL8.** Fully protect all *coral reefs* in the Cayman Islands through legislation. | DoE | CIG<br>MCB | 2015 | 2,3,5,6 |
| **PL9.** Establish and implement ban on use of tributyltin TBT in the Cayman Islands. | DoE | CIG<br>MCB | 2015 | 2,3,5 |
| **PL10.** Expand Marine Parks legislation to address previously unregulated anthropogenic impacts. | DoE | CIG<br>MCB | 2015 | 2,3,5,6 |
| **PL11.** Establish policies to maintain legal access to and use of common resources by the general public, and prevent exclusive exploitation by private enterprise. | DoE | CIG<br>MCB | 2015 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Oppose developments or other proposed activities which threaten net loss or damage of *coral reefs.* | DoE | NT MCB<br>CCMI<br>CITA<br>SITA<br>LSCo | ongoing | 2,3,5 |
| **SM2.** Establish new marine protected areas, incorporating 50% of *coral reef* habitats, prioritising the most biodiverse components of the reef system, and those supporting species not represented elsewhere, particularly *aggregate reef* and *aggregate patch reef*. | DoE | CIG MP<br>CITA<br>SITA<br>MCB | 2015 | 2,3,6 |
| **SM3**. Begin experimental implementations of artificial reefs (such as BioRock constructs) and actions to adapt reefs to changing climatic conditions. | DoE | CIG IntC | 2009 | 3,4,5 |
| **SM4.** Develop guidelines for restoration of degraded *coral reefs.* | DoE | IntC | 2009 | 3,4,5 |
| **SM5.** Subject to RM5, enforce fines and remuneration | DoE | RCIP | 2012 | 2,4,5 |

| | | | | |
|---|---|---|---|---|
| for damage to *coral reefs*, on the basis of established economic valuation. | | CIG LD CIJ | | |
| **SM6.** Implement associated SAPs. | DoE | | | 2,3 |
| **Advisory** | | | | |
| **A1.** Encourage Integrated Coastal Zone Management through collaboration and co-operation between the many interests concerned with *coral reefs.* | DoE | DoP WA MP SITA CITA | ongoing | 2,3,4,5 |
| **A2.** Avoid reduction in water quality from direct and indirect discharges, run-off or inappropriate use. | WA | DoP DoE | ongoing | 2,3,4 |
| **A3.** Minimise the risk of introduction of non-native species through import and quarantine regulations, and controls on the discharge of ballast water. | DoA | DoE PA | ongoing | 2,5 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4,5,6 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *coral reefs* areas around the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *coral reefs*, towards expansion of MPAs, incorporating an assessment of ecological and recreational value, and continuity with other protected areas. | DoE | MCB | 2009 | 6 |
| **RM3.** Maintain long-term *coral reef* monitoring to help inform management. | DoE | | ongoing | 1,2,3,5 |
| **RM4.** Maintain water quality monitoring to help inform management. | DoE | WA | ongoing | 2,3,5 |
| **RM5.** Develop an economic valuation system for application of a monetary value to areas of *coral reef*, towards establishing a firm financial basis for fines, mitigation and restoration measures. | DoE | ESO IntC | 2012 | 2,3,4,5 |
| **RM6.** Incorporate monitoring of heavy metals in our marine ecosystem i.e. lead. | DoE | | 2010 | 2 |
| **RM7.** Maintain and expand existing monitoring of key species (e.g. fish and invertebrates, such as *D. antillarium)* and habitats for *coral reefs*, specifically to reflect any changes in the overall health of the system. | DoE | | 2010 | 3 |
| **RM8.** Develop guidelines for restoration and enhancement of degraded *coral reefs*. | DoE | | 2015 | 2,3,4,5 |
| **RM9.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM10.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM11.** Develop rapid assessment protocols for significant events such as bleaching, hurricanes and ship groundings. | DoE | IntC | 2012 | 2,5 |
| **RM12.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM13.** Continue CARICOMP monitoring of *coral reefs.* | DoE | IntC | ongoing | 2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value and benefits of having healthy *coral reefs.* | DoE | NT CCMI | ongoing | 2,6 |
| **CP2.** Inform public on the location and extent of marine protected areas, through informational signage, leaflets and website information | DoE | | ongoing | 1,2,3,5,6 |

| | | | | |
|---|---|---|---|---|
| **CP3.** Promote Cayman Islands internationally through programmes designed to protect reefs. | DoT | DoE CITA SITA | ongoing | 2,5 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 5 |

## REFERENCES and FURTHER READING for *Coral reefs*


Andrew P. Negri, Luke D. Smith, Nicole S. Webster, Andrew J. Heyward, (2002). Understanding ship-grounding impacts on a coral reef: potential effects of anti-foulant paint contamination on coral recruitment, Mar. Pollut. Bull., 44 111-117.

Fenner, D.P (1993). Some Reefs and corals of Roatan (Honduras), Cayman Brac, and Little Cayman. Atoll Research Bulletin, No. 388: pp. 1-30.

Gattuso, J.P., Frankignoulle, M., Bourge, I., Romaine, S. and Buddemeier, R. W. (1998). Effect of calcium carbonate saturation of seawater on coral calcification. *Glob. Planet. Change* 18, 37-46.

Gardner, T. A., I. M. Cote, J. A. Gill, A. Grant, and A. R.Watkinson. (2005). Hurricanes and Caribbean coral reefs: impacts, recovery patterns, and role in long-term decline. *Ecology* 86:174–184.

Inoue M., A. Suzuki, M. Nohara, H. Kan, A. Edward, H. Kawahata, (2004). Coral skeletal tin and copper concentrations at Pohnpei, Micronesia: possible index for marine pollution by toxic anti-biofouling paints, Environ. Pollut., 129/3 399-407.

Jacobson, M. Z. (2005). Studying ocean acidification with conservative, stable numerical schemes for nonequilibrium air-ocean exchange and ocean equilibrium chemistry. *J. Geophys. Res. Atm*. 110, D07302.

McWilliams JP, Côté IM, Gill JA, Sutherland WJ, and Watkinson AR (2005) Accelerating impacts of temperature-induced coral bleaching in the Caribbean. Ecology 86:2055–2060.

Negri, Andrew P., Luke D. Smith, Nicole S. Webster, Andrew J. Heyward, (2002). Understanding ship-grounding impacts on a coral reef: potential effects of anti-foulant paint contamination on coral recruitment, Mar. Pollut. Bull., 44 111-117.

Nurse, L., G. Sem, J.E. Hay, A.G. Suarez, P.P. Wong, B. Briguglio and S. Ragoonaden (2001). Small Island States. Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, J.J McCarthy, O.F. Canziani, N.A.Leary, D.J. Dokken and KS. White (Eds.), Cambridge University Press, Cambridge, UK., pp. 843-875.

Orr, J. C. *et al.* (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. *Nature* 437, 681-686.

Prospero, J.M., and Nees, R.T. (1986). Impact of the North African drought and El Niño on mineral dust in the Barbados trade winds. *Nature* 320:735–738.

Sear, C., M. Hulme, N. Adger, and K. Brown (2001). The Impact of Global Climate Change on the UK Overseas Territories: Issues and Recommendations, Natural Resources Institute, University of Greenwich, Kent, UK and Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK.

Smith, L. D., Negri, A. P., Philipp, E., Webster, N. S., and Heyward, A. J. (2003). The effects of antifoulant-paint-contaminated sediments on coral recruits and branchlets. ISSN 0025-3162 Marine biology, vol. 143, no4. pp. 651-657.

Spalding, M., Ravilious C., and Green, E. (2001). *World Atlas of Coral Reefs*. Berkeley, CA: University of California Press and UNEP/WCMC.

U. S. Geological Survey. Coral Mortality and African Dust.

## MARINE HABITATS

### *3. Lagoons*

### Definition

*Lagoons* are nearshore reaches of shallow salt or brackish water, separated from the *open sea* by a shallow or exposed sandbank, coral reef, or similar feature. *Seagrass beds* are covered under an individual Habitat Action Plan.

### Local Outline

The majority of the inshore coast of the Cayman Islands comprises reef-protected shallow saltwater *lagoons*. Due to their proximity to coastal development, restricted water circulation, and sensitivity of component habitats to nutrification, freshwater and turbidity derived from runoff, *lagoons* are vulnerable to anthropogenic influence.

In the Cayman Islands, the term "Sound" is most commonly used to describe *lagoon* areas. The largest Sound in the Cayman Islands is "North Sound", Grand Cayman: the second-largest semi-enclosed lagoon in the Caribbean.

### Key Habitat Categories for *Lagoons*

- Seagrass: defined as areas where seagrass species represent the dominant substrate coverage. In cases where algae and seagrass co-exist, coverage is designated as *seagrass beds* if seagrass is dominant, and to the *vegetated sand* category if algae is dominant. *See also separate Seagrass beds HAP*.
- Sediment: unvegetated mud and sand.
- Hardbottom: low-relief pavement or rubble, or low-relief rock, often colonised by algae.
- Vegetated sand: vegetated sediment >=1 mm in diameter.
- Vegetated mud: vegetated sediment <1 mm in diameter.
- Lagoonal coral

### Key Species for *Lagoons*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

**KEY SPECIES for LAGOONS**

**PART 1**

| Category | Detail | Scientific Reference | NBAP |
|---|---|---|---|
| Mammals (marine) | Manatees | Sirenia all species | |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>White-tailed tropic bird (Boatswain bird)<br>Royal tern<br>Least tern (Egg bird)<br>Bridled tern | Aves<br><br><br>*Phaethon lepturus*<br>*Sterna maxima*<br>*Sterna antillarum*<br>*Sterna anaethetus* | <br><br><br>SAP |
| Turtle (marine) | Green turtle | *Chelonia mydas* | SAP |
| Turtle (marine) | Hawksbill turtle | *Eretmochelys imbricata* | SAP |
| Fish (marine, bony) | Tilefish | *Malacanthus plumieri* | |
| Fish (marine, bony) | Filefish | Monacanthidae species | |
| Fish (marine, cartilaginous) | Sharks and rays - *except those specifically listed in Part 2* | Elasmobranchii all species | |
| Corals | All soft corals (including Gorgonians & Telestaceans) | Anthozoa all species | |
| Corals | Gorgonians | Gorgoniacea all species | |

| | | | |
|---|---|---|---|
| Corals | Fire corals | Milleporidae all species | |
| Corals | Hard corals | Scleractinia all species | |
| Corals | Lace corals | Stylasteridae all species | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Sponges | Porifera all species | |
| Invertebrates | Conch - *except those listed in Part 2* | Strombidae all species | |
| Invertebrates | Tritons | Tritonidae all species | |
| Invertebrates | Tuns | Tonnidae all species | |
| Invertebrates | Cassidae | *Cassis tuberosa* | |
| Invertebrates | Cassidae | *Cassis madagascariensis* | |
| Invertebrates | Cassidae | *Cassis flammea* | |
| Invertebrates | Cassidae | *Phalium granulatum* (all varieties) | |
| Invertebrates | Cassidae | *Cypraeacassis testiculus* | |
| **PART 2** | | | |
| Fish (marine, bony) | Fry, Silversides | Atherinidae species | |
| Fish (marine, bony) | Herrings | Clupeidae species | |
| Fish (marine, bony) | Anchovies | Engraulidae species | |
| Fish (marine, bony) | Nassau grouper | *Epinephelus striatus* | SAP |
| Fish (marine, bony) | Goggle eyes | *Selar crumenophthalmus* | |
| Fish (marine, bony) | All bony fish - *except those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Fish (aquatic, bony) | Mosquito fish | *Gambusia xanthosoma* | SAP |
| Fish (aquatic, bony) | Mosquito fish | *Limia caymanensis* | SAP |
| Fish (marine, cartilaginous) | Southern stingray | *Dasyatis americana* | SAP |
| Invertebrates | Tulip mussel | *Cosa caribbaea* | |
| Invertebrates | Commissioner Gerrard's clam | *Transenella gerrardi* | |
| Invertebrates | Lobsters | Palinura species | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |
| Invertebrates | Queen conch | *Strombus gigas* | SAP |
| Invertebrates | Alfred's turbonille | *Turbonilla alfredi* | |
| Plants (marine) | Eel grass | *Halodule wrightii (= ciliate / bermudensis / beaudettei)* | |
| Plants (marine) | Manatee grass | *Syringodium filiforme (= Cymodocea manitorum)* | |
| Plants (marine) | Turtle grass | *Thalassia testudinum* | |
| Plants (marine) | Green algae | Chlorophyta species | |
| Plants (marine) | Brown algae | Phaeophyta species | |
| Plants (marine) | Red algae | Rhodophyta species | |

## Current Status of *Lagoons*

*Link to habitat map: Lagoons Grand Cayman*
*Link to habitat map: Lagoons Cayman Brac*
*Link to habitat map: Lagoons Little Cayman*

| Habitat Status 2006 Lagoons | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Seagrass beds | 15403.57 | 27.00 | 359.54 | 8122.55 | 0.92 | 190.60 | 7281.02 | 26.08 | 168.94 | 52.73 | 3.41 | 53.01 |
| Sediment | 2456.00 | 13.62 | 714.18 | 1611.23 | 0.00 | 441.12 | 844.77 | 13.62 | 273.06 | 65.60 | 0.00 | 61.77 |
| Hardbottom | 851.10 | 97.58 | 298.63 | 460.49 | 16.51 | 204.37 | 390.61 | 81.07 | 94.26 | 54.11 | 16.92 | 68.44 |
| Vegetated sand | 4661.43 | 7.04 | 308.24 | 2165.91 | 0.00 | 219.17 | 2495.52 | 7.04 | 89.07 | 46.46 | 0.00 | 71.10 |
| Vegetated mud | 9.94 | 0.00 | 0.00 | 9.93 | x | x | 0.01 | x | x | 99.90 | x | x |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lagoonal coral | 347.89 | 0.00 | 19.93 | 189.45 | x | 5.10 | 158.44 | x | 14.83 | 54.46 | x | 25.59 |
| No data available | 2567.28 | 0.00 | 0.00 | x | x | x | x | x | x | x | x | x |
| **TOTAL** | **26297.21** | **145.24** | **1700.52** | **12559.56** | **17.43** | **1060.36** | **11170.37** | **127.81** | **640.16** | **47.76** | **12.00** | **62.36** |

Marine Protected Areas in the Cayman Islands include Marine Parks, Replenishment Zones, Environmental Zones, No Dive Zones and Wildlife Interaction Zones: totalling 19,311 acres for Grand Cayman, 2,281 acres for Little Cayman, and 914 acres for Cayman Brac. Total for the Cayman Islands: 22,506 acres (91.08 $km^2$).

## Key Sites for *Lagoons*

GRAND CAYMAN:
North Sound
South Sound
Frank Sound
East End
Bodden Town lagoon
Pease Bay lagoon

CAYMAN BRAC:
Dick Sessinger's Bay
North East Bay

LITTLE CAYMAN:
South Hole Sound
Mary's Bay
Charles Bight
Preston Bay
Point of Sand

## Nature Conservation Importance of *Lagoons*

- *Biodiversity:* marine *lagoons* in the Cayman Islands support several distinct marine habitats, each of which contains a unique complement of associated species.
- *Marine invertebrates:* the varied habitats and substrates of marine *lagoons* contribute habitat which supports a high diversity of marine invertebrates. In addition to echinoderms such as urchins and starfish, the complement of species includes commercially significant species, including Queen conch *Strombus gigas* and Spiny lobster *Panulirus argus*. Whelks *Cittarium pica* constitute fisheries in the Cayman Islands, of sufficient size to impact natural populations to the extent that they have required interventory management.
- *Stingrays:* the Sandbar supports large numbers of Southern stingrays *Dasyatis americana.* This quasi-natural tourist attraction is one of Grand Cayman's most population features with cruise-ship visitors.
- *Turtles*: the sheltered, productive waters of marine *lagoons* provide habitat to adult marine turtles, which feed on *coral reefs* and *seagrass beds*.
- *Seabirds***:** marine shallows and intertidal areas support a variety of shorebirds and waders. Least tern (Egg bird) *Sterna antillarum*, and Bridled tern *Sterna anaethetus* dive for food in nearshore waters. Common migratory (non-breeding) seabirds include the Royal tern (Sprat bird, Old Tom) *Sterna maxima*.

*Other:*

- *Recreation:* a combination of sheltered and productive waters, aesthetic appeal, and proximity to population centres, contribute to significant recreational pressure on *lagoons*. Swimming, snorkelling, scuba diving, recreational fishing, and pleasure boating and sailing, are the main activities, enjoyed by visitors and residents alike.

## Current Factors Affecting *Lagoons*

- *Sediments:* the active dredging of nearshore *lagoons* for fill and access generates particulate matter. The fine nature of this residue enables it to remain suspended in the water column for long periods, during which time it may be carried some distance from the activity footprint. In suspension, this residue contributes to increased turbidity, reduced clarity and increased light attenuation through the water column, compromising the productive capacity of photosynthetic organisms, and associations including *seagrasses* and *corals*. On settlement, these sediments have the capacity to smother *seagrass beds* and damage the fragile feeding mechanisms of *coral* polyps. Due to their fine nature, these sediments are prone to resuspension as a result of modest wave action, or currents generated by passing water craft. Due to the confined, reef-protected nature of much dredged *seabed*, residue has a tendency to remain captive, repeatedly cycling between suspension and sedimentation, migrating within, and impacting, the nearshore system.
- *Buffer vegetation:* damage and clearance of buffering coastal vegetation, particularly *mangrove*, and to a lesser extent, *seagrass beds*, reduces the natural capacity of *lagoons* to absorb elevated nutrient levels. There is currently no planning regulation to maintain coastal vegetation buffers in most areas of the islands.
- *Canalisation:* to facilitate access, causes direct physical damage to *lagoons* through clearance, and is usually accompanied by the filling and development of land immediately adjacent the canal. Canalisation reduces the effectiveness of coastal vegetation and *mangrove* to act as a buffer to influx of freshwater, nutrients and sediment into *lagoons*.
- *Nutrification:* loading of nutrients, often in association with run-off from land treated with fertilizer, and leaching of nutrients from sewage systems.
- *Freshwater runoff:* as the islands become increasingly developed, impervious surfaces such as concrete and black-top road contribute to a greater freshwater runoff. Many *lagoon* species and habitats (such as *seagrass beds*) are sensitive to fluctuations in salinity. Artificial channelling of freshwater runoff through storm drains concentrates freshwater outflow from a large areas, impacting sensitive marine flora and fauna which inhabits the area. Impact of run off is compounded by the clearance of vegetation from the land, combined filling with unconsolidated marl, facilitating ingress of runoff with a heavy silt-burden into the marine environment.
- *Recreational pressure*: recreational pressure on lagoons is generally increasing. Diversification of recreational activities, such as the recent growth in the popularity of personal watercraft (jet skis), has added to pressures on popular areas.
- *Fisheries pressure:* key species, such as Queen conch *Strombus gigas*, and Spiny lobster *Panulirus argus* through subject to regulatory management, remain at population levels well below historic norms.
- *Modification of the foreshore:* construction of docks and groins, construction of seawalls, and poorly considered beach restoration projects impact marine *lagoons*, through modification of natural coastal currents, littering, and aesthetic impact.
- *Poaching:* though local waters are actively policed by Marine Enforcers of the Department of Environment, poaching remains an issue. Effected species include Queen conch *Strombus gigas*, Spiny lobster *Panulirus argus*, and Green turtle *Chelonia mydas*. The evolution of drug-culture, the advent of crack-cocaine, and the development of an unemployable subclass within local society has contributed in large part to a new poaching element, for whom jail-time offers little by way of functional deterrent. As the islands continue to develop, it would be expected that the continued fragmentation of society will increase and diversify pressure on natural resources.
- *Spearfishing*: this popular recreational sport targets and removes large adult breeding stock from the marine environment. Spear fishing is not legally permitted within *lagoons* in the Cayman Islands.
- *Collision:* collisions with motor boats, props and personal water craft contribute to mortality amongst marine mega-fauna, turtles etc., and impact *lagoon* substrates including *seagrasses*, hardbottom, and coral communities.
- *Pollution:* industrial pollutants, such as copper, can impact the natural development of corals. There is also evidence that tributyltin (TBT), a key ingredient in anti-fowling paints, significantly impacts coral growth and recruitment (Negri *et al.* 2002, Smith *et al.* 2003). Vessel grounding events thus have the potential not only to inflict immediate physically damage on coral heads, but

also impact recovery of adult populations through TBT contamination (Smith *et al.* 2008). The impact of TBT on Cayman *lagoons* is largely unstudied.

- *Aggregate extraction:* the Cayman Islands Government currently employs a policy of no aggregate extraction in the North Sound, however, the topography of the Sound, and many other areas around the Islands remain extensively modified by dredging. In addition to direct modification of the seabed, resultant suspended fines increase water turbidity, reduce clarity and impact *seagrasses* and *coral reefs*. Poor flushing of North Sound extends residence time, with sediments repeatedly settling and resuspending when disturbed.
- *Harvesting of small fish:* the harvesting of small fish species and fry constitutes an adverse impact on fish stocks. This non-traditional method of fishing was largely imported to the islands as a component of an increased foreign-national presence. As the Islands continue to develop, it should be expected that the continued growth and diversification of society will result in pressures on previously unexploited sectors of the natural environment. As all fish fewer than eight inches in length (except for certain traditionally fished species which do not normally attain a size greater than eight inches) are protected by law this threat has partially been ameliorated.
- *Anchor damage:* dropping and dragging of anchors and chains in sensitive habitats causes physical damage to the seabed and associated communities. Boat groundings and prop damage similarly impact the seabed.
- *Marine litter:* littering of the seabed, water column and sea-surface from both vessels and land sources (distant and local), results in the death of marine species by smothering, entanglement and ingestion. Sea birds in particular as susceptible to entanglement in discarded fishing gear. Discarded nets and pots continue to trap fish and marine mammals. Ingestion of floating plastics is a significant cause of mortality in marine turtle.
- *Operational discharge:* release of industrial and commercial developments in the form of treated effluent, heated water.
- *Storms:* severe weather physically impacts *lagoons* through wave action and scour, and through introduction of increased loadings of litter, freshwater and sediment to the nearshore system. These effects are generally exacerbated by modification of the coastline, including impervious surfacing, clearance of natural vegetation, and construction of seawalls.
- *Laying of cable and pipelines:* provision of underwater supply of utilities incurs a modest and generally localized impact on the marine environment.
- *Wind turbines:* in recent years, with the advent of an increased awareness of the need to Utilise alternative energy sources, plans for wind turbine developments have included consideration of the establishment of offshore wind farms.

### Opportunities and Current Local Action for *Lagoons*

- The Marine Conservation Law 1986 established a series of Marine Parks Zones and other protected areas. A primary factor for consideration in the siting and designation of these areas was fisheries management in *lagoon* areas. *Lagoon* areas include “no-take” areas (Replenishment Zones) for Queen conch *Strombus gigas* and Spiny lobster *Panulirus argus*. No marine life may be taken on scuba or removed by excavation without prior written approval of the Governor-in-Cabinet.
- North Sound lagoon incorporates Cayman’s most protected marine area: the Environmental Zone. In this area, no in-water activity is permitted. Boat speeds are restricted to 5mph. The Environmental Zone protects areas of undisturbed fringing *mangrove* and *seagrass* beds.
- The proposed Barkers National Park incorporates the *lagoon* off the Barkers peninsula; an area which is currently established as a *Replenishment Zone*. Establishment of Barkers as a National Park would represent the first protected area to incorporate a continuum of habitats, from *coastal shrubland* and *mangrove*, *sandy beach*, *lagoon*, *seagrasses* and *coral reef*.
- Coastal water quality in Grand Cayman is jointly monitored by Department of Environment and the Water Authority.
- The quasi-natural stingray attraction at the Sandbar and Stingray City are major tourist attractions, regulated by established Wildlife Interaction Zones, (Marine Conservation (Marine Parks) Regulations 2007).

- Use of spear guns is banned in *lagoons.*
- Discharge into the marine environment is regulated by the Marine Conservation Law, and the Water Authority Law.

**HABITAT ACTION PLAN for *Lagoons***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *lagoons.* | 2008 |
| **2.** Maintain *lagoons* in a natural state, by eliminating and managing local anthropogenic stressors. | 2015 |
| **3.** Maintain and manage the variety of habitats, communities and species on *lagoons.* | 2015 |
| **4.** Seek improvement of *lagoons* which have been degraded. | 2015 |
| **5.** No net loss or reduction in quality of habitat due to local anthropogenic activity. | 2015 |
| **6.** Protect *lagoons* in the Cayman Islands through legislation, and include a minimum of 30% of currently remaining lagoons within marine protected areas, ensuring that key species and habitats are distributed throughout the MPA system. | 2015 |

| Lagoons PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4,5,6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3,4,5,6 |
| **PL3.** Agree and implement water sports codes of practice with operators which will minimize impacts on biodiversity and promote sustainability of water sports activities. | DoE | CITA DoT SITA MCB | 2010 | 2,3,4,5 |
| **PL4.** Ensure that developments do not adversely affect *lagoons*. | DoE | DoP CIG | ongoing | 2,3,5 |
| **PL5.** Formalise policy of "no dredging" or other excavation in North Sound area, and extend this to other *lagoon* areas, with a view to the long-term development of the islands. | DoE | CIG MCB | 2010 | 2,3,5 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,5,6 |
| **PL7.** Expand marine protected areas to incorporate 30% of *lagoons*. | DoE | CIG MCB | 2015 | 2,3,5,6 |
| **PL8.** Establish and implement ban on use of tributyltin TBT in the Cayman Islands. | DoE | CIG MCB | 2015 | 2,3,5 |
| **PL9.** Expand Marine Parks legislation to address previously unregulated anthropogenic impacts. | DoE | CIG MCB | 2015 | 2,3,5,6 |
| **PL10.** Establish policies to maintain legal access to and use of common resources by the general public, and prevent exclusive exploitation by private enterprise. | DoE | CIG MCB | 2015 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Oppose developments or other proposed activities which threaten net loss or damage of *lagoons.* | DoE | NT MCB CCMI CITA SITA LSCo | ongoing | 2,3,5 |
| **SM2.** Establish new marine protected areas, | DoE | CIG MP | 2015 | 2,3,6 |

| | | | | |
|---|---|---|---|---|
| incorporating 30% of *lagoons*. | | CITA SITA MCB | | |
| **SM3.** Reduce damage to benthic communities especially where they are particularly fragile, vulnerable or unusual. Where damage has already occurred, examine the feasibility of re-establishment and restoration. | DoE | IntC | 2009 | 2,3,4,5 |
| **SM4.** Investigate feasibility of producing boating aids towards reducing damage to key habitats and species. | DoE | PA MCB CITA SITA RCIP | 2012 | 1,2,5 |
| **SM5.** Subject to RM5, enforce fines and remuneration for damage to *lagoons*, on the basis of established economic valuation. | DoE | RCIP CIG LD CIJ | 2012 | 2,4,5 |
| **SM6.** Implement associated SAPs. | DoE | | 2015 | 3,5 |
| **Advisory** | | | | |
| **A1.** Encourage Integrated Coastal Zone Management through collaboration and co-operation between the many interests concerned with *lagoons*. | DoE | DoP WA MP SITA CITA | ongoing | 2,3,4,5 |
| **A2.** Avoid reduction in water quality from direct and indirect discharges, run-off or inappropriate use. | WA | DoP DoE | ongoing | 2,3,4 |
| **A3.** Minimise the risk of introduction of non-native species through import and quarantine regulations, and controls on the discharge of ballast water. | DoA | DoE PA | ongoing | 2,5 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4,5,6 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *lagoons* around the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *lagoons*, towards expansion of MPAs, incorporating an assessment of ecological and recreational value and continuity with other protected areas. | DoE | MCB | | 6 |
| **RM3.** Develop guidelines for restoration and enhancement of degraded *lagoons*, e.g. borrow pits. | DoE | | 2015 | 2,3,4,5 |
| **RM4.** Develop an economic valuation system for application of a monetary value to areas of *lagoons*, towards establishing a firm financial basis for fines, mitigation and restoration measures. | DoE | ESO IntC | 2012 | 2,3,4,5 |
| **RM5.** Maintain water quality monitoring to help inform management. | DoE | WA | ongoing | 2,3,5 |
| **RM6.** Incorporate monitoring of heavy metals in our marine ecosystem i.e. lead. | DoE | | 2010 | 2 |
| **RM7.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM8.** Maintain and expand existing monitoring of key species and habitats for *lagoons*. | DoE | IntC | 2010 | 3 |
| **RM9.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM10.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM11.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |

| | | | | |
|---|---|---|---|---|
| **CP1.** Raise public awareness of the ecological value and benefits of having healthy *lagoons.* | DoE | NT CCMI | ongoing | 2,6 |
| **CP2.** Inform public on the location and extent of marine protected areas, through informational signage, leaflets and website information. | DoE | | ongoing | 1,2,3,5,6 |
| **CP3.** Promote Cayman Islands internationally as a green dive destination with 100% *lagoons* protection. | DoT | DoE CITA SITA | ongoing | 2,5 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 5 |

## REFERENCES and FURTHER READING for *Lagoons*


Negri, Andrew P., Luke D. Smith, Nicole S. Webster, Andrew J. Heyward, (2002). Understanding ship-grounding impacts on a coral reef: potential effects of anti-foulant paint contamination on coral recruitment, Mar. Pollut. Bull., 44 111-117.

Smith, L. D., Negri, A. P., Philipp, E., Webster, N. S., and Heyward, A. J. (2003). The effects of antifoulant-paint-contaminated sediments on coral recruits and branchlets. ISSN 0025-3162 Marine biology, vol. 143, no4. pp. 651-657.

## MARINE HABITATS

### *4. Seagrass beds*

#### Definition

*Seagrass beds* develop in shallow subtidal areas on sand and mud. *Seagrasses* are neither grasses nor seaweed, but aquatic flowering plants. Similar to other flowering plants, they can reproduce by setting seed. *Seagrasses* gain nutrients by photosynthesising light from the water column, and also by absorbing nutrients through their roots and vascular tissue, from the soft sediments on the sea floor.

#### Local Outline

In the Cayman Islands, *seagrasses*, along with *coral reefs* and *mangroves*, constitute one of the three major coastal interface communities. Highly productive habitats, *seagrasses* provide a nursery for the juvenile stages of many marine organisms, and contribute to sediment stability and water clarity. The Cayman Islands support extensive *seagrass beds* in shallow lagoonal back reef areas, where fringing *coral reefs* shelter them from wave-action and storms. The total coverage of seagrasses locally is approximately 7,000 hectares, with the most extensive beds located in North Sound, Grand Cayman. Several different species of *seagrasses* are found in the Cayman Islands. Turtle grass *Thalassia testudinum* is the dominant species.

Green turtles *Chelonia mydas* and sea urchins are among the few animals which are able to digest cellulose and feed directly on seagrasses. Seagrasses, however, provide a substrate which supports a diversity of epiflora and fauna, including diatoms, algae, sponges, amphipods, polychaete worms and echinoderms. This diversity of infauna attracts larger predatory species, including fish. As such, seagrass beds underpin numerous food webs, and include culturally, commercially and trophically important species.

*Seagrasses* are highly sensitive to changes in water quality, including clarity and salinity. Since the late-1960s, local *seagrass beds* have been severely impacted by extensive dredging of shallow *lagoons* to facilitate access, and dredging for fill, using (often unscreened) cutter-head hydraulic and mechanical dredges. In 2001, the DoE resurveyed the original 1976 Wickstead Report sites and found local *seagrass beds* to be significantly impacted by dredging activity, both directly, through the removal of substrate and physical modification of the environment, and indirectly, through the introduction of particulate matter into the water column.

A policy on no further commercial dredging in the North Sound was established in 1997; however, navigational channels and other projects deemed “minor” continue to receive approval. The unwritten nature of this moratorium, and the fact that it does not extend to areas *coral reef*, *seagrass* and *lagoons* outside of North Sound, make it weaker protection than these key ecosystems deserve. The environmental impact of recent and previous development activities remain evident to this day.

#### Key Habitat Categories for *Seagrass beds*

Defined as areas where seagrass species represent the dominant substrate coverage. In cases where algae and seagrass co-exist, coverage is designated as *seagrass beds* if seagrass is dominant, and to the *lagoons, vegetated sand* category if algae is dominant.

#### Key Species for *Seagrass beds*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for SEAGRASS BEDS | | | |
|---|---|---|---|
| PART 1 | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals (marine) | Manatees | Sirenia all species | |

| | | | |
|---|---|---|---|
| Turtles (marine) | Green turtle | *Chelonia mydas* | SAP |
| Fish (marine, bony) | Tilefish | *Malacanthus plumieri* | |
| Fish (marine, bony) | Filefish | Monacanthidae species | |
| Fish (marine, bony) | Nassau grouper | *Epinephelus striatus* | SAP |
| Fish (marine, cartilaginous) | Sharks and rays - *except those specifically listed in Part 2* | Elasmobranchii all species | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Conch - *except those listed in Part 2* | Strombidae all species | |
| Invertebrates | Cassidae | Cassis tuberosa | |
| Invertebrates | Cassidae | Cassis madagascariensis | |
| Invertebrates | Cassidae | Cassis flammea | |
| Invertebrates | Cassidae | Phalium granulatum (all varieties) | |
| Invertebrates | Cassidae | Cypraeacassis testiculus | |
| **PART 2** | | | |
| Fish (marine, bony) | All bony fish - *except those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Invertebrates | Tulip mussel | *Cosa caribbaea* | |
| Invertebrates | Commissioner Gerrard's clam | *Transenella gerrardi* | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |
| Invertebrates | Queen conch | *Strombus gigas* | SAP |
| Invertebrates | Alfred's turbonille | *Turbonilla alfredi* | |
| Plants (marine) | Eel grass | *Halodule wrightii (= ciliate / bermudensis / beaudettei)* | |
| Plants (marine) | Manatee grass | *Syringodium filiforme (= Cymodocea manitorum)* | |
| Plants (marine) | Turtle grass | *Thalassia testudinum* | |
| Plants (marine) | Green algae | Chlorophyta species | |
| Plants (marine) | Brown algae | Phaeophyta species | |
| Plants (marine) | Red algae | Rhodophyta species | |

## Current Status of *Seagrass beds*

*Link to habitat map: Seagrass beds Grand Cayman*
*Link to habitat map: Seagrass beds Cayman Brac*
*Link to habitat map: Seagrass beds Little Cayman*

| Habitat Status 2006 Seagrass beds | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Seagrass beds | 15403.57 | 27.00 | 359.54 | 8122.55 | 0.92 | 190.60 | 7281.02 | 26.08 | 168.94 | 52.73 | 3.41 | 53.01 |

Marine Protected Areas in the Cayman Islands include Marine Parks, Replenishment Zones, Environmental Zones, No Dive Zones and Wildlife Interaction Zones: totalling 19,311 acres for Grand Cayman, 2,281 acres for Little Cayman, and 914 acres for Cayman Brac. Total for the Cayman Islands: 22,506 acres (91.08 $km^2$).

## Key Sites for *Seagrass beds*

GRAND CAYMAN: North Sound
South Sound
Frank Sound

| | |
|---|---|
| | East End |
| CAYMAN BRAC: | Dick Sessinger's Bay |
| LITTLE CAYMAN: | South Hole Sound<br>Mary's Bay |

### Nature Conservation Importance of *Seagrass beds*

- *Productivity*: *seagrass beds* are highly productive habitats, representing a primary source of organic material and nutrients for the marine environment.
- *Habitat: seagrass beds* provide a shelter and attachment substrate for a diverse epiphytic flora and fauna.
- *Food: seagrass beds* provide a direct source of food for a small number of species, most significantly Green turtles *Chelonia mydas*.
- *Nursery*: *seagrass beds* provide a shelter for a variety of species during their larval and juvenile phases.

*Other:*

- *Water clarity:* reduction of flow velocity by the leaf blades of *seagrasses* promotes the deposition of sediments from the water column. Healthy *seagrass beds* serve to stabilize unconsolidated sediments through their rooting systems, promoting water clarity.
- *Coastal protection:* aggregation of sediments in nearshore areas by *seagrass beds* can encourage waves to break further offshore, reducing coastal erosion and encouraging shoreline preservation.

### Current Factors Affecting *Seagrass beds*

- *Sediments:* the active dredging of nearshore *lagoons* for fill and access generates particulate matter. The fine nature of this residue enables it to remain suspended in the water column for long periods, during which time it may be carried some distance from the activity footprint. In suspension, this residue contributes to increased turbidity, reduced clarity and increased light attenuation through the water column, compromising the productive capacity of photosynthetic organisms, and associations including *seagrasses* and *corals*. On settlement, these sediments have the capacity to smother *seagrass beds* and damage the fragile feeding mechanisms of *coral* polyps. Due to their fine nature, these sediments are prone to resuspension as a result of modest wave action, or currents generated by passing water craft. Due to the confined, reef-protected nature of much dredged *seabed*, residue has a tendency to remain captive, repeatedly cycling between suspension and sedimentation, migrating within, and impacting, the nearshore system.
- *Dredged seabed:* typically *dredged seabed* constitutes an alteration of the natural underwater topography, from a shallow, gently sloping relief, to deeper, steep-sided features. This results in permanent modification of prevailing physical conditions, and limits potential for recovery of the natural complement of flora and fauna communities.
- *Prop scarring:* physical damage arising from prop impact and grounding of vessels, results in fragmentation of *seagrass beds* and increased erosion in the vicinity of the scar line.
- *Turbidity:* perpetual resuspension of historical sediments appears to be sufficient to permanently discourage reestablishment of healthy *seagrass* communities in degraded areas. This stressor is likely to reduce habitat quality, maintaining reduced photosynthesis, low system productivity and depleted biodiversity.
- *Private dock construction:* causes immediate physical damage through placement of pilings, suspension of sedimentation during drilling and long-term inhibition of underlying seagrass through shading by planking.
- *Nutrification:* there is evidence that seagrasses have the capacity to absorb and even benefit from low level nutrient enrichment of the marine environment. However, high nitrate levels associated with domestic sewage discharge, agricultural effluent and fertilizer run-off can contribute to a

decline in mature seagrasses, increase in phytoplanktonic blooms and an accelerated growth in epiphytic plankton beyond the handling capacity of the system, resulting in a shift towards macro-algal dominance.

- *Sea defences:* inappropriate construction on naturally dynamic areas of the foreshore may result in the focusing and redirection of wave energy, altering natural currents and exacerbating erosion of the shoreline and nearshore areas.
- *Coastal development projects:* proposals for new developments, which incorporate dredging of new channels and "inter-coastal waterways", to facilitate access by vessels (including "mega-yachts") are an ongoing issue.
- *Laying of pipelines and cables:* the last major project of this nature was undertaken by Caribbean Utilities Company, 2000. The Department of Environment assisted with the restoration of damaged mangrove, however impacted *seagrass beds* were not actively restored; considered sufficiently robust in the area, to recover naturally.
- *Disease:* damage to seagrass beds as a result of a wasting disease caused by slime mold has been reported from other regions, but not so far in the Cayman Islands? It is possible, however, that climate change and associated modification of sea surface temperature may promote susceptibility to disease.
- *Natural cycles:* extent and density of *seagrass beds* are subject to natural perturbation, and may vary considerably as a result of wave action, scour, erosion and deposition of sediment associated with storm events.
- *Climate:* factors associated with climate change, including elevation of sea-surface temperature, sea-level rise, severity of storms and proliferation of invasive species, would be expected to cause considerable stress to *seagrass beds*, resulting in a reduction of area, quality and / or ecological function.
- *Marine pollution:* there is evidence that copper and tributyltin, key ingredients in anti-fowling paints, may significantly impact *seagrasses* (Jensen 2004), reducing nitrogen fixation capacity. *Seagrass* is know to accumulate tributyltin, and possibly other metals and organic pollutants, facilitating its concentration through associated food chains. Use of this agent is currently unregulated in the Cayman Islands. The incidental effects of antifouling paint may be expected to increase, given the expanding use of recreational watercraft locally.
- *Invasive species:* in the UK, species such as *Spartina anglica* and *Sargassum muticum* have impacted native seagrass beds. In the Cayman Islands, dumping of ballast water from cargo vessels represents a potential vector for the introduction of invasive species.

### Opportunities and Current Local Action for *Seagrass beds*

- The *Department of Environment* is the lead body for legal protection of the marine environment in the Cayman Islands.
- *Seagrass* monitoring is undertaken by DoE biannually, as part of CARICOMP.
- There is no active habitat restoration of damaged *seagrass beds* in the Cayman Islands.
- In 2001, the Department of Environment updated guidelines for the construction of private docks, towards minimizing the impact on seagrasses habitats. *Coastal Works* licenses set out requirements for private dock constructions, incorporating design features, such as a minimum board-spacing, aimed at reducing impact on *seagrass beds*. A brochure of these guidelines is available to the public as part of a larger information campaign on the *Coastal Works* application process.
  http://www.gov.ky/pls/portal/docs/PAGE/CIGHOME/FIND/ORGANISATIONS/AZAGENCIES/ENV/DOCUMENTS/COASTALWORKSBROCHURE.PDF
- Sediment arising from new works is required, by *Coastal Works* license, to be contained through the use of silt-screens, however, screens are often ineffectively maintained during the course of major or prolonged projects.

### HABITAT ACTION PLAN for *Seagrass beds*

| OBJECTIVES | TARGET |
|---|---|

| | |
|---|---|
| **1.** Update and refine existing maps of *seagrass beds.* | 2008 |
| **2.** Maintain *seagrass beds* in a natural state, by eliminating and managing local anthropogenic stressors. | 2015 |
| **3.** Maintain and manage the variety of habitats, communities and species on *seagrass beds.* | 2015 |
| **4.** Seek improvement of *seagrass beds* which have been degraded. | 2015 |
| **5.** No net loss or reduction in quality of habitat due to local anthropogenic activity. | 2015 |
| **6.** Protect *seagrass beds* in the Cayman Islands through legislation, and include a minimum of 30% within marine protected areas, ensuring that key species and habitats are distributed throughout the MPA system. | 2015 |

| Seagrass beds<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4,5,6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3,4,5,6 |
| **PL3.** Agree and implement water sports codes of practice with operators which will minimize impacts on biodiversity and promote sustainability of water sports activities. | DoE | CITA<br>DoT<br>SITA<br>MCB | 2010 | 2,3,4,5 |
| **PL4.** Ensure that developments do not adversely affect *seagrass*. | DoE | DoP CIG | ongoing | 2,3,5 |
| **PL5.** Formalise policy of "no dredging" or other excavation in North Sound area, and extend this to other *lagoon* areas, with a view to the long-term development of the islands. | DoE | CIG<br>MCB | 2010 | 2,3,5 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed, with special attention to the Ramsar Convention on Wetlands. | DoE | CIG | ongoing | 2,3,5,6 |
| **PL7.** Expand marine protected areas to incorporate 30% of *seagrass beds.* | DoE | CIG<br>MCB | 2015 | 2,3,5,6 |
| **PL8.** Establish and implement ban on use of tributyltin TBT in the Cayman Islands. | DoE | CIG<br>MCB | 2015 | 2,3,5 |
| **PL9.** Work with appropriate agencies to ensure that *Development Plan*s, including discharge and freshwater outflows, do not adversely affect *seagrass beds.* | WA | DoE DoP<br>NRA | 2010 | 2,3,5 |
| **PL10.** Maintain policy of use of silt screens in association with coastal works in areas where sedimentation is likely to occur, according to the requirements of the Coastal Works License. | DoE | | ongoing | 2,3,5 |
| **PL11.** Define statutory water quality standards for coastal waters. | DoE | WA | 2010 | 2,3,5 |
| **PL12.** Establish policies to maintain legal access to and use of common resources by the general public, and prevent exclusive exploitation by private enterprise. | DoE | CIG<br>MCB | 2015 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Oppose developments or other proposed activities which threaten net loss or damage of *seagrass beds.* | DoE | NT MCB<br>CITA<br>SITA<br>LSCo | ongoing | 2,3,5 |

| | | | | |
|---|---|---|---|---|
| **SM2.** Establish new marine protected areas, incorporating 30% of *seagrass beds*. | DoE | CIG MP CITA SITA MCB | 2015 | 2,3,6 |
| **SM3.** Reduce damage to benthic communities especially where they are particularly fragile, vulnerable or unusual. Where damage has already occurred, examine the feasibility of re-establishment and restoration. | DoE | IntC | 2009 | 2,3,4,5 |
| **SM4.** Develop guidelines for restoration of degraded *seagrass beds.* | DoE | IntC | 2009 | 3,4,5 |
| **SM5.** Investigate feasibility of producing boating aids towards reducing damage to key habitats and species. | DoE | PA MCB CITA SITA RCIP | 2012 | 2,3,5 |
| **SM6.** Subject to RM3, enforce fines and remuneration for damage to *seagrass beds*, on the basis of established economic valuation. | DoE | RCIP CIG LD CIJ | 2012 | 2,4,5 |
| **SM7.** Implement associated SAPs. | DoE | | 2015 | 3 |
| **Advisory** | | | | |
| **A1.** Encourage Integrated Coastal Zone Management through collaboration and co-operation between the many interests concerned with *seagrass beds.* | DoE | DoP WA MP SITA CITA | ongoing | 2,3,4,5 |
| **A2.** Maintain a leaflet detailing guidelines for dock construction. | DoE | | ongoing | 2,5 |
| **A3.** Promote best practice in developments, to ensure the preservation of and natural function of *seagrass beds.* | DoE | WA MP SITA DoP CITA | ongoing | 2,5 |
| **A4.** Ensure that local planning mechanisms take into account the wildlife interest and intrinsic value of *seagrass beds.* | DoE | DoP | ongoing | 2,5 |
| **A5.** Minimise the risk of introduction of non-native species through import and quarantine regulations, and controls on the discharge of ballast water. | DoA | DoE PA | ongoing | 2,5 |
| **A6.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4,5,6 |
| **Research & Monitoring** | | | | |
| **RM1.** Map the extent and quality of all *seagrass beds* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *seagrass beds*, towards expansion of MPAs, incorporating an assessment of ecological and recreational value and continuity with other protected areas. | DoE | MCB | | 6 |
| **RM3.** Develop an economic valuation system for application of a monetary value to areas of *seagrass beds*, towards establishing a firm financial basis for fines, mitigation and restoration measures. | DoE | ESO IntC | 2012 | 2,3,4,5 |
| **RM4.** Collate existing data and case studies on the impact of development on *seagrass beds*, towards improving management and development of effective planning and community regulations for preservation. | DoE | | 2015 | 1,2,3,4,5 |
| **RM5.** Maintain and expand existing standardized monitoring procedures for key species associated with | DoE | | 2012 | 3 |

| | | | | |
|---|---|---|---|---|
| *seagrass beds*. | | | | |
| **RM6.** Determine the diversity of species reliant on local *seagrass beds* for food and habitat. | DoE | | ongoing | 3 |
| **RM7.** Utilise remote sensing to instigate a five-yearly mapping programme for *seagrass beds*. | DoE | | 2015 | 1 |
| **RM8.** Monitor the effectiveness of *seagrass* restoration projects. | DoE | | 2015 | 2,4,5 |
| **RM9.** Improve knowledge of practical techniques for seagrass management and restoration. | DoE | IntC | 2015 | 2,4,5 |
| **RM10.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM11.** Liaise with research institutes and coastal managers within the region and beyond, to exchange data and information on the conservation of *seagrass beds*. | DoE | IntC | ongoing | 2,4,5 |
| **RM12.** Define statutory water quality standards for coastal waters. | DoE | WA | 2010 | 2,5 |
| **RM13.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM14.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM15.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM16.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM17.** Continue CARICOMP monitoring of seagrass. | DoE | IntC | ongoing | 2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value and benefits of having healthy *seagrass beds.* | DoE | NT CCMI | ongoing | 2,6 |
| **CP2.** Inform public on the location and extent of marine protected areas, through informational signage, leaflets and website information | DoE | | ongoing | 1,2,3,5,6 |
| **CP3.** Use restoration programmes and leaflets to raise awareness of the importance of *seagrass beds* in the marine environment. | DoE | NT | ongoing | 3,5 |
| **CP4.** Promote awareness among coastal users of the conservation importance of *seagrass beds* and how to avoid impact on these habitats. | DoE | NT MCB CITA SITA LSCo | | 1,2,3,5,6 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 5 |

## REFERENCES and FURTHER READING for *Seagrass beds*


Green, E.P. and Short, F.T. (2003). *World atlas of seagrasses*, University of California Press.

Jensen, H.F., Holmer, M. and Dahllöf, I. (2004) Effects of tributyltin (TBT) on the seagrass *Ruppia maritima*. *Marine Pollution Bulletin*, Volume 49, Issues 7-8, Pages 564-573

**Global Seagrass Monitoring Network**
SeagrassNet is an expanding monitoring program that investigates and documents the status of seagrass resources worldwide and the threats to this important and imperilled marine ecosystem. The program started in 2001 in the Western Pacific and now includes 70 sites in 23 countries; a global monitoring protocol and web-based data reporting system have been established.
http://www.seagrassnet.org/

**World Seagrass Association**

The World Seagrass Association is a global network of scientists and coastal managers committed to research, protection and management of the world's seagrasses.
http://www.worldseagrass.org/

## MARINE HABITATS

### *5. Dredged seabed*

#### Definition

*Dredged seabed* constitutes any area of lagoon, nearshore waters, reef or shallows, which has been modified as a result of channelisation, coastal development or dredging for fill, and includes canals connecting to the sea.

#### Local outline

*Dredged seabed* constitutes only a small proportion of *lagoons*, inshore waters, *reefs* or shallows in the Cayman Islands. The impacts of dredging, however, range far from the footprint of operation.

As the Islands continue to develop, requirements to access new coastal development, widen access to established developments, and Utilise the seabed as a source of marl to fill low-lying land for development, may be expected to constitute an ongoing and increasing pressure.

The "Study on the Provision of Construction Aggregate and Fill Material for the Cayman Islands", 2001, conducted by CH2M Hill, contained the following dredging-related conclusions:

1. Historical dredging along the western and southern shores of North Sound has irreparably damaged the ecological integrity of this unique shallow habitat - 22% loss.
2. Areas excavated to 15 feet represent ecological barriers, and have not recovered.
3. CIG should prohibit further dredging in North Sound for aggregate and fill acquisition…prevent further ecological segmentation of the system.
4. A more balanced environmental protection policy and ecologically sound development are needed to achieve a sustainable natural and built environment for the Cayman Islands.

#### Key Habitat Categories for *Dredged seabed*

Dredging has the capacity to affect all marine habitats.

#### Key Species for *Dredged seabed*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for DREDGED SEABED | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| None | | | |
| **PART 2** | | | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |

#### Current Status of *Dredged seabed*

*Link to habitat map: Dredged seabed Grand Cayman*
*Link to habitat map: Dredged seabed Cayman Brac*
*Link to habitat map: Dredged seabed Little Cayman*

| Habitat Status 2006 Dredged seabed | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % dredged seabed within protected areas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Dredged seabed | 1271.66 | 3.95 | 12.02 | 162.85 | 0.02 | 4.12 | 1108.81 | 3.93 | 7.9 | 12.81 | 0.51 | 34.28 |

Marine Protected Areas in the Cayman Islands include Marine Parks, Replenishment Zones, Environmental Zones, No Dive Zones and Wildlife Interaction Zones: totalling 19,311 acres for Grand Cayman, 2,281 acres for Little Cayman, and 914 acres for Cayman Brac. Total for the Cayman Islands: 22,506 acres (91.08 $km^2$).

### Key Sites for *Dredged seabed*

| | |
|---|---|
| GRAND CAYMAN: | North Sound<br>South Sound |
| CAYMAN BRAC: | Dick Sessinger's Bay |
| LITTLE CAYMAN: | Muddy Foots<br>Charles Bight |

### Nature Conservation Importance of *Dredged seabed*

- *Biodiversity*: *dredged seabed* typically supports a reduced biodiversity in comparison with natural benthic communities, both within the activity footprint and within the wider area impacted by associated siltation and turbidity. As a result of 23 dredging events between 1968 and 1999, 753 acres of shallow transitional habitat was removed from North Sound, of which 455 acres are the marine borrows pits along the western and southern shores, or 22.5% of this habitat type between the intertidal mangrove wetlands and the deeper seagrass communities (CH2MHILL 2002).
- *Sediments:* the active dredging of marl generates particulate matter. The fine nature of this residue enables it to remain suspended in the water column for long periods, during which time it may be carried some distance from the activity footprint. In suspension, this residue contributes to increased turbidity, reduced clarity and increased light attenuation through the water column, compromising the productive capacity for photosynthetic organisms, and associations including *coral reefs* and *seagrass beds*. On settlement, these sediments have the capacity to smother *seagrass beds* and damage the fragile feeding mechanisms of *coral* polyps. Due to their fine nature, these sediments are prone to resuspension as a result of modest wave action, or currents generated by passing water craft. Due to the confined, reef-protected nature of much dredged *seabed*, residue has a tendency to remain, repeatedly cycling between suspension and sedimentation, migrating within, and variously impacting, the nearshore system.
- *Topography:* typically, *dredged seabed* constitutes an alteration of the natural underwater topography, from a shallow, gently sloping relief, to deeper, steep-sided features. This results in permanent modification of prevailing physical conditions, and limits potential for recovery of the natural complement of flora and fauna communities.
- *Currents*: *dredged seabed* contributes to localized modification of currents, influencing dependent flora and fauna, and the dynamics of unconsolidated sediments, both underwater and along adjacent shoreline.

*Other:*

- *Aesthetic:* turbidity and sedimentation associated with dredging is aesthetically unpleasing, appearing as a milky white cloudy within the water column.
- *Dive industry:* suspended dredge fines damage the fragile feeding mechanisms of *coral* polyps, and associated turbidity significantly reduces underwater visibility; both key attractions for the local dive industry.
- *Storm security*: channelisation of fringing reef, and deepening of nearshore areas generally increases the exposure of adjacent coastline to wave action, erosion of unconsolidated sandy and sediment and storm surge.

### Current Factors Affecting *Dredged seabed*

- *Residential access:* boating access from residential developments to the *open sea* is a requirement of canal developments. In the face of increasingly large and affluent developments, there is increasingly pressure for the deepening, and widening of existing channels, and the development of new access, to facilitate increased traffic, and the passage of larger boats.
- *Commercial access:* boating access to ports and docks
- *Private docks:* construction and modification of private docks contributes to, generally small-scale, dredging in association with placement, repair and maintenance. In the past, some areas adjacent to docks have been dredged for boat access and maximum utility of the structures.
- *Aggregate extraction:* a policy against permitting further extraction of marl for fill from the seabed has been in effect since 1997, however, a combination of the permanent alteration of the physical characteristics of the *dredged seabed*, and the longevity of the resuspension cycle of associated fine sediments means that environmental damage arising from this activity remains ongoing to this day.

### Opportunities and Current Local Action for *Dredged seabed*

- The Marine Parks Regulations 1986 established a series of Marine Parks and protected areas: Replenishment Zones, No Dive Zones and an Environmental Zone in North Sound, Grand Cayman. With the exception of the Environmental Zone, however, the protective status of these areas does not actively preclude dredging.
- A Private Member's Motion accepted in the House in 1998 called for major dredging applications to be moved, debated and voted on in the Legislative Assembly, rather than in Executive Council (now Cabinet). This Motion conflicts with the ExCo's 1997 policy of "no further dredging in North Sound". Irrespective, the practice of bringing major applications to the House was very short-lived (i.e. occurred only once or twice in 1998). Unfortunately, the unwritten nature of this policy, and the fact that it does not extend to similar areas outside of the North Sound, makes it a weaker measure than is warranted.
- North Sound is habitat limited for adult lobster. As a result, lobsters are quick to colonise artificial habitats, such as borrow pits, which offer a three dimensional structure. With appropriate management, these features may be improved, to offset some of the natural habitat lost from Cayman Island's lagoons.

### LOCAL HABITAT ACTION PLAN for *Dredged seabed*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *dredged seabed*, and determine index of natural recovery or potential for artificial restoration and / or habitat enhancement. | 2008 |
| **2.** Ensure no net increase in *dredged seabed* in the Cayman Islands. | 2009 |
| **3.** Implement restoration and habitat enhancement of *dredged seabed* where feasible. | 2015 |

| Dredged seabed<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2 |
| **PL2.** Promote adherence to the findings of the CH2M Hill "Study on the Provision of Construction Aggregate and Fill Material for the Cayman Islands", 2001. | DoE | CIG AAC | ongoing | 2 |
| **PL3.** Formalise policy of "no dredging" or other excavation in North Sound area, and extend this to other *lagoon* areas, with a view to the long-term development of the islands. | DoE | CIG MCB | 2010 | 2 |
| **PL4.** Require EIA for any proposed dredging of the | DoE | CIG DoP | 2006 | 2 |

| | | | | |
|---|---|---|---|---|
| seabed. | | | | |
| **PL5.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2 |
| **PL6.** Encourage rehabilitation of previously dredged areas as part of larger policy on off-site mitigation to enable essential works to progress with not net loss of habitat. | DoE | CIG | 2010 | 1,3 |
| **PL7.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Implement conservation management of pre-existing borrow pits, towards artificial habitat creation for marine species, especially lobster. Establish these sites as managed areas, towards facilitation of a sustainable lobster fishery for the Cayman Islands. | DoE | MCB MP | 2012 | 3 |
| **SM2.** Reduce damage to benthic communities especially where they are particularly fragile, vulnerable or unusual. Where damage has already occurred, examine the feasibility of re-establishment and restoration. | DoE | CIG | 2010 | 3 |
| **SM3.** Implement associated SAPs. | DoE | | 2015 | 3 |
| **Advisory** | | | | |
| **A1.** Encourage integrated Coastal Zone Management through collaboration and co-operation between the many interests concerned with *dredged seabed.* | DoE | DoP | Ongoing | 2,3 |
| **A2.** Work with outside agencies and developers to promote sustainable development in the Cayman Islands. | DoE | MP IntC | Ongoing | 2,3 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2 |
| **Research & Monitoring** | | | | |
| **RM1.** Maintain water quality monitoring, and expand programme to incorporate assessment of sedimentation rates and measures of water clarity. | DoE | WA | 2010 | 1 |
| **RM2.** Investigate *dredged seabed* to determine net environmental loss of habitat due to anthropogenic activity. | DoE | IntC | 2012 | 1,3 |
| **RM3.** Investigate potential to restore benthic communities in *dredged seabed.* | DoE | IntC | 2012 | 1,3 |
| **RM4.** Update relevant sections of CH2MHILL report, to incorporate areas dredged since completion of study. | DoE | IntC | 2012 | 1 |
| **RM5.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM6.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | LS | 2015 | 1 |
| **RM7.** Develop guidelines for the restoration and enhancement of *dredged seabed*, e.g. borrow pits towards maximising habitat value for lobster and other species. | DoE | | 2012 | 1,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Publish the findings of the CH2M Hill report, | DoE | CIG | ongoing | 2 |

| | | | | |
|---|---|---|---|---|
| 2001, in a publicly assessable form. | | | | |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 2 |

## REFERENCES and FURTHER READING for *Dredged seabed*


Source: CHAMP Coral-List Server, posted by Phil Pepe, who was provided this bibliography by Iain McDonald of Manchester Metropolitan University.

Acevedo, R. J., Morelock, J. (1988). Effects of terrigenous sediment on coral reef zonation in South-western Puerto Rico. Sixth International Coral Reef Symposium, Townsville.

Aerts, L. A. M. v. S., R.W.M. (1997). "Quantification of sponge/coral interactions in a physically stressed reef community, NE Colombia." Marine Ecology Progress Series 148: 125-134.

Aller, R. C., Dodge, R.E. (1974). "Animal-sediment relations in a Tropical Lagoon Discovery Bay, Jamaica." Journal of Marine Research 32(2): 209- 231.

Babcock, R. D., P. (1991). "Effects of sedimentation on settlement of *Acropora millepora*." Coral Reefs 9: 205-208.

Bak, R. P. M. E., J.H.B.W. (1976). "Patterns of oil-sediment rejection in corals." Marine Biology 37: 105-113.

Bastidas, C., Bone, D. & Garcia, E.M. (1999). "Sedimentation rates and metal content of sediments in a Venezuelan coral reef." Marine Pollution Bulletin 38(1): 16-24.

Bernecker, M. E., Weidlich, O.B. & Flügel, E.E. (1999). "Response of Triassic reef coral communities to sea-level fluctuations, storms and sedimentation: evidence from a spectacular outcrop (Adnet, Austria)." Facies 40: 229-280.

Boss, S. K. L., W.D. (1987). "Patterns of sediment composition of Jamaican fringing reef facies." Sedimentology 34: 77-87.

Brown, B. E. H., L.S. (1985). "Assessing the effects of "stress" on coral reefs." Advances in Marine Biology 22: 1-63.

Cortes, J. (1993). A reef under siltation stress: a decade of degradation. Colloquium on Global Aspects of Coral Reefs: Health, Hazard, and History, Rosentiel School of Marine and Atmospheric Science, University of Miami.

Cortés, J. N. R., M.J. (1985). "A reef under siltation stress: Cahuita, Costa Rica." Bulletin of Marine Science 36(2): 339-356.

Dallmeyer, D. G., Porter, J.W. & Smith, G.J. (1982). "Effects of particulate peat on the behavior and physiology of the Jamaican reef-building coral *Montastrea annularis*." Marine Biology 68: 229-233.

Dodge, R. E., Aller, R.C. & Thomson, J. (1974). "Coral growth related to resuspension of bottom sediments." Nature 247: 574-577.

Dodge, R. E., Vaisnys, J.R. (1977). "Coral populations and growth patterns: responses to sedimentation and turbidity associated with dredging." Journal of Marine Research 35: 715-730.

Edmunds, P. J. D., P.S. (1989). "An energy budget for *Porites porites* (Scleractinia) growing in a stressed environment." Coral Reefs 8: 37-43.

Garrett, P., Smith, D.L., Wilson, A.O. & Patriquin, D. (1971). "Physiography, ecology, and sediments of two Bermuda patch reefs." Journal of Geology 79: 647-668.

Gischler, E. L., A.J. (1999). "Recent sedimentary facies of isolated carbonate platforms, Belize-Yucatan systems, Central America." Journal of Sedimentary Research 69(3): 747-763.

Hodgson, G. (1989). The Effects of Sedimentation on Indo-Pacific Reef Corals. Zoology Department. Honolulu, Hawaii, University of Hawaii.

Hodgson, G. (1990). "Sediment and the settlement of larvae of the reef coral *Pocillopra damicornis*." Coral Reefs 9(1): 41-43.

Hodgson, G. (1993). Sedimentation damage to reef corals. Colloquium on Global Aspects of Coral Reefs: Health, Hazard, and History, Rosentiel School of Marine and Atmospheric Science, University of Miami.

Hubbard, J. A. E. B. P., Y.P. (1972). "Sediment rejection by recent scleractinian corals:a key to palaeo-environmental reconstruction." Geologische Rundschau 61: 598-626.

Hubbard, D. K. (1986). "Sedimentation as a control of reef development: St.Croix, U.S.V.I." Coral Reefs 5: 117-125.

Larcombe, P. W., K.J. (1999). “Increased sediment supply to the Great Barrier Reef will not increase sediment accumulation at most coral reefs.” Coral Reefs 18: 163-169.

Larcombe, P. W., K.J. (1999). “Terrigenous sediments as influences upon Holcene nearshore coral reefs, central Great Barrier Reef, Australia.” Australian Journal of Earth Sciences 46: 141-154.

Logan, A. (1988). “Sediment shifting capability in Recent solitary coral *Scolymia cubensis* from Bermuda.” Bulletin of Marine Science 43: 241-248.

Loya, Y. (1976). “Effects of water turbidity and sedimentation on the community structure of Puerto Rican corals.” Bulletin of Marine Science 26(4): 450-466.

López, E. O., Bonilla, H.R. & Mejia, J.K. (1998). “Effects of sedimentation on coral communities of southern Socorro island, Revillagigedo archipelago, Mexico.” Ciencias Marinas 24(2): 233-240.

Marshall, S. M., Orr, A.P. (1931). “Sedimentation on Low Isles Reef and its relation to coral growth.” Scientific Report of the Great Barrier Reef Expedition 1(5): 94-133.

Marszalek, D. S. (1981). Impact of dredging on a subtropical reef community, Southeast Florida, U.S.A. Fourth International Coral Reef Symposium, Manila.

McClanahan, T. R., Obura, D. (1997). “Sedimentation effects on shallow coral communities in Kenya.” Journal of Experimental Marine Biology and Ecology 209(1-2): 103-122.

Perry, C. T. (1996). “The rapid response of reef sediments to changes in community composition: Implications for time averaging and sediment accumulation.” Journal of Sedimentary Research 66(3): 459-467.

Peters, E. C. P., M.E.Q. (1985). “A comparative study of the effects of sedimentation on symbiotic and asymbiotic colonies of the coral *Astrangia danae*.” Journal of Experimental Marine Biology and Ecology 92: 215-230.

Richmond, R. H. (1993). Effects of coastal runoff on coral reproduction.

Colloquium on Global Aspects of Coral Reefs: Health, Hazard, and History, Rosentiel School of Marine and Atmospheric Science, University of Miami.

Riegl, B. B., G.M. (1995). “ Effects of sedimentation on the energy budget of four scleractinian (Bourne 1900) and five alcyonacean (Lamouroux 1816) corals.” Journal of Experimental Marine Biology and Ecology 186: 259-275.

Riegl, B., Heine, C. & Branch, G.M. (1996). “Function of funnel-shaped coral growth in a high-sedimentation environment.” Marine Ecology Progress Series 145: 87-93.

Rogers, C. S. (1983). “Sublethal and lethal effects of sediments applied to common Caribbean reef corals in the field.” Marine Pollution Bulletin 14(10): 378-382.

Rogers, C. S. (1990). “Reponses of coral reefs and reef organisms to sedimentation.” Marine Ecology Progress Series 62: 185-202.

Roy, K. J. S., S.V. (1971). “Sedimentation and coral reef development in turbid water: Fanning Lagoon.” Pacific Science 25: 234-248.

Schuhmacher, H. (1977). Ability in Fungiid corals to overcome sedimentation. Third International Coral Reef Symposium, University of Miami, Florida.

Stafford-Smith, M. G. O., R.F.G. (1992). “Sediment-rejection mechanisms of 42 species of Australian Scleractinian corals.” Australian Journal of Marine and Freshwater Research 43: 683-705.

Stafford-Smith, M. G. (1993). “Sediment-rejection efficiency of 22 species of Australian scleractinian corals.” Marine Biology 115: 229-243.

Telesnicki, G. J. G., W.M. (1995). “Effects of turbidity on the photosynthesis and respiration of two South Florida reef coral species.” Bulletin of Marine Science 57(2): 527-539.

van Katwijk, M. M., Meier, N.F., van Loon, R., van Howe, E.M., Giesen, W.B.J.T., van der Velde, G. (1993). “Sabaki River sediment loading and coral stress: correlation between sediments and condition of the Malindi- Watamu reefs in Kenya (Indian Ocean).” Marine Biology 117: 675-683.

Wesseling, I., Uychiaoco, A.J., Aliño, P.M., Aurin, T. & Vermaat, J.E. (1999). “Damage and recovery of four Philippine corals from short-term sediment burial.” Marine Ecology Progress Series 176: 11-15.

Woolfe, K. J. L., P. (1998). “Terrigenous sediment accumulation as a regional control on the distribution of reef carbonates.” Special Publication International Association of Sedimentologists 25: 295-310.

## MARINE HABITATS

### *6. Artificial installations*

### Definition
*Artificial installations* incorporate all maritime constructions, including docks, piers, and groynes. This category also includes underwater structures such as deliberately sunk shipwrecks, underwater sculptures, and artificial reef structures.

### Local outline
Maritime history and seafaring is central to Caymanian culture. The advent of increased affluence in the islands, ports expansion, industrial development, and increased use of pleasure boats and personal watercraft has brought with it an increased use *artificial installations*, towards facilitating trade and recreational access to the marine environment.

Coastal development and land reclamation projects have modified natural beach dynamics and nearshore currents in some areas, resulting in coastal erosion, and emplacement of artificial counter-measures.

Expansion of the tourism industry and the concomitant decline in the health of *coral reefs* has resulted in an increased interest in artificial augmentation of the natural environment, ranging from construction of artificial reefs to offset declining reef biodiversity, to the deliberate sinking of ships and emplacement of novelty underwater sculptures, towards bolstering declining natural tourist attractions.

### Key Habitat Categories for *Artificial installations*
*Artificial installations* have the capacity to affect all marine habitats.

### Key Species for *Artificial installations*
The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

**KEY SPECIES for ARTIFICIAL INSTALLATIONS**

| **PART 1** | | | |
|---|---|---|---|
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Corals | All soft corals (including Gorgonians & Telestaceans) | Anthozoa all species | |
| Corals | Black coral | Antipatharia all species | |
| Corals | Gorgonians | Gorgoniacea all species | |
| Corals | Fire corals | Milleporidae all species | |
| Corals | Hard corals | Scleractinia all species | |
| Corals | Lace corals | Stylasteridae all species | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Sponges | Porifera all species | |
| None | | | |
| **PART 2** | | | |
| Fish (marine, bony) | All bony fish - *except those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |

### Current Status of *Artificial installations*

Due to their small size, *artificial installations* are not a mapped habitat.

### Key Sites for *Artificial installations*

| | |
|---|---|
| GRAND CAYMAN: | Shipwreck City – artificial sinking of Kittiwake |
| | Artificial sinking of the Ore Verde |
| | Sunset Mermaid |
| | Marriott Reefball breakwater |
| CAYMAN BRAC: | Lost City of Atlantis |
| | Artificial sinking of the Capt. Keith Tibbetts |

### Nature Conservation Importance of *Artificial installations*

- *Biodiversity*: appropriate design and placement of *artificial installations* can contribute positively to biodiversity, especially towards restoration of degraded habitats and systems. Success is, however, often highly site specific, and wholly dependent on appropriate structural design, use of appropriate materials, and placement. Biodiversity in associated with *artificial installations* is often greater than that of the surrounding area. The value of *artificial installations* for biodiversity, however, is dependent on the provision of suitable new habitat (as opposed to simply aggregating pre-existing species), and longevity of the installation.
- *Sediments:* dredging and drilling activity associated with placement of *artificial installations* generates particulate matter. Fines may remain suspended in the water column for long periods, during which time it may be carried some distance from the activity footprint.
- *Currents: artificial installations* contribute to localized modification of currents, influencing dependent flora and fauna, and the dynamics of unconsolidated sediments, both underwater and along adjacent shoreline.
- *Storm Damage:* impermanent, unsecured or otherwise weak artificial structures present a littering and debris hazard to natural environments.
- *Pollution:* inappropriate materials, and improperly stripped and sanitized vessels, can contribute to artificial installations presenting pollution threats to natural environments.

*Other:*

- *Aesthetic:* in most cases, *artificial installations* reduce the aesthetic appeal of the natural environment. This is particularly important in areas of outstanding natural beauty, and those visited by people expecting to enjoy a “natural experience”.
- *Storm security*: appropriate design, and placement of *artificial installations* can contribute positively to storm security. *Artificial installations* are not, however, a replacement for natural storm protection. *Artificial installations* are financially costly and, once damaged, have a tendency to degrade rapidly, as opposed to natural features, which tend to recover by natural process, unless damage is irrevocable.

### Current Factors Affecting *Artificial installations*

- *Aesthetic:* divers like to dive on wrecks and other artificial installations.
- *Residential access:* boating access from residential developments to the *open sea* is a requirement of canal developments. In the face of increasingly large and affluent developments, there is increasingly pressure for the deepening, and widening of existing channels, and the development of new access, to facilitate increased traffic, and the passage of larger boats.
- *Commercial access:* boating access to ports and docks.
- *Private docks:* construction and modification of private docks contributes to, generally small-scale, dredging in association with placement, repair and maintenance.

### Opportunities and Current Local Action for *Artificial installations*

- Preservation and protection of historical shipwrecks in the Cayman Islands is minimal

## LOCAL HABITAT ACTION PLAN for *Artificial installations*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *artificial installations*. | 2008 |
| **2.** Ensure that *artificial installations* contribute positively to local biodiversity, and do not negatively impact natural systems or aesthetics. | 2010 |

| Artificial installations<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2 |
| **PL2.** Require environmental assessment or EIA before emplacement of *artificial installations* as appropriate. | DoE | CIG DoP | 2006 | 2 |
| **PL3.** Ensure that new *artificial installations* do not adversely affect natural systems or aesthetics. | DoE | CIG DoP | Ongoing | 2 |
| **PL4.** Establish policies to maintain legal access to and use of common resources by the general public, and prevent exclusive exploitation by private enterprise. | DoE | CIG MCB | 2015 | 2 |
| **PL5.** Adopt existing Coastal Works Policy. | DoE | CIG | 2000 | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Continue and develop design and construction measures for new *artificial installations* to ensure that they do not adversely affect natural systems or aesthetics. | DoE | CIG DoP | Ongoing | 2 |
| **SM2.** Implement associated SAPs. | DoE | | | 2 |
| **Advisory** | | | | |
| **A1.** Encourage integrated Coastal Zone Management through collaboration and co-operation between the many interests concerned with *artificial installations.* | DoE | DoP DoT | ongoing | 2 |
| **A2.** Work with outside agencies and developers to promote sustainable development in the Cayman Islands. | DoE | DoP CIG MP | ongoing | 2 |
| **A3.** Targeted awareness of the need for the National Conservation Law. | DoE | CIG NT | 2006 | 2 |
| **Research & Monitoring** | | | | |
| **RM1.** Expand water quality monitoring, to include assessment of possible leaching of pollutants into the marine environment. | DoE | IntC | 2015 | 2 |
| **RM2.** Monitor artificial installations to determine positive and negative impacts on the marine environment. | DoE | MP CIG | ongoing | 2 |
| **RM3.** Investigate potential to restore benthic communities using *artificial installations.* | DoE | IntC | 2012 | 2 |
| **RM4.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM5.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM6.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Continue to inform the public on best practice guidelines relating to *artificial* installations. E.g. “Design | DoE | CIG | ongoing | 2 |

| | | | | |
|---|---|---|---|---|
| and Construction Guidelines for Docks", and changes to biodiversity caused when natural environments are replaced with artificial ones. | | | | |

## COASTAL HABITATS

### *7. Maritime cliffs and ironshore*

#### Definition

This category encompasses all consolidated rocky coastal areas between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside.

*Beach rock* represents a dynamic feature of the shoreline, constantly forming and eroding. This developing limestone generally forms smooth, seaward-dipping sheets, and is found in areas along the edge of the shoreline (Moore 1973). These accretions are ongoing, as is evidenced by the numerous modern artefacts to be found cemented into the matrix of the rock (Jones and Goodbody 1982). *Beach rock* is also highly prone to erosion, and physical damage during high seas (Jones and Goodbody 1984).

Geologically, "Ironshore Formation" is some of the youngest rock in the Cayman Islands. *Ironshore* is composed of soft fossiliferous white limestone, deposited through numerous transgressions of the sea during the Pleistocene period. Cores into the *ironshore* have dated the surface layers to 129,000 years old, with deeper layers up to almost 500,000 years old (Vézina *et al.* 1999, Jones 2000). The majority of high land, bluff and *maritime cliffs* are older "Cayman Formation" dolostone, probably dating to the Lower / Middle Miocene period, ca. 5-15 million years old. The *maritime cliffs* of Pedro Bluff comprise "Pedro Castle Formation" dolostone and limestone. This younger rock, dating from the Pliocene (ca. 2 million years old) overlies the Cayman Formation in areas limited to the region of Pedro Castle, Grand Cayman, and the West end quarry, Cayman Brac. The oldest rocks in the Cayman Islands are "Brac Formation" limestone or sucrosic dolostone. Forming the lower parts of the *maritime cliffs* at the eastern end of Cayman Brac, "Brac Formation" rock dates from the Lower / Upper Oligocene period, some 28 million years old.

#### Local outline

The majority of the rocky coastline of the Cayman Islands, comprises *ironshore*: white limestone, which weathers to a grey colour. The "Ironshore formation" was named by Matley (Matley 1924) referencing the hard calcrete crust or caliche that typically develops on the weathered surface of the rock (Jones 2000). Though locally generally sharp and jagged, on a larger scale, *ironshore* constitutes a mostly flat or gently sloping topography.

*Maritime cliffs* are formed at the junction between land and sea, as a result of erosion. Notable examples on Grand Cayman include the vertical *maritime cliffs* of Pedro St James (max. 17m) and High Rock (max. 12m). The lack of any protective fringing reef in these areas results in the cliff-tops being exposed to heavy wave action during severe storms.

On Cayman Brac, the Bluff (max. 46m) represents the Cayman Island's most spectacular *maritime cliff* feature. The Bluff is most extant in the eastern portion of the Brac, where the *cliff* falls vertically to the sea surface. However, a low-lying coastal platform bounds the majority of the Bluff, separating the majority of the relict *maritime cliff* from the sea. Wave-cut notches in the *cliff* provide clear indication of previously elevated sea levels. This partial separation of the cliff face from the immediate stresses of the marine environment creates a unique habitat, and gives rise to species found nowhere else in the islands. The coastal platform also supports the majority of the population of Cayman Brac; however, since the advent of Hurricane Ivan, development of the high land on the top of the Bluff has accelerated.

Landward, *maritime cliffs and ironshore* support a sparse but intriguing vegetation, which often adopts a dwarf, prostrate, sometimes an almost encrusting form, in response to the intense environmental conditions of soil and freshwater scarcity, wind exposure and salt-spray. Under these conditions, trees such as Buttonwood *Conocarpus erectus* suffer a natural bonsai effect: their diminutive size belying their age.

Seaward, *maritime cliffs and ironshore* generally become increasingly denuded of vegetation, but support increasing populations of marine invertebrates, such as chitons, (Polyplacophora sp.). Due in part to the

porous nature of limestone, permanent rock pools and associated communities are not a feature generally associated with *ironshore.*

### Key Habitat Categories for *Maritime cliffs and ironshore*

Consolidated rocky coastal areas, between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside. Incorporates the VII.A.1.N.a vegetation formation, as *per* Burton (2008b):

- Cliffs with sparse vascular vegetation VII.A.1.N.a – vegetation of shaded cliffs, supports *Verbesina caymanensis*, restricted to north-facing section of bluff near Peter's Cave, Cayman Brac.
- Marine cliffs
- Ironshore
- Ironshore mosaic – shoreline comprising mostly ironshore, with one or more other substrates
- Beach rock
- Beach rock mosaic – shoreline comprising mostly beach rock, with one or more other substrates

### Key Species for *Maritime cliffs and ironshore*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for MARITIME CLIFFS AND IRONSHORE | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Brown booby<br>White-tailed tropic bird (Boatswain bird)<br>Antillean nighthawk (Rickery-dick)<br>Least tern (Egg Bird)<br>Bridled tern | Aves<br><br><br>*Sula leucogaster*<br>*Phaethon lepturus*<br>*Chordeiles gundlachii*<br>*Sterna antillarum*<br>*Sterna anaethetus* | <br><br><br>SAP<br>SAP |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Chiton, Sea meat / beef | Polyplacophora species | |
| Invertebrates | Periwinkles | Littorinidae species | |
| Invertebrates | Bleeding teeth | Neritae species | |
| Plants | Brac endemic | *Verbesina caymanensis* | |
| **PART 2** | | | |
| Reptiles | Lesser Cayman Islands Curly-tailed lizard | *Leiocephalus carinatus granti* | |
| Reptiles | Grand Cayman Curly-tailed lizard | *Leiocephalus carinatus varius* | |
| Invertebrates | Whelk | *Cittarium pica* | SAP |
| Plants | Buttonwood | *Conocarpus erectus* | |
| Plants (marine) | Green algae | Chlorophyta species | |
| Plants (marine) | Brown algae | Phaeophyta species | |
| Plants (marine) | Red algae | Rhodophyta species | |

### Current Status of *Maritime cliffs and ironshore*

*Link to habitat map: Maritime cliffs and ironshore Grand Cayman*
*Link to habitat map: Maritime cliffs and ironshore Cayman Brac*
*Link to habitat map: Maritime cliffs and ironshore Little Cayman*

| Habitat Status 2006 | Total area (ac) | Area within protected | Area outside protected | % Habitat protected |
|---|---|---|---|---|

| Maritime cliffs and ironshore | | | | areas (ac) | | | areas (ac) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Cliffs with sparse vascular vegetation VII.A.1.N.a | 0.00 | 14.83 | 0.00 | x | 0.00 | x | x | 14.83 | x | x | 0.0 | x |
| Ironshore | 62.55 | 32.29 | 20.35 | 0.17 | 0.00 | 0.00 | 62.38 | 32.29 | 20.35 | 0.3 | 0.0 | 0.0 |
| Ironshore mosaic | 10.73 | 137.97 | 23.66 | 0.00 | 0.00 | 0.00 | 10.73 | 137.97 | 23.66 | 0.0 | 0.0 | 0.0 |
| Beach rock | 0.00 | 0.00 | 0.28 | x | x | 0.00 | x | x | 0.28 | x | x | 0.0 |
| Beach rock mosaic | 24.47 | 20.24 | 16.94 | 0.00 | 0.00 | 0.00 | 24.47 | 20.24 | 16.94 | 0.0 | 0.0 | 0.0 |
| **TOTAL** | **97.75** | **205.33** | **61.23** | **0.17** | **0.00** | **0.00** | **97.58** | **205.33** | **61.23** | **0.2** | **0.0** | **0.0** |

| | Total length (km) | | | Length within protected areas (km) | | | Length outside protected areas (km) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Maritime cliffs | 5.9 | 33.6 | 0.0 | 0.0 | 0.0 | x | 5.9 | 33.6 | x | 0.0 | 0.0 | x |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Maritime cliffs and ironshore*

GRAND CAYMAN: Pedro St James
High Rock and East End Blow Holes
Northwest Point
Smith's Barcadere

CAYMAN BRAC: The Bluff

LITTLE CAYMAN: Salt Rocks
Lighthouse ironshore (north of Point of Sand)

| Protected areas containing *maritime cliffs and ironshore* | Area (ac) | Location | Ownership |
|---|---|---|---|
| Dr Roy's Ironshore – a heavily modified recreational outlook in George Town | 0.17 | Grand Cayman | NT |

Dr Roy's Ironshore is an area of ironshore in central George Town. Its small size, and heavily man-modified aspect make it of little natural interest or conservation value, however, the site is owned by the National Trust for the Cayman Islands, and protected as a historic point of interest, as a look-out over George Town harbour.

*Maritime cliffs and ironshore* are currently critically under-represented within the protected areas of the Cayman Islands.

## Nature Conservation Importance of *Maritime cliffs and ironshore*

- *Natural integrity:* by virtue of their inaccessibility, *maritime cliffs and ironshore* have important landscape value, representing some of the most natural / least modified terrestrial environment.
- *Birdlife: maritime cliffs* provide habitat to some of the Cayman Islands most spectacular seabirds, most notably Brown booby *Sula leucogaster*, and White-tailed tropic bird *Phaethon lepturus*. In the Cayman Islands, Brown boobies are known only from a disjunct nesting colony ranged along the *maritime cliffs* constituting the eastern point of Cayman Brac. White-tailed tropic birds also nest along the Bluff, most notably in the vicinity of Peter's Cave. A small breeding colony of White-tailed tropic birds nested along the *maritime cliffs* at Pedro St James Bluff, ca. 17-20 birds, 1996-97. No birds have been reported at this site since the advent of Hurricane Ivan, 2004. Vidal Key, a small (<0.1ha) *ironshore* cay off the Barkers peninsula, West Bay, supports the Cayman

Islands only known colony of Bridled terns *Sterna anaethetus* (ca.20 pairs). Least tern (Egg bird) *Sterna antillarum* occasionally nests on *ironshore*; however, this species has been forced onto man-made habitats such as exposed marl, in the advent of disturbance of much of its natural habitat. Antillean nighthawk (Rickery-Dick) *Chordeiles gundlachii* nests on *ironshore* and *sandy beaches*, which has similarly needed to adapt to nesting in cleared areas of marl.

- *Biodiversity:* the majority of *maritime cliffs and ironshore* constitute bare rock. As such, much of this area is of little biodiversity significance. However, were conditions permit, highly specialized conditions promote the establishment of niche-adapted flora and fauna. One such example is the colourful Rock crab *Grapsus grapsus*. Another is the herb *Verbesina caymanensis*. This critically endangered endemic plant is known only from a small cluster of individuals, growing on the relict marine cliffs below Peter's Cave, Cayman Brac.
- *Caves:* some *maritime cliffs*, especially those on Cayman Brac, incorporate significant *caves.* In addition to their geological interest, some support biological interest including breeding colonies of birds, and bats. Peter's Cave and Rebecca's Cave, Cayman Brac, are of cultural significance. *Caves* are subject to an individual *Habitat Action Plan.*
- *Unique forms:* prevailing conditions result in a natural dwarfing of trees and shrubs unseen outside of this habitat: the prostrate form of Buttonwood *Conocarpus erectus* is a notable example.
- *Unknown species:* the inaccessible nature and unique conditions associated with *maritime cliffs and ironshore* mean that it is possible that species unknown to science inhabit this habitat.

*Other:*

- *Hedonic value:* the barren nature of these landscape features makes them particularly prone to "spoiling" because screening of unsightly development is more often than not, simply not possible. *Marine cliffs* in particular are natural features of significant aesthetic value, contributing to local quality of life through the provision of scenic vistas, and added commercial premium, as tourist attractions. This may be evidenced by the numerous "look out" points situated on cliff-edges, including Pedro St James, Grand Cayman, and Peter's Cave, the Brac Parrot Reserve lookout, and the Lighthouse cliff top walk, Cayman Brac. *Ironshore*, while so common locally that it is often taken for granted, is a typifying feature of the Cayman Islands, and one which distinguishes us from many other places. Erosional features such as Hell, the Blow Holes, and Smith's Barcadere (Smith's Cove), Grand Cayman, are of geological and aesthetic interest, and established tourist attractions which showcase unique natural aspects in an authentic setting.
- *Caymanite mining*: caymanite is a multicoloured, laminated dolomite deposit, forming in fractures of Cayman Formation limestone. Accessible lenses of caymanite are occasionally found in the outcropping in the Bluffs of Cayman Brac and Grand Cayman, and are valuable resources for local crafters and sculptors. This leads to potential conflict situations between caymanite miners and artisans, private landowners, and souvenir seekers.

### Current Factors Affecting *Maritime cliffs and ironshore*

- *Planning:* set-back for new developments on *maritime cliffs and ironshore* is set at a standard of 50ft from the mean high-water line, regardless of natural exposure. This has resulted in significant development along the stated line of minimum distance. The natural vegetation line in this environment represents a practical indication of the exposure; however, this is not taken into consideration in the current planning process. As a result, many new developments disrupt the natural aesthetic of the coast, extending above and beyond the natural vegetation line. During storm events, these developments are prone to damage, leaving unsightly ruins which may remain uncleared indefinitely. When restoration work is undertaken, more often than not, old inappropriate structures are replaced with identically situated structures, perpetuating the problem.
- *Residential development*: development along the edge of the Bluff in Cayman Brac commenced recently, and has resulted in the disruption of the natural tree-line. Inconsiderate development damages natural features, compromises "unspoilt vistas" which attract tourists, and impacts aesthetics resulting in depreciation in the quality of life and property values for residents.

- *Seawall construction:* in 2007, construction of a 1,800ft seawall was proposed to extend along the length of Little Pedro Point, in a suggested attempt to protect the Savannah Gully area, Grand Cayman.
- *Climbing:* on the Bluff of Cayman Brac, *maritime cliff* climbing has the potential to cause disturbance and desertion to nesting Brown boobies *Sula leucogaster*, especially where this activity is unregulated, or utilizes routes in close proximity to nesting birds.
- *Quarrying:* illegal quarrying has been underway in the Mahogany Estates area for some years. In 2008, the Central Planning Authority rejected an application to extend works to a section of Beach Bay Bluff. An appeal of this decision is currently pending. Caymanite quarrying also represents a potential conflict issue between collectors and land owners.
- *Access:* modification of *ironshore* to provide access for boats and swimming.

### Opportunities and Current Local Action for *Maritime cliffs and ironshore*

- Several natural features of *maritime cliffs and ironshore* are established and popular tourist sites, including Smith's Barcadere (Smith's Cove), Hell, Pedro bluff and the Blowholes on Grand Cayman; and Peter's Cave, Bat Cave, and Great Cave, Cayman Brac. With the exception of the extensively modified Dr Roy's Ironshore, the only protected look-out is that at the south end of the Bight Road, in the Brac Parrot Reserve, Cayman Brac.
- A public right of way exists in the vicinity of the lighthouse at the eastern extreme of the Buff, Cayman Brac. Though currently unprotected Crown land, this site carries some interpretative signage illustrating the Brown booby *Sula leucogaster* colony on site. Unfortunately, this site is unprotected and subject to current development interest. Additionally, the traditional pathway has been subject to inappropriate topping and widening, impacting its traditional form and aesthetic appeal.
- Chitons, periwinkles littorinidae and bleeding teeth have outright protection under the Marine Conservation Law. Under the Marine Conservation Law, Whelks are subject to a catch limit, and closed season.

### LOCAL HABITAT ACTION PLAN for *Maritime cliffs and ironshore*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *maritime cliffs and ironshore*. | 2008 |
| **2.** Maintain *maritime cliffs and ironshore* in a natural state. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *maritime cliffs and ironshore*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect 10% of currently remaining *maritime cliffs and ironshore* habitat in the Cayman Islands. | 2015 |

| Maritime cliffs and ironshore PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Promote change to the Land Surveyors Law and Planning legislation, to incorporate the natural vegetation line into coastal set-back. | DoE | DoP LS CIG | 2003 | 2,3 |
| **PL3.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for coastal management to discourage damage or disturbance to *maritime cliffs and ironshore.* | DoP CPA | CIG MP DoE | ongoing | 2,3,4 |
| **PL4.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for | DoP DCB | CIG MP DoE | ongoing | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| the environmental, social, and economic development of the Islands. | | | | |
| **PL5.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,4 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to purchase and protect priority areas of *maritime cliffs and ironshore* in the Cayman Islands, and secure functional buffer zones at the cliff base and lip. | CC | DoE NT MP CIG | 2015 | 4 |
| **SM2.** Restrict cliff climbing to designated routes, towards reducing impact on nesting seabirds. | DoE | DoP DA DoT NT SITA | 2011 | 3 |
| **SM3.** Develop best practice guidelines for maintaining the value of *Scenic Coastline.* | DoP | DoE | 2011 | 2 |
| **SM4.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plan*s, to ensure the preservation of and natural function of *maritime cliffs and ironshore.* | DoE | DoP | | 2,3 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *maritime cliffs and ironshore.* | DoE | DoP | | 2,3 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *maritime cliffs and ironshore* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *maritime cliffs and ironshore* incorporating ecological and recreational value, and continuity with other protected areas. | DoE | NT MP | 2009 | 1,3 |
| **RM3.** Collate existing data and case studies on the impact of development on *maritime cliffs and ironshore*, towards improving management and development of effective planning regulations. | DoE | | 2015 | 1,2,3 |
| **RM4.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM5.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM6.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value of maritime cliffs and ironshore using *Tropic birds* and *Brown boobies* as a flagship species for preservation. | DoE | NT | 2010 | 3 |
| **CP2.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP HS QEIIBP | ongoing | 3 |
| **CP3.** Raise awareness of the need for effective planning regulations for the preservation of *maritime cliffs and ironshore.* | DoE | DoP CIG | 2009 | 3 |

| | | | | |
|---|---|---|---|---|
| **CP4.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |

## REFERENCES and FURTHER READING for *Maritime cliffs and ironshore*


Jones, B. (1994). Geology of the Cayman Islands. In Brunt, M.A. & Davies J.E. (1994). (eds.) The Cayman Islands Natural History and Biogeography. Kluwer Academic Publishers. p13-49. ISBN 0-7923-2462-5.

Jones, B. (2000). Geology of the Cayman Islands (unpub.) University of Alberta, Edmonton, Alberta, Canada.

Jones, B. and Goodbody, Q.H., (1982). The geological significance of endolithic algae in glass *Canadian Journal of Earth Sciences* 19: 671-678

Jones, B. and Goodbody, Q.H., (1984). Biological alteration of beachrock on Grand Cayman Island, British West Indies. *Bulletin of Canadian Petroleum Geology* 32: 201-215.

Matley, C.A. (1924). Geological survey of the Cayman Islands. Annual General Report, Jamaica, p.41-45.

Moore, C.H. (1973). Intertidal carbonate cementation, Grand Cayman, West Indies. *Journal of Sedimentary Petrology* 43: 591-602.

Squair, C.A. (1988). Surface karst on Grand Cayman Island, BWI. M.Sc. Thesis, Univ. Alberta, Edmonton, 107 pp.

Vézina, J., Jones, B., and Ford, D., (1999) Sea-level highstands over the last 500,000 years: evidence from the Ironshore Formation on Grand Cayman, British West Indies. Journal of Sedimentary Research, v.69, p.317-327.

## COASTAL HABITATS

### *8. Sandy beach and cobble*

#### Definition

The *sandy beach and cobble* category effectively encompasses all unconsolidated coastal sediments, between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside.

#### Local outline

In the Cayman Islands, *sandy beach and cobble* originates as an erosional product of calcareous algae and the *coral reefs* which surround much of the islands, carried to the shore by coastal currents and storm events. *Sandy beach and cobble* are active environments. Formed at the junction between land and sea, *sandy beach and cobble* is subject to complex, but often predictable, physical dynamics.

Due to its unconsolidated and mobile nature, *sandy beach and cobble* is susceptible to lateral movement under the influence of local currents and storms, resulting in the migration of the beach and associated communities along the shoreline. The mobile nature of unconsolidated *sandy beach and cobble* also extends landward from the active shoreline to incorporate the beach ridge. Though naturally vegetated with *coastal shrubland*, the beach ridge remains an active component of the beach, prone to recover its dynamic nature in the event of erosion or lateral migration of the foreshore.

The coral sand which forms the *sandy beaches* of the Cayman Islands is typically "fine sand". The *Seven Mile Beach Nourishment Project*, implemented by Department of Environment, 2004, determined the mean grain size on Seven Mile beach to be 0.4mm, with an 88% shell content. This property contributes greatly to the aesthetic of the beach. The natural dimensions of fine sands limit desirable options for artificial beach restoration, excluding coarser sand sources from consideration. As such, beach sand should be regarded as a valuable and largely irreplaceable national resource, and should be maintained and managed as such.

*Cobble beaches* and "boulders" comprise large reef fragments. On some beaches, "cobble" dominates the entirety of the shoreline. In others, cobble exists in conjunction with fine sand and a variety of intermediates, most often forming an extant "cobble ridge" at the top of the beach, abutting, and subsumed beneath, the permanent vegetation lines.

The Crown owns and is legally responsible for areas of the seabed and beach, up to and including the mean high water mark. As the set-back for developments in coastal areas is generally measured in relation to the mean high water mark, consideration of the predictions of climate change including increase in storm severity and sea-level rise, should require reconsideration of revision of survey baselines.

#### Key Habitat Categories for *Sandy beach and cobble*

All unconsolidated coastal sediments, between the limits of the high water mark on the seaside, and the natural continuous vegetation line on the landside.

- Sandy beach
- Sandy beach mosaic – shoreline comprising mostly sandy beach, with one or more other substrates
- Cobble
- Cobble mosaic – shoreline comprising mostly cobble, with one or more other substrates

#### Key Species for *Sandy beach and cobble*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for SANDY BEACH AND COBBLE | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Shorebirds and waders<br>Antillean nighthawk (Rickery-dick) | Aves<br><br><br>*Chordeiles gundlachii* | |
| Turtles (marine) | Loggerhead turtle | *Caretta caretta* | SAP |
| Turtles (marine) | Green turtle | *Chelonia mydas* | SAP |
| Turtles(marine) | Leatherback turtle | *Dermochelys coriacea* | SAP |
| Turtles (marine) | Hawksbill turtle | *Eretmochelys imbricata* | SAP |
| Plants | | *Chamaesyce bruntii* | |
| Plants | Tea banker | *Pectis caymanensis var. robusta* | SAP |
| **PART 2** | | | |
| Reptiles | Lesser Cayman Islands Curly-tailed lizard | *Leiocephalus carinatus granti* | |
| Reptiles | Grand Cayman Curly-tailed lizard | *Leiocephalus carinatus varius* | |
| Invertebrates | Whelk | *Cittarium pica* | SAP |
| Plants | Inkberry | *Scaevola plumieri* | SAP |
| **INVASIVE** | | | |
| Plants | Weeping willow | *Casuarina equisetifolia* | HAP |
| Plants | Non-native Scaevola (Inkberry SAP) | *Scaevola sericea* | SAP |

## Current Status for *Sandy beach and cobble*

*Link to habitat map: Sandy beach and cobble Grand Cayman*
*Link to habitat map: Sandy beach and cobble Cayman Brac*
*Link to habitat map: Sandy beach and cobble Little Cayman*

| Habitat Status 2006 Sandy Beach and Cobble | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Sandy beach | 112.3 | 5.21 | 2.55 | 0.85 | 0.00 | 0.00 | 111.45 | 5.21 | 2.55 | 0.7 | 0.0 | 0.0 |
| Sandy beach mosaic | 1.55 | 10.83 | 32.88 | 0.00 | 0.00 | 0.00 | 1.55 | 10.83 | 32.88 | 0.0 | 0.0 | 0.0 |
| Cobble | 4.09 | 11.02 | 6.05 | 0.00 | 0.00 | 0.00 | 4.09 | 11.02 | 6.05 | 0.0 | 0.0 | 0.0 |
| Cobble mosaic | 5.95 | 16.00 | 13.56 | 0.00 | 0.00 | 0.00 | 5.95 | 16.00 | 13.56 | 0.0 | 0.0 | 0.0 |
| **TOTAL** | **123.89** | **43.06** | **55.04** | **0.85** | **0.00** | **0.00** | **123.04** | **43.06** | **55.04** | **0.7** | **0.0** | **0.0** |
| | | | | | | | | | | | | |
| | Total length (km) | | | Length within protected areas (km) | | | Length outside protected areas (km) | | | % Habitat protected | | |
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Sandy beach | 45.92 | 2.16 | 1.23 | 0.05 | 0.00 | 0.00 | 45.87 | 2.16 | 1.23 | 0.1 | 0.0 | 0.0 |
| Sandy beach mosaic | 0.97 | 4.31 | 14.78 | 0.00 | 0.00 | 0.00 | 0.97 | 4.31 | 14.78 | 0.0 | 0.0 | 0.0 |
| Cobble | 2.18 | 3.44 | 3.31 | 0.00 | 0.00 | 0.00 | 2.18 | 3.44 | 3.31 | 0.0 | 0.0 | 0.0 |
| Cobble mosaic | 3.47 | 5.74 | 5.98 | 0.00 | 0.00 | 0.00 | 3.47 | 5.74 | 5.98 | 0.0 | 0.0 | 0.0 |
| **TOTAL** | **52.54** | **25.30** | **15.66** | **0.05** | **0.00** | **0.00** | **52.49** | **25.30** | **15.66** | **0.1** | **0.0** | **0.0** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Sandy beach and cobble*

GRAND CAYMAN: Seven Mile Beach
East End Beach

Smith's Barcadere
Barkers Beach
Spotters Bay – site cleared for development, 2008.
Rum Point (artificial)

CAYMAN BRAC: Public Beach

LITTLE CAYMAN: Spott Bay
Point of Sand
Preston Bay Beach
South Hole Sound
Owen Island

| **Protected areas containing *sandy beach and cobble*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| *Heritage Beach* – a small recreational area incorporating some sandy beach | 0.85 | Grand Cayman | NT |
| *Barkers* - subject of current purchase effort by CIG, towards establishment of a National Park – would represent the Cayman Islands' most significant stretch of protected *sandy beach*. Currently Barkers remains unprotected, and so does not contribute towards protected areas statistics. | 94.95 to-date | Grand Cayman | CIG |

No significant *sandy beach and cobble* is currently represented in the protected areas of the Cayman Islands.

### Nature Conservation Importance of *Sandy beach and cobble*

- *Marine turtles:* historically, Cayman was considered the largest rookery for Green turtles *Chelonia mydas* in the Caribbean. Estimates place the original rookery at over one million individuals. *Sandy beach* provides the sole nesting habitat for the Cayman Island's remnant population of marine turtles. During a typical nesting season, from May to October, DoE staff find on average 43 nests in Grand Cayman, 12 nests in Cayman Brac, and 11 nests in Little Cayman. Typically, a female will lay 3 to 6 nests per season. Currently, annual nesting is credited to less then twenty individuals per species. Nesting turtles are notoriously site-specific. Localized degradation of critical beaches may disproportionately impact a small population.
- *Birdlife: sandy beach and cobble* supports a variety of birdlife, especially herons, waders and other shorebirds, with shallows, strandline flotsam and maritime invertebrates providing important food sources. The Antillean nighthawk (Rickery-Dick) *Chordeiles gundlachii* nests in bare areas of beach ridge.
- *Flora:* the fast-draining, shifting, salt-exposed environment is too extreme to support significant plant diversity; however a few highly tolerant species survive, such as Juniper *Suriana maritima*, Lavender *Argusia gnaphalodes*, Bay vine *Ipomoea pes-caprae*, Inkberry *Scaevola plumieri*, Cocoplum *Chrysobalanus icaco*, and the endemic Tea banker *Pectis caymanensis robusta*.
- *Invertebrates:* Ghost crabs *Ocypode quadrata* are common along beaches, where they excavate burrows in the sand.
- *Reptiles:* The Grand Cayman Curly-tailed lizard (Lion lizard) *Leicephalus carinatus varius* remains a common sight on sandy beaches, though is probably in severe decline, with many large colonies lost to beach-front development. Sister Isles Rock Iguanas *Cyclura nubila caymanensis* also nest in this habitat, preferring the beach ridge and associated shrubland. Historically, the American crocodile *Crocodylus acutus* was a beach nester, though Cayman's population has long since been extirpated.

*Other:*

- *Hedonic value:* the natural environment is the mainstay of the Cayman Islands' tourism product. Sandy beaches are integral to both the landscape and seascapes of the Islands, and contribute disproportionately to the natural aesthetic, benefiting quality of life for residents through the provision of scenic vistas, and contributing a financial premium to commercial undertakings.. Inappropriate coastal development may thus be expected to have a very significant impact on the perception of the Cayman Islands as being "spoilt" or "unspoilt" by residents and holiday makers.
- *Storms:* beach ridge integrity is a significant factor in natural storm defence. Structured in large part by successive storm events, the natural beach ridge provides an effective barrier to storm surge. Levelling, excavation and devegetation compromises the structural integrity of the beach ridge, weakening its function as a physical barrier, and facilitating the ingress of storm surge. In many cases, the natural forces of erosion may rapidly come to bear on damaged areas, exploiting weakness in a positive feedback loop, widening fissures and channels, deepening holes, uprooting vegetation and exacerbating loss of *sandy beach and cobble*.
- *Financial premium:* commercial undertakings and real estate in the vicinity of *sandy beach and cobble* generally enjoy a significant financial premium, from access to beach amenities and scenic vistas.
- *Recreation and tourism: sandy beach and cobble* support a variety of recreational activities; including walking, jogging, beach sports, sunbathing and relaxation. Seven Mile Beach in Grand Cayman represents, perhaps, the Cayman Islands' single largest tourism asset
- *Filter:* the physical matrix of *sandy beach and cobble* acts as a natural filter between the land and the sea. In several places in the Cayman Islands, highly organic and sometimes eutrophic *ponds, pools and mangrove lagoons* are separated from adjacent clear-water coastal *lagoons* by the filtering barrier of the beach ridge.

### Current Factors Affecting *Sandy beach and cobble*

- *Over exploitation:* historically, the American crocodile *Crocodylus acutus*, and marine turtles, especially the Green turtle *Chelonia mydas* were amongst the first victims of over-exploitation in the Cayman Islands. Regulatory management is now implemented for a variety of commercial species of fish and invertebrates; however, the sustainability of several fisheries remains a cause for concern.
- *Planning:* in 2001, the maximum permitted elevation of development on Seven Mile Beach was increased from five floors to seven (or 91ft, whichever is least), in response to pressure from developers (Development and Planning (Amendment) (Heights of Buildings) Regulations, 2002). Seven floors is now increasingly the standard for new developments along Seven Mile Beach. The increase in the maximum permitted elevation for development has also contributed to a financial incentive to replace smaller, older developments with bigger developments. In areas of *sandy beach and cobble*, outside of land zoned "Hotel Tourism", the minimum set-back for development is 75ft from the mean high water mark (Development and Planning Regulations (2003 Revision) Section 8 (1)). In land zoned "Hotel Tourism", the minimum set-back is 130ft, with an additional 15ft for each storey. Set-backs are, however, at the discretion of the CPA, and may be reduced, taking into consideration factors such as exposure, reef protection and the set-back of adjacent buildings. As a general rule development occurs along the stated line of minimum distance, regardless of the natural vegetation line. The natural vegetation line in this environment represents an indication of exposure - however, this is not taken into consideration in the current planning process. As a result, many new developments disrupt the natural aesthetic of the coast, extending above and beyond the natural vegetation line. Additionally, during storms, these developments are prone to damage, leaving unsightly rubble which may remain uncleared indefinitely. When restoration work is undertaken, more often than not, old inappropriate structures are replaced with identical structures, perpetuating the problem.
- *Sea walls:* the high premium of beach-front real estate encourages developers to build up to the stated minimum set-back. Rather than extending set-backs, artificial sea walls are often incorporated into plans, by way of defence. Seawalls prevent shoreward dissipation of wave energy, resulting in a magnification of lateral and returning force, exacerbating erosion of

unconsolidated sediments, promoting structural undermining and loss of beaches. In the worst instances, associated degradation of the beach is so extreme as to result in the loss of all unconsolidated *sandy beach and cobble* seaward of the structure, restricting or preventing passage on foot. Destruction of the beach removes a common resource and basic right of access from all residents of the islands, and should be dealt with effectively through appropriate legislation.

- *Residential development:* poorly regulated beachside development, including artificial sea defences, has severely impacted areas of *sandy beach and cobble*, most especially along Seven Mile Beach. Impacts include loss of the natural vegetation and it associated role as an indicator for nesting turtles, introduction of invasive species, loss of shade, increased beach erosion and wind-blown sand, restriction of public access, and increased litter and light pollution.
- *Financial:* coastal land, especially that associated with sandy beaches, constitutes the most expensive real estate in the Cayman Islands. Attempts to establish protected areas containing significant tracks of sandy beaches will probably prove financially prohibitive. Establishment of ecologically viable preserves will, as a result, likely depend upon a complimentary multiple-use capacity for the site, such as the proposed Barkers National Park. Lower coastal land prices in Cayman Brac and Little Cayman may mean that limited funds might be more effectively spent in preserving significant tracks of *sandy beach and cobble* outwith Grand Cayman.
- *Social impact:* with no formal requirement for Environmental Impact Assessment (EIA) under Cayman Islands Law, there remains no formal mechanism for the valuing of environmental and social impacts alongside economic impacts of development proposals. As a result, common resources, such as "the view of the ocean" and "access to the whole of Seven Mile Beach" once assets enjoyed by all residents of the Cayman Islands, are now readily available to few.
- *Beach access: sandy beach* is a popular recreational destination for visitors and residents. Inappropriate planning of beachside developments has resulting in public access to beaches being restricted to narrow corridors between exclusive developments. Residential properties adopt increasingly aggressive policies of annexing beach property, though the extension of fencing and signage onto the beach, lowering aesthetic value, and contributing to the perception of the Cayman Islands as being a "spoilt" destination.
- *Dynamic nature: sandy beach and cobble* is highly susceptible to modification of prevailing physical conditions. Inappropriate construction, artificial sea-defences and coastal structures contribute to shifts in coastal hydrodynamics; encouraging the migration and redistribution of *sandy beach and cobble.* While modifying physical factors remain operative, *ad hoc* restoration attempts generally meet with little or no success. Additionally, once initiated, degradation of *sandy beach and cobble* can become self-perpetuating. While the impacts of some activities, such as sand mining, are immediately obvious, the impact of many modifications take time to manifest. Excavation of sand associated with beach ridge development (e.g. foundations, swimming pools etc.), and back filling with rock and marl, disrupt the dynamics and natural drainage of the unconsolidated surrounds. In many cases, perturbations of this nature will not become apparent until a severe weather event channels erosional forces at the interface of the unconsolidated sediment and permanent structure, resulting in chronic erosion and undermining.
- *Holistic aspects:* as with most habitats, degradation of *sandy beach and cobble* may result in immediate and proximal effects. However, due to the far-reaching effects of altered physical dynamics on unconsolidated sediments, degradative effects may be most severe distal to the point of impact. As a result, inappropriate development will often have the most severe impact on neighbouring properties. Many seawalls, for example, encourage the formation of terminal vortices at their ends, promoting erosion of sediments beyond their immediate extent. For this reason, preservation of isolated areas of *sandy beach and cobble* is inappropriate as a sole mechanism for protection of this habitat. The extension of protective regulations to entire beach communities is the only mechanism to ensure that inappropriate activity by an individual does not result in damage and loss of this common resource.
- *Storms:* severe weather events may significantly redistribute *sandy beach and cobble* leading to contentious issues of ownership, and opportunistic theft of beach sand for fill and construction. Current planning policy states that, where possible sand should be returned to beaches.
- *Invasive species:* Scaevola *Scaevola sericea* is chronically invasive in the Cayman Islands, and appears capable of out-competing most flora naturally associated with *sandy beach and cobble.*

- *Littering:* local and seaborne litter impact the aesthetic value of *sandy beach and cobble.* In the advent of storms, a heavy loading of seaweed can similarly impact the aesthetic of the beach. Litter presents a hazard to wildlife, particularly through entanglement and ingestion. Clearing by non-mechanical means is encouraged.
- *Horse riding:* horse riding is illegal on Seven Mile Beach, but permitted elsewhere in the islands. Horse riding high on the beach has the potential to negatively impact turtle nesting populations, through the crushing of nests. Where usage is heavy and poorly managed, horse droppings compromise the aesthetic of the beach, and contribute bacteria and nutrients to associated waters. Trampling of vegetation may occur, including *seagrass*, where horse riding excursions cross shallow *lagoons*.
- *Automated beach cleaning:* automated beach cleaning machinery, sometimes referred to as "skimmers", can reduce beach stability through the removal of shell fragments. This results in a fine, powdery top-sand, which is highly susceptible to loss through wind-blowing.
- *Sand mining:* Planning legislation enacted to protect the rights of local residents to take sand from the beach for maintenance of traditional sand gardens has recently come under recurrent abuse from building contractors, who illegally remove beach sand for construction projects. Sand mining results in the loss of sand from both the beach, and beach ridge. Sand mining impacts the beach aesthetic and the integrity of the beach ridge, undermining natural vegetation and increasing susceptibility to storm damage. The resulting holes exacerbate erosion, and present an obstacle to hatchling turtles.
- *Motor vehicles:* motor vehicles and tracks impact the aesthetic of "unspoilt" beaches. Heavy vehicles present a crushing danger to marine turtle nests. Deep tracks are an obstacle for turtle hatchlings returning to the sea. Operation of plant machinery for beach cleaning is generally discouraged.
- *Oil spill:* oil has the potential to significantly reduce the recreational value of sandy beaches.

### Opportunities and Current Local Action for *Sandy beach and cobble*

- Commercial and residential developments are encouraged to adopt a range of "turtle friendly" measures during the nesting season. These include installation of "turtle friendly" lighting. Compliance with these recommendations is voluntary.
- Monitoring of turtle breeding is part of an extensive Marine Turtle Research Programme undertaken by the Department of Environment.
- Hunting of wild turtles is illegal in the Cayman Islands. However, some ten licenses for the capture of up to four turtles (of up to 24 inches curved shell length) are issued annually during open season, (December through March), under the auspices of facilitating traditional fishermen. Though Cayman waters are actively patrolled by Marine Conservation Officers, poaching remains a common occurrence, and the current population remains a small fraction of the historical number.
- The *Native Tree Nursery* aims to provide a source of hardy, salt-tolerance species, grown from locally collected seed, for the purpose of private planting, commercial landscaping and habitat restoration.
- Beach monitoring along Seven Mile Beach is currently undertaken by the Department of Lands and Survey, with the support of the Department of Environment: the one-foot contour is walked and GPSed on a monthly basis, and beach profile monitored at 26 fixed sites after storm events.
- Maintenance of Public Beaches falls under the remit of the Parks, Recreation and Cemeteries Unit.
- A Beach Review and Assessment Committee Report was produced by a committee chaired by the Department of Environment in 2003, outlining management recommendations for Cayman Islands' beaches.
- A civic committee was formed to maintain public access to beaches in 2003. This was successful in re-establishing some traditional public access routes to beaches, by obtaining affidavits. The Prescription Law requires public rights of way be maintained if the public have had right of access over a property for 20 years.

### LOCAL HABITAT ACTION PLAN for *Sandy beach and cobble*

Objectives and targets of this Habitat Action Plan are based in-part on formulations of *The Beach Review & Assessment Committee Interim Report*, May 2003.

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *sandy beach and cobble*, and delineate component vegetation formations. | 2008 |
| **2.** Maintain *sandy beach and cobble* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *sandy beach and cobble*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect 10% of currently remaining *sandy beach and cobble* habitat in the Cayman Islands, and extend protective regulations to all beaches in the Cayman Islands. | 2015 |
| **5.** Improve status of *sandy beach and cobble* outwith protected areas. | 2015 |

| Sandy beach and cobble<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Review the powers and duties of authorities for safeguarding this habitat. | DoE | DoP LS<br>CIG | 2010 | 2,3,5 |
| **PL3.** Promote change to the Planning Regulations, to incorporate appropriate factors, such as coastline exposure, water depth, reef presence, and shoreline substrate etc., into coastal set-backs, through implementation of a Coastal Setback Category Map, created utilizing the current and historical natural vegetation line as an indicator of exposure. | DoE | DoP LS<br>CIG<br>NCCA | 2003 | 1,2,5 |
| **PL4.** Commence active enforcement of provisions of the National Conservation Law, *Section 29*, against deliberate importation or release of invasive species. | DoE<br>DoA<br>HMC | CIG | 2008 | 2,3,5 |
| **PL5.** Commence active enforcement of provisions of *Endangered Species Trade and Transport Law*, with the addition of alien invasive plants and animals to *Part 3*. | DoE<br>DoA<br>HMC | CIG | 2009 | 2,3,5 |
| **PL6.** In tandem with the *urban and man-modified areas* HAP, develop protective regulations and covenants within beachfront communities, to promote preservation of the natural ecosystem services enjoyed by all residents of the Cayman Islands, incorporating sensitive development, landscaping and light abatement. | DoE DoP<br>MP | CIG | 2012 | 2,5 |
| **PL7.** Establish policies to maintain legal access to and use of common resources by the general public, and prevent exclusive exploitation by private enterprise, with special attention to maintaining access to beaches, the format and display of private notices and signage, the placement of private amenities such as sun-loungers, tables and chairs, umbrellas, and temporary / semi-permanent structures on beaches, including tents, marquees and fencing. | DoP<br>CPA<br>DoE | CIG<br>MCB | 2012 | 3,5 |
| **PL8.** Develop and enforce regulations for pet owners to prevent fouling of beaches. | DEH<br>DoA | DoE | 2012 | 3,5 |
| **PL9.** Implement recommendations of the Horse Riding | DoA | DoE | 2012 | 3,5 |

| | | | | |
|---|---|---|---|---|
| Committee, and develop and enforce regulations for operators of horse riding facilities, to ensure best practice. Link these regulations to the facility's Operating License. | | | | |
| **PL10.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL11.** Enforce provisions under the National Conservation Law to support Planning Legislation and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 3,5 |
| **PL12.** Amendment of Section 31 of the Development and Planning Law (1999 Revisions) to prevent the practice of traditional sand removal from all beaches. | DoP | DoE CIG | 2008 | 3,5 |
| **PL13.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for coastal management to discourage damage or disturbance to *sandy beach and cobble.* | DoP CPA | CIG MP DoE | ongoing | 2,3,4,5 |
| **PL14.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3,4,5 |
| **PL15.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,4 |
| **PL16.** Implement a policy of Opportunistic Beach Nourishment (return of stock-piled beach sand from previously approved development and any sand removed from the beach ridge during the construction of new foundations, sea walls and pools, and storm events). | DoP CPA DCB | CIG DoE | ongoing | 3,5 |
| **PL17.** Amend Planning Regulations to include a requirement that Heavy Vehicle Access is maintained to the Seven Mile Beach, between future buildings considered for Planning approval, to facilitate heavy equipment access to the beach in the event of a major beach restoration effort. | DoP CPA DCB | DoE | 2012 | 3 |
| **PL18.** Establish a permanent Beach Management Fund with an initial deposit by Government, and in subsequent years from private and Government funding mechanisms to be determined at a later stage. | ME DoE | CIG MP | 2003 | 3 |
| **PL19.** Amend Development and Planning Regulations and/or CPA policies such that all repair of coastal structures damaged by storms and hurricanes shall require new planning permission in accordance with current policies and recommendations. | DoP CPA DCB | DoE CIG | 2012 | 3,5 |
| **PL20.** Develop and implement guidelines on access and use of motor vehicles on beaches. | DoE | CIG RCIP | 2012 | 3,5 |
| **PL21.** Promote a mandatory policy of "turtle friendly" lighting and design for all new beachfront developments. | DoE | CIG DoP CPA DCB | 2012 | 3,5 |
| **PL22.** Promote a mandatory policy of native vegetation maintenance and/or landscaping for all new beachfront developments. | DoE | CIG DoP CPA DCB | 2012 | 2,3,5 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to | CC | DoE NT | 2015 | 4 |

| | | | | |
|---|---|---|---|---|
| purchase and protect priority areas of *sandy beach and cobble* in the Cayman Islands. | | MP CIG | | |
| **SM2.** Extension of protective community regulations to all *sandy beach and cobble* developments in the Cayman Islands. | DoP CPA DCB | DoE MP | 2012 | 3,5 |
| **SM3.** Provide *sandy beach and cobble* species for landscaping and restoration from the *Native Tree Nursery.* | QEIIBP | DoE | 2008 | 3,5 |
| **SM4.** Implement management of *Casuarina equisetifolia* and *Scaevola sericea* in key areas, especially protected areas. | DoE | PRCU | 2010 | 3,5 |
| **SM5.** Establish a 'Strategic Beach Management Plan' | DoE | CIG | 2010 | 2,3,4,5 |
| **SM6.** Remove specifically identified and inappropriately sited rock and rubble obstructions, and damaging sea-defences along Seven Mile Beach | DoE DoP | CIG MP CPA | ongoing | 3 |
| **SM7.** Generate a Coastal Setback Category Map, detailing site-specific setback distances, for all coastlines on Grand Cayman (beginning with Seven Mile Beach), and the Sister Islands. | DoE LS DoP | CIG CPA DCB NCCA | 2010 | 1 |
| **SM8.** Conduct an immediate trial for Government initiated Spot Nourishment of heavily eroded sections of Seven Mile Beach, utilizing sand sources stockpiled on the island from previous construction projects | DoE | CIG | 2009 | 3,5 |
| **SM9.** Develop and implement guidelines for the siting and construction of seawalls and other coastal defences. | DoE DoP | CIG CPA DCB IntC | 2012 | 3,5 |
| **SM10.** Develop a Management Plan for Barkers National Park, which incorporates and promotes compatible multi-use recreational activities for associated *beaches.* | DoE | | 2012 | 3 |
| **SM11.** Implement associated SAPs. | DoE | | 2015 | 2,3 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of *sandy beach and cobble.* | DoE | DoP CPA DCB | ongoing | 2,3,4,5 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *sandy beach and cobble.* | DoE | DoP CPA DCB | ongoing | 2,3,4,5 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4,5 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *sandy beach and cobble* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise the most significant areas of *sandy beach and cobble* incorporating ecological and recreational value, and continuity with other protected areas. | DoE | NT MP | 2009 | 4 |
| **RM3.** Collate existing data and case studies on the impact of development on *sandy beach and cobble*, towards improving management and development of effective planning and community regulations for preservation. | DoE | | 2010 | 3,5 |
| **RM4.** Monitor the effectiveness of beach restoration projects. | DoE LS | | ongoing | 3,5 |
| **RM5.** Incorporate all pre-existing and forthcoming | DoE | | 2015 | 1 |

| | | | | |
|---|---|---|---|---|
| research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | | | | |
| **RM6.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM7.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM8.** Establish the Historic Vegetation Line using suitable archived aerial photography as the benchmark for determining set-backs on all beaches. | LS | DoE | ongoing | 1 |
| **RM9.** Conduct an 'Engineering Feasibility Study' in preparation for a beach nourishment program during the next major erosion event and as a central component of the Strategic Beach Management Plan. | DoE | IntC | ongoing | 3,5 |
| **RM10.** Continue current Beach Monitoring Programme, and utilise data to inform development of the Strategic Beach Management Plan. | DoE LS | | ongoing | 2,3,5 |
| **RM11.** Establish baseline monitoring programme for all beaches. | DoE LS | | 2012 | 2,3,5 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value of *sandy beach and cobble* using *marine turtles* as a flagship for preservation. | DoE | | ongoing | 3 |
| **CP2.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP HS QEIIBP | ongoing | 3 |
| **CP3.** Encourage developers and residents to retain and use native beach vegetation to assist natural beach stabilisation. | DoE DoP | QEIIBP NT | 2008 | 3 |
| **CP4.** Construct and man an interpretation centre at the Barkers National Park, to raise awareness of the value of *sandy beach and cobble* in visitors and residents. | DoE | CIG | 2015 | 3 |
| **CP5.** Raise awareness of the need for effective planning regulations for the preservation of *sandy beach and cobble.* | DoE | DoP CPA DCB CIG NCCA | ongoing | 3 |
| **CP6.** Ensure that the public are fully informed of all issues pertaining to the conservation management of *sandy beach and cobble,* including case study information highlighting the cost and successfulness of beach restoration projects. | DoE | IntC | 2012 | 3 |
| **CP7.** Continue to work with commercial and residential developments to encourage adoption of "turtle friendly" measures, such as light abatement, during the nesting season. | DoE | DoP CPA DCB MP | ongoing | 3 |
| **CP8.** Initiate public awareness campaign on the issue of sand stealing, and implement a *name-and-shame* list of contractors who transgress the law. | DoE | DoP MP | 2010 | 3 |
| **CP9.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |

**REFERENCES and FURTHER READING for *Sandy beach and cobble***

*Seven Mile Beach Nourishment Project, George Town, Cayman Islands, Bahamian Sand Source Analysis* (2004). Report. Department of Environment. Cayman Islands Government.

## COASTAL HABITATS

### *9. Mangrove*

#### Definition

"Mangrove" is a generic term, used most often to describe the "mangle" habitat and associated plant assemblages which grow in saline coastal habitats in the tropics and subtropics. "Mangrove" is also used to categorize the dominant species of trees associated with this habitat.

#### Local outline

In the Cayman Islands, "mangrove trees" comprise four species: Black mangrove *Avicennia germinans*, White mangrove *Laguncularia racemosa*, Red mangrove *Rhizophora mangle*, and Buttonwood *Conocarpus erectus*. A tolerance for wet and salty conditions is a typifying feature of all four; however, their specific tolerances are markedly different. Red mangrove is the pioneering species, and typically constitutes the entirety of the seaward fringe of mangrove forest. Buttonwood, by comparison, occupies the opposite extreme of this range, preferring the driest and least saline environments of the four mangrove species.

While all species of mangrove are highly tolerant of root submersion in water, this tolerance remains within critical boundaries. Normally, oxygen concentrations decline in the pneumatophores (aerial roots) during high tide, and recover quickly during low tide, when the roots are once more exposed to the air. Immersion of the pneumatophores for more than a few days, however, results in a sharp decline in oxygen stored within the roots, effectively "drowning" the trees, and resulting in the mass mortality of submerged forest. Hence, mangroves are highly intolerant of elevated levels of standing water, and susceptible to interruptions to natural drainage. Large scale die-offs of mangrove result in canopy loss and decay of the underground root system, resulting in the exposure and oxidation of the peat layer below. This results in subsidence of the peat layer, often resulting in the formation of permanent pools.

#### Key Habitat Categories for *Mangrove*

Habitat and plant assemblages associated with Black mangrove *Avicennia germinans*, White mangrove *Laguncularia racemosa*, Red mangrove *Rhizophora mangle*, and Buttonwood *Conocarpus erectus*. Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Seasonally flooded evergreen sclerophyllous forest I.A.5.N.c
- Tidally flooded mangrove forest I.A.5.N.e
- Seasonally flooded / saturated sclerophyllous evergreen woodland II.A.1.N.i
- Tidally flooded evergreen woodland II.A.1.N.e
- Seasonally flooded / saturated evergreen shrubland III.A.1.N.f
- Saturated sclerophyllous evergreen shrubland III.A.1.N.h
- Tidally flooded evergreen shrubland III.A.1.N.i

#### Key Species for *Mangrove*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| **KEY SPECIES for MANGROVES** | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Grand Cayman parrot | Aves<br><br>*Amazona leucocephala caymanensis* | <br><br>SAP |

| | | | |
|---|---|---|---|
| | Greater Antillean grackle<br>West Indian Whistling-duck<br>White-crowned pigeon | *Quiscalus niger caymanensis / bangsi*<br>*Dendrocygna arborea*<br>*Patagioenas leucocephala* | SAP |
| Corals | All soft corals (including Gorgonians & Telestaceans) | Anthozoa all species | |
| Reptiles | American crocodile | *Crocodylus acutus* | |
| Invertebrates | Echinoderms | Echinodermata all species | |
| Invertebrates | Sponges | Porifera all species | |
| **PART 2** | | | |
| Reptiles | Hickatee (Taco River Slider) | *Trachemys decussata angusta* | |
| Fish | All bony fish - *except those specifically listed in Part 1 or elsewhere in Part 2* | Teleostei species | |
| Fish | Mosquito fish | *Gambusia xanthosoma* | SAP |
| Fish | Mosquito fish | *Limia caymanensis* | SAP |
| Invertebrates | White Land crab | *Cardisoma guanhumi* | SAP |
| Invertebrates | Lobsters | Palinura species | |
| Invertebrates | Spiny lobster | *Panulirus argus* | SAP |
| Invertebrates | Queen conch | *Strombus gigas* | SAP |
| Plants | Black mangrove | *Avicennia germinans (= nitida)* | |
| Plants | Buttonwood | *Conocarpus erectus* | |
| Plants | White mangrove | *Laguncularia racemosa* | |
| Plants | Red mangrove | *Rhizophora mangle* | |
| Plants | Green algae | Chlorophyta species | |
| Plants | Brown algae | Phaeophyta species | |
| Plants | Red algae | Rhodophyta species | |

## Current Status of *Mangrove*

*Link to habitat map: Mangrove Grand Cayman*
*Link to habitat map: Mangrove Cayman Brac*
*Link to habitat map: Mangrove Little Cayman*

| Habitat Status 2006 Mangrove | Total area (ac) | | | Area within protected areas / buffers (ac) | | | Area outside protected areas / buffers (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Seasonally flooded mangrove shrubland / woodland | 697.3 | 12.4 | 691.9 | 57.6 | 0.1 | 26.0 | 639.7 | 12.3 | 665.9 | 8.26 | 0.48 | 3.76 |
| Seasonally flooded mangrove forest / woodland | 13609.7 | 23.5 | 465.0 | 1398.6 | 0.1 | 9.6 | 12211.1 | 23.5 | 455.4 | 10.28 | 0.26 | 2.06 |
| Tidally flooded mangrove shrubland / woodland | 462.5 | 0.0 | 0.0 | 394.0 | x | x | 68.5 | x | x | 85.20 | x | x |
| Tidally flooded mangrove forest / woodland | 1339.9 | 0.0 | 19.0 | 1037.9 | x | 0.0 | 302.0 | x | 19.0 | 77.46 | x | 0.00 |
| **TOTAL** | **16109.5** | **35.9** | **1175.9** | **2888.2** | **0.1** | **35.6** | **13221.3** | **35.8** | **1140.3** | **17.93** | **0.33** | **3.03** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Mangrove*

GRAND CAYMAN: Central Mangrove Wetland (ca. 8,500 acres)
North Sound Mangrove Buffer

| | |
|---|---|
| | Barkers Mangrove |
| CAYMAN BRAC: | Westerly ponds? |
| LITTLE CAYMAN: | Crown Wetlands (especially Tarpon Lake and surrounds)<br>Booby Pond (northern mangrove fringe)<br>South Hole Sound |

| **Protected areas containing *mangrove*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| *Central Mangrove Wetland* | 592.27 | Grand Cayman | NT |
| *Barkers* - subject of current purchase effort by CIG, towards establishment of a National Park – is mostly *mangrove* modified by MRCU canals. Currently Barkers remains unprotected, and so does not contribute towards protected areas statistics. | 94.95 to-date | Grand Cayman | CIG |
| *North Sound Mangrove Buffer* – where the Environmental Zone overlaps the Central Mangrove Wetland (approximately to the extent of tidal inundation) | 1527.04 | Grand Cayman | Private owners |
| *Booby Pond Nature Reserve* Animal Sanctuary and Ramsar Site – incorporates a fringing *mangrove* buffer | 457.2 | Little Cayman | NT |
| *Colliers Pond* Animal Sanctuary– incorporates a fringing *mangrove* buffer | 28.05 | Grand Cayman | CIG |
| *Meagre Bay Pond* Animal Sanctuary– incorporates a fringing *mangrove* buffer | 96.37 | Grand Cayman | CIG |

*Mangrove* constitutes one of the Cayman Islands' most undervalued and severely impacted habitats.

### Nature Conservation Importance of *Mangrove*

- *Biodiversity: mangrove* contributes significantly to the biodiversity of both terrestrial and marine ecosystems.
- *Marine nursery:* coastal *mangrove* contributes to biodiversity through provision of a secure nursery area. Protected from large predators within the matrix of the mangrove root system, the larvae and juvenile forms of many reef and open sea species grow in *mangrove*, before moving seaward as they mature. Spiny lobster *Panulirus argus* spends up to two years maturing in mangrove roots. Many fish typically associated with *coral reefs* are obligate *mangrove* dwellers in their juvenile stages.
- *Birdlife: Mangrove* is most significant from a terrestrial perspective, with respect to its complement of birdlife. Mangrove is an important roost for several species of local significance, including West Indian Whistling-duck *Dendrocygna arborea* and Greater Antillean grackle *Quiscalus niger*. Black mangrove *Avicennia germinans* provides nesting habitat for a significant proportion of the islands' Grand Cayman parrot *Amazona leucocephala caymanensis* and the White-crowned pigeon *Patagioenas leucocephala*. Mangrove is also of particular value to resident and migratory waders, such as the Snowy egret *Egretta thula*.
- *Flora:* while the floral diversity of mangrove is predominately restricted to the four "mangrove" species, dry keys within the mangrove complex contribute to the floral diversity of the system, with species such as Mahogany *Swietenia mahagoni*, Red birch *Bursera simaruba* and Manchineel *Hippomane mancinella*. The endemic and critically endangered herb *Agalinis kingsii* also occurs locally with in mangrove shrubland in the CMW.
- *Crabs: mangrove* provides habitat to a variety of crabs, including *Eurytium limosum* and *Aratus pisonii*, the grapsid crab *Sesarma angustipes*, the fiddler crab *Uca speciosa*, and land crabs including *Gecarcinus lateralis* and the White Land crab *Cardisoma guanhumi*. Habitat loss and

busy coastal *roads* inflict a heavy toll on land crabs, which of necessity undertake periodic mass-migration to the sea to lay their eggs.

*Other factors:*

- *Water clarity*: the submerged matrix of coastal *mangrove* roots slows water currents, encouraging deposition of sediment, and aggregated by the root network. As such, *mangrove* constitutes an environment of accretion and land building, representing a sink for marine sediment, and a trap for sediment carried in terrestrial run-off. Improvement of water clarity benefits other coastal habitats, including *seagrass* and *coral reef.*
- *Nutrient regulation*: *mangroves* reduce the influx of nutrient-rich terrestrial run-off into the marine environment. Mangroves slow and regulate the release of nutrients into the marine environment, and contribute to the input of carbon and other nutrients, forming a basis of the nearshore foodweb. This slow introduction of nutrients also maintains the natural nutrient-poor status of local waters, deterring the algal proliferation commonly associated with nutrification, which can impact marine habitats, most especially *coral reefs*, and to a lesser extent *seagrasses*.
- *Carbon sink*: *Mangrove* is a highly productive system. Estimates of the global storage of carbon by mangroves varies widely, however, a synthesis of the available data on carbon fluxes in mangrove ecosystems results in a "conservative" estimate of about 218 ± 72 Tg C a−1 (Bouillon *et al.* 2008), making mangrove ecosystems a significant carbon sink.
- *Coastal protection*: The deep rooting systems of *mangrove* impede storm surge, reducing coastal erosion, and damage to coastal property during severe weather.
- *Rainfall production*: Saturated air derived from the moist understory, and transpiration from the leaf surface, rises above the Central Mangrove Wetland and develops into localized cloud. The clouds are carried westward by the prevailing wind, contributing to the rainfall of central and western Grand Cayman. Rainfall in these areas is some 40% higher than in districts on the windward side of the Central Mangrove Wetland.
- *Provision of freshwater*: The hydrological influences and ironpan formation associated with large *mangrove* areas contribute to elevation of the freshwater table in land peripheral to the wetland, resulting in the formation of some of the island's most fertile *farm and grassland*. Canalisation and development disrupt this function, causing salinisation of freshwater lenses, and depleting terrestrial freshwater availability.
- *Aesthetic*: traditionally, *mangrove* has been regarded as worthless land, and a breeding ground for mosquitoes. In 1965 the *Mosquito Research and Control Unit*, MRCU, was established, and rapidly implemented a systematic dyking and canalisation programme for the *mangroves*, in combination with ground-based fogging, and aerial application of larvicide. The effect was to radically reduce the population of mosquitoes throughout the islands, however, local attitudes to mangrove or *"swamp"* improved little. With the concurrent economic boom associated with the advent of the banking and tourism industry, *mangrove* was quickly targeted for profitable residential and canal development.

### Current Factors Affecting *Mangrove*

- *Buffer zone erosion:* though subject to a policy of protection, mangrove buffer zones are regularly eroded by development and canalisation for access.
- *Roads construction:* interruption of natural drainage systems by poorly designed *roads* projects has resulted in the drowning and death of significant tracts of *mangrove*, including Tarpon Lake on Little Cayman, following hurricane Gilbert, and South Sound and Prospect on Grand Cayman, following hurricane Ivan. The currently gazetted central bypass road on Grand Cayman has the potential to significantly impact the Central Mangrove Wetland and encourage development into this area.
- *Quarrying:* several quarries are currently operative within the Central Mangrove Wetland, Grand Cayman, with approximately 100 acres currently slated for expansion of activities.
- *Cut and fill:* the development practice of filling low-lying wetland with spoil gained from excavation of associated canal systems. "Cut and fill" causes immediate physical damage to

*mangrove* through land clearance, and is usually accompanied by the filling and residential development of land immediately adjacent the canal. Canalisation also reduces the effectiveness of *mangrove* as a storm buffer, and contributes to fragmentation and weakening of the habitat.

- *Residential development: mangrove* was once the dominant form of vegetation along the western peninsula of Grand Cayman. Residential development has resulted in the removal of almost all *mangrove* from the area, and has also directly impacted the southern and western edges of the Central Mangrove Wetland. The ecological impact of residential development is often exacerbated by canalisation.
- *Planning:* under the Land Surveyors Regulations (1996 Revision) 28 (3), in areas of *mangrove* coastline, the high water mark is defined "the edge of the mangrove vegetation", regardless of the extent of tidal inundation landward of this point. As such, land-owners legally own land to the extent of the mangrove fringe. Under the Development and Planning Regulations, the minimum set-back for development in mangrove areas is 75 ft from the high water mark: the high water mark being defined as the seaward extent of mangrove. This is a nonsensical legislation, as it means that, effectively, a landowner might increase the area of land under their ownership by planting mangroves at the seaward extent. Once established, the landowner might then legally extend development to the newly established high water mark. In the Cayman Islands, the impracticalities of this law regularly result in planning disputes associated with the clearance and development of *mangrove*. In many cases, back-filling mangrove is not regarded as constituting "development", resulting in the extensive loss of vegetation even within the 75ft set-back.
- *Natural cycles*: the seaward extent of mangroves is subject to natural perturbation, most especially associated with severe storm events. Large areas of mangrove were impacted by the high winds associated with Hurricane Ivan; however, in areas where natural drainage has been preserved recovery is well underway.
- *Sea defences*: inappropriate construction of sea defences along naturally dynamic areas of the foreshore result in the focusing and redirection of wave energy, inhibiting the ability of *mangrove* to establish and survive seaward of the defence, and so undermining the effectiveness of *mangrove* as a functional buffer to storm surge.
- *Invasive species:* Weeping willow *Casuarina equisetifolia* is capable of infiltrating and establishing in areas of disturbed seasonally flooded *mangrove* forest, especially on dyke roads and in areas where fill grades into undisturbed wetland.
- *Climate*: factors associated with climate change, particularly increase in severity of storms have the potential to impact *mangrove*, especially in areas where the natural forest buffer has become fragmented, or weakened as a result of land clearance, development or canalisation.
- *Marine pollution*: mangroves are susceptible to oil spill, and represent a difficult environment in which to mount an effective oil-spill response.
- *Laying of pipelines and cables*: the last major project of this nature was undertaken by Caribbean Utilities Company in 2000. The Department of Environment assisted with the restoration of damaged mangrove.
- *Public education:* In recent years, public awareness regarding the ecological value of mangroves has grown, especially in the younger generation, due in part to the education programmes of the National Trust for the Cayman Islands and the Department of Environment. In 1997, the National Trust commenced purchase of some land parcels within the Central Mangrove Wetland. However, during the course of 1996-9 proposals to designate protected zones for the Central Mangrove Wetland in the *Development Plan* met with vociferous opposition. As a result, the majority of the CMW remains without any legal protection to this day.

### Opportunities and Current Local Action

- Currently, some isolated parcels in the Central Mangrove Wetland fall under the ownership and protection of the National Trust for the Cayman Islands. Others are currently owned by the Crown.
- *Mangrove* productivity is currently monitored by the Department of Environment, on a biannual basis, as part of a CARICOMP initiative.

- A mangrove buffer zone (to the extent of tidal inundation) is established around the Environmental Zone, in North Sound. In some areas, this extends to in excess of 1000ft. However, this protected status has yet to be tested against an application for development.
- The Booby Pond Reserve falls under the ownership and protection of the National Trust for the Cayman Islands, and the Cayman Islands Government, as an Animal Sanctuary and Ramsar site. The area incorporates a mangrove-fringed lagoon, supporting internationally significant numbers of Red-footed boobies *Sula sula.*
- The National Trust for the Cayman Islands produces fact sheets on *Mangroves* and the *Central Mangrove Wetland.* The National Trust and Department of Environment run occasional educational tours to the Little Sound mangrove fringe.
- Under the 2004 Ramsar review, the Central Mangrove Wetland, the proposed Barkers National Park, and the Crown Wetlands on Little Cayman, all qualified as potential Ramsar sites.
- In 2006, as part of the Darwin Initiative and with financial support from US Fish and Wildlife Neotropical Migratory Bird Conservation Act (USFWS NMBCA), the Department of Environment partnered with the Reefball Foundation and Cayman Islands Sailing Club to develop a nursery to grow Red Mangrove in Reefball planters, with the aim of restoring coastal *mangrove* to areas of coastline denuded of mangrove by the effects of Hurricane Ivan. The first experimental plantings took place in 2008. Monitoring is currently underway.

### LOCAL HABITAT ACTION PLAN for *Mangrove*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *mangrove*, and delineate component vegetation formations. | 2008 |
| **2.** Maintain *mangrove* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *mangrove*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect 90% of currently remaining *mangrove* habitat in the Cayman Islands. | 2015 |

| Mangrove PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Promote change to the Land Surveyors Law and Planning legislation, to prevent exploitation of the seaward extent of mangrove land boundaries. | DoE | DoP LS<br>CPA<br>DCB<br>CIG | 2012 | 2,3 |
| **PL3.** Given the common objective of maintaining biodiversity and water clarity, promote "no additional quarrying within the Central Mangrove Wetland", as a sister policy to "no more dredging in the North Sound". | DoE | CIG NT<br>AAC | 2009 | 2 |
| **PL4.** Commence prosecution for offences involving damage to existing Animal Sanctuaries and Ramsar sites, regularise buffer ownership issues, and update and upgrade penalties for transgression of associated regulations. | DoE | CIG | 2009 | 2,4 |
| **PL5.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,4 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3,4,5 |

| | | | | |
|---|---|---|---|---|
| coastal management to discourage damage or disturbance to *mangrove.* | | | | |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3,4,5 |
| **PL8.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL9.** Incorporate fringing mangrove into the continuum of existing marine protected areas and replenishment zones. | CC | DoE NT<br>MP CIG | 2015 | 4 |
| **PL10.** Work with *Department of Planning* to promote and formalize guidelines for the establishment of an escrow fund to cover the costs of site restoration for all new quarry applications. | DoE | DoP<br>CPA<br>DCB | 2012 | 3 |
| **PL11.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the Central Mangrove Wetland, Grand Cayman. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM2.** Once designated, promote the Central Mangrove Wetland for designation as a Ramsar site. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM3.** Establish the Barkers area as a designated National Park under the National Conservation Law. | CC | DoE MP<br>CIG | 2015 | 3,4 |
| **SM4.** Develop a Management Plan for Barkers National Park, which incorporates and promotes compatible multi-use recreational activities for *mangrove*, such a kayaking. | DoE | CC CIG | 2015 | 3,4 |
| **SM5.** Once designated, promote Barkers National Park for designation as a Ramsar site. | CC | DoE MP<br>CIG | 2015 | 3,4 |
| **SM6.** Use the *Environmental Protection Fund* to construct a manned interpretation centre on the shore of Sea Pond, Barkers, to develop tourism capacity, and raise awareness of the value of associated habitats in visitors and residents. | DoE | CIG CC | 2015 | 3,4 |
| **SM7.** Transfer Crown Wetlands in Little Cayman to protected area status. | CC | DoE NT<br>MP CIG | 2012 | 2,4 |
| **SM8.** Subject to SM7, designate Little Cayman Crown Wetlands a Ramsar site. | DoE | CC CIG<br>MP NT | 2012 | 2 |
| **SM9.** Incorporate existing Animal Sanctuaries into a National System of Protected Areas. | CC | DoE CIG | 2006 | 2,4 |
| **SM10.** Establish and maintain *Mangrove Nursery* to provide stock for habitat restoration and coastal protection, subject to favourable field trials. | DoE | IntC | 2010 | 3 |
| **SM11.** Implement management of *Casuarina equisetifolia* in key areas, especially protected areas. | DoE | | 2010 | 3 |
| **SM12.** Develop and implement guidelines for property owners whose land incorporates significant stands of Red mangrove, towards ensuring sensitive vegetation control. | DoE | DoP MP<br>CPA<br>DCB | 2009 | 3 |
| **SM13.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |

| **Advisory** | | | | |
|---|---|---|---|---|
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation of and natural function of *mangrove*. | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest and ecological value of *mangrove* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A3.** Targeted awareness of the need for the National Conservation Law. | DoE | CIG NT | 2006 | 2,3,4 |
| **A4.** Recommend that new roads construction adequately provision for maintenance of natural drainage. | DoE | NRA<br>DoP<br>CPA<br>DCB | ongoing | 2,3 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *mangroves* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *mangrove* in the Cayman Islands. | DoE | NT | ongoing | 1,4 |
| **RM3.** Assess ecological status of existing Animal Sanctuaries and compile Management Plans for their maintenance, upkeep and improvement. | DoE | NT | 2006 | 2,3,4 |
| **RM4.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM5.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM6.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM7.** Continue CARICOMP monitoring of *mangroves*. | DoE | IntC | ongoing | 2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value of *mangrove*. | DoE NT | | ongoing | 3 |
| **CP2.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP HS QEIIBP | ongoing | 3 |
| **CP3.** Utilise designation of new National Parks and Ramsar sites to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |
| **CP4.** Utilise Ramsar designation and protected wetlands in Little Cayman to promote the island internationally as a nature tourism destination. | DoT | CIG DoE | 2015 | 3 |
| **CP5.** Use a compliment of dependent key species as a flagship for mangrove preservation: Cayman Parrot *Amazona leucocephala*, White Land Crab *Cardisoma guanhumi*, Tarpon *Megalops atlanticus* (larval stage), Lobster *Panulirus argus* and reef fishes. | DoE | CIG | 2012 | 3 |
| **CP6.** Publish guidelines for property owners whose land incorporates significant stands of Red mangrove, towards facilitating sensitive control of vegetation. | DoE | DoP | 2009 | 3 |
| **CP7.** Construct and man an interpretation centre at the Barkers National Park, to develop tourism capacity, and raise awareness of the value of *mangrove* in visitors and residents. | DoE | CIG | 2015 | 3 |
| **CP8.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands | DoE | DoT CIG NT MP | 2006 | 3 |

| | | | | |
|---|---|---|---|---|
| internationally. | | | | |

## REFERENCES and FURTHER READING for *Mangrove*


Bouillon, S., Borges A.V., Castañeda-Moya, E., Diele, K., Dittmar, T., Duke N.C., Kristensen, E., Lee, S. Y., Marchand, C., Middelburg, J.J., Rivera-Monroy V.H., Twilley, R.R. (2008). Mangrove production and carbon sinks: A revision of global budget estimates, Global Biogeochem. Cycles, Vol. 22, GB2013.

Brunt, M.A. and Burton, F. (1994). Mangrove swamps of the Cayman Islands. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Brunt, M.A. and Giglioli, M.E.C. (1980). Cayman Islands swamp maps, sheets 1-3, 1:25,000 scale. Land Resources Centre, ODA, London.

Twilley R.R., Chen R. H., and Hargis T. (1992) Carbon sinks in mangroves and their implications to carbon budget of tropical coastal ecosystems. *Water, Air, & Soil Pollution*. Vol. 64, No. 1-2.

Woodroffe, C.D. (1979). Morphology and development of mangrove swamps, Grand Cayman, Cayman Islands, WI. PhD Thesis, Univ. Cambrifge, 632 pp.

Woodroffe, C.D. (1982). Geomorphology and development of mangrove swamps, Grand Cayman Island, WI. Buell. Mar. Sci. 32: 381-398.

Woodroffe, C.D. (1983). Development of mangrove swamps behind beach ridges, Grand Cayman Island, West Indies. Bull. Mar. Sci. 33(4):928.

## COASTAL HABITATS

### *10. Invasive coastal plants*

**Definition**

(FAMILY: Casuarinaceae): Weeping willow (Casuarina, Beefwood, Whistling pine, Australian pine) *Casuarina equisetifolia* is a species of tree native to Australia.

(FAMILY: Goodeniaceae): Beach naupaka (Sea lettuce, Scaevola) *Scaevola sericea*. A genus of more than 80 species, chiefly found in Polynesia and the Australian region.

**Local outline**

Introduced into Florida in the late 1800's, Weeping willow probably established in the Cayman Islands soon afterwards, possibly introduced intentionally for use as a shade tree. Weeping willow aggressively colonises along the margins of high-stress coastal areas, roadsides and disturbed patches within native vegetation. Once adult trees reach maturity, profuse seed is set: tiny, winged nutlets which each contain one seed, inside small, woody cones.

Currently, there are so many Weeping willow trees in the Cayman Islands, that it is possible to map their distribution from satellite imagery. Based on 2004 aerial data, in Grand Cayman alone there were 5,082 stands of Weeping willow, covering approximately 320 acres, and representing ten's of thousands of individual trees. Numbers of Weeping willow are sufficient to constitute their consideration as a monoculture (single species) habitat: *needle-leaved evergreen woodland*.

Introduced as a salt-tolerant ornamental on many West Indian islands, and rapidly becoming naturalized, Beach naupaka *Scaevola sericea* has become an invasive weed in many places, including the Cayman Islands (Proctor 2009). Like Weeping willow, Beach naupaka spreads to the detriment and exclusion of native species, establishing a dense, bushy hedge; readily engulfing and overgrowing slower-growing natives.

Rapid growth rate and profuse seed-setting enable both species to establish and dominate in land cleared by development, or disturbed by natural events, such as storms.

**Key Habitat Categories for *Invasive coastal plants***

The species / monoculture habitats of Weeping willow (Casuarina, Beefwood, Whistling pine, Australian pine) *Casuarina equisetifolia* and Beach naupaka (Sea lettuce, Scaevola) *Scaevola sericea*. Incorporates the following vegetation formations, as *per* Burton (2008b):

- Needle-leaved evergreen woodland II.A.3.C.a.

| KEY SPECIES for INVASIVE COASTAL PLANTS | | | |
|---|---|---|---|
| INVASIVE | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Plants | Weeping willow | *Casuarina equisetifolia* | HAP |
| Plants | Beach naupaka | *Scaevola sericea* | HAP |

*Invasive coastal plants* impact most greatly the natural value of the following habitat categories:

11. Coastal shrubland
18. Urban and suburban
19. Roads

**Current Status of *Invasive coastal plants***

*Link to habitat map: Invasive coastal plants Grand Cayman*
*Link to habitat map: Invasive coastal plants Cayman Brac*

*Link to habitat map: Invasive coastal plants Little Cayman*

| Habitat Status 2006 Invasive coastal plants | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | |
|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Weeping willow *Casuarina equisetifolia* Needle-leaved evergreen woodland II.A.3.C.a. | 320.11 | 12.55 | 7.7 | 0.10 | 0.00 | 0.00 | 320.01 | 12.55 | 7.7 |
| Beach naupaka *Scaevola sericea* | 20.68 | 1.91 | 0.74 | 0.00 | 0.00 | 0.00 | 20.68 | 1.91 | 0.74 |
| **TOTAL** | **340.79** | **14.46** | **8.44** | **0.10** | **0.00** | **0.00** | **340.69** | **14.46** | **8.44** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Invasive coastal plants*

ALL ISLANDS: Coastal areas
Cleared land

## Nature Conservation Importance of *Invasive coastal plants*

- *Invasive ability:* Weeping willow is a chronic invasive species in the Cayman Islands. Capable of establishing in both coastal and inland areas, Weeping willow spreads to the complete exclusion of native flora, until monoculture *needle-leaved evergreen woodland* is established. Of all Cayman's exotic species, the spread of Weeping willow has probably had the greatest impact on native vegetation, most especially *coastal shrubland*. Beach Naupaka *Scaevola sericea* is more restricted in its distribution, favouring coastal areas, but is highly invasive in this environment.
- *Displacement of native flora and fauna:* natural beach ridge supports diverse *coastal shrubland* vegetation. Replacement of *coastal shrubland* by *invasive coastal plants* constitutes a proximal loss in biodiversity of, typically, about 29 native species, and their replacement with single exotic species. The structural uniformity of the *invasive coastal plants* monoculture presents few habitat niches for exploitation by native birds and wildlife, resulting in a landscape significantly depauperate in both plants and animals.
- *Compounding factors:* spread of *invasive coastal plants* insidiously compounds the impact of the clearance and development of *coastal shrubland*. Weeping willow is often mistakenly regarded as a natural feature worthy of preservation. As a result, coastal development and spread of Weeping willow combine to make *coastal shrubland* one of the most highly threatened environments in the Cayman Islands. Beach Naupaka is a staple of coastal landscaping, and is regularly a major component of formal schemes.
- *Beach erosion:* while laterally extensive, the root system of Weeping willow is extremely shallow. This makes Weeping willow prone to toppling in severe weather, uplifting and disturbing unconsolidated *sandy beach* during the full force of severe weather. Weeping willow also contributes indirectly to beach erosion, by virtue of displacing deep-rooting native species such as Sea grape *Coccoloba uvifera*, the presence of which would otherwise more effectively consolidate the beach ridge.
- *Turtle Nesting*: the laterally spreading root structure of the Weeping willow extends throughout the upper surface layers of *sandy beach*, effectively forming a sub-surface network which is impenetrable to the digging of nesting turtles. As a result, establishment of Weeping willow along the natural vegetation line effectively prevents turtles from nesting in this prime habitat. Marginalization of accessible nesting areas may encourage nesting females to select sub-prime locations, including areas further down the beach, at increased risk of tidal inundation.
- *Climate change*: native vegetation, which is adapted to current local conditions, may be expected to come under increasing environmental stress under the influence of shifting climatic factors,

reducing natural capacity to fight infection and increasing susceptibility to being out-competed by *invasive coastal plants*. Predictions of increased severity of storm events associated with many climate change models would further exacerbate the spread of *invasive coastal plants*.

*Other factors:*

- *Shifting baseline:* established in the Cayman Islands for over a generation, Weeping willow is now commonly regarded as a *"local tree"*. Members of the public have previously requested *Tree Preservation Orders* to be issued for individual Weeping willow trees, and have, on occasion, formed human barricades in an attempt to prevent their removal. The *Shifting Baseline* undermines environmental awareness and erodes a concept of cultural heritage, promoting a misplaced attachment and valuing of the exotic, the immediate and the commonplace, above the natural, the traditional and the rare.
- *Storms:* large storm events impact coastal vegetation, generating and exacerbating breaks in the natural vegetation line. While storm events fell more Weeping willow than native vegetation, the toppling of Weeping willow disturbs the beach and disrupts adjacent vegetation, creating an expanse of cleared beach which is quickly colonised by *invasive coastal plants.* Inland, temporary clearings resulting from the felling of individual trees may similarly be colonised by Weeping willow.
- *Aesthetic:* Weeping willow is commonly regarded as an attractive tree. The tree produces a deep, phytotoxic leaf litter, which inhibits the growth of, and kills native vegetation, making ground beneath the canopy effectively barren. This makes areas around Weeping willow easily accessible for shade and recreation. The needle-like leaves additionally produce a pleasant "rushing" sound in the wind. Similarly, the vibrant green foliage and hardy salt-tolerant nature of Beach naupaka, contribute to its being a staple of coastal landscaping. These factors combine to make *invasive coastal plants* popular species.
- *Cultural significance:* Weeping willow has long been adopted as a traditional substitute for Christmas trees. The "pines" are also commonly referenced in place names for beach locations.
- *Financial:* Weeping willow eradication efforts in Florida, and elsewhere, have proven to be extremely expensive.

### Current Factors Affecting *Invasive coastal plants*

- *Speculative land clearance:* the complete clearance of all vegetation from a saleable lot, to demonstrate its extent and topography, is common practice in the Cayman Islands. This results in immediate and long-term damage to the ecological value of the land. Regardless of whether a sale is forthcoming, invasive species colonise the cleared area, compromising both the cleared site and impacting neighbouring parcels; providing a reservoir from which invasive species spread. Speculative clearance removes any option for a prospective buyer to maintain native vegetation outside of the footprint of any new development.
- *Roads:* roads provide an avenue of disturbed land enabling invasive species such as Weeping willow and Wild tamarind *Leucaena leucocephala* to establish and infiltrate otherwise pristine habitat.
- *Shifting baseline:* because Weeping willow is commonly mistaken as "native tree", it is occasionally deliberately replanted following storm events. Beach naupaka remains a common landscaping ornamental.

### Opportunities and Current Local Action for *Invasive coastal plants*

- The *Native Tree Nursery* aims to provide a source of hardy, salt-tolerance species, grown from locally collected seed, for the purpose of private planting, commercial landscaping and habitat restoration.
- The proposed *Barkers National Park* incorporates a significant tract of coastal shrubland, in which Weeping willow is established. Government ownership and management of the area as CATEGORY II: *National Park* would facilitate active management of the area with the objective

of protecting its ecological integrity, including local eradication or control of Weeping Willow. Additionally, the isolated peninsula nature of *Barkers* should promote the longevity of management efforts.

- Potential for collaboration with USFWS *Invasive Species* control programmes, towards benefiting from their experience in the Caribbean with management of this species.
- In 2008, concern over the spread of Weeping willow and Beach naupaka prompted a detailed analysis and delineation of the species' spread in the Cayman Islands. As a result, the Department of Environment has complied accurate baseline maps of the distribution of Weeping willow, based on 2004 aerial data, in Grand Cayman alone there were 5,082 stands of Casuarinas, covering approximately 317 acres, and representing ten's of thousands of individual trees.

## HABITAT ACTION PLAN for *Invasive coastal plants*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Precisely map the distribution of *invasive coastal plants* in the Cayman Islands. | 2008 |
| **2.** Maintain and manage key habitats, communities and species affected by *invasive coastal plants*, and seek improvement of key areas which have been degraded. | 2010 |
| **3.** Halt the spread of *invasive coastal plants* in the Cayman Islands. | 2010 |

| Invasive coastal plants<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Add *Casuarina equisetifolia* and *Scaevola sericea* to Part 3 of the Endangered Species (Trade and Transport) Law, and implement an importation ban. | DoE<br>DoA<br>HMC | CIG | 2009 | 3 |
| **PL4.** Application and enforcement of the National Conservation Law, *Section 29*, when *Casuarina equisetifolia* and *Scaevola sericea* is deliberately planted. | DoE | CIG | 2008 | 2,3 |
| **PL5.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3 |
| **PL6.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 3 |
| **PL7.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for coastal management to discourage establishment and spread of *invasive coastal plants.* | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3 |
| **PL8.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Provide *coastal shrubland* species, and species from other habitats affected by *invasive coastal plants*, for landscaping and restoration from the *Native Tree Nursery.* | DoE | QEIIBP | 2008 | 2,3 |
| **SM2.** Initiate eradication of *invasive coastal plants* from CIG protected areas, prioritizing *coastal shrubland*, to be accompanied by habitat restoration through planting of native trees. | DoE | CIG | 2010 | 2,3 |
| **SM3.** Work with landowners to extend control and restorative management outside of protected areas. | DoE | MP | 2010 | 2,3 |
| **SM4.** Implement associated SAPs. | DoE | | 2015 | 2 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to discourage establishment and spread of *invasive coastal plants*, and ensure the preservation and natural function of *coastal shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3 |

| | | | | |
|---|---|---|---|---|
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest of *coastal shrubland.* | DoE | DoP CPA DCB | ongoing | 2,3 |
| **A3.** Promote retention / planting of native vegetation equal to 20% of the total parcel area in planning applications (exceeding one acre) sited in areas of *coastal shrubland.* | DoE | DoP | ongoing | 2,3 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3 |
| **Research & Monitoring** | | | | |
| **RM1.** Precisely map distribution of *Casuarina equisetifolia* and *Scaevola sericea* in the Cayman Islands. | DoE | | 2008 | 1 |
| RM1. REPORT: DoE staff create GIS shapefiles accurately delineating areas of *Casuarina equisetifolia* and *Scaevola sericea*, 2008. | | | | |
| **RM2.** Investigate and field test control methods for *Casuarina equisetifolia* and *Scaevola sericea* to determine most appropriate management techniques. | DoE | IntC | 2010 | 2,3 |
| **RM3.** Feasibility study and cost analysis of local control of *Casuarina equisetifolia* and *Scaevola sericea.* | DoE | IntC | 2010 | 2,3 |
| **RM4.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM5.** Develop and expand research programmes, to incorporate and target indicators of climate change, with special attention to spread of invasive species. | DoE | IntC | 2010 | 2,3 |
| **RM6.** Utilise remote sensing to instigate a five-yearly mapping programme to detail impact of spread / control of *Casuarina equisetifolia* and *Scaevola sericea*. | DoE | | 2015 | 1,2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Establish international links with conservation managers and agencies experienced in the control of *invasive coastal plants.* | DoE | IntC | 2008 | 3 |
| **CP2.** Report on the effectiveness of control attempts, to benefit international management efforts for the control of *invasive coastal plants.* | DoE | IntC | 2015 | 3 |
| **CP3.** Raise public awareness of the impact of *invasive coastal plants*, and the value of native landscaping. | DoE | CIG MP NT | 2010 | 3 |
| **CP4.** Utilise local preservation and conservation action to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |
| **CP5.** Organise educational *invasive coastal plant* pulls for local schools and community groups. | DoE | DE MP | 2009 | 3 |

## COASTAL HABITATS

### *11. Coastal shrubland*

#### Definition

"Shrubland" is a class of vegetation dominated by flora which ranges in height between 0.5m and 5m. Shrubs tend to grow as separate individuals or clumps of individuals. In *shrubland*, the canopy cover of shrubs constitutes greater than 25% of the total canopy cover. Larger trees may be present in *shrubland;* however, tree canopy cover should constitute less than 25% of the total cover to distinguish the area from "woodland".

*Coastal shrubland,* along with *mangrove,* comprises the natural coastal vegetation of the Cayman Islands.

#### Local outline

*Coastal shrubland* incorporates a diversity of vegetation types and forms, each specifically adapted to the sharp ecological gradients exhibited in the coastal environment. Tolerance to wind-exposure, salt-spray, fluctuating salinity, rapid drainage, and shifting substrates are typical adaptations of *coastal shrubland* plants and trees. In many cases, the physical form of *coastal shrubland* is indicative of the severity of the prevailing environment. The seaward extent of the natural permanent vegetation line indicates the immediate extent of damaging tidal inundation and storm surge. Structural stunting, prostrate habitat and canopy sculpturing are indicative of regular exposure to high winds.

At the seaward extent, herbaceous vegetation such as Lavender *Argusia gnaphalodes*, *Rhachicallis americana* and *Suriana maritima* (both commonly named "Juniper"), and Bay vine *Ipomoea pes-caprae* predominate in a narrow band ahead of the permanent vegetation line. Invasive species such as *Scaevola sericea* complete with these local species, and the rare local Inkberry *Scaevola plumieri*.

In rocky exposed places, the permanent vegetation line adopts a sparse and gentle gradation into dwarf shrubland: the dwarfed and prostrate forms often belying the age of individual specimens. In less extreme environments, the herbaceous fringe quickly gives way to species-diverse shrubland including Sea grape *Coccoloba uvifera*, Broadleaf *Cordia sebestena caymanensis* and Silver Thatch palm *Coccothrinax proctorii*. Exotic species such as the Coconut *Cocos nucifera* and invasive species, such as Weeping willow *Casuarina equisetifolia* are almost ubiquitous.

#### Key Habitat Categories for *Coastal shrubland*

Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Hemi-sclerophyllous evergreen shrubland III.A.1.N.b
- Sclerophyllous evergreen shrubland III.A.1.N.c
- Mixed evergreen: drought-deciduous dwarf-shrubland IV.C.1.N.a.
- Low tropical / subtropical perennial forb vegetation V.B.1.N.b

#### Key Species for *Coastal shrubland*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for COASTAL SHRUBLAND | | | |
|---|---|---|---|
| PART 1 | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Greater Antillean grackle | Aves<br><br>*Quiscalus niger caymanensis / bangsi* | |

| | | | |
|---|---|---|---|
| Reptiles | Grand Cayman Blue iguana | *Cyclura lewisi* | SAP |
| Reptiles | Sister Islands Rock iguana | *Cyclura nubila caymanensis* | SAP |
| Invertebrates | Cayman Lucas' Blue butterfly | *Cyclargus ammon erembis* | |
| Plants | | *Chamaesyce bruntii* | |
| Plants | Tea banker | *Pectis caymanensis var. robusta* | SAP |
| Plants | Cayman sage | *Salvia caymanensis* | SAP |
| **PART 2** | | | |
| Reptiles | Lesser Cayman Islands Curly-tailed lizard | *Leiocephalus carinatus granti* | |
| Reptiles | Grand Cayman Curly-tailed lizard | *Leiocephalus carinatus varius* | |
| Reptiles | Grand Cayman Ground boa (Lazy snake) | *Tropidophis caymanensis caymanensis* | |
| Reptiles | Little Cayman Ground boa (Wood snake) | *Tropidophis caymanensis parkeri* | |
| Reptiles | Cayman Brac Ground boa (Lazy snake) | *Tropidophis caymanensis schwartzi* | |
| Reptiles | Cayman Brac Ground gecko | *Sphaerodactylus argivus argivus* | |
| Reptiles | Little Cayman Ground gecko | *Sphaerodactylus argivus bartschi* | |
| Reptiles | Grand Cayman Ground gecko | *Sphaerodactylus argivus lewisi* | |
| Reptiles | Cayman Brac Blind snake | *Typhlops biminiensis epactia* | |
| Reptiles | Grand Cayman Blind snake | *Typhlops caymanensis* | |
| Reptiles | Bush Lizard, Cayman Brac Brown anole | *Anolis sagrei luteosignifer* | |
| Invertebrates | Scorpion | *Heteronebo caymanensis* | |
| Invertebrates | Soldier crab (Hermit crab) | *Coenobita clypeatus* | |
| Invertebrates | Centipede | *Leptophilus caribeanus* | |
| Invertebrates | | *Cerion martinianum* | |
| Invertebrates | | *Cerion pannosum* | |
| Plants | Cocoplum | *Chrysobalanus icaco* | SAP |
| Plants | Silver Thatch palm | *Coccothrinax proctorii* | SAP |
| Plants | Broadleaf | *Cordia sebestena caymanensis* | SAP |
| Plants | | *Iva imbricata* | |
| Plants | Washwood | *Jaquinia keyensis* | |
| Plants | Inkberry | *Scaevola plumieri* | SAP |
| Plants | Micar | *Sophora tomentosa* | |
| Plants | | *Turnera triglandulosa* | SAP |
| **INVASIVE** | | | |
| Plants | Weeping willow | *Casuarina equisetifolia* | HAP |
| Plants | Non-native Scaevola (Inkberry SAP) | *Scaevola sericea* | SAP |

## Current Status of *Coastal shrubland*

*Link to habitat map: Coastal shrubland Grand Cayman*
*Link to habitat map: Coastal shrubland Cayman Brac*
*Link to habitat map: Coastal shrubland Little Cayman*

| Habitat Status 2006 Coastal shrubland | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Sea grape hedge | 266.46 | 448.92 | 401.54 | 0.03 | 0.13 | 0.06 | 266.43 | 448.79 | 401.48 | 0.01 | 0.03 | 0.01 |
| Dwarf vegetation and vines | 26.57 | 45.03 | 0.00 | 0.00 | 0.10 | x | 26.57 | 44.93 | x | 0.00 | 0.22 | x |
| Coastal sparsely vegetated rock | 0.00 | 7.15 | 0.64 | x | 0.00 | 0.06 | x | 7.15 | 0.58 | x | 0.00 | 9.38 |
| **TOTAL** | **293.03** | **501.10** | **402.18** | **0.03** | **0.23** | **0.12** | **293.00** | **500.87** | **402.06** | **0.01** | **0.05** | **0.03** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little

Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

### Key Sites for *Coastal shrubland*

| | |
|---|---|
| GRAND CAYMAN: | Barkers |
| | North Side |
| | Heritage Beach |
| | Spotters Bay – site cleared for development, 2008. |
| CAYMAN BRAC: | Spot Bay |
| LITTLE CAYMAN: | Point of Sand (includes the only remaining intact native Inkberry hedge) |
| | South coast east of Tarpon Lake (fragmented areas of pristine shrubland, including locally rare species such as *Remirea maritima*). |

| **Protected areas containing *coastal shrubland*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| Heritage Beach – a recreational area incorporating some coastal shrubland | 0.85 | Grand Cayman | NT |
| *Barkers* - subject of current purchase effort by CIG, towards establishment of a National Park – would represent the Cayman Islands' most significant stretch of protected *coastal shrubland*. Currently Barkers remains unprotected, and so does not contribute towards protected areas statistics. | 94.95 to-date | Grand Cayman | CIG |

### Nature Conservation Importance of *Coastal shrubland*

- *Biodiversity:* ecological gradients are typically sharp between the seaward pioneering edge of herbaceous coastal vegetation, the permanent vegetation line and comparatively sheltered areas slightly further inland. As a result, *coastal shrubland* generally comprises a diversity of species and forms within a relatively narrow band along the coastline.
- *Reptile habitat:* the combination of an open canopy facilitating light penetration for basking, and ready availability of unconsolidated substrate for burrowing and nesting contribute to *coastal shrubland* representing highly-significant habitat for many species of reptiles. Fossil records indicate that the Grand Cayman Blue iguana *Cyclura lewisi* was once common in this habitat. The current population centre in the East-End shrublands appears very much to constitute a remnant of the original population distribution. The Sister Islands Rock iguana *Cyclura nubila caymanensis* similarly utilizes coastal areas, especially for nesting. *Coastal shrubland* additionally supports several smaller species endemic lizards and snakes; including the Lazy snake *Tropidophis caymanensis* and Curly-tailed lizard *Leiocephalus carinatus*.
- *Beach stabilization:* deep-rooting native species such as Sea grape *Coccoloba uvifera* effectively consolidate the beach ridge.
- *Turtle nesting:* remnant turtle populations actively select areas along the natural vegetation line as preferred nest sites. Disruption of the structural integrity, form, and function of the natural vegetation line, whether as a result of development or ingress of invasive species, promotes nesting in sub-optimal sites.

*Other factors:*

- *Hedonic value:* the natural environment is the centre of the Cayman Islands' tourism product. The verdancy afforded by *coastal shrubland* is integral to both the landscape and seascapes of the Islands, and contributes disproportionately to the natural aesthetic of the Islands. Inappropriate development of the narrow band of *coastal shrubland* may thus be expected to have a very significant impact on the perception of the Cayman Islands as to being a "spoilt" or an "unspoilt" destination for holiday makers.

- *Recreation: sandy beach* is a primary recreational resource in the Cayman Islands. Given the intensity of the sun, many visitors to beaches generally seek shade for all or part of their visit. With appropriate management, *coastal shrubland* species such as Sea grape *Coccoloba uvifera* can provide excellent permanent shade, as evidenced, for example at Cemetery Beach, however, in most areas, whole-scale clearance of *coastal scrubland* has resulted in a reliance on artificial shading, such as beach umbrellas and marquees. The shade afforded by *coastal shrubland* contributes to its being a preferred venue for traditional Easter camping events enjoyed by local residents.

### Current Factors Affecting the Habitat of *Coastal shrubland*

- *Invasive species:* particularly Weeping willow *Casuarina equisetifolia* and Beach naupaka *Scaevola sericea* establish and spread to the detriment of *coastal shrubland*, impacting native flora and the wildlife which depend on its inherent diversity of species and structural diversity for habitat.
- *Sand mining:* planning legislation enacted to protect the rights of local residents to take sand for maintenance of traditional sand gardens has recently come under recurrent abuse from building contractors, who illegally remove beach sand for commercial construction projects. Sand mining undermines *coastal shrubland*, promoting localized erosion, and compromising the integrity of the beach ridge and its associated capacity to function as a buffer during storm events.
- *Planning:* inappropriate planning set-backs have established a precedent for construction on the beach side of circum-island roadways, heavy impacting the narrow band of *coastal shrubland*. Once a common property and asset to all residents of the Cayman Islands, the aesthetic value of a sea-view is now enjoyed by very few. During storm events, lack of appropriate vegetation buffer to stabilize the dynamic portions of the beach ridge contributes to many beachside developments suffering extensive damage. With property owners not responsible for restoring the appearance of damaged property, unsightly ruins and rubble may remain indefinitely.
- *Shifting baseline: coastal shrubland* is now nonexistent along significant stretches of the coastline of Grand Cayman. In many places, native species are completely absent, replaced by residential development, exotic landscaping and invasive species, such as Weeping willow. Now established for more than one generation, the current *status quo* will be set as the "natural" baseline for the current generation.
- *Non-native landscaping:* for the most part, *coastal shrubland* occupies prime realty sites. This has contributed to the development of much of this habitat by the tourism industry, and affluent residential community. Maintained greenspace within such developments generally comprises wholly exotic species, with little or no value for local wildlife.
- *Lack of public education:* The popularity of exotic plants is generally accompanied by a disregard for native flora. A common belief that Weeping willow actively contributes to beach stability has resulted in the active planting of Weeping willow on beaches after storms, in a misguided effort to restore beach integrity.
- *Financial:* coastal land, especially that associated with *sandy beaches*, constitutes the most expensive real estate in the Cayman Islands. Attempts to establish protected areas containing significant tracks of *coastal shrubland* will probably prove financially prohibitive. Establishment of ecologically viable preserves will, as a result, likely depend upon a complimentary multiple-use capacity for the site, such as the proposed Barkers National Park. Lower coastal land prices in Cayman Brac and Little Cayman may mean that limited funds might be more effectively spent in preserving significant tracks of *coastal shrubland* outwith Grand Cayman.

### Opportunities and Current Local Action for *Coastal shrubland*

- The *Native Tree Nursery* aims to provide a source of *coastal shrubland* trees, grown from locally collected seed, with particular attention to those of particular rarity, endemic status and ecological value, towards reintroducing key species, maintaining the ecological value of the built environment, and preserving wildlife corridors.

- Land purchased by the Crown towards establishing the proposed Barkers National Park currently extends to 95 acres (Jan 2009), and incorporates a significant area of *coastal shrubland*. Establishment of Barkers as a protected area would represent the first significant area of *coastal shrubland* to be protected in the Cayman Islands.

### LOCAL HABITAT ACTION PLAN for *Coastal shrubland*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *coastal shrubland*. | 2008 |
| **2.** Maintain *coastal shrubland* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *coastal shrubland*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect 10% of currently remaining *coastal shrubland* habitat in the Cayman Islands. | 2015 |

| Coastal shrubland<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Commence active enforcement of provisions of the National Conservation Law, *Section 29*, against deliberate importation or release of invasive species. | DoE<br>DoA<br>HMC | CIG | 2008 | 2,3 |
| **PL4.** Commence active enforcement of provisions of *Endangered Species Trade and Transport Law*, with the addition of alien invasive plants, in particular *Casuarina equisetifolia* and *Scaevola sericea* to Part 3, and implement an immediate importation ban. | DoE<br>DoA<br>HMC | CIG | 2009 | 2,3 |
| **PL5.** Application and enforcement of the National Conservation Law, *Section 29* when *Casuarina equisetifolia* or *Scaevola sericea* are deliberately planted | DoE | CIG | 2008 | 3 |
| **PL6.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL7.** Enforcement of provisions under the National Conservation Law to support Planning Legislation, and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 3 |
| **PL8.** Promote change to the Land Surveyors Law and Planning legislation, to incorporate the natural vegetation line into coastal set-back. | DoE | DoP LS<br>CIG | 2003 | 2,3 |
| **PL9.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for coastal management to discourage damage or disturbance to *coastal shrubland*. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3,4 |
| **PL10.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3,4 |
| **PL11.** Continue and improve implementation of international conventions, agreements and declarations to | DoE | CIG | ongoing | 2,4 |

| | | | | |
|---|---|---|---|---|
| which the Cayman Islands is committed. | | | | |
| **PL12.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 2,3 |
| **PL13.** Work with Department of Planning to maintain natural vegetation seaward of building set-backs for new developments, and discourage artificial beach extension inland, or "gardening" of *coastal shrubland*. | DoE | DoP<br>CPA<br>DCB | 2012 | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards protecting 10% of currently remaining *coastal shrubland* with particular attention to traditional public areas in the Cayman Islands. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM2.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards protecting *coastal shrubland* on the south coast of Little Cayman (west of the airstrip), identified as a communal nesting ground for *Cyclura nubila caymanensis*: (78A 42 2.57ac, with adjacent parcels 78A43 1.26ac and 78A41 1.48ac) and establish associated Crown land to the north (77A3 22.8ac), as a protected area. | CC | DoE NT<br>MP CIG | 2010 | 2,4 |
| **SM3.** Provide *coastal shrubland* species for landscaping and restoration from the *Native Tree Nursery.* | QEIIBP | DoE | 2008 | 3 |
| **SM4.** Given the limited potential to establish significant *coastal shrubland* preserves, any established areas should be subject to effective restoration, and rigorous management of invasive species as necessary. | DoE | CC CIG | 2015 | 3 |
| **SM5.** Develop a Management Plan for Barkers National Park, which incorporates and promotes compatible multi-use recreational activities, such as camping, for associated *coastal shrubland*. | DoE | CC CIG | 2015 | 3 |
| **SM6.** Implement active control of invasive fauna, including feral cats, dogs and Green iguanas in protected areas, towards maintaining native wildlife, particularly native lizards and birds. | DoE | DoA<br>DEH | 2010 | 3 |
| **SM7.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of *coastal shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *coastal shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A3.** Promote retention / planting of native vegetation equal to 20% of the total parcel area in planning applications (exceeding one acre) sited in areas of *coastal shrubland.* | DoE | DoP | ongoing | 2,3 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4 |
| **A5.** Work with Department of Planning and local developers to encourage retention of native *coastal* | DoE | DoP MP | 2009 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| *shrubland* as low-maintenance high-aesthetic value elements of developed landscapes. | | | | |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *coastal shrubland* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *coastal shrubland* in the Cayman Islands, incorporating pristine nature, ecological value, presence of key species, financial cost and multi-purpose capacity, such as camping and other traditional recreational uses. | DoE | NT MP | 2009 | 1,3 |
| **RM3.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM4.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM5.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM6.** Establish the Historic Vegetation Line using suitable archived aerial photography as the benchmark for determining set-backs on all beaches. | LS | DoE | ongoing | 1 |
| **RM7.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **Communication & Publicity** | | | | |
| **CP1.** Promote *coastal shrubland* as a valuable feature of the natural environment of the Cayman Islands. | DoE NT | DoT CIG | ongoing | 3 |
| **CP2.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG<br>NT MP<br>HS<br>QEIIBP | ongoing | 3 |
| **CP3.** Construct and man an interpretation centre at the Barkers National Park, to develop tourism capacity, and raise awareness of the value of *coastal shrubland* in visitors and residents. | DoE | CIG | 2015 | 3 |
| **CP4.** Raise awareness of the need for effective planning regulations for the preservation of *coastal shrubland.* | DoE | DoP CIG | 2009 | 3 |
| **CP5.** Promote landscaping with native trees typical of *coastal shrubland.* | DoE | QEIIBP<br>NT | | 3 |
| **CP6.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG<br>NT MP | 2006 | 3 |

**REFERENCES and FURTHER READING for *Coastal shrubland***

## TERRESTRIAL HABITATS

### *12. Salt-tolerant succulents*

#### Definition

*Salt-tolerant succulent* habitats are areas of succulent-dominated forb vegetation (non-woody plants other than a grasses, sedges and rushes) influenced by regimes typically of high salt and temporary or occasional water immersion. In coastal areas, this may include tidal areas, or those influenced by the tide. Further inland, this habitat forms in association with temporarily flooded pastures, and moderately elevated rocky cays, often at the edges of wetlands and *mangroves*.

#### Local outline

In the Cayman Islands, *salt-tolerant succulents* are dominated by succulent vegetation, specifically *Sesuvium portulacastrum* and *Salicornia virginica*, which attracts a number of butterflies.

The vegetation formation of *tidal tropical or subtropical annual forb vegetation* is known from only one location in the Cayman Islands: a land-locked wetland, tidally flooded by seawater percolating through underground fissures, in the area of Preston Bay, Little Cayman, supporting a unique, almost monospecific, stand of *Salicornia bigelovii*.

#### Key Habitat Categories for *Salt-tolerant succulents*

Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Tidally flooded perennial forb vegetation V.B.1.N.e
- Tidal tropical or subtropical annual forb vegetation V.D.1.N.d.

#### Key Species for *Salt-tolerant succulents*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for SALT-TOLERANT SUCCULENTS | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>West Indian Whistling-duck | Aves<br><br>*Dendrocygna arborea* | <br><br>SAP |
| Invertebrates | Pygmy Blue butterfly | *Brephidium exilis thompsoni* | SAP |
| **PART 2** | | | |
| Plants | Black mangrove | *Avicennia germinans (= nitida)* | |
| Plants | Glassworts | Salicornia species | |

#### Current Status of *Salt-tolerant succulents*

*Link to habitat map: Salt-tolerant succulents Grand Cayman*
*Link to habitat map: Salt-tolerant succulents Cayman Brac*
*Link to habitat map: Salt-tolerant succulents Little Cayman*

| Habitat Status 2006 Salt-tolerant succulents | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Tidal tropical or subtropical annual forb vegetation V.D.1.N.d. | 0.0 | 0.0 | 0.6 | x | x | 0.0 | x | x | 0.6 | x | x | 0.0 |
| Salt-tolerant succulents | 33.6 | 0.0 | 0.0 | 0.0 | x | x | 33.6 | x | x | 0.0 | x | x |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL | 33.6 | 0.0 | 0.6 | 0.0 | x | 0.0 | 33.6 | x | 0.6 | 0.0 | x | 0.0 |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

### Key Sites for *Salt-tolerant succulents*

GRAND CAYMAN: Barkers
Salt Creek
Meagre Bay Pond / Midland Acres wetlands
Bowse Land, North Side
LITTLE CAYMAN: Preston Bay

*Salt-tolerant succulents* are currently critically under-represented within the protected areas of the Cayman Islands.

No significant *salt-tolerant succulents* are currently represented in the protected areas of the Cayman Islands.

### Nature Conservation Importance of *Salt-tolerant succulents*

- *Biodiversity: salt-tolerant succulents* support a number of unique species, and often occurs in association with a mosaic wetland habitat. Mosaic wetlands support a high diversity of wildlife, including birds, especially resident and migratory waders and waterfowl.
- *Restricted range: salt-tolerant succulents* are generally patchy and occupies an extremely restricted area. Many are only a few meters square, making them vulnerable to localized disturbance.
- *Butterflies: salt-tolerant succulents* support several species of butterflies, most notable of which is the endemic subspecies, the Cayman Pygmy Blue butterfly *Brephidium exilis thompsoni*. This tiny butterfly is the smallest in the Western hemisphere – possibly in the world. It is highly dependent on *salt-tolerant succulents* at all stages of its life-cycle. In its larva form, the caterpillars feed on *Salicornia perennis*. Adults depend on *Sesuvium portulacastrum* for nectar.

*Other:*

- *Cultural identity:* the lack of species of traditional use and cultural significance contributes to an general undervaluing of *salt-tolerant succulents*, and their underrepresentation in protected areas.
- *Hedonic value:* occupying low-lying, swampy ground, areas supporting *salt-tolerant succulents* would generally be regarded as low-value land.
- *Nature tourism:* mosaic wetland, in its natural form, constitutes an attractive and varied environment, supporting a variety of species of interest, especially birds. Properly managed, mosaic wetland areas have significant nature tourism potential (though care must be taken to avoid trampling damage to the vegetation, by use of board walks or other defined access management).

### Current Factors Affecting *Salt-tolerant succulents*

- *Restricted habitat*: in the Cayman Islands, *salt-tolerant succulents* tend to be highly restricted in area. Generally occupying dry cays within a wetland habitat mosaic, areas of *salt-tolerant succulents* often occupy only a few square meters, making this habitat sensitive to even the most localized perturbation.
- *Development:* many wetland areas have been subjected to extensive development, whether in the form of quarrying, or canalisation and filling. As a result, many surviving *salt-tolerant succulents* exist in close proximity to developed areas.

- *Obscure nature:* the limited size and diminutive species associated with *salt-tolerant succulents* contribute to many members of the public being unaware of their presence, and value to local biodiversity.
- *Sensitivity to visitation: salt-tolerant succulents* are highly sensitive to crushing by feet of pedestrians, and by vehicle tyres. Because salt marsh flora grows in a highly stressed environment, recovery rates can be slow. Any increase in human activity in these areas needs to be managed to limit such damage.

### Opportunities and Current Local Action for *Salt-tolerant succulents*

- Given the small area occupied by *salt-tolerant succulents* in the Cayman Islands, and its low-lying nature contributing to a low market value, purchase and protection of significant representative habitat should not be financially prohibitive. However, due to their sensitivity and dependence on specific hydrological settings, any adjacent developments which altered the hydrological regime might severely impact dependent species. As such, *salt-tolerant succulents* existing adjacent protected areas, or those existing within developed areas might represent the best candidates for effective protection.
- Given the close association of remnant *salt-tolerant succulents* and quarry developments, there may be potential for the modification and management of marl pit surrounds to encourage habitat restoration, and improve biodiversity value, subject to maintenance of a suitably salty surface soil regime.
- A significant area of *salt-tolerant succulents*, incorporating a resident population of Cayman Pygmy Blue butterflies, is present to the south of Palmetto Pond in the Barkers area. Though not currently protected, this site falls within the area designated to be established as the Barkers National Park.

### HABITAT ACTION PLAN for *Salt-tolerant succulents*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *salt-tolerant succulents*. | 2008 |
| **2.** Maintain *salt-tolerant succulents* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *salt-tolerant succulents*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** No net loss of *salt-tolerant succulents* habitat. | 2015 |

| Salt-tolerant succulents PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3 |
| **PL3.** No net loss of *salt-tolerant succulents* habitat. | DoE | CIG | 2008 | 2,3,4 |
| **PL4.** Commence prosecution for offences involving damage to existing Animal Sanctuaries and Ramsar sites, and update and upgrade penalties for transgression of associated regulations. | DoE | CIG | 2009 | 2,4 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL6.** Strengthen the *Development Plan* on Grand | DoP | CIG MP | ongoing | 2,3,4,5 |

| | | | | |
|---|---|---|---|---|
| Cayman, and develop and implement guidelines to discourage damage or disturbance to *salt-tolerant succulents.* | CPA | DoE | | |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3,4,5 |
| **PL8.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,4 |
| **PL9.** Work with *Department of Planning* to promote and formalize guidelines for the establishment of an escrow fund to cover the costs of site restoration, for all new quarry applications. | DoE | DoP CPA DCB | 2012 | 3 |
| **PL10.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP CPA DCB | 2012 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect priority *salt-tolerant succulents* areas in the Cayman Islands. | CC | DoE NT MP CIG | 2012 | 2,4 |
| **SM2.** Purchase and protect *Salt-tolerant succulents* areas in Barkers, and manage access on site, towards maximising visitor experience / minimising impact. | CC | DoE NT CIG | 2012 | 2,3,4 |
| **SM3.** Use the *Environmental Protection Fund* to extend Meagre Bay Pond Animal Sanctuary, to incorporate areas of *salt-tolerant succulents* along the eastern shore, and prevent dumping in this area. | CC | DoE NT CIG | 2012 | 2,3,4 |
| **SM4.** Establish experimental site for the design and testing of techniques to restore artificial *salt-tolerant succulents,* and determine the feasibility of a restoration programme. | DoE | IntC | 2012 | 3,4 |
| **SM5.** Subject to successful conclusion of RM3, embark upon a programme of restoration of *salt-tolerant succulents* habitat to suitable man-modified areas. | DoE | | 2015 | 3,4 |
| **SM6.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation of and natural function of *salt-tolerant succulents.* | DoE | DoP CPA DCB | ongoing | 2,3,4 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *salt-tolerant succulents.* | DoE | DoP CPA DCB | ongoing | 2,3,4 |
| **A3.** Subject to CP2, promote adherence to *salt-tolerant succulents* guidelines in relevant planning applications. | DoE | NT | | 2,3,4 |
| **A4.** Work with *Department of Planning* to formalize an optimal structure of marl-pits, and restoration protocol for quarry applications, incorporating *salt-tolerant succulents* guidelines where appropriate, and promote establishment of an escrow fund to cover the costs of close-plans prior to agreement of new excavations. | DoE | DoP CPA | | 2,3,4 |
| **A5.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & | DoE | CIG NT | 2006 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| Transport) Law. | | | | |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *salt-tolerant succulents* areas in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas for *salt-tolerant succulents* in the Cayman Islands. | DoE | NT | 2009 | 1 |
| **RM3.** Instigate the design and testing of experimental techniques to establish and restore *salt-tolerant succulents* areas, including seed collection, propagation and planting, and the ecology of key fauna, such as *Brephidium exilis*, to determine the feasibility and factors affecting potential restoration programmes. | DoE | | 2012 | 3,4 |
| **RM4.** Subject to successful conclusion of RM3, investigate potential for disused marl-pits in key areas to be acquired by the Crown, for restoration of *salt-tolerant succulents*, and development as managed public recreational amenities and wildlife preserves. | CC | DoE CIG NT | 2015 | 3,4 |
| **RM5.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM6.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM7.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Subject to successful conclusion of RM3, increase public awareness by enabling managed access to the *salt-tolerant succulents* test site for educational purposes. | DoE | MP | 2015 | 3 |
| **CP2.** Subject to successful conclusion of RM3, publish guidelines for restoration of degraded *salt-tolerant succulents* as an educational document for land owners / developers. | DoE | MP | 2015 | 3 |
| **CP3.** Develop and emplace interpretation for *salt-tolerant succulents* in Barkers area, towards maximising visitor experience / minimising impact. | DoE | | 2012 | 3 |
| **CP4.** Raise public awareness of *salt-tolerant succulents* using *Brephidium exilis* as a flagship species. | DoE | NT CN | 2012 | 3 |
| **CP5.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |

## TERRESTRIAL HABITATS

### *13. Pools, ponds and mangrove lagoons*

#### Definition

"Fresh" water is defined as water with less than one part per thousand dissolved salts, (USGS guidelines). Seawater contains about 35 parts per thousand. "Brackish" water generally falls between the two. The salinity of *pools, ponds and mangrove lagoons* generally decreases with heavy rain, and increases due to evaporation. Some become hypersaline, (saltier than seawater), especially during the dry season.

*"Pools, ponds and mangrove lagoons"* incorporates permanent and temporary features, and includes man-modified areas, such as flooded marl pits and dykes. Temporary features may form in response to single rain events, and last only for a few hours or days. Even permanent water features are generally highly seasonal in extent, according to depth.

Natural freshwater pools are a rarity in the Cayman Islands, and of key conservation interest. With appropriate management, the ecological value of man-modified water features can be greatly increased.

#### Local outline

Freshwater ponds and pools are rare in the Cayman Islands. In most cases, pools with a high freshwater content are fringed by semi-permanently flooded grasslands dominated by Bullrush (Typha) *Typha domingensis*. Due to the porous nature of the limestone rock from which the Islands are formed, rainwater quickly drains from the surface, with little opportunity to pool. Freshwater is less dense than brackish water and brine, and, in the absence of physical mixing, freshwater tends to float on top of saltwater. Once below ground, however, rainwater percolates downwards through the rock until it reaches the water table. Here it has a tendency to spread outwards, under the effect of gravity; until, typically, it eventually leeches out into the ocean. In some areas, where erosional fissures in the rock facilitate the ready passage of large volumes of water, freshwater may emerge as springs up welling from the seabed. When in full flow, potable water may be draw from the sea in these areas.

In extensive areas of dry uplands, and in areas where the lateral movement of freshwater is interrupted by impermeable elements in the rock (such as ironpan formation), freshwater builds up, amassing as a subterranean fresh-water lens, often perched atop more saline water below. As a result, in the Cayman Islands, freshwater ponds and pools occur only where surface run-off of rainwater is immediately interrupted by impermeable elements in the rock, or where the ground level drops sufficiently to expose the surface of the freshwater lens. Many inland pools remain under the influence of the tide, by virtue of underground aquifers, resulting in pool waters rising and falling in delayed tandem with tidal levels.

Rather like human beings, most animals and plants are highly sensitive to salinity gradients. Many species are unable to tolerate even modest fluctuations in the salinity of the water which they drink, or in which they live. For this reason, freshwater ponds and pools offer an important source of drinking water to many species, especially birdlife, and support a variety of plants and animals which are not found elsewhere.

The majority of pools and ponds in the Cayman Islands are salty to some extent - ranging from brackish to saline and hypersaline. Due to the tendency for freshwater to float on top of saltwater, the surface waters of undisturbed pools and ponds are generally fresher during the rainy season, with deeper waters generally more brackish. This vertical salinity gradient is termed a *halocline*.

Pools and ponds are abundant in mangrove and Buttonwood wetlands. Small seasonally and tidally flooded *mangrove pools* may arise from the uprooting of Black Mangrove *Avicennia germinans* during hurricanes. They are often isolated from the underlying water table and subject to seasonal flooding and evaporation cycles. Larger permanently or near-permanently flooded *mangrove ponds* are also to be found within both mangrove and Buttonwood forests and shrublands. These may similarly occur in both seasonally and tidally flooded settings, with salinity ranging from hypersaline to lightly brackish according to setting and seasonal rainfall. Mangrove pools and ponds provide habitat for native fish and invertebrates, such as Fiddler Crabs

*Uca speciosa*, and so represent a major food resource for resident and migratory birds, particularly herons and egrets. They also support a large population of Hickatees *Trachemys decussata*.

Large *mangrove lagoons* occur in coastal settings on all three Cayman Islands, separated from the sea by beach ridges. These features are formed by hurricane storm surges and floodwater drowning mangroves, resulting in the death of trees and their replacement by standing water. Mangrove lagoons are typically saline or brackish, with salinity varying seasonally, and peaking during the dry season. *Mangrove lagoons* generally exhibit some weak tidal influence through a connection to groundwater tides. *Mangrove lagoons* are biologically productive, and attract large flocks of waders, shorebirds, herons and egrets – and most notably in Little Cayman, the Booby Pond provides security for the Caribbean's largest breeding colony of Red-footed Boobies *Sula sula*. Several *mangrove lagoons* have been designated Animal Sanctuaries, in recognition of their importance to bird life.

### Key Habitat Categories for *Pools, ponds and mangrove lagoons*

- Semi-permanently flooded grasslands V.A.1.N.h.
- Aquatic vegetation V.C.1.N.a.
- Mangrove pools and ponds
- Mangrove lagoons
- Flooded marl pits

### Key Species for *Pools, ponds and mangrove lagoons*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for POOLS, PONDS AND MANGROVE LAGOONS | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Herons, egrets, waterfowl<br>West Indian Whistling-duck<br>Antillean nighthawk (Rickery-dick) | Aves<br><br><br><br>*Dendrocygna arborea*<br>*Chordeiles gundlachii* | <br><br><br><br>SAP |
| Invertebrates | Pygmy Blue butterfly | *Brephidium exilis thompsoni* | SAP |
| **PART 2** | | | |
| Birds | Blue-winged teal | *Anas discors* | |
| Reptiles | Hickatee (Taco River slider) | *Trachemys decussata angusta* | |
| Reptiles | Grand Cayman Water snake | *Tretanorhinus variabilis lewisi* | |
| Fish | Mosquito fish | *Gambusia xanthosoma* | SAP |
| Fish | Mosquito fish | *Limia caymanensis* | SAP |
| Invertebrates | Isopod | *Anopsilana crenata* | |
| Plants | | *Ruppia maritima* | |
| **INVASIVE** | | | |
| Reptiles | Red-eared slider | *Trachemys scripta* | |
| Plants | Water Snowflake | *Nymphoides indica* | |

### Current Status of *Pools, ponds and mangrove lagoons*

*Link to habitat map: Pools, ponds and mangrove lagoons Grand Cayman*
*Link to habitat map: Pools, ponds and mangrove lagoons Cayman Brac*
*Link to habitat map: Pools, ponds and mangrove lagoons Little Cayman*

| Habitat Status 2006 Pools, ponds and mangrove lagoons | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| **Vegetated** | | | | | | | | | | | | |
| Semi-permanently flooded grasslands V.A.1.N.h | 110.71 | 0.17 | 2.06 | 0.08 | 0.00 | 0.00 | 110.63 | 0.17 | 2.06 | 0.07 | 0.00 | 0.00 |
| Tidal tropical or subtropical annual forb vegetation V.D.1.N.d | 0.00 | 0.00 | 0.60 | x | x | 0.00 | x | x | 0.6 | x | x | 0.00 |
| **Open water** | | | | | | | | | | | | |
| Flooded marl pits | 361.36 | 0.00 | 0.00 | 0.00 | x | x | 361.36 | x | x | 0.00 | x | x |
| Pools, ponds and mangrove lagoons – seasonally variable (exceeding 0.25 ac) * | 837.39 | 51.17 | 241.51 | 146.93 | 14.79 | 59.84 | 690.46 | 36.38 | 181.67 | 17.55 | 28.90 | 24.78 |
| **TOTAL** | **1309.46** | **51.34** | **244.17** | **147.01** | **14.79** | **59.84** | **1162.45** | **36.55** | **184.33** | **11.23** | **28.81** | **24.51** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

* in the estimation of the total area of *pools, ponds and mangrove lagoons*, only pools greater than 0.25 acres were incorporated towards reducing variation associated with highly variable temporary pools.

## Key Sites for *Pools, ponds and mangrove lagoons*

GRAND CAYMAN: Governor Gore's Bird Sanctuary
Palmetto Pond
Malportas Pond
Meagre Bay Pond
Pease Bay Pond
Sea Pond
Vulgunners Pond
Colliers Pond

CAYMAN BRAC: The Splits
Heymann's Pond
Salt Water Pond (Dennis Point Pond)

LITTLE CAYMAN: Booby Pond
Tarpon Lake

| **Protected areas containing *pools, ponds and mangrove lagoons*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| *Barkers* - subject of current purchase effort by CIG, towards establishment of a National Park – would incorporate the large permanent "Sea Pond" and temporary "Palmetto Pond". Currently Barkers remains unprotected, and so does not contribute towards protected areas statistics. | 94.95 to-date | Grand Cayman | CIG |
| Governor Gore's Bird Sanctuary | 1.84 | Grand Cayman | NT |
| Colliers Pond Animal Sanctuary | 28.05 | Grand Cayman | CIG |
| Meagre Bay Pond Animal Sanctuary | 96.37 | Grand Cayman | CIG |
| Uncle Sammy's Pond | 3.28 | Grand Cayman | NT |

| | | | |
|---|---|---|---|
| Botanic Park – incorporating a small pond area | 61.18 | Grand Cayman | CIG / NT |
| Booby Pond Nature Reserve Animal Sanctuary and Ramsar Site – of which ca. 201.6 ac is mangrove lagoon and fringing vegetation | 457.2 | Little Cayman | NT |
| Saltwater Pond Animal Sanctuary | 15.56 | Cayman Brac | CIG |
| The Splits – dry shrubland incorporating small freshwater features | 17.76 | Cayman Brac | NT |

**Nature Conservation Importance of *Pools, ponds and mangrove lagoons***

- *Rarity:* the extreme rarity of freshwater ponds and pools in the natural complement of habitat types of the Cayman Islands probably means that the availability of freshwater has always been a limiting factor for the wildlife of the Islands. As such, any reduction in the existing complement of freshwater ponds and pools would be expected to have severe implications for the wildlife carrying capacity of the Islands.
- *Biodiversity:* freshwater ponds and pools represent oases of highly dependent biodiversity. In addition to aquatic flora and fish, ponds and pools are of particular value to a diversity of invertebrates, many of which are dependent on the availability of freshwater at specific stages in their lifecycle. Permanent freshwater ponds and pools provide the sole dependable source of water for the Island's resident and migratory birds. Freshwater is utilized by birds for drinking and bathing. Many waders, waterfowl, herons and egrets additionally depend on the fish and invertebrate stocks of *ponds, temporary pools and mangrove lagoons* as feeding habitat.
- *Migratory birdlife*: Migratory birds journey to overwinter in the Cayman Islands, mostly via the Eastern Seaboard and Atlantic Flyway routes. Numbers peak Oct-Mar; corresponding with the Islands' driest months. During this period, temporary sources of freshwater are rare or non-existent. This results in a disproportionate reliance on ponds and pools in our migratory bird population. Associated fish and invertebrates also provide a vital source of nourishment for large populations of migratory birds, particularly herons and egrets. In most cases, migratory birds using the Atlantic Flyway probably arrive in Cayman via Cuba. It is estimated that over 60 species annually cross the 150 miles from Florida to Cuba. About half remain there for the winter. Birds which fly on from Cuba will require either that they find suitable over-wintering habitat elsewhere in the Caribbean, or continue on, to South America. If the Cayman Islands is unable to provide adequate provisioning for migratory birds to remain over the winter months, or to replenish stocks sufficient for completion of their journey southward, it is likely that after visiting the Cayman Islands migratory birds will face the challenge of crossing 400 miles of unbroken ocean to the South American coast, lacking adequate provision.
- *Recovery potential:* given the transient nature of many ponds and pools, a large proportion of dependent species tend towards *r-selection* strategies. In ecological theory, *r-selected* species exhibit rapid onset of maturity and reproduction, and wide-spread dispersal ("r" referring to the growth rate of the population as the determining factor in the dynamics of the population). This means that, given appropriate baseline conditions and management, artificially created ponds and pools will have a tendency to rapidly accrue a natural complement of species. This makes ponds and pools a comparatively attractive candidate for restoration projects.

*Other:*

- *Nature tourism & recreation:* given their capacity to attract large numbers of birds, *pools, ponds and mangrove lagoons* are among the sites most valued by birdwatchers. *Governor Gore's Bird Sanctuary*, a small (1.84 acres) freshwater pool in the Spotts area has recorded over 60 species of birds, and incorporates a small hide and interpretative panels. The Booby Pond Nature Reserve on Little Cayman is a major tourism asset. A visitor centre operated by the National Trust provides viewing of the spectacularly large breeding colony of Red-footed boobies *Sula sula* and Magnificent frigatebirds *Fregata magnificens*.

- *Aesthetic value:* Pools, ponds and mangrove lagoons are an attractive feature which can be incorporated into landscaping designs, towards increasing the ecological value of the built environment.
- *Storm water management:* paradoxically, while the natural permeability of the bedrock of the Cayman Islands contributes to a paucity of freshwater ponds and pools established development practice in *urban areas* contributes to infilling of ponds and pools and a proliferation of impermeable surfaces, especially asphalt and concrete. The net effect of this form of development is the loss of natural ponds and pools and the encouragement of water pooling on artificial surfaces, especially roads. Water pooling reduces road longevity, driver's visibility, and contributes to traffic congestion. In many instances, this has necessitated artificial storm water management, such as deep wells. These techniques are expensive to employ, and are of questionable effectiveness given the relatively shallow water table on the majority of the Islands. There is evidence that urban wetlands absorb storm water more cheaply than artificial systems (Poole 1993).
- *Microclimate:* is a localized atmospheric zone where conditions differ from the surrounding area. Evaporation and transpiration associated with ponds and pools contribute to cooling in *urban areas,* and a reduction in urban "hot spots".
- *Wildlife corridors:* ecological isolation of ponds and pools contributes to a reduction in their value, especially with respect to species which depend on ponds and pools for a part of their life-cycle, and so are required to travel large distances to reach freshwater. This is especially significant where migratory corridors are bisected by *roads*.
- *Interruption of natural drainage:* disruption of natural drainage systems by *urban and suburban* construction has modified natural water courses on the islands, cutting-off water supply to some areas, and encouraging pooling of standing water in other areas, resulting in large-scale habitat modification, particularly in wetland areas.

### Current Factors Affecting *Pools, ponds and mangrove lagoons*

- *Quarrying:* low-lying areas are generally regarded as being of little value. This has encouraged the establishment of numerous quarries, both legal and illegal, in low-lying areas. Quarrying activity is generally governed by economic maximization, resulting in the formation of deep, sheer-sided excavations. Modifications which might maintain ecological value, such as shallow banks, sloped sides, and island features, are rarely incorporated into designs. There is generally no requirement for an exit or restoration strategy for quarry workings, and where there is a requirement, this is often not enforced.
- *Invasive species:* the Water Snowflake *Nymphoides indica*, has established in many ponds and pools, blanketing the water surface, reducing light availability and excluding the native Water Lily *Nymphaea ampla.*
- *Residential development:* the expansion of *urban areas* contributes to the filling of natural ponds and pools, or conversely, their extensive deepening as a source of fill. It is standard practice for the resultant deep, steep-sided excavations to be proposed as fulfilling the requirement for *"land for public purposes"* in associated planning applications. In fact, such excavations should be regarded as a public hazard. In addition to obvious issues associated with siting a deep, steep-sided water-filled hole in a residential area, lack of associated management provision, aeration facility, and likely nutrification from landscaping run-off and effluent leachate associated with residential development, promotes eutrophication of the system.
- *Lack of public education: Pools, ponds and mangrove lagoons* are commonly undervalued. There is some misunderstanding of the role of ponds and pools in storm-water management, with a perception that flooding is actually caused by ponds overflowing, rather than receiving and alleviating stormwater burden from the local area.
- *Eutrophication:* nutrification of ponds and pools originating from phosphate and nitrate rich run-off, and artificial stocking with fish in the absence of appropriate management contributes to eutrophication. Typically, algal blooms give rise to signatory bright green water, promoting anoxic conditions in the water column, resulting in fish-kill, bacterial proliferation, and foul odours. Once the ecological balance of a eutrophic system is established, reversion and recovery can be difficult.

- *Aeration:* lack of appropriate aeration of the water column, especially in artificially deepened and nutrient-loaded pools, contributes to poor aeration of the water column, resulting in anoxic conditions. This can lead to fish-kill, bacterial proliferation, and foul odours.
- *Pollution:* nutrients and chemical pollutants, especially oils, introduced through run-off can severely impact sensitive pondlife, especially when the filtration capacity of ponds and pools is reduced by the removal of buffer vegetation.
- *Climate change:* changes in rainfall patterns, severe storms and elevation of sea-level might be expected to impact ponds and pools. Modification of freshwater ponds and pools, especially, may also influence their ability to support migratory birdlife.
- *Local climate:* in the Cayman Islands, *pools, ponds and mangrove lagoons* are dependent on rainwater for maintenance of water-level. Rainfall patterns, particularly in Grand Cayman, are highly localized, with the Central Mangrove Wetland contributing an estimated 40% of the rainfall to western districts. As such, reduction in the extent of the Central Mangrove Wetland would be expected to contribute to a reduction in rainfall feeding freshwater ponds and pools in this area. Hurricanes are a major influence on vegetation surrounding mangrove lagoons. Storm surges and prolonged flooding promote expansion of the open water area at the expense of surrounding mangroves.
- *Buffer vegetation:* peripheral vegetation around *pools, ponds and mangrove lagoons* acts as a barrier to particulate matter, and a sink for nutrients, deterring clouding and nutrification.
- *Water abstraction:* water abstraction for non-potable supply, industry, and irrigation, either directly from standing *pools, ponds and mangrove lagoons*, or from aquifers, can depress water levels and exacerbate nutrient enrichment.
- *Introduction of fish:* Tilapia (a generic term covering ca. 70 species of cichlid fishes) are a common feature of *pools, ponds and mangrove lagoons* in the Cayman Islands. They can survive in both fresh and brackish water. Tilapia may be introduced by human action, or incidental introduction of spawn on the feet of wading birds. Most are omnivorous, feeding on aquatic vegetation and detritus. Their bottom-feeding activity can promote water turbidity, and accelerate the release of nutrients from sediments, exacerbating enrichment.
- *Buffer zone ownership:* Under the Animals Law, *pools, ponds and mangrove lagoons* which constitute Animal Sanctuaries incorporate a buffer zone of vegetation around the shoreline. In the cases of Meagre Bay Pond and Colliers Pond, these buffer zones extend to 300ft inland beyond the high-water line of the ponds. In the cases of the Booby Ponds, the buffer zone is more variable. While designated as protected, buffer zone land remains in private ownership, and has been subject to repeated instances of dumping and clearance in the past.

**Opportunities and Current Local Action for *Pools, ponds and mangrove lagoons***

- *The National Trust for the Cayman Islands* owns and protects the Booby Pond on Little Cayman, in association with land to the north, including the entire breeding colony of Red-footed Boobies and Frigatebirds. The site is a designated Animal Sanctuary, and the Cayman Islands' only Ramsar site.

- *The National Trust for the Cayman Islands* has recently expanded its *Governor Gore's Bird Sanctuary* to 1.84 acres. Restoration of the degraded land was commenced with the planting of trees from the *Native Tree Nursery.*

- *The National Trust for the Cayman Islands* has recently purchased *Sammy's Pond* in West Bay. This extensively man-modified site incorporates a freshwater pool. Modification of the site and stocking of the pool with Tilapia has contributed to unnatural nutrification and eutrophication of the pool. Large-scale fish death has occurred. The vegetation on site is almost entirely non-native. This site will require extensive management if its potential value for wildlife is to be realized.

- Meagre Bay Pond and Colliers Pond on Grand Cayman are protected as Animal Sanctuaries under the Animals Law. With passage of the National Conservation Law it may be possible to afford

stronger protection to these sites. Key mangrove lagoons on Little Cayman (especially Tarpon Lake) are owned by the Crown, and so may also be candidates for legal protection.

- There are a large number of flooded marl pits in Grand Cayman. With appropriate management, the aesthetic impact and ecological value of these sites could be significantly improved.

**HABITAT ACTION PLAN *for Pools, ponds and mangrove lagoons***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *pools, ponds and mangrove lagoons,* and determine salinity profiles. | 2008 |
| **2.** Maintain *pools, ponds and mangrove lagoons* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *pools, ponds and mangrove lagoons*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** No net loss of natural *pools, ponds and mangrove lagoons* habitat. | 2015 |
| **5.** Seek to increase *pools, ponds and mangrove lagoons* through incorporation of ecologically viable pools and ponds into storm water management plans for *roads* and *urban areas*. | 2015 |

| Pools, ponds and mangrove lagoons PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2,3 |
| **PL3.** No net loss of *Pools, ponds and mangrove lagoons* habitat. | DoE | CIG | 2008 | 2,3,4,5 |
| **PL4.** Commence prosecution for offences involving damage to existing Animal Sanctuaries and Ramsar sites, and associated buffer zones, and update and upgrade penalties for transgression of associated regulations. | DoE | CIG | 2009 | 2,4 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines for coastal management to discourage damage or disturbance to *Pools, ponds and mangrove lagoons*. | DoP CPA | CIG MP DoE | ongoing | 2,3,4,5 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3,4,5 |
| **PL8.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,4 |
| **PL9.** Work with *Department of Planning* to promote and formalize guidelines for the establishment of an escrow fund to cover the costs of site restoration, for all new quarry applications. | DoE | DoP CPA DCB CIG | 2012 | 3 |

| | | | | |
|---|---|---|---|---|
| **PL10.** Implement policy and develop mechanisms through the Land Registry to ensure that legal responsibility for the management of artificial water bodies created as a result of new developments remains with private landowners. | DoE LS DoP | CPA DCB CIG | 2012 | 3 |
| **PL11.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP CPA DCB | 2012 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of priority *pools, ponds and mangrove lagoons* in the Cayman Islands. | CC | DoE NT MP CIG | 2015 | 2,4 |
| **SM2.** Incorporate existing Animal Sanctuaries and additional Crown mangrove lagoons into a National System of Protected areas. | CC | DoE CIG | 2006 | 2 |
| **SM3.** Establish experimental site for the design and testing of techniques to restore artificial *pools, ponds and mangrove lagoons* and determine the feasibility of a restoration programme. | DoE | | 2012 | 3,4 |
| **SM4.** Subject to successful conclusion of SM3, embark upon a programme of nutrient control, biomanipulation, species reintroduction, and effective site management towards restoration of man-modified *pools, ponds and mangrove lagoons*, towards regeneration of degraded areas. | DoE | | 2015 | 3,4 |
| **SM5.** Improve visitor experience and reduce disturbance to protected *pools, ponds and mangrove lagoons* through effective interpretation, and management of access (including boardwalks, trails and hides for birdwatching). | DoE | NT | ongoing | 3 |
| **SM6.** Implement Management Plan for the Booby Pond Nature Reserve. | NT | DoE | ongoing | 3 |
| **SM7.** Investigate site clearance and developments adjacent the Booby Ponds, to determine impacts to the site, and undertake enforcement action as required. | DoE NT | CIG | 2010 | 2,3,4 |
| **SM8.** Map and investigate potential for restoration of fringing vegetation, towards improving the biodiversity value of Salt Water Pond, Cayman Brac. | DoE | CIG | 2009 | 3 |
| **SM9.** Transfer Crown Wetlands in Little Cayman to protected area status. | CC | DoE NT MP CIG | 2012 | 2,4 |
| **SM10.** Subject to SM9, designate Little Cayman Crown Wetlands a Ramsar site. | DoE | CC CIG MP NT | 2012 | 2,4 |
| **SM11.** Establish the Barkers area as a designated National Park under the National Conservation Law, protecting Sea Pond and Palmetto Pond. | CC | DoE MP CIG | 2006 | 3,4 |
| **SM12.** Once designated, promote Barkers National Park for designation as a Ramsar site. | CC | DoE MP CIG | 2015 | 3,4 |
| **SM13.** Develop a Management Plan for Barkers National Park which incorporates and promotes compatible multi-use recreational activities for *pools, ponds and mangrove lagoons*, such a kayaking | DoE | CC CIG | 2015 | 3,4 |
| **SM14.** Use the *Environmental Protection Fund* to construct a manned interpretation centre on the shore of Sea Pond, Barkers, to develop tourism capacity, and raise | DoE | CIG CC | 2015 | 3 |

| | | | | |
|---|---|---|---|---|
| awareness of the value of associated habitats in visitors and residents. | | | | |
| **SM15.** Access feasibility of designating Malportas Pond a protected area. This pond is currently under Crown ownership, and has recently been impacted by removal of buffer vegetation by illegal clearance for development. | DoE | DoP CIG | 2012 | 2,4 |
| **SM16.** Produce management plans for *pools, ponds and mangrove lagoons* under National Trust ownership. | NT | DoE | 2009 | 3 |
| **SM17.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4,5 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of *pools, ponds and mangrove lagoons.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4,5 |
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest of *coastal shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4,5 |
| **A3.** Promote adherence to *pools, ponds and mangrove lagoons* guidelines in relevant planning applications. | DoE | NT | 2015 | 2,3,4 |
| **A4.** Work with *Department of Planning* to formalize restoration protocol for quarry applications, incorporating adherence to *pools, ponds and mangrove lagoons* guidelines where appropriate, and promote establishment of an escrow fund to cover the costs of close-plans prior to agreement of new excavations. | DoE | DoP<br>CPA | 2015 | 2,3,4 |
| **A5.** Work with *National Roads Authority* to complement new roads developments with creation of suitably designed artificial *pools, ponds and mangrove lagoons* as an active and aesthetic component of the stormwater management. | DoE | DoP<br>CPA | 2015 | 3,5 |
| **A6.** Provide advice for landowners and developers on the effective management of eutrophic *pools, ponds and mangrove lagoons*, to promote environmental health and conservation of biodiversity. | DoE | | ongoing | 3 |
| **A7.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2 |
| **Research & Monitoring** | | | | |
| **RM1.** Map all *Pools, ponds and mangrove lagoons* in the Cayman Islands. | DoE | | 2008 | 1 |
| **RM2.** Complete analysis of all significant *Pools, ponds and mangrove lagoons* in the Cayman Islands, to determine water quality, nutrient enrichment and salinity. | DoE | | 2009 | 1 |
| **RM3.** Identify and prioritise most significant *Pools, ponds and mangrove lagoons* in the Cayman Islands. | DoE | NT | 2009 | 1 |
| **RM4.** Instigate the design and testing of experimental techniques to restore artificial *Pools, ponds and mangrove lagoons*, including seed collection, propagation and planting, and the ecology of key fauna. | DoE | | 2012 | 3,4,5 |
| **RM5.** Develop guidelines for restoration of degraded man-made *Pools, ponds and mangrove lagoons* to maximize ecological value. | DoE | | 2015 | 3,4 |
| **RM6.** Investigate potential for disused marl-pits in key areas to be acquired by the crown, for restoration and development as public amenities and wildlife preserves. | DoE | CIG MP | 2015 | 3,4 |
| **RM7.** Assess ecological status of existing Animal | DoE | NT | 2006 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| Sanctuaries and compile Management Plans for their maintenance, upkeep and improvement. | | | | |
| **RM8.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM9.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM10.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Subject to successful conclusion of RM4, increase public awareness by developing an artificial *pools, ponds and mangrove lagoons* test site for educational purposes. | DoE | MP | 2015 | 3 |
| **CP2.** Subject to successful conclusion of RM4, publish guidelines for restoration of degraded *pools, ponds and mangrove lagoons* as an educational document for land owners. | DoE | MP | 2015 | 3 |
| **CP3.** Develop and emplace interpretation for *pools, ponds and mangrove lagoons* in Barkers area, towards maximising visitor experience / minimising impact. | DoE | CIG | 2012 | 3 |
| **CP4.** Raise public awareness of *pools, ponds and mangrove lagoons* by introducing an educational "Study Ponds" for schools programme. | DoE | NT CN DE | 2012 | 3 |
| **CP5.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |
| **CP6.** Raise public awareness regarding the biological and physical factors which contribute to eutrophication of *pools, ponds and mangrove lagoons*, and publish guidelines to assist preventative and remedial measures. | DoE | MP | Ongoing | 3 |

## REFERENCES and FURTHER READING for *Pools, ponds and mangrove lagoons*


Baugh, T.M. (1985). Habitat preferences of pond fishes on Grand Cayman, BWI. *Unpublished report, Dept. Biol. Sci., Univ. Nevada*, 9 pp.

Management Plan for the Booby Pond Nature Reserve (1995) (unpub.) Produced by the National Trust for the Cayman Islands, the Environmental Advisory Committee, the Trust's Little Cayman District Committee, and the local community.

Moss, B., Madgwick, F.J. and Phillips, G.L. (1996). A guide to the restoration of nutrient-enriched shallow lakes. Environment Agency and Broads Authority, Norwich.
Organisation for Economic Co-operation and Development (1982). Eutrophication of waters. Monitoring, assessment and control. OECD, Paris.

Poole, W. (1993). *The Case for Urban Open Space*. Draft report prepared for Trust for Public Land, San Francisco, California.

## TERRESTRIAL HABITATS

### *14. Dry shrubland*

#### Definition

"Shrubland" is a class of vegetation dominated by flora which ranges in height between 0.5m and 5m. Shrubs tend to grow as separate individuals or clumps of individuals. In *shrubland*, the canopy cover of shrubs constitutes greater than 25% of the total canopy cover. Larger trees may be present in *shrubland*, however, tree canopy cover should constitute less than 25% of the total cover to distinguish the area from "woodland".

#### Local outline

In the Cayman Islands, several different associations of shrubland exist, including the evergreen shrublands associated with coastal environments and mangrove shrubland. These associations are addressed elsewhere, as elements of *mangrove* and *coastal shrubland* habitats.

The "shrubland" formation develops in response to one or both of two natural environmental stressors. In coastal areas, vegetation growth is limited by exposure to salt spray carried inland by wind. This may be compounded by drought stress at the extreme margins of the Bluff on Cayman Brac, caused by rapid groundwater drainage from the edges of high cliffs. Inland at low elevations where the groundwater lies between 1-2m from the ground surface, there is insufficient depth of unsaturated (aerobic) rock to support rooting of large forest trees, so shrubland predominates.

#### Key Habitat Categories for *Dry shrubland*

Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Tropical or subtropical broad-leaved evergreen shrubland III.A.1.N.a
- Mixed evergreen-drought deciduous shrubland with succulents III.C.1.N.a

#### Key Species for *Dry shrubland*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

**KEY SPECIES for DRY SHRUBLAND**

**PART 1**

| Category | Detail | Scientific Reference | NBAP |
|---|---|---|---|
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Bananaquit<br>Vitelline warbler<br>Caribbean elaenia<br>Cuban bullfinch<br>Western spindalis<br>Red-legged thrush<br>Loggerhead kingbird<br>Thick-billed vireo<br>Yucatan vireo | Aves<br><br><br>*Coereba flaveola sharpei*<br>*Dendroica vitellina crawfordi / vitellina*<br>*Elaenia martinica caymanensis*<br>*Melopyrrha nigra taylori*<br>*Spindalis zena salvini*<br>*Turdus plumbeus coryi*<br>*Tyrannus caudifasciatus caymanensis*<br>*Vireo crassirostris alleni*<br>*Vireo magister caymanensis* | <br><br><br>SAP |
| Reptiles | Grand Cayman Blue iguana | *Cyclura lewisi* | SAP |
| Reptiles | Sister Islands Rock iguana | *Cyclura nubila caymanensis* | SAP |
| Invertebrates | Little Cayman snail | *Cerion nanus* | SAP |
| Plants | | *Banara caymanensis* | SAP |
| Plants | | *Consolea millspaughii caymanensis* | SAP |
| Plants | | *Pleurothallis caymanensis* | |

**PART 2**

| | | | |
|---|---|---|---|
| Reptiles | Grand Cayman Blue-throated anole | *Anolis conspersus* | |
| Reptiles | Wood slave gecko | *Aristelliger praesignis praesignis* | |
| Reptiles | Grand Cayman Ground boa | *Tropodophis caymanensis* | |
| Reptiles | Cayman racer | *Alsophis cantherigerus* | |
| Reptiles | Little Cayman Green anole | *Anolis maynardi* | SAP |
| Reptiles | Grand Cayman Blue-throated anole | *Anolis conspersus* | |
| Invertebrates | Little Cayman cicada | *Diceroprocta caymanensis* | |
| Invertebrates | Grand Cayman cicada | *Diceroprocta cleavesi* | |
| Invertebrates | Cayman Brac cicada | *Diceroprocta ovata* | |
| Invertebrates | Centipede | *Leptophilus caribeanus* | |
| Plants | Corato | *Agave caymanensis* | |
| Plants | | *Allophylus cominia var. caymanensis* | |
| Plants | | *Banara caymanensis* | SAP |
| Plants | | *Buxus bahamensis* | |
| Plants | Ironwood | *Chionanthus caymanensis* | SAP |
| Plants | Silver thatch | *Coccothrinax proctorii* | SAP |
| Plants | Broadleaf | *Cordia sebestena caymanensis* | SAP |
| Plants | | *Dendropemon caymanensis* | SAP |
| Plants | | *Euphorbia cassythoides* | |
| Plants | | *Evolvulus squamosus* | |
| Plants | Banana orchid | *Myrmecophila thomsoniana minor / thomsoniana* | SAP |
| Plants | | *Phyllanthus caymanensis* | |
| Plants | | *Pilostyles globosa caymanensis* | |
| Plants | | *Phyllanthus caymanensis* | |
| Plants | | *Scolosanthus roulstonii* | |
| Plants | Satinwood | *Zanthoxylum flavum* | |

## Current Status of *Dry shrubland*

*Link to habitat map: Dry shrubland Grand Cayman*
*Link to habitat map: Dry shrubland Cayman Brac*
*Link to habitat map: Dry shrubland Little Cayman*

| Habitat Status 2006 Dry shrubland | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Dry shrubland | 2976.9 | 352.5 | 2251.3 | 59.4 | 10.4 | 113.5 | 2917.5 | 342.1 | 2137.8 | 2.00 | 2.95 | 5.04 |
| Inland sparsely vegetated rock | 157.3 | 0.0 | 0.0 | 5.5 | x | x | 151.8 | x | x | 3.50 | x | x |
| **TOTAL** | **3134.2** | **352.5** | **2251.3** | **64.9** | **10.4** | **113.5** | **3069.3** | **342.1** | **2137.8** | **2.07** | **2.95** | **5.04** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Dry shrubland*

GRAND CAYMAN: East End shrublands
High Rock shrublands
CAYMAN BRAC: Lighthouse shrublands
LITTLE CAYMAN: Central shrublands
Cerion shrublands

*Dry shrubland* is currently critically under-represented within the protected areas of the Cayman Islands.

| **Protected areas containing *dry shrubland*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| The Salina Reserve – a large portion of the reserve is dry shrubland – this is currently the release site for the Grand Cayman Blue Iguana | 623.66 | Grand Cayman | NT |
| The Splits – dry shrubland incorporating some freshwater features | 17.76 | Cayman Brac | NT |

### Nature Conservation Importance of *Dry shrubland*

- *Biodiversity*: despite the extreme environmental conditions to which it is subject, *dry shrubland* supports significant and unique biodiversity, some of which occupies an extremely restricted range. For example, the land snail *Cerion nanus* is known only from a single 300m$^2$ patch of *Evolvulus squamosus* on Little Cayman. Along with *dry forest, dry shrubland* is one of the two key habitats for terrestrial biodiversity in the Cayman Islands.
- *Plants:* several endemic plants and trees are unique to Cayman's *dry shrubland,* for example *Scolosanthus roulstonii,* and the Century Plant *Agave caymanensis.*
- *Birds: dry shrubland* supports a diversity of resident and migratory birds, and is of special value for migratory warblers.
- *Reptiles:* the open canopy of *dry shrubland* facilitates the penetration of light through the foliage. This contributes to *dry shrubland* being an important habitat for reptiles, notably the Grand Cayman Blue Iguana *Cyclura lewisi*, and the Sister Isles Rock Iguana *Cyclura nubila caymanensis*.
- *Storm refugia:* a combination of the inland location or elevated position, and uniformity of canopy make *dry shrublands* resistant to storm damage. This resilience enables *dry shrubland* to provide stable refugia to wildlife during severe weather.

### Current Factors Affecting *Dry shrubland*

- *Invasive species:* feral cats and dog packs range widely in *dry shrubland*, maintaining a meagre and opportunistic existence, predating native birds and wildlife.
- *Potential for recovery:* though small in stature, the slow-growing nature of many *dry shrubland* species belies their age. This contributes to the natural compliment of species being slow to recover following clearance. More often than not invasive species, such as Logwood *Haematoxylum campechianum* and Wild tamarind *Leucaena leucocephala* are first to establish. The opportunistic native Maiden plum *Comocladia dentata* is also quick to re-colonise, in some cases giving rise to unnatural and extensive stands of this toxic species.
- *Residential development:* in some settings, *dry shrubland* occupies extensive areas of high ground, and is susceptible to development, either directly, or indirectly as a source of aggregate to fill low-lying property. *Development* has resulted in the clearance of significant tracts of *dry shrubland* in the past 30 years.
- *Speculative clearance:* the complete clearance of all vegetation from a saleable lot, to demonstrate its extent and topography, is a common practice in the Cayman Islands. This results in immediate and long-term damage to the ecological value of the land. Regardless of whether a sale is forthcoming, invasive species colonise the cleared area, compromising both the cleared site and impacting neighbouring parcels. Speculative clearance also removes any option for a prospective buyer to maintaining native vegetation outside of the footprint of any new development.
- *Non-native landscaping:* as areas of *dry shrubland* become increasingly fragmented, they become more susceptible to ingress of invasive species and edge effects, and less functional as viable refugia for native plants and wildlife. Non-native-landscaping of surrounding areas restricts wildlife corridors and seed transport systems, ecologically isolating remnant stands of native vegetation.

- *Agricultural development:* soil pockets in *dry shrubland* have typically provided some of the most fertile and assessable *farm and grasslands* in the Islands. Traditionally, small pockets of soil-rich land were cleared by hand and planted with fruit trees. Larger areas were also cleared, and seeded with grass for rough grazing of cattle. In some cases, traditional *farm and grasslands* have now been abandoned, and are reverting back to *forest and woodland*. However, for the most part, relict *farm and grasslands* quickly revert to dense stands of the potentially undesirable Maiden plum *Comocladia dentata*, and invasive species, such as Logwood *Haematoxylum campechianum* and Wild Tamarind *Leucaena leucocephala*, or are alternately replaced by *urban* development.
- *Fire:* poorly managed use of fire to maintain pasture land often leads to damaging wildfires. Arson also constitutes an occasional source of fire damage to *dry shrubland*. Fire can kill or displace resident wildlife. Damaged areas are susceptible to colonisation by *invasive species*.
- *Cultural identity:* lacking the large trees of traditional use and cultural significance, *dry shrubland* is typically undervalued and underrepresented in protected areas.
- *Hedonic value:* despite its biodiversity value, public awareness of the value of *dry shrubland* lags behind that of *forest and woodland*. Given some of the more spectacular species of flora and fauna, and intriguing rock formations associated with local *dry shrublands*, it is likely that increased public education, supported by on-site interpretation and managed access, would greatly improve the profile of *dry shrublands*.

### Opportunities and Current Local Action for *Dry shrubland*

- The *Native Tree Nursery* aims to provide a source of *dry shrubland* trees, grown from locally collected seed, with particular attention to those of particular rarity, endemic status and ecological value, towards reintroducing key species, maintaining the ecological value of the built environment, and preserving wildlife corridors.
- *Nature tourism:* the Blue Iguana Recovery Programme is currently attempting to establish a 500 acre *dry shrubland* reserve - an area of sufficient size to support a self-sustaining, free-roaming population of the charismatic Grand Cayman Blue iguana *Cyclura lewisi.*

### HABITAT ACTION PLAN for *Dry shrubland*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *dry shrubland*, and delineate component vegetation formations for the Cayman Islands. | 2008 |
| **2.** Maintain *dry shrubland* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *dry shrubland*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect ca. 600 acres of contiguous *dry shrubland* in Grand Cayman (ca. 20% of the total *dry shrubland* in Grand Cayman), and 300 acres on each of the Sister Islands, towards preserving this biodiverse habitat *insitu* and providing a viable reserve for local iguana populations. | 2015 |

| Dry shrubland PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective | DoP | DoE CIG | 2010 | 2,3 |

| | | | | |
|---|---|---|---|---|
| enforcement mechanism. | | | | |
| **PL4.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines to discourage damage or disturbance to *dry shrubland.* | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3,4,5 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3,4,5 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,4 |
| **PL7.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use Crown land protection, and the *Environmental Protection Fund*, to purchase and protect / establish management agreements with landowners, towards protecting ca. 600 acres of *dry shrubland* in the East End of Grand Cayman. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM2.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards protecting ca. 300 acres of scenic *dry shrubland* at the Light House, East End of Cayman Brac. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM3.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards protecting *dry shrubland* in Little Cayman, and protect the *Cerion nanus* population. | CC | DoE NT<br>MP CIG | 2010 | 2,4 |
| **SM4.** Implement active control of invasive fauna, including feral cats, dogs and Green iguanas in protected areas, towards maintaining native wildlife, particularly native lizards and birds. | DoE | DoA<br>DEH | 2010 | 3 |
| **SM5.** Provide *dry shrubland* species for landscaping and restoration from the *Native Tree Nursery*. | QEIIBP | DoE | 2008 | 3 |
| **SM6.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plan*s, to ensure the preservation of and natural function of *dry shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *dry shrubland.* | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3,4 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4 |
| **A4.** Work with Department of Planning and local developers to encourage retaining native *dry shrubland* as low-maintenance high-aesthetic value elements of developed landscapes. | DoE | DoP MP | 2009 | 2,3,4 |
| **Research & Monitoring** | | | | |
| **RM1.** Update and refine existing maps of *dry shrubland.* | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *dry shrubland* the Cayman Islands, incorporating pristine | DoE | NT DoT<br>MP | 2009 | 1,3 |

| | | | | |
|---|---|---|---|---|
| nature, ecological value, and presence of key species. | | | | |
| **RM3.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM4.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM5.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM6.** Expand studies into the biodiversity of *dry shrubland* species. | DoE | IntC | 2009 | 3 |
| **RM7.** To facilitate screening of development projects in the environmental assessment process outlined in the National Conservation Law, update primary vegetation maps for all three Islands. | DoE | CC DoP CPA DCB | 2008 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the ecological value of *dry shrubland* using *Cyclura lewisi* and *Cyclura nubila caymanensis* as flagships for preservation. | BIRP | DoE NT | 2010 | 3 |
| **CP2.** Subject to SM1, use EU funds / *Environmental Protection Fund* to construct and man an interpretation centre in the East End of Grand Cayman, to develop tourism capacity, and raise awareness of the value of *dry shrubland* in visitors and residents. | BIRP | DoE CIG IntC NT | 2009 | 3 |
| **CP3.** Construct and man an interpretation centre at the Light House, East End of Cayman Brac, to develop tourism capacity, and raise awareness of the value of *dry shrubland* in visitors and residents. | DoE | NT CIG | 2015 | 3 |
| **CP4.** Promote *dry shrubland* as a valuable feature of the natural environment of the Cayman Islands | DoE NT | DoT CIG | ongoing | 3 |
| **CP5.** Promote landscaping with native trees typical of *dry shrubland.* | DoE | QEIIBP NT | 2008 | 3 |
| **CP6.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |

**REFERENCES and FURTHER READING for *Dry shrubland***

## TERRESTRIAL HABITATS

### *15. Forest and woodland*

**Definition**
"Forest" is a class of vegetation characterized by a closed tree canopy, with interlocking crowns generally providing 60-100% cover. "Woodland", by comparison, is characterized by an open canopy, with tree crowns constituting just 25-60% cover. The canopy height of *forest and woodland* ranges from about 16m, down to about 4.5m in height, below which *shrubland* species dominate.

**Local outline**
*Mixed evergreen-deciduous forests* comprise the majority of the natural vegetation of the interior of the Cayman Islands.

The majority of the interior of the Cayman Islands is dry, however wet forested areas may occur at the intergrades between *mangrove* wetlands and *lowland semi-deciduous forest*. In these areas, *seasonally flooded / saturated semi-deciduous forest* establishes. In areas prone to flooding, where typically a peaty layer overlies permanently saturated oxisol soil beneath, Red Birch *Bursera simaruba* and Bitter Plum *Picodendron baccatum* predominate, with elegant Royal Palm *Roystonea regia* emergent above the canopy. Where more transiently rain-saturated oxisols overlie limestone pavement, Poison tree *Metopium toxiferum*, Mahogany *Swietenia mahagoni*, and Bull Thatch *Thrinax radiata* are typifying species.

Dry forests are typified by a mixture of evergreen trees (which maintain their foliage year-round) and drought-deciduous trees (which shed their leaves during dry periods). They occur predominantly on higher elevation dry land where the water table is more then 2m below the ground surface. A variant also occurs in soil-covered areas seasonally flooded by rainwater, characterized by species such as mahogany and royal palm, which are tolerant of saturation in the root zone.

The Red Birch *Bursera simaruba* and Cabbage Tree *Guipure discolour* are usually dominant, and as fast-growing and rapidly colonizing species they are especially abundant in forests regenerating after disturbance. Old growth forests show high biodiversity with tree species occurring at a wide range of abundances – some species being extremely sparsely distributed through the forest. Three strata are often present (main canopy, emergents, and understory) giving the forest a complex physical structure offering a wide range of habitats for fauna.

Natural woodland is a rarity in the Cayman Islands. In most cases, woodland represents a transitional habitat, such as secondary growth developing on abandoned *farm and grassland*. Left to mature undisturbed, such woodland would eventually develop into forest. For this reason, woodland and forest are considered related elements here.

There are, however, some examples in the Islands, were woodland is regarded as a natural climax community. For example, in Grand Cayman natural areas of *tropical or subtropical semi-deciduous woodland* remain in woodland form, in areas where prevailing conditions are too dry to support development of forest.

The category of *forest and woodland* incorporates the drier *xeromorphic semi-deciduous forest* characteristic of the elevated Bluff of Cayman Brac, which is typified by xeric vegetation such as agave and cactus.

**Key Habitat Categories for *Forest and woodland***
Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Lowland semi-deciduous forest I.C.1.N.a
- Seasonally flooded / saturated semi-deciduous forest I.C.1.N.c
- Xeromorphic semi-deciduous forest I.C.4.N.b
- Lowland / submontane drought-deciduous woodland II.B1.N.a.
- Tropical or subtropical semi-deciduous woodland II.C.1.N.a

### Key Species for *Forest and woodland*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for FOREST AND WOODLAND | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat: | | |
| | Grand Cayman parrot | *Amazona leucocephala caymanensis* | SAP |
| | Brac parrot | *Amazona leucocephala hesterna* | SAP |
| | Northern flicker | *Colaptes auratus gundlachi* | |
| | White-crowned pigeon | *Patagioenas leucocephala* | |
| | Caribbean dove | *Leptotila jamaicensis collaris* | |
| | West Indian woodpecker | *Melanerpes superciliaris caymanensis* | |
| | Western spindalis | *Spindalis zena salvini* | |
| | Loggerhead kingbird | *Tyrannus caudifasciatus caymanensis* | |
| | Thick-billed vireo | *Vireo crassirostris alleni* | |
| | Yucatan vireo | *Vireo magister caymanensis* | |
| Invertebrates | Soldier crab (Hermit) | *Coenobita clypeatus* | SAP |
| Invertebrates | Cayman Brown Leaf butterfly | *Memphis vericordia danielana* | |
| Invertebrates | Swallowtail butterfly (endemic) | *Heraclides andraemon tailori* | |
| Invertebrates | Cayman Zoe julia | *Dryas iulia zoe* | |
| Plants | | *Aegiphilia caymanensis* | SAP |
| Plants | | *Buxus bahamensis* | |
| Plants | | *Casearia staffordiae* | |
| Plants | Ironwood | *Chionanthus caymanensis* | SAP |
| Plants | Ghost orchid | *Dendrophylax fawcettii* | SAP |
| Plants | | *Encyclia kingsii* | |
| Plants | | *Epiphyllum phyllanthus var. plattsii* | SAP |
| Plants | Old George | *Hohenbergia caymanensis* | SAP |
| Plants | | *Pisonia margarettiae* | SAP |
| Plants | | *Pleurothallis caymanensis* | |
| Plants | | *Terminalia eriostachya margaretiae* | |
| Plants | | *Tolumnia (= Oncidium) calochilum* | |
| Plants | | *Tolumnia (= Oncidium) variegata* | |
| **PART 2** | | | |
| Reptiles | Western Grand Cayman Blue-throated anole | *Anolis conspersus conspersus* | |
| Reptiles | Eastern Grand Cayman Blue-throated anole | *Anolis conspersus lewisi* | |
| Reptiles | Cayman racer | *Alsophis cantherigerus* | |
| Reptiles | Yellow galliwasp | *Celestus crusculus maculatus* | |
| Invertebrates | Little Cayman cicada | *Diceroprocta caymanensis* | |
| Invertebrates | Grand Cayman cicada | *Diceroprocta cleavesi* | |
| Invertebrates | Cayman Brac cicada | *Diceroprocta ovata* | |
| Plants | | *Allophylus cominia var. caymanensis* | |
| Plants | Cayman Silverbush | *Argythamnia proctorii* | |
| Plants | | *Beloglottis costaricensis* | |
| Plants | Yoke wood | *Catalpa longissima* | |
| Plants | Cedar | *Cedrela odorata* | SAP |
| Plants | | *Celtis trinervia* | |

| | | | |
|---|---|---|---|
| Plants | Ironwood | *Chionanthus caymanensis* | SAP |
| Plants | Silver Thatch palm | *Coccothrinax proctorii* | SAP |
| Plants | | *Colubrina arborescens* | |
| Plants | Clamcherry | *Cordia laevigata* | |
| Plants | | *Crossopetalum caymanense* | |
| Plants | | *Daphnopsis americana* | |
| Plants | | *Dendropanax arboreus* | |
| Plants | | *Drypetes sp.* | |
| Plants | Smokewood | *Erythroxylum confusum* | |
| Plants | | *Faramea occidentalis* | |
| Plants | | *Jatropha divaricata* | |
| Plants | | *Licaria triandra* | |
| Plants | Lignum vitae | *Lignum vitae* | |
| Plants | | *Margaritaria nobilis* | |
| Plants | Banana orchid | *Myrmecophila thomsoniana minor / thomsoniana* | SAP |
| Plants | | *Oeceoclades maculata* | |
| Plants | | *Prosthechea cochleata* | |
| Plants | | *Rauvolfia nitida* | |
| Plants | | *Tillandsia festucoides* | |
| Plants | | *Trichilia havanensis* | |
| Plants | Bull rush | *Zamia integrifolia* | |
| Plants | Satinwood | *Zanthoxylum flavum* | |

## Current Status of *Forest and woodland*

*Link to habitat map: Forest and woodland Grand Cayman*
*Link to habitat map: Forest and woodland Cayman Brac*
*Link to habitat map: Forest and woodland Little Cayman*

| Habitat Status 2006 Forest and woodland | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Seasonally flooded / saturated semi-deciduous forest I.C.1.N.c | 163.3 | 0.0 | 0.0 | 59.1 | x | x | 104.2 | x | x | 36.2 | x | x |
| Xeromorphic semi-deciduous forest I.C.4.N.b | 0.0 | 4530.0 | 0.00 | x | 261.7 | x | x | 4268.3 | x | x | 5.8 | x |
| Dry forest and woodland | 7363.6 | 0.00 | 1930.8 | 490.8 | x | 71.4 | 6872.7 | x | 1859.5 | 6.7 | x | 3.7 |
| **TOTAL** | **7526.9** | **4530** | **1930.8** | **549.9** | **261.7** | **71.4** | **6977.0** | **4268.3** | **1859.5** | **7.3** | **5.8** | **3.7** |

Terrestrial Protected Areas in the Cayman Islands are limited to Animal Sanctuaries, National Trust property, and buffer zones associated with Animal Sanctuaries and sensitive marine areas. The Animal Sanctuaries established under the Animals Law (1976), incorporate four significant inland *pools, ponds and mangrove lagoons*, (two in Grand Cayman, one in Cayman Brac, one in Little Cayman), extending to a total of 341 acres. As of Jan 2009, National Trust owned / shared ownership properties, protected under the National Trust for the Cayman Islands Law (1987), extended to a total of ca. 3109 acres.

## Key Sites for *Forest and woodland*

GRAND CAYMAN: The Mastic region, North Side
The Ironwood forest, George Town
CAYMAN BRAC: The Bluff forest
LITTLE CAYMAN: The Central Forest

*Forest and woodland* is currently the best represented terrestrial habitat type within the current protected areas of the Cayman Islands.

| **Protected areas containing *forest and woodland*** | **Area (ac)** | **Location** | **Ownership** |
|---|---|---|---|
| Mastic Reserve – a large reserve, the majority of which is forest and woodland | 998.04 | Grand Cayman | NT (inc. 91 acres in shared ownership) |
| Brac Parrot Reserve | 286.6 | Cayman Brac | NT |
| Booby Pond Nature Reserve - a small portion, in the north of the reserve is forest and woodland | 457.2 | Little Cayman | NT |

Given the complexity of *forest and woodland*, and the high biodiversity it supports, unique areas remain unprotected. On example is the *Ironwood Forest* in George Town. A small (ca. 70 acres) original growth dry forest bounded by urban development, the *Ironwood Forest* contains Grand Cayman's most significant populations of Old George *Hohenbergia caymanensis*, and Ghost orchids *Dendrophylax fawcettii*. In 2008, a controversial roads development through the forest, was shelved amid public outcry. At the present time, this area remains without any form of formal protection.

### Nature Conservation Importance of *Forest and woodland*

- *Biodiversity*: dry forest represents the most biodiverse of all terrestrial habitats in the Cayman Islands (closely followed by *dry shrubland).* Those at higher elevations are structurally complex and ancient, possibly existing above sea level for the last 2.5 million years (Jones *et al.* 1994). Biodiversity is highest in areas where the forest lies adjacent to wetlands. In this situation, moist air derived from the wetland bathes the understory, providing a humid environment beneath the trees canopy; conducive to the profuse growth of epiphytes, including bromeliads and orchids.
- *Rare plants:* dry forests include the Cayman Islands' most significant assemblies of rare and endemic plants and trees.
- *Birds:* dry forest supports a diversity of resident and migratory birds. Fruiting trees of *forest and woodland* provide food and shelter for nest-builders. The living and dead trucks of large forest trees provide a home for cavity nesters.
- *Bats:* dry forest is an important habitat for several species of bat including the White-shouldered bat *Phyllops falcatus* (SAP).

*Other:*

- *Cultural identity:* dry forest supports many species which have played a significant role in the development of the Cayman Islands, and contribute to our cultural identity, including Ironwood *Chionanthus caymanensis*, the National Tree, Silver Thatch palm *Coccothrinax proctorii*, the National Bird, the Cayman parrot *Amazona leucocephala*, and the National Flower, the Banana orchid *Myrmecophila thomsoniana.*
- *Hedonic value:* dry forest supports the largest and most profuse flora in the Cayman Islands. The strong visual aesthetic of the forest, combined with its ancient nature and cultural value contributes to its appreciation as a natural environment. Natural forest vistas represent a significant and tangible component of the popular perception of an "unspoilt" environment.
- *Recreation:* forest trails are enjoyed by local walkers, birdwatchers and by overseas visitors interested in the natural environment. The closed tree canopy which typifies dry forest provides forest trails with shade throughout the course of the day; making forest walks one of few outdoor activities in Cayman, which can be undertaken in the shade.
- *Nature tourism:* local guides are employed to escort visitors on forest trails, on both Grand Cayman (by the *National Trust for the Cayman Islands*), and on Cayman Brac (by the *Department of Tourism*).

### Current Factors Affecting *Forest and woodland*

- *Fragmentation: forest and woodland* is highly susceptible to fragmentation. Fragmentation interrupts wildlife corridors, introduces invasive species and exposes extensive areas of forest to damaging *edge effects*, including wind sheer, ingress of light, and modification of microclimate.
- *Invasive species:* when intact, the closed tree canopy which typifies *forest and woodland* restricts the amount of light reaching the forest floor, and limits the potential for establishment of invasive species. When the canopy is disrupted, however, either by natural events or fragmentation, invasive species colonise disturbed areas more quickly than natural primary colonisers such as Red birch. Once established, edge effects enable ingress of invasive species from the margins of disturbance further into the interior of the forest.
- *Residential development: forest and woodland* typically occupy high ground. Given the low-lying nature of the majority of the land surface of the Cayman Islands, high ground is prized for development – either directly, or as a source of aggregate with which to fill low-lying properties. This has resulted in the clearance of significant tracts of dry forest in the past 30 years.
- *Speculative clearance:* the complete clearance of all vegetation from a saleable lot, to demonstrate its extent and topography, is a common practice in the Cayman Islands. This results in immediate and long-term damage to the ecological value of the land. Regardless of whether a sale is forthcoming, invasive species colonise the cleared area, compromising both the cleared site and impacting neighbouring parcels. Speculative clearance removes any option for a prospective buyer to maintaining native vegetation outside of the footprint of any new development.
- *Non-native landscaping:* as areas of *forest and woodland* become increasingly fragmented, they become more susceptible to ingress of invasive species and edge effects, and less functional as viable refugia for native plants and wildlife. Non-native-landscaping of surrounding areas restricts wildlife corridors and seed transport systems, isolating remnant forest stands ecologically.
- *Agricultural development:* soil pockets in *forest and woodland* have typically provided some of the most fertile farming land in the Islands. Traditionally, small pockets of soil-rich land were cleared by hand and planted with fruit trees. Larger areas were also cleared, and seeded with grass for rough grazing of cattle. In some cases, traditional farm land has now been abandoned, and is reverting back to woodland, however, for the most part, traditional farmlands are been replaced by suburban development.
- *Lack of public education:* there is a popular misconception that *forest and woodland* are more extensive than they are, due to an inability to differentiate native and invasive species. There is a general lack of understanding of how little "visible greenery" of the islands constitutes native vegetation. The homogenous curtain of invasive species lining roads and colonising disturbed areas belies the diversity of species and structure in the interior of the ancient forest.
- *Storm damage:* a combination of the inland location and elevated position of dry forests make this habitat resistant to storm surge. Fragmentation, and disruption of the integrity of the tree canopy, however, undermines the natural protective topography of the tree crowns, and exposes the understory to destructive winds. Damaged areas are susceptible to colonisation by *invasive species*.
- *Fire:* dry forest has been subject to significant fire damage, in the most part arising from fires for agricultural clearance getting out of control, and arson adjacent suburban areas. Damaged areas are susceptible to colonisation by *invasive species*.

### Opportunities and Current Local Action for *Forest and woodland*

- The *Native Tree Nursery* aims to provide a source of *forest and woodland* trees, with particular attention to those of particular rarity, endemic status and ecological value, towards reintroducing key species, maintaining the ecological value of the built environment, and preserving wildlife corridors.
- The purchase and protection of *forest and woodland* has been an ongoing priority programme of the *National Trust for the Cayman Islands* for several years.

### HABITAT ACTION PLAN for *Forest and woodland*

| OBJECTIVES | TARGET |
|---|---|

| | |
|---|---|
| **1.** Update and refine existing maps of *forest and woodland*, and delineate component vegetation formations for the Cayman Islands. | 2008 |
| **2.** Maintain *forest and woodland* in a natural state, by allowing the natural processes which lead to their formation to continue. | 2010 |
| **3.** Maintain and manage the variety of habitats, communities and species of *forest and woodland*, and seek improvement of areas which have been degraded. | 2010 |
| **4.** Protect 20% of currently remaining *forest and woodland* in the Cayman Islands. | 2015 |

| Forest and woodland<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL4.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines to discourage damage or disturbance to *forest and woodland*. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3,4,5 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3,4,5 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,4 |
| **PL7.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards protecting remaining land associated with the Mastic Reserve, Grand Cayman. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM2.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners, towards maintaining the ecological link, and establishing one contiguous protected area, with the Central Mangrove Wetland. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM3.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of the *caves* and *forest and woodland* associated with the Old Man Bay (Bat) Caves, Grand Cayman. | CC | DoE NT<br>MP CIG | 2015 | 2,4 |
| **SM4. S**ubject to favourable assessment of 2005 fire damage to primary forest in the area, use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of | CC | DoE NT<br>MP CIG | 2015 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| *forest and woodland* associated with the Arlington Road wooded community. | | | | |
| **SM5.** Work with and support local landowners to ensure the continued protection of the Ironwood Forest, Grand Cayman, using the *Environmental Protection Fund* to establish management agreements with landowners if necessary. | CC | DoE NT MP CIG | 2015 | 2,4 |
| **SM6.** Use the *Environmental Protection Fund* to purchase and protect the land parcel along the eastern border of the Brac Parrot Reserve, increasing the size of the current reserve by ca. 25%. | CC | DoE NT MP CIG | 2015 | 2,4 |
| **SM7.** Commence establishment of a second protected area of *dry forest* on Cayman Brac, of comparable size to the Brac Parrot Reserve. | CC | DoE NT MP CIG | 2015 | 3,4 |
| **SM8.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of the Central Forest on Little Cayman. | CC | DoE NT MP CIG | 2015 | 2,4 |
| **SM9.** Implement active control of invasive fauna, including feral cats, dogs and Green iguanas in protected areas, towards maintaining native wildlife, particularly native lizards and birds. | DoE | DoA DEH | 2010 | 3 |
| **SM10.** Provide *forest and woodland* species for landscaping and restoration from the *Native Tree Nursery*. | QEIIBP | DoE | 2008 | 3 |
| **SM11.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plan*s, to ensure the preservation of and natural function of *dry forest.* | DoE | DoP CPA DCB | ongoing | 2,3,4 |
| **A2.** Ensure that local planning mechanisms are encouraged to take into account the wildlife interest and hedonic value of *forest and woodland.* | DoE | DoP CPA DCB | ongoing | 2,3,4 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3,4 |
| **A4.** Work with Department of Planning and local developers to encourage retaining native *forest and woodland* as low-maintenance high-aesthetic value elements of developed landscapes. | DoE | DoP MP | 2009 | 2,3,4 |
| **Research & Monitoring** | | | | |
| **RM1.** Update and refine existing maps of *forest and woodland*. | DoE | | 2008 | 1 |
| **RM2.** Identify and prioritise most significant areas of *forest and woodland* the Cayman Islands, incorporating pristine nature, ecological value, and presence of key species. | DoE | NT DoT MP | 2009 | 1,3 |
| **RM3.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM4.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2,5 |
| **RM5.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM6.** Expand studies into the biodiversity of *forest and woodland* species. | DoE | IntC | 2009 | 3 |

| Communication & Publicity | | | | |
|---|---|---|---|---|
| **CP1.** Promote *forest and woodland* as a valuable feature of the natural environment of the Cayman Islands. | DoE NT | DoT CIG | ongoing | 3 |
| **CP2.** Promote landscaping with native trees typical of *forest and woodland*. | DoE | QEIIBP NT | 2008 | 3 |
| **CP3.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 3 |

**REFERENCES and FURTHER READING for *Forest and woodland***

## TERRESTRIAL HABITATS

### *16. Caves*

**Definition**
*Caves* are erosional landforms, including pot holes and fissures, which form as a result of wave action, or the action of rain and underground water courses.

**Local outline**
Over time, the carbonate rock which forms the Cayman Islands has repeatedly been submerged by, and emerged from, the Caribbean Sea. Limestone is a sedimentary rock composed largely of the mineral calcite (calcium carbonate, $CaCO_3$). Older strata have been dolomitized with $CaMgCO_3$ replacing $CaCO_3$. Carbonate rocks are partially soluble in water, making them susceptible to erosion.

The effect of seawater erosion is evident in the *Maritime cliffs* around the Islands, with distinct wave-cut notches clearly visible in the rock. These notches occur both significantly higher and lower than the present sea surface, indicating prehistoric variations in sea-level.

Rain water settling in hollows and cracks dissolves surface rock, infiltrating and widening to form the jagged topography typical of the interior of the Islands. The extension of fissures below the surface of the rock leads to the channelling of underground water courses, resulting in the formation of larger solution cavities and *caves.* These erosional landscapes are known as *karsts*.

**Key Habitat Categories for *Caves***
Erosional landforms, including pot holes and fissures, which form as a result of wave action, or the action of rain and underground water courses.

- Caves

### Key Species for *Caves*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for CAVES | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |

### Current Status of *Caves*

The current status of *caves* in the Cayman Islands is largely unknown. GIS referencing, cave system mapping, and assessment of current biological interest of *caves* will be addressed as part of the *Research & Monitoring* of this HAP. Of the major known *caves*, only the Salina Bat Cave falls within a protected area - the National Trust Salina Reserve.

### Key Sites for *Caves*

GRAND CAYMAN:
Old Man Bay (Bat) Caves
Miller's Caves
Furtherland Farm Caves
Dolphin Caves
Crab Cave
Salina Bat Cave - falls within the National Trust Salina Reserve.
Spotts Cave

CAYMAN BRAC:
Hutia Cave
Fig Tree Cave
Pollard Bay Cave
Shearwater Cave 1 and 2
Sea bird Cave
Spot Bay Cave
Peter's Cave
Patton's Fissure
Chandelier Cave - discovered and vandalised in 2006
Rebecca's Cave

*Caves* are currently underrepresented within the protected areas of the Cayman Islands.

The most significant *caves* sites currently protected are:

*Salina cave*, Grand Cayman, property of the *National Trust for the Cayman Islands*.

### Nature Conservation Importance of *Caves*

- *Bats:* several of Cayman's resident species of bats inhabit *caves*. Bats are important indicator species of a functional environment, and contribute significant biological control of undesirable insects such as mosquitoes. Bats are sensitive to disturbance, some species particularly so, both directly, and indirectly, by virtue of modification of their roost sites. Factors such as air currents and microclimate greatly influence roost site suitability. *Old Man Bay (Bat) Caves* once supported a roosting population of *Tadarida brasiliensis*. When the roost was first assessed, in 1979, Morgan estimated the population size at between 2,000 and 5,000 individuals (Morgan 1994). The *cave* shows signs of significant disturbance, both by lighting of fires and extraction of guano. These activities have probably contributed to complete desertion of the colony by Tadarida, with only a

small population of *Artibeus jamaicensis* remaining. Roosts at Bodden (Pirates) Cave, and the Bat Cave, Cayman Brac, are similarly now largely deserted.
- *New species:* the restricted confines of undisturbed *cave* environments represent a microcosm for evolutionary processes. As a result, new and unique species are often found associated with specific *cave* systems.

*Other:*

- *Geological interest:* erosional features of limestone *caves* contribute to their geological interest.
- *Palaeontological interest:* undisturbed *cave* sediments and deposits can provide a valuable prehistoric record. In the Cayman Islands, the majority of fossils are found close to the surface. Significant deposits have been recovered from *Crab Cave* and *Dolphin Cave* in Grand Cayman, and *Patton's Fissure* and *Pollard Bay Cave* in Cayman Brac - notes currently reside with the Florida Museum of Natural History.
- *Hedonic value:* accessible *caves*, especially those with significant rock formations are of general interest to the public.
- *Cultural: Peter's Cave* is the most significant cave from a cultural perspective. Situated high in the cliffside of the Bluff on Cayman Brac, *Peter's Cave* served to shelter many survivors of the devastating '32 Storm, in which 109 people lost their lives. It is still used as a refuge to this day.
- *Nature tourism:* accessible *caves* have the potential to be developed into popular nature tourism attractions. Tours are usually facilitated through local guides under direction of a Management Authority. Given the sensitivity of the biological and geological features of *caves* to disturbance and damage, effective site management is essential if these features of interest are to be preserved. *Pirate's Cave* in Bodden Town features *Bodden Caves* as part of a low-end tourist attraction, incorporating an (abandoned) roost of *Artibeus jamaicensis* and animal menagerie.
- *Recreation:* where *cave* access is challenging, caving and potholing may become established niche sports. Some exploration and mapping of the *cave* systems in the Cayman Islands has been undertaken, however, this information should be reviewed and updated.

### Current Factors Affecting *Caves*

- *Dumping: caves* and fissures entrances are commonly used as dumping grounds. This practice causes disturbance to *cave* dwelling creatures, and results in the blocking of entranceways, and modification of internal air-currents and microclimate.
- *Development:* when *caves* are uncovered during the course of land clearance and development, they are usually in-filled with rock aggregate. There is generally little impetus for the preservation of *caves* and incorporative site design.
- *Vandalism:* erosional rock formations develop over hundreds and even thousands of years, however, they are generally extremely fragile in nature, and susceptible to momentary physical damage. This makes rock formations an attractive target for vandals and unscrupulous souvenir hunters. Single incidents of vandalism may inflict permanent and irreparable damage.
- *Disturbance: caves* may be subject to deliberate or accidental disturbance. The use of fire, bright lights, and the simple presence of people can be sufficient to encourage a sensitive bat colony to desert an otherwise suitable roost. Sea bird cave in Cayman Brac requires immediate assessment, to determine whether any bird interest remains.
- *Lack of public education:* public fear and folklore contribute to misperceptions regarding bats, and contribute to their persecution and an undervaluing of *caves.*

### Opportunities and Current Local Action for *Caves*

- *Agricultural Pavilion Cave* – a small cave on the northern boundary of the Lower Valley forest, adjacent the Agricultural Pavilion, was filled with debris following Hurricane Ivan. In 2007, discussions commenced with the Department of Agriculture regarding the clearance of debris from the site and restoration of the cave. This initiative would complement current plans by DoA to upgrade the Pavilion site, and promote the Agritourism initiative.

- *Old Man Bay (Bat) Caves* – this network incorporates over a dozen surface caves, and may represent the most significant cave system in the Cayman Islands. In 2004, an abortive attempt to develop the site as a tourist attraction resulted in excavation of the cave floor. Poorly planned widening of established access trails resulted in the establishment of Maiden plum *Comocladia dentata*. Though heavily impacted by fire, which probably contributed to the desertion of the historic colony of *Tadarida brasiliensis*, a bat presence (*Artibeus jamaicensis*) remains in the largest cave, and several of the smaller caves. The site remains of significant interest, and benefits from primary dry forest, incorporating large Strangler figs *Ficus aurea*. This site might respond well to targeted restoration and management.
- *Chandelier Cave Cayman Brac* – discovered in 2006 as a result of new road construction, this cave is of special geological interest for its festoons of slim stalactites. Major features were vandalised within weeks of discovery.

**HABITAT ACTION PLAN for *Caves***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Improve knowledge and understanding of *caves* in the Cayman Islands. | 2015 |
| **2.** Ensure protection of species which rely on *caves* habitat. | 2008 |
| **3.** Protect 30% of currently known *caves* systems in the Cayman Islands. | 2015 |

| Caves<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3 |
| **PL2.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL3.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines to discourage damage or disturbance to *caves*. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2,3 |
| **PL4.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 2,3 |
| **PL5.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3 |
| **PL6.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 2 |
| **PL7.** Clarify land ownership issues associated with *caves*. There is a presumption that *caves* belong to the landowner above, however landownership may be stratified vertically as well as horizontally. This issue may give rise to ambiguity of ownership, particularly in relation to systems which transgress surface ownership boundaries, have multiple openings, or open onto Crown-owned cliff face. | DoE | DoP LS<br>CPA<br>DCB<br>CIG | 2010 | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to | CC | DoE NT | 2015 | 2,3 |

| | | | | |
|---|---|---|---|---|
| purchase and protect / establish management agreements with landowners of the *caves* and *forest and woodland* associated with the Old Man Bay (Bat) Caves, Grand Cayman. | | MP CIG | | |
| **SM2.** Use of the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of Peter's Cave and Chandelier Cave and surrounds, Cayman Brac. | CC | DoE NT MP CIG | 2015 | 2,3 |
| **SM3.** Subject to RM4, use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of the previously unmapped cave system running the length of the Bluff, Cayman Brac. | CC | DoE NT MP CIG | 2015 | 2,3 |
| **SM4.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of a *cave* suitable for establishment as a "show-cave". Develop on-site access and interpretation to facilitate visitation by school-groups, towards educating students regarding the geological and biological interest of *caves*. | CC | DoE NT MP CIG DE | 2015 | 1,2,3 |
| **SM5.** Investigate Bluff-face *caves* in Cayman Brac for nesting seabirds, and employ protective measures and access management at sensitive sites, as necessary. | DoE | IntC | 2010 | 1,2 |
| **SM6.** Work with the *Department of Agriculture* to support the restoration of the *Agriculture Pavilion Cave* as part of the Agritourism site project. | DoA | DoE IntC | 2009 | 2,3 |
| **SM7.** Employ protective measures and access management at sensitive sites, as necessary, towards preserving biological and geological interest. | DoE | IntC | 2015 | 2 |
| **SM8.** Implement KEY SPECIES SAPs, with special attention to the *Bats* SAP.. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Work with *Department of Planning* and developers to encourage incorporative site design, when new *caves* are discovered as a result of clearance for development, towards retaining *caves* as functional elements of developed landscapes | DoE | DoP MP | 2008 | 1,2 |
| **A2.** Promote best practice in *Development Plans*, to ensure the preservation, and natural function, of *caves*. | DoE | DoP CPA DCB | ongoing | 2 |
| **A3.** Ensure that local planning mechanisms take into account the wildlife interest and hedonic value of *caves*. | DoE | DoP CPA DCB | ongoing | 2 |
| **A4.** Targeted awareness of the need for the National Conservation Law. | DoE | CIG NT | 2006 | 2,3 |
| **Research & Monitoring** | | | | |
| **RM1.** Determine ownership status of all significant cave systems. | DoE | | 2010 | 1 |
| **RM2.** Recover and update existing data on the *caves* of the Cayman Islands, including those mapped by Morgan 1994, and files held by the Florida Museum of Natural History. | DoE | | 2010 | 1 |
| **RM3.** Update GIS and internal maps of cave systems and assess immediate threats to their integrity. | DoE | | 2010 | 1,2 |
| **RM4.** Investigate reports of the existence of a cave | DoE | | 2009 | 1 |

| | | | | |
|---|---|---|---|---|
| system running the length of the Bluff on Cayman Brac. | | | | |
| **RM5.** Investigate *caves* for presence of bats, and other possibly unique or unknown species. | DoE | IntC | 2015 | 1 |
| **RM6.** Work with outside agencies to establish management and restoration protocols for protected cave systems. | DoE | IntC | 2015 | 1,2,3 |
| **RM7.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM8.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Promote *caves* as a valuable feature of the natural environment of the Cayman Islands. | DoE NT | DoT CIG | ongoing | 1 |
| **CP2.** Educate public about the specific sensitivities of caves and urge cave visitors to avoid damaging activities. | DoE NT | MP | 2012 | 1 |
| **CP3.** Work with the public and students to allay traditional fears regarding bats. | NT DoE | IntC MP | ongoing | 1 |
| **CP4.** Utilise designation of new National Parks and protected areas to promote the Cayman Islands internationally. | DoE | DoT CIG NT MP | 2006 | 1 |
| **CP5.** Utilise show-cave to educate students about the geological processes which form the Cayman Islands. | DoE | IntC CIG MP | 2015 | 1 |

## REFERENCES and FURTHER READING for *Caves*

Anderson, S., Woods, A.A., Morgan, G.S. and Oliver, W.L.R. (1983). Geocapromys brownie. Am. Aoc. Mammalogists. Mammalian species 201: 1-5.

## TERRESTRIAL HABITATS

### *17. Farm and grassland*

**Definition**
For these purposes, *farm and grassland* is regarded as any land which is activity managed for agricultural purposes (including occasional use), or comes under the influence of agricultural practice, specifically, the growing of fruits, crops or the keeping of livestock.

**Local outline**
Given the paucity of good soil in the Cayman Islands, *farm and grassland* is typically fragmented. Additionally, farming in *karst* areas generally suffers from a lack of surface water, with rainwater quickly moving through crevices and deeper into the ground. A variety of natural habitats are modified to produce land suitable for planting and grazing. Clearance of low-lying buttonwood wetlands results in the formation of *seasonally flooded grasslands*, subject to prolonged flooding during the wet season. In most areas *Urochloa mutica* and *Lippia nodifora* dominate, however, in some unmanaged wet areas, such as the southern portion of the Salina Reserve, grassy marshlands develop. Dominated by Sawgrass *Cladium jamaicense*, these semi-natural grasslands are maintained under the influence of intermittent wildfires. These wildfires may contribute to the maintenance of the associate endemic herb *Agalinis kingsii* (Diochon 2003).

In dryer areas, pasture derived from the clearance of *forest and woodland* results in the formation of *medium tall tropical/subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs* and, in the driest areas, *short tropical or subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs*. In these areas, Guinea grass *Panicum maximum* dominates. A native of Africa, Guinea grass is cultivated providing pasture or cut fodder for cattle. Reversion to forest is generally prevented by seasonal burning which kills tree saplings.

In areas where pastures become relict, dry areas are naturally colonised by species such as Strawberry *Eugenia axillaris*, Lancewood *Randia aculeata* and Parrot berry *Bourreria venosa*. However, in most cases, natural colonisers are marginalized by invasive species such as Logwood *Haematoxylum campechianum* and Wild tamarind *Leucaena leucocephala*.

*Farm and grassland* additionally incorporates crops and plantations. While some vegetables are grown, fruit plantations are the predominant crop, including mango, banana, avocado, sweetsop and soursop.

**Key Habitat Categories for *Farm and grassland***
Incorporates, the following vegetation formations, as *per* Burton (2008b):

- Seasonally flooded grasslands V.A.1.N.g.
- Medium tall tropical/subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs V.A.3.N.c.
- Short tropical or subtropical grassland with broad-leaved evergreen or semi-evergreen shrubs V.A.3.N.f
- Saturated tropical or subtropical perennial forb vegetation V.B.1.N.d
- Agricultural plantation

### Key Species for *Farm and grassland*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are dependent upon this habitat.

| KEY SPECIES for FARM AND GRASSLAND | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Grand Cayman parrot<br>Brac parrot<br>West Indian Whistling-duck | Aves<br><br><br>*Amazona leucocephala caymanensis*<br>*Amazona leucocephala hesterna*<br>*Dendrocygna arborea* | <br><br><br>SAP<br>SAP<br>SAP |
| Reptiles | Grand Cayman Blue iguana | *Cyclura lewisi* | SAP |
| Plants | | *Agalinis kingsii* | |
| **PART 2** | | | |
| None | | | |
| **INVASIVE** | | | |
| Birds | Monk parakeet (Parrot SAP) | *Myiopsitta monachus* | SAP |

### Current Status of *Farm and grassland*

Working with local farmers, the *Department of Agriculture* and the *Agricultural Society*, GIS mapping and assessment of current and relict farmland will be undertaken as part of the *Research & Monitoring* of this HAP - identifying key areas for farming, towards preservation of agricultural practice, and early identification of opportunities and possible conflicts for environmental conservation.

*Link to habitat map: Farm and grassland Grand Cayman*
*Link to habitat map: Farm and grassland Cayman Brac*
*Link to habitat map: Farm and grassland Little Cayman*

| Habitat Status 2006 Seasonally flooded grassland | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % Habitat protected | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Seasonally flooded grassland V.A.1.N.g | 99.6 | 0.3 | 62 | 92.5 | 0.0 | 0.0 | 7.1 | 0.3 | 62 | 92.87 | 0.00 | 0.00 |
| Farmland | Current farmland usage, including crops and plantations, actively grazed pasture, and areas of prime relict farmland, to be determined in consultation with local farmers and partners. | | | | | | | | | | | |

### Key Sites for *Farm and grassland*

Currently, no *farm and grassland* is actively managed for wildlife conservation in the Cayman Islands.

### Nature Conservation Importance of *Farm and grassland*

*Grassland* is not a natural habitat of the Cayman Islands. All pasturelands and grasslands may be regarded as either actively man-modified or influenced. *Grassland* supports a variety of herb species, however, these are generally pantropical weeds; many are invasive species. The lack of structural diversity of grassland, combined with its complement of largely exotic species makes it generally of low biodiversity importance. The loading of exotic species mean that, even once abandoned, invasive species establish ahead of natural succession. As a result, even in relict form, *grassland* rarely reverts to truly native *woodland*.

Of greater conservation interest are the semi-natural Sawgrass Wetlands, in the southern margins of the Salina Reserve. These wetlands support one of only two known populations of the endemic herb *Agalinis*

*kingsii*, the other known population being in disturbed areas of exposed peat, in the Central Mangrove Wetland.

Fruit plantations are of significant biodiversity value. While fruit trees are generally exotic in origin, they are structurally diverse, and many native species are attracted to feed on the fruits. The ready availability of food acts as a *"honeypot"*, attracting native wildlife from the surrounding area. In some cases, predation is restricted to windfall fruits, such as is the case with the Grand Cayman Blue iguana *Cyclura lewisi*. In other cases, native wildlife feeds on, and damages, fruit still on the trees, resulting in a conflict situation with farmers. Damaging species include the Cayman parrot *Amazona leucocephala,* West Indian woodpecker *Melanerpes superciliaris,* Bananaquit *Coereba flaveola* and several species of bats. Feral crop pests include rats, Agoutis *Dasyprocta punctata* and Monk parakeets *Myiopsitta monachus*.

- *Land use planning:* while of limited conservation value, *farm and grassland* has the capacity to directly impact areas of conservation importance through inappropriate land use planning. The current trend towards the loss of prime *farm and grassland* to residential development has to an extent marginalized the agricultural industry. This has the potential to encourage expansion of agricultural land into areas of primary vegetation. Sustainable land use planning would identify and preserve the best areas of agricultural land, and reduce pressure on both agricultural land and natural areas from inappropriate development.
- *Adaptive species: while farm and grassland* is not regarded a natural habitat, some native species are able to effectively adapt to the modified environment which it affords e.g. Grand Cayman Blue iguana *Cyclura lewisi* and the endemic herb *Agalinis kingsii*. As native habitats come under increasing pressure, appropriate management of *farm and grassland* towards encouraging and maintaining its complement of adaptive species will become increasingly important.

*Other:*

- *Cultural value:* agricultural practice is a central component of the culture of the Caymanian people. In recent years, the industry has declined in the face of the immediate and short-term profits from land-sale and real estate, however a core of dedicated farmers remain, and the agricultural tradition in carried on in the backyards and gardens of many Caymanians.

### Current Factors Affecting *Farm and grassland*

- *Illegal shooting:* while some farmers are content to absorb the costs of crop damage by protected species, for others, crop management has long extended to illegal shooting, particularly of Cayman parrots *Amazona leucocephala*. Despite paper protection under the Animals Law, authorities have turned a blind eye to this activity, and to date no prosecutions have been brought.
- *Honeypot effect:* the value of fruit farms as a feeding habitat draws wildlife from outside of the immediate area, into concentrated feeding aggregations. This exacerbates damage and encourages a perception of greater numbers in the population. The *honeypot effect* makes lethal control of wildlife on site especially damaging, establishing a cycle of removal and immigration, resulting a concomitant reduction in both proximal and distal populations.
- *Development:* loss of traditional *farm and grassland* to residential development reduces its value as a wildlife habitat, and may have the knock-on effect of forcing agriculture practice to expand into new areas.
- *Invasive species:* due to its disturbed nature and heavy loading of exotic species, invasive species are usually the first to establish in abandoned farmland.
- *Fire:* poorly managed use of fire to maintain pasture land often leads to damaging wildfires. Deliberate arson attacks also constitute an occasional source of fire damage. Notably, there is some evidence that occasional, moderate burning may contribute to the habitat requirement for *Agalinis kingsii* (Diochon *et al.* 2003).
- *Financial cost:* given the paucity of soil and limited land area, agriculture is not and never will be a highly lucrative business in the Cayman Islands. Financial constraints moderate opportunities for intensive farming practice and many forms of pest control prove cost prohibitive. Immediately

profitable options, such as selling land for real-estate development contribute to the pressure on farmers.

- *Lack of public education:* As land prices in the Cayman Islands increase, traditional farming practice will become increasingly unsustainable financially. If farming is to survive in the future, innovative practices and diversification of product and market will be required in order to maintain the viability of the industry.

### Opportunities and Current Local Action for *Farm and grassland*

- *Parrot Jam*: A long-pending initiative of the *Department of Environment*, the *Parrot Jam Project* seeks to establish an USDA-approved jam-making facility on Grand Cayman to process prime and damaged fruit produce into a premium product for sale locally and to the tourist market. The initiative would pay farmers an elevated premium for their product, and run on a not-for-profit basis, trading on the parrot conservation angle. Profits would be passed directly to farmers to directly offset costs incurred by pest damage, with the objectives of preserving the Cayman parrot and the farmland feeding habitat, and elevating the parrot from a crop pest to an effective marketing tool.
- *Agritourism:* is currently a target area of interest for the Department of Agriculture. Given the honeypot effect of *farm and grassland*, such initiatives might prove effective, assuming legal compliance and effective management, and marketing of initiatives.

### HABITAT ACTION PLAN for *Farm and grassland*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *farm and grassland* for the Cayman Islands. | 2008 |
| **2.** Ensure that environmental consideration is given due weight in the development planning process for *farm and grassland*, with a view to seeking mutually beneficial progress. | 2012 |
| **3.** Reduce any negative impact of *farm and grassland* on the surrounding environment. | 2015 |

| Farm and grassland PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Commence active enforcement of provisions under the *Animals Law, Part 9, 78a, 78b and 78c*, against illegal shooting and removal from the wild of native parrots, in tandem with Government ringing programme. | DoE | CIG<br>RCIP<br>DoA | 2006 | 3 |
| **PL4.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 3 |
| **PL5.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and enforce regulations prohibiting clearance of land by mechanical means without planning permission. | DoE | DoP<br>CPA<br>DCB | 2012 | 2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines towards preservation of traditional high-value *farmland* while maintaining and maximising conservation value. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 2 |
| **PL7.** Promote establishment of a *Development Plan* for | DoP | CIG MP | ongoing | 2 |

| | | | | |
|---|---|---|---|---|
| the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DCB | DoE | | |
| **Safeguards & Management** | | | | |
| **SM1.** Implement KEY SPECIES SAPs, with special attention to the *Cayman Parrot* SAP. | DoE | | | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of the environment of the Cayman Islands. | DoE | DoP CPA DCB | ongoing | 2,3 |
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest of the natural environment of the Cayman Islands. | DoE | DoP CPA DCB | ongoing | 2,3 |
| **A3.** Work with *Department of Planning* to address the loss of natural habitat and prime *farm and grassland* to *urban and suburban* development. | DoP | DoE DoA AS MP | 2009 | 2,3 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3 |
| **A5.** Work with *Department of Agriculture* to ensure that agricultural development policies adequately take into account the preservation and natural function of the natural environment of the Cayman Islands. | DoE | DoA AS CIG MP | 2009 | 2,3 |
| **Research & Monitoring** | | | | |
| **RM1.** Update and refine existing maps of *farm and grassland*. | DoE | | 2008 | 1 |
| **RM2.** Work with *Department of Agriculture* and the *Agricultural Society* to identify key areas for farming, towards preservation for agriculture practice, and early identification of opportunities and possible conflicts for environmental conservation. | DoE | DoA AS | 2009 | 1 |
| **RM3.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM4.** Develop and expand research programmes, to incorporate and target indicators of climate change. | DoE | IntC | 2010 | 2 |
| **RM5.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **RM6.** Expand studies into the biodiversity of *farm and grassland* species. | DoE | IntC | 2009 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Promote environmentally sound farming in the Cayman Islands. | DoE | DoA CIG MP | ongoing | 3 |
| **CP2.** Utilise environmentally sound farming to promote the Cayman Islands internationally. | DoE | DoA DoT CIG NT MP | 2006 | 2 |

## REFERENCES and FURTHER READING for *Farm and grassland*

Diochon, A., Burton, F.J., and Garbary, D.J. 2003. Status and ecology of *Agalinis kingsii* (Scrophulariaceae), a rare endemic to the Cayman Islands (Caribbean Sea). *Rhodora* 105, 178-188.

## TERRESTRIAL HABITATS

### *18. Urban and man-modified areas*

**Definition**
The populated areas of the Cayman Island, and those areas of land subject to direct modification by man.

- commercial and residential areas on the islands, incorporating town centres, industrial sites, hotels and condominiums, and private homes and residential developments
- public and private green-space, such as parking lots, landscaped areas, parks and recreation grounds, cemeteries, and private gardens
- land cleared for development
- actively farmed land
- historically cleared areas, now reverting to nature, and exhibiting secondary growth
- roads are a component of this landscape, and are also assigned an individual *Roads* HAP.

**Local outline**
Since the 1970s, the population of the Cayman Islands has increased at an exponential rate; almost doubling every 10 years: 1960-8,511, 1970–10,068, 1980–17,757, 1990–26,969, 2000–40,800. Latest estimates (2006) are 53,172. (SOURCE: Cayman Islands Economics and Statistics Office).

Expansion of *urban areas* associated with residential development during this period has been concomitant with a boom in the local tourism industry. Tourism in the Cayman Islands began in the 1960s. The first Government statistics in 1963, reported 3,440 visitors. By 1974, the number of visitors had increased to 53,110 annually. In the 2000s, tourist numbers approached 250,000 stay over visitors, and 2 million cruise ship visitors. The expansion of the tourism industry has in large part driven the development of *urban and man-modified areas* and associated infrastructure, including *roads.*

Of the three Cayman Islands, Grand Cayman is the largest and most developed. Supporting some 95% of the population of the country (SOURCE: Statistical Compendium, 1999 (2006).

Spread of the *urban and man-modified areas* at the expense of natural habitats has encouraged some species to adapt to increasingly artificial landscapes, often giving rise to conflict situations. Several species of bats are able to live in roof spaces, as are birds, most notably the Barn owl *Tyto alba*, giving rise to noise and sanitary complaints. Presence of wildlife in gardens on public areas also gives rise to concerns and complaints from members of the public who are unfamiliar with the concept wildlife inhabiting the developed environment. Defence of active nests by Greater Antillean grackle (Ching-ching) *Quiscalus niger*, presence of snakes, scorpions, spiders and the invasive Green iguana *Iguana iguana* constitute the majority of complaints.

With the population of the Islands almost doubling every ten years, protected areas will become increasingly isolated ecologically, unless a concerted effort is made to maintain the biodiversity value of the built surrounds. As urban sprawl expands, the necessity to maintain ecological function within the built environment will become increasingly important, if environmental function and quality of life if to be maintained in the Islands.

**Key Habitat Categories for *Urban and man-modified areas***
*Urban and man-modified areas* impact all terrestrial habitats in the Cayman Islands.

**Key Species for *Urban and man-modified areas***
To a greater or lesser extent, most terrestrial species are impacted by *urban and man-modified areas.*

The following are selected from the schedules of the draft National Conservation Law; illustrating some of the endemic species, and those protected under international agreements, which are associated with this habitat:

| KEY SPECIES for URBAN AND MAN-MODIFIED AREAS | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* Of special significance to this habitat:<br>Grand Cayman parrot<br>Brac parrot<br>West Indian Whistling-duck<br>Greater Antillean grackle | Aves<br><br><br>*Amazona leucocephala caymanensis*<br>*Amazona leucocephala hesterna*<br>*Dendrocygna arborea*<br>*Quiscalus niger caymanensis* | <br><br><br>SAP<br>SAP<br>SAP |
| Invertebrates | Swallowtail butterfly (endemic) | *Heraclides andraemon tailori* | |
| Invertebrates | Cayman Zoe julia | *Dryas iulia zoe* | |
| Plants | Ghost orchid | *Dendrophylax fawcettii* | SAP |
| Plants | Old George | *Hohenbergia caymanensis* | SAP |
| Plants | Tea banker | *Pectis caymanensis var. robusta* | SAP |
| **PART 2** | | | |
| Birds | White-winged dove | *Zenedia asiatica* | |
| Reptiles | Eastern Grand Cayman Blue-Throated anole | *Anolis conspersus lewisi* | |
| Reptiles | Grand Cayman racer | *Alsophis cantherigerus caymanus* | |
| Reptiles | Cayman Brac racer | *Alsophis cantherigerus fuscicauda* | |
| Reptiles | Little Cayman racer | *Alsophis cantherigerus ruttyi* | |
| Reptiles | Grand Cayman Water snake | *Tretanorhinus variabilis lewisi* | |
| Reptiles | Grand Cayman Ground boa (Lazy snake) | *Tropidophis caymanensis caymanensis* | |
| Reptiles | Little Cayman Ground boa (Wood snake) | *Tropidophis caymanensis parkeri* | |
| Reptiles | Cayman Brac Ground boa (Lazy snake) | *Tropidophis caymanensis schwartzi* | |
| Reptiles | Cayman Brac Blind snake | *Typhlops biminiensis epactia* | |
| Reptiles | Grand Cayman Blind snake | *Typhlops caymanensis* | |
| Reptiles | Taco River slider (Hickatee) | *Trachemys decussata angusta* | |
| Plants | Silver Thatch palm | *Coccothrinax proctorii* | SAP |
| Plants | Banana orchid | *Myrmecophila thomsoniana minor / thomsoniana* | SAP |
| **INVASIVE** | | | |
| Birds | Monk parakeet (Parrot SAP) | *Myiopsitta monachus* | SAP |
| Reptiles | Red-eared slider | *Trachemys scripta* | |

## Current Status of *Urban and man-modified areas*

*Link to habitat map: Urban and man-modified areas Grand Cayman*
*Link to habitat map: Urban and man-modified areas Cayman Brac*
*Link to habitat map: Urban and man-modified areas Little Cayman*

| Habitat Status 2006 Urban and man-modified areas | Total area (ac) | | | Area within protected areas (ac) | | | Area outside protected areas (ac) | | | % with protected areas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Buildings | 1006.5 | 65.1 | 10.7 | 1.5 | 0.1 | 0.2 | 1005.0 | 65.0 | 10.5 | 0.15 | 0.12 | 1.69 |
| Man-modified land including: cleared land, public parks, private gardens, landscaped areas, farmland, secondary growth | 18712.0 | 3597.4 | 368.7 | 42.2 | 33.0 | 6.0 | 18669.8 | 3564.5 | 362.8 | 0.23 | 0.92 | 1.63 |
| Land for Public Purposes | 182.79 | 0.0 | 0.0 | 1.67 | x | x | 181.12 | x | x | 0.91 | x | x |

| | Total length of major roads (km) | | | Total length of roads actively designed and managed to minimise ecological impact (km) | | | Total length of roads not actively designed and managed to minimise ecological impact (km) | | | % of roads actively designed and managed to minimise ecological impact (km) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Roads | 500 | 96 | 47 | 0 | 0 | 0 | 500 | 96 | 47 | 0 | 0 | 0 |

### Key Sites for *Urban and man-modified areas*

Actively managed *urban and man-modified areas* are not currently represented in the protected areas of the Cayman Islands.

### Nature Conservation Importance of *Urban and man-modified areas*

- *Habitat destruction:* the spread of *urban and man-modified areas* affect all habitat types, and constitute the primary cause of habitat loss in the Cayman Islands. Coastal land has premium realty value, with high, dry land also an increasingly valuable commodity, particularly in the wake of Hurricane Ivan. Wetland, traditionally regarded as valueless land is converted into highly-profitable estate through canalisation and back-filling, to create canal lots with boating access.
- *Habitat fragmentation:* the impact of *urban and man-modified areas* on native habitat extends beyond the immediate footprint of development. Fragmentation introduces and exacerbates edge effects – ecological factors which come to bare along habitat peripheries. Edge effects include the introduction of exotic and invasive species and the interruption of migratory routes and wildlife corridors.
- *Invasive species: Urban and man-modified areas* represent introduction and radiation points for many invasive species. Invasive flora establishes mainly as a result of land clearance in association with development, and also through landscaping with exotics species, particularly Scaevola *Scaevola sericea*. Importation of exotic vegetation and soil represents the primary avenue of introduction of invasive fauna into the Cayman Islands, through incidental transport. Invasive and exotic species recently associated with exotic landscaping include Cane toad *Bufo marinus*, Brahminy Blind snake *Ramphotyphlops braminus*, Cuban Knight anole *Anolis equestris* and Pink mealybug *Maconellicoccus hirsutus*. Of the invasive fauna associated with *urban areas*, cats *Felis catus* and dogs *Canis lupus familiaris* are commonly known to significantly impact birdlife and reptiles. Vermin established in the islands include Black rat *Rattus rattus*, Brown rat *Rattus norvegicus* and House mouse *Mus musculus*. The impact of feral chickens, *Gallus domesticus*, Green iguanas *Iguana iguana* and Corn snakes *Elaphe guttata* are more poorly understood, and are currently unmanaged. Commencing in 2007, a coordinated attempt to remove feral Monk parakeets *Myiopsitta monachus* from the wild was successful in reducing the population by 86% by 2008.
- *Interruption of wildlife corridors: urban areas* present a barrier to the natural movement of species. Migratory routes, natural ranging, territorial establishment and dispersal are affected.
- *Interruption of natural drainage:* disruption of natural drainage systems by *urban and man-modified areas* has modified natural water courses on the islands, cutting-off water supply to some areas, and encouraging pooling of standing water in other areas, resulting in large-scale habitat impact, particularly in wetland areas.
- *Speculative land clearance:* the complete clearance of all vegetation from a saleable lot, to demonstrate its extent and topography, is common practice in the Cayman Islands. This results in immediate and long-term damage to the ecological value of the land. Regardless of whether a sale is forthcoming, invasive species colonise the cleared area, compromising both the cleared site and impacting neighbouring parcels, through providing a reservoir from which the invasive species spreads. Speculative clearance removes any option for a prospective buyer to maintaining native vegetation outside of the footprint of any new development.
- *Shifting baseline:* increasing urbanisation of the Cayman Islands over the past thirty years means that the current generation is growing into a highly developed *urban and suburban* environment. As a result, familiarity is established with a highly modified environment in which exotic species dominate over native, and this is regarded as the norm. The effect of *shifting baselines* is to

undermine and confuse traditional knowledge, skew cultural development and reduce the impetus for conservation of native species.

- *Wildlife injury:* predation by cats and dogs, and injury arising from physical collision, with road traffic, transparent windows, electrical wires and fencing are the predominant causes of wildlife injury
- *Poisoning:* deliberate and incidental poisoning of wildlife, contributes to a largely unquantified wildlife mortality. Active mosquito control is essential to maintaining the quality of life of people in the Cayman Islands, however, while pesticides are increasingly target-specific, they are likely to impact some non-target species. Setting of broad-range poisons introduces toxicity to natural food-chains and contributes to secondary poisoning of non-target species; a notable example being the death of Barn owls *Tyto alba*, resulting from the ingestion of poisoned rats.

*Other:*

- *Climate change:* removal of woody vegetation from the developmental footprint of *urban and suburban areas* and associated infrastructure constitutes the loss of a significant carbon sink.
- *Microclimate:* is a localized atmospheric zone where conditions differ from the surrounding area. In the case of the *urban and suburban* environment, the effects of radiant heat are exacerbated in the immediate vicinity, as a result of reflectance, and absorbance and reradiation of heat, leading the creation of urban "hot spots".
- *Pollution:* associated with *urban and man-modified areas* includes runoff, air pollution, dust, and chemical, light and noise pollution.

### Current Factors Affecting *Urban and man-modified areas*

- *Increasing population:* since the 1970s, the population of the Cayman Islands has increased at an exponential rate.
- *Development Planning:* a historical lack of effective development planning has contributed to *ad hoc* development, urban sprawl and conflicting land usage, such as mixing of industrial and residential development.
- *Landscaping:* landscaping is generally lacking, or restricted to occasional ornamental palms and exotic shrubs. Landscaping of this nature provides nothing by way of shade for pedestrians and other roads users, serves little or no ecological purpose, and does little to mitigate the aesthetic impact of country roads or to maintain urban green-space.
- *Microclimate:* prevailing hot and sunny weather conditions, lack of shade and paucity of sidewalks and cycle lanes discourage the public from walking even short distances.

*Other:*

- *Tourism:* aesthetically unappealing, poorly landscaped "urban sprawl" contributes directly to the perception of a "spoilt environment" - one which is a disincentive for repeat tourism. "Ugly" *urban and suburban* environments are a feature which most tourists actively avoid.

### Opportunities and Current Local Action for *Urban and man-modified areas*

- The *Native Tree Nursery* aims to provide a source of *dry shrubland* trees, with particular attention to those of particular rarity, endemic status and ecological value, towards reintroducing key species to the built environment, and preserving wildlife corridors between natural areas. Native landscaping maintains biodiversity, cultural value and aesthetic appeal of the build environment.
- The *Humane Society* collects feral cats and dogs, and operates a spay-and-neuter campaign.
- The *Department of Agriculture* collects and impounds feral cats and dogs.
- Commencing in 2007, a coordinated attempt by *Department of Environment* to remove feral Monk parakeets *Myiopsitta monachus* from the wild was successful in reducing the population by 86% by 2008.

- In 2008, all pet cats on Little Cayman were micro-chipped, and some 29 feral cats were captured, in a pilot study implemented by *Department of Agriculture*, *Department of Environment* and *Central Science Laboratories*, with the support of Governor's Fund and local hoteliers. This pilot study was towards eradication of the feral population in Little Cayman, and protection of the significant birdlife and reptile interest of the island.
- According to the Development and Planning Regulations (2006 Revision): Section 28. (1) *According to the size of a subdivision the Authority may require the applicant to set aside land for public purposes including children's playgrounds, sport fields, parks, churches and public rights of way and to reserve, without charge, adequate lots, not exceeding five per cent of the land being developed for public use.* By 2004, 256 parcels of LPP were designated in Grand Cayman, constituting a total area of 183 acres. There is, however, and unfortunate tendency for some developers to attempt to allot excavated pits and road corridors as fulfilling their requirement for LPP.

**HABITAT ACTION PLAN for *Urban and man-modified areas***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *urban and man-modified areas* for the Cayman Islands. | 2008 |
| **2.** Ensure that environmental consideration is given due weight in the *urban and man-modified areas* development planning process. | 2012 |
| **3.** Reduce the negative impact of *urban and man-modified areas* on the surrounding environment. | 2015 |

| Urban and man-modified areas<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Commence active enforcement of provisions under the *Animals Law, Part 9, 78b and 78c*, against illegal removal from the wild and keeping of native parrots as pets. | DoE | CIG<br>RCIP<br>DoA | 2006 | 3 |
| **PL4.** Commence active enforcement of provisions of the National Conservation Law, *Section 29*, against deliberate importation or release of invasive species. | DoE<br>DoA<br>HMC | CIG | 2008 | 3 |
| **PL5.** Commence active enforcement of provisions of *Endangered Species Trade and Transport Law*, with the addition of alien invasive plants and animals to *Part 3*. | DoE<br>DoA<br>HMC | CIG | 2009 | 3 |
| **PL6.** Establish policy of active management of *Land for Public Purposes* LPP towards maintaining the ecological value of the built environment. | DoE | CIG DoP<br>CC | 2012 | 2,3 |
| **PL7.** Establish policy that no *roads* or water-filled excavations be considered as fulfilling the planning requirement for *Land for Public Purposes* LPP, and that all applications submitted on this basis be rejected. | DoE | DoP<br>CPA<br>DCB<br>CIG | 2012 | 2 |
| **PL8.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2 |
| **PL9.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and | DoE | DoP<br>CPA | 2012 | 2,3 |

| | | | | |
|---|---|---|---|---|
| enforce regulations prohibiting clearance of land by mechanical means without planning permission. | | DCB | | |
| **PL10.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines towards maximising the ecological value of *urban and man-modified areas.* | DoP CPA | CIG MP DoE | ongoing | 2,3 |
| **PL11.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Expand the *Native Tree Nursery* to increase output and improve efficiency of use of water and power. | DoE | QEIIBP | 2012 | 3 |
| **SM2.** Provide native trees from *Native Tree Nursery* to supply private and commercial landscaping needs. | DoE | QEIIBP | 2009 | 3 |
| **SM3.** Support efforts aimed at controlling feral cats and dogs. | DoE | DoA HS | ongoing | 3 |
| **SM4.** Maintain annual cat control programme in Little Cayman, with the goal of eradicating all feral cats on the island. | DoE | DoA IntC MP HS | 2009 | 3 |
| **SM5.** Support efforts to reduce vermin, while reducing negative impact of control on non-target species. | DEH | DoE DoA | ongoing | 3 |
| **SM6.** Support efforts to reduce introduction of non-native flora and fauna into the Cayman Islands. | DoA | DoE MP | ongoing | 3 |
| **SM7.** Establish and operate a dedicated facility to receive quarantine and process invasive, introduced and confiscated species, and rehabilitate injured wildlife. | DoE | DoA CIG HMC | 2012 | 3 |
| **SM8.** Implement associated SAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of the natural environment of the Cayman Islands. | DoE | DoP CPA DCB | ongoing | 2 |
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest of the natural environment of the Cayman Islands. | DoE | DoP CPA DCB | ongoing | |
| **A3.** Promote retention / planting of native vegetation equal to 20% of the total parcel area in planning applications (exceeding one acre). | DoE | DoP | ongoing | 2,3 |
| **A4.** Work with *Department of Planning* to implement the *Native Planting Palette* in the landscaping of new developments. | DoP | DoE QEIIBP | ongoing | 3 |
| **A5.** Work with legislators to promote and implement a sustainable energy policy for the Islands. | DoE | CIG | ongoing | 3 |
| **A6.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2,3 |
| **Research & Monitoring** | | | | |
| **RM1.** Update and refine existing maps of *urban and man-modified areas*. | DoE | | 2008 | 1 |
| **RM2.** Develop low-maintenance, wildlife-friendly, resilient, high-shade planting schemes for *urban areas*. | DoE | QEIIBP | 2010 | 3 |
| **RM3.** Investigate feasibility of expanding nest box projects for local birdlife and bats. | DoE | NT | 2010 | 3 |
| **RM4.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and | DoE | | 2015 | 1 |

| | | | | |
|---|---|---|---|---|
| imagery into a spatially-referenced database. | | | | |
| **RM5.** Develop and expand research programmes, to incorporate and target indicators of climate change, with special attention to carbon neutrality. | DoE | IntC | 2010 | 2,5 |
| **RM6.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the social, economic and environmental benefits of maintaining and planting native trees in the built environment. | DoE | QEIIBP NT | ongoing | 3 |
| **CP2.** Support efforts for spaying and neutering of pet cats and dogs. | HS | DoE DoA | ongoing | 3 |
| **CP3.** Raise awareness of the value of artificial housing for wildlife, including bird and bat boxes. | NT | DoE | ongoing | 3 |
| **CP4.** Raise public awareness of potential conflict species including bats, snakes, spiders, scorpions, iguanas, wild birds and frogs. | DoE | NT | ongoing | 3 |
| **CP5.** Raise public awareness of international precedents for an increase in realty value associated with public green space, urban landscaping and association of property with established protected area amenities. | DoE | DoT CIG NT MP | 2006 | 2,3 |

**REFERENCES and FURTHER READING for *Urban and man-modified areas***

## TERRESTRIAL HABITATS

### *19. Roads*

#### Definition

For these purposes, *roads* are defined as the public and private roads network. *Roads* incorporates surfaced and unsurfaced roads and associated landscaping and infrastructure, including roundabouts, mediums, sidewalks, drainage conduits, roadside verges and pathways.

#### Local outline

Population expansion on Grand Cayman has long exceeded the effective handling capacity of the island's *roads* system. In recent years this has resulted in increasing issues related to traffic congestion, poor air quality, and noise and dust pollution. In an attempt to offset traffic congestion, government has embarked upon an ambitious programme of *roads* construction; however, in the face of the exponential expansion of the population, this has failed to alleviate the central issue of traffic congestion on the island. In addition to representing a significant financial burden to the islands, both immediately and in the long-term, the expansion of the *roads* system has greatly impacted the natural environment and exacerbated pollution problems. In many areas, storm-water management issues have arisen, through the associated increase in impermeable surfaces, and the disruption of natural drainage patterns.

With little serviceable public transport provision, use of roads by private vehicles represents the great majority of traffic. In many cases, vehicles are occupied solely by the driver. Usage of public roads by heavy goods vehicles contributes significantly to wear and tear.

Hot weather and a lack of shaded walkways make walking an unattractive option. Similarly, a general lack of provision for cyclists contribute to an underutilization of this method of transport.

In Cayman Brac and Little Cayman, roads networks are generally expanding in anticipation of a population increase. Both islands similarly lack effective public transport provision.

#### Key Habitat Categories for *Roads*

Roads impact all terrestrial habitats in the Cayman Islands. On Grand Cayman, *roads* are currently gazetted to pass through the Central Mangrove Wetland, the Mastic Reserve, the Salina Reserve and the Ironwood Forest.

#### Key Species for *Roads*

To a greater or lesser extent, most terrestrial species are impacted by *roads.*

| KEY SPECIES for ROADS | | | |
|---|---|---|---|
| **PART 1** | | | |
| **Category** | **Detail** | **Scientific Reference** | **NBAP** |
| Mammals | All bats *are protected under part 1.* | Chiroptera | SAP |
| Birds | All birds *are protected under part 1, unless specifically listed in part 2.* | Aves | |
| Reptiles | Grand Cayman Blue iguana | *Cyclura lewisi* | SAP |
| Reptiles | Lesser Cayman Islands iguana | *Cyclura nubila caymanensis* | SAP |
| **PART 2** | | | |
| Invertebrates | White Land crab | *Cardisoma guanhumi* | SAP |
| Plants | | *Epiphyllum phyllanthus var. plattsii* | SAP |
| Plants | | *Pisonia margarettiae* | SAP |
| Plants | Cayman sage | *Salvia caymanensis* | SAP |
| Plants | | *Turnera triglandulosa* | SAP |
| **INVASIVE** | | | |
| Birds | Monk parakeet (Parrot SAP) | *Myiopsitta monachus* | SAP |

## Current Status of *Roads*

*Link to habitat map: Roads Grand Cayman*
*Link to habitat map: Roads Cayman Brac*
*Link to habitat map: Roads Little Cayman*

| Habitat Status 2006 Roads | Total length of major roads (km) | | | Total length of roads actively designed and managed to minimise ecological impact (km) | | | Total length of roads not actively designed and managed to minimise ecological impact (km) | | | % of roads actively designed and managed to minimise ecological impact (km) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GC | CB | LC | GC | CB | LC | GC | CB | LC | GC | CB | LC |
| Roads | 500 | 96 | 47 | 0 | 0 | 0 | 500 | 96 | 47 | 0 | 0 | 0 |

## Key Sites for *Roads*

In 2008, the total length of the major *roads* network in the Cayman Islands exceeded 643 km.

Circum-island coastal *roads* were completed on Grand Cayman and Little Cayman in the early 1980s. These have contributed to accelerated habitat loss, particularly of *coastal shrubland*, through facilitation of coastal development. Associated population collapse in endemic species includes, most famously, the Grand Cayman Blue iguana *Cyclura lewisi*, and to a lesser extent, the Sister Islands Rock iguana *Cyclura nubila caymanensis*, both of which are now critically endangered.

Under pressure from the continuing and largely unplanned development of the islands' interior, *roads* networks increasingly crisscross the islands, threatening further habitat loss and fragmentation.

## Nature Conservation Importance of Roads

- *Lack of appropriate legislation:* There is currently no requirement for *Planning Application* before a road corridor is gazetted. There is currently no requirement for *Environmental Impact Assessment* before a road corridor is gazetted. There is currently no formal mechanism whereby the environmental impact of roads be formally considered, assessed, minimized, or mitigated.
- *Habitat fragmentation:* the impact of roadways on native habitat extends beyond the immediate footprint of development. Fragmentation introduces and exacerbates edge effects – ecological factors which come to bare along habitat peripheries. Edge effects include the introduction of exotic and invasive species and the interruption of migratory routes and wildlife corridors. In the case of forests, road corridors disrupt the natural aspect of the tree canopy, exposing the forest interior to the full force of prevailing winds. During severe weather events, this can result in the progressive collapse of trees along roadsides, facilitating the lateral expansion of edge effects and associated impacts further into the forest.
- *Invasive species:* roads provide an unparalleled mechanism for the transport, introduction and distribution of invasive species throughout habitats. Roads networks infuse the interior of pristine natural environments with tracts of highly modified, disturbed land, often altering the natural exposure, elevation, drainage and substrate of the immediate environment, and deterring recolonisation of roadside areas by neighbouring vegetation. As such, roadside verges are fertile grounds for establishment of invasive species. Once established, invasive species move laterally, colonising further into the natural environment under the impetus of edge effects.
- *Interruption of wildlife corridors:* roads present a barrier to the natural movement of species. Migratory routes, natural ranging, territorial establishment and dispersal are affected. Both ground-based fauna, and many species of birds are affected, according to their natural habit.
- *Interruption of natural drainage:* disruption of natural drainage systems by roads construction has modified natural water courses on the islands, cutting-off water supply to some areas, and encouraging pooling of standing water in other areas, resulting in large-scale habitat impact, particularly in wetland areas. This effect is particularly apparent in the cases of coastal roads, such as those adjacent the Booby Pond and Tarpon Lakes (Little Cayman) and South Sound and

Prospect (Grand Cayman). In the wake of severe storm surge and heavy rain associated with hurricane events, roads construction in these areas prevented to sea-ward drainage of storm water, resulting in the drowning and death of large tracts of mangrove wetland. Impermeable road surfaces prevent natural soak-away of rainwater, and contribute to water pooling on low-lying roads, and an increased storm-water burden on adjacent low-lying areas.

- *Reptiles:* the warm, open surface of asphalt roads attract reptiles to bask and elevate their body temperature. Roads, particularly coastal roads, have contributed significantly to the decline to the Grand Cayman Blue iguana *Cyclura lewisi* and the Sister Islands Rock iguana *Cyclura nubila caymanensis*.
- *Crabs:* busy coastal roads, inflict a heavy toll on the population of the island's land crabs, which of necessity undertake periodic mass-migration to the sea to lay their eggs. Most affected species are *Geocarcinus lateralis, Geocarcinus ruricola* and the White Land crab *Cardisoma guanhumi*.
- *Birdlife:* roads contribute to mortality amongst resident and migratory avifauna. Birds with a ground-based habit, and those which exhibit flight patterns which are direct and low to the ground, such as parrots, woodpeckers and waterfowl are especially prone to collision with vehicles. Some species may be actively drawn to roads, utilizing the open space as unobstructed flyways, or in the case of Barn Owls *Tyto alba* and Yellow-crowned Night Herons *Nyctanassa violacea*, hunting for prey along the open surface and margins. Even when death is not outright, sustained injuries more often than not render birds incapable of successful rehabilitation and release.
- *Associated habitat:* as roads networks expand in an attempt to offset the demands of an increasing population, the land associated with roads infrastructure will increase. As natural habitats are lost, maintenance of the ecological value of habitat associated with roads will become increasingly important. In the Cayman Islands, roadsides already constitute significant habitat for the Grand Cayman endemic Cayman sage, *Salvia caymanensis*, *Pisonia margaretae*, and the Little Cayman endemic *Turnera triglandulosa*.

*Other:*

- *Climate change:* roads contribute directly to accelerated climate change through the production of greenhouse gasses as a result of facilitating increased motor vehicle usage. The removal of woody vegetation from the developmental footprint of *roads* and associated infrastructure constitutes the additional lose of a carbon sink.
- *Microclimate:* is a localized atmospheric zone where conditions differ from the surrounding area. In the case of roads and the built environment, the effects of radiant heat are exacerbated in the immediate vicinity as a result of reflectance, and absorbance and reradiation of heat, leading the creation of urban "hot spots". This, accompanied by a lack of shade and the prevailing hot and sunny weather conditions discourage the public from walking even short distances, and encourages a reliance on air-conditioned car journeys.
- *Pollution:* associated with roads includes of runoff and storm water, and air pollution, including dust, chemical and noise pollution.

### Current Factors Affecting *Roads*

- *Increasing population:* increasing population places an increased demand on transportation infrastructure. Since the 1970s, the population of the Cayman Islands has increased at an exponential rate; almost doubling every 10 years: 1960-8,511, 1970–10,068, 1980–17,757, 1990–26,969, 2000–40,800, latest estimates (2006) are 53,172. (SOURCE: Cayman Islands Economics and Statistics Office). Expansion of a roads network to match a population which doubles every ten years is clearly unsustainable, even within the short-term.
- *Development Planning:* a historical lack of effective development planning has contributed to poorly designed roads network, modification of which is limited by occupation of preferential routes by commercial and residential development.
- *Landscaping:* landscaping of roads is generally lacking, or restricted to occasional ornamental palms and exotic shrubs. Landscaping of this nature provides nothing by way of shade for

pedestrians and other roads users, serves little or no ecological purpose, and does little to mitigate the aesthetic impact of country roads or maintain urban green-space.

- *Pedestrian provision:* most roads lack any provision for pedestrian use. Sidewalks are occasional features, as are cycle paths. No road in the Cayman Islands has been designed to incorporate a shaded pedestrian walkway.
- *Microclimate:* prevailing hot and sunny weather conditions, lack of shade and paucity of sidewalks and cycle lanes discourage the public from walking even short distances.
- *Maintenance cost:* roads use by heavy traffic, heavy goods vehicles, and the prevailing weather conditions combining extreme heating with heavy rains, require that roads are regularly resurfaced. This makes ongoing maintenance of roads a long-term financial burden.
- *Construction cost:* roads construction is an expensive undertaking. Aggregate is at a premium, and the low-lying nature of much of the islands necessitates a considerable fill requirement.
- *Road user demographic:* a combination of affluence and lack of effective public transportation alternatives combine to encourage private car ownership and usage, with many vehicles on the road occupied solely by the driver.
- *Congestion:* easing of congestion and facilitation of development are the primary objectives behind the expansion of roads, however there is a general lack of understanding that these factors are directly antagonistic. Expanding roads in an attempt to reduce congestion facilitates an increase in development and usage which contribute to maintenance of congestion.

*Other:*

- *Tourism:* the roads network forms a necessary component of the transport system required to facilitate the tourism industry, however, aesthetically unappealing, poorly landscaped and congested roads contribute directly to the perception of a "spoilt environment" - one which is a disincentive for repeat tourism. "Ugly", busy roads are a feature which most tourists actively avoid.

### Opportunities and Current Local Action for *Roads*

- *Public awareness:* in 2008, a controversial *roads* development through the *Ironwood Forest* was shelved amid public outcry. The forest is original growth dry forest, bounded on all sides by the *urban and suburban* development of George Town. The forest contains Cayman's most significant populations of Old George *Hohenbergia caymanensis,* and Ghost orchids *Dendrophylax fawcettii*, however, at the present time, the area remains without any formal protection.
- *Public transportation plan:* despite roads extension and widening being a consistent feature of the development of the Cayman Islands' infrastructure in recent years, works consistently fail to outstrip the rate of increase of usage, ensuring that traffic congestion remains more-or-less constant. Public transport in the islands is limited to a poorly scheduled system of minibuses, operating limited routes.
- *National Transportation Plan:* As the financial and environmental cost of building and maintaining the current roads network becomes apparent, public calls for the implementation of an effective *National Transportation Plan* may increase.
- *Hedonic value:* tree-lined avenues and shaded walkways encourage pedestrianisation, and improve the microclimate and aesthetics of the built-environment through provision of shade and lowering radiant heat, encouraging in a reduction in compensatory behaviours, such as use of artificial air conditioning.
- *Financial:* hedonic value of tree-lined landscaped roads and sidewalks translates directly into increased realty value in residential areas (Fox 1990, Morales 1980).
- *Roads preservation:* shading of sidewalks and roadways contributes directly to a reduction in maintenance costs due to weathering (McPherson *et al.* 2005).
- *Pollution control:* trees provide an effective buffer to the noise pollution associated with roads, and also contribute to improved air quality through a reduction in airborne dust and pollution.
- *Storm water management:* permeable growing surfaces planted with trees absorb storm water runoff, and reduce reliance on artificial drainage (Poole 1993).

- *Microclimate modification:* shade and evapotranspiration from urban trees contribute to cooling of the built environment (Dwyer 1993).
- *Climate change:* in addition to the carbon sequestration capacity of urban trees, the benefits to the moderation of urban microclimate, protection and shading of parked cars, roads, sidewalks and buildings contribute to urban trees being of greater influence in moderating climate change than comparable trees outside of the urban environment. Tree planting is a more cost-effective energy conservation and carbon dioxide reduction strategy than many other conservation measures (Akabari 1988, 2002).

**HABITAT ACTION PLAN for *Roads***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Update and refine existing maps of *roads* in the Cayman Islands. | 2008 |
| **2.** Ensure that Environmental consideration is given due weight in the *roads* planning process through the environmental assessment provisions of the National Conservation Law. | 2008 |
| **3.** Encourage the implementation of sustainable transportation alternatives towards establishing an effective long-term *National Transportation Plan*. | 2012 |
| **4.** Reduce the negative environmental impact of new and existing *roads*, and increase the biodiversity value of associated artificially created habitats. | 2010 |

| Roads<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 4 |
| **PL3.** Enforcement of the National Conservation Law, *Section 29* to make EIA mandatory for new roads construction. | DoE | DoP CIG CPA DCB | 2008 | 2,4 |
| **PL4.** Recommend a government policy that all new roads developments incorporate extensive and wholly native landscaping schemes to showcase unique Cayman flora, and incorporate provision of bicycle lanes and shaded medians and sidewalks, to encourage utilisation of alternative transport means. | DoE | DoP CIG CPA DCB | 2012 | 2,3,4 |
| **PL5.** Establish policy that no *roads* be considered as fulfilling the planning requirement for *Land for Public Purposes* LPP, and that all applications submitted on this basis be rejected. | DoE | DoP CPA DCB CIG | 2012 | 2 |
| **PL6.** Continue and improve implementation of international conventions, agreements and declarations to which the Cayman Islands is committed. | DoE | CIG | ongoing | 2,3,4 |
| **PL7.** Strengthen the *Development Plan* on Grand Cayman, and develop and implement guidelines towards minimised the environmental damage caused by *roads.* | DoP CPA | CIG MP DoE | ongoing | 2,3,4 |
| **PL8.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3,4 |
| **PL9.** Work with *Department of Planning* to introduce regulations to prevent speculative clearance of land, and | DoE | DoP CPA | 2012 | 4 |

| | | | | |
|---|---|---|---|---|
| enforce regulations prohibiting clearance of land by mechanical means without planning permission. | | DCB | | |
| **Safeguards & Management** | | | | |
| **SM1.** Expand the *Native Tree Nursery* to increase output and improve efficiency of use of water and power. | DoE | QEIIBP | 2012 | 4 |
| **SM2.** Provide native trees for *roads* and associated landscaping projects through the *Native Tree Nursery.* | DoE | QEIIBP | 2009 | 4 |
| **SM3.** Integrate minimisation of ecological impact into *roads* planning, design and management, incorporating measures such as native landscaping schemes, and provision of bicycle lanes, shaded medians and sidewalks, to encourage utilisation of alternative transport means. | DoE<br>NRA | DoP<br>CPA<br>DCB | 2012 | 2,3,4 |
| **SM4.** Implement associated SAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote best practice in *Development Plans*, to ensure the preservation and natural function of the environment of the Cayman Islands. | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3 |
| **A2.** Ensure that local planning mechanisms take into account the wildlife interest of the natural environment of the Cayman Islands. | DoE | DoP<br>CPA<br>DCB | ongoing | 2,3 |
| **A3.** Recommend revisitation and implementation of an effective *National Transportation Plan* scheme for Grand Cayman. | NRA | DoE CIG | 2012 | 3 |
| **A4.** Work with *National Roads Authority* to develop a policy for landscaping infrastructure, including roundabouts, mediums, sidewalks, drainage conduits and roadside verges, with suitable Native Trees. | DoE<br>NRA | QEIIBP | 2009 | 4 |
| **A5.** Recommend that all roads development be subject to *Planning Permission*. | DoE DoP | CIG | 2012 | 2,4 |
| **A6.** Recommend that *EIA* be mandatory for new roads construction, and for currently gazetted roads which impact environmentally significant areas. | DoE | CIG | 2006 | 2,4 |
| **A7.** Recommend cessation of further expansion of roads networks in the absence of long-term costing and assessment in the context of a *National Transportation Plan* for the islands. | DoE DoP | CIG<br>NRA | 2012 | 3,4 |
| **A8.** Recommend implementation of alternative traffic control measures, including incentives for bicycle, scooter and motorcycle usage, car-pooling and revised tax scale for multiple-vehicle ownership. | DoE | NRA<br>CIG | 2012 | 3,4 |
| **A9.** Targeted awareness of the need for the National Conservation Law. | DoE | CIG NT | 2006 | 2 |
| **A10.** Recommend that new roads construction adequately provision for maintenance of natural drainage. | DoE | NRA<br>DoP<br>CPA<br>DCB | ongoing | 4 |
| **Research & Monitoring** | | | | |
| **RM1.** Update and refine existing maps of *roads*.. | DoE | | 2008 | 1 |
| **RM2.** Develop low-maintenance, high-resilience, high shade planting palettes for *roads*. | DoE | DoP<br>NRA | 2009 | 4 |
| **RM3.** Incorporate all pre-existing and forthcoming research and monitoring data, habitat mapping and imagery into a spatially-referenced database. | DoE | | 2015 | 1 |
| **RM4.** Develop and expand research programmes, to | DoE | IntC | 2010 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| incorporate and target indicators of climate change, with special attention to carbon neutrality. | | | | |
| **RM5.** Utilise remote sensing to instigate a five-yearly habitat mapping programme. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the social, economic and environmental benefits of maintaining and planting native trees in the built environment. | DoE | NT | 2009 | 4 |
| **CP2.** Raise awareness of the social, economic and environmental benefits of developing an efficient public transportation system. | DoE | NRA<br>DoP | | 3,4 |
| **CP3.** Utilise local conservation efforts to promote the Cayman Islands internationally. | DoE | DoT CIG<br>NT MP | 2006 | 4 |
| **CP4.** Promote a "Colours of Cayman" planting scheme for *roads* of suitable native and endemic species, matching the colour palette of the Cayman Islands Coat of Arms. For example: Blue *Salvia caymanensis,* Green *Pisonia margaretae,* Yellow *Agave caymanensis,* Red *Cordia sebestena* var. *Caymanensis.* | DoE | QEIIBP | 2009 | 4 |

## REFERENCES and FURTHER READING for *Roads*


Akabari, H. (1988). The Impact of Summer Heat Islands on Cooling Energy Consumption and CO2 Emissions, American Council for an Energy Efficient Economy.

Akbari, H. (2002). Shade trees reduce building energy use and CO2 emissions from power plants *Environmental Pollution.* Vol. 116, Supp.1, March 2002, Pages S119-S126

Cayman Islands Economics and Statistics Office Statistical Compendium (2006). 11. Population and Vital Statistics. Economics and Statistics Office (ESO). Government of the Cayman Islands. www.eso.ky

Dwyer, J. F. (1993). The Economic Contribution of Trees to Urban Communities. In Trends: Justifying Recreation and Parks to Decision Makers. v. 30, no. 4

Fox, T. (1990). Urban Open Space: An Investment that Pays. The Neighborhood Open Space Coalition, New York, New York.

McPherson, E. G. and Muchnick, J. (2005) Effects of street tree shade on asphalt concrete pavement performance. Journal of Arboriculture 31(6)

Morales, D. J. (1980). The Contribution of Trees to Residential Property Value. *Journal of Arboriculture 6* (11). Pp 305-308.

Poole, W. (1993). *The Case for Urban Open Space*. Draft report prepared for Trust for Public Land, San Francisco, California.

# CAYMAN ISLANDS

## Species Action Plans 2009

*…a just world values and conserves nature…*

Department of Environment

## MARINE SPECIES

### Whelks (West Indian Topshell, Magpie shell, Caribbean Topshell) *Cittarium pica* & Soldier crab (Hermit crab) *Coenobita clypeatus*

INSERT IMAGES

INSERT IMAGE OF WHELK DISTRIBUTION

INSERT IMAGES (whelk image photo credit Leal 2002).

### Taxonomy and Range

Kingdom: Animalia, Phylum: Mollusca, Class: Gastropoda, Order: Vertigastropoda, Family: Trochidae
Genus: Cittarium, Species: pica

Whelks *Cittarium pica* are widely distributed throughout the Caribbean, Florida and Mexico, ranging from 26.5°N to 9.4°N; 88°W to 59.6°W . Depth: 0 to 7 m (0 – 21 ft)

### Status

**Distribution:** Historically common, however, there have been no recent comprehensive studies. According to Hess and Abbott (in Brunt and Davies 1994) "abundant on the lower ironshore all around the island (Abbott 1958); Barcadere Cove, Southwest Point, JP, alive, 1956, hundreds of individuals on ironshore; Prospect Point, ND, alive; North Side, GS, alive, 1969; lower to middle ironshore at Cayman Kai Resort (just east), DH, August, 1968, beach near Apollo 11, AD, 1974, all alive. CAYMAN BRAC: Behind Buccaneer Inn, GS, alive, 1973; also MCZ (JOHNSONIA). LITTLE CAYMAN: All around the island, lower middle and infralittoral iron shore (Potts 1975). Abundant, edible and commonly used in chowders." Whelks are now rapidly decreasing on all three Cayman Islands. Whelks are found in shallow water (0-7m).
**Conservation:** Although widely recognized as overexploited regionally, and despite its status as the third most commercially important invertebrate in the Caribbean (behind the Spiny Lobster, *Panulirus argus*, and the Queen Conch, *Strombus gigas*) there are no regional conservation initiatives for Whelks. Whelks are not listed on CITES or the IUCN Redlist.
**Legal:** *Cittarium pica* from Cayman Waters are specifically protected under the Marine Conservation Law (2007 Revision) Part III Section 8, which establishes a bag limit of 2.5 gallons of Whelks in their shell or 2.5 lbs of processed Whelk meat per person per day. There is a closed season 1st May - 31st October. More general protection is also established through Marine Conservation (Marine Parks) Regulations (2007 Revision) which restricts the removal of anything alive or dead from Marine Parks or the Environmental Zone or anywhere on the islands while on SCUBA. Licences to take marine life from the shoreline (defined as waters deep enough to stand in) are required under *Marine Conservation Law (2007 Revision)* Part V Section 19 for non-Caymanian residents and work permit holders. Licences are issued by the Marine Conservation Board and to-date they have been restricted to finfish, making the collection of any other marine species, including Whelks, illegal by non-Caymanians. Pending legislation, Whelks would be protected under the National Conservation Law (Schedule II). The Department of Environment is the lead body for enforcing the legal protection.

The associated Soldier crab (Hermit crab) *Coenobita clypeatus* has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Whelks *Cittarium pica* typically inhabit *ironshore* coasts and reef crests, hiding in crevices and small holes. Larger individuals (maximum reported size: 136 mm) inhabit areas of increased wave energy, while smaller juvenile snails are more commonly found in sheltered bays (Toller and Gordon 2005). In other areas of the Caribbean there is often a pronounced vertical zonation observed within the community. Smaller snails (shell width, SW, <10 mm) are found in the upper tidal zone, medium snails (SW 10-70 mm) are found to move with the tides and the larger snails are present in the lower tidal zone (Debrot 1990a).

This zonation has been suggested to be attributed to predator avoidance and/or food availability (Debrot 1990a). Although tidal fluctuations are small in the Cayman Islands (1-3 ft) this zonation is still evident.

It has been suggested that the reproductive season ranges from July to October in *C. pica* from the Bahamas, but it should be noted that this season could vary from region to region. Recruitment of 1-2 mm juveniles occurs in January, which suggests spawning around October (Bell 1992). During reproduction, fertilization occurs externally in the water column, with males and females releasing gametes simultaneously. Cleavage is rapid with the first cleavage occurring approximately 20 minutes following fertilization. The trochophore larvae are actively swimming ciliated larvae which hatch from the egg between nine and eleven hours after fertilization. Approximately three days after fertilization, the veliger attaches to a substrate, by use of its sticky muscular foot. Sexual maturity mostly occurs in animals older than three years, and with a shell length greater than 45 mm (Coates *et al.* 2003). lifespan of Whelks is not known, however, other trochid molluscs live 3-30 years (Robertson 2003).

Whelks are most active at night (Debrot 1990). Herbivore-detritivores, they feed on algae, diatoms, organic detritus, also ingesting sand, spicules and calcareous debris. (Randall 1964, Robertson 2003).

### Associated Habitats and Species *for Whelks & Soldier crab*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>2. Coral reef<br>3. Lagoons<br>7. Maritime cliffs and ironshore<br>14. Dry shrubland (Soldier crab)<br>15. Forest and woodland (Soldier crab) | Queen conch *Strombus gigas*<br>Spiny lobster *Panulirus argus* |

### Current Factors Affecting *Whelks & Soldier crab*

- *Natural predators:* these include Wide-mouthed purpura *Purpura patula*, (not recorded in the Cayman Islands), Common octopus *Octopus vulgaris*, Spiny lobster, *Panulirus argus*, Bonefish *Abula vulpes*, Porcupine fish *Diodon hystrix*, Puddingwife wrasse *Halichoeres radiatus*, and Rock hind *Epinephelus adscensionis* (Robertson 2003). Shorebirds and waders are also likely predators.

- *Harvesting:* collection of Whelks by humans has contributed most significantly to the population decline. Whelks are at risk extinction from harvesting, due to a combination of their high economic value (Meyer and Coates, 2005), and limitation of range to the accessible intertidal zone. Harvesting pressure in the Cayman Islands remains unquantified. Though of a subsistence nature it is likely intensive and increasing, due in part to rapid population increase. Whelks are a regular feature on local menus and a prevalent enforcement infraction.

- *Legal:* protection of Whelks is limited to daily bag limits and a seasonal closure of the fishery (May – October). There are currently no minimum size limits for landed shells as in other jurisdictions (Virgin Islands and Puerto Rico). Year-round protected areas or refugia are practically non existent, being severely constrained by the definitions of protected areas within the Marine Conservation (Marine Parks) Regulations (2007 Revision). Under the law, Marine Park boundaries technically extend to the Mean High Water Mark, making enforcement against Whelks collection with Marine Parks virtually unenforceable. Additionally the exclusion of non-Caymanians from shoreline fisheries of marine species is difficult to enforce, and cannot be considered effective. Whelks do not occur within the Environmental Zone, are not protected within Replenishment Zones, which are the zones within which most of the reef crest habitat falls.

- *Inter-species reliance:* an important aspect of the ecology of Whelks is the use of their shells, subject to expiration. Large Whelk shells are amongst few shells of suitable size to house the massive Soldier crab (Hermit crab) *Coenobita clypeatus*, and constitute almost 100% of the crab's

preferred shell selection. Extinction of Whelks would almost certainly be followed, in time, by the extinction of Soldier crabs.

- *Tourism:* shells of Whelks are popular tourist souvenirs, both in raw form and as craft jewellery. While souvenirs are generally derived from discarded shells, and so do not effect the Whelks, these particles are extremely extensive and constitute the whole scale removal of shell supply for Soldier (Hermit) land crab *Coenobita clypeatus.*

- *Bait:* Soldier (Hermit) crab *Coenobita clypeatus* is a popular fishing bait item.

- *Pollution:* tributyl tin has been shown to accumulate in the tissues of marine animals, including molluscs (Folsvik *et al.* 1999).

### Opportunities and Current Local Action *for Whelks & Soldier crab*

Whelks *Cittarium pica* harvesting is subject to bag limit and season. The intertidal zone, which constitutes the majority of Whelks' natural habitat, is not covered by the Cayman Islands system of marine protected areas. Effectiveness of legal protection might be increased by reducing catch limits and harvesting seasons, introduction of a minimum harvestable size limits, and ethnic specific fishery rights. All these measures, however, present some complicated issues for enforcement. Modification of the Marine Parks boundaries definitions to incorporate the intertidal zone, and inclusion of Whelks within the Replenishment Zone Regulations would facilitate enforceable protection, as would a moratorium on harvesting until the natural population showed significant signs of recovery.

In 1997, the Department of Environment undertook an island-wide survey of the shoreline of Grand Cayman. This survey incorporated quantitative intertidal transects at four sites (Jackson Point Terminal, Silver Sands, North Sound, East End Blowholes), where the density and size distributions of Whelks were assessed. Whelks were found on the ironshore west of the public dock at Spots, where the reef meets the shore at Breakers, and at Beach Bay, on the outer rocks surrounding the manmade lagoon. A juvenile snail (approximately 10 -15 mm in length) was found on the "beachrock" just as you enter East End, however, no Whelks could be found north, along the east coast up to, but not including North east point. None were found on the beach rock lining the eastern end of Meagre Pond Bay.

Mariculture opportunities for commercial exploitation utilizing existing facilities present an interesting possibility, which commands further investigation.

Local Whelks are listed as a seafood to "Avoid" under the Cayman Sea Sense education programme.

### SPECIES ACTION PLAN for *Whelks & Soldier crab*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Determine status of and threats to local populations, and ensure that local populations are protected from extirpation. | 2009 |
| **2.** Ensure availability and long-term stability of local Whelk (and dependent species) populations for sustainable harvest. | 2015 |
| **3.** Ensure sustained support for the conservation of Whelks through targeted education and awareness programmes. | 2015 |

| Whelks & Soldier Crab PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & | DoE | CIG | 2006 | 1,2 |

| | | | | |
|---|---|---|---|---|
| Transport) Law. | | | | |
| **PL3.** Protect *Cittarium pica* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Amend Marine Conservation Law to reduce daily catch limits and harvesting season, and introduce a minimum size limit for collection. | MCB DoE | CIG | 2012 | 1,2 |
| **PL5.** Amend Marine Conservation (Marine Parks) Regulations to incorporate Whelk shoreline habitat into the Marine Parks, and include Whelks in Replenishment Zones regulations. | DoE MCB | CIG | 2009 | 1,2 |
| **PL6.** Assess need for a temporary moratorium on harvesting to enable population recovery. | DoE | MCB CIG | 2009 | 1,2 |
| **PL7.** Establish policy of discouraging Cayman Islands' involvement in activities likely to contribute to an increase in pressure on local or regional stocks of threatened marine species e.g. "Conch eating contests". | DoE DoT NT | CIG CITA SITA | ongoing | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Using GIS location data, ensure that critical populations and their associated habitats are protected during Coastal Works and other development processes. | DoE | DoP CIG | 2009 | 1,2 |
| **SM2.** Adequately protect spawning individuals, by extension of closed season as necessary. | DoE MCB | | 2009 | 1,2 |
| **SM3.** Establish minimum harvestable size limits. | DoE MCB | | 2009 | 1,2 |
| **SM4.** Investigate and encourage the potential for commercial farming of Whelks, for augmentation of wild population, or towards sustainably meeting local demand. | DoE | | 2010 | 1,2 |
| **SM5.** Subject to feasibility, introduce artificial retreats for *Coenobita clypeatus* into the marine environment, to address developing shortfall in suitable shell habitat. | DoE | IntC MP | 2015 | 2 |
| **SM6.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Inform Marine Police on issues relating to the legal harvesting of Whelks, towards assisting in enforcement of local regulations. | DoE | RCIP | 2009 | 1,2 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Whelks and Soldier Crab PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Map habitat / potential habitat for *Cittarium pica* on all three islands. | DoE | | 2008 | 1 |
| **RM2.** Survey existing populations to determine baseline. | DoE | | 2010 | 1 |
| **RM3.** Design and implement annual population monitoring program. | DoE | | 2011 | 1 |
| **RM4.** Determine peak spawning season, and seasonal reproductive patterns. | DoE | | 2012 | 1 |
| **RM5.** Determine age at reproductive maturity in conjunction with the relation between reproductive output and age/size and fertilization success in relation to population density. | DoE | | 2012 | 1 |
| **RM6.** Review Caribbean-wide comparison of experience to identify best and worst case scenarios for Whelk management and commercial mariculture. | DoE | IntC | 2009 | 1,2 |
| **RM7.** Conduct morphological and materials analysis to determine suitable form, function, and design for artificial retreats for *Coenobita clypeatus.* | DoE | IntC | 2010 | 2 |
| **Communication & Publicity** | | | | |
| **CP1.** Targeted awareness campaign to key sectors of local community to inform groups that are prone to non-sustainable practice, regarding the need to manage harvesting sustainably. | DoE | MP | 2006 | 3 |
| **CP2.** Targeted awareness campaign to key sectors of Government to assist in adopting management and legislation recommendations. | DoE MCB | CIG | ongoing | 3 |
| **CP3.** Produce educational fact sheet detailing ecology and general biology of Whelks and Soldier Crabs for schools and local public. | DoE | MP DE | 2009 | 3 |
| **CP4.** Involve the public, particularly schools groups, in the artificial retreats project. | DoE | MP DE | 2010 | 3 |
| **CP5.** Raise awareness of sustainable alternatives to threatened fisheries amongst members of the public through involvement with educational programmes e.g. Cayman Sea Sense. | NT | DoE DoT CA MP | ongoing | 3 |
| **CP6.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 3 |

## REFERENCES and FURTHER READING for *Whelks & Soldier crab*


Abbot, R.T. (1958). *The Marine Molluscs of Grand Cayman Island, British West Indies*. Monographs of the Acad. Nat. Sci. of Philadelphia, no. 11, 139pp.

Bell. L.J. (1992). Reproduction and larval development of the West Indian Topshell, *Cittarium pica* (Trochidae) in the Bahamas. Bulletin of Marine Science 51(2): 250-266. (*e.g.* captive spawning and larval rearing)

Bell, L.J. (pending). Mariculture prospects for the West Indian Topshell, *Cittarium pica*. Proc. Gulf and Carib. Fish. Inst: submitted..

Castell, L.L. (1987). *Algunos aspectos de la biologia de la Quigua, Cittarium pica en el parque nacional archipielago de Los Roques*. Honours Thesis, *Universidad Central de Venezuela*, Caracas, Venezuela. 78 pp. (*e.g.* G.S.I., breeding season)

Coates, K., Jantzen-Marson, C., Madeiros, J. and Meyer, E. (2003). West Indian topshell, *Cittarium pica*, reintroduction project in Bermuda: Current status. Integrative and Cooperative Biology 43(6): 862.

Colin, L.J.B. (1991). Reproduction and larval development of *Cittarium pica*, (Gastropoda: Trochidae) in the Bahamas. M.S. Thesis, Florida State University, Tallahassee, FL: 80 pp.

Debrot, A.O. (1987). Ecology and management of the West Indian topshell *Cittarium pica* (L.) (Gastropoda: Trochidae) of the Exuma Islands, Bahamas. Ph.D. Dissertation, Un. of Miami, Coral Gables, Florida. 193 pp.

Debrot, A.O. (1990a). Temporal aspects of population dynamics and dispersal behaviour of the West Indian Topshell, *Cittarium pica* (L.), at selected sites in the Exuma Cays, Bahamas. Bull. Mar. Sci. 47(2): 431-447.

Debrot, A.O. (1990b). Survival, growth, and fecundity of the West Indian Topshell, *Cittarium pica* (Linnaeus), in various rocky intertidal habitats of the Exuma Cays, Bahamas. Veliger 33(4): 363-371.

Folsvik, N., J.A. Berge, E.M. Brevik, M. Walday, (1999). Quantification of organotin compounds and determination of imposex in populations of dogwhelks (Nucella lapillus) from Norway, Chemosphere, 38/3 681-691.

Government of the U.S. Virgin Islands (1991). Tropic News 3(12) 2, Dept. of Planning and Nat. Res., Div. Of Fish Wildlife, St. Thomas, U.S. Virgin Islands. (Management of wild stocks)

Hounsome, M. (1994). Terrestrial invertebrates (other than insects) of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 307-31.

Jory, D.E. and Iversen, E.S. (1985). Molluscan mariculture in the greater Caribbean: An Overview. Marine Fisheries Review 47(4): 1-10. (Refers to whelk culture work carried out by the Smithsonian Institution's Marine Systems Laboratory)
Leal, J.H. (2002). Gastropods. p. 99-147. In: Carpenter, K.E. (ed.). The living marine resources of the Western Central Atlantic. Volume 1: Introduction, molluscs, crustaceans, hagfishes, sharks, batoid fishes, and chimaeras. FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5. 1600pp.

Meyer, E. and Coates, K. (2005). An exploration of gamete maturity, growth and movement studies of the *Cittarium pica* (West Indian Topshell) in Bermuda. The Tentacle (13): 20-21.

Potts, G.W. (1975). Littoral Molluscs of the University of Cambridge expedition to Little Cayman, 1975., pp. 36-37.

Randall, H.A. (1964). A study of the growth and other aspects of the biology of the West Indian Topshell, *Cittarium pica* (Linnaeus). Bull. Mar. Sci. Gulf and Carib. 14: 425-443.

Robertson, R. (2003). The edible West Indian "whelk" *Cittarium pica* (Gastropoda: Trochidae): Natural history with new observations. Proceedings of the Academy of Natural Sciences of Philadelphia 153: 27-47.

Schmidt, S., Wolff, M. and Vargas, J. (2002). Population Ecology and Fishery of *Cittarium pica* (Gastropoda: Trochidae) on the Caribbean coast of Costa Rica. Rev. Biol. Trop 50: 1079-90.

Toller, W. and Gordon, S. (2005). A Population Survey of The West Indian Topshell or Whelk (*Cittarium pica*) in the U.S. Virgin Islands. SEAMAP-C: USVI Whelk Survey Final Report: 2005.

Walker, S.E. (1994). Biological remanie: gastropod fossils used by the living terrestrial hermit crab, *Coenobita clypeatus*, on Bermuda. PALAIOS 9: 403-412.

Wingate, D.B. (1989). The West Indian top shell in Bermuda – a conservation tragedy. Monthly Bull., Dept. of Agric. Fish. and Parks, Bermuda 60: 25-30.

Wingate, D.B. (1990). New hope for the West Indian top shell: re-introduction experiment, Monthly Bull., Dept. of Agric. Fish. And Parks, Bermuda 61:17-22.

Wood, J. and Jackson, K. (2005). "Bermuda" Caribbean Marine Biodiversity: the Known and Unknown. DEStech Publications: Pennsylvaina, U.S.A.

## MARINE SPECIES

### Queen conch *Strombus gigas*

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Mollusca, Class: Gastropoda, Order: Mesogastropoda, Family: Strombidae
Genus: Strombus, Species: gigas

In the Cayman Islands, the genus *Strombus* is represented by the Hawkwing conch *Strombus raninus*, the (Florida) Fighting conch *Strombus alatus*, and the Milk conch *Strombus costatus*. Queen conch *Strombus gigas*, is the most common and economically significant.

### Status

**Distribution:** Greater Caribbean tropical zone, including, Mexico, southern Florida, and the Bahamas, north to Bermuda.
**Conservation:** Conch are subject to quantitative annual survey by the Department of Environment. Data collected 1988-2006 indicate fluctuating but decreasing populations, with a ca.50% relative decrease in observed average conch densities in the Cayman Islands.
**Legal:** Queen conch *Strombus gigas* is protected under the Marine Conservation Law (2007 Revision), and subject to bag limit and closed season (1st May-30th Oct). During open season, bag limits are five conch per person, or ten per boat per day (whichever is least). No one may purchase or receive more than five conch from Cayman waters per day. Conch are also protected under the Endangered Species (Trade & Transport) Law (Parts 1 & 2). It is listed internationally on CITES (Appendix II) and SPAW (Annex III). Pending legislation, all *Strombus* species would be protected under the National Conservation Law (Schedule II). The Department of Environment is the lead body for enforcing the legal protection.

### Natural History

Queen conch *Strombus gigas* is a large marine snail. Adults attain a length of over twelve inches, and may weigh in excess of five pounds. Conch feed on algae. Specimens are found in sandy and hard-bottomed *lagoons*, coral rubble fields, and occasionally *seagrass beds*, at depths ranging from 5 to 500 feet. On hatching from the egg, conch undergo a twenty-one day planktonic larval stage, before taking up their benthic lifestyle. During this planktonic phase, larval veligers may be distributed widely by local and regional currents of the *open sea*. Juvenile conchs are predated by a variety of species; burrowing into the sand and sediment by way of defence.

The Queen conch has been harvested for human consumption since prehistoric times. It represents one of the most commercially exploited marine resources in the Caribbean. This exploitation has led to over-fishing and depletion of most known shallow water stocks.

### Associated Habitats and Species for *Queen conch*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>3. Lagoons<br>4. Seagrass beds<br>5. Dredged seabed<br>9. Mangrove | Whelks & Soldier crab *Cittarium pica & Coenobita clypeatus*<br>Spiny lobster *Panulirus argus* |

### Current Factors Affecting *Queen conch*

- *Habitat loss:* damage to key areas of habitat, particularly *mangrove* and *seagrass beds*, have reduced the availability of nursery areas for young conch.

- *Poaching:* illegal take, in combination with legal take, currently appears to be sufficient to prevent population recovery, despite almost two decades of protection. The evolution of drug-culture, the advent of crack cocaine, and the development of an unemployable subclass within local society has contributed in large part to a new poaching element, for whom jail-time offers little by way of functional deterrent. Individual poachers have the capacity to inflict significant damage on remnant populations.

- *Habitat management:* sub-juvenile habitat is suspected to be shallow Turtle grass *Thalassia testudinum* beds but these areas are currently unidentified and unsurveyed in the Cayman Islands.

- *Critical depensation threshold:* when *Strombus* populations drop below a critical density reproduction ceases to be effective. Due to the complex nature of juvenile dispersal patterns, and reliance on high density breeding populations for successful breeding, Cayman conch populations cannot be considered "healthy" until population density has significantly increased above current levels. If the Cayman population should ever fall below the critical depensation threshold, intensive restoration management will be required for basic stock maintenance.

- *Fishing:* conch have long represented one of our most significant fisheries. Currently, conch are still taken for food, and to a much more limited extent, as shell for the curio trade. The majority of shell take is, however, a by-product of the fishery.

- *Larval stage:* planktonic dispersal makes local conch populations dependent, to some extent, on regional current regimes and healthy international populations.

- *Tourist potential:* as availability of conch becomes limiting, demand for conch meat and shell products may be expected to become a greater.

- *Natural predators:* young conch are prey to many species, however, only a few, such as rays and Loggerhead turtles *Caretta caretta*, are able to crush the thick shell of a fully grown adult conch.

- *Value:* a combination of economic and cultural value, in addition to biological significance, make threats to the viability of the Queen conch of particular concern.

### Opportunities and Current Local Action for *Queen conch*

Conch are protected under the Marine Conservation Law (2007 Revision) and subject to a bag limit and season.

Queen conch *Strombus gigas* are the focus of several international and regional initiatives, including the CITES Review of Critical Trade in Conch Products, and the Caribbean Fisheries Management Council's International Queen conch Initiative.

The Department of Environment undertakes and annual Conch survey, from which management recommendations are drawn.

Local and wild conch are listed as a seafood to "Avoid" under the Cayman Sea Sense education programme. Farmed conch are listed as a "Good Alternative". In practice, however, point-of-sale determination of the origin of seafood is not always simple.

### SPECIES ACTION PLAN for *Queen conch*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize or positivise all surveyed conch population trends. | 2015 |
| **2**. Develop sustainable conch fishery, through effective conservation action, and responsive regulation and enforcement. | 2015 |

| | |
|---|---|
| **3.** Ensure sustained support for the conservation of Whelks through targeted education and awareness programmes. | ongoing |

| Queen conch<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Strombus gigas* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Consider amendment of Marine Conservation Law legislation to reduce daily catch limits and harvesting season, and increase minimum size limit for collection. | DoE<br>MCB | CIG | 2009 | 1,2 |
| **PL5.** Consider amendment of Marine Conservation (Marine Parks) Regulations to incorporate greater protection for critical replenishment habitat for Conch. | DoE<br>MCB | CIG | 2009 | 1,2 |
| **PL6.** Amend Marine Conservation Law as necessary, to close established enforcement loop-holes, to facilitate necessary enforcement and prosecution. | DoE<br>MCB | CIG | 2010 | 1,2 |
| **PL7.** Assess need for a temporary moratorium on harvesting to enable population recovery. | DoE<br>MCB | CIG | 2010 | 1,2 |
| **PL8.** Establish policy of discouraging Cayman Islands' involvement in activities likely to contribute to an increase in pressure on local or regional stocks of threatened marine species e.g. "Conch eating contests". | DoE DoT NT | CIG<br>CITA<br>SITA | ongoing | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Continue active enforcement of Marine Parks and conch fishery limits. | DoE | RCIP | ongoing | 2 |
| **SM2**. Develop contingency plan should conch populations ever drop below biologically viable limits. | DoE<br>MCB | CIG | 2010 | 1,2 |
| **SM3.** Investigate and encourage the potential for commercial farming of conch, for augmentation of wild population, or towards sustainably meeting local demand. | DoE | IntC | ongoing | 1,2 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2 |
| **Advisory** | | | | |
| **A1.** Inform Marine Police on issues relating to the legal harvesting of Whelks, towards assisting in enforcement of local regulations. | DoE | RCIP | 2009 | 1,2 |
| **A2.** Maintain Cayman Islands involvement in regional conch research and management such as the Caribbean Fisheries Management Council's International Queen conch Initiative, CITES Review of Significant Trade in Queen Conch, and SPAW. | DoE | CIG | ongoing | 2 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2 |

| Queen conch<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Continue annual conch population surveys. | DoE | | ongoing | 1 |
| **RM2.** Investigate possible sub-juvenile population monitoring methods. | DoE | | 2009 | 1 |
| **RM3.** Establish commercial value of conch fishery in the Cayman Islands. | DoE | | 2010 | 2 |
| **RM4.** Engage and participate in regional mapping, research and management initiatives. | DoE | IntC | ongoing | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Continue constant reminders of Marine Park & fishery rules. | DoE<br>MCB | MP | ongoing | 3 |
| **CP2.** Targeted awareness campaign to key sectors of the local community, to inform groups which are prone to non-sustainable practice, regarding the need to manage harvesting sustainably. | DoE | MP | ongoing | 3 |
| **CP3.** Targeted awareness campaign to key sectors of Government to assist in adopting management and legislation recommendations. | DoE<br>MCB | CIG | ongoing | 3 |
| **CP4.** Raise awareness of sustainable alternatives to threatened fisheries amongst members of the public through involvement with educational programmes e.g. Cayman Sea Sense. | NT | DoE DoT CA MP | ongoing | 3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 3 |

## REFERENCES and FURTHER READING for *Queen conch*


Fish & Wildlife Conservation Commission, Florida Marine Research Institute (2000). Queen Conch: Florida's Spectacular Sea Snail. Sea Stats, April 2000. http://research.myfwc.com/engine/download_redirection_process.asp?file=q%5Fconch%5F4127%2Epdf&objid=-1595&dltype=product

Gascoigne, J., Lipcius, R. N. (2004). Conserving Populations at Low Abundance: Delayed Functional Maturity and Allee Effects in Reproductive Behaviour of the Queen conch Strombus gigas. Marine Ecology Progress Series, 284: 185-194.

Glazer, R. (2001). Queen conch Restoration. Florida Fish and Wildlife Conservation Commission: Fish and Wildlife Research Institute. http://www.floridamarine.org/features/view_article.asp?id=1250.

Hess, D.F. and Abbott, R.T. (1994). Marine Molluscs of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 139-189.

Peterson, C. H., Black, R. (1988). Density-Dependent Mortality Caused by Physical Stress Interacting with Biotic History. The American Naturalist 131 (2) 257-220.

Stewart, V.N. (1990). Sea-Stats - A Summary of Information and Statistics on Florida's Marine Organisms and the Marine Environment. Queen Conch. (14) (ed.). FL Department of Natural Resources St. Petersburg, FL:10. (reproduced from http://fwie.fw.vt.edu/WWW/macsis/lists/M060165.htm).

Stoner, A. W., and Ray, M. (1996). Queen Conch. Strombus gigas, in Fished and Unfished Locations of the Bahamas: Effects of a Marine Fishery Reserve on Adults, Juveniles, and Larval Production. Fishery Bulletin, 94 (3): 551-565.

Stoner, A. W., and Ray-Culp, M. (2000). Evidence For Allee Effects in an Over-Harvested Marine Gastropod: Density-Dependent Mating and Egg Production. Marine Ecology Progress Series, 202: 297-302.

Stoner, A. W., Sandt, V. J., and Boidronmetairon, I. F. (1992). Seasonality in Reproductive Activity and Larval Abundance of Queen conch Strombus gigas. Fishery Bulletin 90(1):161-170.

Theile, S. (2001). Queen conch fisheries and their management in the Caribbean. TRAFFIC Europe.

Theile, S. (2002). Queen conch and the Review of Significant Trade. CITES World, 10: 3-4.

Turgeon, D. D., Bogan A. E., Coan, E. V., Emerson, W. K., Lyons, W. G., Pratt, W. L., Roper, C. F. E., Scheltema, A., Thompson, F. G., and Williams, J. D. (1988). Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Molluscs. American Fisheries Society Special Publication 16. (ed.):277 (from http://fwie.fw.vt.edu/WWW/macsis/lists/M060165.htm)

## MARINE SPECIES

### Spiny lobster *Panulirus argus*

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Arthropoda, Class: Malacostraca, Order: Decapoda, Family: Palinuridae
Genus: Panulirus, Species: argus

The Caribbean Spiny lobster *Panulirus argus* is one of 21 species of *Panulirus* existing worldwide. Spiny lobster provides an important commercial (including export) fishery for those countries in the region possessing extensive shallow water shelf areas, and important artisanal fisheries for the smaller island nations. The Cayman Islands also supports a population of Spotted Spiny lobster *Panulirus guttatus.* While no formal population assessment has been undertaken, it is likely less abundant that *P. argus*

### Status

**Distribution**: Bermuda and North Carolina, USA to the north and extending southward through the Gulf of Mexico, Florida USA, Bahamas, Caribbean Islands, and coastal areas of Central and South America to as far south as Rio de Janeiro, Brazil. In shallow waters (< 150 feet), especially *coral reefs*, rocky or rubble bottoms, *mangroves*, and *seagrass beds*, where these habitats offer hiding places.
**Conservation:** Although not IUCN or CITES listed, Spiny lobster is reported as being over-fished in some locations, and many of the larger producers manage their Spiny lobster fishery.
**Legal:** Under the current Marine Conservation Law, a three-month closed season for Spiny lobster exists December 1st - end of February. During this time, it is illegal to take Spiny lobster from Cayman waters. No one may purchase, receive, or possess Spiny lobster during these months. The open-season catch limit is three per person, or six per boat, per day, whichever is least. Minimum tail-size for take is six inches. Only *P. argus* may be taken. Lobster may not be taken in any marine protected areas. Pending legislation, all lobster would be protected under that National Conservation Law (Schedule II). The Department of Environment is the lead body for local protection.

### Natural history

Caribbean Spiny lobsters *Panulirus argus* are bottom-dwelling, opportunistic omnivores which forage at night, seeking out any available animal flesh, and occasionally plants. Their strong mandibles are specially adapted for crushing mollusc shells. In mating, the male deposits a spermatophore (sperm packet or "tar spot") on the underside of the female's abdomen. Here it remains until conditions are right for spawning. During spawning the female expels her eggs, simultaneously scratching off the attached spermatophore to release the sperm. The female then carries and cares for the fertilized eggs on the underside of her tail, until they are ready to hatch: a period of 3-4 weeks.

Fecundity in *Panulirus argus* is high. Larger females produce more eggs, than smaller ones, ranging between 40,000 to 2 million per spawning. Water temperature influences spawning frequency, and in very warm waters, spawning may occur year-round.

Spiny lobsters hatch as 3mm long, transparent, spider-like larvae called phyllosomes. Phyllosomes are planktonic, drifting with the prevailing current for 6-12 months. After growing through several moults, the phyllosome metamorphoses into a 2cm long puerulus: a miniature adult body form. The puerulus swims to coastal waters, settling to the bottom, to seek out a suitable, protective nursery habitat. Here it moults and begins to develop the camouflaging colouration of a juvenile lobster. Maturity generally occurs around 1-3 years. It is, however, impossible to accurately age a wild lobster, and the maximum lifespan of the species remains unknown.

### Associated Habitats and Species for *Spiny lobster*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|

| | |
|---|---|
| 1. Open sea<br>2. Coral reefs<br>3. Lagoons<br>4. Seagrass beds<br>5. Dredged seabed<br>6. Artificial installations<br>9. Mangrove | Whelks & Soldier crab *Cittarium pica & Coenobita clypeatus*<br>Queen conch *Strombus gigas* |

### Current Factors Affecting *Spiny lobster*

- *Historical pressure:* local research into recruitment, abundance, and distribution of Spiny lobster began with investigations in the North Sound, Grand Cayman. Anecdotal reports indicate abundant local stocks, however historical investigations, including one as early as 1945, indicated an already depleted stock suffering from low recruitment. This was attributed to the large-scale exploitation of juveniles for bait, and a developing demand for the tourism market. Although historical abundance cannot be confirmed, it is reasonable to assume that higher numbers existed before Cayman began developing in the 1960s.

- *Harvesting:* although it is has been illegal to take juvenile lobsters since 1978, during the past three decades demand for lobster has escalated, along with the tourism boom and concomitant increase in the local populace. In an attempt to lessen fishing pressure and maximize reproduction, following investigations into the reproductive ecology of Spiny lobsters in the North Sound, 2001, the original closed season was extended, and catch limits reduced.

- *Habitat loss:* destructive development and extractive industry in the North Sound, Grand Cayman's largest shallow water lagoon, has particularly impact Spiny lobster. Habitat loss is probably a significant factor affecting both recruitment and adult standing stock. Persistence of associated sedimentation and the large-scale removal of (already limiting) bedrock habitats and mangroves represent compounding influences.

- *Poaching:* despite effective enforcement of the Marine Conservation Law, there exists a certain level of background poaching. The evolution of drug-culture, the advent of crack cocaine, and the development of an unemployable subclass within local society has contributed in large part to a new poaching element, for whom jail-time offers little by way of functional deterrent. Individual poachers have the capacity to inflict significant damage on remnant populations.

- *Value:* a combination of economic and cultural value, in addition to biological significance, make threats to the viability of the Spiny lobster of particular concern.

- *Larval stage:* planktonic dispersal makes local lobster populations, to some extent, dependent on regional current regimes, and healthy regional populations.

### Opportunities and Current Local Action for *Spiny lobster*

While take of Spiny lobster is governed by the Marine Conservation Law, associated regulations were last updated in 2002, and might benefit from further revision.

Since the initial investigations by DoE into larval recruitment, abundance, and reproductive ecology of Spiny Lobster in the North Sound ended in 2000, there has been some preliminary ongoing investigation. This has focused on recruitment of both juveniles and adults to artificial habitats, and with the "seeding" of artificial habitats with harvested post-larvae, with a view to examining the potential for increasing survival, and therefore recruitment to the adult fishery. The results of these studies, while varied and interesting, are too scant to make any statistically valid inferences regarding the viability of artificial supplementation of natural populations. These results, however, warrant further investigation.

Spiny lobster are listed as a seafood to "Avoid" under the Cayman Sea Sense education programme.

**SPECIES ACTION PLAN for *Spiny lobster***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Determine more comprehensively baseline levels of recruitment, abundance, and distribution, towards informing effective conservation management and ensuring the long-term stability of local populations. | ongoing |
| **2.** Ensure more compliance with current provisions of the law, and update as necessary, towards long-term sustainability of harvesting. | ongoing |
| **3.** Ensure continued support for the conservation of the Spiny lobster as a sustainable recreational and local subsistence fishery. | ongoing |

| Spiny lobster<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Panulirus argus* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Continue enforcement of relevant Marine laws and regulations. | DoE | RCIP | ongoing | 2 |
| **PL5.** Amend legislation as necessary, to maintain stability of stocks and encourage sustainability of the lobster fishery**.** | MCB | CIG | ongoing | 2 |
| **PL6.** Amend Marine Laws as necessary, to close established loop-holes, and facilitate necessary enforcement and prosecution. | MCB | CIG | ongoing | 2 |
| **PL7.** Establish policy of discouraging Cayman Islands' involvement in activities likely to contribute to an increase in pressure on local or regional stocks of threatened marine species e.g. "Conch eating contests". | DoE DoT NT | CIG CITA SITA | ongoing | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Implement stricter enforcement of Marine Conservation Law and associated regulations. | DoE | RCIP | ongoing | 2 |
| **SM2.** Implement conservation management of pre-existing *dredged seabed* (borrow pits), towards artificial habitat creation for marine species, especially lobster, and establish these sites as managed areas, towards facilitation of a sustainable lobster fishery for the Cayman Islands. | DoE | MCB MP | 2011 | 1 |
| **SM3.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 2 |

| Spiny lobster<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Complete comprehensive assessment of standing stock abundance, prioritizing North Sound. | DoE | | 2013 | 1 |
| **RM2.** Monitor stock for changes in recruitment patterns. | DoE | IntC | ongoing | 1 |
| **RM3.** Continue monitoring local stocks. | DoE | | ongoing | 1 |
| **RM4.** Continue investigating the potential for artificially supplementation to improve survival of recruits. | DoE | IntC | ongoing | 1 |
| **RM5.** Develop guidelines for the restoration and enhancement of *dredged seabed* (borrow pits) towards maximising habitat value for lobster and other species. | DoE | | 2012 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Target awareness events towards Government and local community to garner support for continued protection. | DoE<br>MCB | CIG MP | ongoing | 3 |
| **CP2.** Scientific publication of Spiny lobster work when appropriate. | DoE | IntC | ongoing | 3 |
| **CP3.** Continue public awareness announcements. | DoE<br>MCB | NT | ongoing | 3 |
| **CP4.** Continue constant reminders of Marine Park & fishery rules. | DoE | | ongoing | 3 |
| **CP5.** Raise awareness of sustainable alternatives to threatened fisheries amongst members of the public through involvement with educational programmes e.g. Cayman Sea Sense. | NT | DoE<br>DoT CA<br>MP | ongoing | 3 |
| **CP6.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP<br>NT DoT | 2010 | 3 |

## MARINE SPECIES

### Southern stingrays *Dasyatis americana*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Chondrichthyes, Order: Dasyatidae, Family: Dasyatidae

The Southern stingray is found in shallow subtropical and tropical waters in the Western Atlantic, the Gulf of Mexico, and the Caribbean.

### Status

**Distribution:** In the Cayman Islands, Southern stingrays are found in *lagoons* and around the *coral reefs*. Free-ranging adult Southern stingrays are also hand-fed by tourists and tour boat operators at two sites; Stingray City and the Sandbar, Grand Cayman. These sites constitute two of the most important tourism attractions in the Cayman Islands.

**Conservation:** The Southern stingray is listed as Data Deficient (IUCN Red List 2008) based on inadequate information to assess extinction risk. At the Sandbar site, the stingray population size has been estimated at 160 individuals. The population size in the wild is unknown (Corcoran 2006).

**Legal:** Under the Cayman Islands Marine Conservation Law, Southern stingrays are protected within designated Wildlife Interaction Zones WIZs (surrounding Stingray City and Sandbar). Outside of these zones, the species has no legal protection in the Cayman Islands.

### Natural history

Southern stingrays are promiscuous and ovoviviparous: females give birth to 2-10 live "pups" each year. Males reach maturity at 51 cm and females at 75–80 cm disc width (maximum recorded size 150 cm disc width). Southern stingrays bury themselves in sand to hide from predators and prey, and use a serrated venom-filled spine at the base of the tail for defence. Sharks are their primarily predators. In the wild, Southern stingrays are generally solitary and nocturnal, feeding on infaunal invertebrates and fish. However, at the Stingray City sites, they have adapted to the diurnal hand-feeding regime - feeding at the waters surface, and living in dense aggregations (Corcoran 2006).

### Associated Habitats and Species for *Southern stingrays*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 2. Coral reefs<br>3. Lagoons | Nassau grouper *Epinephelus striatus*<br>Red lionfish *Pterois volitans* |

### Current Factors Affecting *Southern stingrays*

- *Incidental catch:* in the wild, threats to Southern stingrays include occasional incidental capture and injury from fishhooks.
- *Increased incidence of injuries from boats and predators:* survey indicates that 85% of stingrays at Sandbar site are injured in some way. The majority of injuries at the Sandbar were caused by boats: propellers, anchor chains, and anchors. An increased incidence of injuries from predators was also detected in comparison with wild counterparts. Grouping may attract an increased number of predators to the Sandbar site, and rays at the site may have decreased vigilance when competing for food. Injuries may also reduce the rays' ability to detect, defend against, or escape predators (Semeniuk and Rothley 2008a).

- *Increased parasite loads and potential for disease:* incidence of parasites is increased in Sandbar individuals relative to those occupying wild sites. Parasites are more easily transmitted when animals live in groups.
- *Conspecific injuries (from increased competition):* all rays surveyed at the Sandbar show conspecific bite marks (injuries caused by other stingrays). Competition for food appears to increase aggression. Open wounds can result in infection. Aggressive and competitive behaviour may also result in the use of resources which might otherwise be devoted to growth or reproduction (Semeniuk and Rothley 2008a).
- *Unnatural diet:* stingrays at the Sandbar exhibited fatty-acid (FA) profiles which were significantly different from FA profiles of wild rays, and similar to the FA profiles of North Atlantic and North Pacific squid (*Ilex* and *Loligo* spp.) - the unnatural diet item primarily fed to the rays. As a result, the FA profiles of fed rays are characteristic of coldwater species, raising concerns regarding effects of unnatural diet on growth, immune health, resistance to parasites and disease, growth, reproduction, and survival (Semeniuk *et al.* 2007).
- *Reduced body condition and suboptimal health:* decreased body condition of stingrays at the Sandbar is likely due to the long-term detrimental impacts of feeding (Semeniuk and Rothley 2008a). Furthermore, indicators of health and immune response, such as levels of hematocrit (packed red blood cell volume) and leukocrit (packed white blood cell volume), proportions of leukocytes, concentrations of serum protein, and measures of oxidative stress, suggest that the long-term health and survival of fed rays may be affected (Semeniuk *et al.* submitted).
- *Carrying capacity:* feeding at the Stingray City and Sandbar sites may have caused stingray numbers to increase beyond the carrying capacity of North Sound. If this occurs, rays may become a threat to conch and other invertebrate populations, if feeding is discontinued or is interrupted.

### Opportunities and Current Local Action for *Southern stingrays*

The Guy Harvey Research Institute has been conducting research on stingrays in the Cayman Islands since 2002, and further research efforts have recently been carried out by Dr. Christina Semeniuk and others at Simon Fraser University.

In response to preliminary results, and concerns expressed by water sports operators, the Cayman Islands Marine Conservation Board, the Cayman Islands Tourism Board, the Department of Environment, and local residents, in 2007 the Cayman Islands Government amended the Marine Conservation Law to designate areas surrounding Stingray City and Sandbar as Wildlife Interaction Zones WIZs. Tourist boats must be licensed in order to enter WIZs, and the number of boats and passengers permitted in the zones at any one time is regulated under licensing conditions. Additionally, within these zones, stingrays may not be taken, and efforts have been made to regulate diet by prohibiting feeding any food not approved by the Marine Conservation Board, and regulating feed quantities. Regulations have also been made to prevent anthropogenic injuries, by prohibiting visitors from lifting rays from the water, wearing footwear, or anchoring in waters less than three feet deep.

Future management efforts can be guided by a recently completed system dynamics model (Semeniuk *et al.* 2008b), which was completed with the goal of determining the most effective management plan for the Stingray City sites in terms of tourist numbers, stingray population size and stingray life expectancy. The model suggests that a management plan which controls boat congestion, restricts holding of stingrays (in the water) to tour operators, and reduces feeding, as well as improves the quality of food, will have a positive effect on tourist experience and stingray health in comparison to alternative management plans.

### SPECIES ACTION PLAN for *Southern stingrays*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Ensure the long-term stability of the Stingray City and Sandbar sites. | ongoing |
| **2.** Ensure the long-term stability of wild stingray populations. | ongoing |
| **3.** Manage impacts of Stingray City and Sandbar sites on the natural environment of North Sound, and educate the public and tour operators towards minimising impact. | ongoing |

| Southern stingrays<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law and WIZ regulations. | CIG | DoE | 2009 | 1,2,3 |
| **PL2.** Consider instituting legal protection of wild stingrays. | DoE | MCB | 2010 | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Ensure enforcement of and compliance with WIZ legislation. | DoE | MP<br>CITA | ongoing | 1 |
| **SM2.** Reduce feeding and improve quality of food at Stingray City and Sandbar. | DoE | MP<br>CITA | ongoing | 1 |
| **SM3.** Restrict holding of stingrays in the water to tour operators. | DoE | MP<br>CITA | ongoing | 1 |
| **SM4.** Consider safety devises on boat propellers such as cages and guards. | DoE | MP<br>CITA | 2010 | 1,2,3 |
| **SM5.** Prevent establishment of additional feeding sites. | DoE | CIG | ongoing | 2,3 |
| **SM6.** Develop a hurricane recovery plan for Stingray City and Sandbar – specifically site maintenance and avoidance of detriment to North Sound invertebrate populations. | CITA | DoE | 2010 | 1,3 |
| **SM7.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Advise in the training of water sports operators and development of educational materials for tourists. | DoE | CITA | ongoing | 1,3 |

| Southern stingrays<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Continue monitoring of population size and conducting of research on diet and health of fed rays, including physiological and immunological impacts and inbreeding potential. | IntC DoE | | 2012 | 1 |
| **RM2.** Monitor physiological and immunological indicators - particularly oxidative stress, since this represents a combined diet-adequacy and immune-system indicator. | IntC DoE | | 2012 | 1 |
| **RM3.** Monitor wild stingray populations to determine if legal protection is needed. | IntC DoE | | 2012 | 2 |
| **RM4.** Identify and protect stingray nursery areas. | IntC DoE | | 2012 | 1,2 |
| **Communication & Publicity** | | | | |
| **CP1.** Communicate risks to stingrays from improper handling, crowding, and other conditions. | DoE | CITA | 2009 | 1,3 |
| **CP2.** Educate the public on research conducted to date, threats to stingrays, and the benefits of new management initiatives (WIZ legislation). | DoE | CITA | 2009 | 1,3 |

## REFERENCES and FURTHER READING for *Southern stingrays*

Corcoran (2006). The influence of supplemental feeding on the movement patterns of the southern stingray, *Dasyatis Americana*, at Grand Cayman, Cayman Islands. Master's thesis, Nova Southeastern University.

Guy Harvey Research Institute: http://www.nova.edu/ocean/ghri/

Semeniuk CAD, Speers-Roesch B, Rothley KD (2007). Using fatty-acid profile analysis as an ecologic indicator in the management of tourism impacts on marine wildlife: a case of stingray-feeding in the Caribbean. *Environmental Management* 40(4): 665-677.

Semeniuk CAD, Rothley KD (2008a). Costs of group-living for a normally solitary forager: effects of provisioning tourism on southern stingrays *Dasyatis Americana*. *Marine Ecology Progress Series* 357:271-282.

Semeniuk CAD, Haider W, Beardmore B, Rothley KD (2008b). A multi-attribute trade-off approach for advancing the management of marine wildlife tourism: a quantitative assessment of heterogeneous visitor preferences. *Aquatic Conservation: Marine and Freshwater Ecosystems.* Published online.

Semeniuk CAD, Bourgeon S, Smith SS, Rothley K (submitted). Hematological differences between stingrays at tourist and non-visited sites suggest physiological costs of wildlife tourism. *Biological Conservation.*

## MARINE SPECIES

### Nassau grouper *Epinephelus striatus*

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Actinopterygii, Order: Perciformes, Family: Serranidae
Genus: Epinephelus, Species: striatus

Nassau grouper *Epinephelus striatus* is large sea bass - a prominent member of the twelve species of groupers reported for the Cayman Islands. Nassau grouper previously comprised one of the most economically important spawning aggregation based artisanal fisheries in the Caribbean, however, it is now severely over-fished. It ranges from inshore to about 100m, and is to be found in *coral reef* habitat, *mangrove*, *seagrass* and estuarine habitats, from southern Brazil, throughout the Caribbean, western Yucatan, Bahamas, Florida and Bermuda.

### Status

**Distribution:** Western Atlantic: Bermuda, Florida, Bahamas, Yucatan Peninsula and throughout the Caribbean to Brazil. Eastern Gulf of Mexico only off the coast of Yucatan, at Tortugas and off Key West.
**Conservation:** Endangered throughout its range, and locally extinct in many locations, the Nassau grouper is listed as Endangered A2ad (IUCN Red List, 2008). Of the areas in the Cayman Islands known to have hosted spawning aggregations (SPAGs), only one, Little Cayman West End, still hosts (albeit reduced) reproductively viable numbers. Two sites host remnant aggregations, the reproductive viability of which are unknown (Cayman Brac East End and Twelve Mile Bank NE End). Three sites are considered non-functional (Little Cayman East End and Grand Cayman East End & South West Point). Two other areas of similar geo-morphological and hydrological characteristics are anecdotally reported as historical spawning aggregation sites.
**Legal:** *Epinephelus striatus* is protected under the Marine Conservation Law (2003 Revision) Section 6(7) &9, and the Marine Conservation (Grouper Spawning Areas) Directives 2003. Under the current Marine Conservation Law, fishing for Nassau grouper is seasonally prohibited in eight Designated Grouper Spawning Areas DGSA. Nassau grouper may not be taken by spear, or in any Marine Park area. The legal minimum size for take is 30.5cm. Pending legislation, Nassau grouper would be protected under the National Conservation Law (Schedule II). The Department of Environment and the Marine Conservation Board are the lead bodies for local protection.

### Natural history

As top level predators on the reefs, Nassau grouper lead a predominantly solitary existence for most of the year. With the onset of the full moons in January and February, individuals migrate to specific locations where they form brief (ca. ten day) broadcast spawning aggregations, spawning *en masse*. Located off deep shelf promontories, these aggregations represent 100% of the species annual reproductive output. Spawning gives rise to pelagic larvae, which settle out on reefs within 40 days.

Nassau grouper life history characteristics include large size, long-lived, slow-growth, and contracted reproductive period, coupled with high spawning site fidelity. These factors combine to makes this species especially vulnerable to over-exploitation. At seven or eight years of age, most will recruit to spawning aggregations as reproductive adults. The oldest recorded individual was 29 years of age. Anecdotal evidence suggests they may live much longer.

Populations have declined an estimated 60% during the past three decades. In the Cayman Islands, spawning aggregations have been fished down to a level such that natural replenishment is inhibited.

### Associated Habitats and Species for *Nassau grouper*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>2. Coral reefs<br>4. Seagrass beds<br>9. Mangrove | Southern stingrays *Dasyatis americana*<br>Red lionfish *Pterois volitans* |

## Current Factors Affecting *Nassau grouper*

- *Historical fishing pressure:* fishing pressure on spawning aggregations is overwhelmingly responsible for the endangered status of the this once prolific species. Historically, thousands of Nassau grouper were taken annually from SPAG areas by a small but effective local artisanal fishing fleet. Prior to the 2001 discovery of the Little Cayman West End SPAG, catch from these spawning sites had dwindled steadily, becoming insignificant due to overexploitation. The estimated spawning population of the "new" Little Cayman West End site was more than halved within two seasons, following discovery. This "boom and bust" dynamic of spawning aggregation fisheries is typified throughout the tropics. In 2004, an eight-year ban on fishing Nassau grouper in designated SPAGs was legislated in an attempt to maintain the viability of the remaining Little Cayman SPAG, and towards facilitating the potential recovery of remnant SPAGs and associated local stocks.
- *Poaching:* as is the case with other protected species, it is likely that some background poaching occurs. Compliance with regulations has, however, generally been good during the first five years of the ban (at least for the five 'nearshore' designated SPAGs), affording an opportunity for reestablishment and replenishment. There is, however, suspected fishing at the 12-Mile Bank site.
- *Current fishing pressure:* Nassau grouper is a species of significant commercial and recreational interest. Individuals are taken primarily by hand-line, fish traps, and spear gun. Cessation of SPAG fishing has afforded the most immediate protection from the decimation of already depleted local stock, however, the very limited shelf area of the Cayman Islands may mean that grouper populations remain sensitive to the continued lower level harvest of adults outside the spawning season. An attempt to lessen this potential impact was implemented recently, in the form of a ban on the spearing of this species, addressing a method of take regarded as responsible for the majority of take of adults during the non-spawning months.
- *Aesthetic value:* Nassau grouper are considered an iconic species of tropical Atlantic *coral reefs*. As such, they are an important benchmark for reefs, in attracting dive tourism in the Caribbean.

## Opportunities and Current Local Action for *Nassau grouper*

During 1987–2001, the DoE undertook annual monitoring of the Cayman Island's SPAG fishery. Catch, size of fish, and sex were recorded. Results indicated a strongly significant and steady decrease in both overall catch and individual size over this period. A 1995 a proposal to reduce fishing by 50% went without political support. Subsequent to the 2001 SPAG discovery, and the subsequent unregulated take of fish (approximately 4,000 fish during the spawning seasons of 2001 & 2002), wide-spread public outcry engendered political support for protection. In 2002 legislation for an alternate year fishing strategy dictated that 2003 be a non-fishing year. Calculations showed that with the resumption of fishing in 2004, even with a catch quota of 12 grouper per boat per day, what remained of this SPAG would be decimated.

In December 2003, the Marine Conservation Board banned fishing in the DGSAs for a period of 8 years - this representing one reproductive generation of fish. This resulted in the implementation of the current eight-year ban on SPAG fishing.

Annual *in situ* monitoring of the "new" SPAG by the DoE began in 2002. This research, undertaken in co-operation with the Reef Environmental & Education Foundation REEF, will assess abundance, fish size, and behavioural ecology.

*Reproductive ecology project:* external funding obtained by REEF (through NOAA and organizations such as the Pew Foundation), with in-kind support from the DoE, financed the implementation of an acoustic tracking project to elucidate aspects of Nassau grouper reproductive ecology around Little Cayman. Similar research has been launched in Cayman Brac and Grand Cayman.

All groupers, including Nassau grouper, are listed as seafood to "Avoid" under the Cayman Sea Sense education programme.

## SPECIES ACTION PLAN for *Nassau grouper*

Objectives and targets of this Species Action Plan are based on local and international monitoring and research findings of this species fishery over the past 20 years.

| OBJECTIVES | TARGET |
|---|---|
| **1.** Ensure long-term stability of local Nassau grouper populations. | ongoing |
| **2**. Maintain and expand research programmes towards better informing sustainable fisheries management. | ongoing |
| **3.** Ensure sustained support for the conservation of Nassau groupers through targeted education and awareness. | ongoing |

| Nassau grouper PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Epinephelus striatus* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Depending on status, extend fishing ban in DGSAs for period of another reproductive generation. | MCB | DoE CIG | 2010 | 1 |
| **PL5.** Further amend legislation to include *Epinephelus striatus* on the protected species list. | MCB DoE | CIG | 2015 | 1 |
| **PL6.** Establish policy of discouraging Cayman Islands' involvement in activities likely to contribute to an increase in pressure on local or regional stocks of threatened marine species e.g. "Conch eating contests". | DoE DoT NT | CIG CITA SITA | ongoing | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Mark three main East End DGSAs. | DoE | | 2009 | 2 |
| **SM2.** Implement stricter enforcement of fishing ban and protection of SPAG sites. | DoE | MCB | 2009 | 1,2 |
| **SM3.** Minimize damage to *coral reefs* by controlling nutrient enrichment and anchor damage. | DoE | | ongoing | 1,2 |
| **SM4.** Minimize damage to *seagrass beds* in North Sound by controlling dredging. | DoE | CIG DoP CPA | ongoing | 1,2 |
| **SM5.** Subject to RM11, elevate regulations or extend ban as necessary to afford protection at such a level as to facilitate sustainable recreational and subsistence use, and meaningful replenishment of natural stocks. | MCB | DoE CIG | 2011 | 1,2 |
| **SM6.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Nassau grouper<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Continue monitoring SPAG sites, particularly the Little Cayman SPAG, for possible changes in status. | DoE | REEF | ongoing | 1,2 |
| **RM2.** Continue current reproductive ecology projects, to determine status and viability of 'dormant' historical SPAG sites. | DoE | REEF | ongoing | 1,2 |
| **RM3.** Continue current investigations into the recruitment patterns in the Cayman Islands. | DoE | REEF | ongoing | 1,2 |
| **RM4.** Conclude assessment of Little Cayman SPAG. | DoE | REEF | 2010 | 1,2 |
| **RM5.** Commence preliminary investigations into re-starting dormant historical SPAG sites. | DoE | REEF | 2015 | 1,2 |
| **RM6.** Scientific publication of Nassau grouper programme results. | DoE | REEF | ongoing | 2 |
| **RM7.** Conduct mid-term assessment of the effect of fishery closure on fish abundance and size for Little Cayman SPAG. | DoE | REEF | 2008 | 1,2 |
| **RM8.** Determine the spatial ecology of the Little Cayman and Cayman Brac Nassau grouper populations via acoustic tagging and tracking programme. | DoE | REEF | ongoing | 2 |
| **RM9.** Determine extent of larval connectivity to geographically distant populations via genetic research, and also derive likely levels of self-recruitment from nearshore populations. | DoE | IntC | ongoing | 1,2 |
| **RM10.** Determine levels of recruitment at both population and SPAG levels. | DoE | IntC | ongoing | 1,2 |
| **RM11.** Assess the effectiveness of the eight-year closure of DGSAs to fishing, in order to evaluate any need for extended closure. | DoE MCB | CIG | 2011 | 1,2 |
| **Communication & Publicity** | | | | |
| **CP1.** Targeted awareness campaign to key sectors of Government and local community. | DoE MCB | CIG MP | ongoing | 3 |
| **CP2.** Scientific publication of Nassau grouper programme results. | DoE | REEF | 2008 | 2,3 |
| **CP3.** Raise awareness of sustainable alternatives to threatened fisheries amongst members of the public through involvement with educational programmes e.g. Cayman Sea Sense. | NT | DoE DoT CA MP | ongoing | 2,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP NT DoT | 2010 | 3 |

## REFERENCES and FURTHER READING for *Nassau grouper*

Burgess, G.H., Smith, S.H. and Lane, E.D. (1994). Fishes of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 199-228.

## MARINE SPECIES

### Red lionfish *Pterois volitans* (INVASIVE)

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Actinopterygii, Order: Scorpaeniformes, Family: Scorpaenidae
Genus: Pterois, Species: volitans

Red lionfish *Pterois volitans* favour *coral reefs* and rocky outcrops, ranging throughout the Indo-Pacific: Western Australia and Malaysia to the Marquesas Island and Oeno (Pitcairn Group); north to southern Japan and southern Korea; south to Lord Howe, Kermadec, and Austral Island; throughout Micronesia.

### Status

**Distribution:** Red lionfish *Pterois volitans* is found in depths ranging from 30-260 feet. The first individual was reported locally in Feb 2008, in Little Cayman. They have since been discovered in Cayman Brac, Oct. 2008, with at least five more caught locally, Jan. 2009. How lionfish became established in the Atlantic remains unknown, however, it is accepted that several fish were introduced into the marine waters of Biscayne Bay, Florida, as a result of Hurricane Andrew, 1992. Lionfish have now been documented along the US east coast, from Florida through Massachusetts, east to Bermuda, and south throughout the Bahamas, and the Caribbean, including Turks and Caicos, Jamaica and Cuba.
**Conservation:** Red lionfish *Pterois volitans* is invasive in Cayman waters, and requires implementation of active control to prevent its spread. Lionfish represent a serious threat to both native marine life and human health and safety.
**Legal:** All species of lionfish and stonefish, and any others in family Scorpaenidae & Synanceiidae were added to DoE prohibited aquatic species list, August 2004. Lionfish *Pterois spp.* are listed under Part 3 of the Endangered Species (Trade and Transport) Law, 2004, as requiring strict regulation by the Scientific Authority (DoE).

### Natural History

Red lionfish *Pterois volitans* stand their ground when harassed. When threatened, they arch their backs, pointing their dorsal spines at the aggressor, and swim forward rapidly in order to inflict a sting. Envenomation of the hand, as a result of the sting, is the most common injury. Serious wounds may also result from the handling of recently deceased specimens. The sting causes little or no pain initially, but may become extremely painful later, depending upon the amount of venom injected. Other symptoms of a sting may include swelling, redness, bleeding, nausea, numbness, joint pain, anxiety, headache, disorientation, dizziness, nausea, paralysis, and convulsions.

### Associated Habitats and Species for *Red lionfish* (INVASIVE)

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>2. Coral reef<br>4. Seagrass beds<br>9. Mangrove | Southern stingrays *Dasyatis americana*<br>Nassau grouper *Epinephelus striatus* |

### Current Factors Affecting *Red lionfish* (INVASIVE)

- *Invasive species:* increasing reports of non-native species and the successful invasion of Atlantic and Caribbean waters by the Red lionfish have proven the need for early warning and rapid response to confirmed sightings. Expansion throughout its new range has been rapid and exponential in nature. Ravenous predators, Lionfish eat juvenile fish and crustaceans in large quantities. They have no known native predators. Lionfish reach sexual maturity at 1-2 years of

age, and reproduce year-round. They are generally resistant to parasites and tend to grow quickly, effectively outcompeting native species for food and habitat.

- *Health and safety:* the venomous spines, designed to deter large marine predators, and can inflict painful wounds in humans.

**Opportunities and Current Local Action *Red lionfish*** (INVASIVE)

All specimen reported to-date have been successfully removed from Cayman waters by staff of the Department of Environment.

**SPECIES ACTION PLAN for *Red lionfish*** (INVASIVE)

| OBJECTIVES | TARGET |
|---|---|
| **1.** Halt the spread of *Pterois volitans* in the Cayman Islands, and eradiate if feasible. | ongoing |
| **2.** Maintain close communication with dive resort staff the public, and international research community, to report and effectively manage any sightings and raise awareness. | ongoing |
| **3.** Map reported sightings of *Pterois volitans* in the Cayman Islands to quantify distribution & abundance. | ongoing |

| Red Lionfish PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1 |
| **PL3.** Amend current legislation prohibiting take of fish on SCUBA, to facilitate managed capture and removal of *Pterois volitans* by specially licensed individuals. | DoE MCB | CIG MP | 2006 | 1 |
| **PL4.** Add invasive species to list of species of aquaria fish that are banned from importation. | DoE | CIG DoA | ongoing | 1 |
| PL4. REPORT: All species of lionfish and stonefish and any others in family Scorpaenidae & Synanceiidae added to DoE prohibited aquatic species list, Aug 2004. | | | | |
| **Safeguards & Management** | | | | |
| **SM1.** Initiate eradication of invasive species from Cayman Islands waters. | DoE | CIG | 2010 | 1 |
| SM1. REPORT: To-date, all reported individuals have been removed from the marine environment by DoE. | | | | |
| **SM2.** Set up local scuba diving network to report local sightings. | DoE | MP | 2009 | 1,2,3 |
| **SM3.** Assign a team of individuals to remove animals from marine environment once sighted. | DoE | MP | 2010 | 1,2 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote best practice in aquarium trade to minimize chances of aquarists importing potentially dangerous species of fish into island. | DoE | MP DoA | 2009 | 1 |
| **A2.** Promote that, when fish are imported for the aquarium trade, local aquarists and pet stores import Atlantic species. | DoE | MP DoA | 2009 | 1 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1 |

| | | | | |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Map distribution of *Pterois volitans* as they are sighted in the Cayman Islands. | DoE | | 2008 | 3 |
| **RM2.** Investigate and field test control methods for *Pterois volitans* to determine most appropriate techniques for management purposes. | DoE | | 2009 | 1,2,3 |
| **RM3.** Conduct feasibility study and cost analysis to organize public participation of quarterly annual dives, to locate and dispose of lionfish. | DoE | MP | 2009 | 1,2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Establish international links with organizations and managers who are experienced in the control of *Pterois volitans*. | DoE | IntC CIG | 2008 | 2 |
| CP1. REPORT: Made contact with REEF, USGS and NOAA and have standing arrangement to share information, 2008 | | | | |
| **CP2.** Raise public awareness of invasive species, and the threat *Pterois volitans* poses to the general public, tourists, and the ecology of local *coral reefs.* | DoE | MP CIG<br>DoT<br>CITA<br>SITA | 2008 | 2 |
| CP2. REPORT: Issued press release and flyers to CITA and SITA, requesting assistance in locating lionfish in C.I. waters, Aug 2008. | | | | |
| **CP3.** Compile an annual report on effectiveness of control / eradication attempts, to benefit the international management efforts for the control of *Pterois volitans.* | DoE | MP CIG<br>DoT<br>CITA<br>SITA | 2009 | 1,2,3 |
| **CP4.** Maintain a consistent effort to keep the public informed of the seriousness of the problem posed by lionfish, via news paper ads, public fliers, public signs and talks to school children to keep the problem in the lime light. | DoE | MP CIG<br>DoT DE<br>CITA<br>SITA | 2009 | 2 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE MP<br>NT DoT | 2010 | 2 |

## MARINE SPECIES

### Marine turtles *Chelonia mydas, Caretta caretta, Eretmochelys imbricata, Dermochelys coriacea*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Reptilia, Order: Testudines, Family: Cheloniidae

There are seven living species of marine turtle, four of which have been documented in the Cayman Islands. These are the Green *Chelonia mydas*, the Loggerhead *Caretta caretta*, the Leatherback *Dermochelys coriacea*, and the Hawksbill *Eretmochelys imbricata*.

### Status

**Distribution:** Circumglobal.
**Conservation:** Green and Loggerhead turtles are classified as endangered, while Hawksbill and Leatherback turtles are critically endangered (IUCN Red List 2008)
*Cayman Island nesting:* Green turtles: 17-26 nesting females. Loggerhead turtles: 17-26 nesting females. Hawksbill and Leatherback turtles: nesting populations believed to be extirpated.
*Cayman Islands foraging:* Hawksbill and green turtles: aggregations apparently stable
**Legal:** Marine turtles are protected under the Marine Conservation Law (Turtle Protection Regulations). The Department of Environment is the lead body for protection.

### Natural history

Though the vast majority of their life cycle is spent at sea, female marine turtles nest terrestrially, spending approximately 1–3 hours on shore. Marine turtle hatchlings swim offshore, entering a period of oceanic drifting known as the "lost years." Though Leatherback turtles remain primarily oceanic throughout their life cycle, most hard-shell marine turtles recruit to nearshore feeding grounds such as *coral reefs* and *seagrass beds*. These "developmental habitats" are occupied by individuals originating from many jurisdictions. Upon nearing maturity, (ca. 20 years of age), turtles leave developmental habitats and move to distant adult feeding grounds. Every few years, marine turtles travel thousands of kilometres from adult feeding grounds to nesting beaches, returning to the areas where they were born to breed and nest.

The Cayman Islands once supported one of the world's largest green turtle rookeries, as well as abundant nesting by loggerhead and hawksbill turtles. Every summer, millions of marine turtles are believed to have migrated to Cayman Islands to nest, leading to reports that "…*vessels, which have lost their latitude in hazy weather, have steered entirely by the noise which these creatures make in swimming to attain the Caymana isles.*" However, by the early 1800s, massive exploitation had caused the Cayman Islands' nesting populations to crash. By the 20th century, the Cayman Islands' rookeries were considered extinct.

Recent surveys have revealed that nesting by Green and Loggerhead turtles exists at critically low levels. In Grand Cayman and Little Cayman, between 2000 and 2003, mean annual (±SD, range) number of clutches laid was 26 (±19.0, 5-51) for Green turtles and 26 (±9.8, 13-35) for Loggerhead turtles. Estimating that each female lays an average of three clutches every 2-3 years, nesting populations are likely to number approximately 17-26 females for both Green and Loggerhead turtles. Hawksbill and Leatherback nesting appears to have been extirpated.

Satellite tracking indicates that Cayman Islands Green turtles travel to foraging grounds in Central America, Mexico, and the Florida keys, with their range encompassing over 2,000 km of the Caribbean coastline and the Florida Keys. This dispersion highlights the importance of broad and collaborative marine turtle management and habitat protection. In contrast, Cayman Islands Loggerhead turtles were tracked to foraging habitats in Nicaragua, underscoring the necessity of identifying key habitats and targeting action.

### Associated Habitats and Species for *Marine turtles*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|

| | |
|---|---|
| 1. Open sea<br>2. Coral reefs<br>3. Lagoons<br>4. Seagrass beds<br>5. Dredged seabed<br>8. Sandy beach and cobble<br>9. Mangrove<br>10. Invasive coastal plants (INVASIVE)<br>18. Urban and man-modified areas | Queen conch *Strombus gigas*<br>Spiny lobsters *Panulirus argus*<br>Southern stingrays *Dasyatis americana*<br>Nassau grouper *Epinephelus striatus* |

### Current Factors Affecting *Marine turtles*

- *Legal take:* under the Turtle Protection Law (1996), some twenty people remain eligible for licenses to catch turtles. The level of sea turtle nesting in the Cayman Islands is critically low, and continued legal capture of mature turtles may cause the nesting population to become extinct in the near future.

- *Illegal take:* reports from enforcement officers and members of the public confirm that illegal take of marine turtles is still occurring around all three islands. While prosecutions are made whenever possible, the true scale of the problem remains undetermined.

- *Incidental and accidental capture and mortality:* incidental mortality arises particularly from ingestion of fish hooks and vessel collision.

- *Marine debris:* entanglement in fishing line and ingestion of plastics contributes to a largely unqualified mortality amongst marine turtles.

- *Habitat loss and degradation:* nesting beach habitat has been a primary focus for development since 1960s. Beach erosion and artificial lighting have also adversely affected nesting populations. Foraging populations may be impacted by hurricanes and anthropogenic degradation of *coral reefs* and *seagrass beds*.

- *Disease:* fibropapillomatosis is a condition characterized by debilitating tumors. This disease has reached epidemic proportions in some areas. Locally, fibropapillomatosis is known to affect Green turtles in North Sound.

### Opportunities and Current Local Action for *Marine turtles*

*Marine Turtle Beach Monitoring Programme (MTBMP):* since 1998 the DoE has been conducting a systematic survey along the beaches of the Cayman Islands to identifying signs of nesting by sea turtles. During the turtle nesting season of May-October, the beaches of the Cayman Islands are patrolled by DoE staff and trained volunteers. Data collected is used to assess the quantity, frequency and distribution of nesting, and to aid conservation efforts. The MTBMP has recently expanded to incorporate attaching satellite transmitters to post-nesting female turtles and monitoring their movements once they leave the nesting beaches in the Cayman Islands. Movements of Cayman sea turtles can be viewed at http://www.seaturtle.org/tracking.

*In-Water Programme:* DoE has carried out an intensive in-water monitoring programme since 2000. Throughout the year, sea turtles are captured, tagged, and released off the shores of Grand Cayman and Little Cayman, to assess population trends, and determine migration patterns, habitat utilisation, demographics, and management needs.

### SPECIES ACTION PLAN for *Marine turtles*

| OBJECTIVES | TARGET |
|---|---|
| **1**. Continue to monitor the status of nesting populations and ensure that they are protected from extirpation. | ongoing |
| **2.** Determine the status of, and threats to, foraging populations. | ongoing |
| **3.** Ensure the long-term stability of foraging populations. | ongoing |
| **4.** Ensure sustained support for the conservation of Marine turtles through targeted education and awareness programmes. | ongoing |

| Marine turtles<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|

| Policy & Legislation | | | | |
|---|---|---|---|---|
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3,4 |
| **PL2.** Enact Endangered Species (Trade & Transport) Law in order to fully transpose CITES into domestic law. | DoE | CIG | 2006 | 2,3 |
| **PL3.** Amend legislation to eliminate capture of mature Marine turtles, through moratorium, extended closed season, or implementation of a maximum size limit. | DoE | CIG | 2006 | 1,3 |
| **PL4.** Mobilize volunteer support for nesting beach monitoring and expand volunteer programme. | DoE | VOL | ongoing | 1 |
| **PL5.** Develop and implement a monitoring system to ensure that legal Cayman Turtle Farm products can be differentiated from illegal products. | DoE | CTF MP | ongoing | 2,4 |
| **PL6.** Promote a mandatory policy of "turtle friendly" lighting and design for all new beachfront developments. | DoE | CIG DoP CPA DCB | 2012 | 1 |
| **PL7.** Promote a mandatory policy of native vegetation maintenance and/or landscaping for all new beachfront developments. | DoE | CIG DoP CPA DCB | 2012 | 1 |
| **Safeguards & Management** | | | | |
| **SM1.** Using GIS data, ensure that key nesting habitats are protected from coastal development. | DoE | DOP | 2008 | 1 |
| **SM2.** Using GIS location data, ensure that key foraging habitats are protected. | DoE | DOP | 2006 | 2,3 |
| **SM3.** Mitigate the effects of inappropriate beach lighting by installing "turtle-friendly" lights in key locations. | DoE | DoP MP | ongoing | 1 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Train Customs personnel in identification of marine turtle products. | DoE | HMC CIG | 2006 | 1,3 |
| **A2.** Address marine debris and litter control issues. | DoE | CIG | 2008 | 1,3 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3,4 |

| Marine turtles<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Continue systematic monitoring efforts on nesting beaches on all three islands, in order to determine population trends towards informing conservation management. | DoE | MTRG MCB | ongoing | 1 |
| **RM2.** Conduct sustainable, regular, and frequent inwater monitoring on all three islands to determine trends in abundance of foraging populations, and identify key habitats towards informing conservation management. | DoE | MTRG | ongoing | 2,3 |
| **RM3.** Analyse genetic structure of juvenile Green turtle *Chelonia mydas* populations to determine contribution of Cayman Islands Turtle Farm to wild foraging aggregations. | DoE | MTRG CTF IntC | 2010 | 2 |
| **RM4.** Construct Sister Islands research accommodation (Little Cayman) | DoE | | 2008 | 1,2,3 |
| RM4. REPORT: Accommodation for up to four individuals on Little Cayman established by DoE, 2008. | | | | |

| Communication & Publicity | | | | |
|---|---|---|---|---|
| **CP1.** Targeted awareness campaign to key sectors of Government and local community. | DoE | CIG MP | 2006 | 4 |
| **CP2.** Maintain local and international media campaign. | DoE | MP | ongoing | 4 |
| **CP3.** Launch educational DVD / schools packs. | DoE | DE | 2006 | 4 |
| **CP4.** Promote island-wide awareness of the differences between adult and juvenile sea turtles through production of educational posters, fliers, and media releases. | DoE | DE MP | ongoing | 4 |
| **CP5.** Expand sea turtle education in the National Curriculum. | DoE | DE MP | 2008 | 4 |
| **CP6.** Raise public awareness of the ecological value of *sandy beach and cobble* using *marine turtles* as a flagship for preservation. | DoE | MP | ongoing | 4 |
| **CP7.** Raise awareness of sustainable alternatives to threatened fisheries amongst members of the public through involvement with educational programmes e.g. Cayman Sea Sense | NT | DoE DoT CA MP | ongoing | 4 |
| **CP8.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands | CIG | DoE MP NT DoT | 2010 | 4 |

## REFERENCES and FURTHER READING for *Marine turtles*


Blumenthal JM, Solomon JL, Bell CD, Austin TJ, Ebanks-Petrie G, Coyne MS, AC Broderick, and Godley BJ. (2006). Satellite tracking highlights the need for international cooperation in marine turtle management. Endangered Species Research 2:51–61.

Bell CD, Blumenthal JM, Austin TJ, Ebanks-Petrie G, Broderick AC, and Godley BJ. (2006). Traditional Caymanian Fishery may impede local marine turtle population recovery. Endangered Species Research 2: 63–69.

Bell CD, Solomon J, Blumenthal JM, Austin TJ, Ebanks-Petrie G, Broderick AC, and Godley BJ. (2007). Monitoring and conservation of critically reduced marine turtle nesting populations: Lessons from the Cayman Islands. Animal Conservation 10: 39–47.

Bell CD, Blumenthal JM, Austin TJ, Ebanks-Petrie G, Broderick AC, and Godley BJ. (*in press*). Harnessing recreational divers for the collection of sea turtle data around the Cayman Islands. Tourism in Marine Environments.

Blumenthal JM, Austin TJ, Bothwell JB, Broderick AC, Ebanks-Petrie G, Olynik JR, Orr MF, Solomon JL, Witt MJ, and Godley BJ. (2008). Diving behaviour and movements of juvenile hawksbill turtles Eretmochelys imbricata on a Caribbean coral reef, Coral Reefs. Online First.

Considine, J.L. (1973). Mariculture and the turtling industry of Grand Cayman: man's respose to a vanishing resource. M.A. Thesis, Dept. Geography, Univ. South Carolina, 122 pp.

Duncan, D.D. (1943). Capturing giant turtle in the Caribbean. *Nat. geo. Mag*. 84(August): 177-190.

Wood, F.E. and Wood, J.R. (1994). Sea Turtles of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 229-236.

## COASTAL SPECIES

### *Turnera triglandulosa* Millsp.

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Malpighiales, Family: Turneraceae
Genus: Turnera, Species: triglandulosa

Mostly a tropical American genus, *Turnera* comprising more than 60 species (Proctor 2009). *Turnera triglandulosa* is one of three species of *Turnera* found in the Cayman Islands.

### Status

**Distribution:** Species endemic to Little Cayman and Cayman Brac.
**Conservation:** Data deficient DD - suspected to be at risk, (The Red List, Burton 2008a).
**Legal:** *Turnera triglandulosa* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

*Turnera triglandulosa* most closely resembles the more common Cat bush *Turnera ulmifolia*, but has longer leaves (12cm cf. 3cm), which are hairless. The tip of the leaf-stalk is also three-glandular (from which it gets its name), compared with the two-glandular tip of Cat bush. This attractive little shrub attains a height of about 1.5 m, and is to be found in scattered populations along disturbed roadside verges in Little Cayman. Little is known about its natural habitat. Its distribution in Cayman Brac is currently unknown.

### Associated Habitats and Species for *Turnera*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 11. Coastal shrubland<br>19. Roads | Cayman sage *Salvia caymanensis*<br>Little Cayman snail *Cerion nanus*<br>Little Cayman Green anole *Anolis maynardi*<br>Sister Islands Rock iguana *Cyclura nubila caymanensis* |

## Current Factors Affecting *Turnera*

- *Lack of information:* little is known about the current numbers and natural habitat of *Turnera triglandulosa*. It is listed as *data deficient* in the Red List, (Burton 2008a).

- *Roadside maintenance:* modern populations are best known from man-modified areas, specifically roadside verges on Little Cayman. Effective management of roadside areas has the potential to contribute significantly to maintenance of the Little Cayman population.

- *Lack of protected habitat:* the natural habitat of this species is currently unknown, and is likely not represented within the current system of protected areas.

- *Adaptive nature:* the adaptive nature of *Turnera triglandulosa* encourages predominance in disturbed, roadside habitats.

- *Landscaping potential:* ease of cultivation from seed, lush green foliage, and attractive yellow flowers make *Turnera triglandulosa* suitable for landscaping.

## Opportunities and Current Local Action for *Turnera*

*Turnera triglandulosa* is currently under cultivation in the Queen Elizabeth II Botanic Park, though not part of any formal conservation programme.

## SPECIES ACTION PLAN for *Turnera*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Conduct population survey to determine natural habitat and acquire data to determine Red List status, and prevent further decline of *Turnera triglandulosa.* | 2012 |
| **2.** Preserve *insitu* populations of *Turnera triglandulosa.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Turnera triglandulosa* based in the Sister Islands. | 2012 |

| Turnera triglandulosa PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Turnera triglandulosa* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Collect seeds under the *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM2.** Incorporate a representative sample of natural habitat and population in protected areas system. | CC | DoE NT | 2015 | 1,2 |
| **SM3.** Establish Growing Stations on Little Cayman, from which to propagate, investigate and locally reintroduce key species of plants and trees of significance, targeting private gardens and landscaping schemes. | DoE | MP RBGK QEIIBP | 2010 | 1,3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Meet with Little Cayman roads maintenance authority, to discuss positive management of roadside verges for *Turnera triglandulosa.* | NRA SIDA DoE | PRCU | 2009 | 1,2 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

## REFERENCES and FURTHER READING for *Turnera*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

| Turnera triglandulosa<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Conduct field survey of *Turnera triglandulosa* in Little Cayman and Cayman Brac, to determine the fruiting period, population size, and extent of populations in both disturbed and natural habitats. | DoE | NT | 2012 | 1,2 |
| **RM2.** Subject to RM1, modify SAP and National Conservation Law Schedule II status, as necessary. | DoE | CIG | 2012 | 1,2 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Reassess IUCN Red List status of *Turnera triglandulosa* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Establish and maintain links with Little Cayman roads maintenance authority. | NRA SIDA DoE | PRCU | 2009 | 1,2,3 |
| **CP2.** Raise awareness of the unique nature of *Turnera triglandulosa* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP2. REPORT: *Turnera triglandulosa* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP3.** Raise awareness of *Turnera triglandulosa* with a children's competition to think of a "common name" for the plant. | DoE | MP | 2012 | 1,2,3 |
| **CP4.** Raise awareness of the value of native landscaping, and promote the use of *Turnera triglandulosa* in Little Cayman. | DoE DoP NT | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## COASTAL SPECIES

### Cocoplum *Chrysobalanus icaco* L.

INSERT IMAGES

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Malpighiales, Family: Chrysobalanaceae
Genus: Chrysobalanus, Species: icaco

*Chrysobalanus* is a genus of about three species, only one of which is found in the Cayman Islands (Proctor 2009). Cocoplum *Chrysobalanus icaco* is to be found throughout the West Indies, and Florida, Mexico and northern South America. It is present on all three Cayman Islands.

### Status

**Distribution:** Throughout the West Indies.
**Conservation:** Critically endangered CR A3bc+4bc (The Red List, Burton 2008a).
**Legal:** Cocoplum *Chrysobalanus icaco* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Typically a shrub or small tree up to 3m (9ft) in height. Cocoplum favours coastal areas and sandy thickets. Cocoplum displays long, thin arching branches, with shiny, waxy leaves, and large, fleshy, edible fruit.

The attractive natural form of Cocoplum, coupled with its conservation status and capacity for artificial propagation, make this a highly significant species for *coastal shrubland* restoration and hardy, salt-tolerant landscaping projects.

### Associated Habitats and Species for *Cocoplum*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 10. Invasive coastal plants<br>11. Coastal shrubland | Broadleaf *Cordia sebestena* var. *caymanensis*<br>Tea banker *Pectis caymanensis*<br>Inkberry *Scaevola plumieri* |

### Current Factors Affecting *Cocoplum*

- *Habitat loss:* clearance of *coastal shrubland* for development has contributed to a critical reduction in habitat for this otherwise common species.

- *Invasive species:* potential for reestablishment of native flora is limited by aggressive exotic colonisers in coastal areas, particularly Weeping willow *Casuarina equisetifolia*, *Colubrina asiatica*, Wild tamarind *Leucaena leucocephala* and Beach naupaka *Scaevola sericea*.

- *Landscaping potential:* ease of cultivation from seed, lush waxy green foliage, attractive form and fruits, coupled with extreme tolerance of salty and sandy conditions make Cocoplum suitable for landscaping, especially coastal restoration.

### Opportunities and Current Local Action for *Cocoplum*

Cocoplum has been successfully propagated from seed, and sold by the Native Tree Nursery.

## SPECIES ACTION PLAN for *Cocoplum*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Chrysobalanus icaco* and raise Red List status by at least one category, from *critically endangered*. | 2015 |
| **2.** Preserve *insitu* populations of *Chrysobalanus icaco*. | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Chrysobalanus icaco*. | 2012 |

| Cocoplum PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Chrysobalanus icaco* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Develop and implement importation ban on *Scaevola sericea*. | DoE<br>DoA<br>HMC | QEIIBP<br>CIG<br>LCN | 2010 | 1,2,3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Enforce provisions under the National Conservation Law to support Planning Legislation and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 1,2 |
| **PL7.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL8.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Establish local conservation propagation programme and introduce *Chrysobalanus icaco* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| SM1. REPORT: Native Tree Nursery opens to public, Feb 2009. *Chrysobalanus icaco* sold from Native Tree Nursery, 2008. | | | | |
| **SM2.** Active planting in conjunction with eradication of invasive flora from key areas, commencing with protected areas e.g. Barkers and Heritage Beach. | DoE | DoA<br>DoRPC<br>NT | 2014 | 1,2 |
| **SM3.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Recommend importation / landscaping ban on | DoE | LCN | 2009 | 1,2 |

| | | | | |
|---|---|---|---|---|
| invasive flora, including *Scaevola sericea.* | DoA | | | |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Cocoplum<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Monitor and assist the reestablishment of *Chrysobalanus icaco* in protected areas. | DoE | | 2015 | 1,2,3 |
| **RM2.** Reassess IUCN Red List status of *Chrysobalanus icaco* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the value of native landscaping, and promote the use of *Chrysobalanus icaco*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |
| **CP6.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP QEIIBP | ongoing | 1,2,3 |

## REFERENCES and FURTHER READING for *Cocoplum*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

Sauer, J.D. (1982). Cayman Island seashore vegetation: A study in comparative biogeography. Univ. Cal. Pub. In *Geog.* 25: 1-137.

## COASTAL SPECIES

### Broadleaf *Cordia sebestena* L. var. *caymanensis* (Urb.) Proctor

INSERT IMAGE

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Lamiales, Family: Boraginaceae
Genus: Cordia, Species: sebestena, Variety: caymanensis

*Cordia* is a pantropical genus of about 250 species (Proctor 2009). Of the five species of *Cordia* found in the Cayman Islands, one variety, Broadleaf *Cordia sebestena* var. *caymanensis*, is endemic to the three Cayman Islands. Broadleaf differs from the common variety Geiger tree *Cordia sebestena* var. *sebestena*, which is distributed throughout the West Indies and Florida, in a range of characteristics, including larger leaf size, leaf serrations and smaller flower petals. The Geiger tree is a popular landscaping ornamental.

### Status

**Distribution:** Subspecies endemic to the three Cayman Islands.
**Conservation:** Vulnerable VU A3bc+4bc (The Red List, Burton 2008a).
**Legal:** Broadleaf *Cordia sebestena* var. *caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Broadleaf *Cordia sebestena* var. *caymanensis* typically favours sandy *coastal shrubland.* It exists as a shrub or small tree, generally tall and thin in form, developing a sparse crown. Broadleaf displays bright orange-red flowers, in response to rain, and bears distinctive white fruits.

### Associated Habitats and Species for *Broadleaf*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 10. Invasive coastal plants<br>11. Coastal shrubland<br>14. Dry shrubland<br>15. Forest and woodland | Inkberry *Scaevola plumieri*<br>Cocoplum *Chrysobalanus icaco*<br>Tea banker *Pectis caymanensis* |

### Current Factors Affecting *Broadleaf*

- *Hybridization:* there are concerns that the local variety *Cordia sebestena* var. *caymanensis* is at risk from hybridization with the Geiger tree *Cordia sebestena* var. *sebestena*, a popular landscaping import from Florida. This would result in the loss of the unique Cayman variety.

- *Habitat loss:* clearance of coastal forest for development has contributed to a reduction in habitat of this otherwise common species.

- *Invasive species:* reestablishment of native flora is limited by aggressive exotic colonisers in coastal areas e.g. *Casuarina equisetifolia*, *Colubrina asiatica*, *Leucaena leucocephala* and *Scaevola sericea.*

- *Cultural significance:* the rough leaves of Broadleaf were traditionally used to polish turtle shells.

- *Landscaping potential:* ease of cultivation from seed, compact form and flowers, coupled with extreme tolerance of salty and sandy conditions make Broadleaf suitable for landscaping, including coastal restoration.

- *Insect pests:* defoliation by a beetle larva has been observed to affect nursery stock in Grand Cayman. The pest has not yet been identified and it is not known at this point, whether or not it is native or an invasive exotic species.

### Opportunities and Current Local Action for *Broadleaf*

Broadleaf has been successfully propagated from seed, and sold by the Native Tree Nursery.

## SPECIES ACTION PLAN for *Broadleaf*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Halt population decline of *Cordia sebestena* var. *caymanensis*. | 2015 |
| **2.** Preserve *insitu* populations of *Cordia sebestena* var. *caymanensis.* | 2015 |
| **3.** Develop an *inter-situ* cultivation and conservation programme for *Cordia sebestena* var. *caymanensis.* | 2012 |

| Broadleaf PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Cordia sebestena* var. *caymanensis* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Develop and implement an importation ban on *Cordia sebestena* var. *sebestena*. | DoE DoA HMC | QEIIBP CIG LCN | 2010 | 1,2,3 |
| **PL7.** Enforce provisions under the National Conservation Law to support Planning Legislation and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 1,2 |
| **PL8.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL9.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Collect seeds under the *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM2.** Establish a local conservation propagation programme and introduce *Cordia sebestena* var. *sebestena* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP DoE | RBGK | 2008 | 1,3 |
| SM2. REPORT: Native Tree Nursery opens to public, Feb 2009. *Cordia sebestena* var. *sebestena* sold from Native Tree Nursery, 2008. | | | | |
| **SM3.** Active planting in conjunction with eradication of invasive flora from key areas, commencing with protected areas e.g. Barkers. | DoE | DoA PCRU | 2014 | 1,2 |
| **SM3.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |

| | | | | |
|---|---|---|---|---|
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Recommend importation / landscaping ban on invasive flora, including *Cordia sebestena* var. *sebestena*. | DoE<br>DoA | LCN | 2009 | 1,2 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Broadleaf PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Monitor and assist reestablishment of *Cordia sebestena* var. *caymanensis* in protected areas. | DoE | | 2009 | 3 |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Reassess IUCN Red List status of *Cordia sebestena* var. *caymanensis* locally. | DoE | | 2015 | 1 |
| **RM4.** Identify beetle pest of *Cordia sebestena* var. *caymanensis* and determine its geographic distribution. Develop and implement control techniques as required. | DoE | | 2009 | 1,2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of *Cordia sebestena* var. *caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1.REPORT: *Cordia sebestena var. caymanensis* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Cordia sebestena* var. *caymanensis.* | DoE DoP NT QEIIBP | MP CN GC NRA SB LCN | 2010 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Broadleaf*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

Sauer, J.D. (1982). Cayman Island seashore vegetation: A study in comparative biogeography. Univ. Cal. Pub. In *Geog.* 25: 1-137.

## COASTAL SPECIES

### Inkberry / Bay Balsam *Scaevola plumieri* (L.)

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Asterales, Family: Goodeniaceae
Genus: Scaevola, Species: plumieri

The genus *Scaevola* contains more than 80 species (Proctor 2009). Two species occur naturally in the West Indies, one widespread the other Cuban. Inkberry *Scaevola plumieri* is distributed in coastal areas throughout Florida, the West Indies, the Caribbean coast of Central America, and the coast of tropical Africa (Proctor 2009). Inkberry is indigenous to the three Cayman Islands.

In 2008, one large specimen and three small specimens were known to exist on Grand Cayman, at Anchor point (Barefoot Beach Gardens). A large intact stand is located at Point of Sand, Little Cayman. Three small specimens were recently discovered on Cayman Brac.

### Status

**Distribution:** Coastal pan-tropical.
**Conservation:** Critically endangered CR A1abce; B1ab (i,ii,iii,iv,v) (The Red List, Burton 2008a).
**Legal:** Inkberry *Scaevola plumieri* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II.). The Department of Environment would be the lead body for legal protection.

### Natural History

Inkberry *Scaevola plumieri* grows at the top of *sandy beach and cobble*, on the seaward edge of *coastal shrubland*, attaining a height of 1.5m. This habitat is under pressure from beach front development, and subject to competition from the invasive landscaping staple *Scaevola sericea*. The native Inkberry *S. plumieri* is distinguished from the invasive *S. sericea*, having generally thicker, fleshier leaves, and the inky-black fruit from which it takes its local name. In comparison, the invasive *S. sericea* produces copious white fruit.

### Associated Habitats and Species for *Inkberry*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 8. Sandy beach and cobble<br>10. Invasive coastal plants<br>11. Coastal shrubland | Broadleaf *Cordia sebestena* var. *caymanensis*<br>Tea banker *Pectis caymanensis*<br>Cocoplum *Chrysobalanus icaco* |

### Current Factors Affecting *Inkberry*

- *Restricted habitat:* surviving specimens appear confined to the narrow band of *low tropical / subtropical perennial forb vegetation* at the pioneering seaward edge of the permanent vegetation line.
- *Habitat loss:* beach-front habitat is a prime site for real estate development. New development is generally accompanied by site clearance and exotic landscaping.
- *Storm:* the pioneering seaward edge of the permanent vegetation line is naturally susceptible to impact from high seas.

- *Genetic bottleneck:* in the Cayman Islands, the remnant population of *Scaevola plumieri* is currently known only from a few fruiting individuals, generally of low fecundity.

- *Invasive species:* potential for reestablishment of native flora is limited by aggressive exotic colonisers in coastal areas, particularly Weeping willow *Casuarina equisetifolia*, *Colubrina asiatica*, Wild tamarind *Leucaena leucocephala* and Beach naupaka *Scaevola sericea.*

- *Landscaping potential:* the attractive form of *Scaevola plumieri*, coupled with its extreme tolerance of salty and sandy conditions make Inkberry suitable for landscaping, including coastal restoration. Trials at Queen Elizabeth II Botanic Park, however, have shown it to be difficult to propagate under artificial conditions. Limited seed source is a major issue restricting conservation propagation.

### Opportunities and Current Local Action for *Inkberry*

None.

## SPECIES ACTION PLAN for *Inkberry*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Scaevola plumieri* and raise Red List status by at least one category, from *critically endangered*. | 2015 |
| **2.** Preserve *insitu* populations of *Scaevola plumieri*. | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Scaevola plumieri.* | 2012 |

| Inkberry PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Scaevola plumieri* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Develop and implement importation ban and local commercial propagation ban on *Scaevola sericea*. | DoE DoA | QEIIBP CIG LCN | 2010 | 1,2,3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Enforce provisions under the National Conservation Law to support Planning Legislation and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 1,2 |
| **PL7.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL9.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Establish local *insitu* and *inter-situ* conservation propagation programmes. | QEIIBP DoE | RBGK OS | 2010 | 1,2,3 |
| SM1. REPORT: Initial attempts to propagate *S. plumieri* from seed mostly unsuccessful, due to root rot, 2007. Cuttings, tissue culture and *insitu* propagation to be investigated. | | | | |
| **SM2.** Establish local conservation propagation programme and introduce *Scaevola plumieri* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP DoE | RBGK | 2008 | 1,3 |
| **SM3.** Active planting in conjunction with eradication of invasive flora from key areas, commencing with protected areas e.g. Barkers. | DoE | DoA PCRU | 2014 | 1,2 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Recommend importation / propagation / landscaping | DoE | LCN | 2009 | 1,2 |

| | | | | |
|---|---|---|---|---|
| ban on invasive flora, including *Scaevola sericea.* | DoA | | | |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Inkberry<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Continue current efforts to survey local specimens of *Scaevola plumieri.* | DoE | | 2009 | 1,2 |
| RM1.REPORT: Three small, non-bearing specimens were discovered at Anchor point, Grand Cayman, Jan 2008. All four known Grand Cayman specimens are currently located within a 250m strip of beach at Barefoot Gardens, North Side. Three small specimens were discovered in Cayman Brac, Jul 2008, of which at least two survived hurricane Paloma, Nov 2008. | | | | |
| **RM2.** Instigate island-wide 5-yearly mapping of *Scaevola sericea.* | DoE | | 2010 | 1,2 |
| **RM3.** Monitor and assist reestablishment of *Scaevola plumieri* in protected areas. | DoE | | 2015 | 1,2,3 |
| **RM4.** Reassess IUCN Red List status of *Scaevola plumieri* locally. | DoE | | 2015 | 1 |
| **RM5.** Research and test improved cultivation techniques for *Scaevola plumieri.* | QEIIBP | DoE | 2012 | 1,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the value of native landscaping, and promote the use of *Scaevola plumieri.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |
| **CP3.** Raise public awareness of invasive species, particularly *Scaevola sericea*, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP QEIIBP | ongoing | 1,2,3 |

## REFERENCES and FURTHER READING for *Inkberry*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

Sauer, J.D. (1982). Cayman Island seashore vegetation: A study in comparative biogeography. Univ. Cal. Pub. In *Geog.* 25: 1-137.

## COASTAL SPECIES

### Tea banker / Mint *Pectis caymanensis* (Urb.) Rydb.
### var. *robusta* Proctor
### var. *caymanensis* Proctor

INSERT IMAGES

### Taxonomy and Range
Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Asterales, Family: Asteraceae
Genus: Pectis, Species: Caymanensis, Variety: caymanensis

A tropical / temperate American genus of about 70 species (Proctor 2009). Two species of *Pectis* are present in the Cayman Islands: *Pectis linifolia* (neotropical distribution) and Tea banker *Pectis caymanensis*. The latter is represented by two distinct subspecies, *P.c. caymanensis*, found on all three Cayman islands and also in Cuba, and *P.c. robusta*, which is endemic to Grand Cayman. This action plan will address the conservation management of both subspecies of *Pectis caymanensis*.

### Status
**Distribution:** *Pectis caymanensis robusta* – species endemic to Grand Cayman. *Pectis caymanensis caymanensis* – single neighbour endemic.
**Conservation:** Both subspecies are Critically endangered CR A2acd; B1ab(i,ii,iii,iv,v) +2b (i,ii,iii,iv,v), (The Red List, Burton 2008a).
**Legal:** Tea banker *Pectis caymanensis* has no legal protection in the Cayman Islands. Pending legislation, *Pectis caymanensis robusta* would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History
Tea banker *Pectis caymanensis* is a mat-forming perennial herb, producing a yellow, daisy-like flower with five petals. The variety *robusta* is generally larger in form than the variety *caymanensis*. Tea banker is of cultural significance in the Cayman Islands, being traditionally used in the preparation of an aromatic tea. Tea banker is associated with coastal areas, sand and gravel. Loss of natural coastal habitat has resulted in fragmented populations, remnant in man-modified areas, most notably beachside cemeteries.

### Associated Habitats and Species for *Tea banker*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 8. Sandy beach and cobble<br>10. Invasive coastal plants<br>11. Coastal shrubland<br>18. Urban and man-modified areas | Broadleaf *Cordia sebestena caymanensis*<br>Cocoplum *Chrysobalanus icaco*<br>Cayman sage *Salvia caymanensis*<br>Inkberry *Scaevola plumieri* |

### Current Factors Affecting *Tea banker*

- *Restricted habitat:* surviving specimens appear confined to fragmented remnant populations in beach ridge areas.

- *Habitat loss:* clearance of coastal forest for development has contributed to a reduction in habitat of this otherwise common species.

- *Invasive species:* potential for reestablishment of native flora is limited by aggressive exotic colonisers in coastal areas, particularly Weeping willow *Casuarina equisetifolia, Colubrina asiatica*, Wild tamarind *Leucaena leucocephala* and Beach naupaka *Scaevola sericea.*

- *Storm:* beach ridge vegetation is naturally susceptible to impact from high seas. Potentially catastrophic impact of storms on remnant populations is exacerbated by the fragmentation.

- *Collection:* though of reduced popularity, Tea banker is still used to make tea. A resurgence of public interest in traditional uses of native plants may have a detrimental impact on existing populations if alternative sources are not provided.

- *Grounds maintenance:* remnant populations in man-modified areas are subject to control as part of general grounds maintenance (e.g. in beachside cemeteries).

- *Landscaping potential:* fragrant green foliage and attractive yellow flowers, coupled with extreme tolerance of salty and sandy conditions make Tea banker suitable for landscaping. *Ad hoc* trials, however, have shown Tea banker may be difficult to propagate under artificial conditions.

### Opportunities and Current Local Action for *Tea banker*

*Ad hoc* attempts to propagate Tea banker have generally met with little success.

### SPECIES ACTION PLAN for *Tea banker*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Pectis caymanensis* and raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Pectis caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Pectis caymanensis.* | 2012 |

| Tea banker<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Pectis caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| PL4.REPORT: Collection of 10,000 seeds submitted to MSB, 2008. Confirmation of viability required. | | | | |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Develop and implement importation ban on *Scaevola sericea*. | DoE<br>DoA | QEIIBP<br>CIG<br>LCN | 2010 | 1,2,3 |
| **PL7.** Enforce provisions under the National Conservation Law to support Planning Legislation and reduce incidents of illegal sand mining. | DoE DoP | CIG | 2008 | 1,2 |
| **PL8.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |

| | | | | |
|---|---|---|---|---|
| environmental, social, and economic development of the Islands. | | | | |
| **Safeguards & Management** | | | | |
| **SM1.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK | QEIIBP | 2012 | 3 |
| SM1.REPORT: Collection of 10,000 seeds submitted to MSB, 2008. Confirmation of viability required. | | | | |
| **SM2.** Establish a local conservation propagation programme and introduce *Pectis caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| **SM3.** Work with cemeteries maintenance staff to encourage sympathetic grounds management, and encourage further population establishment. | DoRPC | DoE | 2012 | 1,2 |
| **SM4.** Active planting in conjunction with eradication of invasive flora from key areas, commencing with protected areas e.g. Barkers. | DoE | DoA<br>PCRU | 2014 | 1,2 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Train cemetery maintenance staff in the identification of *Pectis caymanensis* and encourage sympathetic management. | DoE | PCRU | 2008 | 1,2 |
| A1. REPORT: First Tea banker meeting with PCRU staff, 2008. | | | | |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A3.** Recommend importation / propagation / landscaping ban on invasive flora, including *Scaevola sericea*. | DoE<br>DoA | LCN | 2009 | 1,2 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Tea banker<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Pectis caymanensis*. | DoE | | 2009 | 1,2 |
| RM1.REPORT: Populations located in cemeteries in Bodden Town and Old Man Bay (and adjacent land). | | | | |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| RM2.REPORT: Collection of 10,000 seeds submitted to MSB, 2008. Confirmation of viability required. | | | | |
| **RM3.** Improve current knowledge of differentiation between var. *robusta* and var. *caymanensis* amongst conservation workers. | CN | DoE QEIIBP | 2009 | 1 |
| RM3.REPORT: Cayman Nature produces *Pectis* info sheet, 2007. | | | | |
| **RM4.** Undertake literature survey of the genus *Pectis* towards elucidating likely mechanisms of seed dispersal and germination, followed by full investigation of pollination, seed set, seed dispersal and germination to determine the natural ecology of the species, and better inform conservation propagation practice. | DoE QEIIBP | RBGK | 2011 | 3 |
| **RM5**. Assess potential for survival of *Pectis caymanensis* in non-coastal / man-modified areas. | QEIIBP | DoE | 2012 | 1,3 |
| **RM6.** Reassess IUCN Red List status of *Pectis caymanensis* locally. | DoE | | 2015 | 1 |
| **RM7.** Test alternative propagation media and water / fertilization protocols to develop and refine successful nursery propagation procedures. | QEIIBP | DoE RBGK | 2011 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Maintain links with cemeteries management, towards maintaining current populations. | DoRPC | DoE | 2006 | 1,2 |
| **CP2.** Once the conservation programme and regulations are in place, interpret *Pectis caymanensis* in cemeteries, to raise public awareness of this unique plant. | DoRPC | MP DoE | 2010 | 1,2 |
| **CP3.** Raise public awareness of the unique nature of *Pectis caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP3. REPORT: *Pectis caymanensis* featured in Red List of Flora (Burton 2008a). | | | | |
| **CP4.** Raise awareness of the value of native landscaping, and promote the use of *Pectis caymanensis*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |
| **CP6.** Raise public awareness of invasive species, and promote the Natural Heritage of the Cayman Islands. | DoE | DoT CIG NT MP QEIIBP | ongoing | 1,2,3 |

## REFERENCES and FURTHER READING for *Tea banker*

Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

Sauer, J.D. (1982). Cayman Island seashore vegetation: A study in comparative biogeography. Univ. Cal. Pub. In *Geog*. 25: 1-137.

## TERRESTRIAL SPECIES

### White Land crab *Cardisoma guanhumi*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Arthropoda, Class: Malacostraca, Order: Decapoda, Family: Gecarcinidae
Genus: Cardisoma, Species: guanhumi

The White Land crab *Cardisoma guanhumi* is a circumequatorial species found throughout estuarine regions of the Caribbean, Central and South America including Columbia, Venezuela, the Bahamas, the Gulf of Mexico, coastal Florida and Puerto Rico. It is found in greatest numbers on low lying ground, generally within five km of the ocean. Burrow concentrations in optimum habitat may exceed 7500 per acre. The population distribution of this species is heavily influenced by water temperature. In areas where water temperatures fall below 20 °C in winter larval survival is affected.

The White Land crab is found throughout the Cayman Islands due to the relatively close proximity of the coastline, however, no comprehensive distribution studies have been undertaken. Two similar, but smaller, species of Gecarcinidae land crabs are also found in the Cayman Islands; *Gecarcinus ruricola* and *Gecarcinus lateralis*. Conservation efforts made towards the preservation of *Cardisoma guanhumi* will likely be of value to these species also.

### Status

**Distribution:** Circumequatorial.
**Conservation:** There are currently no local or regional conservation initiatives and the species is not listed on CITES or the IUCN Redlist. Local conservation status is unknown.
**Legal:** *Cardisoma guanhumi* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural history

The White Land crab *Cardisoma guanhumi*, is a large burrowing crab. Its distribution on land is generally limited to within five km of the ocean. Large individuals may exceed 11cm across, and weigh over 500g. The White Land crab is slow-growing compared to most other crabs, reaching sexual maturity after approximately four years, when it attains a mass of 40g. Adults of both sexes have carapaces which range in colour from dark blue to various shades of brown, grey and white. Males have one enlarged cheliped. Juveniles generally have brown carapaces and orange legs.

The reproductive cycle of the White Land crab is closely linked to seasonal weather patterns and lunar phases. Migrations are initiated by heavy rains. For the first few weeks of the migratory period, foraging intensity is increased, and the crabs gain weight rapidly. Males actively court ripe females during this period. Fertilization is internal, and throughout July and August most females carry external egg masses. Eggs are carried for approximately two weeks prior to hatching, and must be released into salt water in order for the larvae to survive. Females typically complete spawning migrations within 1-2 days and generally spawn within 1-2 days of a full moon. Thus, though *Cardisoma* and other terrestrial crabs have been successful invaders of the land, they are still dependent on the ocean for at least part of their life cycle.

Several spawns per year may occur, with spawning season varying with location. In Florida, spawning extends June-December, peaking in October and November. In the Bahamas the season extends July-September, and in Venezuela July-November. Eggs hatch into free-swimming larvae. Thereafter, the larvae pass through five zoeal stages and one postlarval, or “megalopal” stage. Typically, development time from hatching to the first adult form is 42 days under laboratory conditions; however, this time may be much reduced in nature. Fecundity in *Cardisoma* is related to body mass. A 300g female may produce 300,000-700,000 eggs per spawning.

Adult crabs colonise various habitats, however, they are limited to areas where they can burrow to intersect the water table, and maintain a 1-2 litre pool in the bottom of the burrow. Thus they are functionally limited to areas where the water table is within approximately two metres of the surface. In south Florida, burrow densities have been found to be highest in firm, muddy substrates. *Cardisoma* tolerate salinities from freshwater to hypersaline, however, larval development has been shown to be optimal at salinities of 20-40 ppt.

*Cardisoma guanhumi* is mostly herbivorous, feeding on leaves, fruits, and grasses collected in the vicinity of burrows. They will also eat insects, carrion, faeces and are sometimes cannibalistic; thus, they are functional omnivores. Preferred foods include the leaves of Red and White mangrove, and Buttonwood. They feed throughout the day in shaded areas; however, if exposed to direct sunlight for prolonged periods, they prefer to feed at night. Peak activity time is at dawn and dusk, though activity tends to increase under low light levels and with reduced food availability.

### Associated Habitats and Species for *White Land crab*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>9. Mangrove<br>18. Urban and man-modified areas<br>19. Roads | Whelks & Soldier crab *Cittarium pica & Coenobita clypeatus*<br>Cayman parrot *Amazona leucocephala*<br>West Indian Whistling-duck *Dendrocygna arborea* |

### Current Factors Affecting *White Land crab*

- *Economic significance:* economically important in the Caribbean and Bahamas. In the Cayman Islands *Cardisoma* is generally exploited for food, though not at a commercial level.

- *Conflict situations*: damage to lawns from burrow digging has resulted in some people regarding Land crabs as garden pests.

- *Cultural significance:* a culturally important local food source within the Cayman Islands, *Cardisoma* is probably subject to significant exploitation. Harvesting pressure is not known, in part due to the subsistence nature of the collection, but is likely intensive and increasing in step with the growing population of the Islands.

- *Habitat loss:* loss of mangrove habitat due to drainage, fragmentation and filling, is likely a significant factor influencing the population of *Cardisoma*, however, no quantitative data currently exist.

- *Road kill:* bisection of migration routes by *roads* is likely the most significant cause of decline in this species. Coastal roads, and road-widening projects, would be expected to have a disproportionate impact on populations returning to the sea to spawn.

- *Insecticide:* impacts associated with landscaping control, and the Mosquito Research and Control Unit's aerial and land-based spraying regime remain undetermined.

### Opportunities and Current Local Action for *White Land crab*

There is currently no legal protection specific for this species, however National Trust for the Cayman Islands Law (1987) Section 19(a) makes it an offence to take any form of wildlife from a Trust Property.

The requirement of migratory movement to and from the sea limits the effectiveness of single site protection for all land crabs.

There is no local action geared towards preservation of this species.

## SPECIES ACTION PLAN for *White Land crab*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Ensure that local populations are protected from extirpation, and maintain the long-term stability of stock for sustainable harvest. | 2015 |
| **2.** Determine status of, and threats to, local populations. | 2009 |
| **3.** Ensure sustained support for the conservation of Land crabs through targeted education and awareness programmes. | 2008 |

| White Land crab<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Cardisoma guanhumi* under Schedule II of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL5.** Develop, maintain and enforce regulations appropriate to maintenance of the long-term sustainable harvesting of *Cardisoma guanhumi*. | DoE MCB | CIG | 2010 | 1 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Establish a closed season and bag limits for collectors, incorporating minimum carapace size limit for collection (possibly to allow ca. 6-7 years worth of reproduction), as necessary to maintain population stability. | DoE | IntC | 2012 | 1 |
| **SM2.** Utilise key habitat and migratory route data to establish a system of protected areas, from which collection is either regulated or banned, as necessary to maintain population stability of *Cardisoma guanhumi* and other migrating land crabs. | CC DoE | IntC | 2012 | 1,2 |
| **SM3.** Investigate potential for under road conduit / animal corridors at key road crossing sites. | DoE | DoP NRA CPA DCB | 2012 | 1,2 |
| **SM4.** Consider ban on collection of berried females, and, subject to RM4, possibly all females as necessary to maintain population stability. | DoE | | 2012 | 1,2 |

| | | | | |
|---|---|---|---|---|
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| None. | | | | |

| White Land crab PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Map potential *Cardisoma guanhumi* habitat on all three islands. | DoE | | 2008 | 2 |
| **RM2.** Survey existing population to determine baseline, immediate threats, and establish monitoring program. | DoE | MRCU | 2010 | 1,2 |
| **RM3.** Monitor biological aspects of catch through catchery sampling. | DoE | | 2010 | 1,2 |
| **RM4.** Identification of local crab catchers, and potential crab processing and outlets. | DoE | MP | 2011 | 1,2 |
| **RM5.** Hold discussions with crab collectors to enlist their participation in the collection of catch information. | DoE | IntC MP | 2011 | 1,2,3 |
| **RM6.** Develop and conduct questionnaires, and field data-sheets for crab catchers to identify catch areas, quantities of catch, indicative effort, frequency of collection, timing and methods of collection, market price, destination of crab, processing etc. | DoE | IntC MP | 2011 | 1,2 |
| **RM7.** Determine peak spawning season and seasonal reproductive patterns. | DoE | IntC | 2010 | 1,2 |
| **RM8.** Determine critical migration routes, and influencing factors, towards implementing modification of road design to reduce mortality to *Cardisoma guanhumi* and other migrating Land crabs. | DoE | IntC | 2012 | 1,2 |
| **RM9.** Collaborate with international researchers to examine designs for under road conduits and animal corridors at key crossing sites along migratory routes for *Cardisoma guanhumi* and other migrating Land crabs. | DoE | IntC NRA MRCU | 2012 | 1,2 |
| **Communication & Publicity** | | | | |
| **CP1.** Targeted awareness campaign to key sectors of local community to inform groups that are prone to non-sustainable Land crab harvesting practices. | DoE | MP | 2010 | 3 |
| **CP2.** Targeted awareness campaign to key sectors of Government to assist in adopting management and legislation recommendations. | DoE | CIG | 2015 | 3 |
| **CP3.** Produce educational fact sheet detailing ecology and biology of Land crabs for schools and local public. | DoE | DE | 2009 | 3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 3 |

## REFERENCES and FURTHER READING for *White Land crab*


Hill, K. (2001). Smithsonian Marine Station – Report.
www.sms.si.edu

"Sustainable Management of the Black Land Crab *Gecarcinus ruricola*, Colombia (162/11/015)"
http://darwin.defra.gov.uk/documents/11015/4212/11-015%20AR1%20-%20edited.pdf

## TERRESTRIAL SPECIES

### Old George *Hohenbergia caymanensis* Britton ex L. B. Smith

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Liliopsida, Order: Bromeliales, Family: Bromeliaceae
Genus: Hohenbergia, Species: caymanensis

*Hohenbergia* is a genus of about 35 species (Proctor 2009). Old George *Hohenbergia caymanensis* is a species unique to Grand Cayman. The entire natural population is restricted to a small area of rocky woodland in southwestern George Town. Old George is the only example of this genus found in the Cayman Islands.

### Status

**Distribution:** Species endemic to Grand Cayman.
**Conservation:** Critically endangered CR A3c+4c; C1+2a(ii) (The Red List, Burton 2008a).
**Legal:** Old George *Hohenbergia caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

Old George *Hohenbergia caymanensis* is a large bromeliad. Mature leaves exceed one metre in length. It is extremely range-limited, with the remnant natural population now confined to a narrow rocky ridge of Cayman Formation dolostone extant in southwestern George Town. This area is known locally as the Ironwood Forest. Within this small area of forest, Old George is profuse; attaching to tree trunks, and fixing into the crevices on the rocky ground. Old George appears dependent on the high moisture content of the air in the Ironwood Forest. The closed tree canopy, in combination with the forest's position within George Town 1500mm rainfall isohyet, and the close proximity of an adjacent mosaic of wetlands, contribute to the humid understory.

### Associated Habitats and Species for *Old George*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Ironwood *Chionanthus caymanensis*<br>Ghost orchid *Dendrophylax fawcettii*<br>Silver Thatch palm *Coccothrinax proctorii* |

## Current Factors Affecting *Old George*

- *Extreme range limitation:* known only from a single population fragment in the Ironwood Forest George Town, *Hohenbergia caymanensis* is especially prone to localized environmental perturbation.

- *Roads construction:* in 2008, a controversial *roads* development through the Ironwood Forest was shelved amid public outcry. At the present time, however, the forest remains without any form of formal protection. A combination of footprint impact, and more significantly, "edge effects" arising from the proposed *roads* project, would likely result in the extinction of this species in the wild.

- *Habitat loss:* clearance and development of unprotected habitat. The Ironwood Forest constitutes the last remnant of original-growth George Town Forest, and is surrounded on all sides by dense *urban and suburban* development.

- *Habitat requirements:* complex habitat requirements may limit potential for effective *exsitu* conservation propagation, and the translocation and establishment of viable new populations.

- *Protected areas:* no natural population currently exists in protected areas, though a number of individuals have been transplanted to the Queen Elizabeth II Botanic Park. This artificially established population has, however, so far failed to propagate, and the reasons for this should be determined as a matter of urgency.

- *Capacity for protection:* given the extremely small area of the known population, protection and *insitu* conservation should be potentially achievable**.**

- *Propagation: ad hoc* trials have successfully propagated Old George from seed, with ease, under artificial conditions. Vegetative propagation is also simple - the small rosettes budding naturally from the base of adult plants can be removed and planted directly (Burton, *pers. comm.*).

- *Landscaping potential:* in common with most bromeliads, Old George makes for an attractive supplemental to landscaping schemes, however, potential is likely to be limited by the availability of suitable conditions of substrate, shade and rainfall.

## Opportunities and Current Local Action for *Old George*

Since 2002, long-standing efforts by local conservation groups to establish the Ironwood Forest as a protected area have not been successful. Currently, the Ironwood Forest remains without any form of legal protection.

In 2008, a controversial *roads* development through the Ironwood Forest was shelved amid public outcry.

In addition to containing the last natural population of Old George, The Ironwood Forest also represents the last remnant of original-growth George Town Forest, and the largest natural population of Ghost orchid *Dendrophylax fawcettii*; compounding the conservation significance of this area.

**SPECIES ACTION PLAN for *Old George***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Hohenbergia caymanensis* and raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Hohenbergia caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Hohenbergia caymanensis.* | 2012 |

| Old George<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Hohenbergia caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL7.** Promote removal of the road gazette through the Ironwood Forest. | DoE<br>NRA | | 2009 | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the Ironwood Forest, to protect *Hohenbergia caymanensis* population *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM3.** Establish local conservation propagation programme and introduce *Hohenbergia caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| **SM4.** Restore the damage done to the Ironwood Forest during the course of preliminary assessments for the road project (restoration of orchids, removal of introduced invasive species, replanting of native trees). | NRA<br>DoE | CIG | 2009 | 1,2 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |

| | | | | |
|---|---|---|---|---|
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2 |

| Old George<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Hohenbergia caymanensis.* | DoE | NT, CN | 2010 | 2 |
| **RM2.** Collect seed under *Millennium Seedbank Project.* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Reassess IUCN Red List status of *Hohenbergia caymanensis* locally. | DoE | | 2015 | 1 |
| **RM4.** Investigate seed dispersal and germination in natural populations, to clarify why this species is not self-propagating in the QEIIBP population, and clarify potential environmental limitations to restoration efforts. | DoE QEIIBP | RBGK IntC | 2012 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of *Hohenbergia caymanensis* with a children's competition to think of a "common name" for the plant. | DoE | MP | 2008 | 1,2,3 |
| CP1.REPORT: Competition launched in Darwin Newsletter, 2008, resulted in a winning entry of "Old George", named by Cristiana McMurdo "because it is found in the last piece of Old George Town forest". "Old George" becomes a focal point in public campaign to preserve the Ironwood Forest, 2008. "Old George" published as common name for *Hohenbergia caymanensis* in Red List (Burton 2008a). | | | | |
| **CP2.** Subject to SM1, develop and deploy *insitu* interpretation related to the value of the Ironwood Forest, southwest George Town. | DoE | DE NT CN | 2012 | 1,2,3 |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Hohenbergia caymanensis.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Old George*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Silver Thatch palm *Coccothrinax proctorii* R.W. Read

**INSERT IMAGES**

### Taxonomy and Range

Kingdom: Plantae, Class: Monocotyledoneae, Order: Arecales, Family: Palmae
Genus: Coccothrinax, Species: proctorii

The genus *Coccothrinax* comprises about 30 species, the majority native to the West Indies (Proctor 2009). Silver Thatch *Coccothrinax proctorii* is the only species to be found in the Cayman Islands. Found on all three islands, the Silver Thatch is endemic to the Cayman Islands.

### Status

**Distribution:** species endemic to the three Cayman Islands.
**Conservation:** Endangered EN A3bc+4bc (The Red List, Burton 2008a).
**Legal:** Silver Thatch Palm *Coccothrinax proctorii* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Silver Thatch palm *Coccothrinax proctorii* is the National Tree of the Cayman Islands. It is extremely slow growing, but abundant in *dry shrublands* and *forest and woodland*. The slender trunk is topped with a hanging crown of large green fronds, each displaying a silver sheen on the underside. Silver Thatch may exceed 10m in height, though 5m is more common. It bears small white flowers; developing into profuse red berries, which blacken as they ripen.

The Silver Thatch has played a significant role in the culture and economy of the Cayman Islands.

### Associated Habitats and Species for *Silver Thatch*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland<br>15. Forest and woodland | Cayman parrot *Amazona leucocephala*<br>Banana orchid *Myrmecophila thomsoniana*<br>Ironwood *Chionanthus caymanensis* |

### Current Factors Affecting *Silver Thatch*

- *Habitat loss:* clearance of forest and shrubland for development and agriculture have contributed to a reduction in habitat of this otherwise common species.

- *Generation time:* extremely slow growth and long generation time make Silver Thatch slow to recover and susceptible to deforestation.

- *Abundance:* the perception of the Silver Thatch as a "common tree" is more immediate than the understanding that deforestation rates are outrunning the long generation time of this species, so that they are being lost much faster than they can regenerate.

- *Cultural significance:* the Silver Thatch has played a significant role in the culture and economy of the Cayman Islands. In addition to thatching the roofs of dwellings, the tough fibres of the central "tops" leaves were stripped and manufactured into a durable rope, resistant to seawater. Additionally, tops were plaited into mats, baskets, hats and a variety of useful items. The recent decline in numbers of Silver Thatch has raised concerns amongst local artisans, including the Cayman Islands Council of Traditional Arts CICTA, for the future of this species – a cornerstone of Caymanian natural heritage.

- *Transplantation*: mature specimens are highly sensitive to relocation. Towards maximizing survivorship, phased trenching and pruning of roots and fronds is necessary, combined with suitable aftercare. Even with appropriate handling and aftercare, survival of specimens is not guaranteed.

- *Landscaping potential:* the cultural significance of Silver Thatch, combined with its compact and attractive nature make it highly desirable for native landscaping, however, its extreme slow-growing nature, and the associated cost of raising trees to a saleable size, limit its potential for use.

### Opportunities and Current Local Action for *Silver Thatch*

In a *National Symbols* campaign spearheaded by the *National Trust for the Cayman Islands* (1995), the Silver Thatch palm was voted the National Tree of the Cayman Islands. (The Wild Banana orchid was chosen as the National Flower and the Cayman parrot as the National Bird). An interpretative folder was produced for schools, containing information and activities centred on the National Symbols. The Trust plans to update the National Symbols campaign in 2006.

### SPECIES ACTION PLAN for *Silver Thatch*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Coccothrinax proctorii.* | 2015 |
| **2.** Preserve *insitu* populations of *Coccothrinax proctorii.* | 2015 |
| **3.** Develop an *inter-situ* cultivation and conservation programme for *Coccothrinax proctorii.* | 2012 |
| **4.** Maintain and improve the profile of *Coccothrinax proctorii* as a flagship for local biodiversity conservation. | ongoing |

| Silver Thatch PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & | DoE | CIG | 2006 | 1,2 |

| | | | | |
|---|---|---|---|---|
| Transport) Law. | | | | |
| **PL3.** Protect *Coccothrinax proctorii* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM2.** Establish an "outdoor classroom" in an accessible area of forest, where visitors can see *Coccothrinax proctorii* and learn about Cayman Biodiversity. | DoE | NT CN CIG | 2008 | 1,2,4 |
| **SM3.** Establish a local conservation propagation programme and introduce *Coccothrinax proctorii* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP DoE | RBGK CICTA | 2008 | 1,3 |
| SM3. REPORT: *Coccothrinax proctorii* growing from seed and translocated seedlings commenced, 2007. | | | | |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE CICTA | 2009 | 1,2,3,4 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3,4 |

| Silver Thatch PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Investigate protocols for relocation / transplantation of mature trees. | DoE QEIIBP | | 2008 | 3 |
| **RM2.** Investigate protocols for accelerating growth of seeds. | DoE QEIIBP | | 2008 | 3 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Reassess IUCN Red List status of *Coccothrinax proctorii* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Update National Symbols campaign. | NT | | 2006 | 4 |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Coccothrinax proctorii*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3,4 |
| **CP3.** Raise awareness of the unique nature of *Coccothrinax proctorii* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN CICTA | 2008 | 1,2,3,4 |
| CP3. REPORT: *Coccothrinax proctorii* featured in Red List of Flora (Burton 2008a). | | | | |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 4 |
| CP4. REPORT: *Coccothrinax proctorii* to feature in Cayman Islands 2008 Chelsea Flower Show exhibit. | | | | |

## REFERENCES and FURTHER READING for *Silver Thatch*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Century plant / Agave / Corato *Agave caymanensis* Proctor

INSERT IMAGE

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Liliopsida, Order: Asparagales, Family: Agavaceae
Genus: Agave, Species: caymanensis

*Agave* is a genus of about 300 species, distributed from the southern United States to tropical South America (Proctor 2009). The Century plant *Agave caymanensis* is endemic to the three Cayman Islands.

### Status

**Distribution:** Species endemic to the Cayman Islands.
**Conservation:** Vulnerable VU A2c+3c+4 (The Red List, Burton 2008a).
**Legal:** Century plant *Agave caymanensis* has no legal protection. It not currently listed in the Schedules of the National Conservation Law (Jan, 2009).

### Natural History

Like all agaves, the Century plant *Agave caymanensis* flowers only once during its lifetime. The single, spectacular flower spikes emerge synchronously, around March each year, reaching a height of 6m or more. Each produces masses of yellow-orange flowers, and miniature clones of the parent plant. After this, the parent plant dies, and dries up. Century plant is a typical, and occasionally dominant, plant of the exposed and rocky *dry shrubland* of the Cayman Islands. One of our most impressive and unique plants, an image of the Century plant graces the cover of *The Threatened Plants of the Cayman Islands: The Red List* (Burton 2008a).

### Associated Habitats and Species for *Century plant*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland | Silver Thatch palm *Coccothrinax proctorii* |

### Current Factors Affecting *Century plant*

- *Habitat loss:* the *dry shrubland* habitat of *Agave caymanensis* is generally rocky and elevated, facilitating easy clearance and development.

- *Regeneration:* slow growth, long generation time, and single lifetime flowering make *Agave caymanensis* slow to recover and susceptible to habitat perturbation and population fragmentation.

- *Fire: Agave caymanensis* is very susceptible to fire damage. The dead basal leaves burn readily, and flames quickly kill the living core of the plant.

- *Protected areas:* the *dry shrubland* habitat of *Agave caymanensis* is poorly represented within the current system of protected areas.

- *Landscaping potential:* despite its attractive and novel form, the large girth and spiky leaves of *Agave caymanensis* restrict landscaping suitability to large, open schemes. Given the predictable limits of size and form, however, *Agave caymanensis* is ideally suited to specific schemes, such as *roads* roundabouts and medians. Adaptation to arid environments makes *Agave caymanensis* especially suited to placement in schemes where irrigation is not possible.

### Opportunities and Current Local Action for *Century plant*

None.

**SPECIES ACTION PLAN for *Century plant***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Agave caymanensis* and maintain or raise Red List status by at least one category, from *vulnerable.* | 2015 |
| **2.** Preserve *insitu* populations of *Agave caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Agave caymanensis.* | 2012 |

| Century plant<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Agave caymanensis* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use Crown land protection, and the *Environmental Protection Fund* to establish a protected area which incorporates a significant area of *dry shrubland* to protect *Agave caymanensis.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM3.** Establish local conservation propagation programme and introduce *Agave caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Liaise with developers and National Roads Authority towards establishing *Agave caymanensis* as a staple in large-scale landscaping projects. | DoE<br>NRA | MP | 2012 | 1,2,3 |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of | DoP | DoE | 2009 | 1,2,3 |

| | | | | |
|---|---|---|---|---|
| *Recommended Planting Palette* in new developments. | | | | |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Century plant<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map key populations of *Agave caymanensis.* | DoE | | 2010 | 2 |
| **RM2.** Investigate cues for flowering, and collect seeds. | DoE | IntC NT QEIIBP RBGK | 2010 | 1,3 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Reassess IUCN Red List status of *Agave caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Agave caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1. REPORT: *Agave caymanensis* featured in Red List of Flora (Burton 2008a). | | | | |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Agave caymanensis*. | DoE DoP NT QEIIBP | MP CN GC NRA SB LCN | 2010 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Century plant*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Banana orchid *Myrmecophila thomsoniana* (Rchb. f.) Rolfe (previously *Schomburgkia thomsoniana*) var. *thomsoniana* var. *minor* (Strachan ex Fawc.) Dressler

INSERT IMAGES

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Liliopsida, Order: Orchidales, Family: Orchidaceae
Genus: Myrmecophila, Species: thomsoniana

*Myrmecophila* is a genus of approximately eight species, distributed through the Greater Antilles, Mexico, Central America and Venezuela (Proctor 2009). Banana orchids comprise two varieties, *Myrmecophila thomsoniana* var. *thomsoniana* in Grand Cayman, and *Myrmecophila thomsoniana* var. *minor* in Little Cayman and Cayman Brac. Both species and subspecies are unique to the Cayman Islands.

### Status

**Distribution:** Species and subspecies endemic to the Cayman Islands.
**Conservation:** Endangered EN A3bc+4bc (The Red List, Burton 2008a).
**Legal:** Banana orchid *Myrmecophila thomsoniana* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

The Banana orchid *Myrmecophila thomsoniana* is the National Flower of the Cayman Islands. One of twenty six orchid species found locally, both varieties have scented flowers with purple lips. The petals are predominantly white on the Grand Cayman variety, while the Sister Islands' variety has smaller flowers, with pale yellow petals. Through human assistance, some hybridization has occurred between varieties.

Banana orchids are particularly abundant in humid woodlands, producing long flower spikes April-May each year. Clusters of finger-like pseudobulbs form the base of the plants. The pseudobulbs resemble bunches of unripe bananas, and it is this feature from which the orchids derive their common name. The scientific name is derived from *Myrmex:* a genus of ants which typically inhabit the pseudobulbs of *Myrmecophila*. Holes in the base of pseudobulbs, facilitate the ant's entrance to their colonies. In the Cayman Islands, Banana orchids exist in the absence of the ants, though the "entrance holes" in the pseudobulbs remain.

### Associated Habitats and Species for *Banana orchid*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland | Silver Thatch palm *Coccothrinax proctorii* |
| 15. Forest and woodland | Cayman parrot *Amazona leucocephala* |
| 18. Urban and man-modified areas | Ghost orchid *Dendrophylax fawcettii* |

### Current Factors Affecting *Banana orchid*

- *Habitat loss:* clearance of forest and shrubland for agriculture and development has contributed to a reduction in primary habitat of this otherwise common species.

- *Hybridization:* crossing of *var. thomsoniana* and *var. minor* as occurred through human–assisted transportation between Grand Cayman and Little Cayman / Cayman Brac.

- *Commercial and private collection:* the Banana orchid is a popular specimen for orchid collectors, however, local abundance has previously been sufficient to offset collection pressure.

- *Transplantation:* translocation is generally simple, with specimens readily reattaching to suitable substrates, and thriving given suitable conditions of shade and humidity. This has contributed to significant numbers of Banana orchids being found in urban and suburban gardens, particularly in the George Town area.

- *Landscaping potential:* Banana orchids are popular with orchid enthusiasts and gardeners.

### Opportunities and Current Local Action for *Banana orchid*

In a *National Symbols* campaign spearheaded by the *National Trust for the Cayman Islands* (1995), the Banana orchid was voted the National Flower of the Cayman Islands. (The Silver Thatch palm was chosen as the National Tree and the Cayman parrot as the National Bird). An interpretative folder was produced for schools, containing information and activities centred on the National Symbols. The National Trust plans to update the National Symbols campaign in 2006.

Banana orchids are one of the specimens commonly collected from land slated for development during *Orchid Rescues*, undertaken by the *Cayman Islands Orchid Society*. Rescued orchids are distributed free-of-charge to local enthusiasts and gardeners.

**SPECIES ACTION PLAN for *Banana orchid***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Myrmecophila thomsoniana.* | 2015 |
| **2.** Preserve *insitu* populations of *Myrmecophila thomsoniana.* | 2015 |
| **3.** Develop an *exsitu* cultivation and conservation programme for *Myrmecophila thomsoniana.* | 2012 |
| **4.** Maintain and improve the profile of *Myrmecophila thomsoniana* as a flagship for local biodiversity conservation. | ongoing |

| Banana orchid<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Myrmecophila thomsoniana* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM2.** Develop system for the propagation of native orchids for habitat restoration and enhancement. | OS | DoE<br>QEIIBP | 2006 | 2,3 |
| SM2. REPORT: Orchid Society Shade House for growing–on orchids completed 2006, complementing existing Conservation Propagation Unit at QEII Botanic Park. Conservation Propagation Volunteers trained in culture techniques 2007. Successful trial cultures of (other) native orchid sp. commenced, 2007. | | | | |
| **SM3.** Establish an "outdoor classroom" in an accessible area of forest, where visitors can see *Myrmecophila thomsoniana* and learn about Cayman Biodiversity. | DoE | NT CN<br>CIG | 2008 | 1,2,4 |
| **SM4.** Mobilize volunteer support for orchid rescue, propagation and conservation activities. | OS | DoE MP<br>VOL | ongoing | 1,3 |
| **SM5.** Establish local conservation propagation programme and introduce *Myrmecophila thomsoniana* to private gardens and landscaping schemes through the Native Tree Nursery, and deter illicit collection. | QEIIBP<br>OS | RBGK<br>DoE | 2008 | 1,3 |

| | | | | |
|---|---|---|---|---|
| **SM6.** Implement associated HAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3,4 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3,4 |

| Banana orchid<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Investigate protocols for tissue culture. | OS | QEIIBP DoE | 2008 | 3 |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Reassess IUCN Red List status of *Myrmecophila thomsoniana* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Update National Symbols campaign. | NT | DoE | 2006 | 4 |
| **CP2.** Raise awareness of the unique nature of *Myrmecophila thomsoniana* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3,4 |
| CP2. REPORT: *Myrmecophila thomsoniana* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Myrmecophila thomsoniana*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3,4 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3,4 |
| CP4. REPORT: *Myrmecophila thomsoniana* to feature in Cayman Islands 2008 Chelsea Flower Show exhibit. | | | | |

## REFERENCES and FURTHER READING for *Banana orchid*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Collett, J. (1988). The Orchids of the Cayman Islands. *Horizons Mag*. 6: 52-53 Grand Cayman.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Ghost orchid *Dendrophylax fawcettii* Rolfe

INSERT IMAGES

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Liliopsida, Order: Asparagales, Family: Orchidaceae
Genus: Dendrophylax, Species: fawcettii

*Dendrophylax* is a Caribbean genus of about fourteen species (Proctor 2009). The Ghost orchid *Dendrophylax fawcettii* is endemic to the island of Grand Cayman, and is known from only two populations; one in the Ironwood Forest, George Town, and a second, smaller population in the region of the Mastic Reserve, North Side.

### Status

**Distribution:** Species endemic to Grand Cayman.
**Conservation:** Critically endangered CR A2abcd+4abcd (The Red List, Burton 2008a).
**Legal:** The Ghost orchid *Dendrophylax fawcettii* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

Known only from two surviving populations on Grand Cayman, the Ghost orchid *Dendrophylax fawcettii* attaches to trees and bare rock surfaces. It thrives in situations where sheltered forest adjoins wetlands, generating a moist air layer beneath the tree canopy. This leafless plant exists as a spider-like network of roots for the majority of the year, giving rise to a delicate pale cream flower, April-June. The flower lasts for about 3 weeks. The pollinator has yet to be identified, but is believed to possibly be a night-flying moth.

"*This species is rare and should be protected; otherwise it is may become extinct in the wild*" Proctor (2009).

### Associated Habitats and Species for *Ghost orchid*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Ironwood *Chionanthus caymanensis*<br>Old George *Hohenbergia caymanensis*<br>Banana orchid *Myrmecophila thomsoniana* |

## Current Factors Affecting *Ghost orchid*

- *Extreme range limitation:* known only from two isolated population fragments, one in the Mastic Reserve, North Side, and one in the Ironwood Forest, George Town, *Dendrophylax fawcettii* is prone to localized environmental perturbation.

- *Roads construction:* in 2008, a controversial *roads* development through the Ironwood Forest was shelved amid public outcry. At the present time, however, the forest remains without any form of legal protection. A combination of footprint impact, and more significantly, "edge effects" arising from this *roads* project, would likely result in the extinction of the George Town population.

- *Habitat loss:* clearance and development of unprotected habitat. The Ironwood Forest constitutes the last remnant of original-growth George Town Forest, and is surrounded on all sides by dense *urban and suburban* development.

- *Capacity for protection:* given the extremely small area of the known population, protection and *insitu* conservation should be potentially achievable**.**

- *Habitat requirements:* complex habitat requirements may limit potential for effective *exsitu* conservation propagation, and the translocation and establishment of viable new populations.

- *Protected areas:* neither of the known natural populations is within protected areas. Both the Ironwood Forest population, and that in the region of the Mastic Reserve, are currently unprotected. A number of specimens have been translocated to the Queen Elizabeth II Botanic Park.

- *Pollination:* the natural pollinator of *Dendrophylax fawcetti*, possibly a night-time flying moth, remains to be identified. Until the pollinator is confirmed, the potential for effective translocation may be limited.

- *Commercial and private collection:* the Ghost orchid is a popular specimen for orchid collectors. Collectors have significantly impacted populations elsewhere in the world and on island.

- *Transplantation:* translocation is generally simple, with specimens readily reattaching to suitable substrates, and thriving, given suitable conditions of shade and humidity. This has contributed to significant numbers of Ghost orchids being found in *urban and suburban* gardens, particularly in the George Town area.

- *Landscaping potential:* Ghost orchids are popular with orchid enthusiasts and gardeners.

## Opportunities and Current Local Action for *Ghost orchid*

Since 2002, long-standing efforts by local conservation groups to establish the Ironwood Forest as a protected area have not been successful to-date. The Ironwood Forest remains without any form of legal protection.

In 2008, a controversial *roads* development through the Ironwood Forest was shelved amid public outcry.

In addition to containing the largest natural population of Ghost orchids, the Ironwood Forest also represents the last remnant of original-growth George Town Forest, and the only natural population of Old George *Hohenbergia caymanensis*; compounding the conservation significance of this area.

Protection of the population in the region of the Mastic Trail, would represent a valuable protective measure for both the Ghost Orchid, and for the associated dry-forest reserve.

Ghost orchids are one of the species commonly collected from land slated for development during *Orchid Rescues*, undertaken by the *Cayman Islands Orchid Society*. Rescued orchids are distributed free-of-charge to local enthusiasts and gardeners. Unfortunately, in 2008, a pre-emptive collection of Ghost Orchids from the designated road corridor, in anticipation of the *roads* project, severely impacted the forest population.

**SPECIES ACTION PLAN for *Ghost orchid***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Dendrophylax fawcettii* and raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Dendrophylax fawcettii*. | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Dendrophylax fawcettii.* | 2012 |

| Ghost orchid<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Dendrophylax fawcettii* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL7.** Promote removal of the road gazette through the Ironwood Forest. | DoE<br>NRA | | 2009 | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the Ironwood Forest, to protect *Dendrophylax fawcettii* population *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the land adjacent the Mastic Reserve, to protect *Dendrophylax fawcettii* population *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM3.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM4.** Develop system for propagation of native orchids for habitat restoration and enhancement. | OS | DoE<br>QEIIBP | 2006 | 1,3 |
| SM4. REPORT: Existing Orchid Propagation Unit complimented by construction of Shade House, to establish local capacity for artificial propagation and growing-on of orchids, 2007. | | | | |
| **SM5.** Establish local conservation propagation programme. Introduce *Dendrophylax fawcettii* to private gardens and landscaping schemes through the Native Tree Nursery, and deter illicit collection. | QEIIBP<br>OS | VOL<br>RBGK<br>DoE | 2008 | 1,3 |
| SM5. REPORT: Orchid Society Shade House for growing–on orchids completed 2006, complementing existing Conservation Propagation Unit at QEII Botanic Park. Conservation Propagation Volunteers trained in culture techniques 2007. Successful trial | | | | |

| | | | | |
|---|---|---|---|---|
| cultures of (other) native orchid sp. commenced, 2007. | | | | |
| **SM6.** Restore the damage done to the Ironwood Forest along the gazetted road corridor, including restoration of orchids, removal of establishing invasive species, and replanting of suitable native trees. | NRA DoE | CIG | 2009 | 1,2 |
| **SM7.** Establish an "outdoor classroom" in an accessible area of forest, where visitors can see *Dendrophylax fawcettii* and learn about Cayman Biodiversity. | DoE | NT CN CIG | 2008 | 1,2,4 |
| **SM8.** Mobilize volunteer support for orchid rescue, propagation and conservation activities. | OS | DoE | ongoing | 1,3 |
| **SM9.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Ghost orchid<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Investigate protocols for tissue culture. | OS | QEIIBP DoE | 2008 | 3 |
| **RM2.** Survey and map remaining populations of *Dendrophylax fawcettii*. | DoE | NT, CN | 2010 | 2 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Reassess IUCN Red List status of *Dendrophylax fawcettii* locally. | DoE | | 2015 | 1 |
| **RM5.** Identify pollinator species and assess its distribution within Grand Cayman. | DoE | QEIIBP IntC | 2012 | 1,2 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Dendrophylax fawcettii* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1. REPORT: "Ghost orchids" became a focal point in public campaign to preserve the Ironwood Forest, 2008. *Dendrophylax fawcettii* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP2.** Subject to SM1, develop and deploy *insitu* interpretation related to the value of the Ironwood Forest, southwest George Town. | DoE | DE NT CN | 2012 | 1,2 |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Dendrophylax fawcettii.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |
| CP4. REPORT: *Dendrophylax fawcettii* to feature in Cayman Islands 2008 Chelsea Flower Show exhibit. | | | | |

## REFERENCES and FURTHER READING for *Ghost orchid*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Collett, J. (1988). The Orchids of the Cayman Islands. *Horizons Mag*. 6: 52-53 Grand Cayman.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Pisonia margaretae* Proctor

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Caryophyllales, Family: Nyctaginaceae
Genus: Pisonia, Species: margaretae

*Pisonia* is a pantropical genus of about 30 species (Proctor 2009). *Pisonia margaretae* is a species unique to Grand Cayman. The entire natural world population is known only from 40 individual specimens in the Spotts area, adjacent Jasmine Lane, Grand Cayman.

### Status

**Distribution:** Species endemic to Grand Cayman. World population known only from a single site in Spotts.
**Conservation:** Critically endangered CR C1+2a(i,ii); D (The Red List, Burton 2008a).
**Legal:** *Pisonia margaretae* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

A branching woody shrub, *Pisonia margaretae* is found beneath the understory of a dry forest remnant adjacent Jasmine Lane, Spotts. *Pisonia margaretae* tends to spread clonally, via a network of suckers. Despite setting viable seed annually, an artificial population at the QEII Botanic Park has failed to produce any wild seedlings.

### Associated Habitats and Species for *Pisonia margaretae*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland<br>19. Roads | *Aegiphila caymanensis* |

## Current Factors Affecting *Pisonia margaretae*

- *Extreme range limitation:* known only from a single cluster of some 40 individuals, in the vicinity of Jasmine Lane, Spotts, *Pisonia margaretae* is especially prone to localized environmental perturbation.

- *Habitat loss:* clearance and development of unprotected habitat. It is likely that adjacent development and roads construction has already seriously impacted this remnant population.

- *Capacity for protection:* given the extremely small area of the known population, protection and *insitu* conservation should be potentially achievable**.**

- *Conservation propagation:* a conservation propagation programme is established at the QEII Botanic Park. This includes root cuttings taken from each of the 40 individuals known in the wild, effectively duplicating the wild population. Despite setting viable seed annually, however, the artificial population has failed to produce any seedlings, and the reasons for this should be investigated as a matter of urgency.

- *Landscaping potential:* the irregular, sprawling habit of *Pisonia margaretae* make this species an unlikely candidate for incorporation into private gardens and formal landscaping schemes. Non-the-less, it may be introduced as a point of interest in larger naturalistic schemes, such as *roads* verge landscaping.

## Opportunities and Current Local Action for *Pisonia margaretae*

A conservation propagation programme is established at the QEII Botanic Park, which includes root cuttings taken from each of the 40 individuals known in the wild.

In addition to containing the world population of *Pisonia margaretae*, the Jasmine Lane Forest also holds the only known specimen of *Aegiphila caymanensis*; compounding the conservation significance of this area.

## SPECIES ACTION PLAN for *Pisonia margaretae*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Pisonia margaretae* and maintain or raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Pisonia margaretae.* | 2015 |
| **3.** Develop *exsitu* cultivation and conservation programme for *Pisonia margaretae.* | 2012 |

| Pisonia margaretae PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Pisonia margaretae* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |

| | | | | |
|---|---|---|---|---|
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the land adjacent Jasmine Lane, to protect *Pisonia margaretae* and *Aegiphila caymanensis* populations *insitu.* | CC | NT, MP DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM3.** Establish a local conservation propagation programme and introduce *Pisonia margaretae* to specialist landscaping schemes through the Native Tree Nursery. | QEIIBP DoE | RBGK | 2008 | 1,3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Pisonia margaretae PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Pisonia margaretae.* | DoE | NT, CN | 2010 | 2 |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Investigate tissue culture as a mechanism for conservation propagation. | OS QEIIBP | DoE | 2008 | 1,3 |
| **RM4.** Investigate seed dispersal and germination in natural populations, to clarify why this species is not self-propagating in the QEIIBP population, and clarify potential environmental limitations to restoration efforts. | DoE QEIIBP | RBGK IntC | 2012 | 3 |
| **RM5.** Investigate potential for establishment of an *exsitu* contingency population of *Pisonia margaretae* within a protected area in Grand Cayman. | DoE | NT | 2010 | 1,3 |
| **RM6.** Reassess IUCN Red List status of *Pisonia margaretae* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of *Pisonia margaretae* with a children's competition to think of a "common name" for the plant. | DoE | | 2010 | 1,2,3 |
| **CP2.** Subject to SM1, develop and deploy *insitu* interpretation related to the value of the Jasmine Lane Forest. | DoE | DE NT CN | 2012 | 1,2 |
| **CP3.** Raise public awareness of the unique nature of *Pisonia margaretae* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP3. REPORT: *Pisonia margaretae* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP4.** Raise awareness of the value of native landscaping, and promote the use of *Pisonia margaretae.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN NRA | 2010 | 1,3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Pisonia margaretae*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Epiphyllum phyllanthus* (L.) Haw. var. *plattsii* Proctor

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Caryophyllales, Family: Cactaceae
Genus: Epiphyllum , Species: phyllanthus, Variety: plattsii

*Epiphyllum* is a tropical American genus, credited with 16 species by Britton and Rose (1923) (in Proctor 2009). *Epiphyllum phyllanthus* var. *plattsii* is a variety apparently unique to Cayman Brac. Known only from a single colony within the *dry forest* on top of the Bluff, its presence remains something of a mystery, since no other cacti of this genus are known to grow wild anywhere else in the West Indies. Further study of its taxonomy and distribution should be undertaken to fully determine its status and providence.

### Status

**Distribution:** Species endemic to Cayman Brac, known only from a single colony.
**Conservation:** Critically endangered CR B1ab(i,ii,iii,v)c(i)+2ab(i,ii,iii,v)c(i);D (The Red List, Burton 2008a).
**Legal:** *Epiphyllum phyllanthus* var. *plattsii* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Epiphyllum phyllanthus* var. *plattsii* is a spineless, night-flowering cactus, with elongate, flattened stems. Rooting into the shaded leaf-litter which accumulates beneath the forest canopy, *Epiphyllum phyllanthus* var. *plattsii* adopts a sprawling form; the long stems looping over the jagged rock pinnacles which form the forest floor. On Cayman Brac, the single Bluff-top colony is bisected by Captain Mabry's Drive. The majority of plants are to be found along the southern border of the road.

### Associated Habitats and Species for *Epiphyllum*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Silver Thatch palm *Coccothrinax proctorii*<br>Banana orchid *Myrmecophila thomsoniana*<br>*Consolea millspaughii* var. *caymanensis* |

### Current Factors Affecting *Epiphyllum*

- *Extreme range limitation:* known only from a single colony of some 70m in diameter, *Epiphyllum phyllanthus* var. *plattsii* is especially prone to localized environmental perturbation. A report of a second colony from the Green Lane area remains unconfirmed, despite extensive search.

- *Habitat loss:* since Hurricane Ivan, Bluff-top development has progressed rapidly on Cayman Brac. Speculative land clearance, residential development, and an expanding *roads* network on the Bluff make this small roadside population extremely vulnerable.

- *Capacity for protection:* given the extremely small area of the known population, protection and *insitu* conservation should be potentially achievable**.**

- *Landscaping potential:* elsewhere, the attractive form and flowering nature of *Epiphyllum* cacti make them very popular.

### Opportunities and Current Local Action for *Epiphyllum*

None.

## SPECIES ACTION PLAN for *Epiphyllum*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Epiphyllum phyllanthus* var. *plattsii* and maintain or raise Red List status from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Epiphyllum phyllanthus* var. *plattsii.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Epiphyllum phyllanthus* var. *plattsii* on Cayman Brac. | 2012 |

| Epiphyllum phyllanthus var. plattsii PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Epiphyllum phyllanthus* var. *plattsii* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| NOTE: All subsequent Safeguards & Management actions are subject to the taxonomic and status determinations of RM2 | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area on Cayman Brac, to effect *insitu* conservation of the entire colony of *Epiphyllum phyllanthus* var. *plattsii*, and associated *dry forest.* | CC | NT, MP DoE CIG | 2010 | 1,2 |
| **SM2.** Establish Growing Stations on Cayman Brac, from which to propagate, investigate and plant out key species of plants and trees of local significance, targeting private gardens and landscaping schemes. | DoE QEIIBP | MP RBGK | 2010 | 1,3 |
| **SM3.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Epiphyllum phyllanthus var. plattsii PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Epiphyllum phyllanthus* var. *plattsii.* | DoE | | 2010 | 2 |
| RM1. REPORT: Preliminary survey of Cayman Brac following Hurricane Paloma reveals damage to forest, but *Epiphyllum* mostly intact, Nov 2008. | | | | |
| **RM2.** Investigate taxonomy and status of *Epiphyllum phyllanthus* var. *plattsii* towards better understanding provenance and requirement for protection. | DoE | IntC RBGK QEIIBP | 2010 | 2 |
| NOTE: All subsequent Research & Monitoring actions are subject to the taxonomic and status determinations of RM2. | | | | |
| **RM3.** Determine natural fruiting period, and collect seeds. | NT | DoE | 2010 | 1,3 |
| **RM4.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM5.** Investigate potential for establishment of an *exsitu* contingency population within a protected area in Cayman Brac. | DoE | NT | 2015 | 1,3 |
| **RM6.** Reassess IUCN Red List status of *Epiphyllum phyllanthus* var. *plattsii* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| NOTE: All subsequent Communication & Publicity actions are subject to the taxonomic and status determinations of RM2 | | | | |
| **CP1.** Raise public awareness of the unique nature of *Epiphyllum phyllanthus* var. *plattsii* with a children's competition to think of a "common name" for the plant. | DoE | | 2015 | 1,2,3 |
| **CP2.** Develop and deploy *insitu* interpretation related to *Epiphyllum phyllanthus* var. *plattsii.* | DoE | NT | 2015 | 1,2 |
| **CP3.** Raise awareness of the unique nature of *Epiphyllum phyllanthus* var. *plattsii* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP3. REPORT: *Epiphyllum phyllanthus var. plattsii* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP4.** Raise awareness of the value of native landscaping, and promote the use of *Epiphyllum phyllanthus* var. *plattsii.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Epiphyllum*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Hunt, D. *et al.* (2006) Ed.The New Cactus Lexicon, Volumes I and II. Descriptions and Illustrations of the Cactus Family (2006). Edited by David Hunt, Nigel Taylor and Graham Charles. 900 pages, 2400 colour illustrations. Published by DH Books. Published under the auspices of the International Cactaceae Systematics group.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Consolea millspaughii* (Britton) A. Berger (previously *Opuntia*) var. *caymanensis* Areces

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Caryophyllales, Family: Cactaceae
Genus: Consolea, Species: millspaughii, Variety: caymanensis

*Consolea* is a widespread American genus of more than 250 species, occurring in both tropical and temperate areas (Proctor 2009). *Consolea millspaughii* var. *caymanensis* used to occur in eastern Little Cayman, but has apparently died out there, for reasons unknown. The cactus is now known only from Cayman Brac.

### Status

**Distribution:** Subspecies endemic to Cayman Brac, known only from sparsely scattered individuals along the North Side of the Bluff, near Captain Mabry's Drive, and the bottom of the southern Bluff cliffs.
**Conservation:** Critically endangered CR C2a(ii) (The Red List, Burton 2008a).
**Legal:** *Consolea millspaughii* var. *caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Consolea millspaughii* var. *caymanensis* is an impressive, spiny, plated cactus. Individuals are to be found at scattered sites in Bluff *forest*, and *dry shrubland*, and at a single site on the south coast platform. Attaining a height of up to 2.5 m, *Consolea*, bears attractive orange-red flowers, which deepen with age.

### Associated Habitats and Species for *Consolea*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland<br>15. Forest and woodland | *Epiphyllum phyllanthus* var. *plattsii* |

### Current Factors Affecting *Consolea*

- *Extreme range limitation:* known only from sparsely scattered individuals along the top and bottom of the southern Bluff cliffs. The small number of individuals make *Consolea millspaughii* var. *caymanensis* especially prone to localized environmental perturbation. In 2008, the single specimen known from the bottom of the Bluff was knocked down by a bull.

- *Habitat loss:* since Hurricane Ivan, Bluff-top development has progressed rapidly on Cayman Brac. Speculative land clearance, residential development, and an expanding *roads* network on the Bluff make remaining specimens extremely vulnerable.

- *Landscaping potential: Consolea millspaughii* var. *caymanensis* is a large and attractive cactus, bearing bright red flowers. The spines, however, are extremely sharp, and so may limit its attractiveness for landscaping of some private gardens.

- *Fecundity:* no fruits have ever been sighted, so potential for recruitment to the current population is unknown, as is the potential for collection of seeds for conservation banking and propagation. Preliminary studies of individuals on Cayman Brac, and the one specimen in cultivation in Little Cayman, indicate that known individuals may all be males, (Strittmatter *pers. comm.* 2005, in Burton 2008).

- *Pest infestation:* severe damage by mining caterpillars has been observed in several individuals, probably as a result of the Cactoblastis moth (Burton 2008).

- *Propagation:* old specimens shed numerous small pads which root readily and are easy to transplant (Burton 2008).

- *Habitat security:* the original Bluff-edge population was probably severely reduced by historical clearing and burning associated with the maintenance of access for egg collection. (Brown booby *Sula leucogaster* eggs are now protected under the Animals Law 1976). The localized nature of the Brac's Bluff-edge population also makes it susceptible to severe weather.

### Opportunities and Current Local Action for *Consolea*

None.

## SPECIES ACTION PLAN for *Consolea*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Consolea millspaughii* var. *caymanensis* and maintain or raise Red List status from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Consolea millspaughii* var. *caymanensis.* | 2015 |
| **3.** Develop *exsitu* cultivation and conservation programme for *Consolea millspaughii* var. *caymanensis* on Cayman Brac. | 2012 |

| Consolea millspaughii var. caymanensis PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Consolea millspaughii* var. *caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Subject to RM2 and RM3, use the *Environmental Protection Fund* to protect areas supporting significant numbers of *Consolea millspaughii* var. *caymanensis*. | CC | NT, MP DoE CIG | 2010 | 1,2 |
| **SM2.** Subject to RM2 and RM3 establish Growing Stations on Cayman Brac, from which to propagate, investigate and plant out key species of plants and trees of local significance, targeting private gardens and landscaping schemes. | DoE | MP RBGK QEIIBP | 2010 | 1,3 |
| **SM3.** Subject to RM2 and RM3, collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK | QEIIBP | 2012 | 3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Consolea millspaughii var. caymanensis PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Consolea millspaughii* var. *caymanensis.* | DoE | NT | 2010 | 2 |
| RM1. REPORT: Preliminary survey of Cayman Brac following Hurricane Paloma fails to relocate *Consolea* at known site at base of Bluff, Nov 2008. | | | | |
| **RM2.** Investigate genetics and sexual status of *Consolea millspaughii* var. *caymanensis* towards better understanding reproductive status. | DoE | NT | 2010 | 1,2,3 |
| **RM3.** Undertake literature review to fully determine taxonomic status of *Consolea millspaughii* var. *caymanensis*. If the remnant Cayman Brac population is not significantly distinct from regional *Consolea millspaughii* populations, introduction of females to revitalise local population may be considered in the absence of local female stock. If var. *caymanensis* is confirmed genetically distinct from neighbouring subspecies, it is recommended that the population be left as a sterile clone, and conservation funds be applied to situations less dependent on such fundamental artificial manipulation. (According to the New Cactus Lexicon, it appears that the former scenario is most likely). | DoE | QEIIBP RBGK IntC | 2011 | 1,2,3 |
| NOTE: All subsequent Research & Monitoring and Communication & Publicity actions are subject to RM2 and RM3. | | | | |
| **RM4.** Determine natural fruiting period, and collect seeds if females are found. | DoE | NT | 2010 | 1,3 |
| **RM5.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM6.** Investigate potential for establishment of an *exsitu* contingency population within a protected area in Cayman Brac. | DoE | NT | 2015 | 1,3 |
| **RM7.** Reassess IUCN Red List status of *Consolea millspaughii* var. *caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Consolea millspaughii* var. *caymanensis* with a children's competition to think of a "common name" for the plant. | DoE | | 2015 | 1,2,3 |
| **CP2.** Raise awareness of the unique nature of *Consolea millspaughii* var. *caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP2. REPORT: *Consolea millspaughii var. caymanensis* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Consolea millspaughii* var. *caymanensis.* | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Consolea*

Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Hunt, D. *et al.* (2006) Ed.The New Cactus Lexicon, Volumes I and II. Descriptions and Illustrations of the Cactus Family (2006). Edited by David Hunt, Nigel Taylor and Graham Charles. 900 pages, 2400 colour illustrations. Published by DH Books. Published under the auspices of the International Cactaceae Systematics group.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Banara caymanensis* Proctor

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Malpighiales, Family: Salicaceae
Genus: Banara, Species: caymanensis

*Banara* is a widely distributed neotropical genus of about 37 species (Proctor 2009). *Banara caymanensis* is a species unique to Cayman Brac and Little Cayman. Known populations are restricted to two cliff-top locations on the south side of Cayman Brac, and the north-western margin of the Central Forest on Little Cayman.

### Status

**Distribution:** Species endemic to Cayman Brac and Little Cayman.
**Conservation:** Critically endangered CR C2a(i,ii) (The Red List, Burton 2008a).
**Legal:** *Banara caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Banara caymanensis* is a small, woody shrub of *dry shrubland*; featuring wiry, slightly zigzag branches and shiny, minutely toothed leaves. *Banara caymanensis* flowers in June, however, no sighting of fruit has ever been recorded. Current estimates suggest there may be between 30 and 150 individuals in the wild, distributed in four small clusters.

### Associated Habitats and Species for *Banara*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland | Cayman parrot *Amazona leucocephala*<br>Agave *Agave caymanensis*<br>Cedar *Cedrela odorata* |

### Current Factors Affecting *Banara*

- *Extreme range limitation:* known only from four small clusters of individuals, *Banara caymanensis* will be especially prone to localized environmental perturbation. Its presence on both Little Cayman and Cayman Brac mitigates immediate risk to some extent.

- *Habitat loss:* clearance and development of unprotected habitat.

- *Protected areas:* a significant proportion of the known population currently exists naturally within the National Trust Brac Parrot Reserve.

- *Fecundity:* no fruits have ever been sighted, so potential for recruitment to the current population is unknown, as is the potential for collection of seeds for conservation banking and propagation.

- *Landscaping potential:* the compact form of *Banara caymanensis* make it suitable for landscaping, though issues of fecundity will limit potential for propagation.

- *Habitat security:* the localized nature of the Brac's Bluff-edge population makes it susceptible to severe weather. Proximity to trailhead may also increase potential for wildfire.

### Opportunities and Current Local Action for *Banara*

While a significant proportion of the known population of *Banara caymanensis* currently exists naturally within the National Trust's Brac Parrot Reserve, there is no specific action focused on the preservation of this species.

## SPECIES ACTION PLAN for *Banara*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Banara caymanensis* and raise Red List status by at least one category, from *critically endangered*. | 2015 |
| **2.** Preserve *insitu* populations of *Banara caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Banara caymanensis* based in the Sister Islands. | 2012 |

| Banara caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Banara caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Subject to RM1 Use the *Environmental Protection Fund* to expand the Brac Parrot reserve, and/or protect Little Cayman population, to protect *Banara caymanensis* population *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Establish Growing Stations on Cayman Brac, from which to propagate, investigate and plant out key species of plants and trees of local significance, targeting private gardens and landscaping schemes. | DoE<br>QEIIBP | MP<br>RBGK | 2010 | 1,3 |
| **SM3.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Banara caymanensis PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Banara caymanensis* in Cayman Brac and Little Cayman. | DoE | NT | 2010 | 2 |
| RM1. REPORT: Preliminary survey of Cayman Brac following Hurricane Paloma reveals wind damage to *Banara*, however, still viable, Nov 2008. | | | | |
| **RM2.** Determine natural fruiting period, and collect seeds. | NT | DoE | 2010 | 1,3 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Reassess IUCN Red List status of *Banara caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Banara caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1. REPORT: *Banara caymanensis* featured in Red List of Flora (Burton 2008a). | | | | |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Banara caymanensis*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Banara*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Dendropemon caymanensis* Proctor

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Santalales, Family: Loranthaceae
Genus: Dendropemon, Species: caymanensis

*Dendropemon* is primarily a West Indian genus, incorporating about 15 species (Proctor 2009). *Dendropemon caymanensis* is a species unique to Little Cayman. Last collected in or near the Central Forest in 1991, *Dendropemon caymanensis* has not been seen since, and is currently known only from dried herbarium specimens lodged with the National Trust for the Cayman Islands.

### Status

**Distribution:** Species endemic to Little Cayman.
**Conservation:** Critically endangered CR C2a(i,ii) (The Red List, Burton 2008a).
**Legal:** *Dendropemon caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Dendropemon caymanensis* is a mistletoe, a parasitic plant known to attach to, and grow on, Headache Bush *Capparis cynophallophora* and Black Candlewood *Erithalis fruiticosa.* Since 1991, repeat surveys of the Central Forest in Little Cayman have failed to discover any new specimens. Associated observations indicate few potential host trees and increasing land clearance in this area; contributing to concerns for the future of this unique and unusual plant.

### Associated Habitats and Species for *Dendropemon*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland<br>15. Forest and woodland | Unknown |

### Current Factors Affecting *Dendropemon*

- *Lack of information:* lack of information on the precise location of the last recorded collection complicates critical assessment. *Dendropemon caymanensis* may already be extinct.

- *Extreme range limitation:* known only from a single site in Little Cayman, *Dendropemon caymanensis* will be especially prone to localized environmental perturbation.

- *Habitat loss:* land clearance and *roads* construction are planned in this vicinity.

- *Host availability:* parasitic dependence of *Dendropemon caymanensis* on Headache bush *Capparis cynophallophora* and Black candlewood *Erithalis fruiticosa*, compound habitat requirements to those which are suitable for the survival of the parasite *and* which contain viable populations of supportive hosts.

- *Landscaping potential:* the diminutive size and parasitic nature of *Dendropemon caymanensis* make this species an unlikely candidate for incorporation into formal landscaping schemes.

### Opportunities and Current Local Action for *Dendropemon*

None.

## SPECIES ACTION PLAN for *Dendropemon*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Locate *Dendropemon caymanensis* and raise Red List status by at least one category from *critically endangered*. | 2015 |
| **2.** Preserve *insitu* populations of *Dendropemon caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Dendropemon caymanensis* based in Little Cayman. | 2012 |

| Dendropemon caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Dendropemon caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| NOTE: All subsequent Safeguards & Management actions are subject to relocation under RM1. | | | | |
| **SM1.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM2.** Use the *Environmental Protection Fund* to establish a protected area on Little Cayman, to effect *insitu* conservation of remaining populations of *Dendropemon caymanensis.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM3.** Establish Growing Stations on Little Cayman, from which to propagate, investigate and plant out key species of plants and trees of local significance, targeting private gardens and landscaping schemes. | DoE<br>QEIIBP | MP<br>RBGK | 2010 | 1,3 |
| **SM4.** Use the *Environmental Protection Fund* to establish a protected area on Little Cayman, to effect *insitu* conservation of *Dendropemon caymanensis* and associated habitat. | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Dendropemon caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Dendropemon caymanensis* and determine whether this species is extinct. | DoE | NT | 2010 | 2 |
| NOTE: All subsequent Research & Monitoring actions are subject to RM1. | | | | |
| **RM2.** Determine natural fruiting period, and collect seeds. | DoE | NT | 2010 | 1,3 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM4.** Investigate potential to establish and grow *Dendropemon caymanensis* on alternative hosts. | QEIIBP | DoE RBGK | 2010 | 1,3 |
| **RM5.** Investigate potential for establishment of an *exsitu* contingency population of *Dendropemon caymanensis* within a protected area in Little Cayman. | DoE | NT | 2015 | 1,3 |
| **Communication & Publicity** | | | | |
| NOTE: All subsequent Communication & Publicity actions are subject to RM1. | | | | |
| **CP1.** Raise public awareness of the unique nature of *Dendropemon caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1. REPORT: *Dendropemon caymanensis* featured in Red List of Flora (Burton 2008a), though no photograph is known to exist. | | | | |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Dendropemon*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1977). A new mistletoe from the Cayman Islands. (*Dendropemon caymanensis*). Phytologia 35: 403

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Cedar *Cedrela odorata* L.

INSERT IMAGE

### Taxonomy and Range

Kingdom: Plantae, Order: Sapindales, Family: Meliaceae
Genus: Cedrela, Species: odorata

*Cedrela* is a tropical American genus of 15 species (Proctor 2009). Cedar *Cedrela odorata* is found throughout the West Indies and continental tropical America.

### Status

**Distribution:** Throughout the West Indies and continental tropical America.
**Conservation:** Critically endangered CR A2bcde+3bce+4 (The Red List, Burton 2008a).
**Legal:** Cedar *Cedrela odorata* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Cedar is readily recognized by its delicate compound leaves and dark, rough bark, which is often peppered with rows of Sapsucker *Sphyrapicus varius* drillings. Fast-growing in suitable habitats, Cedar is associated with *forest and woodlands*. Traditionally, Cedar was prized for its fragrant and insect-resistant wood. Paradoxically, a major threat to the current Cayman Cedar population comes in the form of an insect pest, the Mahogany shoot-borer *Hypsipyla grandella*, which attacks the twigs and terminal shoots of young trees, causing severe damage and deformity.

### Associated Habitats and Species for *Cedar*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Cayman parrot *Amazona leucocephala* |

## Current Factors Affecting *Cedar*

- *Habitat loss:* clearance and development of unprotected habitat. Since Hurricane Ivan, Bluff-top development has progressed rapidly on Cayman Brac.

- *Pest infestation:* the caterpillars of the Mahogany shoot-borer *Hypsipyla grandella* attack seed and fruit capsules, also boring into the terminal shoots and twigs of several locally significant species, including Cedar *Cedrela odorata* and Mahogany *Swietenia mahagoni* (Griffiths 2001), causing severe seed damage and shoot deformity in young trees. In the worse cases, the young trees are killed and/or fail to set any viable seed. As a result, Cedar recruitment to the mature forest population in Cayman Brac is now badly compromised.

  Infestations appear worst under full sunlight and monoculture conditions, such as those of newly planted forests. Widely spaced understory trees generally suffer less damage (Nair 2001). There currently appears to be no single effective chemical control for *Hypsipyla grandella*, though pesticides may best be used at the nursery stage (Wylie 2001). Biological controls appear ineffective in significantly reducing the damage caused by the larvae (Sands and Murphy 2001).

- *Fragmentation:* the expanding *roads* network on the Bluff of Cayman Brac constitutes a significant loss of habitat, and more significantly, fragmentation of existing forest. This opens up the interior of the forest to storm-force winds, and invasive species. Edge-effects, such as elevated light levels, associated with *roads* construction, would be expected to exacerbate the impact of the Mahogany shoot-borer *Hypsipyla grandella* on young Cedar (Nair 2001).

- *Cultural:* Cedar is traditionally prized for its fragrant and insect-resistant wood.

- *Dependent species:* old hollow Cedars are the preferred nest site for the Cayman Brac parrot *Amazona leucocephala hesterna*. In the long-term, loss of Cedar will result in a chronic shortage of suitable nesting cavities.

- *Landscaping potential:* the fast growing nature, impressive form and attractive foliage of cedar *Cedrela odorata* make it highly desirable for large-scale native landscaping.

## Opportunities and Current Local Action for *Cedar*

None.

## SPECIES ACTION PLAN for *Cedar*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Cedrela odorata* and maintain or raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Cedrela odorata.* | 2015 |
| **3.** Develop *exsitu* cultivation and conservation programme for *Cedrela odorata.* | 2012 |

| Cedar<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Cedrela odorata* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection fund* to establish a management agreement with landowners / protected area in the Ironwood Forest, and Lower Valley Forest, Grand Cayman, towards protecting local populations *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Use the Environmental *Protection fund* to establish a management agreement with landowners / extend protected areas on the Bluff , Cayman Brac, towards protecting populations *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM3.** Ensure at least 10% of extant population is represented within system of terrestrial protected areas. | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM4.** Establish small Growing Stations on Cayman Brac, to grow *Cedrela odorata* as a priority species. | DoE<br>QEIIBP | MP | 2010 | 1,3 |
| **SM5.** Introduce *Cedrela odorata* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | MP | 2012 | 1,3 |
| **SM6.** Incorporate *Cedrela odorata* into landscaping of *urban areas*, and *roads* in Cayman Brac. | DoE<br>QEIIBP | MP | 2010 | 1,3 |
| SM6. REPORT: Commercial propagation of *Cedrela odorata* commenced through Native Tree Nursery, 2007. | | | | |
| **SM7.** Collect seeds under *Millennium Seedbank Project* | DoE | | 2012 | 3 |

| | | | | |
|---|---|---|---|---|
| protocol and bank at Kew, with replicate collection for local conservation propagation. | RBGK QEIIBP | | | |
| **SM8.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Liaise with developers and Roads Authority towards establishing *Cedrela odorata* as a staple in large-scale landscaping projects. | DoE NRA | | 2012 | 1,3 |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Cedar<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Cedrela odorata*. | DoE | NT | 2010 | 2 |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Investigate chemical control and silviculture techniques to limit *Hypsipyla grandella.* | DoE | IntC DoA | 2012 | 1,2,3 |
| **RM4.** Investigate feasibility of biological control of *Hypsipyla grandella.* | DoE | IntC DoA | 2012 | 1,2,3 |
| **RM5.** Investigate potential to use tree ring analysis in Cedar to elucidate climate changes and incidence of *Hypsipyla grandella.* | VOL | DoE | ongoing | 1,2 |
| **RM6.** Reassess IUCN Red List status of *Cedrela odorata* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of *Cedrela odorata*, and its importance for parrot nesting. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Cedrela odorata*. | DoE DoP NT QEIIBP | MP CN GC LCN SB NRA | 2010 | 1,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Cedar*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.


## REFERENCES for *Mahogany Shoot-borer*


(SOURCE: University of Florida Institute for Food & Agricultural Sciences, Dept. Entomology & Nematology, and Florida Dept. of Agriculture & Consumer Services, Division of Plant Industry).
http://creatures.ifas.ufl.edu/trees/moths/mahogany_borer-English.htm

Bauer GP. 1987. Swietenia macrophylla and Swietenia macrophylla X S.mahagoni development and growth: the nursery phase and the establishment phase in line planting in the Caribbean National Forest, Puerto Rico. M.S. Thesis. State University of New York, College of Environmental Science and Forestry, Syracuse, N.Y.

Cintron BB. 1990. Cedrela odorata L. Cedro hembra, Spanish cedar, pp. 250-257. In Burns RMH, Barbara H [ed.], Silvics of North America 2: Hardwoods. Agricultural Handbook 644. United States Department of Agriculture, Washington, DC.

Entwistle PF. 1967. The current situation on shoot, fruit and collar borers of the Meliaceae., Proceedings of the 9th British Commonwealth Forestry Conference. Commonwealth Forestry Institute, Oxford.

Floyd RB. 2001. General conclusions and research priorities. pp. 183-187. In Floyd RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Floyd RB., Hauxwell C. (eds.) 2001. Hypsipyla shoot borers in Meliaceaae. Proceedings of an International Conference held at Kandy, Sri Lanka 20-23 August 1996. ACIAR Proceedings No. 97. Australian Centre for International Agricultural Research, Canberra, Australia.

Griffiths MW. 2001. The biology and ecology of Hypsipyla shoot borers. pp. 74-80. In Floyd RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Grijpma P. 1974. Contributions to an integrated control programme of Hypsipyla grandella (Zeller) in Costa Rica. Landbouwhogeschool te Wageningen., Wageningen, Netherlands.

Hauxwell C, Mayhew JE, Newton AC. 2001. Silvicultural management of Hypsipyla spp. pp. 151-163. In Floyd RB, Hauxwell C, (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Holsten EH. 1976. Life cycle of Hypsipyla grandella (Zeller). pp. 112-116. In Whitemore JL [ed.], Studies of the shootborer, Hypsipyla grandella (Zeller) Lep. Pyralidae, CATIE Misc. Publ. No. 1. CATIE, Turrialba, Costa Rica.

Howard FW. 1991. Seasonal incidence of shoot infestation by mahogany shoot borer in Florida. Florida Entomologist 74: 150-151.

Howard FW. 1995. Reduction in damage to mahogany shoot borer and mahogany leaf miner by use of azadirachtin. Journal of Tropical Forest Science 7: 454-461.

Howard FW, Meerow AW. 1993. Effect of mahogany shoot borer on growth of West Indies mahogany in Florida. Journal of Tropical Forest Science 6: 201-203.

Howard FW, Gilblin-Davis R. 1997. The seasonal abundance and feeding damage of Hypsipyla grandella (Lepidoptera: Pyralidae) in seed capsules of Swietenia mahagoni in Florida. Florida Entomologist 80: 35-41.

Mahroof RM, Hauxwell C, Edirisinghe JP, Watt AD, Newton AC. 2000. Effects of artificial shade on attack by the mahogany shoot borer, Hypsipyla robusta (Moore). Agricultural and Forest Entomology 4: 283.

Nair, K.S.S. 2001. *Pest outbreaks in tropical forest plantations. Is there a greater risk for exotic tree species?* Bogor, Indonesia, Center for International Forestry Research (CIFOR), 74 pp.

Newton AC, Baker P, Ramnarine S, Mesén JF, Leakey RRB. 1993. The mahogany shoot borer: prospects for control. Forest Ecology and Management 57: 301-328.

Sands DPA, Murphy ST. 2001. Prospects for biological control of Hypsipyla spp. with insect agents. pp. 121-130. In Floyd RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Solomon JD. 1995. Guide to insect borers of North American broadleaf trees and shrubs. Agriculture Handbook 706. US Department of Agriculture, Forest Service, Washington, DC.

Speight, M. R. 2001. Discussion summary: Integrated pest management of Hypsipyla spp. p. 179. In Floyd RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Taveras R, Hilje L, Carballo M. 2004a. Development of Hypsipyla grandella (Zeller) (Lepidoptera: Pyralidae) in response to constant temperatures. Neotropical-Entomology 33: 1-6.

Taveras R, Hilje L, Hanson P, Mexzon R. 2004b. Population trends and damage patterns of Hypsipyla grandella (Lepidoptera: Pyralidae) in a mahogany stand, in Turrialba, Costa Rica. Agricultural and Forest Entomology 6: 89-98.

Watt AD, Newton AC, Cornelius JP. 2001. Research in resistance of mahoganies to Hypsipyla species. pp. 89-96. In Floyd RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97.

Wylie FR. 2001. Control of Hypsipyla spp. shoot borers with chemical pesticides: a review. Ipp. 109-115. In Floyd. RB, Hauxwell C (eds.), International Workshop on Hypsipyla shoot borers in Meliaceae, 20-23 August 1996. ACIAR Proceedings No. 97: 109-115.

## TERRESTRIAL SPECIES

### Drypetes sp. (species unknown)

INSERT IMAGE

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Malpighiales, Family: Putranjivaceae (previously placed in the family Euphorbiaceae).
Genus: Drypetes, Species: *unknown*

The genus *Drypetes* is pantropical, and comprises about 200 species.

### Status

**Distribution:** Unknown, single individuals found at one site in Grand Cayman and two sites in Cayman Brac.
**Conservation:** Critically endangered CR B1ab(i,ii,iii,iv,v)c(i,iii)+2ab(i,ii,iii,iv,v)c(i,iii); D (The Red List, Burton 2008 *unpub*.)
**Legal:** *Drypetes* sp. currently has no legal protection in the Cayman Islands.

### Natural History

*Drypetes* is known in the Cayman Islands only from single, possibly sterile specimens found in the forest understory at one site in Grand Cayman and two sites in Cayman Brac. The Cayman Islands *Drypetes* remains currently unidentified, and may be a species new to science.

### Associated Habitats and Species for *Drypetes*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Unknown |

### Current Factors Affecting *Drypetes*

- *Lack of information:* until the taxonomic status of the Cayman Islands *Drypetes* sp. is fully determined, it will remain unknown as to whether the local specimens are endemic to the Islands, or otherwise.

- *Restricted range:* only known from three single specimens.

- *Fecundity:* taxonomic determination of local specimens has been hindered in the past because no fruit or flowers have been observed. Specimens appear sterile.

- *Habitat loss:* land clearance may result in the accidental loss of the few known specimens.

### Opportunities and Current Local Action for *Drypetes*

None.

## SPECIES ACTION PLAN for *Drypetes*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Determine full taxonomy of *Drypetes* sp. | 2010 |
| **2.** Determine range and numbers of *Drypetes* sp. | 2012 |
| **3.** Reassess IUCN status, and afford protection to *Drypetes* sp. through legislation and development of conservation management strategy, as appropriate. | 2012 |

| Drypetes sp.<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Subject to RM2, protect *Drypetes* sp. under National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2010 | 1,2,3 |
| **PL4.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 3 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 3 |
| **Safeguards & Management** | | | | |
| None. | | | | |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Drypetes sp.<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey known sites for *Drypetes* sp. and obtain herbarium specimens. | DoE | NT | 2010 | 1,2 |
| **RM2.** Determine full taxonomy of *Drypetes* sp. | DoE | | 2010 | 1 |
| **RM3.** Determine range, numbers and reproductive status of *Drypetes* sp. | DoE | | 2012 | 1,2 |
| **RM4.** Reassess IUCN Red List status of *Drypetes* sp. locally. | DoE | | 2012 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of the endemic flora and fauna of the Cayman Islands. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| **CP2.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Drypetes*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### *Aegiphila caymanensis* Moldenke

INSERT IMAGE

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Lamiales, Family: Verbenaceae
Genus: Aegiphila, Species: caymanensis

*Aegiphila* is a tropical American genus of about 150 species (Proctor 2009). *Aegiphila caymanensis* is a species unique to Grand Cayman. Until quite recently, *Aegiphila caymanensis* was regarded as possibly extinct. Known only from a historical specimen collected in the eastern interior in 1891, it was rediscovered in 1979, but not recorded since. In 2005, following Hurricane Ivan, a single specimen was blown down from the tree canopy in the Spotts area, Jasmine Lane, Grand Cayman.

### Status

**Distribution:** Species endemic to Grand Cayman. World population known only from a single individual in Spotts.
**Conservation:** Critically endangered CR A2ab+3b+4ab;B1ab(i,ii,iii,iv,v)c(iii)+2ab(i,ii,iii,iv,v) c(iii);C1+2a(i,ii);D (The Red List, Burton 2008a).
**Legal:** *Aegiphila caymanensis* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Aegiphila caymanensis* is a scrambling woody vine or liana, which inhabits the tree canopy of *forest and woodland*. *Aegiphila caymanensis* bears bunches of pale, cream-colour flowers, however, when not in flower, its tree-top habit makes it difficult to detect.

### Associated Habitats and Species for *Aegiphila*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | *Pisonia margaretae* |

### Current Factors Affecting *Aegiphila*

- *Extreme range limitation:* known only from a single individual in the vicinity of Jasmine Lane, Spotts, *Aegiphila caymanensis* will be especially prone to localized environmental perturbation. Historic collection suggests the species may still also occur in the east interior of Grand Cayman, but there have been no records in recent decades.

- *Habitat loss:* clearance and development of unprotected habitat. It is likely that adjacent development and roads construction has already seriously impacted this remnant population.

- *Conservation propagation:* a conservation propagation programme was recently established at the QEII Botanic Park, based on cuttings taken from the single known wild individual.

- *Detectability:* the tree-top habit of *Aegiphila caymanensis* make this species difficult to detect, and may mean that other specimens exist, as yet undetected.

- *Landscaping potential:* the tree-top habit of *Aegiphila caymanensis* may limit the potential for incorporation into formal landscaping schemes, unless it can be trained in form.

### Opportunities and Current Local Action for *Aegiphila*

A conservation propagation programme is established at the QEII Botanic Park, based on cuttings taken from the only individual known in the wild, 2005.

In addition to containing the only known specimen of *Aegiphila caymanensis*, the Jasmine Lane Forest also holds the natural world population of *Pisonia margaretae*; compounding the conservation significance of this area.

## SPECIES ACTION PLAN for *Aegiphila*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Stabilize population of *Aegiphila caymanensis* and maintain or raise Red List status from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Aegiphila caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Aegiphila caymanensis.* | 2012 |

| Aegiphila caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Aegiphila caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the land adjacent Jasmine Lane, to protect *Pisonia margaretae* and *Aegiphila caymanensis* population *insitu.* | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM3.** Establish local conservation propagation programme and introduce *Aegiphila caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Aegiphila caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Aegiphila caymanensis.* | DoE | NT, CN | 2010 | 2 |
| **RM2.** Determine natural fruiting period, and collect seeds. | NT | | 2012 | 2,3 |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2012 | 3 |
| **RM4.** Investigate tissue culture as a mechanism for conservation propagation. | DoA OS | DoE IntC | 2008 | 3 |
| **RM5.** Investigate potential for establishment of an *exsitu* contingency population of *Aegiphila caymanensis* within a protected area in Grand Cayman. | DoE | | 2010 | 1,3 |
| **RM6.** Reassess IUCN Red List status of *Aegiphila caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Aegiphila caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 2 |
| CP1. REPORT: *Aegiphila caymanensis* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP2.** Raise awareness of *Aegiphila caymanensis* with a children's competition to think of a "common name" for the plant. | DoE | MP | 2012 | 1,2,3 |
| **CP3.** Subject to SM1, develop and deploy *insitu* interpretation related to the value of the Jasmine Lane Forest. | DoE | DE NT CN | 2012 | 1,2,3 |
| **CP4.** Raise awareness of the value of native landscaping, and promote the use of *Aegiphila caymanensis*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,3 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Aegiphila*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Cayman sage *Salvia caymanensis* Millsp. & Uline

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Lamiales, Family: Labiatae
Genus: Salvia, Species: caymanensis

*Salvia* is a widely distributed genus of over 700 species (Proctor 2009). Cayman sage *Salvia caymanensis* is endemic to Grand Cayman. The last specimen was collected by Martin Brunt in 1967 (No.2061), and stored in the herbarium of the National Trust for the Cayman Islands (sheet 712). The original identification of *Salvia serotina*, was revised by George Proctor (May 1969) to *S. caymanensis*. The plant, however, was not seen since, despite repeated surveys. *Salvia caymanensis* was, until 2007, considered potentially extinct.

### Status

**Distribution:** Species endemic to Grand Cayman.
**Conservation:** Critically endangered CR B1ab(i,ii,iii,iv,v)c(ii,iv)+2ab(i,ii,iii,iv,v)c(ii,iv) (The Red List, Burton 2008a).
**Legal:** Cayman sage *Salvia caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

Cayman sage *Salvia caymanensis* is a pungent herb bearing profuse small pale blue flowers. It is most easily confused with *Saliva serotina*, but differs in having densely white-woolly undersides to the leaves, and growing to one metre tall, (*S. serotina* achieves a height of less than 30cm).

Cayman sage was originally recorded from coastal areas, however, thereafter it was not recorded for almost 40 years, despite repeated surveys. Several small colonies were rediscovered at small roadside locations in 2007, in conjunction with the implementation of this SAP.

### Associated Habitats and Species for *Cayman sage*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 11. Coastal shrubland<br>14. Dry shrubland<br>18. Urban and man-modified areas<br>19. Roads | *Turnera triglandulosa* |

### Current Factors Affecting *Cayman sage*

- *Possible extinction:* with no confirmed records since 1967, Cayman sage *Salvia caymanensis* was rediscovered at a roadside location in 2007.

- *Habitat loss:* clearance and development of beach ridge and shrubland habitat.

- *Lack of protected habitat:* records indicate that natural habitat may have been beach ridge. Currently, several small colonies are known from disturbed roadside locations. None, however, currently exist within protected areas.

- *Adaptive nature:* the adaptive nature of *Salvia caymanensis* encourages predominance in disturbed, roadside habitats.

- *Landscaping potential:* ease of cultivation from seed, hardy nature, and attractive blue flowers make *Salvia caymanensis* suitable for landscaping.

### Opportunities and Current Local Action for *Cayman sage*

None.

## SPECIES ACTION PLAN for *Cayman sage*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Determine if *Salvia caymanensis* is extinct and afford protection if appropriate. | 2008 |
| 1. REPORT: *Salvia caymanensis* rediscovered, 2007. | |
| **2.** If *Salvia caymanensis* is extinct, attempt conservation propagation . | 2008 |
| 2. REPORT: Conservation propagation commenced at QEII Botanic Park Native Tree Nursery, 2007. | |
| **3.** If extant, raise IUCN Red list status of *Salvia caymanensis* to *least concern.* | 2015 |

| Cayman sage<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** If extant, protect *Salvia caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| PL3. REPORT: *Salvia caymanensis* rediscovered, 2007. | | | | |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining populations, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| PL4. REPORT: Full seed collection lodged with Kew, 2007. | | | | |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>CPA | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Determine location / status of herbarium specimens of *Salvia caymanensis*, and obtain any available seed to attempt conservation propagation. | RBGK | NT DoE | 2008 | 2,3 |
| SM1. REPORT: Natural wild seed source identified, 2007. | | | | |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| SM2. REPORT: Millennium Seedbank collection of 10,000 seeds lodged with Kew, 2007. Collection of 3,000 seeds for local propagation at QEIIBP, 2007. | | | | |
| **SM3.** Establish local conservation propagation programme and introduce *Salvia caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP<br>DoE | RBGK | 2008 | 1,3 |
| SM3. REPORT: *Salvia caymanensis* growing from seed, 2007. *Salvia caymanensis* sold from Native Tree Nursery, 2008. | | | | |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Liaise with developers and Roads Authority towards establishing *Salvia caymanensis* as a staple in large-scale landscaping projects. | DoE<br>NRA | | 2012 | 1,3 |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of | DoP | DoE | 2009 | 1,2,3 |

| | | | | |
|---|---|---|---|---|
| *Recommended Planting Palette* in new developments. | | | | |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Cayman sage<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey remaining natural habitat for *Salvia caymanensis.* | DoE | | 2008 | 1 |
| RM1. REPORT: Completed 2007. | | | | |
| **RM2.** Survey modified habitat through public "backyard" survey for *Salvia caymanensis.* | DoE | MP | 2007 | 1 |
| RM2. REPORT: Public competition with CI$1,000 prize launched in Darwin Initiative Newsletter and local media, 2007. Results in rediscovery of *Salvia caymanensis* at six locations around Grand Cayman. | | | | |
| **RM3.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| RM3. REPORT: Collection of 10,000 seeds submitted to MSB, 2008. Confirmation of viability required. | | | | |
| **RM4.** Reassess IUCN Red List status of *Salvia caymanensis* locally. | DoE | | 2015 | 3 |
| RM4. REPORT: In response to rediscovery, Red List status amended to *Critically endangered*, 2007. | | | | |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Salvia caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP1. REPORT: ONGOING JUN 07. Media associated with competition launch and rediscovery of *Salvia caymanensis. Salvia caymanensis* featured in Red List of Flora (Burton 2008a). | | | | |
| **CP2.** Raise awareness of the value of native landscaping, and promote the use of *Salvia caymanensis*. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Cayman sage*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Ironwood *Chionanthus caymanensis* Stearn

INSERT IMAGES

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Lamiales, Family: Oleaceae
Genus: Chionanthus, Species: caymanensis

*Chionanthus* is a pantropical and warm-temperate taxon of more than 150 species (Proctor 2009). Ironwood is endemic to the Cayman Islands.

### Status

**Distribution:** Species endemic to the Cayman Islands.
**Conservation:** Endangered EN A3bc+4bc, (The Red List, Burton 2008a).
**Legal:** Ironwood *Chionanthus caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural History

Ironwood *Chionanthus caymanensis* is a common tree of *forest and woodland*. Ironwood's endangered status results from its slow-growing nature, in combination with and a rapid rate of habitat loss. Ironwood's famously hard and heavy timber is strong and termite resistant, making it a traditional favourite in construction of Cayman-style cabins, especially foundation posts. The hard wood, capable of turning a nail, required old-timers to join the postings with hand-fashioned Ironwood pegs.

### Associated Habitats and Species for *Ironwood*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 15. Forest and woodland | Ghost orchid *Dendrophylax fawcettii*<br>Old George *Hohenbergia caymanensis* |

### Current Factors Affecting *Ironwood*

- *Habitat loss:* clearance and development of unprotected habitat.
- *Regeneration:* in the wild, Ironwood is typified by slow growth and long generation time.
- *Cultural significance:* Ironwood's famously hard and heavy timber is strong and termite resistant, making it a traditional favourite in construction.
- *Landscaping potential:* Ironwood is an attractive tree. Unless accelerated growth is achieved under artificial propagation, however, its slow-growing nature may limit viability for landscaping.

### Opportunities and Current Local Action for *Ironwood*

Since 2002, long-standing efforts by local conservation groups to establish the Ironwood Forest as a protected area have not been successful to-date. The Ironwood Forest remains without any form of legal protection.

In 2008, a controversial *roads* development through the Ironwood Forest was shelved amid public outcry.

In addition to containing the largest natural population of Ghost orchids *Dendrophylax fawcettii*, the Ironwood Forest also represents the last remnant of original-growth George Town Forest, and the only natural population of Old George *Hohenbergia caymanensis*; compounding the conservation significance of this area.

**SPECIES ACTION PLAN for *Ironwood***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Chionanthus caymanensis* and raise Red List status by at least one category, from *endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Chionanthus caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Chionanthus caymanensis.* | 2012 |

| Ironwood PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Chionanthus caymanensis* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners of the Ironwood Forest, to protect *Chionanthus caymanensis* population *insitu.* | CC | NT, MP DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE RBGK QEIIBP | | 2012 | 3 |
| **SM3.** Establish local conservation propagation programme and introduce *Chionanthus caymanensis* to private gardens and landscaping schemes through the Native Tree Nursery. | QEIIBP DoE | RBGK | 2008 | 1,3 |
| SM3. REPORT: *Chionanthus caymanensis* growing from seed and translocated seedlings, 2007. | | | | |
| **SM4.** Establish an "outdoor classroom" in an accessible area of forest, where visitors can see *Chionanthus caymanensis* and learn about Cayman Biodiversity. | DoE | NT CN CIG | 2008 | 1,2,3 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through | DoP | DoE | 2009 | 1,2,3 |

| | | | | |
|---|---|---|---|---|
| maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | | | | |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Ironwood<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Chionanthus caymanensis.* | DoE | | 2010 | 2 |
| **RM2.** Collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Reassess IUCN Red List status of *Chionanthus caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Subject to SM1, develop and deploy *insitu* interpretation related to the value of the Ironwood Forest, southwest George Town. | DoE | DE NT CN | 2012 | 1,2,3 |
| **CP2.** Raise public awareness of the unique nature of *Chionanthus caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP2. REPORT: *Chionanthus caymanensis* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Chionanthus caymanensis.* | DoE DoP NT QEIIBP | MP CN GC NRA SB LCN | 2010 | 1,2,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Ironwood*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

Stearn, W.T. (1979). Three new West Indian species of Chionanthus (Oleaceae). *Bot. Notiser* 132: 57-60.

## TERRESTRIAL SPECIES

### *Verbesina caymanensis* Proctor

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Subclass: Asteridae, Order: Asterales, Family: Asteraceae
Genus: Verbesina, Species: caymanensis

*Verbesina* is a tropical American genus of about 150 species (Proctor 2009). *Verbesina caymanensis* is a species unique to Cayman Brac. The world population is known only from a small area the Bluff cliffs above Spot Bay.

### Status

**Distribution:** Species endemic to Cayman Brac, known only from one site, a section of shaded cliffs, restricted to the north-facing section of bluff near Peter's Cave, Cayman Brac. Cliff of this orientation runs for about 1.5 km, with a height of ca. 40m, limiting *Verbesina caymanensis* to a sparse population ranging over (up to) ca. 14.83 acres of cliff face.
**Conservation:** Critically endangered CR B1ab(v)+2ab(v), (The Red List, Burton 2008a).
**Legal:** *Verbesina caymanensis* currently has no legal protection in the Cayman Islands. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural History

*Verbesina caymanensis* is a small shrub, growing to approximately 1m in height, and bearing small, white flowers. In the wild, the habitat requirements of *Verbesina caymanensis* appear highly specific. Specimens are confined to the rock crevices of a near-vertical section of north-facing Bluff cliff, which remains in permanent shade for the majority of the year. Under artificial conditions, however, *Verbesina caymanensis* appears less specific in its requirements. It was grown successfully in cultivation at the QEII Botanic Park for a number of years, though this artificial population does not appear to remain.

### Associated Habitats and Species for *Verbesina*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 7. Maritime cliffs and ironshore<br>14. Dry shrubland | Brown booby *Sula leucogaster* |

### Current Factors Affecting *Verbesina*

- *Extreme range limitation:* the world population of *Verbesina caymanensis* is known only from a small area of the Bluff cliffs above Spot Bay, Cayman Brac; making it especially prone to localized environmental perturbation.

- *Habitat security:* the inaccessible nature of the vertical cliff face which constitutes the natural habitat of *Verbesina caymanensis* affords the population some protection from the habitat clearance and development which threatens many other Bluff-top species. A newly emerging trend for development along the northern Bluff edge, however, may be a cause for concern. Additionally, the localized nature of the cliff-face population makes it susceptible to other impacts, including severe weather, rock fall and wildfire.

- *Invasive species:* the cliff-face habitat of *Verbesina caymanensis*, is currently subject to the establishment of invasive species, including the non-native shrub Shamrock *Tacoma stans* and Leaf-of-Life *Bryophyllum pinnatum*.

- *Trail management:* in the region of the ascent to Peter's Cave, occasional clearance and burning along the trail promote the establishment and spread of invasive species, and increase the risk of wildfire.

- *Landscaping potential:* conservation propagation by QEII Botanic Park has shown *Verbesina caymanensis* to respond to cultivation. It is possible that, with appropriate management, *Verbesina caymanensis* may be incorporated into suitable schemes.

- *Capacity for protection:* given the small and inaccessible nature of the site in which *Verbesina caymanensis* exists, *insitu* conservation of the population should be potentially achievable.

### Opportunities and Current Local Action for *Verbesina*

None.

## SPECIES ACTION PLAN for *Verbesina*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Reverse population decline of *Verbesina caymanensis* and raise Red List status by at least one category, from *critically endangered.* | 2015 |
| **2.** Preserve *insitu* populations of *Verbesina caymanensis.* | 2015 |
| **3.** Develop *inter-situ* cultivation and conservation programme for *Verbesina caymanensis* on Cayman Brac. | 2012 |

| Verbesina caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Verbesina caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Reduce the threat of a catastrophic loss of the remaining population, through involvement with the *Millennium Seedbank Project.* | DoE<br>RBGK | QEIIBP | 2010 | 3 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect *Verbesina caymanensis* population *insitu*, in the vicinity of Peter's Cave. | CC | NT, MP<br>DoE CIG | 2010 | 1,2 |
| **SM2.** Collect seeds under *Millennium Seedbank Project* protocol and bank at Kew, with replicate collection for local conservation propagation. | DoE<br>RBGK<br>QEIIBP | | 2012 | 3 |
| **SM3.** Establish Growing Stations on Cayman Brac, from which to propagate, investigate and plant out key species of plants and trees of local significance, targeting private gardens and landscaping schemes. | DoE<br>QEIIBP | MP<br>RBGK | 2010 | 1,3 |
| **SM4.** Investigate potential for establishment of a contingency population within a protected area in Cayman Brac. | DoE | NT | 2010 | 1,3 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE CIG | 2010 | 1,2,3 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Verbesina caymanensis<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Verbesina caymanensis.* | DoE | NT | 2010 | 2 |
| RM1. REPORT: Preliminary survey of Cayman Brac following Hurricane Paloma reveals spread of *Bryophyllum pinnatum* and wind damage to *Verbesina*, however, latter still viable, Nov 2008. | | | | |
| **RM2.** Determine natural fruiting period and collect seed under *Millennium Seedbank Project* protocol, including voucher specimens and *insitu* habit images, and transpose into searchable electronic format, linked to *Field Collections Database.* | DoE | RBGK QEIIBP | 2010 | 3 |
| **RM3.** Reassess IUCN Red List status of *Verbesina caymanensis* locally. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Develop and deploy *insitu* interpretation related to the value of the *maritime cliff* adjacent Peter's Cave. | DoE | | 2010 | 1,2 |
| **CP2.** Raise public awareness of the unique nature of *Verbesina caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| CP2. REPORT: *Verbesina caymanensis* featured in Red List of Flora (Burton 2008a) | | | | |
| **CP3.** Raise awareness of the value of native landscaping, and promote the use of *Verbesina caymanensis.* | DoE NT QEIIBP DoP | MP CN GC NRA SB LCN | 2010 | 1,2,3 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Verbesina*


Burton, F. (2007). Wild Trees in the Cayman Islands. 2nd Edition. Pub. International Reptile Conservation Foundation, USA. 240pp. ISBN 978-1-4276-2168-9

Burton, F.J. (2008a). *Threatened Plants of the Cayman Islands: The Red List.* Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Burton, F.J. (2008b). *Vegetation Classification for the Cayman Islands*. In*: Threatened Plants of the Cayman Islands: The Red List*. Pub. Royal Botanic Gardens Kew: Richmond, Surrey UK.

Proctor, G.R. (1984). Flora of the Cayman Islands. Kew Bulletin Additional Series XI. Royal Botanic Gardens, Kew. Her Majesty's Stationary Office. London. ISBN 0-11-242548-8.

Proctor, G.R. (2009 in press). Flora of the Cayman Islands (2nd ed). Royal Botanic Gardens, Kew. Richmond UK.

## TERRESTRIAL SPECIES

### Little Cayman snail *Cerion nanus*

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Mollusca, Class: Gastropoda, Order: Stylommatophora, Family: Cerionidae
Genus: Cerion, Species: nanus

*Cerion nanus* is a small land snail endemic to Little Cayman. The world population is known only from a small area shrubland north of Blossom Village.

### Status

**Distribution:** Species endemic to Little Cayman, known only from one site.
**Conservation:** Critically Endangered B1+2a (Source: IUCN Red List, Hounsome 1996).
**Legal:** *Cerion nanus* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The snail's limited food source, the shrub *Evolvulus squamosus*, currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural history

The Little Cayman snail *Cerion nanus* is a small land snail known only from a single patch of *dry shrubland* in Little Cayman. The area of shrubland known to support living snails measures just a few meters square, potentially making this one of the most restricted snail populations on earth. Empty shells elsewhere on Little Cayman indicate that the present range of the Little Cayman snail may now be significantly less than previously. *Cerion nanus* is found in close association with the sparsely distributed shrub *Evolvulus squamousus*, to which it attaches, appearing to glean food from the surface of the plant.

### Associated Habitats and Species for *Little Cayman snail*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland | Little Cayman Green anole *Anolis maynardi*<br>Sister Islands Rock iguana *Cyclura nubila caymanensis*<br>*Turnera triglandulosa* |

### Current Factors Affecting *Little Cayman snail*

- *Extreme range limitation:* the world population of *Cerion nanus* is known only from a small patch of *dry shrubland* north of Blossom Village, Little Cayman.

- *Habitat security:* the accessible roadside nature of the existing habitat and susceptibility of the *dry shrubland* habitat to perturbation such as wildfire and storm damage, make the current population of *Cerion nanus* extremely vulnerable. Empty shells elsewhere on Little Cayman indicate that the present range of the snail may be significantly less than previously. It is possible that the population has become much reduced as a result of historic storm impact.

- *Species reliance:* the close reliance of *Cerion nanus* on *Evolvulus squamosus* makes the snail susceptible to perturbation of either population.

- *Invasive species:* roadside areas are prone to colonisation by invasive flora, which might have the potential to impact the limited distribution of *Evolvulus squamosus* in this area.

- *Landscaping potential:* given its thin, straggly form *Evolvulus squamosus* would contribute little to a landscaping aesthetic, and so is unlikely to be planted or maintained within a development.

- *Capacity for protection:* given the small nature of the site in which *Cerion nanus* exists, *insitu* conservation of the population should be potentially achievable.

### Opportunities and Current Local Action for *Little Cayman snail*

None.

**SPECIES ACTION PLAN for *Little Cayman snail***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Survey and improve understanding of *Cerion nanus*, and increase population and habitat extent by 100%. | 2015 |
| **2.** Promote preservation of *insitu* populations of *Cerion nanus* and *Evolvulus squamosus.* | 2015 |
| **3.** Promote establishment of contingency populations of *Cerion nanus* and *Evolvulus squamosus* on Little Cayman. | 2010 |

| Little Cayman snail<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Cerion nanus* under Schedule I and *Evolvulus squamosus* under Schedule II, of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect *Cerion nanus* and *Evolvulus squamosus* population *insitu.* | CC | NT, MP DoE CIG | 2010 | 2 |
| **SM2.** Subject to RM3 and RM4, introduce wild or artificially head-started *Cerion nanus* to *Evolvulus squamosus* mosaic around Little Cayman, to increase their range and establish contingency populations in relict areas. | DoE | IntC DWCT MP | 2012 | 1,3 |
| **SM3.** Establish *Evolvulus squamosus* patches in suitable areas around Little Cayman, and repopulate with *Cerion nanus* as necessary. | DoE | MP | 2012 | 1,3 |
| **SM4.** Investigate potential for establishment of a contingency population within a protected area in Little Cayman. | DoE | NT | 2012 | 1,3 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Little Cayman snail<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map known population of *Cerion nanus*, with particular attention to parcels 80A128 (3.71 ac, privately-owned) and 80A14 (45.95 ac, Crown-owned). | DoE | | 2012 | 1,2 |
| **RM2.** Survey and map remaining patches of *Evolvulus squamosus* in Little Cayman, and determine presence or absence of *Cerion nanus*. | DoE | | 2012 | 1,2 |
| **RM3.** Determine feasibility and desirability of transferring individuals from known population to repopulate relict sites, preferably within protected areas, to establish contingency populations in Little Cayman. | DoE | NT | 2012 | 1,3 |
| **RM4.** Investigate potential for artificial rearing of egg masses, to improve survivorship and facilitate repopulation of contingency sites in Little Cayman. | DoE | IntC DWCT | 2012 | 1,3 |
| **RM5.** Facilitate and promote research into terrestrial invertebrates in the Cayman Islands. | DoE | IntC | 2010 | 1 |
| **RM6.** Determine natural fruiting period of *Evolvulus squamosus*, and collect seeds. | DoE | | 2012 | 1,2,3 |
| **RM7.** Establish and develop a national invertebrates collection, with searchable online facility. | DoE | | 2015 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of *Cerion nanus* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| **CP2.** Raise awareness of *Cerion nanus* with a children's competition to think of a "common name" for the snail. | DoE | MP | 2012 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Little Cayman snail*


Clench, W.J. (1964). Land and freshwater mollusca of the Cayman Islands, WI. Occ. Pap. Molluscs. Mus. Comp. Zool. Harvard 2(31): 345-80.

Gould, S.J. (1984). Covariance sets and ordered geographic variation in *Cerion* from Aruba, Bonaire and Curacao – a way of studying non-adaptation. *Systematic Zoology* 33 (2): 217-237.

Hounsome, M.V. and Askew,R.R. (1980). *Cerion nanus* (Maynard) (Mollusca: Cerionidae) on Little Cayman. *Atoll. Res. Bull.* 241: 91-96.

Hounsome, M.V. (1994). Terrestrial invertebrates (other than insects) of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 307-31.

Sinha, K. (1986). A morphometric investigation of the *Cerion* land snails of the Cayman Islands: several species of one varying species? (unpub. Undergraduate paper). Manchester University Zoology Department.

Woodruff, D.S. (1975). A new approach to the systematics and ecology of the genus *Cerion*. *Malacol. Rev.* 8 (1/2): 128

## TERRESTRIAL SPECIES

### Cayman Pygmy Blue butterfly *Brephidium exilis thompsoni*

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Arthropoda, Class: Insecta, Order: Lepidoptera, Family: Lycaenidae
Genus: Brephidium, Species: exilis, Subspecies: thompsoni

### Status

**Distribution:** Subspecies endemic to the Cayman Islands.
**Conservation:** Data deficient.
**Legal:** *Brephidium exilis* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural history

The Cayman Pygmy Blue butterfly *Brephidium exilis thompsoni* is one of the smallest butterflies in the Western hemisphere – possibly in the world. It is highly dependent on *salt-tolerant succulents* for all stages of its life-cycle. In its larva form, the caterpillars feed on *Salicornia perennis*. Adults depend on *Sesuvium portulacastrum* for nectar.

### Associated Habitats and Species for *Cayman Pygmy Blue*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 12. Salt-tolerant succulents<br>13. Pools, ponds and mangrove lagoons | West Indian Whistling-duck *Dendrocygna arborea* |

### Current Factors Affecting *Cayman Pygmy Blue*

- *Range limitation:* this tiny butterfly is endemic to the Cayman Islands.

- *Population fragmentation:* highly dependent upon *salt-tolerant succulents* for all stages of its life-cycle. *Salt-tolerant succulents* habitats are generally highly fragmented in the Cayman Islands. Habitatable areas are generally small; some constitute only a few square metres.

- *Insecticide:* susceptibly of populations to insecticide spraying is unknown.

- *Species reliance:* in its larva form, the caterpillars of the Cayman Pygmy Blue feed on *Salicornia perennis*. Adults depend on *Sesuvium portulacastrum* for nectar.

- *Capacity for protection:* given the small size of areas which appear capable of supporting populations of this butterfly, conservation should be potentially achievable.

- *Recovery potential:* given appropriate baseline conditions and management, artificially created *salt-tolerant succulents* habitat will have a tendency to rapidly accrue a natural complement of species. This makes *salt-tolerant succulents* potentially attractive candidates for artificial creation, and restoration projects. The r-selected nature of many butterfly populations should aid rapid establishment, given suitable habitat.

- *Drainage:* water regime is critical to the functioning of *salt-tolerant succulent* habitat. Elevation or reduction in water level is likely to result in a change in vegetation, and the loss of typifying species, such as *Salicornia perennis* and *Sesuvium portulacastrum*.

### Opportunities and Current Local Action for *Cayman Pygmy Blue*

None.

**SPECIES ACTION PLAN for *Cayman Pygmy Blue***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Survey and improve understanding of *Brephidium exilis thompsoni*, and incorporate 30% of known habitat into protected areas. | 2015 |
| **2.** Promote preservation of *insitu* populations of *Brephidium exilis thompsoni.* | 2015 |
| **3.** Promote establishment of contingency populations of *Brephidium exilis thompsoni.* | 2010 |

| Cayman Pygmy Blue<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Brephidium exilis thompsoni* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect natural *salt-tolerant succulents* habitat for *Brephidium exilis thompsoni.* | CC | NT, MP DoE CIG | 2012 | 1,2 |
| **SM2.** Use the *Environmental Protection Fund* to purchase and protect *salt-tolerant succulents* areas in Barkers, and manage access on site, towards maximising visitor experience / minimising impact. | CC | DoE NT CIG | 2010 | 1,2 |
| **SM3.** Use the *Environmental Protection Fund* to extend Meagre Bay Pond Animal Sanctuary, to incorporate areas of *salt-tolerant succulents* along the eastern shore, and prevent dumping in this area. | CC | DoE NT CIG | 2012 | 1,2 |
| **SM4.** Establish experimental site for the design and testing of techniques to restore artificial *salt-tolerant succulents,* and determine the feasibility of a restoration programme. | DoE | IntC | 2012 | 1,3 |
| **SM5.** Subject to successful conclusion of SM4, embark upon a programme of restoration of *salt-tolerant succulents* habitat to suitable man-modified areas. | DoE | | 2015 | 1,3 |
| **SM6.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Work with *Department of Planning* to formalize | DoE | DoP | 2012 | 3 |

| | | | | |
|---|---|---|---|---|
| restoration protocol for quarry applications, incorporate adherence to *salt-tolerant succulents* guidelines where appropriate, and promote establishment of an escrow fund to cover costs of implementation. | | CPA | | |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| Cayman Pygmy Blue<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map remaining populations of *Brephidium exilis thompsoni*, towards determining conservation status. | DoE | NT | 2012 | 1,2 |
| **RM2.** Identify and prioritise most significant *pools, ponds and mangrove lagoons* and *salt-tolerant succulents* areas in the Cayman Islands | DoE | NT | 2012 | 1,2,3 |
| **RM3.** Instigate the design and testing of experimental techniques to establish and restore *salt-tolerant succulents* areas and *pools, ponds and mangrove lagoons*, including seed collection, propagation and planting, and the ecology of key fauna, such as *Brephidium exilis*, to determine the feasibility and factors affecting potential restoration programmes. | DoE | | 2012 | 1,3 |
| **RM4.** Investigate potential for artificial relocation and rearing / head-starting of *Brephidium exilis* larvae to facilitate population establishment in suitable areas. | DoE | IntC | 2012 | 1,3 |
| **RM5.** Establish experimental site for the design and testing of artificial restoration techniques for *salt-tolerant succulents*. | DoE | IntC | 2012 | 1,3 |
| **RM6.** Facilitate and promote research into terrestrial invertebrates in the Cayman Islands. | DoE | IntC | 2010 | 1 |
| **RM7.** Establish and develop a national invertebrates collection, with searchable online facility. | DoE | | 2012 | 1 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of the unique nature of *Brephidium exilis thompsoni* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| **CP2.** Promote establishment of "study ponds" in schools. | DoE | NT MP DE | 2012 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Cayman Pygmy Blue*


Askew, R.R. (1980). The butterfly (Lepidoptera; Rhopalcera) fauna of the Cayman Islands. *Atoll Res. Bull.* 241: 121-138.

Askew, R.R. (1988). Butterflies of Grand Cayman, a dynamic island fauna. *J. Nat. Hist.* 22: 875-881.

Askew, R.R. (1994). Insects of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 333-356.

Stafford, P.A. and Askew R.R. (2008). Butterflies of the Cayman Islands. Pub. Apollo Books. Pp. 172. ISBN: 8788757854.

## TERRESTRIAL SPECIES

### Mosquito fish *Limia caymanensis & Gambusia xanthosoma*

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Actinopterygii, Order: Cyprinodontiformes, Family: Poeciliidae
Genus: Limia, Species: caymanensis

Kingdom: Animalia, Phylum: Chordata, Class: Actinopterygii, Order: Cyprinodontiformes, Family: Poeciliidae
Genus: Gambusia, Species: xanthosoma

The genus *Limia* is endemic to the Greater Antilles. Some 22 species are to be found on Hispaniola, with single endemic species on Cuba, Jamaica, and Grand Cayman, Cayman Islands.

The genus *Gambusia* consists of over 40 species, with a single endemic species in Grand Cayman, Cayman Islands.

### Status

**Distribution:** Both species are endemic to Grand Cayman.
**Conservation:** Both species are data deficient.
**Legal:** *Limia caymanensis* and *Gambusia xanthosoma* currently have no legal protection. Pending legislation, they would be protected under the National Conservation Law (Schedule II). The Department of Environment would be the lead body for legal protection.

### Natural history

"Mosquito fish" is a generic term, covering many different species of fish. *Limia caymanensis* & *Gambusia xanthosoma* are live-bearing fish, the former growing to 2.8 cm SL (male/unsexed), 3.18 cm SL (female), the latter to about 3.4cm SL (male/unsexed), 3.58cm SL (female).

*Limia caymanensis* is associated with freshwater and brackish water, and is to be found in *pools, ponds and mangrove lagoons*, rock hollows, especially in the vicinity of *mangroves*. They are generally demersal, feeding towards the bottom of the water column, coexisting with *Gambusia affinis*.

*Gambusia xanthosoma* is a *mangrove* species preferring more saline water. It is restricted to the tidal Rhizophora zones close to North Sound.

### Associated Habitats and Species for the *Mosquito fish*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 9. Mangrove<br>13. Pools, ponds and mangrove lagoons | Bats<br>West Indian Whistling-duck *Dendrocygna arborea* |

### Current Factors Affecting *Mosquito fish*

- *Habitat loss: pools, ponds and mangrove lagoons* are a limited and threatened habitat in the Cayman Islands. Loss of *mangroves* fringing North Sound especially impacts *Gambusia xanthosoma*.

- *Quarrying:* modification of natural structure, including deepening, and removal of aquatic and peripheral vegetation, may render artificial pools and marl pits less suitable as habitat for Mosquito fish.

- *Non-native species:* Tilapia have been characterized as a threat to native freshwater fish in the US. Tilapia reproduce quickly, and eat the eggs and juveniles of other fish species (Fitzsimmons 2001).

- *Resilience:* with a minimum population doubling time probably less than 15 months, these small fish should be able to quickly establish, given suitable habitat conditions.

### Opportunities and Current Local Action for *Mosquito fish*

None.

**SPECIES ACTION PLAN for *Mosquito fish***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Improve knowledge of *Mosquito fish*, survey and determine Red List status. | 2015 |
| **2.** Promote preservation of *insitu* populations of *Mosquito fish.* | 2015 |
| **3.** Promote establishment of contingency populations of *Mosquito fish* in modified pools and environments. | 2015 |

| Mosquito fish PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2 |
| **PL3.** Protect *Limia caymanensis* and *Gambusia xanthosoma* under Schedule II of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Establish guidelines for form and function of artificial excavations and marl pits, and for restoration of flooded quarries, toward maintaining and maximizing value for biodiversity. | DoP DoE | AAC | 2012 | 2,3 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect *Mosquito fish* populations. | CC | NT, MP DoE CIG | 2010 | 2 |
| **SM2.** Incorporate habitat requirements for *Mosquito fish* into restoration of *pools, ponds and mangrove lagoons.* | DoE | MP | 2015 | 2 |
| **SM3.** Encourage introduction of *Mosquito fish* into suitable *pools, ponds and mangrove lagoons* and other habitats. | DoE | MP | 2015 | 3 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2,3 |
| **Advisory** | | | | |
| **A1.** Provide advice for landowners on the effective management *pools, ponds and mangrove lagoons*, to conserve *Mosquito fish.* | DoE | NT MP | 2012 | 2 |
| **A2.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2 |

| Mosquito fish<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Survey and map populations of *Mosquito fish.* | DoE | | 2012 | 1 |
| **RM2.** Determine local IUCN status of *Mosquito fish.* | DoE | | 2012 | 1 |
| **RM3.** Identify habitat requirements and key areas of natural habitat for *Mosquito fish* . | DoE | MRCU | 2012 | 1,2,3 |
| **RM4.** Investigate potential for artificial rearing to facilitate improved survivorship, and establishment of contingency populations in suitable sites. | DoE | IntC | 2012 | 1,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Mosquito fish* and other endemic flora and fauna. | DoE NT QEIIBP | MP, CN GC, OS SB, LCN | 2008 | 1,2,3 |
| **CP2.** Raise awareness of *Mosquito fish* with a children's competition to think of a "common name" for each, and promotion of establishment of "study ponds" in schools. | DoE | NT MP DE | 2012 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |

## REFERENCES and FURTHER READING for *Mosquito fish*


Baugh, T.M. (1985). Habitat preferences of pond fishes on Grand Cayman, BWI. *Unpublished report, Dept. Biol. Sci., Univ. Nevada*, 9 pp.

Burgess, G.H., Smith, S.H. and Lane, E.D. (1994). Fishes of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 199-228.

Fitzsimmons, K. (2001). *Environmental and Conservation Issues in Tilapia Aquaculture*. In: Subasinghe, R. and T. Singh, eds., Tilapia: Production, Marketing, and Technological Developments. FAO Infofish, Kuala Lumpur, Malaysia.

Greenfield, D. W. (1983). Gambusia xanthosoma, a new species of poeciliid fish from Grand Cayman Island, BWI. *Copeia* (no. 2): 457-464.

Lee, D.S., Platania S.P. and G.H. Burgess, (1983). *Atlas of North American freshwater fishes, 1983 supplement*. Occasional Papers of the North Carolina Biological Survey no. 1983-6. North Carolina State Museum of Natural History, Raleigh, N.C. 67 p.

Rivas, L. R. and Fink W. L. (1970). A new species of poeciliid fish of the genus Limia from the island of Grand Cayman, B.W.I. *Copeia* (no. 2): 270-274.

## TERRESTRIAL SPECIES

### Little Cayman Green anole *Anolis maynardi*

**INSERT IMAGE**

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Reptilia, Order: Squamata, Family: Polychrotidae
Genus: Anolis, Species: maynardi

*Anolis* is a genus of lizards which incorporates some 400 species. The Little Cayman Green anole *Anolis maynardi* is a species unique to Little Cayman.

### Status

**Distribution:** Species endemic to Little Cayman (believed introduced to Cayman Brac).
**Conservation:** Data deficient.
**Legal:** The Little Cayman Green anole *Anolis maynardi* currently has no legal protection. Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural history

The Little Cayman Green anole *Anolis maynardi* grows to a total length of 21.6cm, and is distinct from the other Cayman anoles by virtue of its exceptionally long pincer-shaped snout. Males are generally larger than females, and exhibit a throat-fan of pale yellow-green skin, which they deploy in displays to other individuals. The anoles are variable in colour, ranging through ochre, green, turquoise, grey and tan, and have the ability to change colour according to mood.

Anolis lizards exhibit strong adaptive radiation and convergent evolution. Populations on isolated islands diverge to occupy different ecological niches. Some are treetop foragers, other trunk forages; with twig ecomorphs having shorter limbs than trunk ecomorphs. These adaptive patterns repeat on numerous islands, with animals in similar habitats converging toward similar body forms (Losos *et al*. 1998).

While little is known about the biology of the Little Cayman Green anole, it is likely that its remarkable snout represents a unique feeding adaptation.

### Associated Habitats and Species for the *Green anole*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland<br>15. Dry forest | Little Cayman snail *Cerion nanus*<br>Sister Islands Rock iguana *Cyclura nubila caymanensis*<br>*Turnera triglandulosa* |

### Current Factors Affecting the *Green anole*

- *Habitat loss:* though both Little Cayman and Cayman Brac are much less developed than Grand Cayman, recent years have seen a proliferation in residential development and *roads* infrastructure, threatening the once abundant habitat of the Green anole.

- *Non-native species:* predation, particularly by rats and cats, is likely to inflict significant impact on native lizard populations; however, the degree of this has not been quantified. Competition from introduced species, such as the Cuban Bush anole *Anolis sagrei* is also a possibility - again this remains to be determined. There is suggestion that potential for competition between these two species may be limited, due to their occupying different ecological levels in the shrubland: the Cuban Bush anole *Anolis sagrei* occupies lower levels of the shrubland, whilst the Green anole *Anolis maynardi* occupies treetops. In Florida, however, introduced *Anolis sagrei* has successfully pushed the local *Anolis carolinensis* northward, despite the fact that when both cohabit the same area *A. sagrei* are primarily terrestrial or restrict themselves to the lower branches of bushes, while *A. carolinensis* (similar to *Anolis maynardi*) remain higher up in the foliage.

- *Introduction:* the Green anole has recently been introduced to Cayman Brac. This population was reported to have established in the vicinity of Stake Bay, ca. 1991, however, it is now appears widespread along the Bluff. The full extent of the Brac population, and the impact on species native to Cayman Brac has yet to be determined.

- *Legal:* DoE staff are not currently legally enabled to use firearms to effect lethal control of invasive species. This has resulted in situations in which immediate control of feral cats and dogs to preserve endangered native species has not been possible, likely resulting in the loss of individuals through reliance on less immediate control mechanisms.

### Opportunities and Current Local Action the *Green anole*

None.

**SPECIES ACTION PLAN for the *Green anole***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Improve understanding of *Anolis maynardi*, and determine Red List status. | 2015 |
| **2.** Promote preservation of *insitu* populations of *Anolis maynardi.* | 2015 |

| Green anole<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Anolis maynardi* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2 |
| **PL6.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Eradicate feral cats in Little Cayman, and spay / neuter all domestic cats. | DoE | DEH DoA, MP | 2015 | 2 |
| **SM2.** Incorporate key areas of natural habitat for *Anolis maynardi* into system of protected areas. | CC | NT, MP DoE CIG | 2010 | 2 |
| **SM3.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with landowners to protect *Anolis maynardi* populations. | CC | NT, MP DoE CIG | 2015 | 2 |
| **SM4.** Implement associated HAPs. | DoE | | 2015 | 1,2 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2 |

| Green anole<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Develop survey protocol and map populations of *Anolis maynardi* on Little Cayman and Cayman Brac. | DoE | IntC | 2010 | 1,2 |
| **RM2.** Determine IUCN status of *Anolis maynardi.* | DoE | | 2012 | 1,2 |
| **RM3.** Identify habitat requirements for *Anolis maynardi* and key areas of natural habitat. | DoE | | 2010 | 1,2 |
| **RM4.** Determine nature of interactions with *Anolis sagrei.* | DoE | | 2012 | 1,2 |
| **RM5.** Conduct pilot project towards eradication of feral cats in Little Cayman. | DoE CSL | DoA | 2015 | 2 |
| RM5. REPORT: Pilot project completed by DoE and DoA, 2008. All pet cats in Little Cayman were micro-chipped. Twenty eight cats were removed through trapping, however, more remain. Trap-shy individuals will require alternative control methods. | | | | |
| **RM6.** Construct quarters for visiting scientists in Little Cayman and Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | IntC | 2012 | 1 |
| RM6. REPORT: Accommodation for up to four individuals on Little Cayman established by DoE, 2008. | | | | |
| **Communication & Publicity** | | | | |
| **CP1.** Raise awareness of the unique nature of *Anolis sagrei* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 1,2,3 |
| **CP2.** Utilise the unique fauna of Little Cayman to promote the Island. | CIG | DoE DoT NT MP | 2010 | 1,2,3 |
| **CP3.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1,2,3 |
| CP3. REPORT: A partnership between the DoE and Cayman Islands Philatelic Bureau produced a stamp issue, which included a Green anole stamp with associated ecological interpretation, 2008. | | | | |

## REFERENCES and FURTHER READING FOR *Green anole*


Echternacht, A.C. and Gerber, G.P. (1990). Comparative ecology and ethology of *Anolis conspersus* and *Anolis sagrei* (Sauria, Iguanidae) on Grand Cayman Island. *Unpublished Prog. Report No 1., Univ Tennessee*, 16 pp.

Franz, R., Morgan, G.S. and Davies, J.E. (1986). Some recent introductions of reptiles in the Cayman Islands, *W.I. Herp. Review* 18: 10-11.

Losos, J. B., Jackman, T. R., Larson, A., de Queiroz, K., and Rodriguez-Schettino, L. (1998). Contingency and determinism in replicated adaptive radiations of island lizards. *Science*, 279, 2115-2118.

Seidel, M.E. and Franz, R. (1994). Amphibians and reptiles (exclusive of marine turtles) of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 307-31.

## TERRESTRIAL SPECIES

### Sister Islands Rock iguana *Cyclura nubila caymanensis*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Sauropsida, Order: Squamata, Family: Iguanidae
Genus: Cyclura, Species: nubila, Subspecies: caymanensis

The Sister Islands Rock iguana *Cyclura nubila caymanensis*, is endemic to Cayman Brac and Little Cayman. A subspecies of the Cuban Rock iguana, it apparently diverged from a common ancestor some two-three million years ago.

### Status

**Distribution:** Subspecies endemic to Cayman Brac and Little Cayman.
**Conservation:** Critically endangered (IUCN Red List, Gerber, G. (1996). Recent surveys, (M. Goetz 2008, pers. comm.) indicate the iguana to be nearly extinct on Cayman Brac (less than 50 animals). Little Cayman supports a population of, very approximately, 2,000 individuals (M. Goetz 2008, studies in progress).
**Legal:** The Sister Islands Rock iguana *Cyclura nubila caymanensis* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

Like all *Cyclura* species, the Sister Islands Rock iguana is primarily herbivorous; consuming leaves, flowers and fruits. Their natural diet includes native shrubs such as the flowers of Bay vine *Ipomoea pes-caprae* and the fruit of Broadleaf *Cordia sebestena caymanensis*. The iguanas likely serve an important ecological role as a seed disperser. As a result, extinction of the iguanas could have serious consequences for the endemic flora of Little Cayman and Cayman Brac.

In common with the Grand Cayman Blue iguana *Cyclura lewisi*, the Sister Islands Rock iguana has also been quick to adapt to cultivation of the land. In Cayman Brac iguanas have been reported to feed on windfall fruits, including pawpaw, plums and mango.

The Sister Islands Rock iguana lays its eggs in excavated burrows; making access to suitable nesting areas essential. Soil deposits are limited on both islands, and in Little Cayman iguanas have been observed to excavate nests in the sandy beach ridge, down to within 9m of the high water mark. Females nest May-June, and may lay up to 20 eggs at a time (Gerber, Goetz: *unpub*.).

Eggs generally hatch after about 10 weeks. Emergent hatchlings are prey to the native Racer snake *Alsophis cantherigerus*, and tend to adopt an arboreal nature in their early months, reaching sexual maturity about two-three years-of-age. As adults, they are primarily terrestrial in nature, seeking shelter in natural rock crevices and excavated burrows during the evening hours. They emerge in the morning, as ambient temperatures rise above 80$^{o}$C, to bask in the sunshine and warm up.

Natural longevity in the wild is unknown, but is presumed to be many decades.

### Associated Habitats and Species for *Sister Islands Rock iguana*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|

| | |
|---|---|
| 11. Coastal shrubland<br>14. Dry shrubland<br>17. Farm and grassland | Broadleaf *Cordia sebestena caymanensis*<br>Cocoplum *Chrysobalanus icaco*<br>*Banara caymanensis*<br>Century plant *Agave caymanensis*<br>Little Cayman snail *Cerion nanus*<br>Little Cayman Green anole *Anolis maynardi*<br>Grand Cayman Blue iguana *Cyclura lewisi* |

### Current Factors Affecting *Sister Islands Rock iguana*

- *Habitat loss:* though both Little Cayman and Cayman Brac are much less developed than Grand Cayman, recent years have seen a proliferation in residential development and roads infrastructure. In common with Grand Cayman, beachfront and coastal property is increasingly a real estate premium, making establishment of protected areas increasingly cost-prohibitive.

- *Habitat fragmentation:* proliferation of *roads* networks, particularly the development of circum-island *roads* networks effectively separates shrubland foraging habitat from coastal nesting areas.

- *Non-native species:* predation of young iguanas by rats and cats, and adults by dogs is a growing problem. Habitat fragmentation and increasing ingress of residential areas into remnants of natural habitat facilitate access and establishment of invasive species.

- *Road kill:* iguanas are attracted to *roads* surface for thermo-regulation, and many are killed on the *roads* each year.

- *Artificial feeding:* feeding of iguanas by tourists has encouraged aggregation of increased numbers of animals in certain areas. Artificial feeding of animals contributes to a modification of natural behaviour, making individuals bolder and on occasion, more aggressive. Iguanas deliver a powerful bite, and several injuries have been reported to date.

- *Shifting baseline:* it is now possible to purchase "souvenirs" from Cayman Brac, sporting an image of Green iguana *Iguana iguana*. The Green Iguana was first reported from Little Cayman around 2005, and efforts to prevent establishment may or may not have succeeded.

- *Legal:* DoE staff are not currently legally enabled to use firearms to effect lethal control of invasive species. This has resulted in situations in which immediate control of feral cats and dogs to preserve endangered native species has not been possible, likely resulting in the loss of individuals through reliance on less immediate control mechanisms.

### Opportunities and Current Local Action for *Sister Islands Rock Iguana*

No formal conservation programme exists for the Sister Islands Rock Iguana, however, the Blue Iguana Recovery Programme is currently working with the Durrell Wildlife Conservation Trust, to survey the Little Cayman population, and assess conservation needs.

Scientific and project management expertise are available through the Blue Iguana Recovery Programme, with strong volunteer, international partner support, and internet presence through www.BlueIguana.ky.

In 2007, the DoE, with support of DoA and CSL, instigated a feral cat eradication pilot project on Little Cayman.

The iguanas are a popular and well-established tourist attraction in Little Cayman.

**SPECIES ACTION PLAN for *Sister Islands Rock iguana***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Restore, maintain and protect free-roaming Sister Islands Rock Iguanas in their natural habitats. | 2015 |
| **2.** Acquire and protect shrubland in Little Cayman sufficient to support a least one thousand Sister Islands Rock Iguanas . | 2015 |
| **3.** Secure protected habitat for iguanas on Cayman Brac with measures to reduce threats sufficient to allow for population recovery. | 2015 |
| **4.** Address major threats and impact of invasive species on Sister Islands Rock Iguanas | 2015 |
| **5.** Restock Cayman Brac population with genetically diverse individuals drawn from Little Cayman. | 2015 |
| **6.** Ensure sustained support for the conservation of the Sister Islands Rock iguana through targeted education and awareness programmes. | 2010 |
| **7.** Secure sufficient financial, technical and human resources for the long-term conservation of Sister Islands Rock Iguana. | 2015 |

| Sister Islands Rock Iguana<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1-7 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1,2,3,4 |
| **PL3.** Protect *Cyclura nubila caymanensis* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1-7 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 1,2,3,4 |
| **PL6.** Universal enforcement of leash laws for dogs on the Sister Isles. | DoA | DoE CIG | 2010 | 4 |
| **PL7.** Conduct a Species Recovery Plan workshop to update and refine this SAP once research data is adequate. | BIRP | DoE NT | 2015 | 1-7 |
| **PL8.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 4 |
| **Safeguards & Management** | | | | |
| **SM1.** Eradicate feral cats and dogs in Little Cayman, feral dogs in Cayman Brac, and *Iguana iguana* on both islands. | DoE | DEH,<br>IntC<br>DoA, MP | 2012 | 4 |
| **SM2.** Incorporate key areas of natural habitat for *Cyclura nubila caymanensis* into system of protected areas. | CC | NT MP<br>DoE CIG<br>IntC | 2010 | 1,2,3 |
| **SM3.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements | CC | NT, MP<br>DoE CIG | 2010 | 1,2,3,7 |

| | | | | |
|---|---|---|---|---|
| with landowners, towards protecting *coastal shrubland* on the south coast of Little Cayman (west of the airstrip), identified as a communal nesting ground for *Cyclura nubila caymanensis*: (78A 42 2.57ac, with adjacent parcels 78A43 1.26ac and 78A41 1.48ac) and establish associated Crown land to the north (77A3 22.8ac), as a protected area. | | IntC | | |
| **SM4.** Request international contributions and matched Crown contributions of land for reserves establishment / expansion. | CC | DoE IntC CIG NT MP | 2015 | 1,2,3,7 |
| **SM5.** Agree and implement management plans for the protected areas. | BIRP | DoE NT | 2015 | 1-7 |
| **SM6.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1-7 |
| **SM7.** Staged translocations from Little Cayman to Cayman Brac to restock Brac populations once the habitat is ready. | BIRP | DoE NT | 2012 | 1,3,4,5 |
| **SM8.** Implement associated HAPs. | DoE | | 2015 | 1-7 |
| **Advisory** | | | | |
| **A1.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-7 |

| Sister Islands Rock Iguana<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Conduct pilot project towards eradication of feral cats in Little Cayman. | DoE CSL | DoA | 2015 | 1,2,4 |
| RM1. REPORT: Pilot project completed by DoE and DoA, 2008. All pet cats in Little Cayman were micro-chipped. Twenty eight cats were removed through trapping, however, more remain. Trap-shy individuals will require alternative control methods. | | | | |
| **RM2.** Monitor and eradicate *Iguana iguana* in Little Cayman and Cayman Brac. | DoE | DoA DEH MP | ongoing | 1,2,4 |
| RM2. REPORT: Two feral Green iguanas reported on Little Cayman are identified and removed, 2007. | | | | |
| **RM3.** Quantify genetic structure of wild population of *Cyclura nubila caymanensis* in Little Cayman and assess viability of reintroduction of individuals to Cayman Brac. | BIRP | DoE NT | 2015 | 1,3,5 |
| **RM4.** Monitor released iguanas on Cayman Brac to ensure viability of restocking and measure progress. | BIRP | DoE NT | 2015 | 1,3,5 |
| **RM5.** Construct quarters for visiting scientists in Little Cayman and Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | IntC | 2012 | 7 |
| RM5. REPORT: Accommodation for up to four individuals on Little Cayman established by DoE, 2008. | | | | |
| **RM6.** Conduct island-wide survey of Little Cayman, to determine population of *Cyclura nubila caymanensis.* | BIRP DWT | NT DoE | 2010 | 1,2,7 |
| RM6. REPORT: Population survey currently underway (Matt Goetz DWT). | | | | |
| **RM7.** Conduct island-wide survey of Cayman Brac, to determine population of *Cyclura nubila caymanensis.* | BIRP DWT | NT DoE | 2015 | 1,3,7 |
| **RM8.** Commence formal record keeping of road deaths of *Cyclura nubila caymanensis.* | DoE | BIRP DWT | 2008 | 4 |
| **RM9.** Undertake taxonomic analysis of *Cyclura nubila caymanensis*, to further elucidate relationship between Cuban Rock Iguana *Cyclura nubila.* | BIRP | | 2015 | 6 |

| | | | | |
|---|---|---|---|---|
| **RM10.** Utilise population and habitat surveys to determine appropriate sizes and locations of protected areas sufficient to support a population of 1000 individuals in the wild. | BIRP DWT | NT DoE | 2010 | 1,2,3,5,7 |
| **Communication & Publicity** | | | | |
| **CP1.** Island wide awareness campaign towards distinguishing differences between *Iguana iguana* and *Cyclura nubila caymanensis* and explain the threat posed to native wildlife by *Iguana iguana.* | DoE | NT MP IRCF | 2010 | 4 |
| **CP2.** Raise awareness of the unique nature of *Cyclura nubila caymanensis* and other endemic flora and fauna. | DoE NT QEIIBP | MP CN GC OS SB LCN | 2008 | 6 |
| **CP3.** Utilise the unique fauna of Little Cayman to promote the Island. | CIG | DoE DoT NT MP | 2010 | 6 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 6 |
| **CP5.** Make road kill statistics highly visible to the public and emplace traffic-slowing interpretation towards encouraging motorists to be aware of iguanas, and reduce mortality of *Cyclura nubila caymanensis*. | DoE BIRP | | 2008 | 4,6 |
| **CP6.** Island wide awareness of illegality and undesirability of moving iguanas between islands, outside of managed transfers. | DoE BIRP | CIG | 2008 | 6 |
| **CP7.** Emplace signage at tourist sites to provide information to the public about the iguanas, and discourage feeding. | DoE NT | | 2010 | 6 |

## REFERENCES and FURTHER READING for *Sister Islands Rock iguana*


Barbour, T. and Noble, G.K. (1916). A revision of the lizards of the genus *Cyclura*. *Bull. Mus. Comp. zool*., Harvard Univ. 60:149-164. (New spp. *caymanensis*).

Seidel, M.E. and Franz, R. (1994). Amphibians and reptiles (exclusive of marine turtles) of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 307-31.

## TERRESTRIAL SPECIES

### Grand Cayman Blue iguana *Cyclura lewisi*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Sauropsida, Order: Squamata, Family: Iguanidae
Genus: Cyclura, Species: lewisi

The Grand Cayman Blue iguana, *Cyclura lewisi*, is endemic to the island of Grand Cayman. Closest relatives are *Cyclura nubila* (Cuba), and *Cyclura cychlura* (Bahamas); all three having apparently diverged from a common ancestor some three million years ago.

### Status

**Distribution:** Species endemic to Grand Cayman.
**Conservation:** Critically endangered (IUCN Red List). In 2002 surveys indicated a wild population of 10-25 individuals. By 2005 any young being born into the unmanaged wild population were not surviving to breeding age, making the population functionally extinct. *Cyclura lewisi* is now the most endangered iguana on Earth.
**Legal:** The Grand Cayman Blue iguana *Cyclura lewisi* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection. The Blue Iguana Recovery Programme BIRP operates under an exemption to the Animals Law, granted to the National Trust for the Cayman Islands.

### Natural history

While it is likely that the original population included many animals living in *coastal shrubland* environments, the Blue iguana now only occurs inland, in natural *dry shrubland*, and along the margins of *dry forest*. Adults are primarily terrestrial, occupying rock holes and low tree cavities. Younger individuals tend to be more arboreal. Like all *Cyclura* species the Blue iguana is primarily herbivorous, consuming leaves, flowers and fruits. This diet is very rarely supplemented with insect larvae, crabs, slugs, dead birds and fungi. Hatchlings are preyed upon by the native Racer snake *Alsophis cantherigerus*. Adults have no natural predators. The age of sexual maturity is typically three years. Natural longevity in the wild is unknown, but is presumed to be many decades. One captive individual, in the USA, lived to 67 years-of-age.

The present-day population is restricted to the eastern interior of Grand Cayman, where it was reduced to a critically low density prior to the first survey, 1938. Their range has contracted significantly over the last 25 years, with many sites once populated now showing no signs of wild iguanas.

### Associated Habitats and Species for *Blue iguana*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 11. Coastal shrubland<br>14. Dry shrubland<br>17. Farm and grassland | Century plant *Agave caymanensis*<br>Cocoplum *Chrysobalanus icaco*<br>Broadleaf *Cordia sebestena caymanensis*<br>Banana orchid *Myrmecophila thompsoni*<br>Silver Thatch palm *Coccothrinax proctorii*<br>Sister Islands Rock iguana *Cyclura nubila caymanensis* |

## Current Factors Affecting *Blue iguana*

- *Traditional habitat loss:* fossil records indicate that beach-ridge habitat was, historically, a favoured habitat for *C. lewisi*. This area has been a primary focus for development since the 1960s, and intersected by a busy coastal road since the 1980s.

- *Remnant habitat fragmentation:* interior habitat has been degraded through land conversion, change in agricultural practice (grazing replacing traditional fruit farming), and proliferation of the roads network.

- *Hunting:* historically, iguanas were hunted for food, and occasionally mistaken and persecuted as a crop-pest.

- *Poaching:* endangered status of *C. lewisi*. may have encouraged recent incidents of theft. In 2008, seven individuals were killed in what appeared to a deliberate act of vandalism.

- *Non-native species:* predation of youngsters by rats and cats, and adults by dogs is a growing problem, exacerbated by habitat fragmentation and increasing ingress of residential areas into remnants of natural habitat.

- *Road kill:* iguanas are attracted to roads surface for thermo-regulation, and many are killed on the roads each year.

- *Shifting baseline:* confusion with Green iguana *Iguana iguana.*

- *Legal:* DoE staff are not currently legally enabled to use firearms to effect lethal control of invasive species. This has resulted in situations in which immediate control of feral cats and dogs to preserve endangered native species has not been possible, likely resulting in the loss of individuals through reliance on less immediate control mechanisms.

## Opportunities and Current Local Action for *Blue iguana*

The National Trust for the Cayman Islands established the Blue Iguana Recovery Programme. Based at the QEII Botanic Park, Grand Cayman, this incorporates a successful captive breeding / release programme.

The Recovery Programme currently employs three full-time staff (two salaried), and delivers ca. 100 hatchlings per year. Directed by Fred Burton, the programme is assisted by a consortium of local and international specialists. Management strategy is implemented through a *Species Recovery Plan*, updated on a three-yearly basis.

The restored, free-roaming QE II Botanic Park subpopulation, breeding since 2001, now numbers ca. 40 individuals (as of Dec 2007). The restored free-roaming Salina Reserve subpopulation numbered over 200 in 2008, and began breeding in 2006.

Expanding education and merchandising programme, with strong internet support through www.BlueIguana.ky. Development of a self-financing strategy to cover core programme costs, through revenue-generating nature tours of the captive breeding facility.

## SPECIES ACTION PLAN for *Blue iguana*

Objectives and targets of this Species Action Plan are based on formulations of the *Species Recovery Plan for the Grand Cayman Blue iguana, Cyclura lewisi 2009-2011.*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Acquire and protect xerophytic shrubland in eastern Grand Cayman sufficient to support one thousand Blue iguanas (requirement 300 – 500 acres). | 2009 |
| **2.** Restore, maintain and protect free-roaming Blue iguanas in natural habitats. | ongoing |
| **3.** Provide genetically optimal animals for reintroduction through the existing on-island captive breeding and head-starting programme. | ongoing |
| **4.** Safeguard against catastrophic loss of Grand Cayman Blue iguana populations by maintaining the off-island captive breeding population. | ongoing |
| **5.** Ensure sustained support for the conservation of the Blue iguana through targeted education and awareness programmes. | ongoing |
| **6.** Secure sufficient financial, technical and human resources for the long-term sustainability of the Blue Iguana Recovery Programme. | ongoing |

| Grand Cayman Blue iguana<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1-6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Cyclura lewisi* under Schedule I of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1-6 |
| **PL4**. Implementation of Species Recovery Plan for *Cyclura lewisi.* | BIRP | DoE NT QEIIBP | ongoing - 2008 | 1-6 |
| **PL5.** Maintain local and international volunteer support for captive facility and field work. | BIRP | NT | ongoing | 6 |
| **PL6.** Develop a business plan to develop revenue lines and ensure long-term financial sustainability of the Recovery Programme, including core staff salaries. | BIRP | NT DoE IRCF DWCT | 2006 | 6 |
| **PL7.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,2 |
| **PL8.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 2,6 |
| **PL9.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,2 |
| **Safeguards & Management** | | | | |
| **SM1.** Identify land acquisition options and prioritise for the establishment of a shrubland reserve. | NT | EAC | 2006 | 1,2 |
| SM1. REPORT: Completed. From a half-dozen candidate sites, the two most suitable areas of shrubland were identified in the East End of Grand Cayman, 2007. Both incorporate areas of Crown land: one abutting the southern boundary of the East End quarry, the other located approximately midway between the Salina Reserve and Colliers Pond. | | | | |

| | | | | |
|---|---|---|---|---|
| **SM2.** Use Crown land protection and the *Environmental Protection Fund* to negotiate and purchase a shrubland reserve with Government and local landowners. | CC | DoE NT MP | 2009 | 1,2 |
| **SM3.** Request international contributions and matched Crown contributions of land / funds for reserve establishment. | DoE | | 2009-2010 | 1,2 |
| **SM4.** Establish an inalienable protected shrubland area of ca. 500 acres. | DoE | NT | 2010 | 1,2 |
| **SM5.** Joint management agreement and nature tourism strategy for sustainable financing of a reserve. | DoE NT | | ongoing - 2010 | 1,2 |
| **SM6.** Suitable habitat in the Salina and Botanic Park to be stocked to capacity. | BIRP | NT | 2007 - 2010 | 2 |
| **SM7.** Optimize genetic diversity of worldwide breeding strategy and expand to 225 individuals / 20 founder lines. | BIRP | SDZ | ongoing - 2007 | 3,4 |
| **SM8.** Acquire and protect parcel of shrubland (65A / 37) to consolidate Salina Reserve and increase its carrying capacity for Blue Iguanas. | NT | DoE | 2009 | 1,2 |
| **SM9.** Improve dietary supply, content and diversity. | BIRP | NT | 2008 | 2 |
| SM9. REPORT: Completed. Diet of pelleted iguana food replaced by wholly fresh diet of leaves, flowers and fruit, collected daily. Dietary change is accompanied by a significant increase in fecundity. | | | | |
| **SM10.** Security improvements at the breeding facility. | BIRP | NT | 2008-9 | 2 |
| SM10. REPORT: Seven adult iguanas were killed inside the captive breeding facility in what appears to be a wilful act of vandalism, 2008. RCIP investigations have, as yet, failed to identify perpetrators. In a second incident, two free-roaming adults were killed inside the Park by feral dogs, 2008. DoE Conservation Officers were halted from shooting the dogs amid legal concerns. Some dogs were trapped, however, at least one remains at large. | | | | |
| **SM11.** Implement associated HAPs. | DoE | | 2015 | 1-6 |
| **Advisory** | | | | |
| **A1.** Secure amendment of gazetted road corridors through the critical east interior habitat. | DoE | NT | 2009 | 1,2 |
| **A2.** Train Government officers / key personnel in identification of *Iguana iguana* and *Cyclura lewisi.* | BIRP | DoE | 2006 | 6 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-6 |

| Grand Cayman Blue iguana<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Identify capacity of additional areas for re-stocking (Barkers, Mastic, Wilderness Farm etc.). | BIRP | NT DoE CIG | 2006 | 2 |
| RM1. REPORT: Completed. Barkers and Wilderness Farm would support small populations, but pose significant ongoing management issues. The Mastic grassland pockets are now reverting to secondary growth woodland. Most suitable sites were identified as two shrubland areas in East End, 2007. | | | | |
| **RM2.** Develop and test methods of non-native predator control for managed iguana habitats. | BIRP | DoE | 2007 | 2,6 |
| **RM3.** Assess the ecological impact of *Iguana iguana* on *Cyclura lewisi.* | BIRP | DWCT ISG DoE | 2010 | 2,6 |
| **RM4.** Quantify genetic structure of wild and captive populations. | BIRP | DWCT | 2008-9 | 3 |
| **RM5.** Publish existing data on Blue iguana diet. | BIRP | | 2010 | 2,3 |
| **RM6.** Regular health screening of captive and QEIIBP wild populations. | BIRP | WCS DoA | ongoing | 2 |
| **RM7.** Construct quarters for visiting scientists. | BIRP | DoE | 2009 | 6 |
| **Communication & Publicity** | | | | |
| **CP1.** Targeted awareness campaign to key sectors of Government and the local community | NT | DoE | 2006 ongoing | 5 |
| **CP2.** Local and international media campaign. | NT | DoE BIRP | ongoing - 2006 | 5 |
| **CP3.** Launch of educational DVD / schools packs. | BIRP | NT DE | 2006-2009 | 5 |
| **CP4.** Island wide awareness of the differences between *Iguana iguana* and *Cyclura lewisi.* | BIRP | NT IRCF DoE | ongoing - 2007 | 5 |
| **CP5.** Construction of a *Blue iguana shrublands* interpretative centre / classroom. | BIRP | DoE CIG NT IntC | 2009 | 5 |
| **CP6.** Develop and expand merchandising lines. | BIRP | NT IRCF | ongoing | 5,6 |
| **CP7.** Use *Cyclura lewisi* as a flagship for *dry shrubland* preservation. | DoE NT | CIG | 2008 ongoing | 1-6 |
| **CP8.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 1-6 |

## FURTHER READING AND REFERENCES for *Blue iguana*


Barbour, T. and Noble, G.K. (1916). A revision of the lizards of the genus *Cyclura*. *Bull. Mus. Comp. zool*., Harvard Univ. 60:149-164. (New spp. *caymanensis*).

Burton, F.J. *et al.* (2000). The Grand Cayman Blue iguana *Cyclura nubila lewisi Species* Recovery Plan 2001 – 2006.

Burton, F.J. *et al.* (2006). Species Recovery Plan for the Grand Cayman Blue iguana, *Cyclura lewisi* 2005 - 2009.

Burton, F.J. *et al.* (2009). Species Recovery Plan for the Grand Cayman Blue iguana, *Cyclura lewisi* 2009 - 2011.

Burton, F.J. (2004). Revision to Species of *Cyclura nubila lewisi*, the Grand Cayman Blue iguana. *Caribbean Journal of Science, Vol. 40, No. 2, 198-203.*

Seidel, M.E. and Franz, R. (1994). Amphibians and reptiles (exclusive of marine turtles) of the Cayman Islands. In M.A. Brunt and J. Davis, eds., The Cayman Islands, natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 307-31.

www.BlueIguana.ky

www.ircf.org

## TERRESTRIAL SPECIES

### White-tailed tropicbird (Boatswain bird) *Phaethon lepturus*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Pelecaniformes, Family: Phaethontidae
Genus: Phaethon, Species: lepturus

The White-tailed tropicbird (Boatswain bird) *Phaeton lepturus* is widely dispersed throughout tropical and subtropical oceans. A summer breeding visitor to the Cayman Islands, they are known from a small colony (ca. 10 pairs – possibly now abandoned), nesting in holes on the coastal bluff from Bats Cave east of Bodden Town, Grand Cayman, and a larger colony (ca. 40 individuals), in caves and holes in the cliffs along the north and south coast of the eastern end of the Bluff, Cayman Brac (Bradley 2000). The tropicbird is one of the Cayman Islands' six breeding seabirds.

### Status

**Distribution:** In the West Indies, the White-tailed tropicbird *Phaethon lepturus* breeds from the Bahamas, south to St. Vincent. It has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km² (IUCN). In the Cayman Islands, breeding sites are confined to two areas of Bluff cliff, one each on Grand Cayman and Cayman Brac.
**Conservation:** The White-tailed tropicbird *Phaethon lepturus* has a large global population, estimated to be ca. 50,000 individuals. As a result, it is listed as least concern globally (IUCN), however, the Cayman Island's birds have undergone a population collapse during the past 30 years. Once an abundant breeder in the Islands, with ca. 800 individuals reported in the 1980s, Brac residents reported 1990s numbers to be the lowest in living memory, with just 28 pairs individuals observed in 1996 (Bradley 2000), with numbers increasing slightly 1999-2003, to about 50 pairs (Bradley *pers com*).
**Legal:** The White-tailed tropicbird *Phaethon lepturus* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

The most distinguishing feature of the White-tailed tropicbird *Phaethon lepturus* is its extraordinarily long central tail-feathers, or "streamers", which equal the length of its entire body. These are displayed to best effect by the tropicbird's characteristically aerobatic flight.

White-tailed tropicbirds disperse widely across the oceans when not breeding. These slender seabirds feed on fish and squid, diving from the air in a similar fashion to a booby. They breed late January–July, laying a single egg, in rock crevices and caves (Bradley 2000).

### Associated Habitats and Species for *White-tailed tropicbirds*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>7. Maritime cliffs and Ironshore<br>16. Caves | *Verbesina caymanensis*<br>Brown booby *Sula leucogaster*<br>Cayman parrot *Amazona leucocephala* |

### Current Factors Affecting *White-tailed tropicbirds*

- *El Niño Southern Oscillation* (ENSO): commonly referred to as simply "El Niño", ENSO is a global ocean-atmosphere phenomenon. The precipitous decline of the White-tailed tropicbird in the Cayman Islands is largely linked to the effects of El Niño, reducing the accessibility of fish stocks to foraging birds.

- *Disease:* the carcass of a White-tailed tropicbird infected with avian pox was recovered from Cayman Brac, 2008.

- *Introduced predators:* predators such as rats and cats probably inflict a significant toll on these ground-nesting birds.

- *Maritime pollution:* Cayman Brac lies close to major shipping lanes.

- *Aesthetic:* the White-tailed tropicbird is one of our most attractive seabirds. If successful, conservation efforts would effectively preserve one of the most spectacular species in the natural complement of the Cayman Islands.

- *Natural predators:* birds of prey, especially wintering Peregrine falcons *Falco peregrinus*.

### Opportunities and Current Local Action for *White-tailed tropicbirds*

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

A *Checklist of Birds of the Cayman Islands* was published (Bradley 2006).

### SPECIES ACTION PLAN for *White-tailed tropicbirds*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Commence detailed studies of *Phaethon lepturus* to determine status of local populations, and the nature of their decline. | 2009 |
| **2.** Implement conservation action towards halting the decline of *Phaethon lepturus*, and encouraging a population recovery. | 2012 |
| **3.** Increase nesting population of *Phaethon lepturus* by 100%. | 2015 |

| White-tailed tropicbirds<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Phaethon lepturus* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Strengthen the *Development Plan* on Grand | DoP | CIG MP | ongoing | 2 |

| | | | | |
|---|---|---|---|---|
| Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | CPA | DoE | | |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2 |
| **PL7.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 2,3 |
| **Safeguards & Management** | | | | |
| **SM1.** Establish the bluff face Crown lands as protected areas, and use the *Environmental Protection Fund* to protect key areas of the lip of the Bluff edge, to provide a buffer from disturbance for breeding colonies. | CC | DoE MP NT | 2009 | 2,3 |
| **SM2.** Control predation by rats, cats, and deter potential for predation by *Iguana iguana*. | DEH DoE HS DoA | NT | 2009 | 2,3 |
| **SM3.** Restore damaged nesting habitat where possible, and utilise artificial cavities as appropriate, towards recovering 1980s population levels. | DoE NT MP | | 2012 | 2,3 |
| **SM4.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1,2,3 |
| **SM5.** Implement associated HAPs. | DoE | | 2015 | 2 |
| **Advisory** | | | | |
| **A1.** Develop and recommend guidelines for native vegetation maintenance / landscaping, particularly for developments in littoral areas. | DoE DoP | SIDA | 2009 | 2 |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 2 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3 |

| White-tailed tropicbirds<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Develop and implement methods of non-native predator control in colony areas. | DoE DoA | NT HS IntC | 2009 | 1,2,3 |
| **RM2.** Complete detailed mapping of nest sites to determine precise colony distribution and numbers. | DoE | NT IntC | 2012 | 1 |
| **RM3.** Undertake nest site monitoring, to determine feeding regimes, diet selection and breeding success, towards elucidating factors influencing fecundity. | DoE | IntC | 2012 | 1 |
| **RM4.** Assess population for possible effects of pollution and/or disease. | DoE | DoA MP IntC | 2012 | 1 |
| **RM5.** Collaborate with scientists from other Caribbean islands, with previous experience of artificial nesting cavity construction for *Phaethon lepturus*. | DoE | IntC | 2012 | 1 |
| **RM6.** Construct quarters for visiting scientists in Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | | 2012 | 1,2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of *Phaethon lepturus* and other birds through local media (e.g. *Know Your Islands*), special events (e.g. *Birds* stamp issue), public talks and schools presentations (e.g. *Do You Know Me?*) and natural history websites. | NT | DoE BC DE | 2006 ongoing | 2 |
| CP1. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for National Trust's "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands launched through CaymanBiodiversity.com, 2007. | | | | |
| **CP2.** Install interpretative signs on nature trails and areas of interest. | NT DoE | | 2006 | 2 |
| **CP3.** Use *Phaethon lepturus* as a flagship for the protection of key areas of *Marine cliffs and Ironshore* as areas of outstanding natural beauty. | DoE NT | CIG | 2009 | 2 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 2 |

## REFERENCES and FURTHER READING for *White-tailed tropicbirds*


Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1997) Report on the birds of Cayman Brac. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (1996) The status of the birds of Cayman Brac as a national resource and their potential for nature tourism. Report for Cayman Islands Department of Environment.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

Johnston, D.W (1975) Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171) Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911) On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### Red-footed booby *Sula sula*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Pelecaniformes, Family: Sulidae
Genus: Sula, Species: sula

The Red-footed booby *Sula sula* has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km². The Red-footed booby is pan tropical, breeding off the Yucatan Peninsula, cays and small islands off Belize, Venezuela and Tobago. Also in the West Indies: Little Cayman, Puerto Rico, Hispaniola, the US Virgin Islands, Redonda and the Grenadines in the Lesser Antilles, and a few pairs in the Bahamas. It is one of the Cayman Islands' six species of breeding seabirds.

### Status

**Distribution:** The Red-footed booby *Sula sula* is resident in the Cayman Islands, but breeds only on Little Cayman.
**Conservation:** The global population is estimated to be 600,000 individuals (M. Crosby in litt. 2003). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern. Local population trends, however, may be significantly different.
**Legal:** The Red-footed booby is protected under the Animals Law (1976). The Booby Pond and associated breeding colony came under full legal protection with the Animals (Sanctuaries) Regulations (1982) as amended by Gazette No. 24 of 1993. Management responsibility for the colony was assigned to the National Trust for the Cayman Islands in 1995. The Booby Pond Reserve has since been expanded to a total area of 135 ha. All National Trust properties fall under the protection of the National Trust for the Cayman Islands Law (1987). The reserve is also a designated Ramsar site, and is listed as an Important Bird Area (IBA) by Birdlife International. Pending legislation, the Red-footed booby would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

The Red-footed booby *Sula sula* is named for its feet, which are distinctly red. Adults appear in two plumage colour phases: "brown phase" (predominantly brown, with distinct white hind parts and tail) and "white phase" (almost completely white). Sexes appear alike, with no seasonal variation in plumage, however, immature birds are a sooty brown colour, paler below, and may display a dark band across the breast.

Boobies forage for fish in coastal areas, and further out to sea, plunging into the water from a height. Courtship between prospective mates comprises pair flights, territorial displays, and symbolic nesting building. Red-footed boobies typically nest in colonies on remote islands. This is the only booby in the Caribbean that nests in trees. Nest areas may be tightly packed, but are strongly defended, usually through a display of ritualised head movements. Birds breed September-June, laying one egg.

The Booby Pond is a 43ha brackish to hypersaline lagoon located on the south coast of Little Cayman. Once open to the sea, it is now separated by a coastal road. The seabird rookery is located in the mangrove and shrubland along the northern edge of the pond. Covering an area of approximately 16.5 ha, the area includes a colony of up to ca. 800 Magnificent frigatebirds *Fregata magnificens*, (1997, Bradley 2000). The associated Red-footed booby colony is globally significant - one of the four largest colonies in the Caribbean (Bradley and Norton 2009).

The colony was first reported on Owen Island, a cay in the South Hole Sound, Little Cayman. In 1859 it moved to the littoral Sea grape *Coccoloba uvifera* on Little Cayman, as a result of fire, and later settled in

the *mangrove* swamp behind the coastal ridge. After the Hurricanes of 1932 and 1935, the breeding colony moved to its present site (Bradley 2000). Since 1986 it has generally expanded, moving north into the woodland. Immature birds are thought to disperse to other colonies in the region, but return to their natal colony to breed. The colony was first described in August 1975, surveyed for the first time in 1986, and subsequently, in 1997 (Burton *et al.* 1997).

The colony has seen an increase in size from the mid 1980s through the 1990s. However, a significant decline in nesting birds was noted in 2008 (Betty Anne Schreiber, 2008 *pers comm.*)

| Year | Nesting Pairs | Type of Count |
|---|---|---|
| 1986 | 2,600 | Transect |
| 1997 | 4,849 | Transect |
| 2008 | 670-700 | Colony count |

### Associated Habitats and Species for *Red-footed booby*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea | Sister Islands Rock iguana *Cyclura nubila caymanensis* |
| 9. Mangrove | Little Cayman Green anole *Anolis maynardi* |
| 13. Pools, ponds and mangrove lagoons | Little Cayman snail *Cerion nanus* |
| 14. Dry shrubland | West Indian Whistling-duck *Dendrocygna arborea* |
| 15. Forest and woodland | Vitelline warbler *Dendroica vitellina crawfordii* |

### Current Factors Affecting *Red-footed booby*

- *Illegal development:* despite legal protection, the southern side of the Booby Pond has been subject to encroachment by the construction and clearance of land as recently as 2008. These issues remain currently unresolved.

- *Development:* an increase in commercial and residential construction in the vicinity of Blossom Village will likely impact the colony through increased light pollution, and ingress of invasive species, most especially rats and cats. Seepage from sewage systems is suggested to contribute to offensive odour arising from the pond, and requires investigation.

- *Airport:* a new airport, possibly one that can accommodate jets, is planned to the north of the colony. This has the potential to inflict significant disturbance on the colony through light and noise pollution. Presently collision of boobies with aircraft is infrequent, however, if the airport is relocated, sensitive pre-emptive planning will be required if potentially serious accidents are to be avoided.

- *Natural predators:* birds of prey, especially wintering Peregrine falcons *Falco peregrinus*.

- *Introduced predators:* rats and cats. Unwanted kittens are brought over to Little Cayman from Cayman Brac, and dumped.

- *Historic exploitation:*, though now much reduced, collection of eggs is reported as recently as 1987.

- *Commercial fisheries:* a potential source of conflict, this may not represent a significant issue in Cayman. Local fisheries are of a subsistence / recreational nature, non-the-less, boobies are known to range widely on individual fishing expeditions, and it would be expected that regional fisheries trends may effect local populations of the birds. Entanglement in fishing line has resulted in the death of some individuals.

- *Maritime pollution:* Little Cayman lies close to major shipping lanes. Birds oiled or covered in bilge wash are occasionally collected along the shore.

- *Storms:* Little Cayman is a small (28km$^2$) low-lying island. No point is more than 1.5 km from the sea. This makes Little Cayman especially vulnerable to storm surge. The nesting habitat of along the Booby Pond has suffered damage in successive hurricanes, most recently Ivan, Gustav and Paloma.

- *Climate change:* the low lying nature of Little Cayman would make it especially vulnerable to sea-level rise, and increasingly severe storms: both current predications associated with climate change.

- *Colonial nature:* the colonial nature of the boobies will mean that, if the breeding site becomes overly-disturbed, polluted, or in any other way unsuitable, the colony is likely to shift *en-mass*. If the colony remains in the Cayman Islands, it would likely re-establish in an area which is completely unprotected.

- *Tourism:* the Booby Pond Reserve is a major tourist attraction for Little Cayman.

- *Offensive odours:* since land-locking of the Booby Pond altered the natural drainage and flushing dynamics of the pond, issues associated with foul odours arising from the sediments have arisen occasionally. It is believed that the odour is related to bacterial action, and the smell appears to worsen when the sediments are exposed and drying, or when exposed sediments are rehydrated. While some bacteria and algae may be potentially harmful to the birds, the boobies do not generally enter the water in the pond, and the potential threat of this phenomenon remains undetermined. Suggested flushing of the pond by re-establishing culverts beneath the coastal road may have serious consequences for the adjacent marine environment.

### Opportunities and Current Local Action for *Red-footed booby*

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands, has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

A *Checklist of Birds of the Cayman Islands* was published (Bradley 2006).

A National Trust interpretation centre on the south-west corner of the Booby Pond provides tourists with information about the site. This centre has a raised observation platform with telescopes.

Local residents take an interest in the fauna of their island, and are often pleased to talk to tourists who pause to enjoy the Booby Pond Reserve.

### SPECIES ACTION PLAN for *Red-footed booby*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Ensure no reduction in Red-footed booby *Sula sula* due to anthropogenic influence, and encourage population stability and / or expansion, through appropriate conservation management. | ongoing |
| **2.** Establish a regular, long-term, minimum-disturbance monitoring programme for the booby colony. | 2010 |
| **3.** Reduce predation of Red-footed boobies by non-native species. | 2010 |
| **4.** Improve media profile and public understanding of the Red-footed booby. | 2009 |

| Red-footed booby | LEAD | PARTNERS | TARGET | MEETS |
|---|---|---|---|---|

| PROPOSED ACTION | | | | OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2,3,4 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 1 |
| **PL3.** Protect *Sula sula* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2,3,4 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1 |
| **PL6.** Promote sympathetic management of current airport facilities, and appropriate siting and management of proposed airport facilities, to ensure minimal risk to aircraft passengers from birdstrike, and minimal impact on local birdlife. | DoE NT | CIG | ongoing | 1 |
| **PL7.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 1,3 |
| **PL8.** Commence prosecution for offences involving damage to existing Animal Sanctuaries and Ramsar sites, and associated buffer zones, and update and upgrade penalties for transgression of associated regulations. | DoE | CIG | 2009 | 1 |
| **Safeguards & Management** | | | | |
| **SM1.** Continue protection and reserves management. | NT | DoE | ongoing | 1,2,3,4 |
| **SM2.** Demarcation of the northern boundary of the reserve, using DoE's GPS capability. | DoE | NT | 2010 | 1 |
| **SM3.** Subject to RM3, eradicate feral cats in Little Cayman, and spay all domestic cats. | DEH DoA DoE | SIDA HS | 2012 | 4 |
| **SM4.** Subject to RM3, develop and implement long-term non-native predator control on site. | DEH NT DoA DoE | SIDA HS | 2012 | 4 |
| **SM5.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1,2,3,4 |
| **SM6.** Update the 1995 Management Plan for the Booby Pond Nature Reserve. | NT DoE | IntC | 2012 | 1,2,3,4 |
| **SM7.** Implement associated HAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Recommend replanting of old landfill site, with native species congruent with the native vegetation of the Booby Pond reserve. | NT DoE | | 2012 | 1 |
| **A2.** Recommend restrictive guidelines for artificial lighting in this area. | DoE | CIG | 2010 | 1 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2,3,4 |

| Red-footed booby<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Develop and implement regular, minimum disturbance aerial monitoring programme for the booby colony, to determine population size, incorporating occasional ground survey, to calibrate accuracy of aerial observations and determine breeding success. | NT DoE MRCU | RSPB IntC | 2010 | 2 |
| RM1. REPORT: DoE, with support of RSPB, purchases gyroscopic-mount camera system for high quality aerial photography, 2009. | | | | |
| **RM2.** Construct quarters for visiting scientists in Little Cayman and Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | IntC | 2012 | 1,2,3,4 |
| RM2. REPORT: Accommodation for up to four individuals on Little Cayman established by DoE, 2008. | | | | |
| **RM3.** Conduct pilot project towards eradication of feral cats in Little Cayman. | DoE CSL | DoA | 2015 | 1,3 |
| RM3. REPORT: Pilot project completed by DoE and DoA, 2008. All pet cats in Little Cayman were micro-chipped. Twenty eight cats were removed through trapping, however, more remain. Trap-shy individuals will require alternative control methods. | | | | |
| **RM4.** Monitor the rookery area, ensuring the buffer protection zone is adequate. | NT DoE | | 2010 | 1,2 |
| **Communication & Publicity** | | | | |
| **CP1**. Produce brochure guides to the area. | DoT NT SIDA | DoE | ongoing | 4 |
| **CP2.** Establish of a dedicated warden / nature tour guide, responsible for site maintenance. | NT | DoE DoT SIDA | 2012 | 1,2,3,4 |
| **CP3.** Improve interpretative facilities at key areas. | NT | DoE DoT SIDA | ongoing | 4 |
| **CP4.** Raise public awareness of the Red-footed booby and other birds through local media (e.g. *Know your Islands column*), public talks and schools presentations (e.g. *Do You Know Me?*), and natural history websites. | NT | DoE DE | ongoing | 4 |
| CP4. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for NT "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands through CaymanBiodiversity.com, 2007. | | | | |

## REFERENCES and FURTHER READING FOR *Red-footed booby*


**Specific:**

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

Burton, F.J., Bradley, P.E., Schreiber, E.A., Schenk, G.A., and Burton, R.W. (1999). Status of Red-footed Boobies *Sula sula* on Little Cayman, British West Indies, British West Indies. Bird Conservation International 9: 227-33.

Clapp, R.B. (1987). Status of the Red-footed booby Colony on Little Cayman Island. *Atoll Research Bulletin, No. 304, 1-15*

Diamond, A.W. (1980b). The Red-footed Booby colony on Little Cayman: size, structure and significance. Atoll Research Bulletin 241; 165-70.

Management Plan for the Booby Pond Nature Reserve (1995) (unpub.) Produced by the National Trust for the Cayman Islands, the Environmental Advisory Committee, the Trust's Little Cayman District Committee, and the local community.

Schreiber, E.A. (2008) Report on Research Visit to Booby Colony, Little Cayman Island, 17-21 January 2008 (unpublished). Cayman Islands Department of Environment, Terrestrial Ecology.

**General:**

Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1999). Report on the birds and their habitats on Little Cayman. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Bradley, P.E. and Norton, R.L. (2009). *An inventory of breeding seabirds in the Caribbean*. Eds. Bradley, P.E. and Norton, R.L. University Press of Florida, Gainesville, 500 pages.

Bradley, P.E., Population counts of wetland birds on Grand Cayman and Little Cayman, 1982-1986 (unpublished report).

Johnston, D.W (1975). Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171). Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911). On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### Brown booby *Sula leucogaster*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Pelecaniformes, Family: Sulidae
Genus: Sula, Species: leucogaster

The Brown booby *Sula leucogaster* is the most common of the three West Indian boobies, breeding on cays off the coast of the Yucatan Peninsula, Panama, Columbia, Venezuela, and throughout the West Indies. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km² (IUCN). The Brown booby is one of the Cayman Islands' six breeding seabirds.

### Status

**Distribution:** The Brown booby is resident in the Cayman Islands, and breeds only on Cayman Brac. It is vagrant in Grand Cayman: most commonly juveniles displaced during stormy weather.
**Conservation:** The Brown booby *Sula leucogaster* has a large global population, estimated to be ca. 200,000 individuals (IUCN). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). As a result, it is listed as least concern globally (IUCN); however, the Cayman Island's birds have undergone a significant population decline during the past 30 years. Once an abundant breeder in the Islands, despite historical exploitation, with ca. 480 individuals reported in the 1980s, numbers fell to below 100 individuals by the end of the 1990s. The last estimate of numbers was 350 (max.) individuals in 2007 (Bradley *in prep*.). The slight recovery observed in recent years may have suffered a severe set-back with the advent of hurricane Paloma, Nov 2008.
**Legal:** The Brown booby *Sula leucogaster* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

The Cayman Brac colony has been noted in ornithological records since 1888. Following a decline > 80% during the 1980-90s, the colony appears stabilized.

| Year | Nesting Pairs | Fledglings | Total |
|---|---|---|---|
| 1983 | 170 | 140 | 480 |
| 1996 | 32 | 20 | 84 |
| 2000 | 49 | 5 | 103 |
| 2001 | 61 | 8 | 130 |
| 2003 | 60-80 | | |
| 2007 | 80-110 | | |

### Natural history

The striking adult plumage of the Brown booby comprises chocolate brown head and upperparts, sharply defined from white belly and abdomen. In juveniles, the belly and abdomen remain light brown. Bobbies forage for fish in coastal areas, and further out at sea, plunging into the water from some height. Courtship between prospective mates comprises pair flights, territorial displays, and symbolic nesting building. This may last 4-8 weeks, during which time the pair bond is formed / renewed. Nesting is confined to inaccessible *maritime cliffs*: a simple scrape on bare rock, or a more elaborate collection of seagrass, Sargassum, flotsam, sticks and stones. Locally, a single prolonged breeding season is evident (Bradley 1994, 1997). Peak nesting period is Oct-Apr, however breeding has been observed in all months. Clutches of 1-2 white eggs are laid. In cases where both eggs hatch, the second is usually dispatched by "sibling murder" within the first two weeks.

Absent from the fossil record of the Sister Islands (Morgan 1994), it remains unclear as to whether the Brown and Red-footed Boobies were ever sympatric on the Brac and Little Cayman, or whether they have always segregated, possible as a result of habitat preference.

**Associated Habitats and Species for *Brown booby***

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 1. Open sea<br>7. Maritime cliffs and ironshore<br>11. Coastal shrubland<br>16. Caves | *Verbesina caymanensis*<br>White-tailed tropicbird *Phaethon lepturus*<br>Cayman parrot *Amazona leucocephala*<br>Sister Islands Rock iguana *Cyclura nubila caymanensis* |

## Current Factors Affecting *Brown booby*

- *Development:* the northwest section of the large bluff-top land parcel on which many of the birds nest has commenced subdivision into residential bluff-edge plots.

- *Human disturbance:* the Lighthouse trail facilitates access to and disturbance of the Brown boobies which nest along the Bluff lip. The unwillingness of sitting birds to vacate nests coupled with a lack of access restriction and on-site interpretation means that visitors tend to approach close to nesting birds. Since the 1990s the area has became increasingly popular with climbers and cavers. At one point, some 250 climbers used 75 routes. About 15 of these routes were close to nesting sites. This activity has now relinquished somewhat. Tour boat guides have been observed to "clap" their hands to encourage nesting birds to take flight, for the edification of tourists.

- *Natural predators:* birds of prey, especially wintering Peregrine falcons *Falco peregrinus*.

- *Introduced predators:* rats and cats. This area is a dumping site for unwanted kittens.

- *Historically exploitation:* harvesting of eggs continued routinely until the mid-1970s, ceasing by the early 1990s.

- *Decline in Sargassum:* shortage of this preferred nesting material may increase clutch vulnerability during incubation.

- *Displacement:* terrestrial disturbance and predator avoidance encourage nesting on lower ledges, vulnerable to inundation during high seas.

- *Commercial fisheries:* a potential source of conflict, this is not a significant issue in Cayman, as local fisheries are of a subsistence / recreational nature.

- *Maritime pollution:* Cayman Brac lies close to major shipping lanes. Birds covered in oil and bilge wash are occasionally collected from along the shore.

- *Storms:* Bluff-edge habitat is susceptible to severe weather. The carcasses of twenty-one adult birds were retrieved following Hurricane Paloma, Nov 2008.

## Opportunities and Current Local Action for *Brown booby*

A *Management Plan to Conserve and sustain the Brown booby Colony and its Habitat on Cayman Brac* has been completed, (Bradley 2002).

Interpretative signage has been installed at the Lighthouse trailhead.

A *Checklist of Birds of the Cayman Islands* was published (Bradley 2006).

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands, has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

## SPECIES ACTION PLAN for *Brown booby*

This Species Action Plan is based on *Management Plan to Conserve and sustain the Brown booby Colony and its Habitat on Cayman Brac* (Bradley 2002).

| OBJECTIVES | TARGET |
|---|---|
| **1.** Restore population to 1980s level (ca. 200 breeding pairs). | 2015 |

| | |
|---|---|
| **2.** Establish a protected area on the bluff, sufficient to ensure survival and continued recovery of the established booby colony. | 2010 |
| **3.** Implement management measures to minimize impact of human disturbance and developmental impacts on established nest sites. | 2011 |
| **4.** Reduce predation by non-native species. | 2011 |
| **5.** Preserve the aesthetic and ecological value of this area of outstanding natural beauty. | 2015 |
| **6.** Improve media profile and public understanding of the Brown booby. | 2009 |

| Brown booby<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1-6 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 3 |
| **PL3.** Protect *Sula leucogaster* under Schedule I of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1-6 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 3,5 |
| **PL5.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP<br>DCB | CIG MP<br>DoE | ongoing | 3,5 |
| **PL6.** Universal enforcement of leash laws for dogs on the Sister Isles. | DoA | DoE CIG MP | 2010 | 3,4 |
| **PL7.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 3,4 |
| **Safeguards & Management** | | | | |
| **SM1.** Establish the bluff face Crown lands and Little Cayman Brac as protected areas, and use the *Environmental Protection Fund* to establish a protected area / management agreement with land owners including, the vertical face of the bluff, lip, associated caves, and parcels 111E 220 and 111A 5,70,69. | CC | CIG MP<br>SIDA<br>DCB<br>DoE NT | 2009 | 1,2,5 |
| **SM2.** Negotiate with land owners for the establishment of a bluff-top protected area extending inland 25m from the cliff edge. | CC | CIG MP<br>SIDA<br>DCB<br>DoE NT | 2009 | 1,2,5 |
| **SM3.** Use the *Environmental Protection Fund* to purchase and protect the six-acre lighthouse site, as a base for conservation management and interpretation of the area. | CC | CIG MP<br>SIDA<br>DCB<br>DoE NT | 2009 | 1,2,5 |
| **SM4.** Use the *Environmental Protection Fund* to establish a protected area / management agreement with land owners encompassing the 200 hectare strip along the bluff lip. | CC | CIG MP<br>SIDA<br>DCB<br>DoE NT | 2009 | 1,2,5 |
| **SM5.** Employ a warden / guide on site to undertake reserves management, species monitoring, interpretation | DoE | DoT<br>SIDA NT | 2015 | 1-6 |

| | | | | |
|---|---|---|---|---|
| and assist visitors as necessary. | | CIG | | |
| **SM6.** Management of caving activities, including prohibition of access to the large cave (N19°44'50" W79°43'40") during breeding season. | DoE DoT SIDA | | 2010 | 3 |
| **SM7.** Management of climbing activities, including code of conduct, development of new routes, bolt placement and seasonal access restrictions. | DoE DoT | SIDA | 2010 | 3 |
| **SM8.** Develop code of conduct for boat operators. | DoE DoT | SIDA | 2010 | 3 |
| **SM9.** Develop and implement long-term non-native predator control on site. | DEH DoA | DoE SIDA | 2010 | 3,4 |
| **SM10.** Promote spaying and neutering of domestic cats. | DoA | DoE | ongoing | 3,4 |
| **SM11.** Eradicate feral dogs and *Iguana iguana* in Cayman Brac. | DoE | DEH IntC DoA MP | 2010 | 3,4 |
| **SM12.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1-6 |
| **SM13.** Implement associated HAPs. | DoE | | 2015 | 1-6 |
| **Advisory** | | | | |
| **A1.** Recommend maintenance of an unsealed road for 500m directly west of lighthouse, with no further expansion, and no perimeter road on the eastern bluff. | DoE DCB NRA | LS, DoP AGC SIDA | 2008 | 3,5 |
| **A2.** Recommend appropriate building set-back from the bluff edge and base. | DoE DCB | SIDA MP DoP | 2008 | 3,5 |
| **A3.** Recommend appropriate restrictions on removal of vegetation from the bluff edge. | DoE DCB | SIDA MP DoP | 2008 | 3,5 |
| **A4.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-6 |

| Brown booby<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Monitor population and breeding success every three years (minimum). | DoE | NT | 2008 | 1,6 |
| RM1. REPORT: Preliminary assessment of site reveals 21 dead adults in wake of Hurricane Paloma, Nov 2008. | | | | |
| **RM2.** Investigate the potential for artificial augmentation of nesting ledges to assist in colony expansion / relocation. | DoE | NT,<br>SIDA | 2012 | 1,3 |
| **RM3.** Monitor and eradicate *Iguana iguana* in Little Cayman and Cayman Brac. | DoE | DoA<br>DEH MP | ongoing | 4 |
| **RM4.** Conduct pilot project towards eradication of feral cats in Little Cayman, and improve control of rats and feral cats on Cayman Brac. | DoE | DoA<br>CSL | 2015 | 4 |
| **RM5.** Construct quarters for visiting scientists in Little Cayman and Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | | 2012 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Develop and publicize a code of conduct for visitors (inc. climbers, cavers, boaters) outlining site status and restrictions. | DoE | SIDA<br>DoT | 2012 | 3,6 |
| **CP2**. Produce brochure guides to the area. | DoT<br>SIDA | DoE, NT | ongoing | 6 |
| **CP3.** Establish of a dedicated warden / nature tour guide, responsible for site interpretation. | DoT<br>SIDA | DoE, NT | 2015 | 1-6 |
| **CP4.** Improve interpretative facilities at key areas. | DoT<br>SIDA | DoE, NT | 2012 | 3,6 |
| **CP5.** Raise public awareness of the Brown booby and other birds through local media (e.g. *Know Your Islands* column), public talks and schools presentations (e.g. *Do You Know Me?*), and natural history websites. | NT | DoE<br>DE | ongoing | 6 |
| CP5. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for NT "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands through CaymanBiodiversity.com, 2007. | | | | |
| **CP6.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT<br>NT MP<br>QEIIBP | 2010 | 5,6 |

## REFERENCES and FURTHER READING FOR *Brown booby*


**Specific:**

Bradley, P.E. (1996) The status of the birds of Cayman Brac as a national resource and their potential for nature tourism. Report for Cayman Islands Department of Environment.

Bradley, P.E. (2002). Management plan to conserve the Brown Booby colony and its habitat on Cayman Brac, 2002-2006. Cayman Islands Government publications.

**General:**

Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1997). Report on the birds of Cayman Brac. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

Bradley, P.E. and Norton, R.L. (2009). *An inventory of breeding seabirds in the Caribbean*. Eds. Bradley, P.E. and Norton, R.L. University Press of Florida, Gainesville, 500 pages.

Johnston, D.W (1975). Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171). Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911). On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### West Indian Whistling-duck (Whistler) *Dendrocygna arborea*

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Anseriformes, Family: Anatidae
Genus: Dendrocygna, Species: arborea

The West Indian Whistling-duck *Dendrocygna arborea* breeds in many countries throughout the Caribbean, locally ranging from common to very rare. This West Indian endemic species is generally of conservation concern over its range (Bradley 2000).

### Status

**Distribution:** Resident year-round and breeding on all three Cayman Islands.
**Conservation:** The West Indian Whistling-duck *Dendrocygna arborea* is a species endemic to the West Indies, and is listed as vulnerable (IUCN Red List 3.1).
**Legal:** CITES Appendix II. CMS Appendix II. The West Indian Whistling-duck *Dendrocygna arborea* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

The West Indian Whistling-duck *Dendrocygna arborea* is Cayman's only breeding duck. They are non-migratory. Largely crepuscular or nocturnal by nature, they are mostly inactive during the day; roosting in mangroves, reed beds, and swampy areas. At dusk they tend to move to fresh and saltwater *pools, ponds and mangrove lagoons*, and temporary wetlands to feed. These behaviours are, however, only generally applicable, and in some places ducks will be seen feeding throughout the day.

Nest site choice is variable, though is generally on or near the ground. Preferred nest sites include rough pasture, bushes, and even hollow trees. The comparative safety of isolated *ironshore* outcrops and islands within *pools, ponds and mangrove lagoons*, and *lagoons*, contribute to their being amongst favoured nesting sites. Whistling-ducks breed all year round. Clutches generally contain 5-13 eggs.

In the 1980s, numbers fell as low as 180-220 individuals on Grand Cayman and Little Cayman. Numbers subsequently recovered to 1000-1200, 1996-97, with current estimates of approximately 2000 birds between the three Islands (Bradley *pers comm.*).

### Associated Habitats and Species for *West Indian Whistling-duck*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 3. Lagoons<br>9. Mangrove<br>12. Salt-tolerant succulents<br>13. Pools, ponds and mangrove lagoons<br>17. Farm and grassland<br>18. Urban and man-modified areas | Red-footed booby *Sula sula*<br>Cayman parrot *Amazona leucocephala*<br>Cayman Pygmy Blue butterfly *Brephidium exilis thompsoni* |

## Current Factors Affecting *West Indian Whistling-duck*

- *Hunting pressure:* historic hunting pressure contributed in large part to the decline of this species in the Cayman Islands. Lows of 180-220 individuals were recorded on Grand Cayman and Little Cayman in the 1980s.

- *Poaching:* though protected under the Animals Law, a level of background hunting has remained persistent.

- *Habitat loss:* loss of habitat, including *mangrove* roosting habitat and *salt-tolerant succulents* feeding habitat, has contributed to the decline of the natural population.

- *Supplementary feeding:* supplementary feeding initiated by Willie Ebanks, and the late Jim Ebanks, North Side, Grand Cayman, 1992, and later supported by CIG, has contributed in large part to an increase in numbers locally. Currently several feeding stations are active on both Grand Cayman and Cayman Brac. While supplemental feeding has probably been a significant factor in the recovery of the wild population, feeding sites have a tendency to attract large numbers of birds, potentially encouraging dependency, and attracting predators.

- *Introduced predators:* predators such as rats, cats, and especially packs of feral dogs, inflict a significant toll on these ground / near-ground nesting birds.

- *Flagship status:* the Whistling-duck is being established as a flagship for wetland preservation, through the work of groups such as the West Indian Whistling-duck Working Group of the Society for the Conservation and Study of Caribbean Birds, SCSCB.

- *Aesthetic appeal:* these attractive birds invite the care and support of members of the public, many of whom enjoy feeding the birds.

- *Adaptation:* in the face of loss of their natural habitat, the West Indian Whistling-duck has proven adaptable, adjusting to suitable niches maintained within the built environment, and successfully establishing in *urban and man-modified areas*.

## Opportunities and Current Local Action for *West Indian Whistling-duck*

Since 1997, the West Indian Whistling-duck Working Group, SCSCB, has conducted a region-wide public education and awareness programme that provides local teachers and educators with training and educational materials; working to raise awareness and appreciation for the value of local wetlands and wetland biodiversity: www.whistlingduck.org.

The Nature Tourism Project under development in Cayman Brac and Little Cayman, 2001, incorporated trails and observation platforms, established at points of natural interest, especially in association with *pools, ponds and mangrove lagoons.*

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands, has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

A *Checklist of Birds of the Cayman Islands* was published (Bradley 2006).

The Cayman Islands Bird Club conducts an annual Bird Count in Grand Cayman, in March of each year, which incorporates an count of Whistling-duck.

**SPECIES ACTION PLAN for *West Indian Whistling-duck***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Commence detailed studies of *Dendrocygna arborea* to determine status and dynamics of local populations. | 2009 |
| **2.** Implement planning and conservation action towards maintaining *Dendrocygna arborea*, and encouraging population stability, and recovery. | 2012 |

| West Indian Whistling-duck PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1,2 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 2 |
| **PL3.** Protect *Dendrocygna arborea* under Schedule I of the National Conservation Law, through establishment of conservation regulations. | DoE | CIG | 2006 | 1,2 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2 |
| **PL5.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 2 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2 |
| **PL7.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 2 |
| **Safeguards & Management** | | | | |
| **SM1.** Use the *Environmental Protection Fund* to protect key areas of habitat for *Dendrocygna arborea.* | CC | DoE MP NT | 2006 | 2 |
| **SM2.** Transfer Little Cayman Crown Wetlands to protected area status. | CC | DoE CIG MP NT | 2012 | 2 |
| **SM3.** Subject to SM2, designate Little Cayman Crown Wetlands a Ramsar site. | DoE | CC CIG MP NT | 2012 | 2 |
| **SM4.** Control predation by rats, cats, and deter potential for predation by *Iguana iguana*. | DEH DoE DoA | NT HS | 2009 | 2 |
| **SM5.** Restore damaged nesting habitat where possible. | DoE NT MP | | 2010 | 2 |
| **SM6.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1,2 |
| **SM7.** Incorporate isolated islands into development guidelines for restoration of degraded *pools, ponds and mangrove lagoons*, to facilitate roosting and nesting habitat for *Dendrocygna arborea.* | DoE | DoP CPA DCB MP | 2012 | 1,2 |
| **SM8.** Implement associated HAPs. | DoE | | 2015 | 1,2 |

| Advisory | | | | |
|---|---|---|---|---|
| **A1.** Develop and recommend guidelines for native vegetation maintenance / landscaping, particularly for developments in wetland areas. | DoE DoP | SIDA | 2009 | 2 |
| **A2.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 2 |
| **A3.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1,2 |

| West Indian Whistling-duck<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Develop and implement methods of non-native predator control in colony areas. | DoE<br>DoA | NT<br>HS | 2007 | 1,2 |
| **RM2.** Complete detailed mapping of nest sites to determine precise population distribution and numbers, and key areas of habitat. | DoE | NT | ongoing | 1 |
| **RM3.** Undertake monitoring of artificial feeding sites to determine diet and nature of interactions, and need to develop guidelines. | DoE | | 2010 | 1 |
| **RM4.** Collaborate with scientists from other Caribbean islands, to encourage work on projects complimentary to the conservation of *Dendrocygna arborea.* | DoE | SCSCB<br>IntC | 2010 | 1 |
| **RM5.** Investigate potential for artificial nest box programme to promote population sustainability. | DoE | NT | 2009 | 2 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of *Dendrocygna arborea* and other birds through local media (e.g. *Know Your Islands*), special events (e.g. *Birds* stamp issue), public talks and schools presentations (e.g. *Do You Know Me?*) and natural history websites. | NT | DoE BC<br>DE | 2006<br>ongoing | 2 |
| CP1. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for NT "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands through CaymanBiodiversity.com, 2007. | | | | |
| **CP2.** Install interpretative signs on nature trails. | NT | DoE | 2006 | 2 |
| CP2. REPORT: Informational signage featuring Whistling-ducks installed by NT, adjacent highways in Grand Cayman, 2008, toward discouraging roadside feeding, and encouraging traffic to slow down. | | | | |
| **CP3.** Use *Dendrocygna arborea* as a flagship for the protection of key areas of *mangrove* and *salt-tolerant succulents.* | DoE NT | CIG | 2010 | 2 |
| **CP4.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT<br>NT MP<br>QEIIBP | 2010 | 2 |

## REFERENCES and FURTHER READING FOR *West Indian Whistling-duck*


**Specific:**

Bradley, P.E. (1996) The status of the birds of Cayman Brac as a national resource and their potential for nature tourism. Report for Cayman Islands Department of Environment.

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

*Wondrous West Indian Wetlands: Teachers' Resource Book*. This 276-page workbook, published in July 2001, was written by the WIWD Working Group for teachers and educators in the West Indies.

**General:**

Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1997). Report on the birds of Cayman Brac. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (1999). Report on the birds and their habitats on Little Cayman. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Bradley, P.E., Population counts of wetland birds on Grand Cayman and Little Cayman, 1982-1986 (unpublished report).

Johnston, D.W (1975). Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171). Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911). On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### Cayman parrot / Cuban parrot / Rose-throated parrot *Amazona leucocephala*

INSERT IMAGE

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Psittaciformes, Family: Psittacidae
Genus: Amazona, Species: leucocephala

The Cayman parrot *Amazona leucocephala* is a restricted range neotropical species occurring in the Cayman Islands, Cuba and the Bahamas. There are five endemic races: *A. l. caymanensis* on Grand Cayman and *A. l. hesterna* on Cayman Brac; two races on Cuba, and one in the Bahamas, confined to Great Inagua and Abaco. Preliminary genetic analysis indicates *A. l hesterna* as highly divergent from the other four races, and studies are in progress to determine its status as a separate species.

On Grand Cayman, *A. l. caymanensis* suffered a major loss of breeding habitat following devastation of mature Black mangrove in the Central Mangrove Wetland during hurricane Ivan (2004). Breeding is currently restricted to central and eastern dry forest. On Cayman Brac *A. l hesterna* breeds on the bluff in mature *dry forest*. On Little Cayman, the race *A. l. hesterna* became extirpated in the 1940s. Current status on Little Cayman is problematic. Four birds recolonised from Cayman Brac in 2000. In 2006, three birds were regularly observed on the south coast (a pair and a young bird). One of the adults, however, was possibly *A. l. caymanensis*. It is currently undetermined whether this offspring is a hybrid. Only one bird remained in 2007/8.

### Status

**Distribution:** Subspecies endemic to Grand Cayman, and Cayman Brac.
**Conservation:** The Cayman parrot is listed as near-threatened (IUCN Red List; Appendix 1 CITES) due to its restricted range. The last population estimates for *A. l. leucocephala* gave max. 2000 birds in 1995, and 400 birds for *A. l. hesterna.* Presently DoE is undertaking a new survey of parrot populations on Grand Cayman and Cayman Brac, with the support of USFWS. The race *hesterna* is considered at risk of extinction (Wiley *et al*. 2004).
**Legal:** The Cayman parrot *Amazona leucocephala* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

The Cayman parrot is the National Bird of the Cayman Islands. It is a cavity nester, breeding only in mature habitats: *dry forest* and *mangrove* forest. There is one instance of a wild pair breeding in an artificial nestbox at the Botanic Park. The species forages throughout Grand Cayman and Cayman Brac. On Grand Cayman parrots breed in cavities in dead and live Black mangrove *Avicennia germinans* and in dry forest, in Mango *Mangifera indica*, Strangler fig *Ficus aurea*, Royal palm *Roystonea regia* and Red birch *Bursera simaruba*.

On Cayman Brac, Cedar *Cederola odorata* is the preferred cavity tree, but recruitment of Cedar is currently very low due to infestation by the Mahogany shoot-borer *Hypsipyla grandella*. The Brac Parrots are seen throughout the island, feeding in *dry shrubland* in the interior, along the littoral Seagrape *Coccoloba uvifera* and Cocoplum *Chrysobalanus icaco* of *coastal shrubland*, and in gardens and plantations. The parrot is frugivorous, but also forages on young leaves and flowers. Crop predation by parrots results in their persecution by some farmers.

Clutch size ranges from 2-5 eggs (mean 3.2). Incubation is about 28 days. Young fledge by 55-60 days, and remain with their parents, at least until the next breeding season. Natural predators include Racer snakes *Alsophis cantherigerus*, Barn Owl *Tyto alba* and Peregrine Falcon *Falco peregrinus*.

**Associated Habitats and Species for the *Cayman parrot***

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 9. Mangrove<br>11. Coastal shrubland<br>14. Dry shrubland<br>15. Dry forest<br>17. Farm and grassland<br>18. Urban and man-modified areas | Vitelline warbler *Dendroica vitellina*<br>Banana orchid *Myrmecophila thompsoni*<br>Silver Thatch palm *Coccothrinax proctorii*<br>Cedar *Cedrela odorata* |

## Current Factors Affecting the *Cayman parrot*

- *Habitat loss: dry forest* has been a primary target for development on Grand Cayman since 1980. Wetlands in western Grand Cayman have been cleared since 1984, and no viable breeding habitat remains. Breeding habitat in the Central Mangrove Wetland, (Black mangrove *Avicennia germinans*) was significantly impacted during hurricane Ivan, 2004. Though it has since re-established somewhat, full recovery of this habitat will likely take another 20 years. Since 2000, rapid development of the bluff has impacted *dry forest* habitat on Cayman Brac.

- *Remnant habitat fragmentation:* through land clearance, urban development, agricultural clearance, rapid expansion of roads networks on both islands.

- *Introduced predators:* rats, cats. Green iguanas *Iguana iguana* may take eggs.

- *Human impact:* despite legal protection, persistent illegal hunting as a crop pest (high impact from a limited number of individuals) and illegal trapping (for the pet trade) continues, both on Grand Cayman, and to a lesser extent, on Cayman Brac. Removal of chicks often involves the permanent destruction of the nest cavity. Deliberate and incidental poisoning are largely unknown quantities.

- *Limited fecundity:* it is likely that only a fraction of the adult population is actively breeding, due in part to limited nest site availability. Nest site limitation is likely especially acute on Cayman Brac.

- *Road traffic:* collision with cars is a significant cause of mortality for this direct, low-flying species.

- *Legislation:* originally listed as a game bird under Section 69 of the Animals Law (1976), the parrot, along with several other bird species, was removed from the game bird list and given full protection under Section 2 of The Animals (Protection) Regulations (1989). Grand-fathering in of pre-existing captive pet parrots prior to introduction of the Law contributed to the Law becoming largely unenforceable in its current form, facilitating continuation of the illegal capture, pet trade, and shooting of parrots, most especially by fruit-farmers for whom the parrot represents a crop pest.

- *Contention:* of all species (with the possible exception of Weeping willow) conservation issues associated with the Cayman parrot are perhaps the most contentious. Being both a crop-pest and a National Symbol for conservation, legally protected and exploited with impunity, conservation efforts geared towards the preservation of Cayman parrots will be subject to highly polarized public opinion.

- *Shifting baselines:* a feral population of invasive Monk parakeets *Myiopsitta monachus* is becoming increasingly well-established in Grand Cayman. This crop-pest is a competitor for food with the Cayman parrot, and despite its looking remarkably different, apparently a confusion species. “Tour-guides” point out Monk parakeets to visitors, identifying them as Cayman parrots. The Yellow-naped Amazon *Amazona auropalliata* is also establishing on Grand Cayman, with approximately 20 pairs breeding in the wild, mostly in the Savannah district.

## Opportunities and Current Local Action for the *Cayman parrot*

In a National Symbols campaign spearheaded by the National Trust for the Cayman Islands (1995), the Cayman parrot was voted the National Bird of the Cayman Islands. (The Silver Thatch palm was chosen as the National Tree and the Wild Banana orchid as the National Flower). An interpretative folder was produced for schools, containing information and activities centred on the National Symbols. The Trust plans to update the National Symbols campaign in 2006.

*Proposed Important Bird Areas (IBAs) for the Cayman Islands* (Bradley *et al*. 2006) identifies areas of habitat sufficient to sustain the Cayman parrot. Sites include the Mastic Reserve, Botanic Park and Salina, eastern forests in Grand Cayman, and the Brac Parrot Reserve and the Splits in Cayman Brac.

In 2004, the National Trust purchased additional land in the Mastic Reserve, Grand Cayman. In 2005, the National Trust, with funding from DoE CIG and USFWS NMBCA, purchased additional land in the Brac Parrot Reserve, consolidating this protected area. Also in conjunction with this grant, a series of bird lectures (*Do You Know Me?*) and bird ID cards are delivered to local schools.

A *Checklist of Birds of the Cayman Islands* published (Bradley 2006).

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands, has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

Surveys by the Bird Club, include monitoring of the parrot on Grand Cayman since hurricane Ivan. A comprehensive study is underway by DoE / USFWS, with the objective of developing an annual survey methodology incorporating Distance Sampling protocol.

**SPECIES ACTION PLAN for the *Cayman parrot***

| OBJECTIVES | TARGET |
|---|---|
| **1.** Purchase and protect essential feeding and breeding habitat in Grand Cayman and Cayman Brac, toward sustaining parrot populations in perpetuity. | 2015 |
| **2.** Increase cavity availability for nesting. | 2010 |
| **3.** Conduct annual population estimates and map distribution of nest sites . | 2008 |
| **4.** Maintain and improve the profile of the Cayman parrot as a flagship for local biodiversity conservation. | ongoing |
| **5.** Encourage adherence to local laws prohibiting trade and transport, illegal shooting and trapping of parrots, and active enforcement of these laws when contravened. | 2006 |
| **6.** Maintain wildlife corridors through protection of woodland in suburban areas, and planting mini-woodlands of local species to serve as foraging habitat. | 2010 |
| **7.** Reduce impacts from introduced predators. | 2010 |

| Cayman parrot PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1-7 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 5,7 |
| **PL3.** Protect *Amazona leucocephala* under Schedule I of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1-7 |
| **PL4.** Secure Cayman Islands Important Birds Areas (IBAs) - once accepted by Birdlife. | DoE | CIG NT | 2010 | 1 |
| **PL5.** Implement mandatory registration of all captive breeding sources for parrots, combined with ringing / microchipping and recording of all captive bred chicks. | DoE | DoA | 2009 | 5 |
| **PL6.** Implement a six-month amnesty on captive parrots, to enable ringing/microchipping and recording of all individuals. | DoE | DoA | 2009 | 5 |
| **PL7.** Conservation Officers to commence active prosecution for infractions of protective laws, including illegal killing, collection and keeping of unregistered / unringed / un-microchipped birds. | DoE | DoA CIG | 2010 | 5 |
| **PL8.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,6 |
| **PL9.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,6 |
| **PL10.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,6 |
| **PL11.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 7 |

| Safeguards & Management | | | | |
|---|---|---|---|---|
| **SM1.** Prioritise land acquisition options to establish sufficient breeding and foraging reserves on Grand Cayman and Cayman Brac to sustain the species, with special attention to the Mastic Reserve, Grand Cayman, and Hemmington Forest and the Brac Parrot reserve, Cayman Brac. | DoE CC | MP NT | 2009 | 1,6 |
| **SM2.** Use the *Environmental Protection Fund* to protect key IBA areas: consolidation of the Mastic Reserve, protection of eastern shrubland, and Central Mangrove Wetland, Grand Cayman, and dry forest in Cayman Brac (including Salt Water Pond Walk, Hemmington Forest and expansion of the Brac Parrot reserve). | CC | DoE MP NT | 2009 | 1 |
| **SM3.** Establish strategic woodland patches in *urban and man-modified areas*, including LPP, to act as refugia, to maintain wildlife corridors. | DoE | MP NT CIG DoP CPA DCB | 2006 | 6 |
| **SM4.** Restore damaged habitat where possible. | DoE NT | MP | 2010 | 1,2,6 |
| **SM5.** Develop and implement sustainable management strategies for parrot conservation, which reasonably mitigate local farmers for damage to their fruit crops. | DoE | DoT NT CIG MP DoA AS | 2015 | 1,5 |
| **SM6.** Reduce predation by introduced species. | DEH DoE DoA | HS | 2010 | 7 |
| **SM7.** Eradicate Monk parakeets *Myiopsitta monachus* from the Cayman Islands, towards removing this crop-pest and confusion species. | DoE | MP | 2009 | 7 |
| **SM8.** Conservation propagation of Cedar *Cedrela odorata* in Growing Stations on Cayman Brac, for restoration of depauperate natural habitat and improvement of suburban areas. | DoE | NT MP QEIIBP IntC | 2010 | 2,6 |
| **SM9.** Develop and expand artificial nest box programme to increase capacity of degraded habitats. | DoE | NT MP IntC | 2010 | 2,6 |
| **SM10.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 1-7 |
| **SM11.** Implement ringing and recording programme for all captive parrots. | DoE | DoA | 2009 | 5 |
| **SM12.** Commence active enforcement of non-compliance with laws protecting parrots. | DoE | CIG | 2009 | 5 |
| **SM13.** Implement associated HAPs. | DoE | | 2015 | 1-7 |
| **Advisory** | | | | |
| **A1.** Secure amendment of gazetted road corridors in order that they no pass through (i) critical east interior habitat, Grand Cayman (ii) the Nature Trail, Little Cayman and (iii) the parrot Reserve, Cayman Brac. | DoE NRA | NT DoP CPA DCB | ongoing | 1,6 |
| **A2.** Establish management strategy to develop nature tourism in reserves with sustainable financial planning. | NT SIDA CITA SITA | DoE DoA | 2006 ongoing | 4 |
| **A3.** Develop and recommend guidelines for native vegetation maintenance / landscaping, particularly for developments in littoral areas. | DoE DoP | SIDA | 2009 | 6 |
| **A4.** Promote use of native food plants in landscaping, through maintenance of existing vegetation and use of | DoP | DoE | 2009 | 6 |

| | | | | |
|---|---|---|---|---|
| *Recommended Planting Palette* in new developments. | | | | |
| **A5.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-7 |

| Cayman parrot<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Investigate feasibility of artificial nest box installation in protected areas. | NT | DoE | 2009 | 2,6 |
| **RM2**. Determine genetic status of race *hesterna.* | DoE NT | | 2015 | 4 |
| **RM3.** Develop and implement predator control in managed parrot habitats. | DoE DoA | HS NT | 2007 | 7 |
| **RM4.** Assess the ecological impact of *Iguana iguana* on *A. l. caymanensis.* | DoE | NT | 2007 | 7 |
| **RM5.** Undertake population dynamics study - improve annual population estimates and map distribution of nest sites. | DoE | NT BC | ongoing | 3 |
| **RM6.** Investigate feasibility of implementing *Parrot Jam Project* – a financial / PR incentive scheme to offset crop damages suffered by local fruit farmers. | DoE MP DoA AS | DoT NT CIG | 2012 | 4,5 |
| **RM7.** Construct quarters for visiting scientists in Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | | 2012 | 3 |
| **Communication & Publicity** | | | | |
| **CP1.** Targeted awareness of this flagship species and its international importance to key sectors: tourism, business, Government, local community. | NT DoT DoE | CIG DE SITA CITA | 2007 | 4,5 |
| **CP2.** Update National Symbols campaign. | NT | | 2006 | 4,5 |
| **CP3.** Raise public awareness of Parrots and other birds through local media (e.g. *Know Your Islands*), special events (e.g. *Birds* stamp issue), public talks and schools presentations (e.g. *Do You Know Me?*) and natural history websites. | NT | DoE BC DE | 2006 ongoing | 4,5 |
| CP3. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for NT "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands through CaymanBiodiversity.com, 2007. | | | | |
| **CP4.** Development of National Trust's interpretative centre for conservation education. | NT | | 2007 | 4,5 |
| **CP5.** Install interpretative signage on National Trust owned nature trails. | NT | DoE | 2006 | 4,5 |
| **CP6.** Promote island wide awareness of the illegality and undesirability of moving parrots between islands, outside of managed transfers. | DoE | CIG | 2008 | 5 |
| **CP7.** Raise awareness of the value of native landscaping for wildlife. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 6 |
| **CP8.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT NT MP QEIIBP | 2010 | 4 |

## REFERENCES and FURTHER READING for the *Cayman parrot*

**Specific:**

Bradley, P.E. (1986) A census of *Amazona leucocephala caymanensis*, Grand Cayman and *Amazona leucocephala hesterna*, Cayman Brac. Cayman Islands Government Technical Publication 1, George Town, Grand Cayman.

Bradley, P.E. (1996) The status of the birds of Cayman Brac as a national resource and their potential for nature tourism. Report for Cayman Islands Department of Environment.

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

Burton, F.J. Wiley, J. and Bradley, P.E. (1999). National Trust census of the breeding population of the Cayman Brac parrot *Amazona leucocephala hesterna*. Unpublished report, National Trust for the Cayman Islands, Grand Cayman, Cayman Islands.

Noegel, R. (1980) *Amazona leucocephala*: status in the wild and potential for captive breeding. In R. Pasquier, ed., Conservation of the New World parrots. Washington DC: Smithsonian Institute Press (ICBP Techn. Publ. 1): 73-9.

Noegel, R. (1983). Caribbean island amazons, captive breeding for conservation. In A.C. Risser and F.S. Todd, eds. Proceedings of the Jean Delacour/ICFCB Symposium on breeding birds in captivity. Los Angeles, California: International Foundation for the Conservation of Birds: 187-92.

Noegel, R. (1985). The Grand Cayman island amazon on the increase, Parrot Soc 19: 250-3.

Wiley, J.W. (1991) Status and conservation of parrots and parakeets in the Greater Antilles, Bahama Islands, and the Cayman Islands. Bird Conservation International 1: 187-214.

Wiley, J.W., Gnam, R.S., Burton, F., Walsh, M., Weech, J., Strausberger, B. and Marden, M. (1992a). Report on observations of the Cayman Brac Parrot (*Amazona leucocephala hesterna*) on Cayman Brac, June 1991. Report for the International Council for Bird Preservation, Cambridge.

Wiley, J.W., Snyder, N.F.R. and Gnam, R.S. (1992b). Reintroduction as a conservation strategy for parrots. In S. Beissinger and N.F.R. Snyder, eds., New World parrots in crisis. Solutions from conservation biology. Washing DC: Smithsonian Institute Press: 165-200.

Wiley, J.W. Ground McCoy, D., Cross, S., Scarr, P., Burton, F.J., Ebanks-Petrie, G., Marsden, M., Butler, P. and Prescott, K. (1991) Report on surveys of the Cayman Brac Parrot (*Amazona leucocephala hesterna*) on Cayman Brac, February 1991 (unpublished report). George Town, Grand Cayman: National Trust for the Cayman Islands.

Wiley, J.W., Gnam, R.S., Koenig, S.E., Dornell, A., Galvez, X., Bradley, P.E., White, T. and Zamore, M. (2004). Status and conservation of the family *Psittacidae* in the West Indies. El Pitirre. Journal of Caribbean Ornithology 17: 94-154.

**General:**

Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1997). Report on the birds of Cayman Brac. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Johnston, D.W (1975). Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171). Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911). On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### Vitelline warbler *Dendroica vitellina* (Cory.)

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Aves, Order: Passeriformes, Family: Parulidae
Genus: Dendroica, Species: vitellina

The Vitelline warbler *Dendroica vitellina* is a restricted range neotropical species confined to the Cayman Islands and Swan Islands. There are three endemic races: *D. v. vitellina* on Grand Cayman, *D. v. crawfordi* on Cayman Brac and Little Cayman and *D. v. nelsoni* on the Swan Islands. It is similar to and closely related to the migrant Prairie warbler, *D.* discolour, and often considered part of a superspecies. Preliminary genetic analysis by Irby Lovatt at Cornell University indicates that the Vitelline warbler is a full species.

### Status

**Distribution:** Subspecies endemic to each of Grand Cayman and Cayman Brac.
**Conservation:** The Vitelline warbler is listed as near-threatened (IUCN), with a decreasing population trend.
**Legal:** The Vitelline warbler *Dendroica vitellina* is protected under the Animals Law (1976). Pending legislation, it would be protected under the National Conservation Law (Schedule I). The Department of Environment is the lead body for legal protection.

### Natural history

The Vitelline warbler *Dendroica vitellina* breeds primarily in *forest and woodland* and *dry shrubland* (infrequently in xerophytic shrubland), and also in disturbed edge habitat bordering shrubland and dry forest. It will forage, but seldom breeds, in edge wetland and littoral habitats on Grand Cayman. On Cayman Brac and Little Cayman, birds forage in edge wetland habitats but seldom breed there, whilst they forage and occasionally breed in littoral habitats. Species of the genus *Dendroica sp.* have been recovered from 12,000 year-old fossil deposits (owl pellets) from caves on Cayman Brac, but have not yet been identified to the species level.

The Vitelline warbler is insectivorous, and occasionally frugivorous. No full life history study has been made of this species, but observations indicate that it exhibits similarities to that of the Prairie warbler (Nolan 1978). Vitelline warblers construct a small woven cup nest in the outer branches of trees, in the fork of a low shrub, or hidden in bromeliads. Nest elevation varies from 1-7m. Clutches of two eggs are normal, incubated for 14 days. The young are fed by both parents; fledging by 14 days. Predators include rats, snakes, Smooth-billed ani *Crotophaga ani*, Greater Antillean grackle *Quiscalus niger*, and Barn owl *Tyto alba*.

### Associated Habitats and Species for *Vitelline warbler*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| 14. Dry shrubland | Century plant *Agave caymanensis* |
| 15. Dry forest | Silver Thatch palm *Coccothrinax proctorii* |
| 18. Urban and man-modified areas | Cayman parrot *Amazona leucocephala* |

### Current Factors Affecting *Vitelline warbler*

- *Restricted range: D. v. vitellina* on Grand Cayman is restricted to the eastern interior. In the early 1980s, it was fairly common throughout preferred habitat on Grand Cayman but, from the mid-1980s to mid-1990s, a steady population decline related to loss of habitat began in western Grand Cayman, spreading to developed areas further east, to Bodden Town and beyond. The decline speeded up in the late-1990s and, following hurricane Ivan, resulted in only a few relictual individuals remaining in the western half of Grand Cayman, 2006. *D. v. crawfordi* is common on Cayman Brac and fairly common on Little Cayman.

- *Traditional habitat loss: dry forest, dry shrubland,* and secondary habitats have been targets for development since the 1980s, especially in the western half of Grand Cayman.

- *Remnant habitat fragmentation:* interior habitat has been degraded through land clearing for *urban and suburban* development, agricultural and expansion of the *roads* network.

- *Introduced predators:* rats, cats, and potentially Green iguana *Iguana iguana*. The parasitic Shiny cowbird *Molothrus bonariensis*, while not currently a problem, should not be allowed to establish in the Cayman Islands.

### Opportunities and Current Local Action for *Vitelline warbler*

Surveys by Bradley (2000) and the Bird Club, include monitoring of all endemic land birds on Grand Cayman. Frequency has increased since hurricane Ivan.

*Proposed Important Bird Areas (IBAs) for the Cayman Islands* (Bradley *et al*. 2006) identifies areas of habitat sufficient to sustain the Vitelline warbler in perpetuity. In Grand Cayman, key areas are the Mastic Reserve, Botanic Park, Salina Reserve, and eastern forests. In Cayman Brac, key areas are the Brac Parrot Reserve and the Splits. In Little Cayman, the key area is the Central Forest.

In 2004, the National Trust purchased additional land in the Mastic Reserve, Grand Cayman. In 2005, the National Trust, with funding from DoE CIG and USFWS NMBCA, purchased additional land in the Brac Parrot Reserve, consolidating this protected area. Also in conjunction with this grant, a series of bird lectures (*Do You Know Me?*) and bird ID cards are delivered to local schools.

A *Checklist of Birds of the Cayman Islands* (Bradley 2006) was published this year.

Training of nature guides in bird identification on Cayman Brac and Little Cayman as part of the Nature Tourism Initiative on the Sister Islands, has been completed, however a structured monitoring and reporting programme for the islands' birdlife is not in place.

### SPECIES ACTION PLAN for *Vitelline warbler*

| OBJECTIVES | TARGET |
|---|---|
| **1.** Purchase and protect key areas of habitat to sustain *Dendroica vitellina* in perpetuity. | 2015 |
| **2.** Map the distribution of *Dendroica vitellina* and continue to monitor numbers. | 2006 |
| **3.** Ensure sustained support for *Dendroica vitellina* and local bird conservation through targeted education. | ongoing |
| **4.** Maintain and enhance relictual populations. | 2009 |
| **5.** Reduce predation by non-native species. | 2008 |

| Vitelline warbler | LEAD | PARTNERS | TARGET | MEETS |
|---|---|---|---|---|

| PROPOSED ACTION | | | | OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Pass and implement the National Conservation Law. | CIG | DoE | 2006 | 1-5 |
| **PL2.** Implement the Endangered Species (Trade & Transport) Law. | DoE | CIG | 2006 | 5 |
| **PL3.** Protect *Dendroica vitellina* under Schedule I of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1-5 |
| **PL4.** Secure Cayman Islands Important Birds Areas (IBAs) - once accepted by Birdlife. | DoE | CIG NT IntC | 2007 | 1 |
| **PL5.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 1,4 |
| **PL6.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 1,4 |
| **PL7.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 1,4 |
| **PL8.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | 2008 | 5 |
| **Safeguards & Management** | | | | |
| **SM1.** Prioritise potential dry forest and shrubland acquisition options, and undertake negotiations towards establishing protected areas on the three islands sufficient to sustain the species in perpetuity. | DoE NT | MP | 2006 ongoing | 1 |
| **SM2.** Use the *Environmental Protection Fund* to protect / establish management agreements with landowners of key IBA areas, including consolidation of the Mastic Reserve, protection of eastern shrubland and Central Mangrove Wetland, Grand Cayman, and dry forest in Cayman Brac (including Salt Water Pond Walk), and the Central Forest, Little Cayman. | CC | DoE MP NT | 2006 | 1 |
| **SM3.** Continue to request local / international funds and matched contributions to establish key reserves. | DoE NT | IntC | ongoing | 1 |
| **SM4.** Purchase strategically important patches of woodland that act as refugia, including urban areas in West Bay and Ventnor's, East End. | NT DoE | DoE MP | 2010 | 1,4 |
| **SM5.** Establish strategic woodland patches in *urban and man-modified areas*, including LPP, to act as refugia and maintain wildlife corridors. | DoE | MP NT CIG DoP | 2006 | 1,4 |
| **SM6.** Control predation by rats, cats, *Iguana iguana*, and potential colonisation of the Shiny cowbird *Molothrus bonariensis*. | DEH DoE DoA | NT HS | 2007 | 5 |
| **SM7.** Restore damaged habitat where possible. | DoE NT MP | | 2010 | 1,4 |
| **SM8.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement | DoE | | 2012 | 1-5 |

| | | | | |
|---|---|---|---|---|
| conservation actions. | | | | |
| **SM9.** Implement associated HAPs. | DoE | | 2015 | 1-5 |
| **Advisory** | | | | |
| **A1.** Secure amendment of gazetted road corridors in order that they no pass through (i) critical east interior habitat, Grand Cayman (ii) the Nature Trail, Little Cayman and (iii) the parrot Reserve, Cayman Brac. | DoE<br>NRA | NT<br>DoP<br>CPA<br>DCB | ongoing | 1 |
| **A2.** Establish management strategy to develop nature tourism in reserves with sustainable financial planning. | NT<br>SIDA<br>CITA<br>SITA | DoE<br>DoA | 2006<br>ongoing | 3 |
| **A3.** Develop and recommend guidelines for native vegetation maintenance / landscaping, particularly for developments in littoral areas. | DoE DoP | SIDA | 2009 | 4 |
| **A4.** Promote use of native plants in landscaping, through maintenance of existing vegetation and use of *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 4 |
| **A5.** Targeted awareness of the need for the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-5 |

| Vitelline warbler<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Develop and implement methods of non-native predator control for managed warbler habitats. | DoE<br>DoA | NT<br>HS | 20010 | 5 |
| **RM2.** Assess the ecological impact of *Iguana iguana* on the Vitelline warbler. | DoE | NT | 2010 | 5 |
| **RM3.** Continue monitoring and map distribution of the Vitelline warbler in the Cayman Islands. | DoE NT<br>BC MP | | ongoing | 2 |
| **RM4.** Assess population status of Vitelline warblers in the Swan Islands, towards contextualising conservation status of local populations. | DoE NT<br>BC MP | | ongoing | 2 |
| **RM5.** Monitor habitat for early stages of the colonisation by *Molothrus bonariensis.* | DoE NT<br>BC MP | | ongoing | 5 |
| **RM6.** Construct quarters for visiting scientists in Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | | 2012 | 2,3 |
| **Communication & Publicity** | | | | |
| **CP1.** Raise public awareness of Vitelline warblers and other birds through local media (e.g. *Know Your Islands*), special events (e.g. *Birds* stamp issue), public talks and schools presentations (e.g. *Do You Know Me?*) and natural history websites. | NT | DoE BC<br>DE | 2006<br>ongoing | 3 |
| CP1. REPORT: DoE and NMBCA jointly fund development of Bird ID cards for NT "Do You Know Me?" programme, and Virtual Bird Guide for the Cayman Islands through CaymanBiodiversity.com, 2007. | | | | |
| **CP2.** Development of National Trust's interpretative centre for conservation education. | NT | | 2007 | 3 |
| **CP3.** Install interpretative signs on National Trust nature trails. | NT | DoE | 2006 | 3 |
| **CP4.** Raise awareness of the value of native landscaping for wildlife. | DoE DoP<br>NT<br>QEIIBP | MP CN<br>GC OS<br>SB LCN | 2010 | 3,4 |
| **CP5.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG | DoE DoT<br>NT MP<br>QEIIBP | 2010 | 3 |

## REFERENCES and FURTHER READING for *Vitelline warbler*


**Specific:**

Burden, D.W. (1972). A taxonomic reappraisal of *Dendroica vitellina (*Aves: *Parulidae)* of the Cayman Islands and Swan Islands, West Indies. MSc Thesis. Louisiana State University, Baton Rouge.

**General:**

BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15).

Bradley, P.E. (1994) The avifauna of the Cayman Islands: an overview. In M.A. Brunt and J. Davies, eds., The Cayman Islands: natural history and biogeography. The Netherlands: Kluwer Academic Publishers: 377-407.

Bradley, P.E. (1995) Birds of the Cayman Islands (with photographs by Y.-J. Rey-Millet) (2nd edn). Italy: Caerulea Press.

Bradley, P.E. (1997). Report on the birds of Cayman Brac. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (1999). Report on the birds and their habitats on Little Cayman. Report for the Department of Environment, CI Government, Cayman Islands.

Bradley, P.E. (2000) The birds of the Cayman Islands: BOU checklist series 19. Tring, UK: British Ornithological library.

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2006). Cayman Islands section, pages 65-96. In: Sanders, S.M. ed (2006) *Important Bird Areas in the United Kingdom Overseas Territories.* Sandy, UK: RSPB. ISBN: 1-901930-76-9

Bradley, P.E., Cottam, M., Ebanks-Petrie, G. and Solomon, J. (2008). Cayman Islands section, pages 109-118. In: BirdLife International (2008) *Important Bird Areas in the Caribbean : key sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No.15). ISBN: 978-0-946888-65-8.

Johnston, D.W (1975). Ecological analysis of Cayman Islands avifauna. Bulletin of the Florida State Museum of Science 19(5): 235-300.

Johnston, DW., Blake, C.H. and Buden, D.W. (171). Avifauna of the Cayman Islands. Quarterly Journal of the Florida Academy of Science 34(2): 141-56.

Lowe, P.R. (1911). On the birds of the Cayman Islands, West Indies. Ibis Series 9(5): 137-61.

Moore, A.G. (1985) Winter status of birds on Grand Cayman Island. Bulletin of the British Ornithological Society 104(1): 8-17.

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and Raffaele, J. (2003). Birds of the West Indies. Princeton University Press. 216 pages. ISBN 0-691-11319-X.

## TERRESTRIAL SPECIES

### Bats

INSERT IMAGES

### Taxonomy and Range

Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Chiroptera

There are nine species of bats in the Cayman Islands. None are Vampire Bats. Bats constitute our only extant native mammals. Bats are not rodents: the common term *"rat bats"* is a misnomer.

### Status

**Distribution:** While many species are distributed widely throughout the Caribbean, Central and South America, the Big Brown bat *Eptesicus fuscus minor*, the smallest known representative of *E. fuscus*, is a subspecies endemic to Grand Cayman (Morgan 1994). The subspecies found on Cayman Brac is the same as the Cuban subspecies. Neither is recorded on Little Cayman.

**Conservation:**

Big Brown bat *Eptesicus fuscus minor* is listed as Lower Risk/least concern (IUCN), however, the status of the Cayman Islands' population is currently unknown. There has been recent evidence of roost desertion on Grand Cayman. Three were observed in a garage roof, indicating that some may utilise artificial structures.

Buffy Flower bat *Erophylla sezekorni* is listed as Lower Risk/least concern(IUCN), however, the status of the Cayman Islands' population is currently unknown. It is currently unknown whether *E. sezekorni* is a genetically distinct population in the Cayman Islands.

Antillean Nectar bat *Brachyphylla nana nana* is listed as Lower Risk/near threatened (IUCN). The status of the Cayman Islands' population is currently unknown. Furthermore, no roosting sites have ever been located, making protection of critical habitat difficult.

Jamaican Fruit bat *Artibeus jamaicensis parvipes* is listed as Lower Risk/least concern (IUCN). The population on Grand Cayman will likely recover following Hurricane Ivan, given maintenance of undisturbed roosting areas and foraging sites over the next few years.

Brazilian Free-tailed bat *Tadarida brasiliensis muscala* is listed as Lower Risk/near threatened (IUCN). The status of the Cayman Islands' population is currently unknown, though calls have been documented via Anabat and a D-20 Petterson bat detector (Freeman 1979, Simmons et al 1978). A colony of est. 8,000-30,000 appears to have abandoned the large cave in Old Man Bay. Sixteen were observed in the Salina Cave, pre-hurricane Ivan.

Pallas' Mastiff bat *Molossus molossus* is listed as Lower Risk/least concern (IUCN). Currently there is no critical concern for the status of the local population of *M. molossus minor*, which is known only from the Cayman Islands and Cuba.

Red bat *Lasiurus borealis* (subspecies unknown) is listed as Lower Risk/least concern (IUCN), however the status of the Cayman Islands' population is currently unknown. Only three individuals have ever been recorded on Grand Cayman; with singles in the Lower Valley Forest, the Botanic Park and Northward.

Waterhouse's Leaf-nosed bat *Macrotus waterhousii minor* is listed as Lower Risk/least concern (IUCN). The population in Little Cayman currently appears stable, but should be monitored. In Grand Cayman, roosts have been abandoned at Old Man Bay, Spotts Bat Cave, the Agriculture Pavilion Cave, and Pirate's Cave side tunnel.

White-shouldered Bat *Phyllops falcatus* is listed as Lower Risk/near threatened (IUCN), however, the status of the Cayman Islands' population is currently unknown. This bat has always appeared rare on Grand

Cayman (Morgan 1994, Band 2007) and, if still present, likely is threatened due to Hurricane Ivan and anthropogenic destruction of its mature *dry forest* habitat (Band 2007). More intensive monitoring is needed to assess the possibility of this species having been extirpated on Grand Cayman.

**Legal:** *Bats* currently have no legal protection in the Cayman Islands. Pending legislation, *bats* would be protected under the National Conservation Law (Schedule I). The Department of Environment would be the lead body for legal protection.

### Natural history

The following is an abbreviated overview of the natural history of bats in the Cayman Islands. For more detail see the DoE report "*The status of bats in the Cayman Islands 2006*".

Bats occupy a variety of ecological niches, making them important indicators of a healthy and functional natural environment. Some, such as Pallas' Mastiff bat *Molossus molossus*, are insectivorous, consuming night-flying insects including mosquitoes. Others are nectivorous and frugivorous, pollinating many species of native plants and dispersing their seeds. Only two of Cayman' nine species of bats eat cultivated fruit, however, this propensity results in conflict situations arising with fruit-growers and farmers. While damaging some fruit, bats equally contribute to pollination, and effective removal of insect fruit pests. Seed dispersal by bats helps maintain forest diversity, and contributes to natural reseeding and restoration of degraded habitats.

Individual bats may live up to 30 years, but most bear only a single pup each year. This low productivity makes bats vulnerable to extinction and slow to recover numbers following losses.

Caves provide crucial habitat for several species of bats. Some species are especially sensitive to human disturbance of their roost sites, and may desert an otherwise suitable site *en-mass* if disturbed. Spring and early summer months are critical periods, when flightless youngsters are present, and may be deserted if parents are disturbed. Other species are more adaptable to living alongside humans.

In the face of natural habitat loss some, such as Pallas' Mastiff bat, will colonize roof cavities. This can result in undesirable noise, droppings and odours. For this reason, a *Bat Conservation Project* has long been operative in the Cayman Islands. Volunteer workers inspect roof spaces, construct and emplace bat houses, and assist with advice on exclusion methods; removing bats safely and permanently from roof spaces. To-date, with the cooperation of Caribbean Utilities Co., Ltd (CUC) the *Bat Conservation Project* has erected over 95 bat houses on utility poles around Grand Cayman, providing an alternative roost for bats, while maintaining their eco-system services within *urban and man-modified areas*.

### Associated Habitats and Species for *Bats*

| ASSOCIATED HABITAT PLANS | ASSOCIATED SPECIES PLANS |
|---|---|
| | Cayman parrot *Amazona leucocephala.* |
| 9. Mangrove | *E. fuscus, M. molossus, L. borealis.* |
| 13. Pools, ponds and mangrove lagoons | Most species of insectivorous bats benefit from the insects associated with *pools, ponds and mangrove lagoons.* |
| 14. Dry shrubland | *E. sezekorni, L. borealis, M. waterhousii.* |
| 15. Dry forest | *E. fuscus, E. sezekorni, B. nana, A. jamaicensis, T. brasiliensis, M. molossus, L. borealis, M. waterhousii, P. falcatus.* |
| 16. Caves | *E. sezekorni, B. nana, A. jamaicensis, T. brasiliensis, M. waterhousii, E. fuscus on GC and M. molossus on Brac.* |
| 17. Farm and grassland | *E. fuscus, E. sezekorni, B. nana, A. jamaicensis, T. brasiliensis, M. molossus, L. borealis, M. waterhousii, P. falcatus.* |

| | |
|---|---|
| 18. Urban and man-modified areas | *T. brasiliensis, M. molossus, P. falcatus, A. jamaicensis.* |

## Current Factors Affecting *Bats*

- *Disturbance of natural roosts:* many species of bats are highly sensitive to human disturbance of roost sites, elevating the risk of accidental disturbance by visiting members of the public and inappropriate scientific research methods. Deliberate disturbance of roosts arises from cultural fear of bats, blanket persecution of (all) species as crop pests, and deliberation acts of vandalism.

- *Disturbance of man-made roosts:* hygiene and disturbance issues associated with bats occupying roof cavities makes most people unwilling to share their houses with bats. Inappropriate exclusion of bats can result in animals being trapped and dying in roof cavities. Humane exclusions guard against trapping, and are only performed outside of the breeding season. Where feasible, impact of humane exclusion may be mitigated by on-site placement of an artificial bat box.

- *Loss of natural roosts:* clearance of vegetation and in-filling of caves in land slated for development and dumping of garbage in caves contribute to a loss of natural roost sites.

- *Loss / fragmentation of natural habitat:* land clearance and development impact nature roosting and feeding habitats for bats.

- *Landscaping:* non-native landscaping reduces natural food availability for many species of bats.

- *Incidental factors:* disruption of traditional flight lines, motor traffic, mosquito control, power lines, and wind turbines can result in the incidental death of bats. A study by Edward B. Arnett (BCI), financed largely by the American Wind Energy Association, conducted at Florida Power & Light Co's Mountaineer Wind Energy Centre, indicated that its 44 turbines may have caused between 1,300 and 2,000 bat deaths in a six-week period, 2005.

- *Cultural:* along with snakes and frogs, bats are shunned as "frightening" creatures by many cultures and by phobic individuals.

- *Predation by non-native species:* rats have the potential to significantly impact colonies.

- *Conservation efforts:* despite their lack of protected status, bats in the Cayman Islands have benefited from an effective long-term voluntary Bat Conservation Programme.

## Opportunities and Current Local Action for *Bats*

The National Trust for the Cayman Islands has a long established Bat Conservation Programme, run by Ms. Lois Blumenthal. This programme raises public awareness through the media, PowerPoint presentations to public groups and schools, and an informational website: www.Caymanwildlife.org.

The Bat Conservation Programme also assists with the active management of bat colonies which establish in roof spaces. Volunteer workers inspect roof spaces, construct and emplace bat houses, and assist with advice on exclusion methods; removing bats safely, humanely and permanently from roof spaces. To-date, with the cooperation of Caribbean Utilities Co., Ltd (CUC) the Programme has erected over 95 bat houses on utility poles around Grand Cayman, providing an alternative roost for bats, while maintaining their eco-system services within *urban and man-modified areas*.

## SPECIES ACTION PLAN for *Bats*

The Proposed Actions for *Bats* are largely based on the research and recommendations of Dr. Annie Band, arising from her long-term studies, and an assessment of bats funded by DoE in conjunction with the Bat Conservation Programme, following Hurricane Ivan "*The status of bats in the Cayman Islands*" (Band 2006).

| OBJECTIVES | TARGET |
|---|---|
| **1.** Establish legal protection for all bats in the Cayman Islands. | 2006 |
| **2**. Reduce impact resulting from conflict situations between bats and humans. | ongoing |
| **3**. Improve understanding of, and protect, key habitat, especially natural roost sites. | 2015 |
| **4**. Expand educational programmes to inform the public, allay fears, facilitate timely and practical management, and raise awareness of the ecological role of bats. | ongoing |

| Bats<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Policy & Legislation** | | | | |
| **PL1.** Targeted awareness towards the promotion of the National Conservation Law and the Endangered Species (Trade & Transport) Law. | DoE | CIG NT | 2006 | 1-4 |
| **PL2.** Protect *Bats* under Schedule I of the National Conservation Law , through establishment of conservation regulations. | DoE | CIG | 2006 | 1-4 |
| **PL3.** Act to protect all known established natural roosts, and implement protection of newly discovered natural roosts, and critical foraging habitat. | DoE | CIG MP NT | 2010 | 1,3 |
| **PL4.** Promote amendment of the Planning Law, to facilitate rapid imposition of stop-orders on illegal developments and provide a responsive and effective enforcement mechanism. | DoP | DoE CIG | 2010 | 2,3 |
| **PL5.** Strengthen the *Development Plan* on Grand Cayman, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP CPA | CIG MP DoE | ongoing | 2,3 |
| **PL6.** Promote establishment of a *Development Plan* for the Sister Islands, incorporating a long-term vision for the environmental, social, and economic development of the Islands. | DoP DCB | CIG MP DoE | ongoing | 2,3 |
| **PL7.** Enable DoE Conservation Officers to implement legal eradication of invasive species, as necessary to ensure the survival of endangered native species. | DoE | CIG | ongoing | 3 |
| **Safeguards & Management** | | | | |
| **SM1.** Maintain and expand bat house construction and placement initiative under the current Bat Conservation Programme, towards conserving *M. molossus.* | NT | DoE IntC MP | ongoing | 2 |
| **SM2.** Develop and implement sustainable management strategies for conservation of *A. jamaicensis* and *B. nana*, which reasonably mitigate local farmers for damage to their fruit crops. | DoE DoA | DoT NT CIG MP IntC | 2015 | 2,3,4 |
| **SM3.** Eradicate Monk parakeets *Myiopsitta monachus* from the Cayman Islands, towards removing this crop-pest. | DoE | MP | 2009 | 2 |
| **SM4.** Use the *Environmental Protection Fund* to | CC | DoE NT | 2015 | 3 |

| | | | | |
|---|---|---|---|---|
| purchase and protect / establish management agreements with landowners of the *caves* and *forest and woodland* associated with the Old Man Bay (Bat) Caves, Grand Cayman to assist in the preservation of *E. fuscus* and *A. jamaicensis*. This system is also a historic roost site for *T. brasiliensis.* | | MP CIG IntC | | |
| **SM5.** Investigate feasibility of establishing Cayman Brac Bluff Cave site as a protected area/ establish management agreements with landowners, towards preserving the only known roost of *E. sezekorni*. | CC | NT MP DoE CIG IntC | 2010 | 3 |
| **SM6.** Investigate feasibility of establishing Miller's Cave system as a protected area / establish management agreements with landowners, towards preserving *A. jamaicensis*. | CC | NT MP DoE CIG IntC | 2010 | 3 |
| **SM7.** Investigate feasibility of establishing Dolphin. Cave (Sybil McLaughlin's property on Queen's Highway) as a protected area / establish management agreements with landowners, to assist in the preservation of *A. jamaicensis*. | CC | NT MP DoE CIG IntC | 2010 | 3 |
| **SM8.** Investigate status of the Salinas Reserve cave, to assist in the preservation of *A. jamaicensis, M. waterhousii* and *T. brasiliensis*. | CC NT | MP DoE IntC | 2010 | 3 |
| **SM9.** Investigate the feasibility of establishing protected caves at two sites on Cayman Brac bluff, one at the base, the other a single cave with small opening about 20 feet up on the bluff face - the latter being home to ca. 500 *M. molossus.* | CC | NT MP DoE CIG IntC | 2010 | 3 |
| **SM10.** Investigate feasibility of restoring the Agriculture Pavilion Cave, and establishing the site as a protected area. This is currently inaccessible to bats due to the dumping of garbage. Cleanup and fencing would be a simple inexpensive way to restore this cave roost for potential recolonisation by *A. jamaicensis* and *M. waterhousii,* in line with DoA's Agritourism initiative. | DoA | NT MP DoE CIG IntC | 2010 | 3 |
| **SM11.** Investigate feasibility of establishing Spot Bay Bat Cave as a protected area / establish management agreements with landowners, to assist in the preservation of *Macrotus waterhousii*. | CC | NT MP DoE CIG IntC | 2010 | 3 |
| **SM12.** Encourage maintenance and planting of mature fruit trees in developed areas. *P. falcatus*, for example, will roost adjacent to housing complexes if mature *Ficus* remain. | DoE QEIIBP | NT | 2008 | 2,3 |
| **SM13.** Supply native trees suitable for bats feeding and roosting, through the *Native Tree Nursery*. | DoE QEIIBP | NT | 2008 | 2,3 |
| **SM14.** Use the *Environmental Protection Fund* to purchase and protect / establish management agreements with landowners of a *cave* suitable for establishment as a "show-cave". Develop on-site access and interpretation to facilitate visitation by school-groups, towards educating students regarding the geological and biological interest of *caves*. | CC | DoE NT MP CIG DE | 2015 | 2,3,4 |
| **SM15.** Control predation by rats and cats. | DEH DoE HS DoA | NT | 2007 | 3 |
| **SM16.** Restore damaged roosting habitat where possible. | DoE NT | | 2010 | 3 |

| | | | | |
|---|---|---|---|---|
| | MP | | | |
| **SM17.** Establish a full-time DoE field conservation officer on Cayman Brac and Little Cayman to implement conservation actions. | DoE | | 2012 | 2,3,4 |
| **SM18.** Implement associated HAPs. | DoE | | 2015 | 1,2,3,4 |
| **Advisory** | | | | |
| **A1.** Maintain communications with planning agencies and developers, towards early identification of potential development conflicts, and effective mitigation action towards the preservation / incorporation of roosts into new developments. This measure will be of particular importance to species such as *B. nana* and *E. sezekorni.* | DoE | DoP NRA MP | ongoing | 2,3 |
| **A2.** Work with planners to encourage maintenance of mature fruit trees in developments. *P. falcatus*, for example, will roost adjacent to housing complexes if mature *Ficus* trees remain. | DoE | DoP NRA MP | ongoing | 2,3 |
| **A3.** Promote the use of native plants in landscaping, through maintenance of existing vegetation and use of a *Recommended Planting Palette* in new developments. | DoP | DoE | 2009 | 2,3,4 |

| Bats<br>PROPOSED ACTION | LEAD | PARTNERS | TARGET | MEETS OBJECTIVE |
|---|---|---|---|---|
| **Research & Monitoring** | | | | |
| **RM1.** Further monitoring via mist-netting is needed to assess whether *P. falcatus* and *E. sezekorni* are still present on Grand Cayman, and if so, determine extent of population recovery. | DoE NT | IntC | 2010 | 3 |
| **RM2.** Augment existing studies with more sophisticated radio-telemetry efforts and acoustical monitoring via Anabat or Sonobat. | DoE NT | IntC | 2010 | 3 |
| **RM3.** Determine location of new roost sites for all species, a priority being species for which no roost sites are currently known, such as *B. nana*, and species with a dependency on primary forest, such as *P. falcatus*. | DoE NT | IntC | 2010 | 3 |
| **RM4.** Determine foraging habitat requirements and key sites for all species (mature forest appears critical to some species, such as *P. falcatus*, others are able to adapt to secondary forest, and low-development farmland and plantation). | DoE NT | IntC | 2010 | 3 |
| **RM5.** Extend bat monitoring programme, to monitor populations, impact of development and effectiveness of conservation management efforts. | DoE NT | IntC | 2010 | 3 |
| **RM6.** Promote international links and facilitate visiting scientists when their methods and studies have the potential to benefit the conservation of Cayman Islands bats. | DoE NT | IntC | ongoing | 3 |
| **RM7**. Ban unnecessarily invasive research techniques, which might encourage desertion of roosts, with particular attention to sensitive species such as *E. sezekorni*. | DoE NT | IntC | ongoing | 2,3 |
| **RM8**. Work with international experts to determine appropriate management of specific sites and species, especially where species are sensitive to critical environmental conditions, or disturbance, such as *E. sezekorni*. | DoE NT | IntC | ongoing | 3 |
| **RM9.** Investigate feasibility of implementing *Parrot Jam Project* – a financial / PR incentive scheme to offset crop damage suffered by local fruit farmers. | DoE MP DoA | DoT NT CIG | 2012 | 2,3,4 |
| **RM10.** Construct quarters for visiting scientists in Cayman Brac, and support research initiatives complimentary to the objectives of the NBAP. | DoE | | 2012 | 2,3,4 |
| **Communication & Publicity** | | | | |
| **CP1.** Continue proactive public awareness initiative, to raise awareness of the Bat House Conservation Programme to conserve *M. molossus*, and reduce incidental deaths of the endemic *Eptesicus fuscus.* | NT | DoE IntC | ongoing | 2,4 |
| **CP2.** Raise public awareness of the sensitivity of some bats species to disturbance, such as *E. sezekorni.* | NT | DoE | ongoing | 2,3,4 |
| **CP3.** Subject to SM14, utilise a "show colony" site to raise public awareness of the importance of bats. | CC | DoE NT MP CIG DE | 2015 | 2,3,4 |
| **CP4.** Establish a schools involvement programme to run in conjunction with appropriate RM actions. | NT | DoE DE IntC | 2010 | 2,3,4 |

| | | | | |
|---|---|---|---|---|
| **CP5.** Establish a lectures and publicity programme for all visiting scientists. | DoE NT | IntC | ongoing | 4 |
| **CP6.** Raise awareness of the value of native landscaping for wildlife. | DoE DoP NT QEIIBP | MP CN GC OS SB LCN | 2010 | 3 |
| **CP7.** Investigate potential for red-light / infra-red live streaming link to active colony, to that the public can view a colony in action. | DoE NT | IntC | 2010 | 3,4 |
| **CP8.** Utilise native flora and fauna, and associated preservation efforts, in the international promotion of the Cayman Islands. | CIG DoT QEIIBP | DoE NT MP | 2010 | 4 |

## REFERENCES and FURTHER READING for *Bats*


Adams, R. and S. Pedersen (1999). The effects of natural disasters on bat populations on Montserrat, BWI. American Zoologist 38(5): 52A

Alcover, JA, Sans A, Palmer M. (1998). The extent of extinctions of mammals on islands. Journal of Biogeography 25: 913-918

Altringham, J. D. (1996). Bat Biology and Behavior. Oxford Univ. Press, Oxford, England. 262 pp.

Anderson, S. (1969). *Macrotus waterhousii.* Mammalian Species, no. 1, 4 pp.

Avila-Flores, R. and M. B. Fenton (2005). Use of Spatial Features by Foraging Insevtivorous Bats in a Large Urban Landscape. J. of Mamm., 86(6):1193-1204.

Baker R.J., Genoways H.H. (1978). Zoogeography of Antillean Bats. In: Gill FB (ed) Zoogeography in the Caribbean. Acad. Nat. Sci. Philadelphia, Spec. Publ. 13 . p 53-97

Barbour, R.W., and Davis W.H. (1969). Bats of America. Univ. Press of Kentucky, Lexington. 286 pp.

Black, H.L. (1972). Differential exploitation of moths by the bats *Eptesicus fuscus* and *Lasiurus cinereus.* J. Mammal., 53:598-601.

Black, H.L. (1974). A north temperate bat community: Structure and prey populations. J. Mammal., 138-157.

Brigham, R.M. (1983). Roost selection and foraging by radio-tracked big brown bats *(Eptesicus fuscus).* Bat. Res. News, 24:50-51.

Cosson J.F., Pons J.M., and Masson D. (1999). Effects of forest fragmentation on frugivorous and nectarivorous bats in French Guiana. J Trop. Ecol 15:515-534

Erkert, H.G. (1978). Sunset related timing of flight activity in neotropical bats. Oecologia 37(1) 59-68.

Fenton, M. B. (1992). Bats. Facts on File, Inc. 207 pp.

Fleming, T.H., Heithaus E.R. (1981). Frugivorous bats, seed shadows and the structure of tropical forests. Reprod Bot Supplement to Biotropica 13:45-53

Fleming, T.H. (1993). Plant-visiting bats. Amer. Sci. 81: 460-467.

Fleming, T.H., Hooper, E.T., Wilson, D.E. (1972). Three Central American bat communities: structure, reproductive cycles, and movement patterns. Ecology 53: 555-569.

Freeman, P.W. (1979). Specialized insectivory: beetle eating and moth eating molossid bats. J. Mamm. 60(3) 467-479.

Freeman, P.W. (1981). A multivariate study of the Family Molossidae: morphology, ecology, and evolution. Fieldiana: Zoology, new series 7: 1-173.

Furlonger, C.L., H.J. Dewar, and Fenton M.B. (1987). Habitat use by foraging insectivorous bats. Can J Zool 65:284-288

Gannon, M. R. and M. R. Willig. (1994). The effects of Hurricane Hugo on bats of the Luquillo Experimental Forest of Puerto Rico. Biotropica, 26:320-321.

Gannon M.R., Willig M.R. (1997). The Effect of Lunar Illumination on Movement and Activity of the Red Fig-eating Bat *(Stenodema rufum*) Biotropica 29(4):525–529

Gardner, A. L. (1977). Feeding habits. Pp. 293-350 *in* Biology of Bats of the New World Family Phyllostomatidae. Vol. 2. (R.J. Baker, J.K. Jones, and D.C. Carter, eds.). Spec. Publ. Mus. Texas Tech. Univ., Lubbock. 364 pp.

Genoways, H.H., Timm R.M., Baker R.J., Phillips C.J., and Schlitter D.A. (2001). Bats of the West Indian Island of Dominica: Natural History, areography, and trophic structure. Special Publication of the Museum, Texas Tech University 43:1-43

Griffiths, T.A., and Klingener D. (1986). On the distribution of Greater Antillean bats. Biotropica (20):240-251

Goodwin, R.E. (1970). The ecology of Jamaican Bats. J. of Mamm., 51:571-579.

Gould, E. (1978). Opportunistic feeding by tropical bats. Biotropica, 10:75-76.

Handley, C.O. (1976). Mammals of the Smithsonian Venezuelan Project. Brigham Young Univ. Sci. Bull., Biol. Sur. 20(5): 1-89.

Handley, C. O. Jr., D. E. Wilson, A. L. Gardner. (1991). Demography and Natural History of the Common Fruit Bat *Artibeus jamaicensis* on Barro Colorado Island, Panama. Smithsonian Institution Press Washington, D. C. 173 pp.

Hickey, M.B.C., and Fenton M.B. (1990). Foraging by red bats *(Lasiurus borealis):* do intraspecific chases mean territoriality? Can J Zool 68:2477-2482

Howell, D.J. (1979). Flock foraging in nectar-feeding bats: advantages to the bats and to the host plants. Amer. Nat. 114: 23-49.

Humphrey, S.R., and Kunz T.H. (1976). Ecology of a Pleistocene relic, the western big-eared bat *(Plecotus townsendii)* in the southern Great Plains. J. Mammal. 56: 470-494.

Jones, K. E., Barlow, K. E., Vaughn, N., Rodriguez-Duran, A., and Gannon, M.R. (2001). Short-term impacts of extreme environmental disturbance on the bats of Puerto Rico. Anim. Conserv., 4:59-66.

Julian, S. and Altringham, J. D. (1994). Bat predation by a tawny owl. Naturalist 119: 49-56.

Klingener, D., Genoways H.H., Baker R.J. (1978). Bats from southern Haiti. Ann Carnegie Mus. 47:81-97

Koopman, K.F. (1989). A review and analysis of the bats of the West Indies. In: Biogeography of the West Indies. p 635-644

Kunz, T.H. (1973). Resource utilization: Temporal and spatial components of bat activity in central Iowa. J. Mammal., 54:14-32.

Kunz, T.H. (1982). Roosting ecology of bats. Pp. 1-55 *in* Ecology of Bats. (T.H. Kunz, ed.) Plenum Press, New York. 425 pp.

Kurta, A. and Teramino, J.A. (1992). Bat community structure in an urban park. Ecography 15:257-261

Law, B.S. and Lean, M. (1999). Common blossom bats (Syconycteris australis) as pollinators in fragmented Australian tropical rainforest. Biol. Conserv., 91:201-212.

Macias S.E., Mora C., Koch C., and von Helversen O. (2005). Echolocation behavior of *Phyllops falcatus* (Chiroptera: Phyllostomidae): Unusual frequency range for the first harmonic. Acta Chiropterol 7(2):275-283(9)

Mancina C.A., and Rivera L.G. (2000). Notes on the natural history of *Phyllops falcatus* (Gray 1839) (Phyllostomidae: Stenodermatinae) in Cuba. Chirop Neotrop 6(1-2):123-125

Medellin, R.A., Equihua, M. and Amin M.A. (2000). Bat Diversity and Abundance as Indicators of Disturbance in Neotropical Rainforests. Conserv. Biol., 14(6):1666-1675.

Mello, M.A. and Schitini, G.M. (2005). Ecological analysis of three bat assemblages from conservation units in the Lowland Atlantic Forest of Rio de Janeiro, Brazil. Chiropt. Neotrop., 11:206-210.

Morgan, G.S. (1994). Mammals of the Cayman Islands. IN Brunt, M.A. & Davies J.E. (1994). (eds.) The Cayman Islands Natural History and Biogeography. Kluwer Academic Publishers. ISBN 0-7923-2462-5. p.435-463.

Morgan G.S. (1994). Late quaternary fossil vertebrates from the Cayman Islands. In: The Cayman Islands: Natural History and Biogeography. Kluwer Academic Publishers, the Netherlands p 465-508

Nellis, D.W. and Ehle, C.P. (1977). Observations on the behavior of *Brachyphylla cavernarum* in Virgin Islands. Mammalia 41: 403-409

Nowak, R.M. (1994). Walker's Bats of the World. Smithsonian Institution Press, Washington, D. C. 287 pp.

Silva Taboada G. (1979). Los Murcielagos del Cuba. Editorial Academia, La Habana

Silva Taboada, G. and Pine, R.H. (1969). Morphological and behavioral evidence for the relationship between the bat genus *Brachyphylla* and the *Phyllonycterinae.* Biotropica 1: 10-19.

Shultze, M.D., Seavy, N.E. and Whitacre, D.F. (2000). A comparison of the Phyllostomid bat assemblages in undisturbed Neotropical forest and in forest fragments of a slash-and-burn farming mosaic in Peten, Guatemala. Biotropica, 32(1):174-184.

Shump, K.A. Jr, and Shump, A.U. (1982). *Lasiurus borealis*. Mammalian Species, no 183, Amer Soc Mamm, Lawrence, Kansas

Simmons, J.A., Lavender, W.A., Lavender, B.A., Childs, J.E., Hulebak, K., Rigden, M.R., Sherman J., Woolman B. and O'Farrell M. J. (1978). Echolocation by free-tailed bats *(Tadarida).* J. Comp. Physiol., 125:291-299.

Thomas, D.W. (1988). Diets of plant-visiting bats. Pp. 211-220 *in* Ecological and Behavioral Methods for the Study of Bats. (T.H. Kunz, ed.) Smithsonian Institution Press, Washington, D.C. 533 pp.

Twente, J.W. (1955). Some aspects of habitat selection and other behavior of cavern-dwelling bats. Ecology 36: 706-732.

Vandermeer, J., Boucher, D., Perfecto, I., and Granzow de la Cerda I. (1996). A theory of disturbance and species diversity: Evidence from Nicaragua after hurricane Joan. Biotropica 28(4):600-613

Waide, R.B. (1991). Summary of the response of animal populations to hurricanes in the Caribbean. Biotropica, 23(4):508-512.

Werner, T. K. (1981). Responses of non-flying moths to ultrasound: The threat of gleaning bats. Can. J. Zool., 59:525-529.

Whittaker, J. O. Jr., C. Maser, and S .P. Cross. (1981). Food habits of eastern Oregon bats based on stomach and scat analysis. Northwest Science, 55:281-292.

Willig, M.R., Camillo, G.R., and Noble, S. J. (1993). Dietary overlap in frugivorous and insectivorous bats from edaphic cerrado habitats of Brazil. J. Mammal. 74:117-128.

Zimmerman J.K., Willig M.R., Walker L.R., and Silver W.L. (1996) Introduction: Disturbance and Caribbean Ecosystems. Biotropica 28:414-423

Informational website: www.Caymanwildlife.org