

# Bermuda



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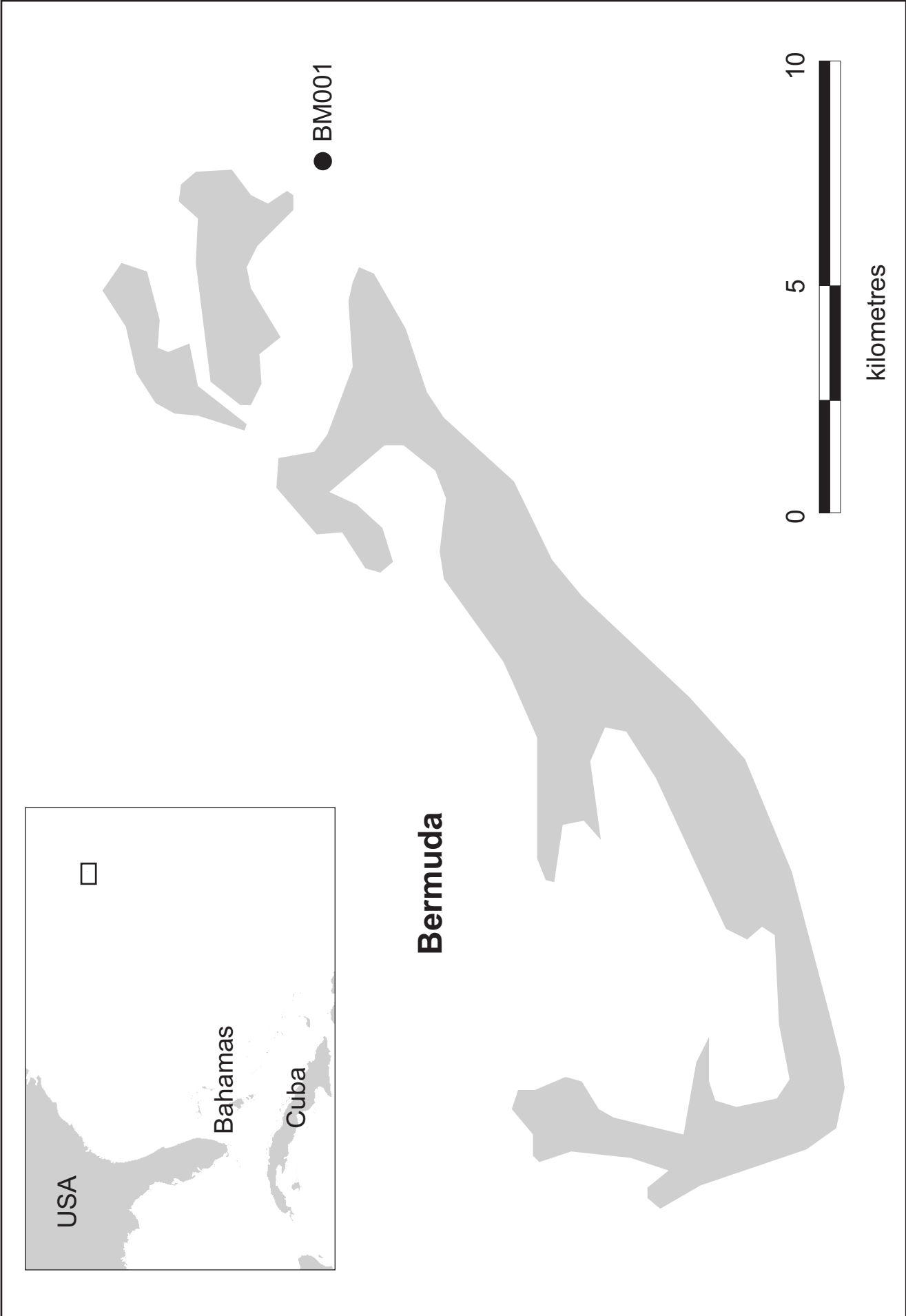
Castle Islands Nature Reserve looking south-west from Nonsuch Island.

## General introduction

Bermuda is situated in the western North Atlantic, 570 miles (917 km) from Cape Hatteras, the nearest landfall in the USA. It is made up of a mini-archipelago of approximately 150 islands, of which the eight largest are joined by bridges or causeways.

Bermuda is volcanic in origin and is the largest of three volcanic seamounts, which rise from mid-oceanic depths of 3,658 to 4,267 m. There appear to have been two main periods of volcanic activity, the first approximately 110 million years ago and the last 30–28 million years ago. Bermuda at this time probably appeared as a typical steep-sided volcanic island with one or more peaks rising to a considerable height, similar in appearance to Tristan da Cunha. Millions of years of wave and rain action completely eroded all volcanic material below sea level, creating a shallow submerged bank over 205 square miles (530 square km) in area. The shallow waters, coupled with the warm waters of the nearby Gulf Stream, which passes 400 miles (644 km) to the west of the island, provided ideal conditions for the growth of coral and other calcium-fixing

organisms. Over time, a thick cap of limestone, comprising lagoonal and aeolian (wind-blown) deposits built up over the volcanic base to the extent that the present visible islands are formed entirely of limestone. Most of the Bermuda Bank remains shallowly submerged, with areas of active coral reef surrounded by large areas of sand and sediment eroded from the reefs by wave action and the effects of various marine organisms. During periods of low ocean levels, such as the Ice Ages, this calcium-carbonate sand was exposed to the winds and blown into large sand dunes, which tended to accumulate on the south and south-east sides of the platform. When ocean levels rose during the interglacial periods, the dunes were all that remained above the surface. The sand making up these dune complexes was slowly cemented together by the action of rain into soft, porous aeolian limestone, which becomes much harder, more indurate and cavernous with age. The oldest limestone formations now exposed on the surface range from 600,000 to 1.6 million years in age. The dune origins of the present island result in a hilly, rolling



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landscape with relatively steep, parallel hills and ridges separated by inter-dune lows or valleys, some of which extend below water level to form wetland areas. There are very few natural level areas of any size, the largest being the inland peat-marsh basins in Devonshire and Pembroke Parishes. Extensive land reclamation by the US military in the early 1940s to build naval and air force operating bases added over one square mile to Bermuda's area and greatly increased the amount of relatively low, level area on the island. The total land area is only about 21 square miles (55 square km).

Bermuda's climate is considered sub-tropical, mainly due to the influence of the Gulf Stream, which passes to the west and north-west of the island. Annual rainfall is 1,400 mm, distributed fairly evenly throughout the year. Monthly average temperatures range from 18°C in February to 27°C in August.

Bermuda was discovered in about 1505 but has only been settled since 1609. Today, the country is largely suburban in nature and its total population of 63,000 people makes it one of the most densely populated countries in the world. The impact of human development on native fauna and flora has been significant. About 94% of present flora is introduced, much of it now naturalised.

At the time of its discovery, Bermuda was almost entirely covered in a dense, mostly evergreen forest dominated by several endemic tree species, notably Bermuda Cedar *Juniperus bermudiana*, Bermuda Palmetto Palm *Sabal bermudiana* and Bermuda Olivewood *Cassine laneanum*. Massive disturbance of Bermuda's vegetative cover was carried out by the early settlers, through clearing for agriculture and lumber, wholesale burning of large areas of forest to control a plague of rats, and the introduction of mammals such as pigs, rats, goats and cattle. By the late 1800s, only the Bermuda Cedar remained common, becoming Bermuda's main forest cover, with an understorey of other, less common, native and endemic plants. Only 246 species of vascular plant are recognised among Bermuda's indigenous flora, of which 14 are endemic.

Following an infestation of accidentally introduced juniper scale insect in the late 1940s, up to 96% of the Bermuda Cedar forest died, leaving the land essentially defoliated. Over 1,000 species of exotic plants have been introduced since that time, with many becoming invasive and

completely dominating the inland vegetation cover. In 2003, only some coastal cliff and dune areas were still dominated by native plant communities, along with some of the more exposed and isolated offshore islands. There are a number of native reforestation projects carried out by the Bermuda Department of Conservation Services, notably the Nonsuch Island Living Museum, the Walsingham Trust Property, Paget Marsh nature reserve and Morgan's Island nature reserve.

Bermuda's small size and geographical isolation have made it very difficult for mammals, amphibians and reptiles to become established naturally. Prior to human settlement, only one species of terrestrial reptile was resident, the endemic Rock Lizard or Bermuda Skink *Eumeces longirostris*, which is now common only on some of the offshore islands, in particular the Castle Harbour Islands. There are also three species of West Indian Anolis lizards, introduced from the Caribbean, which are established on Bermuda. These include the Jamaican Anole *Anolis grahami*, the most widespread species, the Antiguan Anole *Anolis leachii*, found mainly in the central Parishes of the main island, and the Barbados Anole *Anolis roquet*, found only on Somerset Island and the westernmost Parish.

There are no native amphibian species, although two introduced species, the Giant Toad *Bufo marinus* and the tiny Whistling Frog *Eleutherodactylus johnstonii*, are common on the larger islands.

There are no indigenous mammals recorded from Bermuda except for five species of bat, which visit the island only on migration as vagrants. Because of accidental and deliberate introduction by man, there are two species of rat, *Rattus norvegicus* and *Rattus rattus*, now common on Bermuda, as well as the House Mouse *Mus musculus*. There is also a large population of domestic and feral house cats, which impact on bird populations in some areas. Dogs are much better controlled, with a dog authority enforcing annual licensing, ensuring that there are very few, if any, feral animals.

Other mammals sold primarily as pets, such as guinea pigs and hamsters, are occasionally released in parks or nature reserves by irresponsible owners. Attempts by pet stores to introduce other exotic mammals, such as African pygmy hedgehogs and de-scented skunks, were recently prevented by the introduction of new legislation.

### Ornithological importance

About 375 bird species have been recorded in Bermuda, most of which are North American neo-tropical migrants. Although most of these migrants stay for only a matter of days or weeks to rebuild energy reserves before continuing on their migration, a number will stay on in varying numbers for the entire winter period (October to April). For example, up to 25 species of North American Wood Warblers regularly winter on Bermuda.

There are three species of global conservation concern

occurring on Bermuda, the most important being the Endangered endemic Bermuda Petrel, or Cahow. It was super-abundant before human settlement, but was nearly driven to extinction by earlier settlers. It has now increased to 70 breeding pairs nesting on four rocky islets near Cooper's and Nonsuch Islands. A recovery programme for Bermuda's national bird has been under way since 1951 and is managed by the Department of Conservation Services under the direction of the Terrestrial Conservation

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Officer. The Vulnerable Piping Plover and the Near-Threatened Buff-breasted Sandpiper are both occasional migrants, visiting mainly in autumn.

Only 16 species of resident birds breed annually, including one endemic sub-species, the Bermuda White-eyed Vireo, and several native species: Common Ground-doves, Mourning Doves, Grey Catbirds, Eastern Bluebirds and Barn Owls.

The Yellow-crowned Night-heron was successfully reintroduced to Bermuda for natural control of the abundant Red Land Crab, after the discovery of sub-fossil remains in limestone caves, and the descriptions of early settlers confirmed that the bird once nested there. Breeding of the Green Heron, suspected for years, was confirmed in 2003 around the edge of the mangrove-fringed Trott's Pond

and Mangrove Lake; it extended its breeding range in 2004.

Three seabird species visit Bermuda to breed. The endangered Bermuda Petrel is discussed above. The White-tailed Tropicbird is Bermuda's only common seabird, with approximately 2,000 nesting pairs found on coastal cliffs and offshore islands around Bermuda. The Common Tern nests on small rocks and islets in several of the larger inshore harbours, maintaining a small population of 18 to 25 nesting pairs. Hurricane Fabian (2003) had a disastrous effect on Common Terns, with only six pairs returning to breed in 2004. In addition, several other species of seabird visit Bermuda as vagrants. Of special interest is an increasing number of vagrant Sooty Terns, which seem to show an interest in the nesting Common Terns and may be attempting to colonise.

### Conservation infrastructure and Protected Area system

Bermuda is a signatory to a number of international environmental conventions: Vienna Convention on Substances that deplete the Ozone Layer; Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters; Convention on Wetlands of International Importance (Ramsar); Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES); Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage); and the International Convention on the Regulation of Whaling.

The first conservation legislation was passed in 1616, when the Governor issued a proclamation against 'the spoyle and havoocke of the cahows'. A number of acts cover the protection of species and habitats. These include: the Coral Reef Preserves Act 1966; the Fisheries Act 1972; the Protection of Birds Act 1975; the Endangered Animals and Plants Act 1976; the Bermuda National Parks Act 1986; and the Protected Species Act 2003. Although birds are covered there are other terrestrial species for example, the critically endangered Bermuda Skink that have no protection unless they are found within a National Park.

There are a number of government bodies responsible for the management of natural resources on Bermuda, which all fall under the umbrella of the Ministry of Environment, Development and Opportunity. These include the Department of Environmental Protection, the Department of Conservation Services, the Department of Planning and the Department of Parks. There are also 13 non-governmental organisations (NGOs), which play an important role in assisting the government in meeting its conservation objectives.

In 2003, Bermuda produced a five-year Biodiversity Strategy and Action Plan. This outlines 12 objectives and a series of prioritised actions for achieving them.

A total of 9%, or about 500 ha, of Bermuda's land area is designated as park and nature reserves. National Parks are areas that are protected under the National Parks Act 1986 for the enjoyment of present and future generations. Nature reserves are areas of special scientific interest, and all forms of development are prohibited. There are 177 ha of privately owned nature reserve, of which the Bermuda National Trust and Bermuda Audubon Society own about 50%.

### Overview of the inventory

Only one site on Bermuda qualifies for Important Bird Area (IBA) status. It covers an area of 43 ha, which is approximately 1% of the total land area of Bermuda.

Data collected by the Terrestrial Conservation Office under

the Cahow Recovery Project and the White-tailed Tropicbird Project, and the surveys led by the Bermuda Audubon Society were used to prepare this inventory.

### Sites of global conservation importance

IBA code	Site name	A1	A2	A4i	A4ii	A4iii
BM001	Cooper's Island and Castle Islands nature reserve	X			X	

## Site accounts

# BM001(a): Cooper's Island

# BM001(b) Castle Islands nature reserve

<b>Ref number</b>	BM001(a)
<b>Admin region</b>	Bermuda
<b>Coordinates</b>	32°21'N 64°39'W
<b>Area</b>	31.4 ha
<b>Altitude</b>	0–18 m
<b>IBA categories (details below)</b>	A1, A4ii
<b>Status</b>	Part nature reserve (2.6 ha), part National Park land and part government owned (previously NASA tracking station lands)

<b>Ref number</b>	BM001(b)
<b>Admin region</b>	Bermuda
<b>Coordinates</b>	32°20'N 64°39'W
<b>Area</b>	11.48 ha
<b>Altitude</b>	0–21 m
<b>IBA categories (details below)</b>	A1, A4ii
<b>Status</b>	Government nature reserve

### Site description

Cooper's Island and the adjacent Castle Islands nature reserve are situated at the east end of Bermuda in St George's Parish.

#### Cooper's Island

Cooper's Island is located on the eastern side of Castle Harbour and juts out into the centre of the Castle Islands. Its general alignment is from north-west to south-east. The rock type is limestone. It was a separate island of 31.4 ha until 1943 when it was connected to St David's Island by dredged fill during the construction of the US Air Force base, now the international airport. Prior to its connection with St David's Island, Cooper's Island was one of Bermuda's largest offshore satellite islands, and the most isolated and ecologically diverse. Even today it retains most of this diversity and ecological importance because the military and NASA installations have not altered the contours significantly and the superb beaches and coastline remain. Currently, the island is part nature reserve, part National Park land and part former NASA tracking station lands, which were recently handed back to the Bermuda Government (2002) with the closure of that station. The reserve and its associated Clearwater Beach National Park are currently of great importance for both recreation and public understanding of the environment. Local people enjoy hiking through one of the last remaining wild and open spaces on the islands. There is potential to convert the NASA land and buildings to a National Park and/or nature reserve, resulting in the creation of significant educational and visitor facilities, with associated cultural, environmental and socio-economic benefits.

#### Castle Islands nature reserve

The Castle Islands nature reserve is located along the south-east edge of Castle Harbour, with Bermuda's main island to the west and St David's Island to the east. There are a number of open channels between these islands that connect Castle Harbour with the open waters of the Atlantic Ocean. The largest of these channels, Castle Roads, used to be an important entrance for ships through the reef line during the 17th and 18th centuries. These islands are surrounded by extensive coral reefs and sea grass beds, which provide habitat for sea turtles and many species of reef fish and other organisms.

The reserve includes Nonsuch Island, which at 6.9 ha is the largest of the more isolated Castle Harbour Islands and supports the widest diversity of habitats. It is also the site of the Nonsuch Living Museum Project, which has been managed since 1962 as a restoration of the original plant and animal communities found on Bermuda before human settlement. The island also features a former quarantine hospital complex built in the 1860s, now used as a warden's residence with facilities for guided tours.

There are three other islands in the reserve more than 1.25 ha in size, including Castle Island (1.89 ha) and Charles Island (1.85 ha). These three islands also contain historically important early colonial fortifications, some dating from as early as 1612. These were built to protect the Castle Roads Channel and Castle Harbour. Considered to be the keystone of defence, Castle Island contains no less than three separate forts. Southampton Island is also the site of a colonial fort dating back to 1620. The presence of these forts and their importance to the defence of the early capital of



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St George's Town has resulted in these three islands being designated as World Heritage Sites.

There are also at least 14 smaller islands, of less than 1.2 hectares, which are situated in the reserve both east and west of Cooper's Island.

The Castle Islands nature reserve is notable for supporting a diverse range of marine and coastal habitats, including rocky coastal, sandy beach/dune, coral reefs (including boiler and patch reefs), sand flats and sea grass beds. There is some consideration to declare the waters around the Castle Harbour Islands a marine nature reserve.

Access by the public to Castle and Charles Islands is allowed under strict regulations. These include no landing of domestic animals on the islands, no fires, all litter to be taken back off the islands, and no animals or vegetation to be harmed, disturbed or removed. This policy is likely to continue for the present, unless evidence shows that visitors are negatively affecting the island populations of tropicbirds and skinks. The other islands east of Castle Roads Channel are all regulated as restricted-access nature reserves with landing by special permit only. This includes Nonsuch Island and all of the cahow nesting islands. Visitors are allowed to swim or snorkel off the beaches and coastline of Nonsuch, but boats must be moored offshore to prevent accidental introductions. No fishing is allowed within 100 metres of Nonsuch. School and educational tours by qualified and trained guides are allowed during the spring and summer months, with a maximum of 35 people. In addition, there is one 'ecotour' (open to visitors and local residents) per week, weather permitting, catering for a maximum of 25 people.

There are a number of active research and ecological management projects currently being carried out on the Castle Harbour Islands and in the surrounding waters. These include the following.

**Nonsuch Island Living Museum Project:** the restoration of island habitats and their floral and faunal communities to pre-colonial status; under way since 1960 and managed by the Bermuda Department of Conservation Services under the direction of the Terrestrial Conservation Officer.

**Bermuda Skink Survey:** a study to determine population size and distribution, genetics and aspects of breeding biology of the endemic Bermuda Skink;

carried out by a PhD student under the direction of the Bermuda Biodiversity Project.

**Bermuda Turtle Project:** a long-term project (over 30 years) to tag, take morphometric measurements, sex and study genetics of the Green Turtle *Chelonia mydas* in Bermuda, including areas around the Castle Harbour Islands and Cooper's Island.

**West Indian Top Shell Survey:** survey running since 2000 to determine population size, biology and distribution of the West Indian Top Shell *Cittarium pica*, a native inter-tidal gastropod snail extirpated by early colonists and reintroduced successfully to the Castle Harbour Islands in 1984.

### Birds

See the accompanying table for details of key species.

The Castle Islands nature reserve is Bermuda's most important area for nesting seabirds. The entire world population of Critically Endangered Cahows, or Bermuda Petrels, breeds on four islets within the reserve.

In addition, the reserve is the main breeding habitat for 40–45% of Bermuda's population of White-tailed Tropicbirds (local name: the Longtail), representing up to 700 breeding pairs. There are also a small number of Common Terns (two to six pairs), which nest on two of the smaller islets just west of Nonsuch Island.

The endemic race of White-eyed Vireos is found on Nonsuch and Castle Islands, which have the heavier vegetative cover favoured by this species. The Yellow-crowned Night-Heron was reintroduced to Bermuda on Nonsuch Island in the late 1970s. Approximately 25 pairs now nest on Nonsuch and up to six pairs on Grasbury's Island on the east side of Cooper's Island.

### Other threatened/endemic wildlife

Several rare and endemic species of plant occur, including the globally threatened Bermuda Cedar *Juniperus bermudiana* (CR), and the Bermuda Palmetto Palm *Sabal bermudiana* (EN). The endemic Darrell's Fleabane *Erigeron darrellianus*, Bermuda Snowberry *Chiococca bermudiana* and Bermudiana *Sisyrinchium bermudiana* are also found.

The smaller islands in the reserve are managed to exclude invasive alien plant species and support almost pure native plant communities, including several rare species such as Darrell's Fleabane. Most of the larger islands were planted

### Key species

Criteria	Key species	Number of breeding pairs (if known)	Notes
A1, A4ii	Bermuda Petrel <i>Pterodroma cahow</i>	70	Entire world population
A4ii	White-tailed Tropicbird <i>Phaethon lepturus (catsbyii)</i>	700	40–45% of Bermuda's population

with a mixture of ornamental and native species during the 1960s and 1970s. Some of the exotic ornamental species, in particular the Australian Casuarina, or Whistling Pine, *Casuarina equisetifolia* have become invasive and attract roosting European Starlings (themselves an invasive species) from the Bermuda mainland. The starlings release thousands of seeds of the highly invasive Brazil Pepper *Schinus terebinthifolius* from the mainland in their droppings so that they have readily become established. Casuarina and Brazil Pepper are in the process of being removed from Castle, Charles and Nonsuch Islands.

As mentioned above, Nonsuch Island is being managed and restored as a reproduction of Bermuda's pre-colonial plant and animal communities. Much of the island is now covered with a dense, 40-year-old replanted forest of Bermuda Cedar, Palmetto Palm, Bermuda Olivewood, Southern Hackberry *Celtis laevigata*, Yellow-wood *Zanthoxylum flavum*, Bermuda Snowberry, White Stopper *Eugenia auxillaris*, Wax Myrtle *Myrica cerifera*, Jamaica Dogwood *Dodonaea jamaicensis* and Virginia Creeper *Parthenocissus quinquefolia*. Understorey plants growing in the shade of the forest canopy include rare endemic species such as Bermuda Sedge *Carex bermudiana* and Wild Bermuda Pepper *Peperomia septentrionalis*. Coastal areas include such salt-loving native species as Bay Grape *Coccoloba uvifera*, Buttonwood *Conocarpus erecta*, Tassel Plant *Suriana maritima*, Iodine Plant *Mallotonia graphalodes* and Sea Ox-eye *Borrichia arborescens*. Beach and dune areas include Seaside Morning Glory *Ipomoea pes-capre*, Bay Bean *Canavali lineata*, Beach Lobelia *Scaevola plumieri*, Burr Grass *Cenchrus tribuloides* and Scurvy Grass *Cakile lanceolata*. It should be noted that almost all these plants were propagated from seeds and cuttings of native plants obtained from the main island of Bermuda, many barely surviving in tiny pockets of habitat on coastal cliffs, peat marshes and relatively undisturbed cavernous rocky karst topography.

The Castle Harbour Islands are also noteworthy as being the only locations in which the endemic Bermuda Skink, or Rock Lizard, *Eumeces longirostris* (CR), is commonly found. The Skink sometimes peacefully co-inhabits the nesting burrows of Bermuda Petrels. Now rare elsewhere on Bermuda, there is some evidence that the Skink also survives on Cooper's Island, which contains suitable habitat and also holds great promise in any case for restocking or translocation projects with the species.

Good numbers of the endangered Green Turtle *Chelonia mydas* can be seen feeding on sea grass beds around Nonsuch and Cooper's Islands. The Critically Endangered Hawksbill Turtle *Eretmochelys imbricate* is also occasionally seen feeding around the coral reefs.

The West Indian Top Shell *Cittarium pica* is a large inter-tidal gastropod, which was extirpated because of over-exploitation by 1800. It was reintroduced to Bermuda on Nonsuch Island in 1984 and has successfully bred to the point where it has reoccupied much of its original habitat on the south coast of Bermuda. It is listed as a fully protected species, with the largest populations on Cooper's and the other Castle Harbour Islands.

## Conservation issues/threats

The former NASA tracking station on Cooper's Island represents one of the few remaining open spaces in Bermuda and acts as a buffer zone for the critically important offshore islands, thus its importance cannot be over-emphasised. It has no protective designation or status at present, neither is there any security in place except for the chain-link fence remaining from the NASA period. This fence has been breached in several places, with the result that the public is gaining unrestricted access in order to fish, collect land crabs for bait, vandalise buildings and so on. In addition, commercial tour boats and private vessels have been landing on the beaches, with swimming and snorkelling taking place (sometimes involving large numbers of people), around the Cahows' nesting islands. Discussions are currently under way to decide the future development of the area. The Bermuda Government (Ministry of Works & Engineering) and Bermuda Land Development Corporation are interested in developing the area into a hotel/cottage colony. However, Bermuda has the unique opportunity to reclaim the remainder of Cooper's Island as an extension to the current Castle Harbour Islands reserve. There is potential to convert the NASA land and buildings to a National Park and/or nature reserve, resulting in the creation of significant educational and visitor facilities, with associated cultural, environmental and socio-economic benefits.

There is occasional illegal landing on the Cahows' nesting islands, especially the two islands east of, and in close proximity to, Cooper's Island. This has occurred despite the presence of warning signs signifying no landing. This has not generally been a problem on the two western nesting islands, which are more difficult to access and more easily observed from the warden's residence on Nonsuch Island.

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