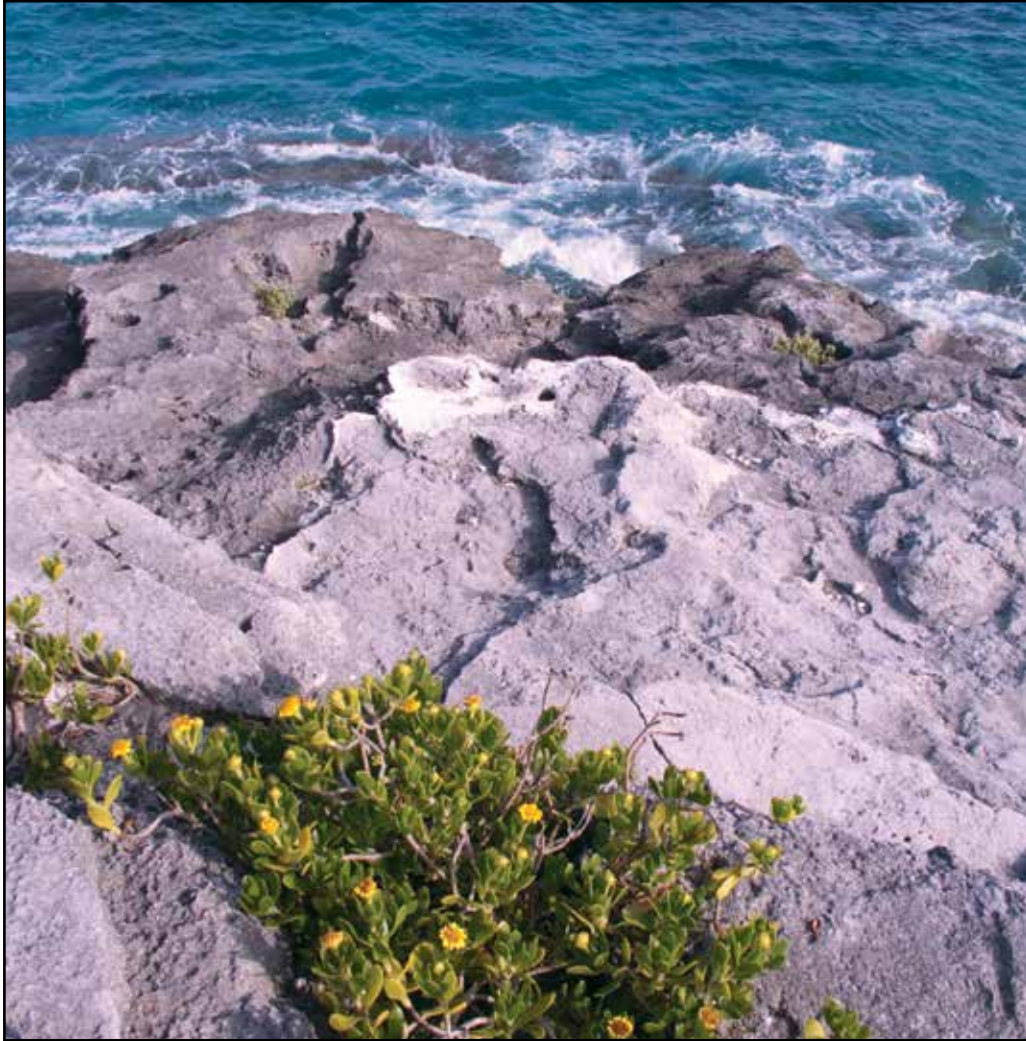


Spittal Pond

NATURE RESERVE GUIDE



THE BERMUDA NATIONAL TRUST



ACKNOWLEDGEMENTS

The Bermuda National Trust thanks AXIS Capital Holding Limited for sponsoring this publication. Some of the images, illustrations and information used in this publication were provided by the following individuals and organizations; their work is greatly appreciated. The Bermuda Zoological Society, Alison Copeland, Lisa Greene, Richard Ground, Susan Harvey, Louise Lamphier, Don Lubin, Michelle Pasquin, J.P. Rouja, Dr. Wolfgang Sterrer, Craig Talbot, Dr. Martin Thomas, Dr. David Wingate and Sharna Yates.



To protect Bermuda's unique natural & cultural heritage forever

Preface

Ever since Bermuda was first settled 400 years ago, its residents have been making an impact on these islands, for better and for worse. They have crafted and built beautiful things...houses, boats, furniture and silver spoons. They have also changed the landscape, using biodiversity-rich marshes as rubbish dumps, importing invasive plant and animal species that threaten the native species, over-developing this narrow strip of land in the ocean. The threat of losing valuable open spaces and historic treasures sparked the creation of the Bermuda Monuments Trust in 1937 by a group of Bermudians who wanted to ensure that future generations would have the opportunity to understand their past. In 1970 the Bermuda National Trust was founded and took over from the Monuments Trust. Since then it has grown to become one of the island's most respected institutions. It is an independent not-for-profit organization which promotes the preservation of the island's architectural, historic and environmental treasures, and encourages public access to and enjoyment of them. Its members and friends are from all walks of life, having in common a love of Bermuda and the desire that its special aspects should be safeguarded for everyone to enjoy now, and forever.

This guide provides information on the importance, history, geography and biology of this very special Bermuda National Trust property. It highlights individual habitats, the most common flora and fauna and offers images which will help you to identify species found within the reserve. We hope that this guide will enhance your visit to our nature reserve and encourage you to visit other Trust properties soon.

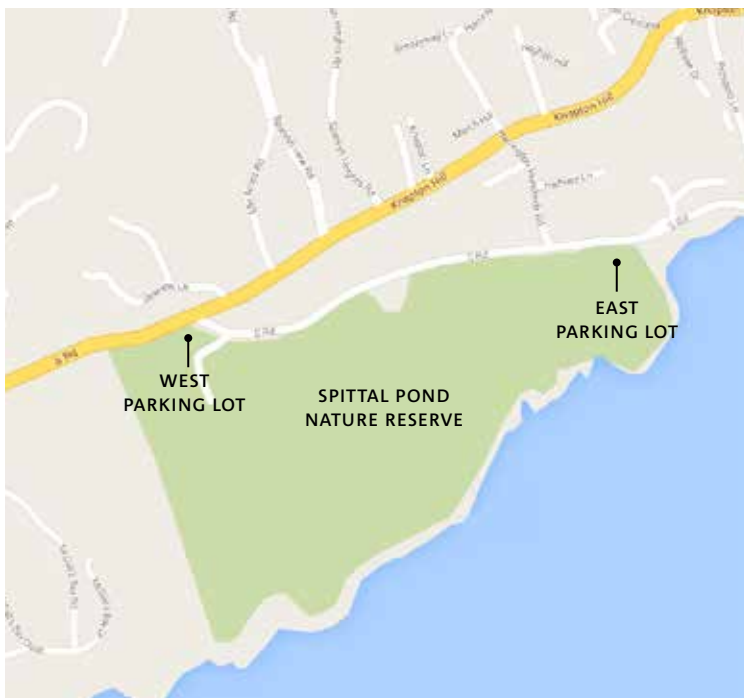
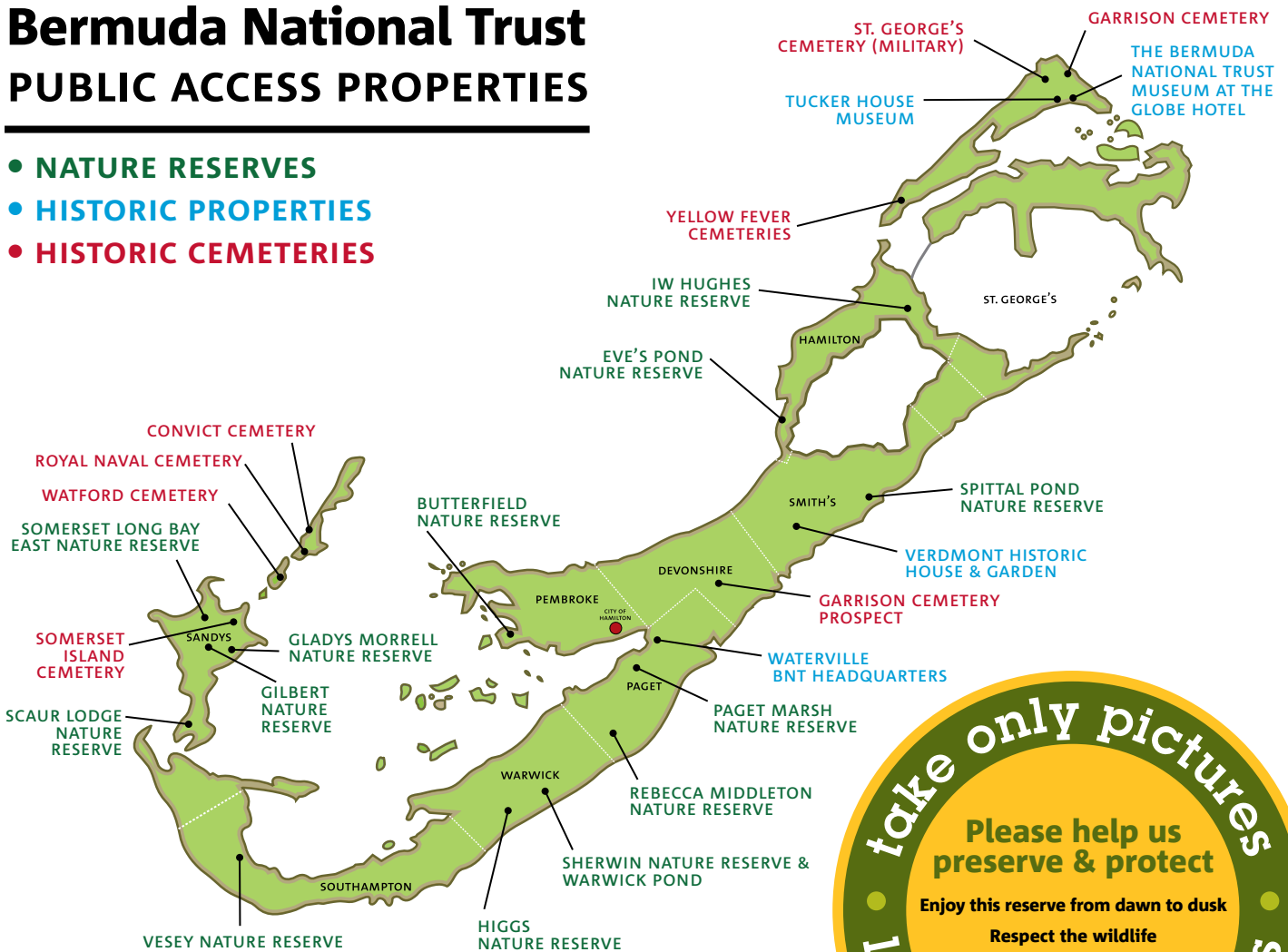
For more information on the Bermuda National Trust, the properties in its care, programmes, events, membership and volunteer opportunities please visit www.bnt.bm or contact us at 441 236 6483.

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Bermuda National Trust PUBLIC ACCESS PROPERTIES

- NATURE RESERVES
- HISTORIC PROPERTIES
- HISTORIC CEMETERIES



Directions

Spittal Pond Nature Reserve is located on South Shore Road in Smith's Parish. If traveling by public transportation, take the Number 1 bus leaving from the City of Hamilton or the Town of St. George's, about a 20 minute trip. See the current (season) schedule that provides the times. The bus stop close to the eastern end of Spittal Pond is a short walking distance to the east car parking area and is one of two entrances to the reserve.

Spittal Pond NATURE RESERVE



AN OCEANFRONT VALLEY ON THE SOUTH SHORE, THIS NATIONAL TRUST property forms the centre of a jointly owned nature reserve of 64 acres. The Bermuda National Trust owns almost 24 acres, the Spittal Pond Bird Sanctuary. The surrounding land, Spittal Pond National Park, is owned by the Bermuda Government, which leases part of it to a dairy farmer. While today it seems obvious that the public should have access to the Trust's portion of the reserve, the decision to create the first trail in 1966 came only after much debate.

In the end, concern about a lack of open space, evident even at that early date, trumped the desire to retain the reserve as an undisturbed bird sanctuary. Balance was achieved by fencing off the core and laying out the trail so that visitors could see every part of the pond, without actually entering the protected area. The pond continues to be of environmental significance and was declared a Ramsar site in 1999 because it is 'Bermuda's most important wetland for wintering waterfowl'.

Spittal Pond Nature Reserve includes a variety of Bermuda ecosystems, ranging from upland forest to coastal shore line. It contains the only salt marsh ecosystem in Bermuda, unique in that it is a spillover marsh flooded by the sea in hurricanes and severe storms. This made it unappealing for development, and is why such a large piece of land in an otherwise desirable location has remained intact. The sea flooding maintains the habitat as open water and mudflats, creating a variation in salinity through the year. Few species can survive in such an environment, although those which can – such as **Wigeongrass** (*Ruppia maritima*) and **Mosquito Fish** (*Gambusia holbrooki*) – flourish due to the richness of the habitat. Some 20 bird species regularly winter at Spittal Pond, while a total of 200 species have been recorded as visitors there.

The reserve also contains some excellent Bermudian geological features. Most notable is the 'Checkerboard Formation', which effectively provides a record of sea level recession from the time of the last interglacial high sea stand around 120,000 years ago. To complete the picture, Spittal Pond boasts two important historic sites, Jeffrey's Cave, where an escaped slave concealed himself, and the well known Portuguese Rock.

In spite of the awareness of its value to the people of Bermuda, it took decades to actually protect Spittal Pond for the public. Original land grants in Bermuda were north/south oriented strips of land, so acquiring the property involved a complex process of buying the 10 strips that make up the area. The first piece, the eastern 4.2 acres was bought in 1946 by founder of the Bermuda Historical Monuments Trust, Dr Henry Wilkinson, and transferred to the Bermuda National Trust in 1973. In 1956, Government purchased the North's Point headland and turned it into a roadside park. Gradually over the years, additional land was added as it became available, and in 1976 the Government transferred the strip incorporating Portuguese Rock to the Trust.

The name Spittal Pond comes from its use as a hospital ('spital) for sick animals or indigent people. Used as a 'grazing commons' over the years, it has also been known as Mangrove Lake and Peniston's Pond. The reserve was badly damaged when it took a direct hit from Hurricane Fabian in 2003. A generous donation by Bermuda residents Richard and Helen Fraser enabled extensive restoration to take place in 2005. The management objectives require that Spittal Pond serves both as a recreation area and a bird sanctuary.



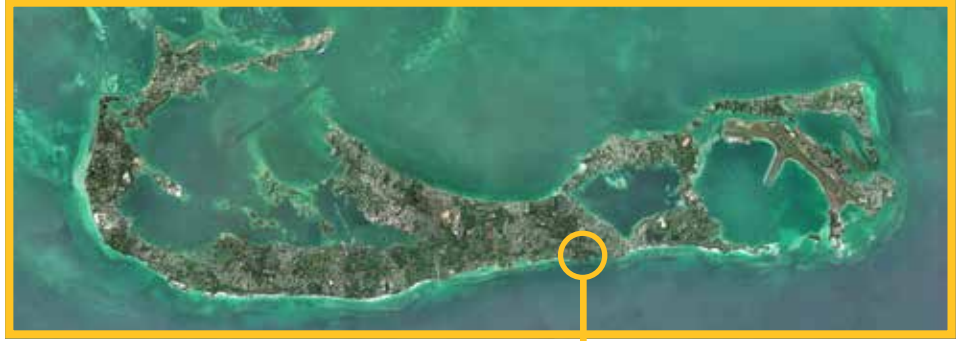
History of the land

Prior to becoming a nature reserve the area was used for a number of activities: Agriculture – celery grew along the pond edge up until the 1920s; Hunting – ducks and other waterfowl were hunted until the 1930s; Military – used as a firing range in the late 1880s until WWI; Cattle – cattle grazing, dairy farm (still present in the western area).

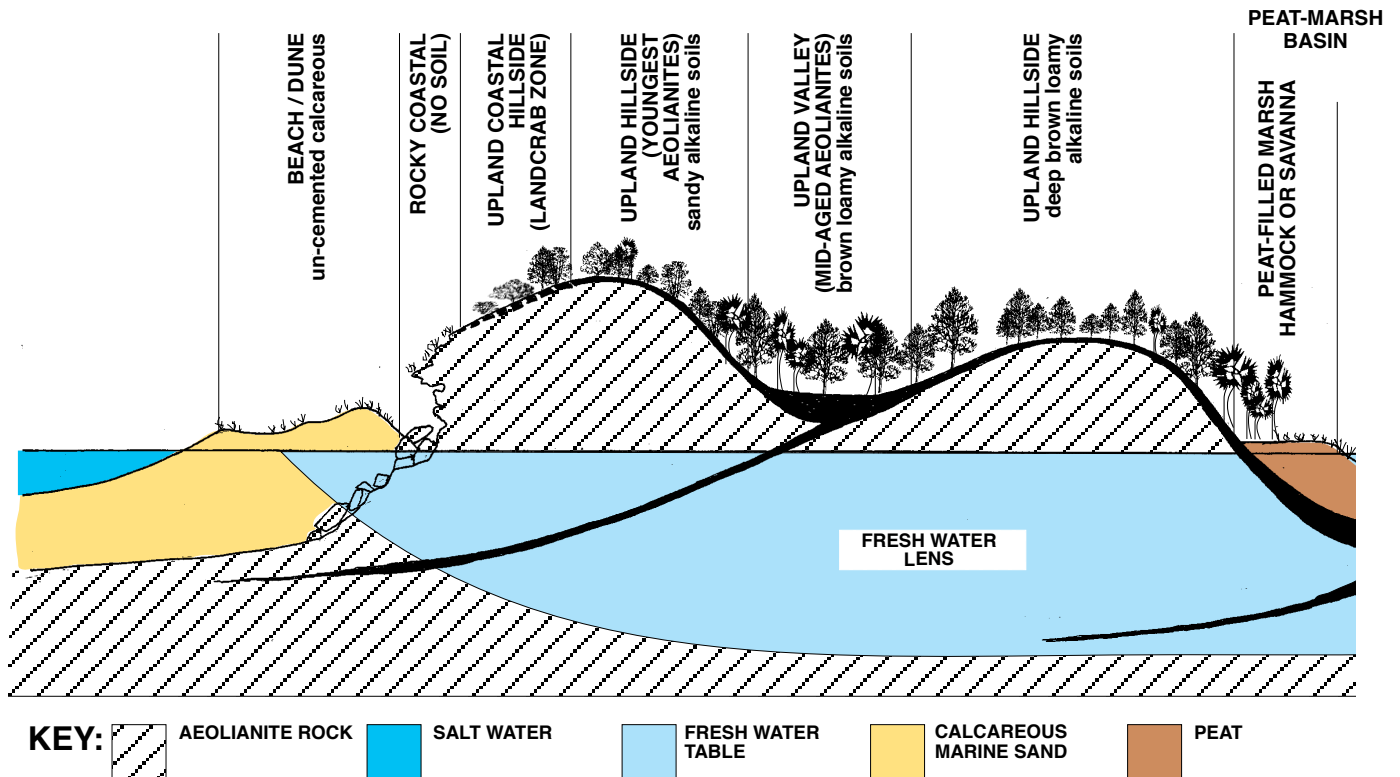
Spittal Pond

Reserve Trail

The reserve can be easily explored by following the well marked loop trail from either the east or west car parks. The trail provides a diverse view of the different habitats, from rocky coast and shoreline to brackish pond and upland forest. Allow at least 2 hours to tour the area. The entire loop is approximately 1.8 km (1.1 mi). Please remember that nature reserves are special areas – please keep your dogs on a leash and keep to the trail to avoid startling wildlife. Never remove plants or animals from a nature reserve.



PHOTOS: © BERMUDA ZOOLOGICAL SOCIETY



History of Woodland Management at Spittal Pond

As late as the 1940s, the hills surrounding Spittal Pond supported a monoculture forest of Bermuda Cedar with Sage Bush as understorey and Buttonwood on the coast.

The invasive cedar scale killed the forest completely by 1953 and exposed the Sage Bushes. Most died out leaving only grass cover and dead trees taken for timber by a contingent from the British Military Garrison at Prospect about 1954-55. A Casuarina forest was planted in their place on hills on the south-east of the pond.

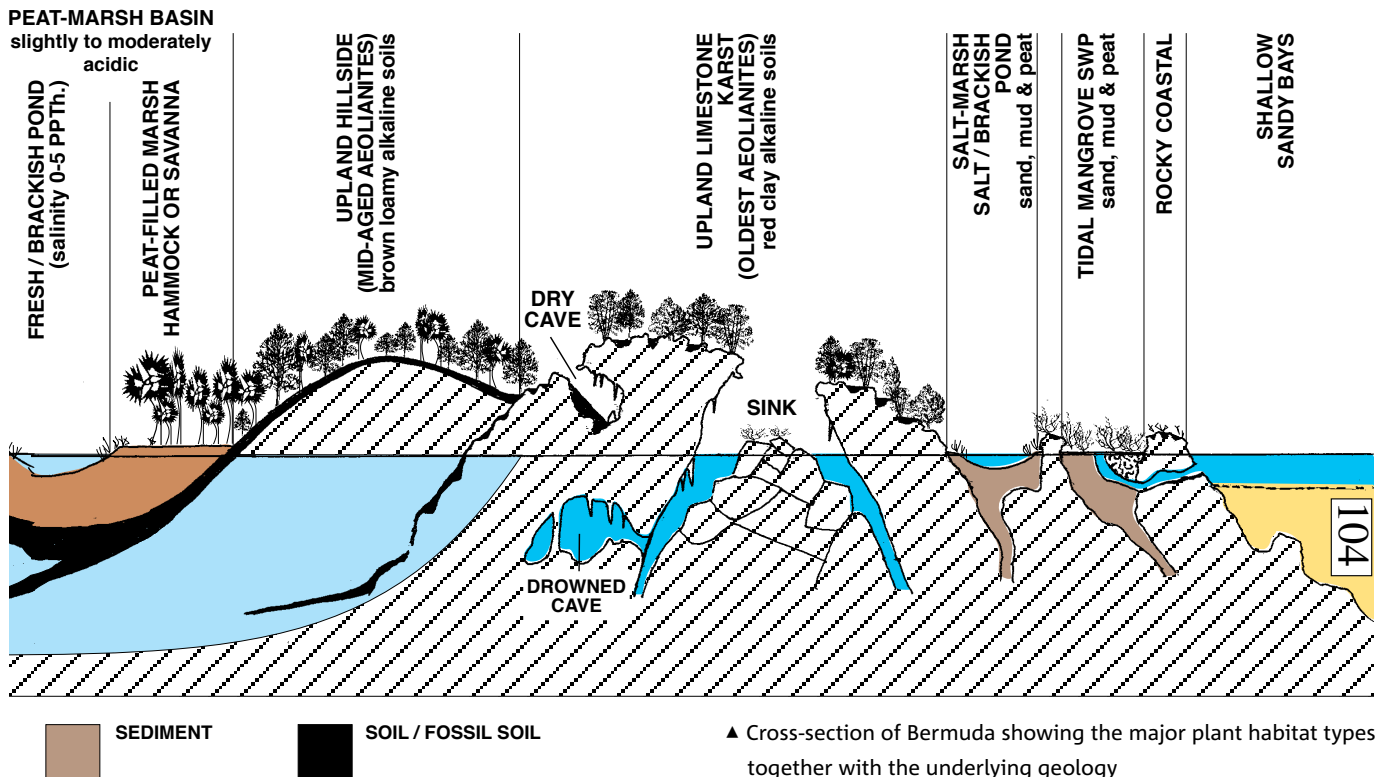
Late in the mid 1960s a wide variety of exotic trees from Tulo Valley nursery stocks were planted on the big western hill, notably Olives, additional Casuarina trees, palms and Indian Almond.

By this time invasive flora like Fiddlewood, Allspice, Brazil Pepper and Chinese Fan Palm was invading throughout, forming new broadleaf woodland.

Following Hurricane Emily in 1987, when tornadoes felled swaths of Casuarinas, two areas of the reserve, notably the deep valley between woodland pond and Portuguese Rock and the east end of the pond below the car park of north point, were cleared of invasives and restored to native woodland with mainly Bermuda Cedar, Bermuda Palmetto, Hackberry, Olivewood and Forestiera.

Additional block clearings and native woodland restoration are planned for the future.

Source: Dr. David B. Wingate, 2012



Definition of Terms

Native: A species which colonised Bermuda naturally without human help. Most arrived long before human settlement and are found in other countries too

Endemic: A native species which has been isolated in Bermuda long enough to have evolved into a unique species

Introduced: A species which is not found naturally in Bermuda, but has been brought here either accidentally or intentionally by humans

Invasive: An introduced self-propagating species which has a tendency to spread rapidly, overwhelming the native and endemic species and/or causing economic damage

Resident: A bird that nests in Bermuda and does not make seasonal journeys off-island

Migrant: A bird that makes regular seasonal journeys to Bermuda from elsewhere for the purpose of feeding or breeding

Vagrant: A bird very rarely seen in Bermuda, probably blown off course

Abiotic Factors: are the non-living factors in an ecosystem that affect the population growth of a species. Such factors include:

- Water (e.g. salinity, oxygen content, level, pollution)
- Soil (e.g. pH, humus content, moisture, depth)
- Sunlight (e.g. light intensity)
- Wind exposure
- Temperature

Biotic Factors: are the living components in an ecosystem. These include members from all five kingdoms – plants, animals, bacteria, fungi and protists. The members of an ecosystem live in dynamic interaction with each other and with their environment. Hence, one species may affect the population growth of another species through:

- Competition with other species
- Predation
- Grazing by herbivores
- Food supply
- Population density
- Symbiotic relationships (e.g. where several organisms depend on each other)
 - Symbiotic relationships include:
 - Mutualism:** in which each organism benefits
 - Parasitism:** in which one organism benefits and the other is generally harmed
 - Commensalism:** in which one organism benefits whilst causing little or no harm to the other
 - Disease**

Appreciating Our Open Spaces

In order to appreciate and take care of our open space, we need to understand what space is available, how it is being used, why it is important to maintain open space and what threats impact the environment.

Land usage in Bermuda as of 2008

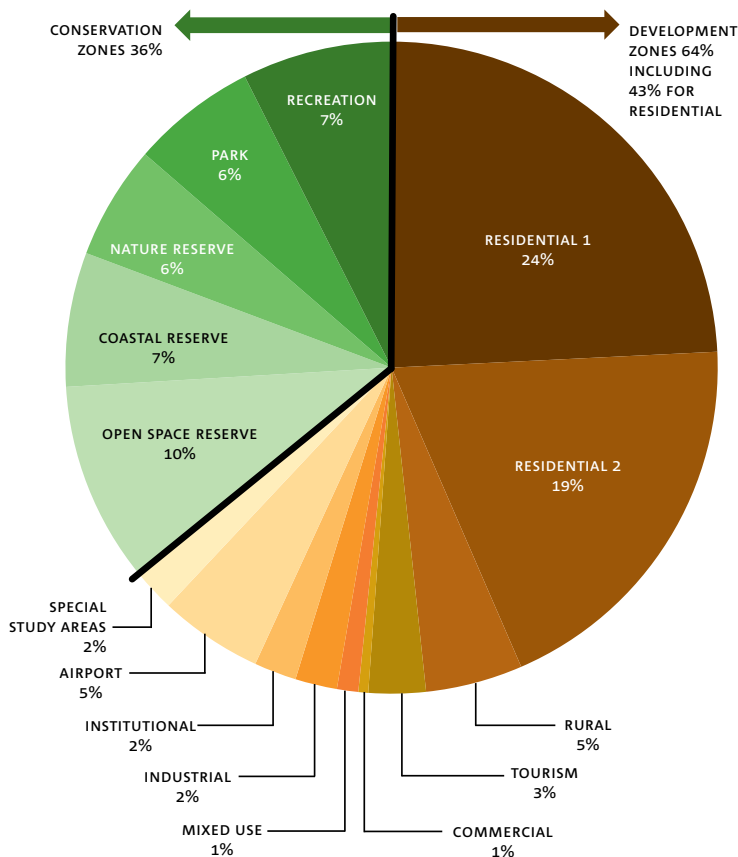
The chart below shows a breakdown of how Bermuda's land is used.

Conservation Zones totalled = 36%

- 10% Open space reserve
- 6% Parks
- 7% Reserves - coastal
- 6% Reserves - nature
- 7% Recreation

Development Zones totalled = 64%

- | | |
|------------------|--------------------|
| 5% Airport | 5% Rural |
| 1% Commercial | 2% Special studies |
| 2% Industrial | 1% Mixed use |
| 2% Institutional | 3% Tourism |
| 43% Residential | |



Open Space is Important Because

- Natural beauty attracts visitors and encourages tourism
- It provides recreational areas such as sports and playgrounds
- As amenity space, it enhances our psychological well-being
- It maintains our unique biodiversity

Threats to Terrestrial Habitats

The key threats to terrestrial habitats in Bermuda are:

- Domination of existing open space by invasive species
- Loss of open space through development

The reasons for development include:

- Economic growth
- Housing
- Other individual requests – pools, large houses, upscale condos, driveways

Other threats to the environment include:

- Pollution
- Littering
- Vandalism
- Natural causes such as erosion and storm damage

It is every citizen's responsibility to protect the natural environment wherever we are in the world so that future generations will have clean air to breathe, unpolluted and abundant food, and water and energy sources


Sources: The Bermuda Zoological Society and the Bermuda Aquarium, Museum and Zoo, *Bermuda Biodiversity Country Study*, Bermuda, 2001, Bermuda Department of Planning – Forward Planning Branch, 2008

Spittal Pond's Habitats

Spittal Pond Nature Reserve contains unique habitats. Bodies of water include a large brackish pond combined with a salt marsh, a freshwater pond, and a brackish woodland pond. The freshwater and woodland pond are man-made. Upland and coastal hillside areas are dispersed throughout along both sides of the ponds. The rocky coast with its cliffs and tidal pools represents another distinctive habitat. Small mangrove areas are beginning to grow in at the east end of the pond.



Know Your Terms



NATIVE: Species which colonised Bermuda naturally without human help. Most arrived long before human settlement and are found in other countries too

ENDEMIC: A native species which has been isolated in Bermuda long enough to have evolved into a unique species

INTRODUCED: A species which is not found naturally in Bermuda, but has been brought here either accidentally or intentionally by humans

INVASIVE: An introduced self-propagating species which has a tendency to spread rapidly, overwhelming the native and endemic species and/or causing economic damage

RESIDENT: A bird that nests in Bermuda and does not make seasonal journeys off-island

MIGRANT: A bird that makes regular seasonal journeys to Bermuda from elsewhere for the purpose of feeding or breeding

VAGRANT: A bird very rarely seen in Bermuda, probably blown off course

Brackish & Freshwater Ponds

Bermuda does not have extensive freshwater habitats. There are several reasons for this. First the islands are just too small, secondly the soil and underlying rocks are very porous, allowing quick drainage and thirdly saltwater is likely to enter any freshwater as saline rain, splash, spray or percolation through underlying rocks. This means that most freshwater bodies have some salt content at least at times. Freshwater with small additions of salt is termed brackish. Permanent or temporary brackish conditions exclude many freshwater organisms.

The Main Pond

The submerged valley of Spittal Pond is filled to within one foot or so of water surface with sandy sediment and diatomaceous mud that essentially seals off the pond from saltwater seepage through the porous limestone from the adjacent seashore. Hence, it is almost non-tidal and tends to become less and less brackish with rainwater and rain runoff in between periods of flooding from storm surge and waves in hurricanes and winter storms. Hurricanes can turn it temporarily into a saltwater bay. At the other extreme, summer droughts can lower the pond level by evaporation, exposing the sediment as extensive mudflats. These mudflats then attract a host of migrating shorebirds or sandpipers from July through September.

Most ponds are brackish at some time, but some are permanently so. The best example of a brackish pond is the large pond at Spittal Pond Nature Reserve. It is the most important wildfowl habitat in Bermuda. This body of water is intermediate between fresh and saltwater ponds. A sluice gate was installed in 1979 to control the level of pond pollution from the runoff of the nearby dairy farm, allowing flushing of the pond with new oxygen-containing water. Salinity levels fluctuate because heavy rains dilute the salt, while storms bring new sea water in. Evaporation and opening of the gate increased salinity. Since 1990 the gates have not been in operation and the dairy farm

is managed differently, keeping the cows away from the pond edge. The **Mosquito Fish** (*Gambusia holbrooki*), which were introduced to Bermuda in the 1928 to combat the mosquito population which had spread yellow fever, can tolerate high salinity. Stress from organic pollution is derived from the dairy farm along the pond's north shore. Spittal Pond is a very unstable, stressed location and in consequence its biodiversity is very low and mass mortalities of some resident organisms are common.

In the water are masses of **Widgeon Grass** (*Ruppia maritima*), a submerging flowering plant typical of brackish water and the pond is surrounded by a border of **Sheathed Paspalum** (*Paspalum vaginatum*). Aside from the large numbers of Mosquito Fish, little else in the way of higher organisms can be seen although **American Eels** (*Anguilla rostrata*) are present in winter and species of snails are periodically abundant. Aquatic insects such as the **Water Strider** (or pond skaters) can be seen 'walking on water' in search of other insects. Beneath the surface small **Water Boatman** (*Trichocorixa reticulata*) are highly active and swimming in large clusters. The sediment contains countless shells of small brackish water ostracods, which attest to their occasional abundance.

In warm weather large pink, grey or bright blue patches of the **Sulphur-Reducing Bacteria** are very common and a sulphurous smell may be present. Whenever you detect a sulphurous smell in nature, you can safely assume that the oxygen content in that environment is very low. Since almost all living organisms need oxygen, this makes life difficult. Mosquito Fish can handle this situation because they can breathe atmospheric air. Sulphur-Reducing Bacteria are an example of a life-form that does not require oxygen – they use anaerobic respiration. The pond is very unstable and this makes it difficult for marine organisms to colonise it. It shows the lowest biodiversity among Bermuda saltwater ponds.



Eastern Mosquito Fish
Gambusia holbrooki
INTRODUCED



American Eel
Anguilla rostrata **NATIVE**



Sheathed Paspalum Grass
Paspalum vaginatum **NATIVE**



Sulphur-Reducing Bacteria at the pond's edge

Fringing Salt Marsh

A salt marsh fringes the large pond and is different from other salt marshes in that it does not have a tidal connection with the sea. Instead it gets seawater from spillover during storms. The salinity of the pond averages about half that of seawater, but, as already explained, it is very variable, ranging from almost fresh to saltier than the sea at different times, depending on the weather. It can show higher salinity than the sea if an incident of marine inundation is followed by a hot, dry period that causes high rates of evaporation.

Mangroves



Black Mangrove *Avicennia germinans* **NATIVE**

Small areas of **Black Mangroves** (*Avicennia germinans*) are growing along the edge of the large pond on the eastern side. The Black Mangrove looks more like a tree than the spidery **Red Mangrove** (*Rhizophora mangle*). It has silvery green leaves and a dark trunk and can grow to 30-40 ft tall. If you look closely at the leaves of the Black Mangrove, you may see crystals of salt on the surface. This is one of the ways the Black Mangrove has adapted to live in a saltwater environment that would kill other plants.

The trees are able to take up saltwater, use the water, and expel the salt out onto their leaves. Another way the Black Mangrove has adapted to its environment is by having roots that poke up out of the sediment instead of growing into it. These roots are called pneumatophores, which mean 'air breathing roots'. All plants need to breathe, so the Black Mangrove has developed these roots that act like snorkels, allowing the tree to get air, even though it is standing in seawater or soggy mud.

Black Mangroves have white flowers in spring and summer, followed by green lima bean-like shaped seeds. The seeds fall off the plant and float on the surface of the ocean and sprout when they are washed up on suitable a shoreline. Unlike the Red Mangrove, Black Mangrove seeds do not grow in the water, so Black Mangroves are usually found higher up the shore than Red Mangroves. Black Mangroves are native to Bermuda, the Southern United States and the West Indies. Bermuda is the northern-most place on the Atlantic Ocean where this species is found. Other plants in the salt marsh include: **Sheathed Paspalum** (*Paspalum vaginatum*), **Sand Spurry** (*Spergularia marina*), **Seaside Heliotrope** (*Heliotropum curassavicum*), **Seaside Purslane** (*Sesuvium portulacastrum*), and the invasive **New Zealand Spinach** (*Tetragonia tetragonioides*).



Black mangrove seed



Leaf & flower



Pneumatophores



Salt crystals on leaf

Freshwater & Woodland Ponds

Spittal Pond Nature Reserve contains two small man-made ponds in depressions between the main pond and the shore. One is a freshwater pond and the other is referred to as the woodland pond and has a connection with ocean water. The western pond is freshwater and the eastern or woodland pond is brackish. Both ponds are a very important habitat for resident and migratory waterfowl; compared to ponds elsewhere, species diversity is very low.

Forests

History of Upland Forest (Hillside)

Very little is known about the composition of the first forests in Bermuda. They were likely to have developed under different climatic conditions than experienced today. The trees of upland forests left little fossil remains, except perhaps the pollen deposited in swamps and ponds and preserved in sediments. Unfortunately, little of this 'pollen record' has been investigated to date. The records of the first explorers and settlers provide the best possible information available. What is known is that with the arrival of man the forests went into a rapid decline. There were several reasons for this.

- Pigs released by New World explorers on many of the larger islands rooted through the forests for food, disrupting natural regeneration and decimating the ground layer of delicate herbs, ferns and mosses.
- Rats from vessels also invaded most of the islands and started eating the seeds of forest species.
- Man contributed to the decline by clearing and burning for agriculture and harvesting several useful tree species for timber and later cutting huge areas of forest for housing and business.
- Ornamental gardens were planted and a further destructive series of changes happened due to competition and displacement by invasive plants, insects, pests and diseases.

The end result of all this is that out of all the natural habitats in Bermuda, the upland forest is the most changed. Little remains of the original forest and there are only scattered remnants that are richer in the original species than others. Not surprisingly, these remnants are in difficult terrain or on islands where pigs and rats did not become established.

Some of the original trees reaching Bermuda evolved into distinct new species after they started to grow and reproduce here; these are the endemic species that occur naturally nowhere else but Bermuda. Two examples are the **Bermuda Cedar** (*Juniperus bermudiana*) and the **Bermuda Palmetto** (*Sabal bermudana*). There is little doubt that these two trees dominated the original forest. Both were useful to man and their presence was therefore well documented. Another tree, the **Bermuda Olivewood** (*Cassine laneana*) also evolved in the Bermudian forests. This tree was probably never dominant in any forest but scattered among the cedars, palmettos and native trees; its bark was used for tanning by early settlers. As the forest became established, a unique new habitat was created under the trees and other species evolved in this damp, stable environment. Examples of these are the **Bermuda Sedge** (*Carex bermudiana*), the moss **Bermuda Trichostoma** (*Trichostomum bermudanum*), the **Bermuda Maidenhair Fern** (*Adiantum bellum*) and the shrub **Bermuda Snowberry** (*Chiococca bermudiana*).



Bermuda Cedar **ENDEMIC**
Juniperus bermudiana



Male Cedar showing pollen



Female Cedar showing berries

PHOTOS: DEPARTMENT OF CONSERVATION SERVICES



Palmetto **ENDEMIC**
Sabal bermudana



Palmetto leaf & seeds



Olivewood **ENDEMIC**
Cassine laneana



Bermuda Sedge **ENDEMIC**
Carex bermudiana



Bermuda Maiden-Hair Fern **ENDEMIC**
Adiantum bellum



Bermuda Snowberry **NATIVE**
Chiococca bermudiana

Native species are those that arrived in Bermuda by natural means but remain essentially identical with their forebearers elsewhere. Thus they arrived by the same means as the endemics; by the ocean, wind, or transported on bodies of or in the intestines of migrating or windborne flying creatures. The difference with native species is that they did not evolve into a new species. Several native species important in the original forest never form large trees and are usually classified as shrubs. These are **Forestiera** (*Forestiera segregata*), **White Stopper** (*Eugenia axillaris*) and **Jamaica Dogwood** (*Dodonaea visosa*). These shrubs growing up to 7m or 20ft in height probably formed what is called the understory, growing beneath the canopy of the larger trees.



Forestiera **NATIVE**
Forestiera segregata



White Stopper **NATIVE**
Eugenia axillaris



Jamaica Dogwood **NATIVE**
Dodonaea viscosa

Forest Plants & Animals Today

The plants and animals of the Bermuda forests, commonly termed the 'forest biota', are made up of a wide variety of ecological groups. Some are typical forest species that live nowhere else. Others are from a broader ecological group of organisms which are found in a variety of habitats but can tolerate forest conditions. This latter group can be expected to frequent forest edges rather than the deep recesses of woodland. Quite a few of the animals are not by any means permanent forest dwellers but move in and out seasonally, in migration or when certain food sources become available. Some birds use forest habitat as a protected nesting site, but feed elsewhere. The forest is a highly structured system that has habitats within it that are extremely stable.

As mentioned before, clearing, grazing and invasive species have radically changed the upland forest. A management programme exists to protect and restore these areas to their native state. The native fauna originally consisted of land snails, birds and skinks but has been altered by the presence of introduced species – frogs, lizards and toads. The forest habitat is still an important site for birds. The structure of these woodlands will depend on whether it is hillside or valley, distance to the sea, the history of land use and human disturbance.

Spittal Pond's upland forest as well as other forests in Bermuda is strongly dominated by introduced trees. This area is characterised by plants that prefer deep, nutrient rich soils and protection from high wind and salt spray. The main two species in this group are the **Fiddlewood** (*Citharexylum spinosum*) and the **Allspice** (*Pimenta dioica*) although the **Brazil** or **Mexican Pepper** (*Schinus terebinthifolius*) has also become very common in recent years. An introduced shrub, the **Surinam Cherry** (*Eugenia uniflora*) now dominates many areas that were originally treed forest. All of these species, although introduced, have become naturalised. This means that they reproduce naturally in the wild and are now widespread.



Fiddlewood *Citharexylum spinosum*
INTRODUCED
NATIVE



Allspice *Pimenta dioica*
INTRODUCED
NATIVE



Brazil Pepper *Schinus terebinthifolius*
INTRODUCED
INVASIVE



Surinam Cherry *Eugenia uniflora*
INTRODUCED
INVASIVE



Warwick Lizard *Anolis leachii*
INTRODUCED



Marine/Cane Toad *Bufo marinus*
INTRODUCED



Marine/Cane Toadlets

Diseases & Pests



PHOTO: DAVID WINGATE

Spittal Pond after cedar blight, 1958

It is not only the introduced species outcompeting the native and endemic ones which are a problem but also diseases and pests arriving on introduced species and spreading to endemic ones. The best examples of this are the **Oystershell Scale** (*Insulaspis pallid*) and the **Cedar Scale** (*Carulapis minima*) both of which attacked the Bermuda Cedar. The scale insects are tiny creatures that are protected by a shell-like covering. They feed on plant sap and spread virus diseases. The Oystershell Scale was introduced in 1940 and the Cedar Scale probably in 1942, both on ornamental junipers closely related to the Bermuda Cedar. By 1949 over

15,000 dead cedar trees had been cut down; by 1953, 90% of the island-wide population was dead. A total of over 3 million trees had been lost because of the Cedar Scale. Fortunately, some of the surviving Bermuda Cedars had some resistance to the scale and others have been bred from these. Today the Bermuda Cedar is being reintroduced on a wide scale and in places is quite common. Another scale insect, the **Palmetto Scale** (*Comstockiella sabalium*), introduced on ornamental palms, attacked the endemic Bermuda Palmetto but its effects have, fortunately, not been as severe as with the Cedar Scale.

Upland Coastal Hillside

The flora of sheltered coastal areas more closely resembles that of Upland Forests with some salt intolerant species. Pre-settlement species included endemics such as Bermuda Cedar and Bermuda Palmettos, as well as natives such as **Bay Grape** (*Coccoloba uvifera*) and **Buttonwood** (*Conocarpus erectus*). Unfortunately invasive species such as the Brazil Pepper and Casuarina are now invading this habitat as well, significantly changing woodland composition.

The Coastal Forest habitat suffers similar stresses, but there is more soil, providing for a more diverse plant community. In general, the plant adaptations are the same as the rocky coast, as seen in the **Spanish Bayonet** (*Yucca aloifolia*) and **Prickly Pear** (*Opuntia stricta* var *dillenii*), both native. However, less specifically adapted plants are also found, such as the **Seaside Goldenrod** (*Solidago sempervirens*) and **Lantana** – also known as **Common Sage** (*Lantana involucrata*).

The sheer cliff affords many crevices suitable for the nests of the **White-tailed Tropicbird**, **Longtail** (*Phaethon lepturus catesbyi*), which breeds in Bermuda between May and September. During the winter months it stays at sea, resting on the water and sleeping on the wing.



Seaside Goldenrod **NATIVE**
Solidago sempervirens



Bay Grape **NATIVE**
Coccoloba uvifera



White-tailed Tropicbird **NATIVE**
Phaethon lepturus catesbyi

Bermuda's forests play such a vital, if largely unappreciated role, in the maintenance of the high quality of life and standard of living enjoyed by Bermudians. Not only do woodlands support the lifecycles of Bermuda's native and endemic flora and fauna, they also:

- Protect structures and farmlands against salt laden ocean winds and storms
- Provide shade and reduce temperature
- Reduce rapid storm water runoff
- Minimize rainwater evaporation
- Increase soil fertility
- Absorb and store carbon dioxide
- Filter dust and pollution from the air
- Provide life-giving oxygen
- Provide aesthetically pleasing settings
- Provide camouflage and screen development and help to reduce traffic noise
- Provide recreational and educational opportunities and amenity value to locals and visitors

The Rocky Coast

The rocky coastal zone is defined as the area between the high tide line and the beginning of significant soil cover. It grades into the coastal hillside zone where patches of soil and ground cover plants become continuous. While freshly eroded limestone is the same colour as beach sand, after several years of exposure the surface assumes a blackish gray colour. This is caused by colonisation of the rock surface by a blue-green algae. Key indicator plant species in this zone are **Sea Oxeye** (*Borrchia arborescens*), a fleshy leaved shrub which grows to 2' tall; **Coast Spurge** (*Euphorbia buxifolia*), a tiny leaved shrub which grows prostrate in rock depressions; and **Buttonwood** (*Conacarpus erecta*), a woody shrub which grows prostrate over the rocks but is capable of growing to bush or tree size where sheltered from wind and salt spray. The fauna of this zone includes 3 supra-littoral snails, most notably the **Beaded Periwinkle** (*Tectarius muricata*), and the **Sally Lightfoot** (*Grapsus grapsus*), which ranges up into this zone from the intertidal zone at night to shed its shell when growing larger. Deep sandy crevices in the cliffs are home to the now rare endemic **Bermuda Skink** or **Rock Lizard** (*Pleistodon longirostris*), which feeds on insects or carrion in the form of dead fish or broken seabird eggs. The **Longtail**, scientifically known as the **White-tailed Tropicbird** (*Phaethon lepturus*), returns from the surrounding ocean in March to nest in deep sandy floored cavities and erosional crevices in the cliffs where it lays its single reddish brown egg from April to June and rears the chick on fish and squid caught far at sea between June and August. Some late starting nesters may still be feeding a fledgling as late as mid November. Unfortunately, feral **Rock Doves** or **Pigeons** which feed at the nearby dairy farm are now competing with the longtails for those coastal cliff nest sites and storm waves in early season hurricanes occasionally wash out the nestling longtails as well.

Access to the rocky coastal zone is possible from the nature trail system at three points in the reserve. The first is the low lying area at east end of the pond where the sea floods in during storms. Here large blocks of fractured cliff rock lie scattered over the ground surface attesting to the power of hurricane waves that deposited them there. The second area is accessed by the steep trail up to the Portuguese Rock inscription site and then westward past Jeffrey's Cave to the saddle between hills where the trail turns inland again. The third area is the Checkerboard at the south west corner of the pond, another hurricane flood zone where large wave-washed boulders are scattered well inland.



Seaside Oxeye *Borrichia arborescens* NATIVE



Coast Spurge *Euphorbia mesembrianthemifolia* NATIVE



Buttonwood *Conocarpus erectus* NATIVE



Beaded Periwinkle *Tectarius muricatus* NATIVE



Sally Lightfoot *Grapsus grapsus* NATIVE



Bermuda Skink *Pleistodon longirostris* ENDEMIC



White-tailed Tropicbird *Phaethon lepturus catesbyi* NATIVE



White-tailed Tropicbird Brooding



White-tailed Tropicbird Chick in nest

Boiler Reefs

Off the rocky coast of Bermuda's south shore, boiler reefs are visible as the ocean swells break over them. They are not made of coral like most reefs but are produced by biological processes from calcareous worm shells and algae. They are very strong and shaped like a wine glass, the stem being under water. These reefs play the important role of lessening the force of the Atlantic on Bermuda's south shore, which is particularly vulnerable to erosion from wave action. The Boiler Reefs can be seen easily from Portuguese Rock.



Tidal Pools



West Indian Chiton *Chiton tuberculatus* NATIVE

The path through the wildlife sanctuary at Spittal Pond Nature Reserve provides access to the south shore at several points. The best location is probably one near to the eastern gate, since it has fairly easy littoral gradients, but it is not as exposed as the Checkerboard near the western boundary of the reserve. However this second site is more difficult to study due to vertical drops of over 1m in several spots. It is however, more varied, has higher species richness and also has excellent tidal pools. The more westerly site has large populations of a **Rock-burrowing Urchin** (*Echinometra lucunter*). This site in particular is dangerous when waves from the south are breaking. Even in a north wind, southerly swells may make the intertidal inaccessible. Look in tidal pools for fish, **West Indian Chiton** (*Chiton tuberculatus*), **West Indian Top Shell** (*Cittarium pica*) and **Vermetid worms** (*Vermetidae*), with irregularly coiled gastropod shells.

Birds at Spittal Pond

Spittal Pond is Bermuda's main refuge for migratory waterfowl and is therefore a very important bird sanctuary. The ponds provide a feeding ground for waterfowl in the winter and for shorebirds during the fall migration. Over 350 species of birds have been recorded in Bermuda, but there are only 20 resident species. This reserve is known as one of the most interesting, diverse and compact waterfowl sanctuaries in the world. It also has resident **Mallards** (*Anas platyrhynchos*), **Yellow-crowned Night-Herons** (*Nyctanassa violacea*) and **Common Moorhens** (*Gallinula chloropus*). The Mallards are dabbling ducks, which feed by tipping tail-up to reach aquatic plants, seeds and snails. There are a number of oddly coloured hybrid pairs. The Common Moorhens are distinguished from the **American Coots** (*Fulica americana*) by their red forehead shields and yellow-tipped red bills. The Coots' bills are white with a dark band near the tips and they often appear in large numbers during the fall migration. Yellow-crowned Night-Herons feed nocturnally on the common **Red Land Crabs** (*Gecarcinus lateralis*). Please respect the privacy of the birds and be as quiet as possible while observing them in their daytime roosting site in the small woodland pond. It's there that you may see the Moorhens, which tend to silently glide in and out of the trailing plants and fallen trees at the pond's edge. They can also be found feeding around the edge of the main pond.



Mallard **RESIDENT**
Anas platyrhynchos



Yellow-crowned Night-Heron **RESIDENT**
Nyctanassa violacea



Common Moorhen **RESIDENT**
Gallinula chloropus



American Coot **MIGRANT**
Fulica americana



Red Land Crab **NATIVE**
Gecarcinus lateralis

Spring to Summer

The spring migration, unlike the fall, sees only stray birds here, as they tend to migrate north in high pressure cells, which generally steer them well away from Bermuda. However, you may spot **Eastern Kingbirds** (*Tyrannus tyrannus*), **Chimney Swifts** (*Chaetura pelagica*), **Belted Kingfishers** (*Megaceryle alcyon*), **Cedar Waxwings** (*Bombycilla cedrorum*) and at least twelve species of warbler. Of course, you will enjoy the spring serenade of local birds, especially the bright scarlet male Cardinals. You might see a summering **Snowy Egret** (*Egretta thula*) or a **Ring-necked Duck** (*Aythya collaris*).

Bermuda's harbinger of the spring season is the White-Tailed Tropicbird or Longtail. The early settlers called them 'Bosun Birds'. They come to Bermuda each year in spring to breed and leave again to go south for the winter. Peak viewing times are during the morning. You can watch these beautiful black and white seabirds perform their graceful aerial courtship just offshore. Bermuda is the northernmost breeding area for them. Spittal Pond's cliffs are one of the best places to see these native birds courting and feeding close to the surface of the water. Unfortunately, their nesting sites along our cliffs are being usurped by feral pigeons. Many have also been destroyed by storm damage. Sadly, the 2000 statistics show the numbers of their young down from previous years.



Eastern Kingbird *Tyrannus tyrannus* **MIGRANT**



Chimney Swift *Chaetura pelagica* **MIGRANT**



Belted Kingfisher *Megaceryle alcyon* **MIGRANT**



Cedar Waxwing *Bombycilla cedrorum* **MIGRANT**



Snowy Egret *Egretta thula* **MIGRANT**



Ring-necked Duck *Aythya collaris* **MIGRANT**

Fall

During the fall, shorebirds arrive as early as July and will be seen throughout the season as long as the water level is not too high. Regular species include **Greater Yellowlegs** (*Tringa melanoleuca*) and **Lesser Yellowlegs** (*Tringa flavipes*), **Spotted Sandpipers** (*Actitis macularia*) and **Solitary Sandpipers** (*Tringa solitaria*), **Semipalmated Sandpipers** (*Calidris pusilla*) and **Least Sandpipers** (*Calidris minutilla*). Migrant warblers tend to arrive from mid-August with the largest influx in September and early October. Other arrivals include herons and egrets, swallows and martins (especially over the farm), migrant vireos, grosbeaks and buntings.

The margins of the pond are important for herons and egrets. You may recognise the **Great Blue** (*Ardea Herodias*), **Little Blue** (*Egretta caerulea*), **Green** (*Butorides virescens*) and **Tri-couloured Herons** (*Egretta tricolor*), **Great** (*Ardea alba*), **Snowy** (*Egretta thula*) and **Cattle Egrets** (*Bubulcus ibis*) are often seen feeding during the day and some roost here at night. **American Bittern** (*Botaurus lentiginosus*) are often recorded in the fall standing well camouflaged between the grass at the edge of the pond. **Merlin** (*Falco columbarius*) is the most frequently observed bird of prey.



14" TALL

Greater Yellowlegs **MIGRANT**
Tringa melanoleuca



10-11" TALL

Lesser Yellowlegs **MIGRANT**
Tringa flavipes



Spotted Sandpiper **MIGRANT**
Actitis macularia



Solitary Sandpiper **MIGRANT**
Tringa solitaria



Semipalmated Sandpiper **MIGRANT**
Calidris pusilla



Least Sandpiper **MIGRANT**
Calidris minutilla



Great Blue Heron **MIGRANT**
Ardea herodias



Little Blue Heron **MIGRANT**
Egretta caerulea



Green Heron **RESIDENT**
Butorides virescens



Tricolored Heron
Egretta tricolor **MIGRANT**



Great Egret
Ardea albus **MIGRANT**



Snowy Egret
Egretta thula **MIGRANT**



Cattle Egret **MIGRANT**
Bubulcus ibis



American Bittern **MIGRANT**
Botaurus lentiginosus



Merlin **MIGRANT**
Falco columbarius

Winter

In the winter you may observe **Pied-billed Grebes** (*Podilymbus podiceps*). These small brown waterbirds are found in much of North America. They have a fascinating defence mechanism – submerging ‘submarine fashion’ when alarmed. Also during the winter you might see **Blue-winged Teal** (*Anas discors*), **Ringed-necked Duck** (*Aythya collaris*) or **Lesser Scaup** (*Aythya affinis*), **American Duck** (*Anas rubripes*) or **Hooded Merganser** (*Lophodytes cucullatus*).



Pied-billed Grebe **RESIDENT**
Podilymbus podiceps



Blue-winged Teal
Anas discors **MIGRANT**



Ring-necked Duck
Aythya collaris **MIGRANT**



Lesser Scaup **MIGRANT**
Aythya affinis



American Black Duck **MIGRANT**
Anas rubripes



Hooded Merganser **MIGRANT**
Lophodytes cucullatus

Woodland Birds

Resident birds in the woodland areas of this park include the **Mourning** (*Zenaida macroura*) and **Ground Doves** (*Columbina passerina*) and **Great Kiskadee** (*Pitangus sulphuratus*), **Grey Catbird** (*Dumetella carolinensis*), **White-eyed Vireo** or **Chick-of-the-village** (*Vireo griseus bermudianus*), **Northern Cardinal** (*Cardinalis cardinalis*) and **European Goldfinch** (*Carduelis carduelis*). During the winter months the trees and thickets provide shelter for a number of winter residents. You might be lucky enough to catch sight of a warbler such as the **Black-and-white** (*Mniotila varia*), **American Redstart** (*Setophaga ruticilla*), **Ovenbird** (*Seiurus aurocapillus*) and **Northern Waterthrush** (*Seiurus noveboracensis*). **Indigo Bunting** (*Passerina cyanea*) may also be glimpsed.



Mourning Dove **RESIDENT**
Zenaida macroura



Common Ground-Dove **RESIDENT**
Columbina passerina



Grey Catbird **RESIDENT**
Dumetella carolinensis



Bermuda White-eyed Vireo **ENDEMIC**
Vireo griseus bermudianus



Northern Cardinal **RESIDENT**
Cardinalis cardinalis



European Goldfinch **RESIDENT**
Carduelis carduelis



American Redstart **MIGRANT**
Setophaga ruticilla



Northern Waterthrush **MIGRANT**
Seiurus noveboracensis



Indigo Bunting **MIGRANT**
Passerina cyanea

Historic & Geological Sites

Portuguese Rock

At the cliff face a bronze plaque records an early inscription believed to have been carved in the stone by survivors off a Portuguese ship wrecked on Bermuda's reefs in 1543. The original carving has deteriorated but the bronze plaque was cast from a lead mould taken of the inscription in 1893.

This site was formerly known as Spanish Rock because the initials were mistakenly thought to be those of a Spaniard. Later research, however, interpreted that a sailor, from a Portuguese ship out of Hispanolia wrecked off Bermuda's north shore, carved the initials as R.P. (an abbreviation for Rex Portugaliae, King of Portugal) and the cross as the Portuguese Order of Christ. The stranded Portuguese mariners did not stay long but built a new vessel and left the island. This inscription commemorates the longstanding presence and contribution of Bermuda's Portuguese community. It was renamed Portuguese Rock on September 24, 2009.

This site also provides a good vantage point to watch **Humpback Whale** (*Megaptera novaeangliae*) migration north in spring.



left:
The bronze plaque was cast from a lead mould taken of the inscription in 1893

Jeffrey's Cave

The small cavern, entered from an opening in the ground above is called 'Jeffrey's Cave', so called for a slave of that name who, according to legend, attempted to escape his servitude by hiding in the dank, subterranean lair. Jeffrey had escaped from his master, who searched for weeks to find him. The search was abandoned when it was believed he had escaped from Bermuda on a sailing vessel. However, the master began to notice the mysterious behaviour of one of his female slaves, who disappeared daily at sunset, always carrying a small package. He followed her as she walked through the woods, by the side of a pond and to the rocky shoreline. The next day a friend accompanied the master over the same route, which led them to a cave in which they found the well-concealed Jeffrey.

Many slaves tried to run away from their masters. Rewards offered ran from \$20 for a runaway slave mason to \$2 for a slave boy. In spite of rewards, slaves helped their fellow slaves to hide and run away.



African Diaspora Heritage Trail • Bermuda

The Bermuda Department of Tourism and the international body **African Diaspora** created a trail linking sites, monuments and museums which have a common legacy of slavery. These sites were officially designated as part of the transnational heritage tourism initiative formed in 2001 and are part of the **UNESCO Slave Route Project** with the aim to protect and educate about the heritage and culture of those belonging to the African Diaspora.



Checkerboard

This limestone oddity was created by nature, despite the fact that it looks so uniform that one might speculate that man had made it. The cracks are 'systematic joints' along which there has been little movement of the rock. "Systematic" in that there is a clear pattern, in this case, rectangular or even square. Sand and small stones are carried backward and forward by the waves, thus enlarging the cracks. Look for tiny creatures and little crab molts in these openings.

The fracturing is the result of pressure of the forces of plate tectonics. The lower part of the rock is Belmont 'marine' (deposited in the sea) and was later exposed to the air, due to a drop in sea level (the Checkerboard itself). Layered on top of the rock are a beach berm and a back beach dune. The Checkerboard reveals the submarine deposits left by the receding ocean. Keep a lookout for the tidal pools here which contain small hermit crabs. During Bermuda's whaling industry days in the 18th century, whales were hauled ashore here and stripped of their commercially valuable blubber.



left:
The cracks are 'systematic joints' along which there has been little movement of the rock

Plant & Animal Life at Spittal Pond



Allspice
Pimenta dioica **INVASIVE**



Ardisia
Ardisia polycephala **INVASIVE**



Asparagus Fern
Asparagus setaceus **INTRODUCED INVASIVE**



Bay Grape
Coccoloba uvifera **NATIVE**



Bermuda Maiden-Hair Fern
Adiantum bellum **ENDEMIC**



Olivewood
Cassine laneana **ENDEMIC**



Bermuda Cedar
Juniperus bermudiana **ENDEMIC**



Male Cedar showing pollen



Female Cedar showing berries

PHOTOS: DEPARTMENT OF CONSERVATION SERVICES



Palmetto
Sabal bermudana **ENDEMIC**



Palmetto leaf & seeds



Bermuda Snowberry
Chiococca bermudiana **NATIVE**

Spittal Pond has a wide variety of animal and plant life within its habitats. The following list contains most that can be seen on a walk through the winding trails around the ponds, upland and coastal forest and rocky coast. When walking along the paths from either entrance notice how the plants change as you go down the hills towards the ocean; the grass changes from the common crab grass to those that are more salt tolerant.

Source: Martin L. H. Thomas, Bermuda Zoological Society, A Naturalist's Field Guide to Bermuda Bermuda Zoological Society, Project Nature Field Study Guides: Bermuda Wetlands, Bermuda Forests, The Rocky Coast

Plants



Bermudiana **ENDEMIC**
Sisyrinchium bermudiana



Black Mangrove **NATIVE**
Avicennia germinans



Black Mangrove **NATIVE**
Pneumatophores (roots)



Morning Glory **INTRODUCED**
Ipomoea indica **INVASIVE**



Brazil Pepper **INTRODUCED**
Schinus terebinthifolius **INVASIVE**



Burr Bush **NATIVE**
Triumfetta semitriloba



Buttonwood **NATIVE**
Conocarpus erectus



Casuarina **INTRODUCED**
Casuarina equisetifolia **INVASIVE**



Chinese Fan Palm **INVASIVE**
Livistonia chinensis



Cinnamon Fern **NATIVE**
Osmunda cinnamomea



Coast Sophora **NATIVE**
Sophora tomentosa



Coast Spurge **NATIVE**
Euphorbia mesembrianthemifolia

Plants



Darrell's Fleabane ENDEMIC
Erigeron darrellianus



Fiddlewood INVASIVE
Citharexylum spinosum



Flopper or Life Plant INTRODUCED
Kalanchoe pinnata



Forestiera NATIVE
Forestiera segregata



Giant Fern NATIVE
Acrostichum danaeifolium



Holly Fern NATIVE
Cyrtomium falcatum



Indian Laurel INVASIVE
Ficus microcarpa



Joseph's Coat or Poinsettia NATIVE
Euhorbia heterophylla



Match-Me-If-You-Can INTRODUCED
Acalypha amentacea wilkesiana



Nasturtium NATIVE
Tropaeolum majus



Natal Plum NATIVE
Carrisa grandiflora



Prickly Pear NATIVE
Opuntia stricta var dilleni

Plants



Psilotum
Psilotum nudum **NATIVE**



Red Mangrove
Rhizophora mangle **NATIVE**



Rouge Plant or Blood Berry
Rivina humilis **INTRODUCED**



Royal Fern
Osmunda regalis var spectabilis **NATIVE**



Sawgrass
Cladium jamaicense **NATIVE**



Screw Palm or Pine
Pandanus utilis **INTRODUCED**



Sea Lavender
Limonium carolinianum **NATIVE**



Sea Rush
Juncus maritimus **NATIVE**



Seaside Daisy
Wedelia trilobata **INTRODUCED**



Seaside Goldenrod
Solidago sempervirens **NATIVE**



Seaside Oxeye
Borrichia arborescens **NATIVE**



Seaside Purslane
Sesuvium portulacastrum **NATIVE**

Plants



Sheathed Paspalum Grass
Paspalum vaginatum **NATIVE**



Shrubby Fleabane
Pluchea odorata **NATIVE**



Spanish Bayonet
Yucca aloifolia **NATIVE**



Surinam Cherry
Eugenia uniflora **INTRODUCED**



Sword Fern
Nephrolepis exaltata **NATIVE**



Tamarisk or Spruce
Tamarix gallica **INTRODUCED**



Turnera
Turnera ulmifolia **NATIVE**



Umbrella Sedge
Cyperus alternifolius **INTRODUCED**



Virginia Creeper
Parthenocissus quinquefolia **NATIVE**



Wax Myrtle
Morella cerifera **NATIVE**



Widgeongrass
Ruppia maritima **NATIVE**



White Beggar Ticks
Bidens pilosa **NATIVE**

Animals



American Eel
Anguilla rostrata NATIVE



Warwick Lizard
Anolis leachii INTRODUCED



Beaded Periwinkle
Tectarius muricatus NATIVE



Bermuda Skink
Eumeces longirostris ENDEMIC



Blue Dasher Dragonfly
Pachydiplax longipennis NATIVE



Buckeye Butterfly
Junonia coenia NATIVE



Marine/Cane Toad
Bufo marinus INTRODUCED



Monarch Butterfly
Danaus plexippus NATIVE



Eastern Mosquito Fish
Gambusia holbrooki INTRODUCED



Red Land Crab
Gecarcinus lateralis NATIVE



Sally Lightfoot
Grapsus grapsus NATIVE



Vermilion Glider
Tramea abdominalis



White-tailed Tropicbird
Phaethon lepturus catesbyi NATIVE



West Indian Chiton
Chiton tuberculatus NATIVE

Glossary

Absconder: someone who runs away secretly to avoid punishment

Abundant: present in great quantity; more than adequate; over sufficient

Adapt: to make suitable for the requirements or conditions; to modify fittingly

Agriculture: the science, art or occupation concerned with cultivating land, raising crops, and feeding, breeding, and raising livestock

Apprehend: to take into custody, arrest by legal warrant or authority

Bio-deposition: the process that forms coral reefs on and around the platform and marine organisms, such as seaweed and algae

Biodiversity: the number of different species present at a location

Brackish: a mix of fresh and salt water

Calcareous: containing or composed of calcium

Camouflage: the act, means, or results of obscuring things to deceive an enemy; concealment by some means that alters the appearance

Climate change: the long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature; usually referred to as a consequence of human impacts

Commemorate: to serve as a memorial or reminder of something, honouring a memory

Conservation management: a procedure for maintaining a species or habitat in a particular state. It is a means whereby humankind secures wildlife in a favourable condition for contemplation, education or research

Defence mechanism: the reaction of an organism to protect it from unacceptable or painful impacts

Development: the act or process of growing or progressing

Distinguish: to mark off or recognise as different

Diverse: of various kinds, forms or character

Dominate: the act of ruling or taking over, controlling

Ecology: the external surroundings in which a plant or animal lives which tend to influence its development and behaviour

Ecosystem: a system involving the interactions between a community and its non-living environment

Endangered: threatened with extinction

Erosion: the process by which the surface is worn away by the action of water, wind, waves etc.

Eutrophication: an abundant accumulation of nutrients that support dense growth of algae and other organisms, the decay of which depletes the shallow waters of oxygen in summer

Evaporation: the act of changing from a liquid state into vapour

Evolve: to develop gradually

Exoskeleton: an external covering or integument, especially when hard

Extinct: no longer in existence

Fluctuate: to change continually; to shift back and forth; to vary irregularly

Fossil: any remains, impression, or trace of a living thing of a former geological age

Geological: of or pertaining to the science that deals with the dynamics and physical history of the earth, the rocks of which it is composed, and the physical, chemical, and biological changes that the earth has undergone or is undergoing

Habitat: a small area of environment where animals live

Herbaceous: of, pertaining to, or characteristic of a herb, a flowering plant valued for its medicinal properties, flavour or scent

Impenetrable: cannot be penetrated; unable to pass through

Indigent: lacking food, clothing, and other necessities of life because of poverty

Inscription: a historical record cut or impressed on a hard surface; usually a dedication

Littoral: of or pertaining to the biogeographic region between the sublittoral zone and the high-water line

Monospecific: composed almost entirely of a single species

Nocturnal: active at night

Percolation: the slow movement of water through the pores in soil or permeable rock

Pneumatophores: air breathing roots

Porous: able to be penetrated by water or air

Predator: any organism that exists by preying upon other organisms

Preserve: to keep alive or in existence; make lasting

Propagate: to cause an organism to multiply by any process of natural reproduction

Ramsar: an international treaty for the conservation and sustainable utilisation of wetlands; i.e. to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value

Refuge: shelter or protection from danger or trouble; a place where one has recourse for aid or relief

Regeneration: the restoration or new growth by an organism that has been lost, removed or injured

Remnant: a remaining, usually small, part

Restoration: the act of returning something to a former, original, or unimpaired condition

Salinity: the total dissolved salt content of water

Sanctuary: a sheltered place, or sometimes facility, where animals can live protected, able to maintain comfortable conditions; a safe haven

Sediment: mineral or organic matter deposited by water, air or ice; the matter that settles at the bottom of liquid

Servitude: compulsory service or labour as punishment; slavery or bondage of any kind

Settlement: a stable or permanent basis; an arrangement of business affairs

Sluice gate: an artificial channel for conducting water at the upper end for regulating the flow

Strata: layers of material, naturally or artificially formed; a single bed of sedimentary rock, generally consisting of one kind of matter representing continuous deposition

Submerged: hidden or covered under the surface of water

Subterranean lair: a secluded or hidden place under the surface of the earth

Succulent: having fleshy and juicy tissues

Surge: a strong, wavelike forward movement; the swelling and rolling sea

Systematic: having or involving a system, method or plan; can be concerned with classification

Tectonic plates: The two sub-layers of the earth-crust (lithosphere); their motion of colliding with, sliding under, or moving past adjacent plates causes geological reactions and formations

Threat: an indication of warning or probable trouble

Tolerant: to allow the existence, presence, or act of something without prohibition or hinderance

Vertebrate: an animal having a backbone or spinal column

Vulnerable: capable of or susceptible to being wounded or hurt; open to attack

Wetland: land that has a wet and spongy soil

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For more information on educational tours and activities see the full Teacher Resource Guide at www.bnt.bm