Paget Marsh
NATURE RESERVE

TEACHER RESOURCE 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 and Dr. Martin Thomas.

To protect and promote Bermuda's unique natural and cultural heritage for everyone, forever

Learning with the Bermuda National Trust Education Programme

The Bermuda National Trust's teacher resources focus on nature reserves and historic homes owned and maintained by the Trust, offering comprehensive resources and creative learning experiences for visitors, teachers and students. We provide first-hand experiences that cannot be re-created in the classroom. Guided tours can be scheduled with a member of our education staff for preschool, primary, middle and senior level classes.

It is our hope that students will visit all the Trust properties, beginning at preschool or primary 1 - 2, and experience repeated visits throughout later primary, middle and senior years. Repeat visits help students build on their prior learning and develop a deeper understanding of the concepts and terms associated with each site. Senior students are encouraged to visit each site to learn about the care and preservation of nature reserves and historical homes. Opportunities are available for senior students to participate in our AIM Programme, allowing them to volunteer their time caring for Trust properties, which can be applied to required community service hours.

Table of Contents

Arranging a Class Trip/Teacher Resources

>Note to Teachers

Our goal is to make a visit to Paget Marsh valuable and meaningful to children and to stimulate a lifelong interest in the environment, their surroundings and some of the features that make Bermuda so unique. This resource was created to provide background information on the reserve along with suggested activities that you can conduct with your students before your class visit to the reserve and afterwards, to enhance your students' learning experience and help you achieve your curriculum goals.

There are a few options to support you before and after the field trip:

Teacher workshop

We can provide a "group teacher workshop" in our AXIS Education Classroom prior to a field trip with your students. A minimum of 10 teachers is required, maximum group size is 15. The time allotted for the work shop is 1.5 - 2 hours.

The overall focus of the workshop is to:

- Obtain a copy of the Paget Marsh Nature Reserve resource booklet
- Review the history of the pond, resources and suggested activities
- Obtain materials to create a map of Bermuda and labels to show the location of Bermuda National Trust properties and other local landmarks, which can be used in their classroom introductory lesson before taking the class tour
- Network with other teachers to brainstorm ideas for additional activities that can be offered to promote student learning before and after the class tour

Three-Part Learning Experience

We offer a three-part learning experience. After booking a field trip, a Bermuda National Trust educator can provide an introductory lesson for your students in your classroom, providing information about the site. This is an excellent preparation for the field trip which builds on students' prior knowledge and is helpful for engaged learning during the field trip. After the site visit a follow-up lesson can also be scheduled. Students will be guided in a review of their field trip and summarise their new knowledge.

1	2	3
PREPARATORY UNIT Introduction to site and target of learning	**FIELD TRIP** Informal engaged learning	**SUMMARY** Students will use their field trip experience towards new learning

Follow up Visit

Teachers are welcome to schedule a follow-up visit for their class at our AXIS Education Classroom at our Waterville site after the tour, preferably within two to three weeks. The goal is to review what students learned about the reserve/marsh and for them to share/highlight the work they have completed. The time allotted for this student follow up visit at Waterville is approximately 1.5 hours.

Tips for Using This Resource

Reading through the background information will assist teachers in answering the more probing questions from inquisitive students, and help create additional activities that extend the learning associated with Paget Marsh.

The activities provided focus on the Cambridge International Curriculum Key Stages 1 and 2, Primary Stages 1–6 and Secondary 1, Middle Stages 7-9. Curriculum links to activities are provided for integrating the Bermuda Ministry of Education's Science and Social Studies. While looking through the activities provided, teachers may also think of ways to integrate all other subject areas. The teacher's method of preparation and delivery will vary with students' needs and interests.

The activities presented here aim to engage young minds, foster observation skills and inquisitiveness about our environment, encourage respect and appreciation for nature and open spaces and promote knowledge and understanding of the unique features of this reserve.

We continue to seek ways to improve our educational programmes and welcome suggestions for enhancing this resource and the experience for the children. Please contact us with any suggestions or comments.

Enjoy yourselves,
The Education Team
Bermuda National Trust

education@bnt.bm
236-6483

Scheduling a filed trip to Paget Marsh

To schedule a trip to Paget Marsh download and complete a school field trip booking form on our website, www.bnt.bm (found under the school tours heading) or copy the form in the back of this book. Return the form via email to: education@bnt.bm.

The ratio of guided tours is one adult for every ten children. Additional adults are welcome.

Ensuring a Safe and Enjoyable Visit

To ensure that students and adults have a safe and enjoyable experience to the reserve, it essential for teachers to:

- Assume responsibility for safety, behaviour, support and welfare of students. The reserve has a boardwalk that extends out over a body of water and students will need to be supervised at all times
- Ensure that students are prepared with appropriate clothing and walking shoes
- Prepare and carry a register to include the names of all students with emergency and medical information
- Ensure that each student has a completed Bermuda National Trust parent/guardian consent form to attend the tour, which includes our photo release policy. This form is included in the appendix. Teachers need to notify the Trust staff member leading the tour of any students who do not have prior consent to be photographed
- Provide necessary information for the Trust staff member about relevant student learning needs, behavioural support, allergies or health
- Bring a first aid kit and a cell phone to be used in the event of an emergency – teachers and other adults are to refrain from using cell phones and texting for personal use during the tour
- We ask that teachers support students in their learning before, during the tour and after their visit

Before the Tour, Setting the Stage for Student Learning

After booking the tour, teachers are encouraged to review the information that follows:

- The formation of Paget Marsh and map showing the location of the reserve
- The definitions of key terms relating to plant and animal life
- The plants and animals that inhabit the reserve

In preparation for the tour, initial classroom activities are provided and are meant to assist students in recalling their prior knowledge of nature reserves and open spaces and to learn specific information about Paget Marsh. The scope of students' learning will depend on the grade level, their prior exposure to reserves, background knowledge and understanding of terms. Although the activities provided begin at the lower primary level, teachers of older students can modify the activities for the grade and developmental level of their students' abilities. We hope that teachers will generate new ideas for creating additional activities and share them with our education staff.

Provide students with the following information: The importance of Paget Marsh

- It is virtually unchanged since before humans colonised Bermuda
- There are rare and unique, endemic and native plants located on the property
- The marsh is of significant benefit to wildlife (e.g. migratory and resident birds)
- The location of the four major habitats (pond, mangrove, sawgrass and cedar-palmetto forest) is determined by the level of the peat in relation to the water table
- Taking care of nature reserves, the do's and dont's once they get there; especially staying on the boardwalk since poison ivy does grow in this nature reserve
- Nature reserves are important for our health and well-being
- The meaning of the terms native, endemic, introduced and invasive (see definition of terms)
- Ways that we can take care of nature reserves. Keep the areas free of trash, leave the walking paths, trees, plants, flowers and overall area as you found them
- Whether you are visiting as a student, teacher, with family or friends, it is important to be respectful of this beautiful public space

Bermuda National Trust
STEWARDSHIP PROPERTIES

- NATURE RESERVES
- HISTORIC PROPERTIES
- HISTORIC CEMETERIES

take only pictures

Please help us preserve & protect

Enjoy this reserve from dawn to dusk

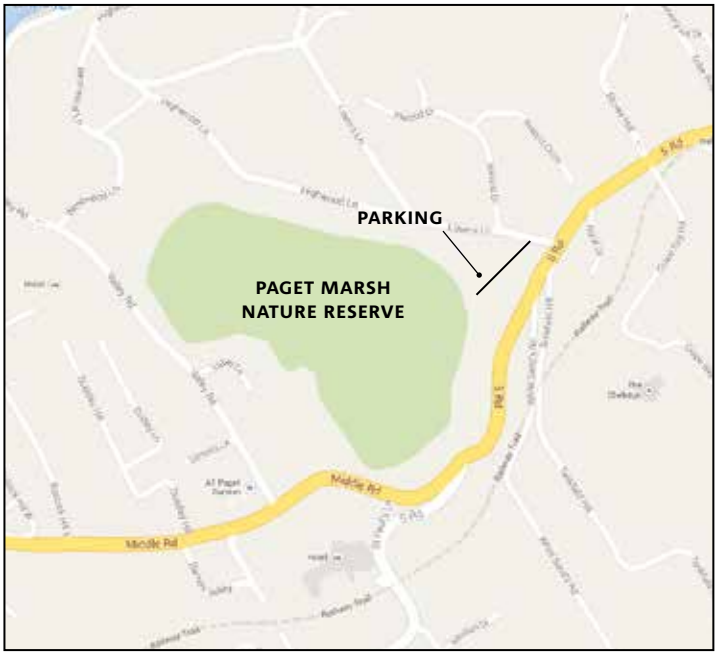
Respect the wildlife

Be considerate of others

No vehicles

Dogs must be on lead

leave only footprints



Directions

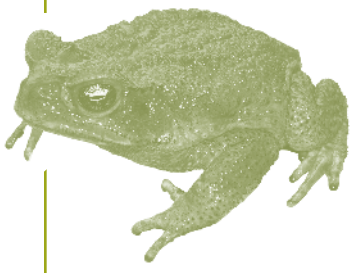
Paget Marsh is located off Middle Road on Lovers Lane in Paget. As you turn onto Lovers Lane from Middle Road, take the first left and drive down the lane into the nature reserve parking area. The boardwalk extending out over the marsh is adjacent to the parking lot.

Paget Marsh
NATURE RESERVE

FROM THE MOMENT YOU ARRIVE, PAGET MARSH INVITES YOU TO come in and explore. This lush and leafy nature reserve, tucked in a low-lying valley, holds secrets about a way of life seldom seen. It is a time capsule preserving one of the last remnants of Bermuda's natural heritage – a native Bermudian ecological community.

Jointly owned by the Bermuda National Trust and the Bermuda Audubon Society, Paget Marsh is a unique green space of 25 acres of original Bermuda, completely surrounded by homes, shops, roads and the hustle-bustle of our island life. It's also a walk back in time to life as it was 1,000 years ago. Thanks to creative and careful environmental work, people in Bermuda can see what life was like before there were people in Bermuda!

The Bermuda National Trust named the Paget Marsh boardwalk 'Dennis's Walk' and the freshwater area 'David's Pond' in recognition of the enormous contribution two great friends of the Trust have made to preserving the nature reserve and promoting its careful use. The boardwalk and improvements to the nature reserve were made possible by a donation from Dennis Sherwin, a very active member of the National Trust since 1976 and a former president. The pond and boardwalk were designed by Dr David Wingate, Bermuda's first conservation officer, a founding member of the Trust and former president of the Audubon Society.



Paget Marsh

TOP PHOTO: © BERMUDA ZOOLOGICAL SOCIETY
BOTTOM PHOTOS: COURTESY OF THE MINISTRY OF WORKS & ENGINEERING, SURVEY SECTION

The Human Impact on Paget Marsh

The National Trust has completed improvements to the marsh that enables everyone to visit and enjoy this tranquil setting. The walk begins on a tarmac installed in the late 20th century and joins a wooden boardwalk that winds through the pond, marsh, mangroves, grasslands and woods to the Bermuda of the 17th century. In the marsh, you see the island as the first settlers found it, when it was covered with a cedar and palmetto forest.

This fragment of the original forest has survived through a combination of circumstance and conservation management. Its boggy nature made it difficult to build on, so it was bypassed during Bermuda's early colonisation and our more recent development boom. The natural resources of Cedar, Palmetto and Wax Myrtle (*Myrica cerifera*) would have been difficult to reach in this stretch of land and so have remained virtually untouched. When an official garbage collection system was implemented in the 1920s, Paget Marsh, like other marshes, became a community dumpsite. Dr Henry Wilkinson, recognising the value of Paget Marsh, stopped the dumping and arranged for the Historical Monuments Trust (predecessor of the Bermuda National Trust) to acquire much of the marsh from the Anglican Church and private landowners in the 1950s. Cattle grazing frequently occurred up until about 1990 at the western end of Paget Marsh. Today, agricultural plots exist in this area.

The acidic peat soil of Paget Marsh is inhospitable to most of the plants imported to Bermuda over generations. Many of those species have become 'invasive' on other parts of the Island, choking out the native plants. The few invasive plants that do take hold in the marsh, notably **Guava** (*Psidium guajava*), **Chinese Fan Palm** (*Livistona chinensis*) and **Marlberry** (*Ardisea*) are culled out through a woodland management programme begun in the 1970s.

Your Visit

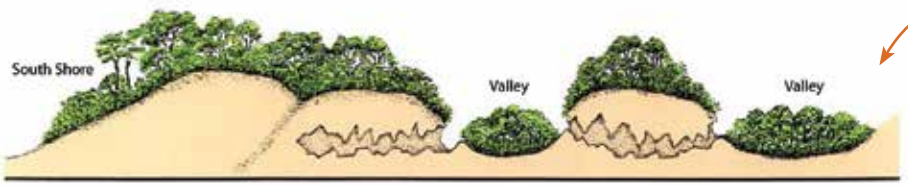
As you wander through the nature reserve, interpretive signs present the story of the marsh, from how it developed thousands of years ago to how it is being preserved today. Natural habitats are described and illustrated, making a visit to the marsh especially enjoyable by helping people to appreciate what they are seeing.

The Formation of Paget Marsh

The low hills of Bermuda's landscape began as dunes of sand, building inland from coastal beaches. Over the course of 400,000 years, percolation of rain turned the oldest of these sandy hills into well-cemented rock with cave formations. Paget Marsh, an interdune low, is enclosed by older hills on the north and the south but connected by caves to Hamilton Harbour. Thus the marsh began as a tidal saltwater pond surrounded by mangroves.

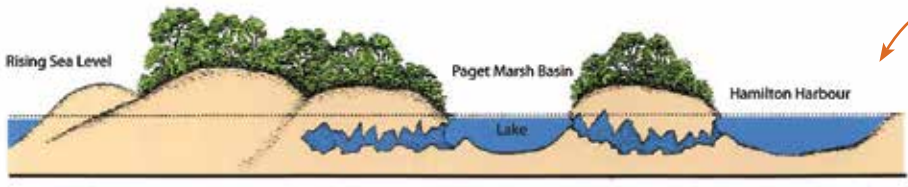
After the last Ice Age 10-12,000 years ago, valleys between these hills were filled by the rising sea level. About 4,000 years ago, the rapid sea level rise slowed down sufficiently to allow the accumulation of dead plant material from mangroves and other plants, thus forming peat. Peat forms when there is not enough oxygen to decompose the vegetation that falls into the pond and so it accumulates. This peat gradually built up to clog the underground tidal channels. This changed the marsh from a saltwater to a freshwater environment, leaving the mangroves isolated. The build-up of peat continued until it ultimately filled all of the open water areas and became firm enough to support a peat marsh forest. The peat ranges from 4-20 ft deep and may be up to 40 ft deep in some places.

Currently, there are several distinct sequential stages of peat accumulation in Paget Marsh resulting in several distinctly different habitats. These can all be seen from the boardwalk and range from an open water pond, where the peat has not yet built up to the water surface, through mangroves and Sawgrass (*Cladium jamaicense*) to the Cedar (*Juniperus bermudiana*) Palmetto (*Sabal bermudana*) forest hammock, where the peat has accumulated well above the water level. Noticeable from the parking area are two other distinct communities: the agricultural field bordered by banana trees and the wooded hillside dominated by introduced and invasive tree species.



20,000 years ago

Approximately 20,000 years ago during the Ice Age, the sea level was lower and thus the areas which now form Hamilton Harbour and Paget Marsh were dry valleys.



10,000 years ago

Approximately 10,000 years ago, at the end of the Ice Age, a rapid rise in sea level began causing water to fill Hamilton Harbour and Paget Marsh through connecting caves.

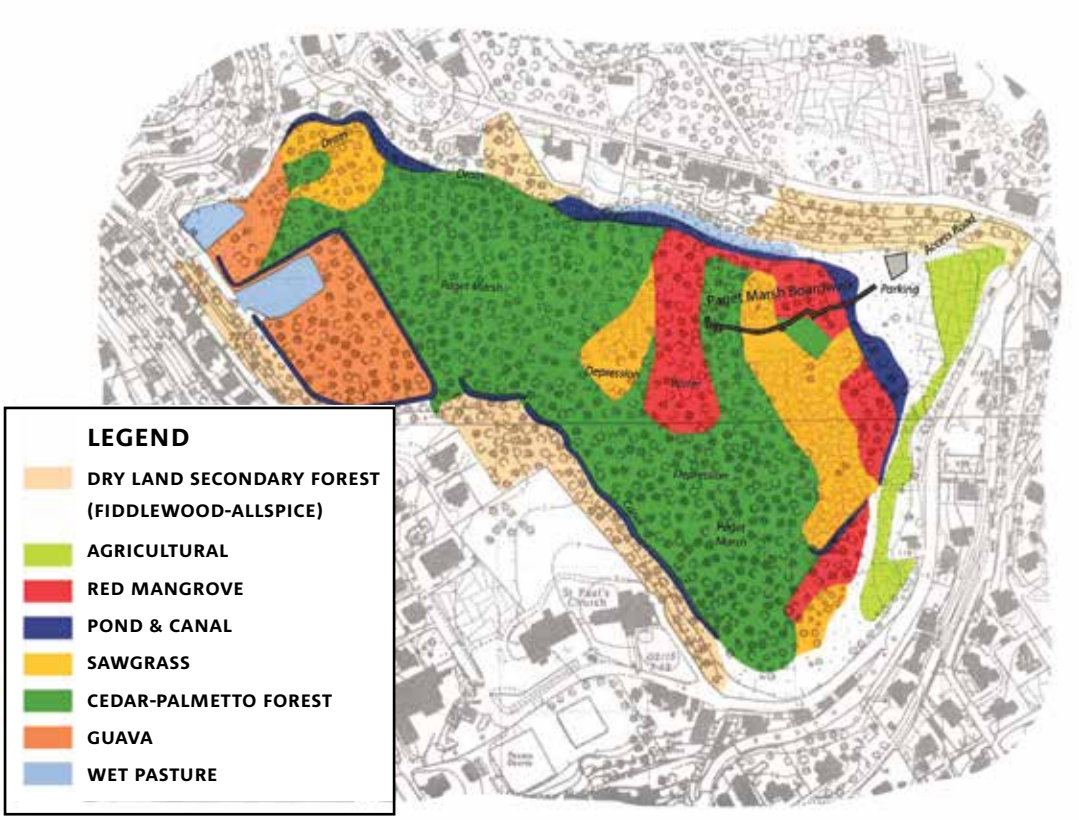
4,000 years ago - present

Over the past 4,000 years the rise in sea level has slowed down and the connecting caves have filled with peat, blocking the flow of water from Hamilton Harbour to Paget Marsh.

Plant Communities

Paget Marsh has several plant communities in a small area determined by the water level relative to the peat surface.

Deep water areas result in an open water pond with submergent or floating plants. Shallow water areas support emergent cattails, bulrushes and spike rushes. Seasonally submerged peat supports giant ferns and sawgrass and permanently dry peat surfaces support the cedar, palmetto and wax myrtle forest. The mangrove forest, which is a remnant from an earlier era, grows in fresh water amid sawgrass and cedar palmetto forests.



Low Species Diversity

The plant communities of Paget Marsh resemble those of the Florida Everglades because most of our species originated from that region via wind, ocean currents and migratory birds. However, only a few of the vast array of species found in the Everglades are capable of dispersing successfully across the 800-mile ocean barrier to Bermuda, so our peat marsh community is characterised by low species diversity.

Reserve Management

Considering that Paget Marsh is unique as the last significant tract of land in Bermuda to have survived almost intact and unmodified by humans since prehistoric times, and given its location alongside the busiest traffic route from Hamilton to Somerset, it is imperative that the marsh is managed if it is to be maintained. In 1997, the Trust began the process of erecting a boardwalk to protect the rarer plant species and plant communities from being trampled. With the boardwalk in place, public usage is more carefully controlled, while allowing visitors and residents the opportunity to experience the diverse natural habitats at Paget Marsh. The informational signs enhance the educational value of the site.

At the same time, a pond was created by excavating an area previously used as a dump. The excavated soil was then used as an embankment around the pond. The pond was linked into the existing drainage canal system to assist the circulation of water and prevent stagnation. The pond and islands encourage birdlife and hence serve as a sanctuary and feeding spot for resident and migratory birds.

Ecosystems change over time and ponds are no exception. Under stable sea level conditions, eutrophication continues and peat accumulates, filling in a pond. This has been the situation for the last 4,000 years. The grasses and mangroves bordering the edge encroach further and further over time until the entire marsh basin fills with peat. In Paget Marsh the present pond and perimeter ditch exist only because they have been excavated periodically by humans. Thus pond management is critical to maintaining the current state.

This situation has begun to change radically, however, as a result of a recent renewed trend of global warming which most scientists attribute to the greenhouse effect caused by man's industrial combustion of fossil fuels. One manifestation of this has been a resumption of sea level rise which exceeded seven inches during the 20th century and continues to accelerate. A period of prolonged high tides in September 2002 pushed up the water level in the marsh by nearly two feet and lasted so long that more than 50% of the cedars were drowned including most along the route of the boardwalk. This is the first real manifestation of an ecological catastrophe that may be expected if global warming continues. Dead trees are a natural part of the ecosystem so they will not be removed from the nature reserve.

The National Trust does occasional plantings of native and endemics in the marsh but, more frequently, there is a need for extensive culling of invasives, notably **Guava** (*Psidium guajava*), **Marlberry, Murray Red Gum** (*Eucalyptus camaldulensis*), **Umbrella Tree** (*Schefflera actinophylla*) and **Indian Laurel** (*Ficus microcarpus*) which thrive on the acidic peat in the soil. The long-term goal of the Bermuda National Trust for this reserve is to maintain the various habitats as they were before human settlement insofar as changes due to global warming will permit.

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 accidently 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

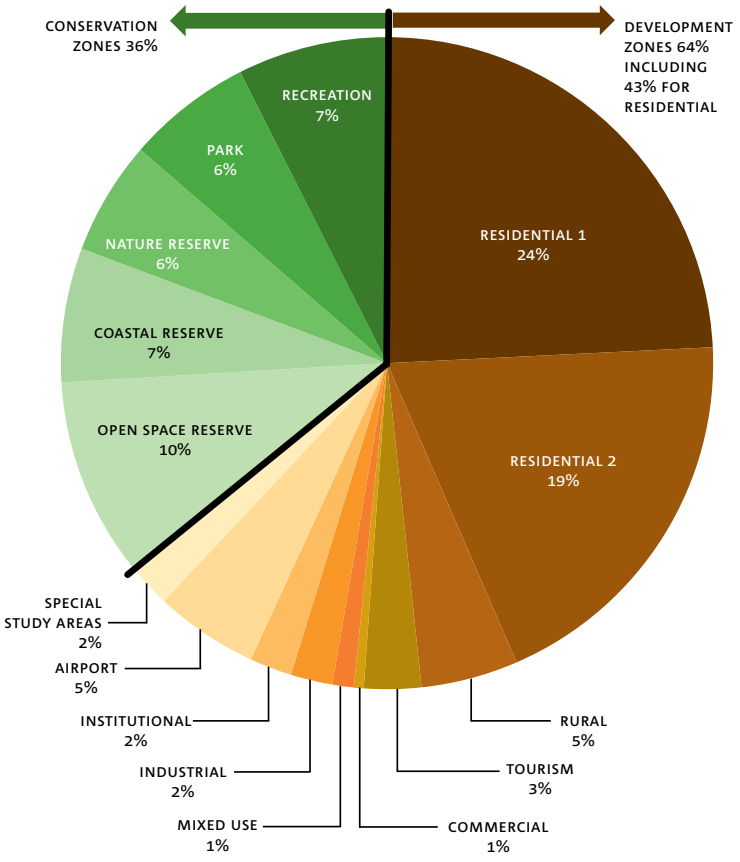
The chart below shows a breakdown of how Bermuda's land is used.

Conservation Zones totalled = 36%

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

Development Zones totalled = 64%

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



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

Pond Life

At the entrance to the marsh, the half-acre pond, created by the Bermuda Audubon Society in 1998, has become home to an amazing array of wildlife.

The freshwater pond sits on a layer of peat. Because the peat is in turn layered on salt water that is connected to Hamilton Harbour, the pond is subject to daily tidal fluctuation of approximately half an inch. Long term tidal fluctuation, averaging higher or lower than normal, can range up to 18 inches.

The dark colour of the water results from tannic acid released from decomposing plants and is a by-product of peat formation.

All of Bermuda's ponds are threatened by invasive species as well as with run-off pollution from roads and neighbouring farmland. Reducing pollutants in the pond is an ongoing and long-term problem.

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 accidently 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

Animal & Bird Life

Wildlife abounds at Paget Marsh. The **Yellow-crowned Night Heron** (*Nyctanassa violacea*) is a frequent visitor. The **Great Egret** (*Ardea albus*), **Greater and Lesser Yellowlegs** (*Tringa melanoleuca*) and (*Tringa flavipes*), **Belted Kingfisher** (*Ceryle alcyon*), **Wood Duck** (*Aix sponsa*) and **Merganser** (North American) are among the many water birds often spotted there. The resident common native marsh bird, the **Moorhen** (*Gallinula chloropus*), is certainly at home here on the pond as it is at Warwick and Spittal Ponds. Less obvious are the **damselfly** suborder and **dragonflies** that make their home in the marsh. Below the surface, **toads**, **tadpoles** and **Mosquito Fish** (*Gambusia holbrooki*) lurk. The invasive **Red-eared Terrapin** (*Trachemys scripta elegans*) is common and a recent introduction to the pond.

Red-eared Terrapin
Trachemys scripta elegans
INTRODUCED
INVASIVE

Blue Dasher Dragonfly
Pachydiplax longipennis
NATIVE

Marine/Cane Toad
Bufo marinus INTRODUCED

Yellow-crowned Night Heron
Nyctanassa violacea RESIDENT

Great Egret MIGRANT
Ardea alba

Common Moorhen MIGRANT
Gallinula chloropus

Greater Yellowlegs MIGRANT
Tringa melanoleuca

Lesser Yellowlegs
Tringa flavipes MIGRANT

Green Heron RESIDENT
Butorides virescens

Mangrove Habitat

The first forested habitat you enter on the boardwalk is an area dominated by Red Mangroves (*Rhizophora mangle*), with its distinctive hanging prop roots. It is one of two mangrove species that occur in Bermuda. It's unusual to see mangroves in an area of fresh water and their presence in Paget Marsh has to do with how the marsh was formed.

Red Mangroves

The prop roots of Red Mangroves not only serve to stabilise the growing tree, but, in salt water, usually become home to many marine organisms like algae, sponges and crustaceans that require a stationary support. Most of the saltwater creatures that once inhabited the mangroves, such as crabs, snails and oysters, died out long ago, but the mangroves remain a favourite habitat for migrant birds.

Mangroves worldwide are recognised for their ability to reclaim land, or at least prevent erosion of coastline, providing that they can accumulate peat at a rate greater than the rate at which sea level rises. In other parts of the world, the bark of the tree is used for tannin and salt may be collected from the leaves.

PHOTO: ALISON COPELAND

Red Mangrove NATIVE
Rhizophora mangle

Propagule

Leaf & flower

Prop roots

Migrant Birds

Red Mangroves create a supportive habitat for migrant birds. The **Northern Water Thrush** (*Parkesia noveboracensis*) feeds in the dead leaves. The **Black and White Warbler** (*Mniotilta varia*) feeds on the mangrove stems. The **American Redstart** (*Setophaga ruticilla*) feeds in the canopy. In total, 38 species of wood warbler visit Bermuda from North America each fall, and 20 spend the winter here.

Northern Water Thrush
Parkesia noveboracensis
MIGRANT

Black and White Warbler
Mniotilta varia MIGRANT

American Redstart
Setophaga ruticilla MIGRANT

Giant Fern

Adjacent to the mangroves is the home of Bermuda's largest native fern, the **Giant Fern** (*Acrostichum danaeifolium*), which grows only where the ground is permanently flooded. It grows to 8 feet in height. The fern thirves under the shaded canopy.

Giant Fern NATIVE
Acrostichum danaeifolium

Ferns in Bermuda

Bermuda has 25 (possibly 26) fern species including three endemic ferns: **Bermuda Maidenhair Fern**, **Bermuda Shield Fern** and **Governor Laffan's Fern**. The latter is extinct in the wild but is grown at the Bermuda Botanical Gardens. Six of the ferns are critically endangered or endangered and a fern recovery plan for these species is recommended at www.conservation.bm.

Bermuda Maidenhair Fern
Adiantum bellum
ENDEMIC

Sword Fern NATIVE
Nephrolepis exaltata

Southern Braken NATIVE
Pteridium caudatum

COMMON NAME	LATIN NAME	DESIGNATION
Bermuda Maidenhair Fern	*Adiantum bellum*	ENDEMIC
Governor Laffan's Fern	*Diplazium laffanianum*	ENDEMIC, CRITICALLY ENDANGERED
Bermuda Shield Fern	*Goniopteris bermudiana 9syn. Dryopteris bermudiana)*	ENDEMIC, CRITICALLY ENDANGERED
Plume Polypody	*Pecluma plumula (syn. Polypodium plumula)*	NATIVE, CRITICALLY ENDANGERED
Bermuda Cave Fern	*Ctenitis sloanei*	NATIVE, CRITICALLY ENDANGERED
Marsh Shield Fern	*Thelypteris kunthii (syn. Dryopteris normalis)*	NATIVE
Royal Fern	*Osmunda regalis*	NATIVE
Cinnamon Fern	*Osmunda cinnamomea*	NATIVE
Southern Bracken	*Pteridium caudatum (syn. Aequilinum var. caudatum)*	NATIVE
Ten Day Fern	*Rumohra andiantiformis*	NATIVE
Virginia Chain Fern	*Woodwardia virginica*	NATIVE
Giant Leather Fern	*Acrostichum danaeifolium*	NATIVE
Sword Fern (Boston Fern)	*Nephrolepsis exaltata*	NATIVE
Cut-Leaved Brake	*Anopterus hexagona*	NATIVE
Toothed Spleenwort	*Asplenium trichomanes-dentatum*	NATIVE, ENDANGERED
Parsley Fern	*Asplenium myriophyllum*	NATIVE
Long Spleenwort	*Asplenium heterochroum*	NATIVE, ENDANGERED
Holly Fern	*Cyrtomium falcatum*	INTRODUCED
Creeping Fern	*Phymatosaurus scolopendria*	INTRODUCED
Long-Leaved Brake	*Pteris longifolia*	NATURALIZED, INTRODUCED 1875
Water Fern	*Salvinia minima*	INTRODUCED
New York Fern	*Thelypteris noveboracensis*	NATIVE
Psilotum	*Psilotum nudum*	NATIVE
Olfer's Salvinia	*Salvinia olfersiana*	INTRODUCED

Fern Growth & Reproduction

Ferns belong together with the mosses, algae and horsetails to the group of flowerless plants (see taxonomy chart). They do not produce flowers or seeds and in many cases reproduce by asexual reproduction.

There are more than 10,000 species of ferns. They predominantly grow in moist and shady places. Ferns have true leaves, stems and roots, and also have horizontal rhizomes that grow in the soil helping the fern to spread over its surroundings.

The reproduction of most flowerless plants differs from the usual reproduction of flowering plants. They go through a two-stage reproduction known as alternation of generations. In this, a type of asexual reproduction alternates with true sexual reproduction, involving male and female sex cells. At other times, the plants may reproduce by asexual reproduction alone, for instance by producing new bud-like plants called gemmae.

Ferns evolved when the only other plants around were mosses and fungi. Many ferns live in symbiotic relationships with fungi. Some ferns cannot survive without their accompanying fungi. These fungi are most likely growing around the roots of the ferns.

Most ferns have specialised habitat requirements and this makes them particularly vulnerable to familiar threats such as invasive plants, human activities and climate change.

Classification of Ferns

PLANTS
Kingdom: Plantae

DO THEY HAVE FLOWERS?

YES

Flowering Plants

GYMNOSPERMAE (naked seed)

ANGIOSPERMAE (seeds in fruit)

NO

Non-Flowering Plants

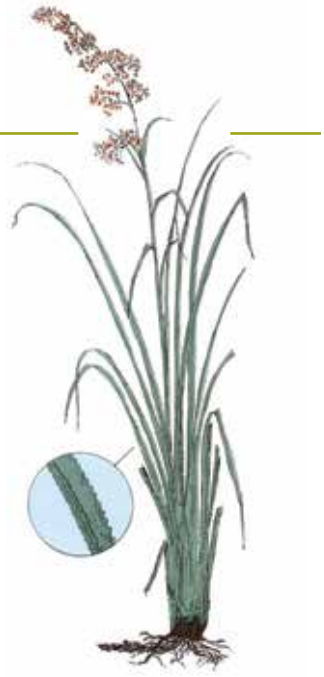
MOSSES **FERNS** **HORSETAILS** **THALLOPHYTA**

ALGAE **LICHENS** **FUNGI**

Sawgrass Habitat

This wet grassland is similar to huge areas of the Florida Everglades, but because the sawgrass is so dominant, few other species can compete. For plant communities it has become a 'monoculture habitat' - a sort of one-plant town. Serrated leaves, which can cut like a razor, give Sawgrass its name.

Sawgrass NATIVE
Cladium jamaicense



Other Plants

Though Sawgrass dominates, look for **Cinnamon Fern** (O*smunda cinnamomea*), **Doc Bush** (*Baccharis glomeruliflora*), **Morning Glory** (*Ipomoea indica*) and **Poison Ivy** (*Toxicodendron radicans*) interspersed in this habitat.

Cinnamon Fern NATIVE
Osmunda cinnamomea

Doc Bush NATIVE
Baccharis glomeruliflora

Morning Glory INTRODUCED INVASIVE
Ipomoea indica

Birds

The sawgrass habitat attracts a variety of birds and is a favourite spot for the migratory **Black and White Warbler** (*Mniotilta varia*), the **Yellowthroat** (*Geothlypis trichas*) and the **Sora Rail** (*Porzana carolina*). 'Rails' hide protected in the Sawgrass.

Black and White Warbler
Mniotilta varia MIGRANT

Common Yellowthroat
Geothlypis trichas MIGRANT

Sora Rail MIGRANT
Porzana carolina

Cedar-Palmetto Forest

Near the end of the boardwalk, you reach an area where the peat is firm and dry enough to support a forest of Bermuda Cedar, Palmetto and the native Wax Myrtle.

Since the first settlers arrived nearly 400 years ago, **Bermuda Cedar** (*Juniperus bermudiana*), with its rich red wood and resistance to decay, has been valued for its many uses – in shipbuilding, house building and furniture making. So valued was it that sometimes plots of Cedar forests were given as a dowry. Additionally, the Cedar berries had a variety of uses including the production of Cedar berry wine or liqueur and cough syrup.

The first settlers also recognised the value of another of Bermuda's endemics, the **Palmetto** (*Sabal bermudana*). The leaves have been used for everything from thatching roofs to making umbrellas, baskets, mats, hats and rope. The hearts may be eaten and the berries are enjoyed by a number of birds and mammals. The sap of the trunk was once tapped and used to make a very strong alcoholic drink called 'Bibby'.

Wax Myrtle (*Morella cerifera*), a native woody bush, is common in peat marshes. In other parts of the world it is called Bayberry and candles are made from the waxy berries of this tree.

Bermuda Cedar ENDEMIC
Juniperus bermudiana

Palmetto ENDEMIC
Sabal bermudana

Wax Myrtle NATIVE
Morella cerifera

Other Plants

In the shade of these trees, ferns – **Cinnamon** (*Osmunda cinnamomea*), **Royal** (*Osmunda regalis*), **Sword** (*Nephrolepis exaltata*) and **Southern Bracken** (*Pteridium caudatum*) dominate the undergrowth. **Virginia Creeper** (*Parthenocissus quinquefolia*), an introduced vine resembling poison ivy, winds its way up many of the Cedars.

Royal Fern NATIVE
Osmunda regalis

Sword Fern NATIVE
Nephrolepis exaltata

Virginia Creeper NATIVE
Parthenocissus quinquefolia

Rare Plants

Two very rare plants can be seen, though not easily, in the shaded ground cover. The **Bermuda Sedge** (*Carex bermudiana*), which looks like a fountain of grass stems, is unique to Bermuda and virtually confined to Paget Marsh. The second is **Psilotum** (*Psilotum nudum*), an extremely primitive rootless plant that looks like a sprig of **Casuarina** (*Casuarina equisetifolia*) foliage.

Bermuda Sedge NATIVE
Carex bermudiana

Psilotum NATIVE
Psilotum nudum

Birds

While you're trying to spot these elusive plants, you may hear a **White-eyed Vireo** (*Vireo griseus*), the bird Bermudians call "Chick-of-the-Village", announce its presence in song. Or a **Myrtle Warbler** (*Dendroica coronata*), the most abundant wintering bird in the marsh, may be flitting and feeding on the Wax Myrtle berries.

Bermuda White-eyed Vireo
Vireo griseus bermudianus
ENDEMIC

Myrtle Warbler MIGRANT
Dendroica coronata

Invasive Species

Invasive species now dominate the flora and fauna of Bermuda so completely that it is impossible for our original heritage to survive without human assistance.

Invasive birds have played a major role in spreading **Brazil Pepper** (*Schinus terebinthifolius*), **Chinese Fan Palm** (*Livistonia chinensis*), **Japanese Pittosporum** (*Pittosporum undulatum*), **Surinam Cherry** (*Eugenia uniflora*) and other species. Chief culprits are the highly mobile **Starling** (*Sturnus vulgaris*), which colonised Bermuda in the 1960s, and the **Great Kiskadee** (*Pitangus sulphuratus*), which was introduced in 1957 as a misguided biological control for the introduced **Anole Lizards** (*Anolis carolinensis*).

Brazil Pepper INVASIVE
Schinus terebinthifolius

Chinese Fan Palm INVASIVE
Livistonia chinensis

Japanese Pittosporum INVASIVE
Pittosporum undulatum

Surinam Cherry INVASIVE
Eugenia uniflora

Starling INVASIVE
Sturnus vulgaris

Great Kiskadee INVASIVE
Pitangus sulphuratus

Three introduced trees – the **Guava** (*Psidium guajava*), the **Marlberry** (*Ardisia sp.*) and the **Chinese Fan Palm** (*Livistonia chinensis*) – were threatening to replace the native plant community with monocultures. Conservation management to cull invasive species and restore the marsh began in 1976. More recent culprits are the **Indian Laurel** (*Ficus microcarpa*), the **Australian Murray Red Gum Tree** (*Eucalyptus camaldulensis*) and the **Australian Umbrella Tree** (*Schefflera actinophylla*). Routine culling ensures that invasive plants, such as these, rarely grow beyond the seedling stage.

Indian Laurel INVASIVE
Ficus microcarpa

Australian Murray Red Gum INVASIVE
Eucalyptus camaldulensis

Australian Umbrella Tree INVASIVE
Schefflera actinophylla

The Red-eared Slider

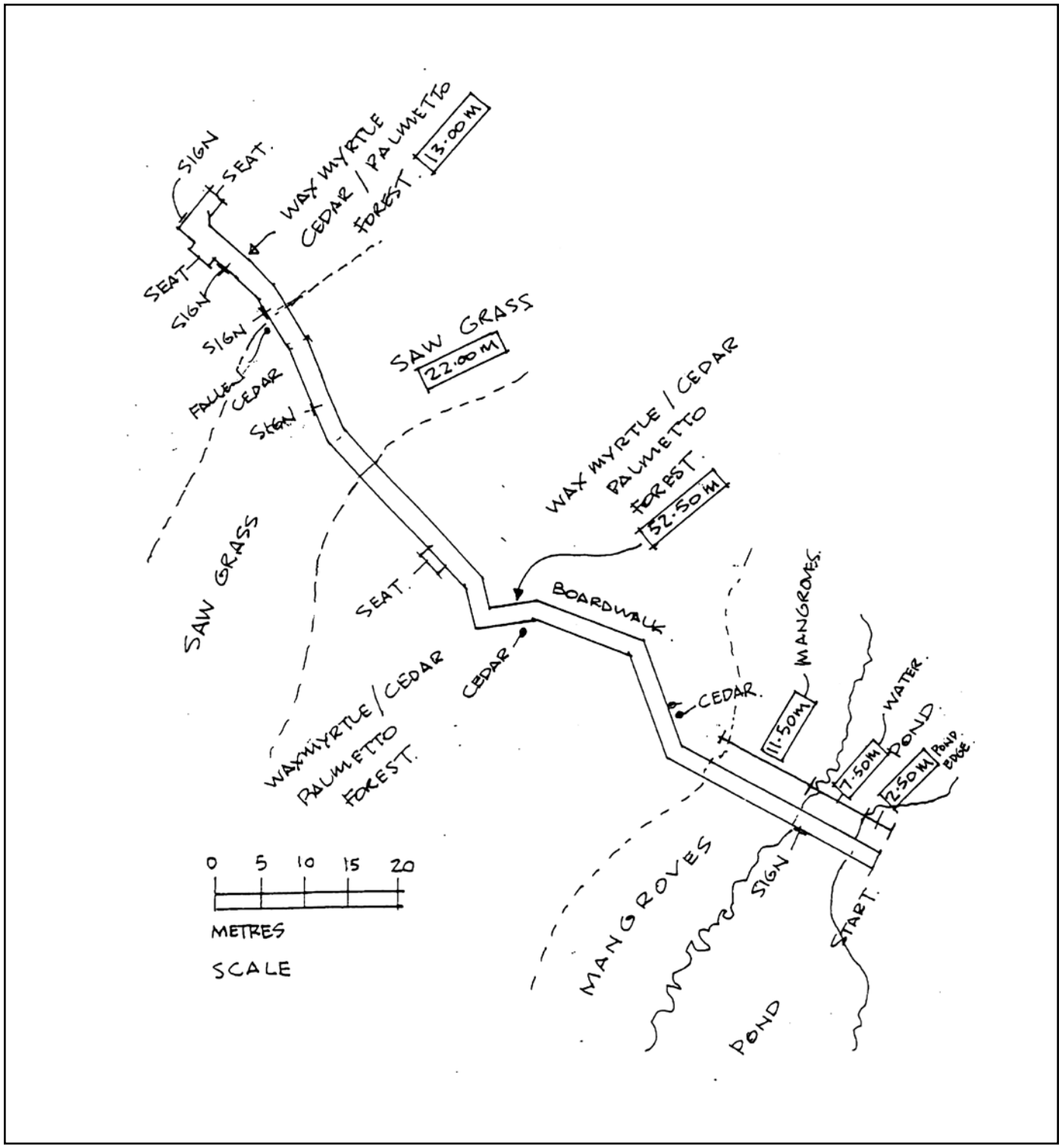
Red-eared Terrapin
Trachemys scripta elegans

INTRODUCED
INVASIVE

An introduced terrapin – the **Red-eared Slider,** (*Trachemys scripta elegans*) – has been enjoying the pond at Paget Marsh. Red-eared Sliders have devastating impacts on pond ecosystems because they eat almost anything including water plants, molluscs, insects and small fish. In Bermuda they eat the **Killifish** (*Fundulus bermudae*) and the **Mosquito Fish** (*Gambusia holbrooki*) which keep the mosquito numbers down. This has serious implications for human health because of mosquito-bourne disease and general wellbeing – no one likes mosquito bites! The Killifish are also endemic to Bermuda and endangered. Like all reptiles, Red-eared Sliders are cold blooded, so they must pull themselves out of the ponds and bask in the sun to warm up their bodies so they can properly digest their food. Unfortunately one of the sliders preferred basking places is on top of the water level nests of wetland birds such as the **American Coot** and **Moorhen**. Sliders are known to crush bird eggs in this way; they also have been known to eat the chicks. The impact of the introduction of Red-eared Sliders on other pond species, like the native **Diamondback Terrapin** (*Malaclemys terrapin*), is unknown. However it is clear that with no predators to keep the population in check, the Red-eared Sliders are significantly upsetting the ecology of Bermuda's ponds.

Most of the Red-eared Sliders in Bermuda's parks and nature reserves were released there by pet owners who no longer wanted them. If you no longer want your terrapin, make the responsible choice and have it put down by your veterinarian or take it to the Department of Conservation Services at 'Shorelands' located adjacent to the Bermuda Aquarium Museum and Zoo parking area.

Paget Marsh
Habitat Location Map



Teacher Resources/Activities

Before your visit/Introducing Students to Paget Marsh

The activities included aspire to engage young minds and foster observation skills and inquisitiveness about our environment. We encourage respect and appreciation for nature and open spaces, and promote knowledge and understanding of the unique features of the reserve.

Curriculum links to all activities are provided in the appendix

✱ACTIVITY 1/PRIMARY 1-3
Science Vocabulary

Primary students should be introduced to or review the following vocabulary as it applies to the reserve before their visit:

Flora: flowers, plants, bushes, trees that live in and around our island

Fauna: birds/animals that live in and around our island

Pond: a small still body of water formed naturally or created artificially

Marsh: low-lying waterlogged land that is poorly drained and liable to flood when it rains

Peat: partly decayed, moisture-absorbing plant matter found in ancient bogs and swamps, used as a plant covering or fuel

Boggy: wet, spongy ground, characterised by decaying mosses that form peat; bog - a marsh or swamp

Habitat: the natural conditions and environment in which a plant or animal lives

Nature Reserve: a managed and protected area of land usually containing rare or endangered plants or animals

Mangroves: an evergreen tree found growing along pond edges with their roots exposed at low tide

✱ACTIVITY 2/PRIMARY 1-3
Geography/Where is Paget Marsh?

Having a visual sense of the reserve's location and where students will be traveling for the upcoming tour helps to build excitement before the visit. This activity also provides a springboard for visiting other Trust reserves – Somerset Long Bay East Nature Reserve, Spittal and Warwick ponds.

This activity also focuses on:

- The location of parishes
- Bodies of water in and around our island
- Learning directional terms, north, south, east, west
- The location of other Trust properties, light houses, caves, tribe roads, forts, the airport, etc.
- A key, which displays symbols that correlate to areas on the map

MATERIALS

- Access to a Smartboard, a computer and printer are needed
- Images of Bermuda maps and Trust properties are available on our website under our teacher resources heading
- Print both maps — one with Trust property locations and one without
- Print images of Trust nature reserves

To expand the activity, teachers can print images of other Trust properties available on our website and find other images of island landmarks online through Google/Images.

Additional Materials: poster board, self-adhesive Velcro, glue sticks and access to a poster size laminator. Local copy stores can enlarge/laminate the map and laminate landmark images.

PREPARATION · BEFORE THE ACTIVITY

- Print the maps of Bermuda. Enlarge the map without nature reserve locations to suit a size large enough for a whole group introductory lesson and laminate for durability. Back the laminated map on a display board
- Print pictures of the nature reserves, back them with poster board and laminate; the recommended size of images – 2" x 2"
- Create and print names of parishes, tribe roads, etc. Google/Images of local landmarks and print as well
- Attach Velcro to the laminated images and the display map in the appropriate locations of Trust properties and refer to the map showing the nature reserve locations as a reference
- Have the display map and images ready for the Paget Marsh introductory lesson
- Log onto the Trust website/education section and display the digital images of Paget Marsh and other Trust nature reserves on a Smartboard; or print 8½ " x 11" size to share with students

DURING THE ACTIVITY

- Ask students if they have visited a local reserve in the past; if so, which one(s). The images shown on the Smartboard or those printed will help them to recall prior visits and/or may instill an interest in visiting nature reserves
- Ask students what they know about nature reserves, what is important about them, and additional information they would like to learn
- Refer to the created display map and landmark signs. Allow students to choose a landmark and place the labeled photo sign its proper location. The map with identified locations can be used as a reference

Note: Once the students have had this introduction to the location of Paget Marsh and other landmarks they can work individually or with a peer to create their own map.

INDIVIDUAL AND PAIRED STUDENT LEARNING

- Print a map for each student; recommended size - 8½" x 14"
- Print photos of nature reserve signs and additional landmarks
- Ensure that students have glue sticks, scissors and pencils
- Students cut out the reserve and landmark signs and glue them in their correct locations, working individually or in pairs

Option: students can draw landmark signs or create them on a computer and print

✱ACTIVITY 3/PRIMARY 4-6
Introduction to Paget Marsh

MATERIALS

• Access to a Smartboard, a computer and printer are needed

Teachers of Upper Primary and Middle levels should assess their students' prior knowledge of nature reserves and the science vocabulary (see Lower Primary Introduction) in preparation for their introduction to Paget Marsh. Creating a classroom map will also benefit students who have not developed an understanding of the reserve's location as well as other important landmarks.

Log on to our website/education section and display the digital images of Paget Marsh and other Trust nature reserves on a Smartboard, or print 8½" x 11" size to share with students.

Review the history and importance of Paget Marsh with students and create:

• A table to show the timeline of how the nature reserve evolved to include a title, dates and description of each period
• The overall importance of Paget Marsh (possible headings: environmental value, peat, pond, green space in heavily developed area)

Differentiation: Teachers can create a time line with students through the use of a Smartboard, a blank table that enables them to complete the information on a computer or by hand. Students can create the table on their own

THE DAY OF THE TOUR TO PAGET MARSH

Tour materials needed - at a glance

Teachers need to:

• Ensure that all students have written parent/guardian consent to attend the tour
• Prepare a register to include the names of students in attendance and their emergency contact
• We ask that the teacher notify the Trust education staff member of any students who do not have consent to be photographed during the tour

What to wear

We advise everyone to wear appropriate clothing, comfortable walking shoes and hats and to apply sunscreen prior to the visit.

Bring the following items:

• First aid kit, a pre-charged cell phone
• Camera and binoculars 'optional' for adults and mature students (who will be responsible for such items)
• Light-weight blanket(s) to allow students to have a 'snack break' during the tour

Materials needed for each student:

• Clipboard, 2 pencils
• Snack and water bottle
• Backpack
• Lunch – if time allows after the tour

Capturing moments during the tour

Teachers are encouraged to bring a camera and photograph the experience and to use the images in activities afterwards. Older mature students can bring a camera (and take responsibility for it) to photograph the experience as well.

Paget Marsh is a showcase of plants, pond life and birds. Binoculars allow students to get a closer look. Suggested activities will include ideas for the use of photographs as a creative way to extend student learning about the reserve.

During your visit/Class Field Trip Activities

The following activities are meant to take place at Paget Marsh during a tour guided by a member of the National Trust Education Staff or teachers who choose to take their students to the reserve on their own.

Primary Level Investigations

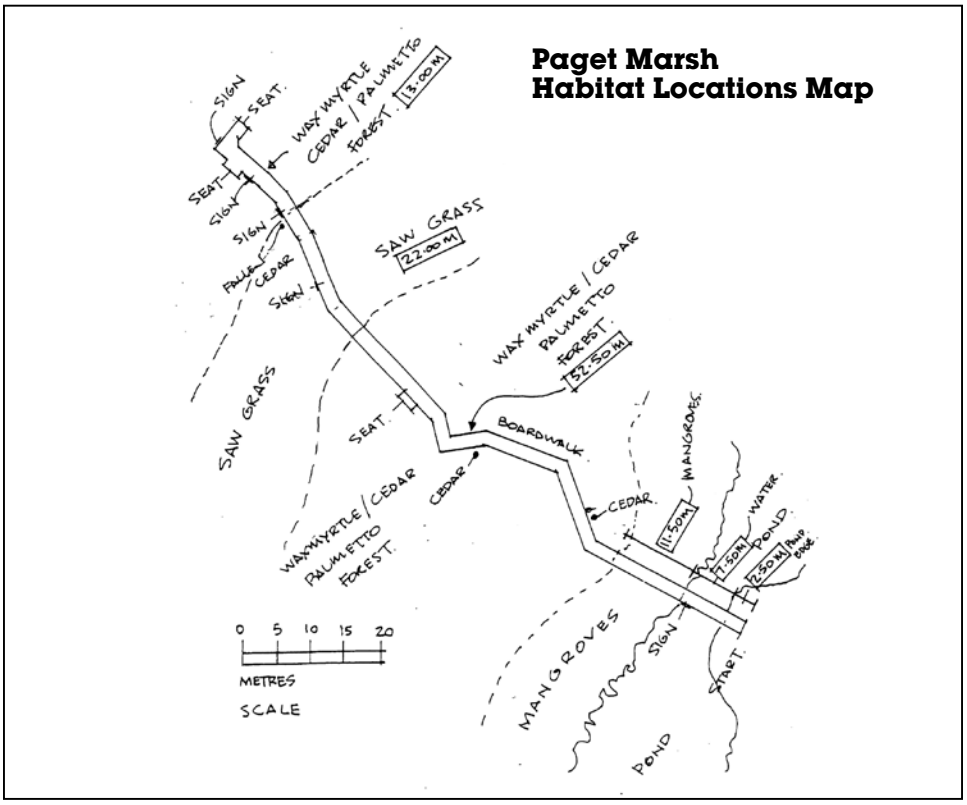
OBJECTIVES/To familiarize students with the habitats at Paget Marsh and the uniqueness of the flora and fauna by:

ACTIVITIES/Students will split into groups and complete the following:

1. Identifying and drawing plants at Paget Marsh - P1-2 and P3-4.
2. Observing and drawing animals in the pond habitat - P1-2 and P3-4.
3. Investigating the components of leaf litter at the edge of the pond.
4. Measuring the boundaries of the habitats along the boardwalk at Paget Marsh.
5. Discovering the formation and importance of Paget Marsh and the problems . the marsh faces
6. Scavenger Hunt.

MATERIALS

- ▫ buckets
- ▫ hand nets
- ▫ magnifying glasses
- ▫ jars with lids
- ▫ pond life identification guides
- ▫ tape measure
- ▫ worksheets
- ▫ pencils & clipboards



See a larger version of this map on page 29

✱ ACTIVITY 1 / PRIMARY 1-2 & 3-4
Identifying & Drawing Plants at Paget Marsh

MATERIALS

- ▫ pencils & clipboards
- ▫ magnifying glasses
- ▫ worksheets

METHOD

1. Go to one of the Paget Marsh habitats along the boardwalk.
(pond, mangrove, sawgrass, or cedar-palmetto forest).
2. Choose three different plants in the habitat.
3. Carefully look at leaves from each of these plants.
4. Sketch the shape of a leaf from each plant.
5. Use a magnifying glass to observe the leaves.
6. Add details to your sketches of leaf shapes.
7. Identify the three plants by using the signs on the boardwalk
Indicate whether they are native/endemic or introduced.
8. Record the conditions of the habitat (wet, dry, sunny, shady, wet soil, dry soil, other).
9. Choose another Paget Marsh habitat along the boardwalk and do the same.

DISCUSSION QUESTIONS

1. How many habitats are there at Paget Marsh?
2. What is it like at the location of each habitat?
(hot, cool, sunny, shady, dry soil, wet soil, acid soil/alkaline soil)
3. How can you tell when one habitat ends and another begins?
4. Why do some plants only grow in certain places at Paget Marsh?
5. What might happen if one of the plant species became extinct?
6. How do plants at Paget Marsh benefit or harm Bermuda?
7. Why are the plants at Paget Marsh special?
8. What did you see or learn today that surprised you the most?
9. Use the animals and plants you saw today to make a food chain or web
10. Find out what adaptations the plants at Paget Marsh have that
have helped them to live there

Identifying & Drawing Plants

Location: _____

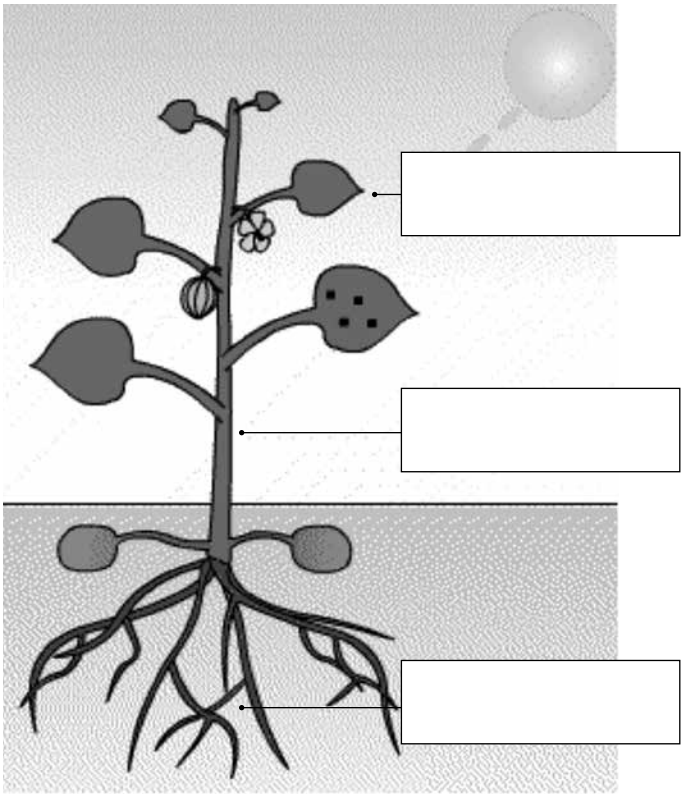
Name: _____

Date: _____

Part #1

Label the three main parts of a plant:

ROOT LEAF STEM



Part #2

Find a plant at Paget Marsh and use a magnifying glass to get a closer look. Draw a picture below of the plant you see Label the parts of the plant as you did in part #1.

ROOT LEAF STEM

✱ACTIVITY 1B/PAGET MARSH/PRIMARY 3-4

Identifying & Drawing Plants

Examine and draw the shapes of a leaf from 3 different plants in 2 different habitats along the boardwalk. Record the conditions of each habitat.

Name: _____

Date: _____

Habitat #1:

Conditions:

PLANT #1:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

PLANT #2:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

PLANT #3:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

Habitat #2:

Conditions:

PLANT #1:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

PLANT #2:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

PLANT #3:

IS THIS PLANT: NATIVE ENDEMIC INTRODUCED

Primary Level Investigations

✱ ACTIVITY 2 / PRIMARY 1-2 & 3-4
Observing & Drawing Animals in the Pond Habitat

MATERIALS

- ▫ pencils & clipboards
- ▫ magnifying glasses
- ▫ worksheets
- ▫ bucket
- ▫ hand nets
- ▫ cups

METHOD

1. Sit quietly for one minute and look in, on and around the pond for any animals.
2. List as many animals as you can see.
3. Fill the bucket with some pond water.
4. Use a hand net to scoop around pond plants to catch other pond animals and put them in the bucket.
5. Look in the bucket and gently scoop out any animals and put them in a cup. Be very careful handling the animals as they bruise easily
6. Use a magnifying glass to examine the animals carefully.
7. Draw and identify any animals you find.

ADDITIONAL ACTIVITIES & QUESTIONS

1. Use the animals and plants you saw today to make a food chain or food web.
2. Find out which animals are herbivores, carnivores or omnivores.
3. Find out what adaptations the animals have that help them survive in the pond.
4. How do these animals benefit Bermuda?
5. What did you see or learn today that surprised you the most?

✱ACTIVITY 2A/PAGET MARSH/PRIMARY 1-2

Observing & Drawing Animals in the Pond Habitat

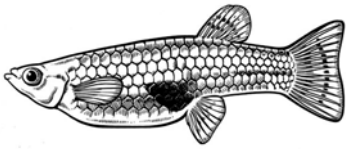
Name: _____

Date: _____

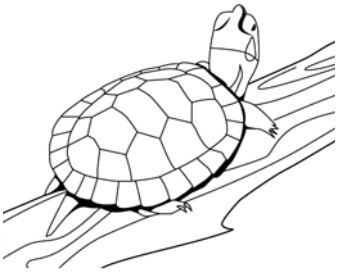
Here are a few animals that live in and around Paget Marsh. Circle those that you see during your visit.

Frog

Bird



Fish



Terrapin

Draw a picture of an animal that you see at Paget Marsh.

✱ACTIVITY 2B/PAGET MARSH/PRIMARY 3-4

Observing & Drawing Animals in the Pond Habitat

Make a list of the animals in, on or near the pond.
Draw 3 animals in this habitat.

Name: _____

Date: _____

LIST THE ANIMALS YOU SEE IN, ON, OR AROUND THE POND:

ANIMAL #1:

IS THIS ANIMAL: NATIVE ENDEMIC INTRODUCED

ANIMAL #2:

IS THIS ANIMAL: NATIVE ENDEMIC INTRODUCED

ANIMAL #3:

IS THIS ANIMAL: NATIVE ENDEMIC INTRODUCED

Primary Level Investigations

✱ACTIVITY 3 /PRIMARY 5-6
Investigating the Components of Leaf Litter

MATERIALS

- ▫ pencils & clipboards
- ▫ magnifying glasses
- ▫ worksheets
- ▫ bucket
- ▫ tray
- ▫ cups
- ▫ bottle of tap water

METHOD

1. Use a cup to scoop some decaying plant matter from the bottom of the pond.
2. Put the plant matter in a tray.
3. List all the different things you see.
4. With a magnifying glass, examine the leaves for look, feel and smell.
5. Draw 3 examples of leaves in various stages of decay. Record your observations for each.

DISCUSSION QUESTIONS

1. What colours are the leaves in the leaf litter?
2. Describe how they feel. Do the different coloured leaves feel different?
3. What is causing the leaves to decay?
4. How do you know that the leaves are decaying? What proof is there?
5. Why are micro-organisms important to Paget Marsh?
6. What might happen if all the micro-organisms died at Paget Marsh?
7. How do micro-organisms benefit people?
8. How do micro-organisms harm people?
9. Draw a food chain or web showing how micro-organisms fit in at Paget Marsh.

✱ACTIVITY 3/PAGET MARSH/PRIMARY 5-6

Investigating the Components of Leaf Litter

Name: _____

Date: _____

1. Use a cup to scoop some decaying plant matter from the bottom of the pond.
2. Put the plant matter in a tray.
3. List all the different things you see.
4. With a magnifying glass, examine the leaves for look, feel and smell.
5. Draw 3 examples of leaves in various stages of decay. Record your observations for each.

LIST ALL THE THINGS YOU FIND IN THE LEAF LITTER:

LEAF #1:

LOOK:

FEEL:

SMELL:

LEAF #2:

LOOK:

FEEL:

SMELL:

LEAF #3:

LOOK:

FEEL:

SMELL:

Primary Level Investigations

✱ACTIVITY 4 /PRIMARY 3-4 & 5
Measuring the Boundaries of the Habitats along the Boardwalk at Paget Marsh

MATERIALS

- ▫ pencils & clipboards
- ▫ tape measure
- ▫ worksheets and maps

METHOD

1. Choose one person to be the walker and measure the length of their shoe from toe to heel. Record your measurement on your worksheet.

2. Have that person walk from heel to toe from the start of the boardwalk to each habitat, counting steps as they go.

3. Write down the number of steps that have been taken from the beginning of the habitat to the end.

4. Multiply the length of the person's shoe by the number of steps recorded for each habitat. Record your findings.

5. Record your measurements on the map.

6. Label each habitat on the map.

DISCUSSION QUESTIONS

1. Which was the longest habitat along the boardwalk?

2. Which was the shortest habitat along the boardwalk?

3. How many habitats did you measure?

4. How many habitats are there at Paget Marsh?

5. How did you know when one habitat ended and a new one began?

6. What was the most difficult part of this exercise?

7. Why are mangroves found close to the pond?

8. Why do you think cedar trees are not found growing right next to the pond?

9. What determines where plants grow in Paget Marsh?

10. What might happen to the habitats at Paget Marsh if the sea level rose?

11. What might happen to the habitats at Paget Marsh if the sea level fell?

✱ACTIVITY 4/PAGET MARSH/PRIMARY 3-4 & 5

Measuring the Boundaries of the Habitats Along the Boardwalk at Paget Marsh

Name of Recorder: _____

Name of Walker: _____

Shoe Length: _____

Date: _____

Measure the shoe length of the walker. Have the walker step heel-to-toe along the boardwalk and count the number of steps in each habitat. Multiply by the shoe length to get the length of the habitat.

HABITAT NAME	NUMBER OF STEPS HEEL TO TOE	X	LENGTH OF SHOE	=	LENGTH OF HABITAT

Primary Level Investigations

✱ ACTIVITY 5 / PRIMARY 4 & 6
Discovering the Formation & Importance of Paget Marsh

MATERIALS

- ▫ pencils & clipboards
- ▫ worksheets

METHOD

1. Using the signs at Paget Marsh, have students answer the questions on the worksheet.

✱ ACTIVITY 6 / PRIMARY 3-4
Junior Scientist Scavenger Hunt

MATERIALS

- ▫ pencils & clipboards
- ▫ worksheets

METHOD

1. Have students split into small groups, allowing them to walk along the boardwalk and the pond areas to locate different items on the worksheet.

✱ACTIVITY 5/PAGET MARSH/PRIMARY 4 & 6
Discovering the Formation & Importance of Paget Marsh

Complete the following questions using the signs at Paget Marsh.

Name: _____

Date: _____

GENERAL INFORMATION

How large is Paget Marsh? _____

Who owns Paget Marsh?

_____ & _____

FORMATION

Approximately _____ years ago during the Ice Age, the sea level was lower and Paget Marsh was a _____ _____ .

Approximately 10,000 years ago, Paget Marsh was flooded through connecting _____ because of a rapid rise in _____ _____ .

Over the past 4,000 years, the connecting caves have filled with _____ . The pond at Paget Marsh is now a _____ (fresh or salt) water pond.

POND LIFE

Name 3 birds you might see near the pond. Put a tick next to their name if you saw them.

☐ **1.** _____

☐ **2.** _____

☐ **3.** _____

Name 2 other animals you might see in, on or near the water. Put a tick if you saw them.

☐ **1.** _____

☐ **2.** _____

☐ **3.** _____

MANGROVE HABITAT

What type of mangrove is at Paget Marsh? _____

What makes this mangove distinctive? _____

What is the native fern growing here? _____

Name one condition it needs to grow. _____

SAWGRASS HABITAT

Where else in the world do you find huge areas of Sawgrass marsh? _____

Why does 'sawgrass' have this name? _____

Name 2 birds found in this habitat. Put a tick next to them if you saw them.

☐ **1.** _____ ☐ **2.** _____

Why is the Sora Rail so well adapted to this habitat?

CEDAR PALMETTO FOREST

Name 2 of the main trees you see in this habitat. Put a tick if you saw them.

☐ **1.** _____ ☐ **2.** _____

Name 3 types of ferns you might see. Put a tick if you saw them. ☐ **1.** _____

☐ **2.** _____ ☐ **3.** _____

Name one of the two unusual native plants you might see here. Put a tick if you saw them.

☐ **1.** _____

INVASIVE SPECIES

Name one invasive plant and one invasive animal found at Paget Marsh.

Plant: _____ Animal: _____

How do invasive plants threaten the Paget Marsh communities? _____

How do invasive birds help spread invasive plants?

✱ACTIVITY 6/PAGET MARSH/PRIMARY 3 & 4

Scavenger Hunt

Name: _____

Date: _____

Walk along the Paget Marsh boardwalk. Identify and record an example of each of the following items without disturbing them.

	ITEMS TO FIND	NOTES: LOCATION, NAME, ETC.
☐	The largest thing	
☐	The smallest thing	
☐	The coldest place	
☐	The warmest place	
☐	A seed, spore or a new shoot	
☐	Something that can be recycled	
☐	Something alive that is camouflaged	
☐	Something with six legs	
☐	Something with wings	
☐	Something that swims	
☐	Something alive that makes a noise	
☐	Something that pollutes	
☐	A home for an animal	
☐	Something that hurts the environment	
☐	Something that helps the environment	
☐	The beginning of something	
☐	A stem, leaf, root	
☐	An interaction between a living and a non-living thing	
☐	An introduced organism	
☐	An invasive organism	

During your visit/Class Field Trip Activities

The following activities are meant to take place at Paget Marsh during a tour guided by a member of the National Trust Education Staff or teachers who choose to take their students to the reserve on their own.

Middle 1 & 3 Level Investigations

PURPOSE/To identify the different habitats at Paget Marsh, the different species in each habitat and their roles and to identify factors affecting the distribution of species around the pond.

ACTIVITIES/Students will split into groups and complete the following:

1. Marsh Habitat Investigation.
2. Seniors Scavenger Hunt.

MATERIALS

- ▫ pencils & clipboards
- ▫ worksheets
- ▫ plant identification guides
- ▫ pond life identification guides
- ▫ index cards
- ▫ magnifying glasses
- ▫ metre sticks (4 for each group)
- ▫ pH paper (optional)

✱ACTIVITY 7
Marsh Habitat Investigation

MATERIALS

- ▫ pencils & clipboards
- ▫ worksheets
- ▫ plant identification guides
- ▫ metre sticks (4 for each group)
- ▫ pH paper (optional)

METHOD

1. Observe the length of the boardwalk and note the location of the different habitats.
2. Sketch the approximate locations of the habitats onto the map and label them.
3. Divide into 4 groups to examine one habitat each in more detail.
4. At each habitat, place the metre sticks to form a square (also called a quadrant) and isolate an area on the boardwalk. This will be your 'sample quadrant' for this area. (Be careful not to drop your sticks over the side of the boardwalk as there is poison ivy throughout this area).
5. Record the following information on the data sheets:
   - **a.** Identify and count the number of each species in the quadrant.
   - **b.** Determine whether each organism is a producer (P), consumer (C) or decomposer (D).
   - **c.** Determine the predominant species in the quadrant.
   - **d.** Look around the habitat and determine the predominant species in the habitat.
   - **e.** Determine what other species are also in this habitat, but not in the quadrant.
   - **f.** Determine the abiotic and biotic factors that influence this habitat (abiotic – nonliving things, biotic – living things).
6. Stand or sit quietly for 10 minutes. Record what you hear, see and smell around you.

✱ACTIVITY 1/PAGET MARSH/MIDDLE

Paget Marsh Habitat Investigation

Names of persons recording: _____

Habitat: _____

Site: _____ **Date:** _____

From the boardwalk, select a habitat and list the species found in a quadrant and in the general vicinity. Identify the abiotic and biotic factors in this habitat.

Species found in quadrant	Number of individuals for each species	P (producer) C (consumer) D (decomposer)

Predominant species in quadrant (one species): _____

Predominant species in general vicinity (one species): _____

Other species in general vicinity: _____

Abiotic Factors (temperature, wind, pH, light, etc.) _____

Biotic Factors (competition, predators, disease, parasites, etc.) _____

Paget Marsh Habitat Investigation Discussion Questions

Categorising Species

1. What is the predominant species in each habitat?
2. Which habitat had the most producers, consumers, decomposers? Why?
3. Which habitat had the most native and endemic species? Why?
4. Which habitat had the most introduced species? Why?
5. What invasive species are in each habitat? What problems do invasive species cause?
6. Are any of Bermuda's plants or animals endangered? What efforts are being made to protect them?

Variety within Habitats

1. Which habitat has the highest variety?
   a. What were the abiotic and biotic factors in that habitat?
   b. Why do you think variety is highest in that habitat?
   c. What are some limiting factors at work in this habitat?
   d. What are some adaptations that organisms might have to be able to live in this habitat?
2. Where was the lowest diversity?
   a. What were the abiotic and biotic factors at that point?
   b. Why do you think there was low diversity there?
   c. What are some limiting factors at work in this habitat?
   d. What are some adaptations that organisms might have to be able to live in this habitat?
3. What are the benefits of high biodiversity in an area?
4. What could cause the biodiversity of a pond or marsh to decrease?

Zonation in an Ecosystem

1. Why do the habitats form?
2. What might cause the borders of the habitats to change?
3. What do you think are limiting factors in each habitat?
4. What might happen if the following occurred:
   a. Road run-off was directed into the pond?
   b. Waste from the nearby drycleaners was dumped directly into the pond?
   c. The pond was not managed by conservation organizations?

Energy Flow in an Ecosystem

1. Make up a food chain that could occur in each habitat.
2. Use your food chains to make a food web. You may have to add more organisms to create the extra links necessary to construct a food web.

Progression

1. How do you think the pond might have looked 20 years ago?
2. How do you think the pond might look 20 years in the future?

Human Interaction

1. How do humans interact with ponds?
2. What benefits do humans gain from ponds?
3. How are ponds beneficial to the environment?
4. Investigate how the early settlers to Bermuda used the plants they found.

Global Context

1. Compare the species found in the Bermuda pond to those commonly found in a pond in the USA or the UK.
2. Compare the species diversity of the Sawgrass habitat to the species diversity found in the sawgrass swamps of Florida. Why is there a difference?
3. What other kinds of wetlands are there in the world other than freshwater ponds? Describe the types of animals and plants in them.
4. Investigate mangrove swamps in other parts of the world. Of what benefit are they to the environment? To humans?
5. Investigate migratory patterns of birds or butterflies.

✱ACTIVITY 8
Senior Scavenger Hunt

PURPOSE

- To assess students' knowledge of classification, biology of organisms, evolution, ecological relationships and use of research tools.
- To allow students to collaborate and share ideas, talents and efforts while working towards a common goal.
- To engage students in the learning process; to be directly involved in accumulating knowledge.

MATERIALS

- ▫ pencils & clipboards
- ▫ worksheets
- ▫ index cards
- ▫ magnifying glasses
- ▫ pond life identification guides

METHOD

1. Divide students into teams of 4 students.
2. Each team must "collect" examples of the items on the scavenger list and determine how best to display them. Animals and plants are hand drawn and are NOT to be removed.
3. Items need to be identified in drawings, labeled and described.
4. Items are worth either one or two points depending on their complexity.

ASSESSMENT & EVALUATION

Students are assessed based on several criteria. Points are awarded for collaborative effort and for following the rules. Credit points are awarded for the variety of items collected (drawn) and the quality of the presentation.

✱ACTIVITY 2/PAGET MARSH/MIDDLE 1 & 3
Senior Scavenger Hunt

Name: _____

Date: _____

Draw an example of each of the following items on an index card. Identify the specimen; note the date, location and 'collector'. Label and describe each specimen.

WORTH 1 POINT EACH

- ☐ an arthropod
- ☐ an insect
- ☐ an arachnid
- ☐ a reptile
- ☐ an amphibian
- ☐ a mollusk
- ☐ a dicot plant (plant with two leaves at germination)
- ☐ a monocot plant (plant with a single seed leaf)
- ☐ a fungus
- ☐ a resident bird
- ☐ a migratory bird
- ☐ a mammal
- ☐ an organism's home
- ☐ the reproductive structure of a plant
- ☐ a gymnosperm (woody cone-bearing plant)
- ☐ an angiosperm (flowering plant)
- ☐ a bryophyte (non-flowering simple plant)
- ☐ a fern
- ☐ seed dispersal by animals
- ☐ seed dispersal by wind or water
- ☐ an animal larva or pupa

WORTH 2 POINTS EACH

- ☐ a food chain
- ☐ a food web
- ☐ two different life stages of the same organism
- ☐ the interaction between an invasive animal and invasive plant
- ☐ an environmental disaster
- ☐ an environmental success
- ☐ genetic variation within a population
- ☐ sporophyte and gametophyte (generations of the same plant)
- ☐ example of a plant adaptation
- ☐ example of an animal adaptation
- ☐ an example of asexual reproduction
- ☐ territorial behaviour in animals
- ☐ mating behaviour in animals
- ☐ an example of mutualism (advantageous relationship between species)
- ☐ an example of commensalism
- ☐ relationship between two different species, in which one benefits, while the other remains unharmed and unaffected
- ☐ a parasite and host
- ☐ a population
- ☐ a community

ACTIVITY 9
Toadling Abnormalities

While walking through the marsh one day you discover a number of toadlings that appear to be deformed. Some have missing limbs, others have skin abnormalities. Your task is to determine what might be causing these abnormalities and deformities. You also need to make a case for a solution of the problem. Your report must include statistics and diagrams if applicable. Finally, make a prediction about the environmental effects of not allowing toads to breed in the marsh.

ACTIVITY 10
Population & Land Use Comparison

The island of Manhattan in New York City is approximately the same geographical size as Bermuda. In 1810 the population of Manhattan was 96,000 people. In 1830 the population of Bermuda was 9,000 people. Currently the population in Bermuda is about 60,000 people while the population in Manhattan is 1,500,000 people. How has Manhattan used its land resources in comparison to Bermuda? If Bermuda's population tripled to 180,000 people predict how land use would change. Predict the effect on open space, sustainable development and infrastructure.

ACTIVITY 11
Preserving Paget Marsh

Generally in Bermuda residents maintain well-kept gardens. Landscaping is a big business in Bermuda. Paget Marsh has remained unchanged for thousands of years. Because of human encroachment intervention is necessary to maintain the original ecosystem in the marsh. You are in charge of the preservation of the marsh. What will you do? Make a prediction about what will happen if nothing is done.

ACTIVITY 12
Environmental Impact of the Release of Pets

Before the arrival of man skinks, cahows and longtails were the main resident terrestrials in Bermuda. Since the settlement of Bermuda the native fauna and flora including cedars have all been seriously reduced. The first visitors to Bermuda introduced pigs, rats and seeds of foreign plants. Many residents keep pets, i.e. dogs, cats, fish, turtles, birds etc. The government also receives requests for the importation of other pets such as ferrets and snakes. Red-eared Slider Terrapins have been observed in a number of ponds. There are also now feral cats, rabbits and chickens in the ecosystem. What is the impact of all of this? What preventive and corrective steps should be taken? For your consideration, some countries allow hunting during the winter months with rifles and bows to cull populations. Predict the environmental impact if many pets were released into the wild. Your problem solution should include data collection, observation records of feral animal habitats, import information on exotic pets and top sellers in pet stores.

After your visit/Additional Information & Activities

Activities listed in this section encourage students to learn further with the help of seven fun and engaging activities.

OBJECTIVES

- To summarise students' learning
- To reflect on the field trip experience

✱ACTIVITY 1/PRIMARY 6 · MIDDLE 1 & 3
Protecting the Communities within Paget Marsh Nature Reserve

Map out the different communities within the reserve: pond, mangrove habitat, sawgrass habitat and forest. Discuss what changes have occurred to this area over time and those which may occur in the future. How have humans influenced the reserve? How can we protect this natural resource? Write a description of the nature reserve as a guide for future visitors and include how every visitor can protect and preserve nature reserves on the island.

✱ACTIVITY 2/PRIMARY 6 · MIDDLE 1 & 3
Major Plants, Invertebrates, Vertebrates at Paget Marsh Nature Reserve

List the plants and other animals you saw at the reserve. Discuss their features and what makes them suitable to live in the area. Write a description of the plants and animals.

✱ACTIVITY 3/PRIMARY 6 · MIDDLE 1 & 3
Food Chains at Paget Marsh Nature Reserve

Identify food chains within the communities at the reserve. Who are producers, consumers, decomposers? Draw an ecological trophic pyramid or diagram to show how they relate to each other.

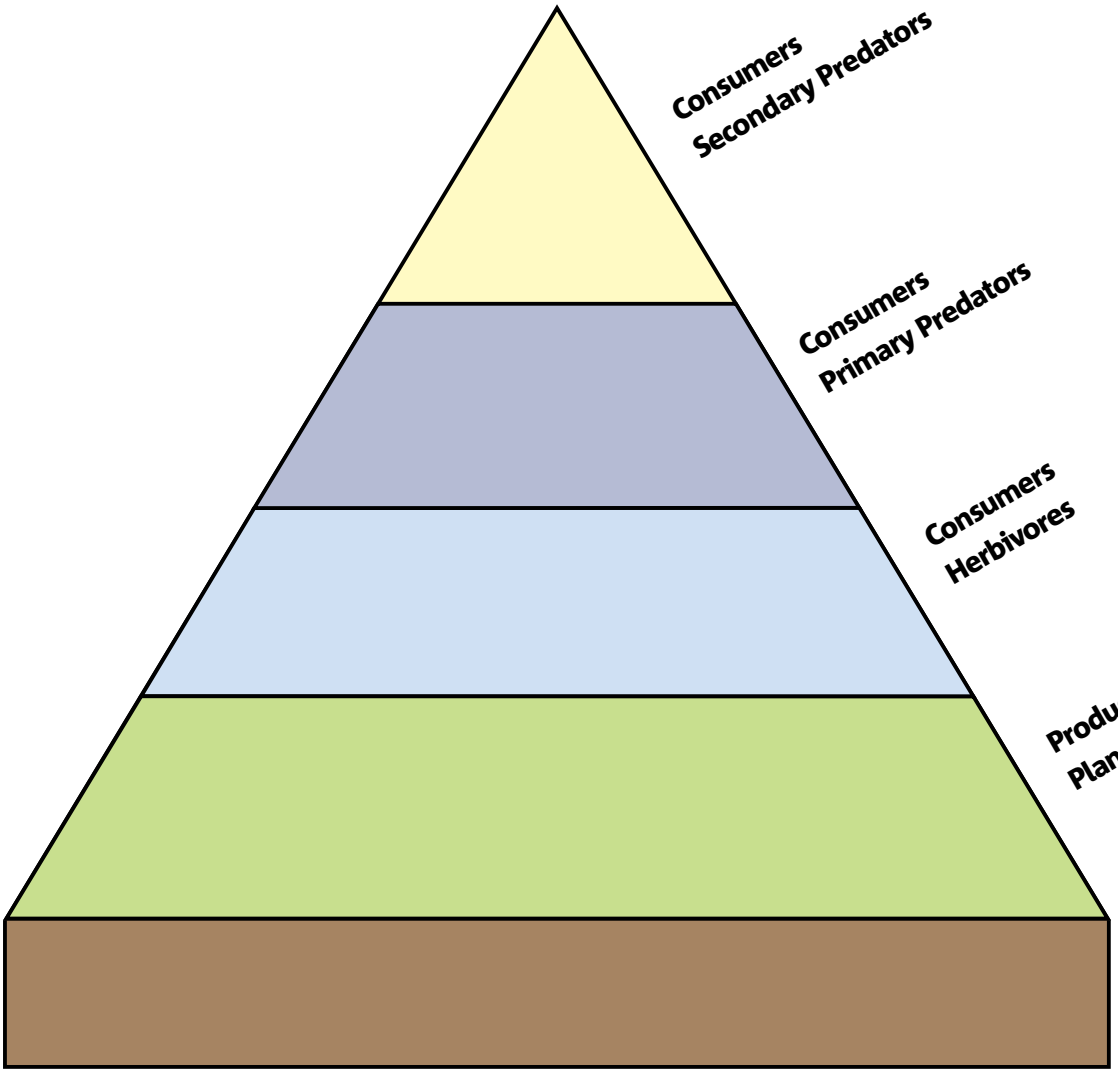
✱ACTIVITY 3/PAGET MARSH/PRIMARY 6 · MIDDLE 1 & 3

Trophic Pyramid of Paget Marsh Community

Identify food chains within the communities at the reserve. Who are producers, consumers, decomposers and predators? Draw an ecological trophic pyramid or diagram to show how they relate to each other.

Name: _____

Date: _____



Decomposers
Bacteria and Fungi

Appendix

✤ APPENDIX · ACTIVITY 1

My Visit to Paget Marsh Nature Reserve

Name: _____

Date: _____

1. Paget Marsh Nature Reserve is located in .....parish.

2. I visited on (date) .....

3. Three interesting plants I saw were: .....

4. Three interesting animals I saw were:

5. While I was at Paget Marsh Nature Reserve I learned about different habitats. Here are a few that are in the reserve.

6. My favorite experience at Paget Marsh Nature Reserve was.....

Glossary

Abundant: present in great quantity; more than adequate; oversufficient

Accumulate: to gather into a heap or mass; to form a steadily increasing quantity

Biological control: the use of living organisms to control pests

Bog: freshwater wetland dominated by moss

Colonise: to establish a territory

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

Conservation Officer: A person whose job is to advocate or strongly promote preservation and careful management of natural resources and the environment

Decompose: to separate or break down into constituent parts or elements

Development: The act or process of growing, progressing, or development

Distinct: different; not identical

Dominant: The most important organism in a community. Usually taken as the one contributing the greatest biomass

Ecological community: a naturally occurring group of organisms

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

Encroach: to advance beyond proper, established, or usual limits

Endemic species: a species which evolves to a new species after colonisation of a new area

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

Excavate: to make a hole or cavity by removing material

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

Fragment: an isolated, unfinished, or incomplete part

Global warming: an increase in the earth's average atmospheric temperature that causes corresponding changes in climate resulting from the greenhouse effect

Habitat: the place or type of place where a plant or animal naturally or normally lives or grows

Implement: to put into effect according to, or by means of, a definite plan or procedure

Inhospitable: not offering shelter or favourable conditions

Introduced species: a species transferred to a new location by man, either accidentally or on purpose

Invasive: spreads aggressively by itself

Isolated: separated from other things; alone and solitary

Lush: richly abundant and luxuriant vegetation

Migratory/Migration: going from one country, region, or place to another

Native species: a species which arrived in a new area by natural means and subsequently reproduced and survived

Peat: an organic material in marshy regions, composed or partially decayed vegetation

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

Predator: an animal that lives by killing and eating other animals

Preserve: to keep alive or in existence; make lasting

Prop roots: an adventitious (in an abnormal position or place) root that supports the plant

Rapid: occurring within a short time; happening quickly

Reclaim: to claim or demand the return or restoration of something, as a right, possession

Resistance: the act or power of opposing or withstanding another

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

Sequential: following one thing after another; a continuous or connected series

Stabilise: to establish a consistent condition; to make steady and able to last without change

Stagnate: to be or become stale, ceasing to flow

Threat: an indication of warning or probable trouble

Tranquil: free from commotion or disturbances; peaceful and calm

Vegetation: all the plant life of a place, taken as a whole.

Paget Marsh Nature Reserve
Teacher Resources

Activities & Curriculum Links

Before your visit/ Introducing Students to Paget Marsh Nature Reserve

Activity	Grade Level	Subject	Curriculum Link
Activity 1 Science Vocabulary **Activity 2** Geography Where is Paget Marsh? **Activity 3** Introduction to Paget Marsh Nature Reserve	Primary 1, 2, 3	Social Studies	**P1** – Understand the concept of a map. Identify a map of the island of Bermuda . **P2** – Be able to connect places with their correct parish. **P3** – Create and interpret simple maps. Indentify, draw or model and describe Bermuda's landforms, bodies of water, identify bridges, parishes and places as noted in the P1 and P2 curriculum.
	Primary 4-6	Social Studies	**P4** – Create and interpret maps of Bermuda, using cardinal signs, symbols and simple legends; identify and describe major land forms and water bodies in Bermuda. **P5** – Use cardinal and intermediate directions, latitude and longitude to locate specific points in the community. **P6** – Use physical and thematic maps to make comparisons about natural resources and natural vegetation.
		Information Technology	**P4, 5, 6** – Manage computer generated documents. Format text using a word processor. Use graphic software tools.

During your visit/Class Field Trip Activities

Primary Level Investigations

Activity	Grade Level	Subject	Curriculum Link
Activity 1 Identifying and Drawing Plants	Primary 1-2 Primary 3-4	Science	**P1** – Know animals or plants are living things. Know that there are living things and things that have never been alive. Explore ways that different animals and plant inhabit local environments. **P2** – Can identify similarities and differences between local environments and know about some of the ways in which these affect the animals and plants found there. **P3** – Can sort things into groups using simple features and describe rational for groupings. **P4** – Investigate how different animals are found in different habitats and are suited to the environment in which they are found. Can use simple identification keys.
Activity 2 Observing and Drawing Animals in the Pond Habitat	Primary 1-2 Primary 3-4	Science	**P1** – Know animals or plants are living things. Know that there are living things and things that have never been alive. Explore ways that different animals and plant inhabit local environments. **P2** – Can identify similarities and differences between local environments and know about some of the ways in which these affect the animals and plants found there. **P3** – Can sort things into groups using simple features and describe rational for groupings. **P4** – Investigate how different animals are found in different habitats and are suited to the environment in which they are found. Can use simple identification keys.
Activity 3 Investigating the Components of Leaf Litter	Primary 5, 6	Science Social Studies	**P6** – Children have explored and can construct food chains in the environment. **P5** – Explain the impact of population increases on the environment. Explain how people in Bermuda have adapted to and changed the environment over time. **P6** – Explain how the human and natural alterations of the physical environment have produced positive and negative effects on the environment. Demonstrate how people can work together to solve /prevent environmental problems and prevent future ones.

Primary Level Investigations continued

Activity	Grade Level	Subject	Curriculum Link
Activity 4 Measuring the Boundaries of the Habitats Along the Boardwalk at Paget Marsh	Primary 3, 4, 5	Math	**P3** – Choose and use appropriate units and equipment to estimate, measure and record measurements. Answer a real-life question by collecting, organising and interpreting data. **P4** – Choose and use standard metric units and their abbreviations when estimating, measuring and recording length, weight and capacity. Answer a question by indentifying what data to collect, organizing, presenting and interpreting data in tables. **P5** – Read, choose, use and record standard units to estimate and measure length, mass and capacity to a suitable degree of accuracy.
Activity 5 Discovering the Formation and Importance of Paget Marsh	Primary 4 Primary 4, 5, 6	Science Social Studies	**P4** – Investigate how different animals are found in different habitats and are suited to the environment in which they are found. Can use simple identification keys. **P4** – Identify and describe major land forms and water bodies in Bermuda. **P5** – Explain how people in Bermuda have adapted to and changed the environment over time. **P6** – Explain how the human and natural alterations of the physical environment have produced positive and negative effects on the environment. Demonstrate how people can work together to solve/prevent environmental problems and prevent future ones.
Activity 6 Jr. Scavenger Hunt			**P3-4** – Reading non-fiction **P3** – Can sort things into groups using simple features and describe rational for groupings. **P4** – Investigate how different animals are found in different habitats and are suited to the environment in which they are found. Can use simple identification keys.

During your visit/Class Field Trip Activities

Middle Level Investigations

Activity	Grade Level	Subject	Curriculum Link
Activity 1 Marsh Habitat Investigation	Middle 1 & 3	Math	**M1** – Choose suitable units of measurements to estimate, measure, calculate and solve problems in everyday contexts. **M3** – Solve problems involving measurements in a variety of contexts.
		Science	**M1** – Understand what is meant by a species. Classify animals and plants into major groups, using some locally occurring examples. **M3** – Use and construct keys to identify plants and animals.
Activity 2 Middle Level Scavenger Hunt	Middle 1 & 3	Science	**M1** – Recognise the positions and know the functions of the major organs of flowering plants. Classify animals and plants into major groups, using some locally occurring examples. **M3** – Understand sexual reproduction in flowering plants. Explain the ways in which living things are adapted to their habitats. Explain and model food chains and food webs.
Activity 3 Toadling Abnormalities	Middle 1 & 3	Science	**M1** – Discuss positive and negative influence of humans on the environment. **M3** – Describe and investigate some effects of human influences on the environment.
		Social Studies	**M3** – Investigate at least two environmental threats to Bermuda
Activity 4 Population and Land Use Comparison	Middle 1 & 3	Science	**M1** – Discuss positive and negative influence of humans on the environment. **M3** – Describe factors affecting the size of populations. Describe and investigate some effects of human influences on the environment.
		Social Studies	**M3** – Develop an understanding of sustainable development.
Activity 5 Preserving Paget Marsh	Middle 3	Social Studies	**M3** – Investigate at least two environmental threats to Bermuda. Develop an understanding of sustainable development.
Activity 6 Environmental Impact of the Release of Pets Into the Wild	Middle 1 & 3	Science	**M1** – Discuss positive and negative influence of humans on the environment. **M3** – Describe and investigate some effects of human influences on the environment.
		Social Studies	**M3** – Investigate at least two environmental threats to Bermuda.

After your visit/Additional Information & Activities

Activity	Grade Level	Subject	Curriculum Link
Activity 1 Protecting the Communities within Paget Marsh Nature Reserve	Primary 6	English	P6 – Reading and writing non-fiction.
	Primary 6	Social Studies	P6 – Use physical and thematic maps to make comparisons about natural resources and natural vegetation. Explain how the human and natural alterations have produced positive and negative consequences.
	Middle – 1	Science	M1 – Discuss positive and negative influence of humans on the environment.
	Middle - 3	Science	M3 – Explain the ways in which living things are adapted to their habitats. Describe factors affecting the size of populations.
Activity 2 Major Plants, Invertebrates, Vertebrates at Paget Marsh Nature Reserve	Middle - 3	Science	M3 – Explain the ways in which living things are adapted to their habitats.
Activity 3 Food Chains at Paget Marsh Nature Reserve	Primary 6	Science	P6 – Children have explored and can construct food chains in a particular habitat.
	Middle 1	Science	M1 – Draw and model simple food chains.
	Middle 3	Science	M3 – Explain and model food chains, food webs

References

Amos, E. J. R. *A Guide to the Birds of Bermuda*. E.J.R. Amos, Warwick, Bermuda 1991.

Bermuda Zoological Society *Bermuda Wetlands, Project Nature, Field Study Guides for Bermuda Habitats*. Bermuda Zoological Society, Bermuda 2001.

Bermuda Zoological Society *The Bermuda Forests, Project Nature, Field Study Guides for Bermuda Habitats*. Bermuda Zoological Society, Bermuda 2001.

Bermuda Zoological Society *Project Nature, Eco-File, Information Sheets on Bermuda's Natural History.* Bermuda Zoological Society, Bermuda 1995.

Collett, Jill *Bermuda: Her Plants and Gardens 1609-1850* MacMillan, Bermuda National Trust, London 1987.

Ministry of the Environment *Growing With Trees, Millennium Tree Planting Guide.* Ministry of the Environment 2000.

Peterson, Roger Tory *A Field Guide to the Birds of Eastern and Central North America.* Houghton Mifflin Company, Boston 1980.

Phillips-Watlington, Christine *A Field Guide to Bermuda's Botanical Wonderland*. MacMillan Education Ltd. 1996.

Wetlands Websites

The Ramsar Convention on Wetlands
http://www.ramsar.org/

Lost Wetlands
http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/peril_wetlands.html

US Fish & Wildlife Service, National Wetlands Inventory
http://www.nwi.fws.gov/

US Fish & Wildlife Service, National Wetlands Inventory Kids & Teachers Page
http://www.nwi.fws.gov/educator.htm

Wetlands - National Wildlife Federation
http://www.nwf.org/wetlands/

EPA Office of Water Wetlands
http://www.epa.gov/owow/wetlands/