

Flora and Fauna of the Bermuda Protected Species Act (2003)



2016



GOVERNMENT OF BERMUDA
MINISTRY OF THE ENVIRONMENT
Department of Environment and Natural Resources

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Bermuda and the surrounding reef platform, 1998

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Introduction

The Protected Species Act 2003 (the Act) provides the Government with the ability to conserve, protect and lead the recovery of Bermuda's most threatened plants and animals, including the Cahow (Bermuda's National Bird), the Bermuda Skink (one of the world's oldest and rarest rock lizards), Bermuda Killifish (now only found in a few land-locked ponds) and the Governor Laffan's Fern (a plant that is extinct in the wild). These species serve, as much as anything else, to promote the truly unique identity of Bermuda.

Unfortunately, many of our native and endemic species are under threat due to a combination of habitat loss, competition from invasive species, predation, climate change and pollution.

It is the role of the Department of Environment and Natural Resources to oversee the recovery of our imperiled plants and animals through the development and implementation of recovery plans and to raise awareness of their importance through educational programs run by the Bermuda Aquarium, Museum and Zoo.

This document has been developed to provide the reader with information relevant to each species protected under the Act.

Cahow



Governor Laffan's Fern



Skink



Killifish



Legislation

Bermuda has a number of pieces of legislation that protect its unique ecology, including the Fisheries Act 1972 and the Protection of Birds Act 1975; however the main piece of legislation is the Protected Species Act 2003 and the subsequent Protected Species Orders listing individual threatened species.

Purpose of legislation

The Protected Species Act 2003 provides delegated responsibility to the Director of the Department of Environment and Natural Resources to conserve, protect and recover plants and animals that are identified as threatened in Bermuda.

Goal

The goal of the Act is to promote recovery of threatened species to the point where they no longer need human support and can be removed from the list of protected species.

Objectives

1. To protect threatened species.
2. To recover threatened species to the point that they are self-sustaining and no longer need protection. This can be done

through actions that enable conservation of a protected species, e.g. monitoring, assessment, research, restoration, maintenance and management.

3. To encourage human assistance in the preservation and recovery of protected species where possible.
4. To protect critical habitats.

How species are nominated

The Act allows for any threatened species to be nominated so as to safeguard and maintain them and protect Bermuda's special and fragile natural resources. Species nominations are based upon consideration of status (e.g. endemic or native), abundance, global and local distribution, identified natural and manmade threats (potential or existing) e.g. destruction of habitat, over-exploitation, disease, predatory behavior of other species, and use of chemicals.

Each species is classified as **Critically Endangered** (CR), **Endangered** (EN), **Vulnerable** (VU), **Near Threatened** (NT), or **Least Concern** (LC) in accordance with the criteria set out in the International Union for the Conservation of Nature (IUCN).

The science behind the IUCN Red List Categories and Criteria can be understood by visiting www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria

Levels of protection for protected species

The level of protection is not only based on how threatened the species is but also determined on the optimal strategy for its recovery.

Level 1

- a) A high level of expertise is required for each stage of recovery.
- b) Optimal strategy for recovery of the species involves licensed researchers only.
- c) No community involvement is permitted in the conservation of the species.

Level 2

- a) A medium level of expertise is required for each stage of recovery.
- b) Optimal strategy for recovery of the species involves licensed researchers and individuals holding permits to undertake a defined action e.g. relocation.
- c) Community involvement in the conservation of the species is restricted to individuals holding permits.

Level 3

- a) A low level of expertise is required for each stage of recovery or:
- b) Optimal strategy for recovery of the species involves the general community.
- c) General community involvement is permitted in the conservation of the species.

Powers of legislation

1. To protect any species so as to safeguard and maintain threatened species and protect Bermuda's special and fragile natural resources.
2. To classify a species and determine the appropriate level of protection.
3. To create or designate critical habitat(s).
4. To create **Recovery Plans** for threatened species.
5. To license interaction with protected species for scientific research, exhibition, aquaculture, horticulture, reintroduction into the wild and/or rehabilitation of injured specimens.
6. To permit relocation, restoration, and/or destruction under exceptional circumstances. If destruction is permitted then the proponent has a duty to undertake mitigation action to minimise the negative impact to the species or critical habitat. Destruction is the last course of action, where human health or a structure is at risk, or in the case of critical habitat, to address an area affected by disease that will impact the overall health of a protected species.
7. To authorize officers to seize, enter, stop, or detain anyone when they have reasonable grounds for suspecting an offense has been committed against the Act.

8. Penalties for offenses

- Level 1 – up to \$25,000
- Level 2 – up to \$15,000
- Level 3 – up to \$5,000

See Section 9 of the Protected Species Act 2003 for description of offenses.

Process for listing and delisting species

Under Section 12 of the Act species shall be listed, modified or delisted by an Order approved by Cabinet, followed by gazetting of a *Protected Species Notice of Intention* and a 30 day public consultation period during which proposals can be viewed on line or physically at the Department's headquarters. After the consultation period the Order is made and laid before Parliament.

For further information

Contact:

#17 North Shore Road, Flatt's, FL04, Bermuda

T: (441) 293-2727

Email: enviro@gov.bm

www.environment.bm



The native Yellowwood tree being propagated at a Nursery, 2014



Injured Longtail being cared for at the Bermuda Aquarium, Museum and Zoo, 2015

Definitions

Other local legislation

Protection of Birds Act 1975. All birds, with the exception of six pest bird species, are protected under this Act.

Fisheries Act 1972 & Fisheries Protected Order 1978 protects a number of marine species (see [www.bermulaws.bm/Laws/Consolidated%20Laws/Fisheries%20\(Protected%20Species\)%20Order%201978.pdf](http://www.bermulaws.bm/Laws/Consolidated%20Laws/Fisheries%20(Protected%20Species)%20Order%201978.pdf)).

Note: a number of species are protected by both the Protected Species Act 2003 and the Fisheries Act 1972.

Endangered Plants and Animals Act 2006. A number of species are protected from import and export due to their globally threatened status.

International legislation and treaties

International Union for the Conservation of Nature Red List of Threatened Species (IUCN). The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species.

The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies.

According to IUCN (1996), the formally stated goals of the Red List are (1) to provide scientifically based information on the status of species and subspecies at a global level, (2) to draw attention to the magnitude and importance of threatened biodiversity, (3) to influence national and international policy and decision-making, and (4) to provide information to guide actions to conserve biological diversity.

Note: The Bermuda (Bda) red list and the IUCN red list may not match for some native species because of criteria applied under local conditions (see www.iucnredlist.org)

Convention on Migratory Species of Wild Animals (CMS). Contracting Parties that host endangered migratory species are required to prevent, reduce or control factors that are endangering or likely to further endanger the species e.g. sea turtles, whales, sharks, and dolphins. Bermuda was included in UK ratification in 1985.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Bermuda was included in UK ratification in 1976. This provides for the regulation of international trade in whole plants and animal, dead or alive, their parts and derivatives. Examples include:

- Sea Turtles
- Diamondback Terrapins
- Queen Conchs
- Corals
- Seahorses
- Whales
- European Eels

Level 1 Species

*Note: E – Endemic, N – Native, CR – Critically Endangered, EN – Endangered, VU - Vulnerable

Birds

Bermuda Petrel or Cahow (*Pterodroma cahow*) (E) EN (D)
White-tailed Tropicbird (*Phaethon lepturus catesbyi*) (N) VU (D1+2)
White-eyed Vireo or Chick-of-the-Village (*Vireo griseus bermudianus*) (E) VU (D1+2)
Common Tern (*Sterna hirundo*) (N) VU

Cave Amphipods

Bermudagidiella bermudensis (E) CR (B1+2C)
Cocoharpinia iliffei (E) CR (B1+2C)
Idunella sketi (E) CR (B1+2C)
Ingolfiella longipes (E) CR (B1+2C)
Pseudoniphargus grandimanus (E) CR (B1+2C)

Cave Copepods

Antriscopia prehensilis (E) CR (B1+2C)
Erebonectes nesioticus (E) CR (B1+2C)
Nanocopia minuta (E) CR (B1+2C)
Paracyclops naessi (E) CR (B1+2C)
Speleoithona bermudensis (E) CR (B1+2C)
Speleophria bivexilla (E) CR (B1+2C)
Speleophriopsis scottodicarloi (E) CR (B1+2C)

Cave Isopods

Atlantasellus cavernicolus (E) CR (B1+2C)
Arubolana aruboides (E) CR (B1+2C)
Currassanthura bermudensis (E) CR (B1+2C)

Cave Mictaceans

Mictocaris halope (E) CR (B1+2C)

Cave Mysids

Platyops sterreri (E) CR (B1+2C)

Cave Ostracods

Spelaeoecia bermudensis (E) CR (B1+2C)

Cave Segmented Worms

Phalldriloides macmasterae (E) CR (B1+2C)

Cave Shrimps

Barbouria cubensis (N) CR (B1+2C)
Parhippolyte sterreri (N) CR (B1+2C)
Procaris chacei (E) CR (B1+2C)
Typhlatya iliffei (E) CR (B1+2C)

Finfish

Lined Seahorse (*Hippocampus erectus*) (N) VU (A4cd)
Longsnout Seahorse (*Hippocampus reidi*) (N) VU (D)
Gag (*Mycteroperca microlepis*) (N) VU (A1bd+2d)
Mutton Hamlet (*Alphistes afer*) (N) CR (A1d)
Nassau Grouper (*Epinephelus striatus*) (N) EN (A2ad)

Snowy Grouper (*Epinephelus niveatus*) (N) VU (A1d+2d, B1+2e)

Tiger Grouper (*Mycteroperca tigris*) (N) EN (A1d)

Freshwater Molluscs

Ancylus bermudensis (E) CR (D)

Pisidium volutabundum (E) CR (D)

Land Crabs

Giant Land Crab (*Cardisoma guanhumi*) (N) VU

Marine Mammals

Humpback Whale (*Megaptera novaeangliae*) (N) VU

Sperm whale (*Physeter macrocephalus*) (N) VU (A1d)

Marine Molluscs

Queen Conch (*Lobatus gigas*) (N) EN (B2ab)

Moss

Bermuda Campylopus (*Campylopus bermudianus*) (E) CR (C)

Rays and Skates

Spotted Eagle Ray (*Aetobatus narinari*) (N) VU (A2d)

Reptiles

Bermuda Skink (*Plestiodon longirostris*) (E) CR (B1+2bcde)

Green Turtle (*Chelonia mydas*) (N) EN (A1bd)

Hawksbill Turtle (*Eretmochelys imbricata*) (N) CR (A1bd)

Kemp's Ridley Turtle (*Lepidochelys kempii*) (N) CR (A1ab)

Leatherback Turtle (*Dermochelys coriacea*) (N) CR (A1abd)

Loggerhead Turtle (*Caretta caretta*) (N) EN (A1abd)

Sharks

Whale Shark (*Rhincodon typus*) (N) VU (A1bd +2d)

Terrestrial Snails

Greater Bermuda Land Snail (*Poecilozonites bermudensis*)

(E) CR (A2ce, B1ab+2ab)

Lesser Bermuda Land Snail (*Poecilozonites circumfirmatus*)

(E) CR (A2ce, B2ab)

Cahow (Bermuda Petrel)

Pterodroma cahow



Photo: K. Zufelt

Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: EN (D)

CMS: Appendix I

Author:

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Revised: April 2016

Ecology

Identification

The Cahow is a long-winged, pelagic seabird which is endemic to Bermuda, nesting no-where else on Earth. Adults are approximately 15 inches in length with a wingspan of up to 36 inches. The bill is black, relatively short and sharply hooked at the end. The top half of the body is various shades of grey while the underside is mainly white. The wings are grey on top and white underneath with distinct black leading and trailing edges. They make eerie moaning calls and high-pitched yelping cries, which early sailors thought came from evil spirits, giving Bermuda the nick-name “Isle of Devils.”

Range

Although Cahows nest only on Bermuda, recent studies with geolocators have shown that they range very widely over most of the North Atlantic Ocean. During the nesting season, they generally range to the offshore waters of the U.S. East Coast and up to Newfoundland, and the Grand Banks, but during the summer, non-breeding season, they mainly forage north of the Azores Islands, and travel as far as 2800 miles to the northeast of Bermuda, foraging just to the southwest of Ireland and northwest of Spain.

Habitat

Cahows nest in small colonies only on Nonsuch Island and several smaller rocky islets in Castle Harbour, where they nest either in rocky crevices up to 10 ft. deep, or in artificial concrete burrows 6-8 ft. deep constructed for them as part of the management program. Originally described by the early settlers as digging soil burrows under the forest on coastal hillsides.

Reproduction and Life Cycle

Cahows are nocturnal and first return to the nesting islands at night for courtship activities and nest-building in October and November. They return to sea during December to fatten up for egg incubation. The birds return to their nests at the beginning of January, with the female laying a single egg, which is incubated in turns by both adults for about 53 days. The egg hatches between late February and mid-March. The adult Cahows leave their chick and both travel out to sea to catch food, returning every few nights to feed the chick squid, small fish and shrimp. The chick takes 85-100 days to mature and fledge to sea on their own, not returning to land for 3 to 5 years. Males return first and choose a nest burrow, to which they try and attract a mate. Cahows are monogamous and mate for life or until the death of their partner. Cahows are long-lived and are estimated to reach over 40 years of age.

Why protect this species?

The Cahow is Endangered and is one of the rarest seabirds on Earth. It is unique to Bermuda and is a symbol of the island, being declared the official National Bird in 2003.

The Cahow is also subject to a number of threats and limiting factors, including: (1) nest site competition from the native Longtail or White-tailed Tropicbird (*Phaethon lepturus catsbyii*) (2) the threat of introduced mammal predators (in particular, rats) swimming out to the nesting islets. (3) lack of enough available suitable nest sites and habitat on the original sub-optimal nesting areas. (4) the annual threat of damage or destruction to nest sites on the present small nesting islets.

Cahow (Bermuda Petrel)

Pterodroma cahow

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Endangered EN (D) v. 3.1

Research: research has focused on the annual monitoring of the entire breeding population to study the breeding biology, determine breeding success and measurement of chick growth rates. and assessment of potential habitats for future introduction. There have also been studies of the oceanic range of the Cahow, using geolocator tags, and further studies with more accurate GPS tags are planned.

Present Management Actions: Much of the present management program for the Cahow is focused on addressing the various challenges and threats to the species. The problem of insufficient suitable nest sites is being addressed by a program of artificial nest burrow construction on the nesting islands; poison bait is also set out on these islands annually to eradicate rats.

New Colony Establishment Through Translocation of Chicks: The continuing erosion of the original nesting islands and destruction of nest burrows by hurricanes and sea-level rise is now considered to be the single most important threat to the Cahow. This threat cannot be fully addressed on the original nesting islets, so new nesting colonies are being established by translocating chicks to nearby larger islands which are managed to exclude mammal predators. These chicks are then hand-fed and imprint on the new island, returning there when mature. This program has been successful in establishing a new breeding colony on Nonsuch Island, which they had not bred on since the 1620s. A second translocation project to establish a second colony on Nonsuch is underway.

Protective legislation

Protection of Birds Act (1975)
Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you think that you have seen this seabird in the wild please report it to the Department of Conservation Services at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

Carlile, N., Priddel, D. and Madeiros, J. *Establishment of a new, secure colony of Endangered Bermuda Petrel Pterodroma cahow by translocation of near-fledged nestlings*. Bird Conservation International, available on Cambridge Journals Online 2012 doi: 10.1017/S0959270911000372

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Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Common Tern

Sterna hirundo

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: No

Bda Red List: VU

CMS: Appendix II

Author:

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Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

The Common Tern is a small, elegant seabird with a dark black head cap and a gull-like appearance. They have a sharp, pointed red-orange bill with a black tip. During the summer the adults exhibit dark grey upperparts and pale grey to whitish underparts. Their wings are relatively long, pointed and have black tips. The feet are red-orange and are very small in size. The tail of the Common Tern is long, white and forked in appearance. Juvenile Common Terns have an all light brown body with black spots. Their bills are light orange with a black tip.

Habitat

The Common Tern is a migratory seabird that comes to Bermuda between April and August. They can be seen in Harrington Sound, Hamilton Harbor and around the islands of the Great Sound. Their diet consists of small fish like Sardines and fry, which they obtain by circling just above the ocean before dive-bombing for their prey. Common Terns are known for forming large colonies which can be as large as 2000 pairs. However, the migrant Terns of Bermuda utilize a significantly different breeding strategy. These terns exhibit a solitary nesting style, with only 2-4 pairs residing on small, flat and partially vegetated rocky islets throughout Bermuda's harbors. Despite the numerous islets that surround Bermuda, Common Terns are highly selective of the islets they choose to breed on. They favor relatively flat islands with soft substrates, short vegetation and good visibility, so they can spot potential danger. When not breeding, band recoveries have proven that Bermuda's Common Terns travel as far south as Central America and the north coastline of Brazil.

Reproduction and Life Cycle

Common Terns do not make a real nest, often being only a scrape in the sand or short grass. They utilize various nesting strategies to increase their chance of nesting success. A single adult pair can produce 2-3 light brown to light green, spotted eggs that are well camouflaged to blend in with the substrate. Such camouflage can prevent predation of tern eggs by some avian predators, including Ruddy Turnstones (*Arenaria interpres*). Common Terns also demonstrate aggressive dive-bombing behavior when their territory is being invaded, especially when newly hatched offspring are present. Despite these effective strategies, Common Terns are still prone to numerous threats to their reproductive success. Such threats include hurricanes, which can cause severe erosion and flooding of the nesting islets, and can also kill inexperienced young birds and accompanying adult males before they fly south. Crows and Great Blue Herons can also predate on the eggs and chicks. Repeated disturbance by boats and jet-skis can also cause breeding failure.

Why protect this species?

The Common Tern (despite its name) has now declined and become very rare on Bermuda. By breeding between April and August, they encounter environmental factors that can hinder their breeding success. In 2003, hurricane Fabian caused a severe decline in the already small local population of Common Terns, which originally consisted of only 31 pairs. Out of 54 fledged chicks in Harrington Sound the day before the hurricane, only 3 survived, and only 6-8 pairs nested the following year. Ironically, such catastrophic events have made the Common Tern Bermuda's rarest breeding seabird.

Common Tern

Sterna hirundo

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Least Concern v 3.1 (BridLife International, 2015).

The Nature Reserves (Tern Nesting Areas) Order 1976 was made under the protection of Birds Act 1975.

Artificial nesting sites: studies show that terns will use artificial rafts for nesting (IUCN)

Nesting islands are regularly maintained to retain ideal nesting conditions, for example through the removal of invasive introduced plant species such as Casuarina, which can completely overgrow and island and make it unsuitable for nesting.

Nesting islands are also baited to destroy rats, which are a threat to eggs and newly hatched chicks.

Research: research has focused on a annual population census and check of numbers of fledged chicks. All chicks that can be caught are also fitted with identification bands. A study of the morphometrics of adult terns has also been made.

Protective legislation

Protected Species Act (2003)
Protection of Birds Act (1975)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you think that you have seen this seabird nesting on an island, do not disturb but please report it to the Department at www.environment.bm/contact-us/ or 299-2329 ext. 2141

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Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

White-eyed Vireo (Chick of the Village)

Vireo griseus bermudianus



© Alison Copeland

Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: VU (D1+2)

CMS: No

Author:

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Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

The White-eyed Vireo is commonly known in Bermuda as the “Chick-of-the-Village”. The Bermudian population of this small songbird is an endemic sub-species of the North American White-eyed Vireo, but as it is not migratory, it has developed much shorter wings adapted for living in thickets and woodland.

Its most distinctive feature is the eyes, which in the adults have distinctive white irises (juveniles have dark brown eyes for the first year). The bill is relatively short, thick and pointed. The bird has a yellow patch around its eyes. The belly is yellowish-white, and the wings, upper side of the body and tail are an greyish-olive in color. There are two distinct white bars on each of the wings. The song is unmistakable, consisting of a 6 to 7-note phrase sounding like the nickname “Chick-of-the-Village.”

Range

The Bermuda White-eyed Vireo is found only on the islands of Bermuda, generally on any islands large enough to support significant stands of vegetation.

Habitat

The White-eyed Vireo is found in woodland habitat and shrubby thickets around Bermuda. Originally found in native woodland dominated by Bermuda Cedar (*Juniperus bermudiana*), It lost much of this original habitat with the loss of the cedar forest in the 1940s. It has however adapted well to the change in forest from cedars to introduced broadleaf trees

Reproduction and Life Cycle

The Bermuda White-eyed Vireo is usually found in pairs, with the male “shadowing” or “guarding” the female, both during the breeding season and during the rest of the year. Around April or May they build tightly woven nests in thick vegetation, usually suspended with the help of spider webs from a fork in a branch. Vireos lay 3 to 5 dark-spotted white eggs, and both male and female share incubation duties. The eggs are incubated for 12-16 days before hatching, after which the chicks are fed insects, spiders and berries by both adults. The chicks develop extremely quickly, leaving the nest in about 9 to 11 days. Fledglings will continue to be fed by the adults for some weeks before becoming independent. White-eyed Vireos breed when one year of age.

Why protect this species?

The Bermuda White-eyed Vireo, being restricted to woodland or thicket habitat on Bermuda, suffers from a very restricted range. With the rapid urbanization of the island in the last 50 years and accompanying loss of these vegetative habitats to ongoing commercial and residential development, The ultimate future of the vireo is still under threat.

White-eyed Vireos also face additional threats in Bermuda, including predation of the eggs and young by introduced invasive species, including rats, kiskadee flycatchers (*Pitangus sulphuratus*) and American Crows (*Corvus brachyrhynchos*). There is also evidence that eggs and young are being predated by both the invasive introduced Argentine Ant (*Linepithema humile*) and the large, introduced Antigua Anole lizard (*Anolis leachii*).

White-eyed Vireo (Chick-of-the-Village)

Vireo griseus bermudianus

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: subspecies has not been assessed

Research: Banding and recapture studies using mist-nets are being carried out at present in parkland and nature reserve areas, particularly around the east end of Bermuda. These will help to determine which vegetative habitats the Vireo does well in and achieves the highest population densities in.

Present Management Actions: White-eyed Vireos were moved from the mainland out to the Nonsuch Island Nature Reserve and re-established successfully after they were lost from that island following the loss of the cedar forest in the 1940s. Following two destructive hurricanes in 2014, which defoliated vegetation and decimated insect populations on Nonsuch, the numbers of Vireos fell to dangerously low levels again. This population was strengthened in April 2016 by the translocation of additional Vireos from the Ferry Point area out to Nonsuch.

Protective legislation

Protection of Birds Act (1975)

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you observe protected woodland reserve or nature reserve habitat being cleared illegally, please report it to the Department at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

To learn more please visit: www.environment.bm

Dobson, A. 2002. *A Birdwatching Guide to Bermuda*. Arlequin Press, Chelmsford, Essex CMI ISW



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Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

White-tailed Tropicbird (Longtail)

Phaethon lepturus catsbyii



J. Madeiros

Current Status

Native

BPSA: Level 1

CITES: No

Bda Red List: VU

CMS: No

Author:

Jeremy Madeiros

Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

The White-tailed Tropicbird, usually called the Longtail in Bermuda, is a beautiful medium-sized Seabird which is glossy white with a black eye-stripe and black wing-bars and wingtips. The distinctive tail streamers are used in courtship and can be longer than the rest of the body, especially in males. The streamers can have a salmon-pink color, especially early in the breeding season. The long, strong bill is reddish-orange or yellow. The call consists of metallic single notes or a harsh grating cry.

Range

The Tropicbird is pelagic, living on the open ocean in tropical and subtropical areas in the North and South Atlantic Oceans, as well as the Indian and Pacific Oceans. *Phaethon lepturus catsbyii* is the Western Atlantic sub-species, which nests in Bermuda, the Caribbean and islands off northern South America.

Habitat

Tropicbirds return to land to Breed, nesting in erosional cliff cavities and crevices and artificial "Igloo" nests installed in coastal cliff areas around Bermuda. Geolocator studies have found that they range widely into the central Atlantic during both the breeding and non-breeding season. About 3000 pairs nest in Bermuda, with the largest concentrations found around the Castle Harbor Islands, the High Point/Church Bay area in Southampton and Great Head in St. David's.

Reproduction and Life Cycle

Tropicbirds first appear in Bermuda in late February and March, and have long been acknowledged as the first sign of spring. Pairs of birds can be seen in aerial courtship throughout April, and a single egg is laid in the nest cavity by the end of April/beginning of May. The egg takes 43-47 days to hatch and is incubated in turn by both parents, with most hatching in June and July. The parents return daily to the nest over the course of the summer with squid and Flying Fish to feed the growing chick. The chicks take 65 to 70 days to fledge from the nest, with most leaving in August and September when the parents stop bringing them food.

Fledgling Tropicbirds take 3 to 4 years to mature and return to the approximate location that they fledged from. Young male birds look for a suitable nest cavity in coastal cliff areas, however they will readily accept artificial nests installed in these areas. Once it has chosen a nest site, the male bird then attempts to attract a female to the nest; if the female finds it suitable, they will carry out an acrobatic display and courtship flight, involving flying in formation and touching the tail streamers. The pair then returns to the nest to mate and cement the pair-bond.

Why protect this species?

Bermuda's population of nesting Tropicbirds is the largest nesting population in the Atlantic basin. The Tropicbird's cliff nesting sites are under increased threat from coastal erosion during hurricanes. Coastal development also destroys nest cavities. The eggs & chicks of Tropicbirds nesting on the main islands are vulnerable to predation from invasive rats and American Crows. Invasive feral Pigeons are also a threat as they compete for nesting cavities with the Tropicbirds and foul the nests while the Tropicbirds are at sea in the winter.

White-tailed Tropicbird (Longtail)

Phaethon lepturus catsbyii

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Least Concern v3.1 (for *P. lepturus* all subspecies)

Due to the significance of Bermuda as a breeding ground for this iconic bird, many conservation activities have been undertaken to improve breeding success and control threats.

Intensive management to improve Tropicbird breeding success are ongoing on the Castle Harbor Islands Nature Reserve. **Activities** include the active control of rats, American Crows and feral Pigeons, and the installation of artificial nesting chambers ("Igloo" nests), to supplement the stock of natural nest sites and replace nests destroyed by hurricane erosion.

Research: research is being carried out on breeding biology and a comparison of breeding success between natural and artificial nest sites as part of a long-term study. There is also ongoing research on their oceanic range using geolocators.

Protective legislation

Protected Species Act (2003)
Protection of Birds Act (1975)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Tropicbird Igloo nests are available for sale to the public through the Bermuda Audubon Society and can be installed on many coastal properties with cliffs or retaining walls.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you think that you have seen Crows or Pigeons in Tropicbird nest sites, please report it to the Department at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

To learn more please visit: www.environment.bm

Beebe, W. (1932) *Nonsuch: Land of Water*, New York: Brewer, Warren and Putnam.

Birdlife International (2009) *Important Bird Areas—Americas; Priority Sites for Biodiversity Conservation*, Birdlife Conservation Series No. 16.

Bradley, P. E. and Norton, R. L. (2009) *An Inventory of Breeding Seabirds of the Caribbean*. University Press of Florida. Gainesville/Tallahassee/Tampa/Baca Raton/Pensacola/Orlando/Miami/Ft. Myers/Sarasota.

Dobson, A. and Madeiros, J. (2006) Bermuda. Pp. 29-36 in S.M. Sanders, ed. *Important Bird Areas in the United Kingdom Overseas Territories*. Sandy, U.K. Royal Society for the Protection of Birds.

Gross, A.O. (1912). *Observations on the Yellow-billed Tropicbird (Phaethon americanus) at the Bermuda Islands*. Auk 29: 49-71.



J. Madeiros



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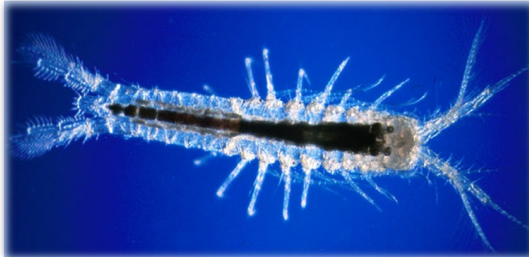
Marine Cave Fauna

Copepods, Ostracods, Isopods, Amphipods, Shrimps, Mysids, Mictaceans, Worms

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Cave mictacean *Mictocaris halope*
© Peter Parks

Current Status

Endemic and Native

BPSA: Level 1

CITES: No

Bda Red List: CR (B1 + 2C)

CMS: No

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Over 75 cave-adapted, relatively small invertebrate species have been discovered in Bermuda's submerged marine caves. This diversity has resulted in the global recognition of these environments as a biodiversity hotspot (a relatively small area with exceptional concentrations of endemic species).

Identification

Twenty three species are presently listed under the Protected Species Act and includes 7 copepods, 1 ostracod (seed shrimp), 3 isopods, 5 amphipods, 4 shrimps, 1 mysid (opossum shrimp), 1 mictacean and 1 segmented worms.

Habitat

All live within submerged marine caves and the underwater passages that connect those caves. Because of their isolation, and if unaffected by humans, these habitats normally have very stable environmental conditions.

Range

Bermuda. Many of these species appear to be restricted to a single cave system and some to only one cave within a system. The greatest known concentration of cave systems in Bermuda is in Hamilton Parish between Harrington Sound and Castle Harbour.

Diet, Reproduction and Life Cycle

Very little is known about the diet, reproduction and life cycle of these species. It is assumed that most feed on plankton which drifts in on tidal currents from the sea.

Bermuda's protected cave fauna

Copepods

Antriscopia prehensilis E
Erebonectes nesioticus E
Paracyclopia naessi E
Speleophira bivexilla E
Speleophriopsis scottodicarloi E
Nanocopia minuta E
Speleithona bermudensis E

Ostracods

Spelaeoecia bermudensis E

Isopods

Atlantasellus cavernicolus E
Currassanthura bermudensis E
Arubolana aruboides E

Amphipods

Idunella sketi E
Cocoharpinia iliffei E
Pseudoniphargus grandimanus
Ingolfiella longipes E
Bermudagidiella bermudensis E

Shrimps

Typhlatya iliffei E
Procaris chacei E
Parhippolyte sterreri N
Barbouria cubensis N

Mysids

Platyops sterreri E

Mictaceans

Mictocaris halope E

Segmented worms

Phallogriloides macmasterae E

Cave isopod *Arubolana aruboides*

© Tom Illiffe



Marine Cave Fauna

Copepods, Ostracods, Isopods, Amphipods, Shrimps, Mysids, Mictaceans, Worms

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources

Why protect these species?

Bermuda's caves are rare, fragile and unique environments. They are mostly threatened by land development and quarrying activities (which causes habitat destruction) as well as by pollution from sewage seepage and also from individuals dumping trash and other waste into caves and sinkholes. All of these listed species have an extremely limited distribution and few recorded mature animals living in the natural environment. Some are extremely ancient relict organisms that can be legitimately referred to as "living fossils".

What is being done to conserve them?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Critically Endangered (B1 + 2c); all are presently undergoing re-assessment

Recovery Plan: A Management Plan was created in 2014 which discusses the threats and conservation efforts for these species. Glasspool, A. 2014. Management Plan for Bermuda's Critically Endangered Cave Fauna. Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Research: Past research has focused on mapping the cave systems and cave faunal distributions using technical SCUBA divers who are qualified to dive in these fragile environments. Cave water quality monitoring and threat assessments to cave ecosystems have also been undertaken.

Habitat protection: Most of Bermuda's caves are protected from development under Section 28 of the Planning Act 1974 (Fourth Schedule).

Protective legislation

Protected Species Act (2003)
Planning Act (1974)

What you can do?

Learn: Understand how the destruction of habitats and the impact of invasive species threatens Bermuda's native and endemic biodiversity.

Report: members of the public are encouraged to report incidences of damage to any cave system to the Department of Environment and Natural Resources via environment@gov.bm

Join a conservation group

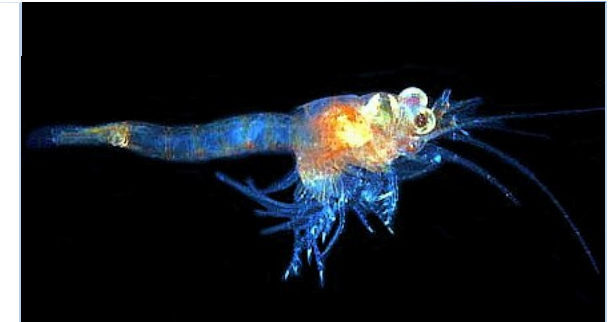
Information sources

To learn more about Bermuda's unique cave environments and the creatures that inhabit them please visit:

www.tamug.edu/cavebiology/Bermuda/BermudaIntro.html

Glasspool, A. 2014. Management Plan for Bermuda's Critically Endangered Cave Fauna. Department of Conservation Services, Government of Bermuda.

Sket, B. and T.M. Iliffe, 1980. Cave fauna of Bermuda. *Int. Rev. gesamten Hydrobiol.*, 65:871-882.



Cave mysid *Bermudamysis spelunca*

© Tom Illiffe



Cave amphipod *Pseudoniphargus grandimanus*

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Tiger grouper (top), Nassau Grouper (bottom)



© Alison Copeland

Current Status

Native

BPSA: Level 1

CITES: No

Bda Red List: *M.microlepis* VU,
E.niveatus VU, *M.tigris* EN, *E.striatus* EN,
A.affer CR

CMS: No

Authors:

A. Copeland, Biodiversity Officer
S. Massey, Marine Conservation Officer

Revised: April 2016

Ecology

A number of grouper species are found around Bermuda, most of the large groupers have some level of protection under the Fisheries (Protected Species) Order 1978 or the Fisheries Regulations 2010. However five grouper species are also listed under the Protected Species Order 2012, they are *Mycteroperca tigris*, *Epinephelus striatus*, *Mycteroperca microlepis*, *Alphestes afer*, and *Epinephelus niveatus*

Identification

Identification of the larger groupers is challenging because most have the ability to radically change their colors and markings.

The tiger grouper (*Mycteroperca tigris*) has approximately 9 diagonal dark brown/black (occasionally bright red) “tiger-stripe” bars over a light background. The gill plates are covered by irregular dark round spots. A marbled effect of irregular patterns can be visible on the underside of the Tiger Grouper. A yellowish colour may be observed on the margins of the pectoral fins.

The Nassau grouper (*Epinephelus striatus*) is distinctively marked with a series of 5 irregular dark bars over an olive to light grey background. This species is distinguished by a black saddle patch at the base of the tail.

The gag (*Mycteroperca microlepis*) is pale grey or olive grey and marked with darker grey blotches. Dark lines radiate from the eye and the tail is square and dark with a thin bluish margin. It grows to about 70 cm in length.

The mutton hamlet (*Alphestes afer*) has a mottled pattern in shades of orange, brown, red and white, with dark bands on the pectoral fins. The large eyes have red irises and are positioned close to the tip of the snout.

The snowy grouper (*Epinephelus niveatus*) reaches about 120 cm in length. This species has a dark saddle patch at the base of the tail. Smaller specimens have white spots.

Range

All of the grouper species native to Bermuda populate various ranges in the Western Atlantic, from New England to Brazil.

Habitat

Groupers inhabit a wide range of depths in the shallow marine environment including seagrass beds, inshore patch reefs down to 200-metre (660-foot) depths. The snowy grouper occurs on rocky bottoms offshore, mostly in water over 100m deep. Many species are bottom dwelling and hide under ledges and undercut reefs.

Diet

Large groupers are top predators on Bermuda’s coral reefs. They are solitary carnivores that prey on fish, octopus, lobsters and other crustaceans.

Reproduction and Life Cycle

Groupers are long lived, slow growing fish that reach sexual maturity later in life. They are hermaphrodites (they begin life as females but change to males with maturity) and spawn in large aggregations at specific sites at certain times of the year. This behaviour makes them particularly vulnerable to overharvesting.

Why protect these species?

The main threats to groupers are overfishing, habitat loss or alteration, and potential competition from invasive lionfish. Many of the listed groupers are threatened by commercial and recreational fishing throughout their range. A number of these species were once important commercial species in Bermuda, but their numbers have been reduced to such an extent that they are rarely seen and no longer commercially viable. Their populations are slow to recover from overfishing or other adverse events.

Groupers

What is being done to conserve them?

Protected Species Act Listing: Level 1, 2016

IUCN Red List: The Nassau grouper is considered Endangered (EN) by IUCN, and the snowy grouper is listed as Vulnerable (VU). The current status of the tiger grouper, gag and mutton hamlet are Least Concern (LC) and the population trend is either unknown or decreasing.

Recovery Plan: Needs to be developed

Public awareness: Information on groupers and related fishing regulations is available online from www.environment.bm and on the Bermuda Government Portal (www.gov.bm). Materials such as cooler stickers with a ruler, pamphlets and maps have been created. Signs have been installed at popular shore fishing sites showing species and bag limits.

Habitat Protection: Known grouper spawning aggregation sites are seasonally closed to fishing and patrolled.

Protective legislation

Fisheries Protected Species Order (1978)

The following species are protected year round and may not be taken: red grouper (*Epinephelus morio*), yellowfin grouper (*Mycteroperca venenosa*), Nassau grouper (*Epinephelus striatus*), mutton hamlet (*Alphistes afer*), gag grouper (*Mycteroperca microlepis*) and tiger grouper (*Mycteroperca tigris*).

Protected Species Act (2003)

Fisheries (Protected Areas) Order (2005)

Line fishing, spearfishing and lobster diving are prohibited year round in 29 dive site protected areas. Additionally, the taking of any fish is prohibited from May 1st to August 31st in the North Eastern and South Western Areas.

What you can do?

Learn: Understand how pollution, overfishing and accidental by-catch lead to loss of endangered and threatened marine species. Tell others what you have learned. Know the general restrictions for fishing and spear fishing including licenses, bag limits and minimum sizes, protected areas and species.

Choose to eat responsibly caught fish. Visit www.seafoodwatch.org to view seafood that have less of an impact on the environment.

Be a Citizen Scientist: Participate in the Bermuda Zoological Society's Reef Watch and other fish monitoring activities.

Do not litter. Marine debris is a serious threat wildlife.

Information sources

IUCN Red List of Threatened Species. www.iucnredlist.org.
Downloaded on 25 February 2016.

Humann, Paul. Edited Ned DeLoach. 1994. *Reef Fish Identification 2nd Ed.* New World Publications Inc., Jacksonville Florida USA.

Smith-Vaniz, William F., Bruce B. Collette and Brian E. Luckhurst. 1999. *Fishes of Bermuda: History, Zoogeography, Annotated Checklist and Identification Keys.* The American Society of Ichthyologists and Herpetologists Special Publication Number 4.

Sterrer, Wolfgang (ed). 1986. *Marine Fauna and Flora of Bermuda: A systematic guide to the identification of marine organisms.* Wiley-Interscience Publication.



Tiger grouper (top), Nassau Grouper (bottom)



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Longsnout & Lined Seahorses

Hippocampus reidi & *Hippocampus erectus*

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



Longsnout seahorse *Hippocampus reidi*

© Jessica Reiderer

Current Status

Native

BPSA: Level 1

CITES: Appendix II

Bda Red List: VU

CMS: No

Author: Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Three species of seahorses have been recorded from Bermuda's marine environment; the longsnout (*Hippocampus reidi*), the lined (*H. erectus*) and the dwarf (*H. zosterae*). The latter, however, was last sighted in 1908 and is not considered to have an established presence. Seahorses are known to change colour, are masters of disguise, have a prehensile tail, and propel themselves using their small dorsal fins. Uncommon in nature, it is the male seahorse that gives birth to the young.

Identification

Seahorses are unlike other fish, as they don't have scales. Instead they have bony plates covered by a thin skin. Longsnout seahorses have a snout that is almost half of the overall head length and body pigmentation consisting of distinct dark round spots. Colouration ranges from yellow to orange, brown or black and is sometimes two-toned. Lined seahorses have numerous lines on the head which often extend down the neck and back. Coloration can be grey, orange, brown or black and may include splotches of lighter colours.

Both species can grow to over 17 cm (ca.7 inches) in length.

Range

The longsnout seahorse is found in the Western Atlantic and range from Brazil to North Carolina in the U.S.A. The lined seahorse is found from Brazil, throughout the Caribbean, Gulf of Mexico and as far north as Nova Scotia.

Habitat

Seahorses are rarely seen in Bermuda. They can be found in seagrass beds, coral reefs and algae-covered bottoms, as well as on boat mooring lines, around docks and in floating mats of *Sargassum* seaweed.

Diet

Seahorses spend much of their day looking for food. They are an ambush predator and they only eat live prey. Seahorses eat small crustaceans and plankton by sucking the prey into their mouths and swallowing it whole. They don't have teeth or a fully developed digestive system.

Reproduction and Life Cycle

Their lifespan is unknown as is the age when they reach sexual maturity. Males can be distinguished from females by the presence of a brood pouch on the abdomen. Females lay their eggs inside this pouch and the male will carry these fertilized eggs for up to three weeks before giving birth to as many as 1,500 live young.

Why protect these species?

Seahorses are under threat world-wide due to collection for use in Asian medicine and ornamental display in private aquariums as well as handling in the wild by curious people and habitat loss.

In Bermuda seahorses were likely never abundant. They may be locally common in small areas with lots of available prey, but their distribution is patchy. The small size and fragmented distribution of the population makes it less likely to recover from disturbance such as coastal development and illegal collecting.

Longsnout & Lined Seahorses

Hippocampus reidi & *Hippocampus erectus*

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve them?

Hippocampus species are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: *Hippocampus reidi* (data deficient);
Hippocampus erectus VU (A4cd) v. 3.1

Recovery Plan: Presently being drafted.

Research: Past research has included abundance and distributional surveys as well as feeding and breeding observations of seahorses in captivity at the Bermuda Aquarium Museum and Zoo.

Habitat protection: Bermuda's seagrass and coral reef environments are protected by the Protected Species Act (2003) and the Fisheries Order (1978) respectively.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how pollution, overfishing and accidental by-catch lead to loss of endangered and threatened marine species. Tell others what you have learned.

Report: if you have seen a seahorse in Bermuda's waters, please report it to the Department of Environment and Natural Resources at 299-2329 ext. 2141 or the Contact Us form at www.environment.bm

Do not litter: Marine debris is a serious threat to wildlife.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Information sources

www.fishbase.org

Smith-Vaniz, W., Collette, B.B., and Luckhurst, B.E. 1999. Fishes of Bermuda: History, Zoogeography, Annotated Checklist, and Identification Keys. *American Society of Ichthyologists and Herpetologists* 4:187-191.



Lined seahorse *Hippocampus erectus*

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Freshwater Limpet

Ancylus bermudensis

Bermuda Protected Species



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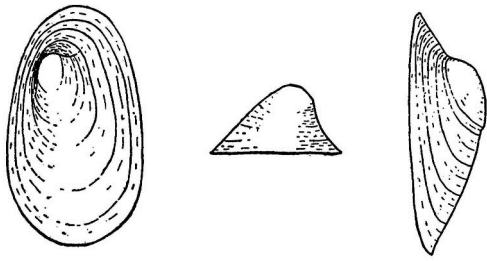


Fig. 4.—*Ancylus bermudensis* n. sp.

Ecology

Organisms in the genus *Ancylus* are small freshwater limpets. They are aquatic pulmonate gastropods, meaning they are air-breathing. They have a lung and a false gill (Pseudobranch) which allows them to breath air and to survive underwater. These limpets feed by scraping and will attach to aquatic vegetation and rocks.

The ecology of *Ancylus bermudensis* has not been studied.

Identification

Ancylus bermudensis was first described by Edward Guirey Vanatta in the Proceedings of the Academy of Natural Sciences of Philadelphia in 1910. He described the shell as follows: “Oval, greatest width in front, high, thin, horn colour, apex with microscopic radial striae, situated near the posterior right margin, anterior slope convex, posterior and right side concave, left side nearly straight. Surface marked with concentric lines of growth and a few obscure radial lines. Alt. .90, diam. 1.73, length 3.10 mm.”

This species was once known as *Ferrissia bermudensis*

Range

Unique to Bermuda.

Habitat

This limpet was known to inhabit a freshwater ditch within the Pembroke Marsh complex during the early twentieth century..

Why protect this species?

This species was recorded as “rare” by E.G. Vanatta in 1910. Serious modifications have been made to the Pembroke Marsh complex over the last 100 years, and it is thought that this species may have declined further or possibly gone extinct. This endemic species is only recorded from one location, Pembroke Marsh, and the number of remaining individuals is believed to be very low, therefore this species is listed as Critically Endangered.

Threats faced by this species include:

- Habitat loss and fragmentation
- Water pollution from road run-off and Marsh Folly dump
- Habitat modification by invasive aquatic plants
- Lack of awareness leading to accidental destruction

© E.G Vanatta

Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: CR (D)

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Freshwater Limpet

Ancylus bermudensis

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Not assessed.

Recovery Plan: Proposed.

Research: No active conservation actions are currently taking place for this species. Surveys undertaken between 2007 and 2008 in 23 different wetlands across Bermuda, including its former range, failed to find any living specimens. Examination of the type specimens for this species and possible return of the specimens to Bermuda's Natural History Museum is desirable.

Habitat Protection: The freshwater habitat at Pembroke Marsh is protected within a Government-managed Nature Reserve.

Protective legislation

Protected Species Act 2003

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust, or the Bermuda Audubon Society.

Support Wetland Protection

Volunteer to remove invasive plants from our wetlands.

Information sources

To learn more please visit: www.environment.bm

Outerbridge, M.E., and Thomas, M.H.L. 2009. Fresh and brackish water molluscs in Bermuda. Unpublished Report.

Vanatta, E.G. 1910. Bermuda Shells. Proceedings of the Academy of Natural Sciences of Philadelphia 62: 664-672.



Pembroke Marsh

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Pea Clam

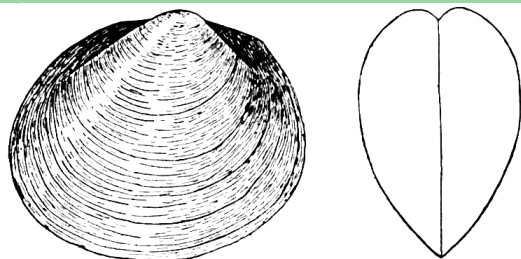
Psidium volutabundum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© E.G Vanatta

Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: CR (D)

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Shells in the genus *Psidium* are very small freshwater clams known as pea clams, pill clams or fingernail clams. *Psidium volutabundum* is a species which is endemic to Bermuda. It was first described by E.G. Vanatta in 1910 as follows: “*Shell equivalve, suborbicular, umbones moderately prominent, thin, horn colour, superior margin nearly straight, anterior margin subtruncate, inferior margin arcuate, posterior margin convex. Surface finely striate with irregular lines of growth. Hinge arcuate, narrow, ligament scar concave with a slight longitudinal ridge in the centre. The right valve with one large cardinal and two laterals at each end, the lower ones the largest. The left valve provided with two cardinals the lower recurved and a little anterior, a very heavy lateral at each end of the hinge line, with a deep groove between it and the edge of the shell. Alt. 2.56, diam. 1.73, length 3.13 mm.*”

Range

Unique to Bermuda.

Habitat

This species was first collected and described from Pembroke Marsh in 1910. It is thought to be endemic to the freshwater habitat of the Pembroke Marsh complex.

Why protect this species?

This endemic species is only recorded from one location, Pembroke Marsh, and the number of remaining individuals is believed to be very low, therefore this species is listed as Critically Endangered.

Significant changes have occurred to its habitat in the last 100 years, including draining of the marsh and pollution of the remaining water. These changes likely impacted the abundance of this species, and it is possible that it has already become extinct.

Threats faced by this species include:

- Habitat loss and fragmentation
- Water pollution from road run-off and Marsh Folly dump
- Habitat modification by invasive aquatic plants
- Lack of awareness leading to accidental destruction

Pea Clam

Psidium volutabundum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Not assessed.

Recovery Plan: Proposed.

Research: No active conservation actions are currently taking place for this species. Surveys undertaken between 2007 and 2008 in 23 different wetlands across Bermuda, including its former range, failed to find any living specimens. Examination of the type specimens for this species and possible return of the specimens to Bermuda's Natural History Museum is desirable.

Habitat Protection: The freshwater habitat at Pembroke Marsh is protected within a Government-managed Nature Reserve.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust, or the Bermuda Audubon Society.

Support Wetland Protection

Volunteer to remove invasive plants from our wetlands.

Information sources

To learn more please visit: www.environment.bm

Outerbridge, M.E., and Thomas, M.H.L. 2009. Fresh and brackish water molluscs in Bermuda. Unpublished Report.

Vanatta, E.G. 1910. Bermuda Shells. Proceedings of the Academy of Natural Sciences of Philadelphia 62: 664-672.



Pembroke Marsh

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Giant Land Crab

Cardisoma guanhumu

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© JP Rouja

Current Status

Native

BPSA: Level 1

CITES: No

Bda Red List: VU

CMS: No

Author:

Jeremy Madeiros

Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

Also called the blue land crab, the giant land crab is the largest burrowing crab in Bermuda. Adults can reach weights of up to 500grams and the width of the carapace can be as great as 15cm. The total width of its outstretched claws can be over 45cm. Its eyes are stalked and fairly widespread. The males have dimorphic claws with one claw growing as big as the carapace or even longer. Younger adult males are a fairly bright blue color, fading to a chalky white as they mature. Females usually appear light gray or white. Juveniles generally have a brown carapace with orange colored legs.

Range

Native to Bermuda, the Caribbean, Florida and Central America.

Habitat

These crabs live in colonies around the margins of mangrove swamps in protected bays and around the margins of salt ponds, often associated with the Black Mangrove. Although they spend a considerable amount of their life on land, they are still heavily dependent on the ocean for early development. They dig large burrows to reach the water table so as to maintain a small pool of fresh or salt water, at the bottom, to keep their gills moist. Generally, only a single individual occupies a burrow. However small juveniles do not dig their own burrows and will often share with an adult

Diet

They are mainly active at night, eating leaf litter, fruit, dead fish, and marine life they find along the shore, and occasionally also decaying animals and insects.

Reproduction and Life Cycle

The giant land crab reaches sexual maturity in approximately 4 years when it attains a mass of 40g. It is common for adult crabs to measure 10-11cm and weigh up to 500g. It is slow growing species compared to most other crabs. It tends to require up to 60 molts to reach its adult 500g weight compared to 20 molts of other crabs. Pre-molt crabs seal the entrances to their burrows until molting takes place in 6 to 10 days.

Why protect this species?

Bermuda is probably the northern most latitude of occurrence of this species. With pressures for development on the edge of mangroves, the species continues to be marginalized. The total population on Bermuda is unknown; however, 186 active burrows were found at Hungry Bay in 2000 and twenty large active burrows at Wreck Hill in Ely's Harbour. An undetermined proportion of the 186 active burrows were likely occupied by other crab species. Smaller numbers (less than 5 individuals) recorded on Coopers Island and Ferry Reach in the 1990s have not been found in more recent surveys. A small colony that had been established on the Nonsuch Island Nature Reserve was completely destroyed by hurricane "Fabian" in 2003.

Its numbers have declined in much of its range as it is either exploited for food or treated as a pest. Threatened by habitat loss, filling of holes because they are a pest, vibrations, coastal erosion, harvesting for food or bait.

Giant Land Crab

Cardisoma guanhum

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Not assessed

Recovery Plan: Proposed.

Research: Periodic population assessments are undertaken at Hungry Bay and Ely's Harbour. Local residents and landowners also monitor these populations. Mapping of burrows with a handheld GPS has been undertaken for some populations (Wreck Hill; St. David's).

There is also a possibility of establishing new populations in appropriate, protected Mangrove habitat, although research is required to determine the best methods for carrying this out.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Understand how pollution, coastal development, habitat loss and invasive species lead to loss of endangered and threatened marine species. Tell others what you have learned.

Report: if you have seen a Giant Land Crab please report it to the Department of Environment and Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Do not litter: Marine debris on the shoreline is a serious threat to wildlife.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

To learn more please visit: www.environment.bm

Coleman, G. 2001. Population study of the great land crab, *Cardisoma guanhum*, at Hungry Bay and Ely's Harbor. Bermuda Biodiversity Project Intern Report.



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Humpback Whale

Megaptera novaeangliae

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: VU

CITES: Appendix 1

Bda Red List: VU

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Identification

Humpbacks belong to the group known as baleen whales. Reaching body lengths of up to 45 feet and weighing approximately one ton per foot length, Humpback whales can easily be distinguished from other large whales by virtue of their long, white pectoral fins. These fins are about 16 feet long, which is one-third of their total body length. Individual whales can be identified by examining the shape and color patterns found on their flukes (tails).

Habitat

Humpback whales are found in the Atlantic, Pacific and Indian oceans.

Range

Humpback whales make annual migrations of many thousands of miles from their summer coastal feeding grounds in high-latitude waters to their breeding and calving grounds near islands and shallow banks in low-latitude waters. Thus, the whales seen off of Bermuda during the spring spend the winter months in the Caribbean and the summer months in New England, the Maritime provinces of Canada, Greenland, Iceland and even Scandinavia.

Diet

Humpback whales are filter feeders and consume vast amounts of small schooling fishes, invertebrates (e.g. krill and copepods) and plankton found in the cooler waters of Northern regions.

Reproduction and Life Cycle

Sexual maturity in both males and females occurs at

approximately five to eight years of age. Females conceive during the winter season or while migrating to their winter grounds. Gestation lasts for 11-12 months and they give birth to a single calf the following winter. Humpbacks typically have a biennial breeding-cycle (i.e. one calf every two years).

Humpback whales exhibit interesting social organization and behavior. One important aspect of behavior is a complex vocalization known as "song". Male humpbacks sing primarily while on their winter grounds and during migration. Singers are typically stationary, solitary males. Many theories exist to explain the unique and haunting nature of their songs, however its function is still not fully understood. One of the humpback's more spectacular behaviors is the breach, in which an individual leaps out of the water (pictured on the left).

Scientists estimate the average life span of humpback whales in the wild to be between 30-40 years, but some may live for as long as 80 years.

Why protect this species?

Humpback whales, like so many other whales species, were hunted for centuries for their oil and meat. Although hunting in the North Atlantic ended in 1956, it wasn't until 1966 that the International Whaling Commission agreed to globally ban the hunting of humpbacks.

Despite being safe from commercial whaling, humpback whales continue to face threats and disturbances from entanglement in marine debris and fishing gear, boat strikes, competition for food resources with commercial fisheries, increased undersea noise from Navy sonar and commercial undersea seismic exploration, and habitat degradation from pollution.

Whale watching has proven to be a very popular activity in many regions and provides educational experiences for the public who might normally never see this marine mammal.

Humpback Whale

Megaptera novaeangliae

What is being done to conserve it?

Humpback whales are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Least Concern ver. 3.1

All species of whales, dolphins and porpoises are protected in Bermudian waters under the Fisheries Act (1972).

Habitat protection: More than 170,000 square miles of ocean surrounding Bermuda were declared a Marine Mammal Sanctuary in 2012 which provides additional protection for this species while they travel along their migratory routes in the Atlantic Ocean. Humpback whales would also benefit from protection being afforded to the Sargasso Sea.

Research: The Humpback Whale Research Foundation has been gathering data on Bermuda's whales since 2007. Work focus has been mainly on fluke identification and acoustics to better understand trans-Atlantic movement and pelagic social behaviors as humpback whales migrate past the Bermuda seamount from their calving grounds in the Caribbean to their feeding grounds in Northern waters.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Pilot boats responsibly when whale watching in order to minimize disturbing them. Drive slowly and with caution; where possible post a dedicated lookout in addition to the skipper. Do not approach any whale closer than 100 meters (ca. 300 feet). The Department of Environment and Natural Resources has published a full set of guidelines (see link below) for whale watching vessels to ensure that whales are not harassed while migrating past Bermuda.

Report: Members of the public are encouraged to report a whale stranding to the Department of Environment and Natural Resources and the Bermuda Aquarium Museum and Zoo (293-2727).

Information sources

To learn more about Bermuda's humpback whales please visit:

<http://www.environment.bm/whale-watching-guidelines>

<http://www.whalesbermuda.com>

http://stellwagen.noaa.gov/sister/pdfs/bermuda_ssfs12.pdf



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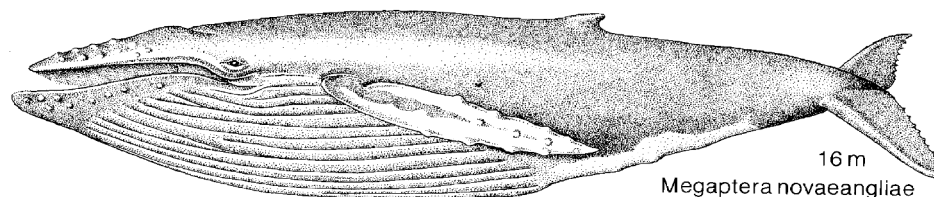
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Sperm Whale

Physeter macrocephalus

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: VU (A1d)

CITES: Appendix 1

Bda Red List: VU

CMS: Appendix I and II

Fisheries Order: Yes

Author: Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

The sperm whale is the largest of the toothed whales (Odontoceti). Males reach 50 to 60 feet (15 to 18 m) and weigh 48 tons (43 m tones), while females grow to 15-38 feet (4.6 to 11.6 m), and are much smaller. This species is very distinctive looking, with a massive blunt square head which can be one third the length of its body. This whale has a long, narrow lower jaw which contains 36-40 teeth, while the top jaw contains sockets into which the lower teeth fit. Sperm whale teeth were historically used to create scrimshaw art by sailors and whalers during the 18th, 19th and 20th centuries.

Toothed whales have a single nostril, unlike baleen whales which have two. In the sperm whale, the nostril is on the left side at the front of the head. When the whale blows, a 15 foot (4.5m) spout is projected forward and to the left.

The body colour of the sperm whale is dark grey or brown and the skin on the back half of the whale towards the tail is wrinkled. Sperm whales have a short rounded dorsal fin and flippers. The dorsal fin is a low hump followed by a series of bumps along the back. The fluke is roundly triangular with a deep central notch, rounded tips and smooth, straight edges. The sperm whale raises its fluke out of the water when it makes a deep dive (see lower photo on left).

Habitat

Sperm whales are found in the open ocean, particularly waters over 1000 m deep which are ice free. They are occasionally seen around Bermuda by offshore boaters and yachts passing between Bermuda, the Caribbean and North America.

Range

The sperm whale has a wide global distribution. They migrate seasonally in search of food.

Diet

Sperm whales primarily eat squid, but will eat fish. They hunt in darkness at depths over 1000 feet, so they produce loud sonar clicks to find food and communicate with each other. The huge head of the sperm whale contains a large quantity of waxy liquid called spermaceti which is thought to help with this kind of echo location behavior.

Reproduction and Life Cycle

The sperm whale has the slowest reproductive rate of all whale species, with females producing a single calf about every four years. The gestation period is about 15 months, after which the female nurses her calf for around two years.

Why protect this species?

In the 18th and 19th century spermaceti was used to produce candles and other products and was considered extremely valuable. The oil produced from boiling the fat (blubber) of sperm whales was burned for heat and light and was used to make lubricants for machinery and soap. Sperm whales were widely hunted to obtain these valuable products, leading to a world-wide decline in their population.

Due to their historic decline from whaling activities and other more modern threats like ship strikes, entanglement in fishing gear, pollution and man-made noise in the ocean, sperm whales are considered globally Vulnerable.

Sperm Whale

Physeter macrocephalus

What is being done to conserve it?

Sperm whales are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Vulnerable (A1d) ver. 3.1

All species of whales, dolphins and porpoises are protected in Bermudian waters under the Fisheries Act (1972).

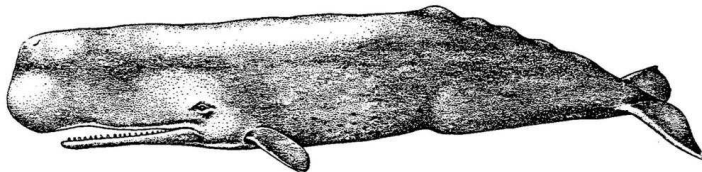
Habitat protection: More than 170,000 square miles of ocean surrounding Bermuda were declared a Marine Mammal Sanctuary in 2012 which provides additional protection for this species while they travel along their migratory routes in the Atlantic Ocean. Sperm whales would also benefit from protection being afforded to the Sargasso Sea.

Reporting: Several sperm whales have stranded in Bermuda over the years, and this data is recorded at the Bermuda Natural History Museum. Recent observations of sperm whales offshore have been reported during research cruises for other purposes.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)



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What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Pilot boats responsibly when whale watching in order to minimize disturbing them. Drive slowly and with caution; where possible post a dedicated lookout in addition to the skipper. Do not approach any whale closer than 100 meters (ca. 300 feet). The Department of Environment and Natural Resources has published a full set of guidelines (see link below) for whale watching vessels to ensure that whales are not harassed while migrating past Bermuda.

Report: Members of the public are encouraged to report a sperm whale sighting or stranding to the Department of Environment and Natural Resources and the Bermuda Aquarium Museum and Zoo (293-2727). Photos are appreciated.

Information sources

Taylor, B.L, Baird, R., Barlow, J., Dawson, S.M., Ford, J., Mead, J.G., Notarbartolo di Sciara, G., Wade, P. & Pitman, R. L. 2008. *Physeter macrocephalus*. The IUCN Red List of Threatened Species 2008.

Katona, S.K., Rough, V. and Richardson, D. T. 1993. A Field Guide to Whales, Porpoises and Seals from Cape Cod to Newfoundland. 4th ed. Smithsonian Institution Press.

To learn more about guidelines for whale watching please visit:

<http://www.environment.bm/whale-watching-guidelines>



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Queen Conch

Lobatus gigas

Bermuda Protected Species



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Department of Environment & Natural Resources



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Ecology

Identification

Lobatus gigas is the second largest of the five Caribbean species of *Lobatus* and the larger of the two species found in Bermuda. Adult queen conch can be told apart from the harbour or milk conch, *Lobatus costatus*, the only other common species of *lobatus* in Bermuda, by a large, flaring shell lip and pink to orange color inside the lip. Adult Harbour conch are an aluminum gray color inside the lip. Juveniles of both species are creamy or pink inside the lip, which is not flared. Juvenile queen conch usually have long, pointed nodes or spines on the whorls of the shell whereas harbor conch have low, blunt nodes. Queen conch reach a maximum shell length of about 300 mm. Adult mean shell length for Bermuda is about 250 mm, with a maximum of 320 mm. In the greater Caribbean queen conch have been an important commercial fishery. Commercial, sustenance and recreational fisheries have all contributed to population declines throughout the range of the queen conch.

Range

Queen conch are restricted to the Gulf of Mexico, the Caribbean, and in the greater Atlantic to northern Brazil and Bermuda. Limited genetic data suggest the Bermuda population is strongly isolated from other populations.

Habitat

In Bermuda, adult and juvenile queen conch are consistently found at a few sites located along the northern and western rim reefs and reef flats, on patch reefs of the North Lagoon, and nearer shore at the east and west ends of Bermuda. Adults are usually found on sandy bottoms with sparse seagrass, whereas juveniles are found in areas with more grass, all at depths of less than 20 m. Home ranges of adult queen conch can be more than 2 hectares (20,000 m²). Habitat destruction and degradation are both factors in the determination of population sizes. Adult conch are seen on the surface of the

seabed, often with diverse attached fauna on their shells, whereas juveniles usually are found partly buried with seagrass and macroalgae attached to their shells. Juveniles with shells less than 80 mm are thought to bury in the sediments for most of the day, making them difficult to find; adults appear to bury as well, but leave obvious tracks to their burial sites.

Diet

Conch feed on a variety of green algae and on detritus and diatoms growing on seagrass, sand and rocks.

Reproduction and Life Cycle

No specific life cycle studies have been done in Bermuda. However, over their geographic range queen conch live 20-30 years up to, possibly, 40 years. They become sexually mature at about 4 years, with separate sexes. Individuals come together to form spawning aggregations. In 1988 and 1989, spawning aggregations were found at five sites in Bermuda, in 2000 three of these sites were re-assessed and were still active, and ongoing benthic surveys confirm that spawning occurs at the one site that is regularly visited (DCS). Fertilization is internal so that spawning pairs are formed; in Bermuda mating or egg laying has been observed from May to September. Egg masses are covered in sand and remain on the bottom. Hatched larvae are planktonic, remaining in the water column for 2 to 8 weeks, where they are subject to the whims of the currents. Juveniles seem to recruit to denser seagrass in shallower water than is typical of adult habitat.

Why protect this species?

- Low densities—ongoing despite fishing ban since 1978; numbers are in decline throughout the species' range.
- High visibility—some adult aggregations occur in locations heavily used for recreation and the snails are very vulnerable to disturbance.

Current Status

Native

BPSA: Level 1

CITES: Appendix II

Bda Red List: EN

CMS: No

Fisheries Order: Yes

Authors:

Drs K. A. Coates and S. A. Manuel
Senior Marine Conservation Officer

Revised: April 2016

Queen Conch

Lobatus gigas

What is being done to conserve it?

Globally, trade in *Lobatus gigas* has been regulated by CITES since 1992 when *L. gigas* (as *Strombus gigas*) was listed under Appendix II.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Not assessed.

Recovery Plan: A recovery plan has been developed. Sarkis S. and J. Ward, 2009. Recovery Plan for the Queen Conch, *Strombus gigas*, in Bermuda. Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Public awareness: Undertake a public awareness campaign.

Research: Focus on: environmental conditions affecting reproduction and survival; genetic structure of Bermudian populations; recruitment frequency and success; juvenile habitat; populations size and demographics.

Habitat protection: Reefs and seagrass beds are protected to some degree through protection of corals and individual seagrass species, however, need to heighten protection for the locations of known conch aggregations

Artificial propagation: Potential exists.

Protective legislation

Protected Species Act (2003)
Fisheries Act (1972)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of biological diversity. Tell others what you have learned.

Do not collect or disturb molluscs

Do not litter or pollute in marine habitats

Do not anchor on seagrass

Information sources

To learn more please visit: www.environment.bm

Berg, C., Ward, J., Luckhurst, B., Nisbet, K., Couper, F. 1992a. Proceedings of Gulf and Caribbean Fisheries Institute 42: 161–171.

Berg, C. J. Jr., Couper F., Nisbet, K., Ward, J. 1992b. Proceedings of Gulf and Caribbean Fisheries Institute 41: 433-438.

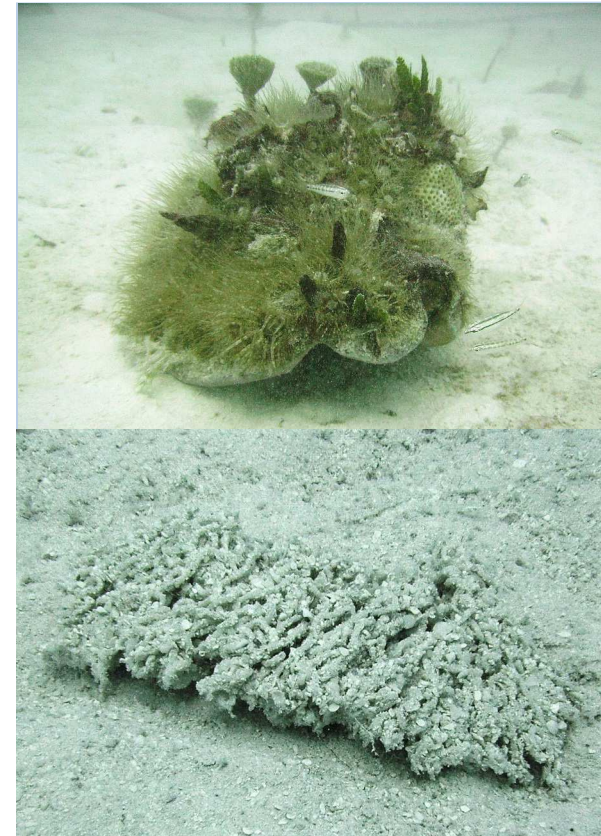
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Stoner, A. W. 2003. Marine Ecology Progress Series 257: 275-289.



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Bermuda Campylopus

Campylopus bermudianus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: CR (C)

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: March 2016

Ecology

Bermuda Campylopus is a moss that is endemic to Bermuda. Very little is known about the ecology of this moss.

Identification

Bermuda Campylopus moss is dark green and grows to about 2.5 inches (6 cm) tall. The leaves are often crowded toward the tips of branching stems. The leaves, which encircle the stems, are pointed and straight edged with a toothed tip. This moss grows in loose tufts.

Range

Unique to Bermuda.

Habitat

Bermuda Campylopus is quite rare, as it is only found in Paget Marsh growing at the base of Bermuda Palmetto trees. It may have been more common historically in palmetto-dominated freshwater marsh habitats or damp woodlands, but was never abundant.

Reproduction and Life Cycle

Unknown

Why protect this species?

Elizabeth Britton wrote in 1915 that Bermuda's rarer mosses, including Campylopus, "*are likely to become extinct with the clearing, burning and cultivation of the marshes.*" It is therefore remarkable that this species continues to hang on 100 years later.

This species has been listed as Critically Endangered under the Bermuda Protected Species Act 2003. It is considered at high risk of extinction because only a limited population remains at only one location on the island; Paget Marsh. As a Bermuda endemic, Paget Marsh is also the global distribution of this moss. Very few individuals of this species are thought to remain, and a continued decline is expected without protection and conservation action.

Threats faced by this species include:

- Habitat loss and fragmentation
- Competition from invasive plants
- Lack of awareness leading to destruction of plants
- Mosses may be vulnerable to impacts from climate change

Bermuda Campylopus

Campylopus bermudianus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Not assessed

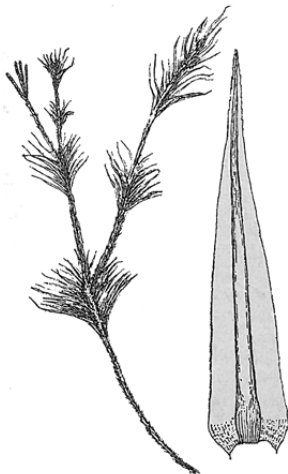
Wetland Protection: Paget Marsh is protected as a Nature Reserve by the Bermuda National Trust and Bermuda Audubon Society.

Bermuda Campylopus has been listed under the Protected Species Act since 2007. At present no active conservation measures are underway for this species.

Research: Monitoring of the Campylopus population and investigations into its ecology should be carried out in the future.

Protective legislation

Protected Species Act 2003



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What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust, or the Bermuda Audubon Society.

Support Wetland Protection

Volunteer to remove invasive plants from our wetlands.

Stay on the boardwalk when visiting Paget Marsh and do not touch the plants.

Information sources

To learn more please visit: www.environment.bm

Elizabeth G. Britton. 1915. Mosses of Bermuda. Bulletin of the Torrey Botanical Club, Vol. 42, No. 2 (Feb., 1915), pp. 71-76.

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Brian J. O'Shea. 2009. A new view of Bermuda's mosses. Archive for Bryology 57 (2009).



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Moss growing on a Palmetto trunk

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Spotted Eagle Ray

Aetobatus narinari

Bermuda Protected Species



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Ecology

Identification

The spotted eagle ray's (*Aetobatus narinari*) local name is the "whip moray". The unique white or yellowish pattern of spots and circular markings on the dark back are used to identify individuals. The underside is white. Eagle rays have a pronounced head with a flattened, broad snout. At the base of the long, thin tail are one to five barbed venomous spines. The average width from wing tip to wing tip of rays sampled in Harrington Sound and Flatt's Inlet was 125 cm and the average weight was 35 kg with the largest ray recorded at 73 kg. Rays are usually seen foraging and swimming solo but occasionally in pairs and, on rare occasion, school during social interactions or in preparation for large-scale movement.

Range

Aetobatus narinari live in warm-temperate and tropical waters, and have a widespread distribution across the Indo-Pacific, and the eastern and western Atlantic Oceans. In Bermuda, these animals migrate between the Great Sound, North Shore and Harrington Sound. Males exhibited significantly higher movement rates than females and more transient behavior between inshore lagoons and outer coral reefs.

Habitat

In Bermuda, most spotted eagle rays exhibit high fidelity to Harrington Sound, Flatt's Inlet and adjacent waters of North Shore. Within Harrington Sound rays exhibit a strong affinity to shallow (<10 m) sand and sand-shell bottom habitats. The seagrass beds in Harrington Sound, in addition to small bays of the Great Sound, may represent pupping and nursery grounds.

Diet

Bivalves and gastropods were identified in the gut contents of eagle rays sampled from Harrington Sound. Research indicates that this species forages on different prey items at different life stages but the diet of most individuals was monotypic. Calico clams (*Megapitaria maculata*) were found in the highest densities in the shallow sandy areas in Harrington Sound. This was the adult rays primary food source followed by the ark clam (*Anadara notabilis*), moon snail (*Natica* sp.) and milk conch (*Lobatus costatus*). Juvenile rays were found to consume the smaller tiger lucine (*Codakia orbicularis*) and the thinner-shelled purplish tagelus (*Tagelus divisus*).

Reproduction and Life Cycle

The life history has not been studied in Bermuda. The literature indicates that sexual maturation occurs between 4 to 6 years of age and that females bear a maximum of four pups per litter after a gestation period of approximately a year. Sharks are known predators of rays.

Why protect this species?

Evidence suggests that this species may be resident to Bermuda and has a restricted distribution due to specific habitat and food requirements. Globally, the current population trend is decreasing primarily due to human activity. The population status is unconfirmed for eagle rays in Bermuda. The population that inhabits Harrington Sound has been estimated at 307 individuals but this number is believed to be an overestimate by the author of the study.

Current Status

Native

BPSA: Protected Level 1

CITES: No

Bda Red List: VU (A2d)

CMS: No

Authors:

Simieon Massey and Dr S. A. Manuel
Marine Conservation Officers

Revised: April 2016

Spotted Eagle Ray

Aetobatus narinari

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Near Threatened ver. 3.1

Recovery Plan: Needs to be developed.

Public awareness: Information is available on The Government of Bermuda Department of Environment and Natural Resources website www.environment.bm

Research: Research has focused on the foraging ecology and habitat use of spotted eagle rays in Harrington Sound . Data is lacking on the life history including age, growth, longevity, movement patterns, habitat use, nursery areas, diet, reproduction and the genetic uniqueness of Bermuda's population.

Report: Members of the public can report incidents and illegal activity to the Department of Environment and Natural Resources. Please take photographs of the observed issue. Your report will be treated in strict confidence. Injured animals can be delivered to the Bermuda Aquarium, Museum and Zoo. Tel: 293-2727.

Protective Legislation

Protected Species Act (2003)

What you can do?

Learn: Become familiar with Bermuda's marine resources, general restrictions and protected organisms and areas.

Become a steward of the environment.

Information Sources

IUCN. 2006. *2006 IUCN Red List of Threatened Species*. www.iucnredlist.org. Downloaded on 10 February 2016.

The references cited here are available from the library at the Bermuda Natural History Museum.

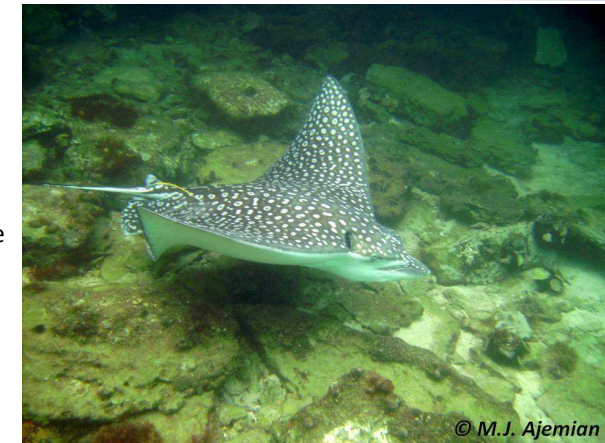
Ajemian, M. J. and S. P. Powers. 2014. Towed-float satellite telemetry tracks large-scale movement and habitat connectivity of myliobatid stingrays. *Environ. Biol. Fish.* 97(9): 1067-1081.

Ajemian, M. J., S. P. Powers and T. J. T. Murdoch. 2012. Estimating the Potential Impacts of Large Mesopredators on Benthic Resources: Integrative Assessment of Spotted Eagle Ray Foraging Ecology in Bermuda. *PLOS One.* 7(7): 17 pp.

Ajemian, M. J. 2010. BZS/BAMZ report 2010 - Spotted Eagle Rays in Harrington Sound. *Unp. MSc.* 13 pp.

Humann, P. 1994. Reef fish Identification: Florida, Caribbean, Bahamas. New World Publications, Inc., Florida USA: 396pp.

Sterrer, W. 1986. Marine Fauna and Flora of Bermuda: A systematic guide to the identification of marine organisms. Wiley, New York: 742pp.



For Further Information

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www.environment.bm

Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Bermuda Skink

Plestiodon longirostris



© Carolyn Copeland

Ecology

Fossil evidence indicates that skinks were living on Bermuda 400,000 years ago; however, paleontological and geological evidence suggest they may have been present here for 1-2 million years.

Identification

Adult males and females have shiny brown, grey or black body scales, a pale belly and a salmon coloured throat patch. They can grow up to 25 cm long. Juveniles have copper coloured scales with cream coloured longitudinal stripes down their sides, a pale belly, and a salmon coloured throat. Hatchlings have a brilliant blue tail which fades as they mature.

Range

Only found on Bermuda.

Habitat

Historically described as very common and often seen around old walls and stone heaps in cedar groves, skinks are now only found living on the rocky shorelines of the coast in small populations scattered across the islands. While the total population of skinks is unknown, most live on the Castle Harbour Islands and in Spittal Pond.

Diet

Bermuda's skinks are known to eat terrestrial amphipods, isopods (pill bugs), and small snails, as well as a wide variety of small insects such as cockroach nymphs, beetles, grasshoppers,

crickets and flies. They also eat carrion and the ripe fruit of prickly pears (*Opuntia*).

Reproduction and Life Cycle

Bermuda's skinks live on the ground rather than in trees, are active year-round and have a very small home range. These animals reach full maturity in two to four years and are thought to live for 15 to 20 years. In the early summer female skinks lay between three and six eggs in a moist burrow or under rocks. The female will stay and guard her eggs, which hatch after a month-long incubation period. Skinks are thought to have an ecological association with longtails and cahows and are observed in the nest cavities of these seabirds.

Why protect this species?

- Predation from invasive species such as kiskadees, cats, adult anolis lizards, night herons, rats and cane toads.
- Destruction and fragmentation of habitat.
- Lethal litter (e.g. glass bottles which trap and kill skinks that enter them).

Current Status

Endemic

BPSA: Level 1

CITES: No

Red List: CR

CMS: No

Author:

Dr. Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Bermuda Skink

Plestiodon longirostris

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Critically Endangered B1+B2b,c,d,e

Recovery Plan: a recovery plan has been developed. Edgar, P., L. Kitson, and A.F. Glasspool. 2010. Recovery Plan for the Bermuda Skink. Department of Conservation Services, Government of Bermuda.

Research: research has focused on multiple population censuses to describe abundance, field surveys to discover new populations, and assessment of environment to understand habitat requirements. Studies examining diet, reproductive biology and genetic diversity between populations throughout Bermuda are ongoing.

Habitat restoration: removal of non-native vegetation and re-establishment of skink friendly rocky coastal habitat is currently occurring on Castle Island.

Artificial propagation

- Lifeboat program partnered with the Chester Zoo, U.K.

Protective Legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conversation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: If you think that you have seen this Skink in the wild please report it to the Department of Environment and Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Do not litter: pick up glass bottles when you find them, especially in parks and nature reserves.

Monitor your cats hunting activity and consider keeping it indoors to prevent it from killing local wildlife.

Information Sources

To learn more please visit: www.environment.bm

Bacon, J.P., J.A. Gray, and L. Kitson. 2006. Status and Conservation of the reptiles and amphibians of the Bermuda islands. *Applied Herpetology* 3:323-344.

Davenport, J., J. Hills, A. Glasspool, J. Ward. 2001. Threats to the Critically Endangered endemic Bermudian skink *Eumeces longirostris*. *Oryx* 35(4):332-339.

Olsen, S.L., P.J. Hearty, and G.K. Pregill. 2006. Geological constraints on evolution and survival of endemic reptiles on Bermuda. *Journal of Herpetology* 40:394-398.



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Green Turtle

Chelonia mydas

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix 1

Bda Red List: EN A1b,d

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Bermuda once had a thriving green sea turtle breeding colony but, because of centuries of hunting pressure on the largest individuals, only immature turtles are presently found on the Bermuda Platform. The current aggregations that are resident here consist of individuals which originate from rookeries throughout the Caribbean and Central America.

Identification

Smooth shell (carapace) with non-overlapping scutes, a single pair of elongated prefrontal scales between the eyes and a strongly serrated lower jaw. Adult females can grow as large as 144 cm straight carapace length and weigh 177 kg (390 pounds).

Range

Throughout the tropical and subtropical oceans of the world.

Habitat

Sea turtles have a complex life cycle that requires many different habitats, depending on their stage of development, often involving many different nations. Generally, adult females use beaches for nesting, neonate and young juveniles use convergence zones in the open ocean during the epi-pelagic phase, and both juveniles and adults use the benthic environments of coastal areas as feeding grounds. Bermuda serves as a developmental habitat for immature green turtles which are typically found feeding on seagrass meadows in relatively shallow waters.

Diet

Very young green turtles (neonates) begin feeding on plant and animal material (as well as plastics and tar balls) in oceanic surface waters. When juveniles enter coastal waters they become herbivorous, feeding mainly upon seagrasses and macroalgae.

Reproduction and Life Cycle

Sexual maturity is reached between the ages of 20-40 years. Green turtles nest on island and continental beaches, generally between 30°N and 30°S latitude. Numerous eggs (100-150) are laid in a deep chamber dug into the sand during the night. Incubation typically lasts for about two months (depends on temperature) and after hatching the baby turtles crawl to the sea where they spend a number of years drifting with oceanic currents. The next phase of their life cycle involves living in benthic environments for up to two decades (e.g. Bermuda) after which they depart for their natal region where they will reach sexual maturity. Green turtles are thought to live for 80-90 years.

Why protect this species?

Green turtle populations throughout the world have been affected by overfishing (for their meat) and the harvest of eggs from nesting beaches. Other threats include:

- Destruction/alteration of feeding and nesting grounds
- Incidental capture in gill net fisheries
- Entanglement and ingestion of marine debris
- Disease (notably fibropapillomatosis)

Green Turtle

Chelonia mydas

What is being done to conserve it?

Green turtles are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Endangered (A2bd) ver. 3.1

Recovery Plan: A plan was created in 2014 which discusses the threats and conservation efforts for this species. Sarkis, S., Outerbridge, M. 2014. Management Plan for Bermuda's Resident Green and Hawksbill Sea Turtles (*Chelonia mydas*, *Eretmochelys imbricata*). Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Research: Green turtles have been studied in Bermuda since 1967. Topics have included egg restocking, hatchling movements at sea, genetics, seasonal movements and habitat use by juveniles, demographic assessments (i.e. sex ratios, size classes, growth rates), international migration patterns and local causes of mortality. There is a great need to understand local population size and trends in abundance. Furthermore, a beach surveillance programme to monitor nesting activity is being planned for the future.

Habitat protection: Bermuda's seagrass meadows are protected by the Protected Species Act (2003). This species would benefit from protection being afforded to the Sargasso Sea.

Reporting injured animals: Members of the public can call or deliver injured sea turtles to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village, Bermuda. Tel (441) 293-2727.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Do not litter: Marine debris is a serious threat to wildlife. Abandoned fishing line causes turtle entanglement and death by drowning.

Operate motor boats and jet skis with caution when travelling through areas populated by sea turtles.

Join a conservation group such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

Meylan, P.A., Meylan, A.B., Gray, J.A. 2011. The Ecology and Migrations of Sea Turtles: Tests of the Developmental Habitat Hypothesis. Bulletin of the American Museum of Natural History 357:1-70.

Witherington, B.E., Bresette, M., and Herren, R. 2006. *Chelonia mydas*—Green Turtle. In: Meylan, P.A. (Ed.) Biology and Conservation of Florida Turtles. Chelonian Research Monographs 3:90-104.



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Hawksbill Turtle

Eretmochelys imbricata

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix 1

Bda Red List: CR A1b,d

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

The present aggregations that are resident on the Bermuda Platform consist of immature turtles which originate from rookeries throughout the Caribbean and Central America.

Identification

Sharp, pointed beak, overlapping scutes on the shell (carapace) and a serrated appearance to the edges of the back half of the shell. Adult females average 82 cm straight carapace length and weigh 60 kg (132 pounds).

Range

Throughout the tropical and subtropical oceans of the world.

Habitat

Sea turtles have a complex life cycle that requires many different habitats, depending on their stage of development, often involving many different nations. Generally, adult females use beaches for nesting, neonate and young juveniles use convergence zones in the open ocean during the epi-pelagic phase, and both juveniles and adults use the benthic environments of coastal areas as feeding grounds. Bermuda serves as a developmental habitat for immature hawksbill turtles which are typically found on coral reefs.

Diet

Very young hawksbill turtles (neonates) begin feeding on plant and animal material (as well as plastics and tar balls) in oceanic surface waters. When juveniles enter coastal waters they feed primarily upon sponges, and to a lesser extent zooanthids and corallimorpharians (coral-like anemones).

Reproduction and Life Cycle

Sexual maturity is reached at the age of 25 years. Hawksbill turtles nest on island and continental beaches, generally between 30°N and 30°S latitude. Numerous eggs (100-150) are laid in a deep chamber dug into the sand during the night. Incubation typically lasts for about two months (depends on temperature) and after hatching the baby turtles crawl to the sea where they spend a number of years drifting with oceanic currents. The next phase of their life cycle involves living in benthic environments for two decades (e.g. Bermuda) after which they depart for their natal region where they will reach sexual maturity.

Why protect this species?

Hawksbill populations throughout the world are thought to be small and declining because of overfishing (for the shell) and the harvest of eggs from nesting beaches. Other threats include:

- Destruction/alteration of feeding and nesting grounds
- Incidental capture in gill net fisheries
- Entanglement and ingestion of marine debris
- Disease (notably fibropapillomatosis)

Hawksbill turtle

Eretmochelys imbricata

What is being done to conserve it?

Hawksbill turtles are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Critically Endangered (A2bd) ver. 3.1

Recovery Plan: A plan was created in 2014 which discusses the threats and conservation efforts for this species. Sarkis, S., Outerbridge, M. 2014. Management Plan for Bermuda's Resident Green and Hawksbill Sea Turtles (*Chelonia mydas*, *Eretmochelys imbricata*). Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Research: Genetics, size classes, growth rates, international migration patterns and local causes of mortality. There is a great need to understand local population size and trends in abundance.

Habitat protection: Bermuda's coral reef environments are protected by the Protected Species Act (2003) and the Fisheries Order (1978) respectively. This species would benefit from protection being afforded to the Sargasso Sea.

Reporting injured animals: Members of the public can call or deliver injured sea turtles to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village, Bermuda. Tel (441) 293-2727.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Do not litter: Marine debris is a serious threat to wildlife. Abandoned fishing line causes turtle entanglement and death by drowning.

Operate motor boats and jet skis with caution when travelling through areas populated by sea turtles.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

Meylan, A.B., and Redlow, A. 2006. *Eretmochelys imbricata* — Hawksbill Turtle. In: Meylan, P.A. (Ed.) Biology and Conservation of Florida Turtles. Chelonian Research Monographs 3:105-127.

Meylan, P.A., Meylan, A.B., Gray, J.A. 2011. The Ecology and Migrations of Sea Turtles: Tests of the Developmental Habitat Hypothesis. Bulletin of the American Museum of Natural History 357:1-70.



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Kemp's Ridley Turtle

Lepidochelys kempii

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix 1

Bda Red List: CR A1a,b,d

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Identification

The Kemp's Ridley is among the smallest of the sea turtles, with adults reaching two feet in carapace (shell) length and weighing up to 100 pounds. Adults have an olive-gray oval carapace that is almost as wide as it is long. The Kemp's Ridley also has a triangular-shaped head with a somewhat hooked beak.

Habitat

The major habitat for adult and sub-adult Kemp's Ridley turtles is nearshore and inshore waters that contain muddy or sandy bottoms where prey can be found.

Range

Hatchlings and small juveniles inhabit the open ocean within the Gulf of Mexico and the Atlantic Ocean where they are known to associate with floating *Sargassum* seaweed, utilizing the algae as an area of refuge, rest, and feeding.

Only two Kemp's Ridley turtles have been reported from Bermuda since the early 1980s, but they serve as proof that this species occasionally strays into Bermuda's territorial waters.

Diet

This species is a shallow water bottom feeder with a diet consisting primarily of crabs, clams, mussels, and shrimp.

Reproduction and Life Cycle

All sea turtles have a complex life cycle that involves many different habitats across multiple regions over numerous decades. Bermuda serves as a developmental habitat where juvenile turtles feed and grow in the complete absence of adults.

Why protect this species?

The Kemp's Ridley is the most endangered of the planet's sea turtles. Numbers have precipitously declined after 1947, when over 40,000 nesting females were estimated at a single location in Mexico (the largest nesting area known to exist). Between 1978 and 1991 only 200 female Kemp's Ridley turtles were observed nesting annually, but conservation efforts undertaken since then have caused the number of reported nesting females to slowly increase to 3,600 by 2003 (NOAA data).

The decline of this species is attributed primarily to human activities, which include the direct harvest of adults and eggs for food and incidental capture in commercial fishing operations – most notably shrimp trawling - but also in gill nets, longlines, traps and pots, and dredges in the Gulf of Mexico and North Atlantic.

Kemp's Ridley Turtle

Lepidochelys kempii

What is being done to conserve it?

Kemp's Ridley turtles are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2016

IUCN Red List: CR A1a,b,d

Recovery Plan: proposed

Research: This species will be monitored via the Sea Turtle Stranding Network in addition to any at-sea sightings.

Habitat protection: ongoing marine pollution control.

Recovery of injured animals: members of the public can call or deliver injured wildlife (protected species) to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village, Bermuda. Tel (441) 293-2727

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: members of the public are encouraged to report sea turtle strandings to the Department of Environment and Natural Resources and to deliver injured turtles to the Bermuda Aquarium Museum and Zoo (293-2727).

Information sources

To learn more please visit: www.environment.bm

Additional reading about Bermuda's sea turtles should include: Meylan, P.A., A.B. Meylan, J.A. Gray. 2011. The ecology and migrations of sea turtles 8. Tests of the developmental habitat hypothesis. Bulletin of the American Museum of Natural History. No.357 (a copy of which can be found at <http://digitallibrary.amnh.org/dspace/bitstream/handle/2246/6126/b357.pdf>)



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Leatherback Turtle

Dermochelys coriacea

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix 1

Bda Red List: CR A1a,b,d

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Leatherback turtles are solitary, pelagic animals that dwell in the open ocean. They have unique physiological adaptations which allow them to inhabit extremely cold water and dive to depths greater than 3,000 feet. Bermuda does not have a resident aggregation of leatherback turtles but large individuals are occasionally observed migrating through the oceanic waters that surround the islands.

Identification

This species is gigantic in comparison to other sea turtles. The overall body coloration is black and covered with irregular white spots. The shell (carapace) is covered in skin, has seven longitudinal ridges and tapers to a distinct point. There are two sharp cusps on the upper jaw which interlock with a single sharp cusp on the lower jaw. Extensive papillae (fleshy protuberances) are found in the mouth and throat. Leatherback turtles can reach a curved carapace length of 159 cm and a total length (nose to tip of tail) of 291 cm (9.7 feet). Mass has been recorded to reach over 900 kg (2000 pounds).

Range

Leatherback turtles have a cosmopolitan global range, being found in tropical, subtropical and temperate oceans, that extends into the Arctic Circle.

Habitat

Sea turtles have a complex life cycle that requires many different habitats, depending on their stage of development, often involving many different nations.

Diet

Leatherback turtles mainly feed on gelatinous organisms which include jellyfish, siphonophores and salps. Young leatherback turtles (i.e. neonates and juveniles) feed in convergence zones in the open ocean during the epi-pelagic phase. Adults use the pelagic zone in temperate and subarctic waters and concentrate their foraging efforts near watermass boundaries and other areas of high productivity where their prey congregate.

Reproduction and Life Cycle

Sexual maturity is reached by the age of nine years.

Leatherback turtles nest on tropical and subtropical beaches, generally between 30°N and 20°S. Numerous eggs (approx. 115, of which one third usually do not have yolk) are laid in a deep chamber dug into the sand during the night. Incubation typically lasts for about two months (depends on temperature) and after hatching the baby turtles crawl to the sea where they spend a number of years drifting with oceanic currents. Growth is rapid and leatherback turtles are known to migrate thousands of miles between their feeding and nesting grounds.

Why protect this species?

Leatherback turtle populations throughout the world have been affected by:

- Harvest of eggs from nesting beaches
- Destruction/alteration of nesting grounds
- Incidental capture or entanglement in fishing gear (e.g. gill nets, lobster and crab pots, pelagic longlines)
- Ingestion of marine debris (especially plastic bags)

Leatherback Turtle

Dermochelys coriacea

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources

What is being done to conserve it?

Leatherback turtles are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Vulnerable A2bd ver. 3.1

Recovery Plan: A Monitoring Plan is in place for this species.

Research: Leatherback turtles have not been the focus of research in Bermuda because they are not a resident species.

Habitat protection: This species would benefit from protection being afforded to the Sargasso Sea.

Reporting injured animals: Members of the public can call or deliver injured sea turtles to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village, Bermuda. Tel (441) 293-2727.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Do not litter: Marine debris is a serious threat to wildlife. Abandoned fishing line causes turtle entanglement and death by drowning.

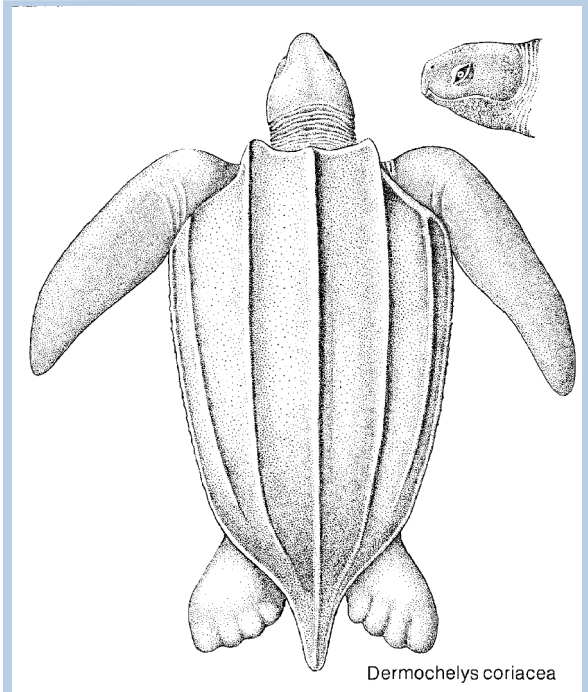
Operate motor boats and jet skis with caution when travelling through areas populated by sea turtles.

Join a conservation group such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

Franklin, C.J. 2007. Turtles— An Extraordinary Natural History 245 Million Years in the Making. Voyageur Press. 89-95.

Stewart, K., and Johnson, C. 2006. *Dermochelys coriacea*— Leatherback Sea Turtle. *In:* Meylan, P.A. (Ed.) Biology and Conservation of Florida Turtles. Chelonian Research Monographs 3:144-157.



Dermochelys coriacea

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For Further Information

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Loggerhead Turtle

Caretta caretta

Bermuda Protected Species



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Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix 1

Bda Red List: EN A1a,b,d

CMS: Yes

Fisheries Order: Yes

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Bermuda does not have a resident aggregation of loggerhead turtles but individuals are present in the oceanic waters that surround the islands. These comprise mainly young juveniles in the epi-pelagic phase of their life cycle which reside in the Sargasso Sea.

Identification

Named for their noticeably large head, which has two pairs of prefrontal scales between the eyes, loggerhead turtles have non-overlapping scutes on the shell (carapace) which is typically rusty brown in colour and can often be covered in large white barnacles. Adult females can grow as large as 107 cm straight carapace length and weigh 187 kg (411 pounds).

Range

Throughout the subtropical and temperate oceans of the world.

Habitat

Sea turtles have a complex life cycle that requires many different habitats, depending on their stage of development, often involving many different nations. Generally, adult females use beaches for nesting, neonate and young juveniles use convergence zones in the open ocean during the epi-pelagic phase, and both juveniles and adults use the benthic environments of coastal areas as feeding grounds.

Diet

Very young turtles (neonates) begin feeding on plant and animal material (as well as plastics and tar balls) in oceanic surface waters. When juveniles enter coastal waters they become carnivorous, feeding upon large crustaceans (e.g. shrimp, crabs, lobsters) and hard-shelled molluscs (e.g. mussels and conch).

Reproduction and Life Cycle

Sexual maturity is usually reached between the ages of 15-30 years. Loggerhead turtles nest on island and continental beaches, generally between 19° and 36° latitude in each hemisphere. Numerous eggs (70-165) are laid in a deep chamber dug into the sand during the night. Incubation typically lasts for about two months (depends on temperature) and after hatching the baby turtles crawl to the sea where they spend up to 12 years following oceanic currents. The next phase of their life cycle involves living in benthic environments (although some remain in the open ocean), after which they depart for their natal region where they will reach sexual maturity.

Why protect this species?

Loggerhead turtle populations throughout the world have been affected by:

- Destruction/alteration of feeding and nesting grounds
- Incidental capture in longline and trawl net fisheries
- Entanglement and ingestion of marine debris
- The harvest of eggs from nesting beaches

Loggerhead Turtle

Caretta caretta

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it? What you can do?

Loggerhead turtles are protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Vulnerable A2b ver 3.1

Recovery Plan: A Monitoring Plan is in place for this species.

Research: Loggerhead turtles have not been the focus of research in Bermuda because they are not a resident species; however, young turtles that have stranded onto Bermuda's shorelines are recovered and rehabilitated at the Bermuda Aquarium Museum and Zoo before being released. Because this species has been recorded as nesting on Bermuda, a beach surveillance programme to monitor nesting activity is being planned for the future.

Habitat protection: This species would benefit from protection being afforded to the Sargasso Sea.

Reporting injured animals: Members of the public can call or deliver injured sea turtles to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village, Bermuda. Tel (441) 293-2727.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Do not litter: Marine debris is a serious threat to wildlife. Abandoned fishing line causes turtle entanglement and death by drowning.

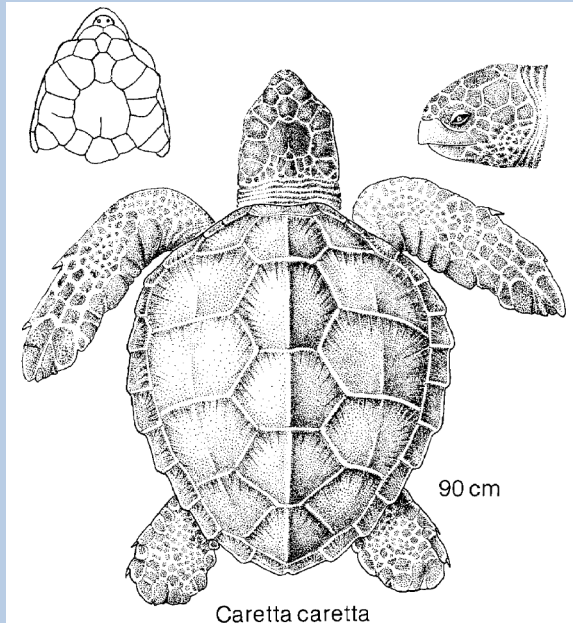
Operate motor boats and jet skis with caution when travelling through areas populated by sea turtles.

Join a conservation group such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

Meylan, P.A., Meylan, A.B., Gray, J.A. 2011. The Ecology and Migrations of Sea Turtles: Tests of the Developmental Habitat Hypothesis. *Bulletin of the American Museum of Natural History* 357:1-70.

Witherington, B.E., Herren, R., and Bresette, M. 2006. *Caretta caretta*—Loggerhead Sea Turtle. *In: Meylan, P.A. (Ed.) Biology and Conservation of Florida Turtles. Chelonian Research Monographs* 3:74-89.



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For Further Information

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www.environment.bm

Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Whale Shark

Rhincodon typus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 1

CITES: Appendix II

Bda Red List: VU (A1b, d+2d)

CMS: Appendix II + Sharks MOU

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

The Whale Shark is the world's largest fish; it grows to 40 feet long (12 m) and can weigh over 20 tonnes. Whale Sharks have a wide, flat head shaped like a blunt square, with a very wide mouth in front and small eyes on the side. The mouth is lined with numerous rows of very small teeth. Whale Sharks have a large dorsal fin more than halfway back on their bodies, followed by another smaller fin near the tail. Three ridges run along each side of the Whale Shark from the head to the base of its tail. The tail itself is crescent-shaped.

The skin of a whale shark is distinctively patterned. The back of the fish is grey to grey-brown, paling to white or yellowish on the underside. Thin, vertical and horizontal white lines join white spots on the back. Research has shown that the spot pattern is unique to individual fish.

Range

Tropical and warm temperate seas (except the Mediterranean) most frequently between 30° N and 35° S. Whale Sharks are known to make oceanic migrations of several thousand kilometres.

Habitat

Open Ocean; shallow and deep coastal waters.

The Whale Shark is an oceanic species, inhabiting tropical and warm open ocean habitats worldwide. It is often seen on offshore banks or cruising along drop-offs, cliffs or walls. In Bermuda they are occasionally seen on offshore banks. Whale

Sharks are migratory and seasonal gatherings have been observed at sites in Australia, Africa and Central America, usually associated with events such as coral or fish spawning which provide abundant planktonic food. When not at these gatherings, Whale Sharks are usually observed singly. They are known to be slow swimmers.

Diet

Whale Sharks eat small fish, squid, pelagic crustaceans and plankton which they sieve from the water. The shark sucks in a mouth full of water, closes its mouth and pushes the water out through its gills, which are specially evolved for filter feeding.

Reproduction and Life Cycle

The life-cycle of the Whale Shark is not well known.

Why protect this species?

The world population of Whale Sharks is unknown but they are targeted by commercial fisheries in parts of Asia for meat and oil. Many targeted fisheries have been closed in recent years due to declining catches. Whale Sharks are also accidentally captured and killed in other fisheries.

Ecotourism centered on whale shark encounters offers coastal communities a revenue source other than capture fisheries, which will benefit this species, if the number of visitors is limited, and activities are carried out in a way that does not disrupt their behavior or habitat.

Whale Shark

Rhincodon typus

What is being done to conserve it?

Whale sharks are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 1, 2012

IUCN Red List: VU A2bd+3d (v.3.1)

Recovery Plan: Proposed.

Monitoring: Sightings of Whale Sharks in Bermuda's waters are recorded when reported.

Shark Protection: The finning of sharks at sea was banned in Bermuda's waters in 2010.

The Convention on Migratory Species MOU on shark conservation has also been extended to Bermuda.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Understand how pollution, overfishing and accidental by-catch lead to loss of endangered and threatened marine species. Tell others what you have learned.

Report: if you have seen a Whale Shark in Bermuda's waters, please report it to the Department of Environment and Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Be a Citizen Scientist: Wild Me collects Whale Shark photos from the public and matches the dot patterns to identify individual fish and track their movements.
www.whaleshark.org

Do not litter: Marine debris is a serious threat to wildlife.

When traveling overseas, choose a responsible eco-tour operator for your whale shark encounter.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Information sources

To learn more please visit: www.environment.bm

Norman, B. 2005. *Rhincodon typus*. The IUCN Red List of Threatened Species 2005: e.T19488A8913502.



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For Further Information

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Greater Bermuda Land Snail

Poecilozonites bermudensis



© Mark Outerbridge

Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: CR (A2,B2a)

CMS: No

Author:

Dr. Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Poecilozonites is a highly distinctive genus of zonitid snails that has spent more than 1,000,000 years surviving radical changes in land area and ecology on Bermuda. At least twelve different species are known from the fossil record which represent a single lineage that exhibited pulses in size and shape that correlate with fluctuating sea levels throughout the Pleistocene era.

Only two species remained living on Bermuda by the middle of the 20th century; *Poecilozonites circumfirmatus* and *P. bermudensis* but both rapidly declined island-wide after the introduction of several species of predatory snails during the 1950s and 1960s. By the early 1990s *P. bermudensis* was believed to be extinct; however in September 2014 a relict population was discovered.

Identification

Poecilozonites bermudensis has a domed shell with a low spire and a relatively high aperture (opening). A hole (the umbilicus) is clearly visible on the underside of the shell. When young, snails typically have a characteristic zigzag (flame) pattern but this fades with age. Individuals often form a chestnut brown solid band along the edge of the outer whorls as they mature. Maximum shell diameter is 22.5 mm.

Range

Unique to Bermuda. Considered to be very common in the mid 20th century, this species is now restricted to one small area within the City of Hamilton.

Habitat

Historically associated with leaf litter and under herbaceous materials, but now only found in a damp concrete alley and courtyard approx. 200 square feet in area.

Reproduction and Life Cycle

Poecilozonites is capable of reproducing both sexually and asexually. Observations of snails in captivity have revealed that this species burrows into soil to deposit numerous (over a dozen) white circular eggs. The incubation period lasts for approximately one month, and the life span is thought to be between one and two years.

Why protect this species?

- Competition/predation from invasive species (especially carnivorous snails).
- Development and habitat fragmentation

Greater Bermuda Land Snail

Poecilonites bermudensis

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2016

IUCN Red List: Presently being assessed

Research: research has focused on a population census to describe abundance, environmental conditions that affect survival, field surveys for new populations, and assessment of potential habitats for future introduction. Studies examining dietary requirements and reproductive biology are ongoing.

Artificial propagation

- On-island breeding program at the Department of Environment and Natural Resources.
- Off-Island conservation—“**Lifeboat Program**” partnering with London Zoo, U.K.
- Anticipated future reintroductions in suitable locations in the wild.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda’s plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you think that you have seen this snail in the wild please report it to the Department of Conservation Services at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

To learn more please visit: www.environment.bm

Hearty, P.J. and S.L. Olsen. 2010. Geochronology, biostratigraphy, and changing shell morphology in the land snail subgenus *Poecilonites* during the Quaternary of Bermuda. *Palaeogeography, Palaeoclimatology, Palaeoecology* 293:9–29.

Bieler, R. and J. Slapcinsky, 2000. A case study for the development of an island fauna: recent terrestrial mollusks of Bermuda. *Nemouria* 44:1-100.

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Gould, S.J. 1993. *Eight little piggies*. W.W. Norton & Co.



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Lesser Bermuda Land Snail

Poecilozonites circumfirmatus



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Current Status

Endemic

BPSA: Level 1

CITES: No

Bda Red List: CR (A2,B2a)

CMS: No

Author:

Dr. Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Poecilozonites is a highly distinctive genus of zonitid snails that has spent more than 1 million years surviving radical changes in land area and ecology on Bermuda. At least twelve different species are known from the fossil record which represent a single lineage that exhibited pulses in size and shape that correlate with fluctuating sea levels throughout the Pleistocene era.

Only two species remained living on Bermuda by the middle of the 20th century; *Poecilozonites circumfirmatus* and *P. bermudensis* but both rapidly declined island-wide after the introduction of several species of predatory snails during the 1950s and 1960s.

Identification

Poecilozonites circumfirmatus has a domed shell with an obtuse spire, a relatively high aperture (opening) and a characteristic brownish colored zigzag (flame) pattern. A hole (the umbilicus) is clearly visible on the underside of the shell. Maximum shell diameter is 8.6 mm.

Range

Unique to Bermuda. Considered to be very common throughout Bermuda in the mid 20th century but by 2002 *P. circumfirmatus* could only be found living in four different locations in the central parishes of Bermuda along the southern shoreline. Surveys undertaken in 2010 failed to find any living specimens. This species is now believed to be extinct in the wild.

Habitat

Historically found in upland coastal habitats under loose rocks lying in leaf litter.

Reproduction & Life Cycle

Poecilozonites is capable of reproducing both sexually and asexually. Observations of snails in captivity have revealed that this species burrows into soil to deposit a cluster of small (ca. 1 mm), white, circular eggs. The incubation period lasts for 5-6 weeks. Development time from hatchling to adult size (8 mm) is between five and six months and the life span is thought to be about 18 months.

Why protect this species?

- Competition/predation from invasive species (especially carnivorous snails).
- Development and habitat fragmentation

Lesser Bermuda Land Snail

Poecilozonites circumfirmatus

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012

IUCN Red List: Presently being assessed.

Recovery Plan: A recovery plan has been developed. Sarkis, S. 2010. Recovery Plan for the Bermuda Land Snail, *Poecilozonites circumfirmatus*. Department of Conservation Services, Government of Bermuda.

Research: Past research has involved distributional surveys, trial translocations, captive breeding, and assessments of potential habitats for future reintroduction to the wild.

Habitat protection: There is a need to undertake invasive species removal at sites selected for future *P. circumfirmatus* reintroductions.

Artificial propagation

- Off-island "Lifeboat" conservation and breeding programs partnering with the London Zoo in the U.K. (2004-present).
- On-island breeding program at the Department of Environment and Natural Resources (2013-present).

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

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Report: if you think that you have seen this snail in the wild please report it to the Department of Environment and Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

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Hearty, P.J. and S.L. Olsen. 2010. Geochronology, biostratigraphy, and changing shell morphology in the land snail subgenus *Poecilozonites* during the Quaternary of Bermuda. *Palaeogeography, Palaeoclimatology, Palaeoecology* 293:9-29.

Lines, A. 2002. Survival and distribution of Bermuda's native and endemic terrestrial snails. BBP student project report. Bermuda Aquarium Museum and Zoo No.1184.



Adult snail (left) and a hatchling snail (right)

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Level 2 Species

*Note: E – Endemic, N – Native, CR – Critically Endangered,
EN – Endangered, VU - Vulnerable

Arthropod

Leaf Cutter Bee (*Megachile pruina pruina*) (N) VU

Corals (Black)

Cupressopathes gracilis (N) VU
Tanacetipathes hirta (N) VU
Tanacetipathes tanacetum (N) VU
Tanacetipathes thamnea (N) VU
Antipathes atlantica (N) VU
Antipathes furcata (N) VU
Stichopathes occidentalis (N) VU
Stichopathes setacea (N) VU
Stichopathes cf. spiessi (N) VU
Parantipathes tetrasticha (N) VU

Corals (Hard)

Agaricia fragilis dana (N) VU
Stephanocoenia intersepta (N) VU
Diploria labyrinthiformis (N) VU
Pseudodiploria strigosa (N) VU
Favia fragum (N) VU
Dichocoenia stokesi (N) VU
Meandrina meandrites (N) VU
Orbicella franksi (N) VU
Montastraea cavernosa (N) VU
Isophyllia sinuosa (N) VU

Scolymia cubensis (N) VU
Oculina diffusa (N) VU
Oculina varicosa (N) VU
Oculina valenciennesi (N) VU
Madracis auretenra (N) VU
Madracis decactis (N) VU
Porites porites (N) VU
Porites astreoides (N) VU
Siderastrea radians (N) VU
Siderastrea siderea (N) VU
Caryophyllia ambrosia ambrosia (N) VU
Caryophyllia sarsiae (N) VU
Coenocyathus goreau (N) VU
Deltocyathus calcar (N) VU
Deltocyathus eccentricus (N) VU
Deltocyathus italicus (N) VU
Deltocyathus moseleyi (N) VU
Desmophyllum dianthus (N) VU
Lophelia pertusa (N) VU
Oxysmilia rotundifolia (N) VU
Paracyathus pulchellus (N) VU
Phyllangia americana americana (N) VU
Solenosmilia variabilis (N) VU
Tethocyathus cylindraceus (N) VU
Enallopsammia rostrata (N) VU
Rhizopsammia bermudensis (N) VU
Javania cailleti (N) VU
Polymyces wellsi (N) VU
Fungiacyathus symmetricus (N) VU
Guynia annulata (N) VU
Madrepora carolina (N) VU
Madrepora oculata (N) VU
Madracis asperula (N) VU

Madracis myriaster (N) VU
Astrangia solitaria (N) VU
Colangia immersa (N) VU
Stenocyathus vermiformis (N) VU
Deltocyathoides stimpsonii (N) VU

Corals (Soft)

Briareum asbestinum (N) VU
Gorgonia ventalina (N) VU
Leptogorgia cf. setacea (N) VU
Antillogorgia acerosa (N) VU
Antillogorgia americana (N) VU
Pterogorgia citrina (N) VU
Eunicea calyculata (N) VU
Eunicea clavigera(N) VU
Eunicea fusca (N) VU
Eunicea knighti (N) VU
Eunicea tourneforti (N) VU
Eunicea tourneforti forma atra (N) VU
Muricea atlantica (N) VU
Muricea laxa (N) VU
Muricea muricata (N) VU
Muricea pinnata (N) VU
Muricea cf. waltonsmithi (N) VU
Plexaura flexuosa (N) VU
Plexaura homomalla (N) VU
Plexaurella dichotoma (N) VU
Plexaurella grisea (N) VU
Plexaurella nutans (N) VU
Pseudoplexaura flagellosa (N) VU
Pseudoplexaura porosa (N) VU
Pseudoplexaura wagnaari (N) VU

Nidalia occidentals (N) VU
Gersemia rubiformis (N) VU
Chrysogorgia fewkesii (N) VU
Callogorgia sp. (N) VU
Callogorgia gracilis (N) VU
Callogorgia verticillata (N) VU
Candidella imbricata (N) VU
Narella alvinae (N) VU
Narella versluysi (N) VU
Narella bellissima (N) VU
Thouarella sp. (N) VU
Thouarella (Euthouarella) grasshoffi (N) VU
Ceratoisis flexibilis (N) VU
Chelidonisis aurantiaca (N) VU
Lepidisis caryophyllia (N) VU
Lepidisis simplex (N) VU
Thelogorgia vossi (N) VU
Bebryce parastellata (N) VU
Muriceides kükenhali (N) VU
Scleracis guadalupensis (N) VU
Scleracis petrosa (N) VU
Thesea citrina (N) VU
Placogorgia cf. intermedia (N) VU
Placogorgia tenuis (N) VU
Eunicea pinta (N) VU
Lytreaia plana (N) VU
Muricea elongate (N) VU
Plexaurella nutans (N) VU
Sclerobelemnon theseus (N) VU
Telestula septentrionalis (N) VU

Echinoderms

- Long-spined Urchin (*Diadema antillarum*) (N) VU
- Four Sided Sea Cucumber (*Isostichopus badionotus*) (N) VU
- West Indian Sea Egg (*Tripneustes ventricosus*) (N) VU

Ferns

- Bermuda Cave Fern (*Ctenitis sloanei*) (N) CR (B1)
- Bermuda Shield Fern (*Thelypteris bermudiana*) (E) CR (B2)
- Governor Laffan's Fern (*Diplazium laffanianum*) (E) CR (D)
- Long Spleenwort (*Asplenium heterochroum*) (N) EN (C2a)
- Ten-day or Leatherleaf Fern (*Rumohra adiantiformis*) (N)
- Toothed Spleenwort (*Asplenium dentatum*) (N) EN (B1ab)

Finfish

- American Eel (*Anguilla rostrata*) (N) VU
- European Eel (*Anguilla anguilla*) (N) CR (A2bd+4bd)
- Bermuda Killifish (*Fundulus bermudae*) (E) EN
- Killifish (*Fundulus relictus*) (E) EN

Fire Coral

- Millepora alcicornis* (N) VU

Flowering Plants

- Black Mangrove (*Avicennia germinans*) (N) VU
- Red Mangrove (*Rhizophora mangle*) (N) VU

Land Crabs

- Land Hermit Crab (*Coenobita clypeatus*) (N) VU

Marine Molluscs

- Bermuda Sand Scallop (*Euvola ziczac*) (N) EN

- Calico Scallop (*Argopecten gibbus*) (N) EN

Marine Plants

- Manatee Grass (*Syringodium filiforme*) (N) VU
- Shoal Grass (*Halodule sp.*) (N) VU
- Shoal Grass (*Halodule bermudensis*) (E) CR
- Paddle Grass (*Halophila decipiens*) (N) VU
- Turtle Grass (*Thalassia testudinum*) (N) VU

Reptiles

- Diamondback Terrapin (*Malaclemys terrapin*) (N) VU

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Leaf Cutter Bee

Megachile pruina prunia

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Author:

Mr. Drew Pettit

Director

Revised: April 2016

Ecology

Identification

Leaf Cutter bees are solitary bees from the family Megachilidae. The Leaf Cutter bee is somewhat larger and its abdomen is more white and black opposed to yellow and black of the common European Honey Bee. Pollen is carried on the underside of the abdomen, never on the hind legs. One sign of their presence is the circular holes cut in the leaves of certain plants.

Range

Common to North America, Leaf Cutter Bees occur in North Carolina, Georgia and Florida. The Bermuda Leaf Cutter bee was first observed in 1913 on Nonsuch Island. In 1928 it was observed on the main islands. However in a study undertaken in 1990 it was noted to be surviving only in and around Nonsuch, Island. Currently it is known to only aggregate on two islands in the Castle Harbour Area. They forage on the Nonsuch and Cooper's Island Nature Reserves.

Habitat

Rocky coastal area of Bermuda's South Shore in vicinity of the Castle Island Harbour. Foraging on flowering coastal plants and nesting in cavities in the Bermuda sand stone.

Life Cycle

Unlike the European Honey Bee, the Leaf Cutter Bee does not create a hive with a queen and workers, nor do they work together for a common cause. Solitary bees typically take one whole year to pass through a complete life cycle, with an adult living only a couple of week. Therefore the young have to fend for themselves.

Newly emerged females begin constructing nests in Spring. In Bermuda these nests are found in the cavities of the island's porous limestone. The female will prepare a burrow by overlapping segments of a cut leaf to create a lined cell. In each cell they will lay a single egg and supply it with pollen upon which the larva will feed once it hatches. The larvae pupate will mature in the cell over winter and emerge in early May.

When they were first observed in Bermuda they were noted to make their circular incisions in rose leaves and nest in dry stone walls. Currently in their isolated locations in the Castle Harbour Reserve they are utilizing Jamaica Dogwood *Dodonaea viscosa*, Virginia Creeper *Parthenocissus quinquefolia*, Peach *Prunus persica*, Burr Bush *Triumfetta semitriloba* and Wax Myrtle *Myrica cerifera*.

Diet

Important native pollinators of North America. One of the reasons they are efficient pollinators is their frequency of visits to plants. This is because they are extremely inefficient at collecting pollen; compared to all other bee families. Megachilids require on average nearly 10 times as many trips to flowers to gather sufficient resources to provision a single brood cell. In Bermuda bees forage on Sea Ox-eye flowers in May-June.

Why protect this species?

Reasons for population decrease are unknown at this time and require research. Likely candidates include destruction of habitat, competition/predation from invasive species and pesticide use.

Leaf Cutter Bee

Megachile pruina prunia

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed.

Recovery Plan: Not yet written.

Public awareness: To be launched.

Research: Research has focused on identification and understanding of life cycle; however there is a need to monitor population trends, conduct comprehensive surveys of likely habitat to develop population size estimates, determine parameters limiting habitat, determine recruitment over several successive years and examine genetic variation in order to determine if the Bermuda form is an endemic subspecies.

Habitat protection: limit pesticide use, undertake invasive species removal, pollution control and remediation.

Artificial habitat: Investigations are ongoing into use of artificial bee boxes.

Local breeding programs: Potential.

Protective legislation

Protected Species Act (2003)

What you can do

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Do not use insecticides that harm bees in your garden.

Observe: Report distinctive circular incisions in leaves of Peach tree, Jamaican Dogwood, Virginia Creeper in May-June. Email environment@gov.bm.

Plant: Plant native plants for forage and nesting material.

Information sources

To learn more please visit: www.environment.bm

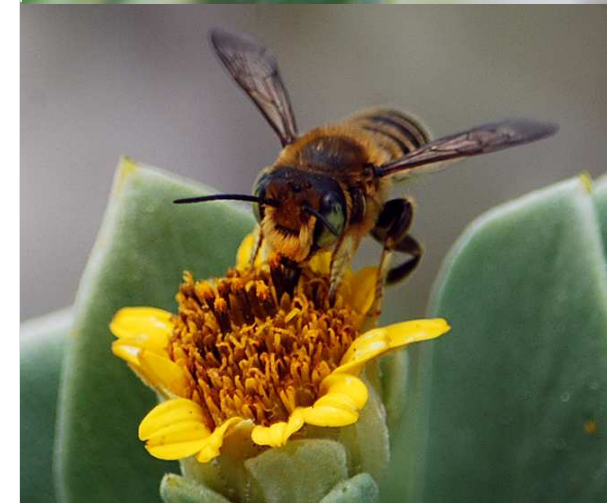
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Typical Leaf Cutter Bee circular incisions on Virginia Creeper



© Drew Pettit

For Further Information

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www.environment.bm

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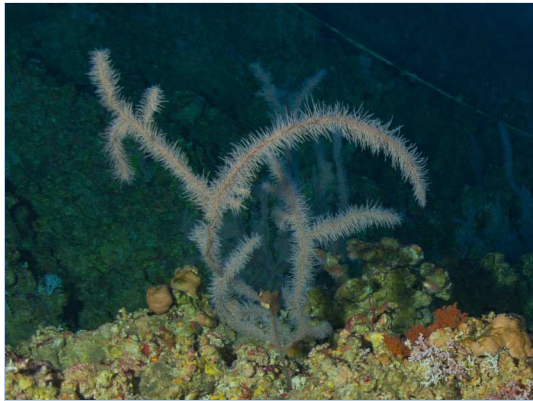
Black Corals or Antipatharia

Class: Anthozoa; Order: Antipatharia

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Bottle brush bush black coral
Tandacetipathes hirta
© Jill Heinerth

Current Status

Native

BPSA: Level 2

CITES: Appendix II

Bda Red List: VU

CMS: No

Fisheries Order: Yes

Author: Dr. Struan Smith

Curator, Natural History Museum

Revised: April 2016

Ecology

Identification

Black corals are an abundant group of animals living on Bermuda's deep reefs and the offshore Challenger and Plantagenet (Argus) banks. These corals are colonial animals that produce internal flexible skeletons made of protein. There are 9 species of black corals known from Bermuda's deep reefs and seamount slopes. They range in colour from black to brown but few specimens of the different species exist. The colour comes from soft tissue surrounding the internal skeleton. Their shapes are varied: small fans, tall with few branches, limited branching in one plane, long spiraling whips and a bottle-brush shape

Bermuda's black corals

Cupressopathes gracilis
Tanacetipathes hirta
Tanacetipathes tanacetum
Tanacetipathes thamnea
Antipathes atlantica
Antipathes furcata
Stichopathes lutkeni
Stichopathes cf. spiessi
Parantipathes tetrasticha

Three black coral specimens remain unidentified and may be new species.



Gray sea fan black coral,
Antipathes atlantica
© S.R. Smith

Habitat

Black corals are very common on deep reefs (>50m) and on the offshore banks. They also occur on the flank of the seamounts to great depths (>1000m). Black corals are poorly studied below 60m and may decline with depth. 9 deep water species have been reported but are poorly studied.

Range

Bermuda's black coral species are common in the Caribbean. There is a possibility that some black corals in Bermuda may be new species.

Feeding Habits

Black corals use polyps with only six tentacles to capture plankton from the water. They are slow growing, very long lived (decades to millennia) and are poorly known because of the extreme depths they inhabit. There are reports of symbiotic algae (zooxanthellae) living in their tissues who could pass simple sugars, derived from photosynthesis, to the coral for energy. This has not been verified in Bermuda black corals.

Reproduction and Life Cycle

Reproduction and life cycles traits of black corals have not been studied in Bermuda. Some species have an annual reproductive cycle that produces free-swimming larvae.

Why protect these species?

Corals living on deeper reefs are damaged by anchors and fishing gear, including lobster traps.

Black Corals or Antipatharia

Class: Anthozoa; Order: Antipatharia

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve them?

Black corals are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: To be developed

Public awareness: Included in the broad outreach to communicate the status of protected species in Bermuda

Research: Technical divers have been able to retrieve specimens down to 140m

Artificial propagation: None required

Recovery of injured animals: None required, damaged corals should be left in place

Protective legislation

Protected Species Act (2003)

Fisheries Act (1972)

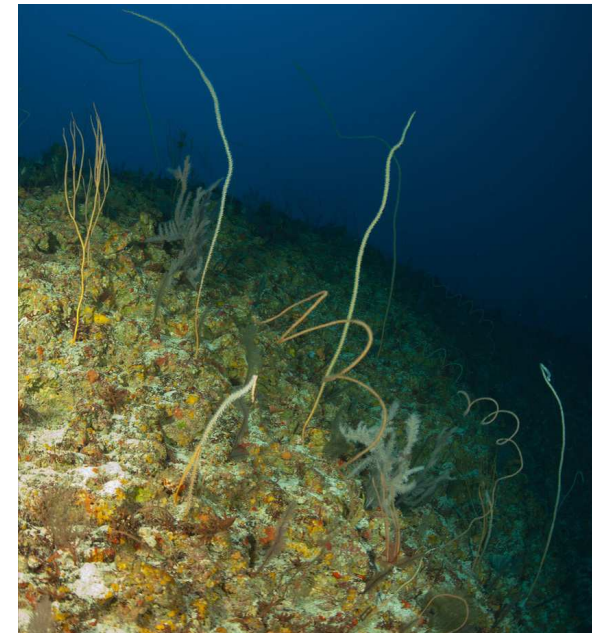
What you can do?

Learn: Understand how destruction of black corals leads to loss of species on Bermuda's deep reefs. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society and Reef Watch.

Information sources

To learn more please visit: www.environment.bm



Black corals off Kitchen shoals at 115m depth.

© Jill Heinerth

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Fire Coral

Millepora alcicornis

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Philippe Rouja

Current Status

Native

BPSA: Level 2

CITES: Appendix II

Bda Red List: VU

CMS: No

Author: Dr. Struan Smith

Curator, Natural History Museum

Revised: April 2016

Ecology

Identification

This coral is distinguished by its consistent yellow brown colour with pale whitish branch tips. This coral can rapidly and aggressively over-grow other corals, taking on their shape. In calm protected inshore water the corals can grow into large bush-like colonies with many branches. In exposed conditions on the outer reefs or the boilers it appears as a crust with few branches.

It is a hydrozoan and distantly related to hard corals, but has the same trait of forming a calcium carbonate skeleton that contributes to reef growth.

Habitat

This coral can be found in very shallow water in our inshore bays and across the patch reefs of the North lagoon. It is common the outer rim reefs but declines in abundance on the deeper outer terrace reefs. It grows as large crusts on the sides of our boiler reefs.

Range

This coral species is common throughout the Caribbean and the Florida Keys.

Feeding Habits

This coral uses very small tentacles to capture plankton from the water. It relies on symbiotic algae (zooxanthellae) living in its tissues to pass simple sugars, derived from photosynthesis, to it for energy. The tentacles have stinging cells that have a potent reaction with our skin and one should avoid touching fire coral.

Reproduction and Life Cycle

Fire corals release eggs and sperm cells into the water in the summer months to create larvae that settle back onto the reef. Fire corals grow asexually and form large colonies that can persist for decades. Growth and reproduction of this coral has not been studied in Bermuda.

Why protect this species?

- Fire coral is susceptible to thermal stress in the summer months that causes coral bleaching. Some bleached colonies may die while others suffer reduced growth and reproduction.
- Living in shallow water leaves this coral vulnerable to boat strikes and anchor damage.
- Inshore colonies are frequently entangled with fishing line and damaged by attempts to retrieve the line.

Fire Coral

Millepora alcicornis

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Fire coral are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Least Concern ver. 3.1

Recovery Plan: Proposed

Public awareness: Included in the broad outreach to communicate the status of protected species in Bermuda

Research: This species is recorded in reef surveys.

Habitat protection: Included in the broad protection of Bermuda's reefs and also present in all Marine Protected Areas

Artificial propagation. None required

Recovery of injured animals: None required, damaged corals should be left in place

Protective legislation

Protected Species Act (2003)

Fisheries Act (1972)

What you can do?

Learn: Learn to recognize the species in the wild to avoid being stung and to reduce damage to the colonies. Understand how destruction of habitat leads to loss or reduction of species on Bermuda's reefs. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society and Reef Watch.

Do not anchor on reefs.

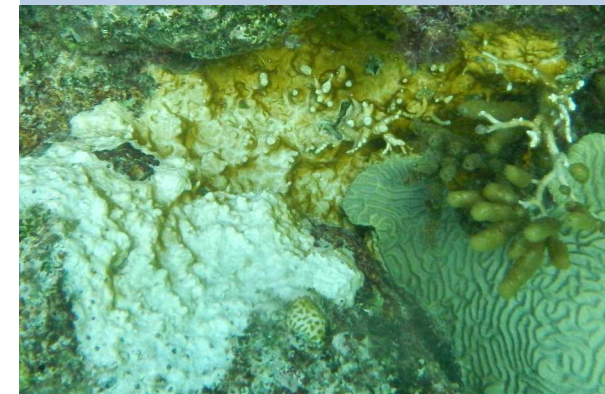
When fishing from the shore try untangle your fishing line from the bottom carefully. Pulling hard will break the coral before it breaks the line.

Information sources

To learn more please visit: www.environment.bm



© Philippe Rouja



Coral Bleaching , © Struan Smith

For Further Information

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Hard or Stony Corals

Class: Anthozoa; Order: Scleractinia

Bermuda Protected Species



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Brain coral, *Pseudodiploria strigosa*



Madracis decactis and *Madracis auretenra* ©
Thad Murdoch

Current Status

Native

BPSA: Level 2

CITES: Appendix II

Bda Red List: VU **CMS:** No

Fisheries Order: Yes

Author: Dr. Struan Smith

Curator, Natural History Museum

Revised: April 2016

Ecology

Identification

The hard or stony corals are the most critical group of animals living on Bermuda's reefs. These corals are colonial animals that produce hard calcium carbonate external skeletons. The growth, death and accumulation of coral skeletons is how Bermuda's reefs were formed. There are 20 species of hard corals found on Bermuda's shallow reefs, including the brain corals and stars corals. They range in colour from dark brown to yellow-green to pinkish-white. Their shapes are varied: large hemispheres, small mounds, plates, crusts, and branching colonies. The shapes reflect prevailing environmental conditions.

Habitat

Hard corals can be found in our inshore bays and harbours, on patch reefs across the North Lagoon, becoming very abundant on our rim reefs and outer terrace reefs. Hard corals decline in abundance below 30m but can be found at depths below 1000m. 29 deep water species have been reported.

Range

All Bermuda's shallow coral species are common throughout the Caribbean and the Florida Keys. Hard corals at depths below 30m are not well studied.

Bermuda's shallow zooxanthellate hard corals

Agaricia fragilis dana
Stephanocoenia intersepta
Diploria labyrinthiformis
Pseudodiploria strigosa
Favia fragum
Dichocoenia stokesi
Meandrina meandrites
Orbicella franksi
Montastraea cavernosa
Isophyllia sinuosa
Scolymia cubensis
Oculina diffusa
Oculina varicosa
Oculina valenciennesi
Madracis auretenra
Madracis decactis
Porites porites
Porites astreoides
Siderastrea radians
Siderastrea siderea
Caryophyllia ambrosia ambrosia
Caryophyllia sarsiae
Coenocyathus goreau
Deltocyathus calcar
Deltocyathus eccentricus
Deltocyathus italicus
Deltocyathus moseleyi
Desmophyllum dianthus
Lophelia pertusa
Oxysmilia rotundifolia
Paracyathus pulchellus
Phyllangia americana americana
Solenosmilia variabilis
Tethocyathus cylindraceus
Enallopsammia rostrata
Rhizopsammia bermudensis
Javania cailleti
Polymyces wellsii

Fungiacyathus symmetricus
Guynia annulata
Madrepora carolina
Madrepora oculata
Madracis asperula
Madracis myriaster
Astrangia solitaria
Colangia immersa
Stenocyathus vermiformis
Deltocyathoides stimpsonii

Hard or Stony Corals

Class: Anthozoa; Order: Scleractinia

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

Feeding Habits

Hard corals use soft polyps with small tentacles to capture plankton from the water. They also rely on symbiotic algae (zooxanthellae) living in their tissues to pass simple sugars, derived from photosynthesis, to them for energy. It is the pigments in the plant cells that give the hard corals their colouration. Deep water hard corals lack zooxanthellae (termed azooxanthellate) and are slow growing and do not build reefs.

Reproduction and Life Cycle

Hard corals release eggs and sperm cells into the water in the summer months, usually 7-10 days after the full moon to create larvae that settle back onto the reef. Hard corals grow asexually and form large colonies that can persist for centuries, star coral may exceed 1000 years of age. Growth and reproduction of many hard corals have been studied in Bermuda.

Why protect these species?

- Corals living on shallow reefs are vulnerable to boat strikes and anchor damage.
- Corals living on deeper reef are damaged by anchors and fishing gear, including lobster traps.
- Hard corals are susceptible to thermal stress in the summer months that causes coral bleaching. Some bleached colonies may die while others will suffer reduced growth and reproduction.

What is being done to conserve them?

Hard corals are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which

restricts their international trade.

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: no plan has been developed.

Public awareness: included in the broad outreach to communicate the status of protected species in Bermuda

Research: Hard corals are recorded in reef surveys.

Habitat protection: included in the broad protection of Bermuda's reefs and many are also present in Marine Protected Areas

Artificial propagation: none required

Recovery of injured animals: none required, damaged corals should be left in place

Protective legislation

Protected Species Act (2003)

Fisheries Act (1972)

What you can do?

Learn: to recognize the species and reduce damage to the corals. Understand how destruction of corals leads to loss of species on Bermuda's reefs. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society and Reef Watch.

Do not anchor on reefs

Information sources

To learn more please visit: www.environment.bm



Large colony of the lesser star coral, *Orbicella franksi*

© Chris Burville



Endemic cave coral, *Rhizopsammia bermudensis*

© Ian Murdoch

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Soft Corals or Octocorals

Class: Anthozoa; Order: Alcyonacea



Sea fan, *Gorgonia ventalina*



Purple sea rod, *Plexaura flexuosa*

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU **CMS:** No

Fisheries Order: Yes

Author: Dr. Struan Smith,
Curator, Natural History Museum

Revised: April 2016

Ecology

Identification

Soft corals are an abundant group of animals living on Bermuda's reefs and inshore bays. These corals are colonial animals that produce internal flexible skeletons made of protein. There are 5 species of soft corals found on Bermuda's shallow reefs, including the sea fan, sea rods and sea feathers. They range in colour from black to dark purple to brown and pale white. The colour comes from elements in the soft tissue surrounding the internal skeleton. Their shapes are varied: large fans, tall with few branches, bushy and branched in all directions, limited branching in one plane. There is one encrusting species.

Habitat

Soft corals are found in our inshore bays and harbours, on patch reefs across the North Lagoon, and are abundant on our rim reefs. Soft corals decline in abundance below 20m but are found at depths below 1000m. 29 deep water species have been reported but are poorly studied.

Range

All Bermuda's shallow soft coral species are common in the Caribbean and the Florida Keys.

Feeding Habits

Soft corals use polyps with only eight tentacles to capture plankton from the water. They also rely on symbiotic algae (zooxanthellae) living in their tissues to pass simple sugars, derived from photosynthesis, to them for energy. Deep water soft corals lack zooxanthellae (termed azooxanthellate) and are slow growing and are poorly known.

Bermuda's known shallow zooxanthellate soft corals

<i>Briareum asbestinum</i>	<i>Candidella imbricata</i>
<i>Gorgonia ventalina</i>	<i>Narella alviniae</i>
<i>Leptogorgia</i> cf. <i>setacea</i>	<i>Narella versluysi</i>
<i>Antillogorgia acerosa</i>	<i>Narella bellissima</i>
<i>Antillogorgia americana</i>	<i>Thouarella</i> sp.
<i>Pterogorgia citrina</i>	<i>Thouarella</i> (<i>Euthouarella</i>)
<i>Eunicea calyculata</i>	<i>grasshoffi</i>
<i>Eunicea clavigera</i>	<i>Ceratoisis flexibilis</i>
<i>Eunicea fusca</i>	<i>Chelidonisis aurantiaca</i>
<i>Eunicea knighti</i>	<i>Lepidisis caryophyllia</i>
<i>Eunicea tourneforti</i>	<i>Lepidisis simplex</i>
<i>Eunicea tourneforti</i> forma <i>atra</i>	<i>Thelogorgia vossi</i>
<i>Muricea atlantica</i>	<i>Bebryce parastellata</i>
<i>Muricea laxa</i>	<i>Muriceides kükenethali</i>
<i>Muricea muricata</i>	<i>Scleracis guadalupensis</i>
<i>Muricea pinnata</i>	<i>Scleracis petrosa</i>
<i>Muricea</i> cf. <i>waltonsmithi</i>	<i>Thesea citrina</i>
<i>Plexaura flexuosa</i>	<i>Placogorgia</i> cf. <i>intermedia</i>
<i>Plexaura homomalla</i>	<i>Placogorgia tenuis</i>
<i>Plexaurella dichotoma</i>	<i>Eunicea pinta</i>
<i>Plexaurella grisea</i>	<i>Lytreia plana</i>
<i>Plexaurella nutans</i>	<i>Muricea elongata</i>
<i>Pseudoplexaura flagellosa</i>	<i>Plexaurella nutans</i>
<i>Pseudoplexaura porosa</i>	<i>Sclerobelemnon theseus</i>
<i>Pseudoplexaura wagnaari</i>	<i>Telestula septentrionalis</i>
<i>Nidalia occidentalis</i>	
<i>Gersemia rubiformis</i>	
<i>Chrysogorgia fewkesii</i>	
<i>Callogorgia</i> sp.	
<i>Callogorgia gracilis</i>	
<i>Callogorgia verticillata</i>	

Soft Corals or Octocorals

Class: Anthozoa; Order: Alcyonacea

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

Reproduction and Life Cycle

Soft corals release eggs and sperm cells into the water in the summer months, usually 5-8 days after the full moon to create larvae that settle back onto the reef. Soft corals grow asexually and form large colonies that can survive for decades.

Reproduction has been studied in only two soft corals in Bermuda.

Why protect these species?

- Corals living on shallow reefs are vulnerable to boat strikes and anchor damage
- Corals living on deeper reefs are damaged by anchors and fishing gear, including lobster traps.
- Soft corals are susceptible to thermal stress in the summer months that causes minor coral bleaching.
- One disease is known to affect the sea fan.

What is being done to conserve them?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: Proposed

Public awareness: Included in the broad outreach to communicate the status of protected species in Bermuda

Research: Soft corals are recorded in reef surveys.

Habitat protection: included in the broad protection of Bermuda's reefs and many are also present in Marine Protected Areas

Artificial propagation: none required

Recovery of injured animals: None required, damaged corals should be left in place

Protective legislation

Protected Species Act (2003)

Fisheries Act (1972)

What you can do?

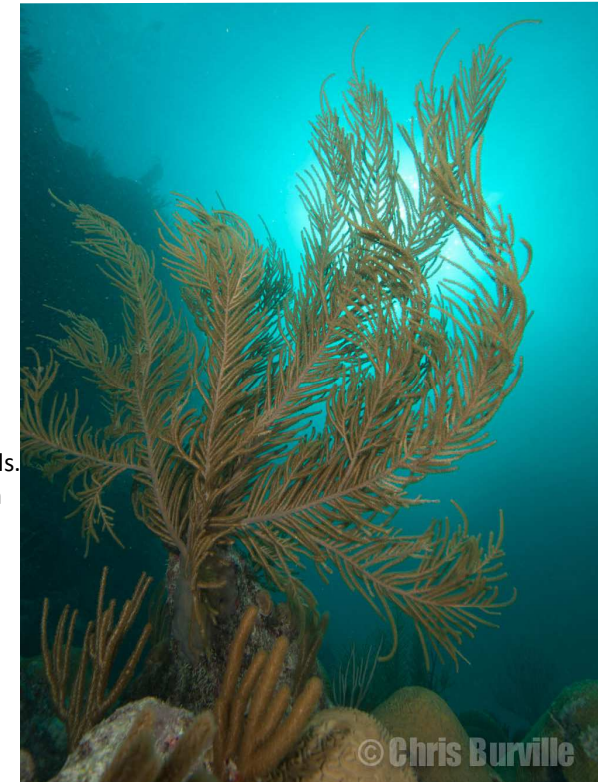
Learn: To recognize the species and reduce damage to the corals. Understand how destruction of corals leads to loss of species on Bermuda's reefs. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society and Reef Watch.

Do not anchor on reefs.

Information sources

To learn more please visit: www.environment.bm



Sea Feather, *Antillologorgia americana*

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Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Four Sided Sea Cucumber

Isostichopus badiotus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© S. A. Manuel, Bermuda

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Fisheries Order: No

Author:

Drs K. A. Coates and S. A. Manuel

Marine Management Section

Revised: April 2016

Ecology

Identification

Isostichopus badiotus or the four sided sea cucumber is also commonly called three-rowed sea cucumber and, in Bermuda, sea pudding. It is the largest sea cucumber found in Bermuda, often 20 to 30 cm long and 8 cm in diameter, and comes in browns and blacks in a variety of patterns. Individuals are frequently all black, but can be patchy black and golden brown or mostly brown with black spots, like chocolate chips. The body wall is thick and rigid with many pointed papillae that protrude from the lateral and upper walls of the body. The body has a distinct, flattened, ventral side with three rows of tube feet.

Range

The four sided sea cucumber is found throughout the Caribbean, Gulf of Mexico and along the southern US east coast, as well as off the north coast of Brazil and at Ascension Island. It is the most commercially exploited species of sea cucumber in the greater Caribbean.

Habitat

Studies done in Bermuda in the late 1970s found the highest density populations of *I. badiotus* in sheltered, low energy locations less than 15 m deep, on sandy bottoms, on patch reefs or associated with low cover seagrass beds. The highest densities were about 8 individuals per 10 square metres. Department of Conservation Services (DCS) surveys from 2006 to 2008 found sea cucumbers at depths from 1 to 22 m, very widespread in the north lagoon and inshore bays and harbours, infrequently with densities greater than 1 per 10 square metres.

Isostichopus badiotus is a deposit feeder, ingesting sediments and reducing sand and organic matter into finer particles. These processes increase nutrient availability for

other marine organisms and turn over the top layers of sediment allowing oxygen to penetrate. The *I. badiotus* population of the past century in Harrington Sound was estimated to ingest 500-1000 tons of sand annually.

Reproduction and Life Cycle

Sexes are separate, fertilization is external, and early larvae are pelagic. There are no published studies on the reproduction of *I. badiotus* in Bermuda, but from studies of this species in other geographic locations (e.g. Brazil, Bonaire, Panama) maximum spawning activity occurs when the water is at its warmest. Other environmental cues may be important to reproduction.

Why protect this species?

- The aquaculture service of the Food and Agriculture Organization considers *I. badiotus* threatened in the Caribbean.
- Easy to exploit: it is sedentary and highly visible on shallow sandy bottoms.
- Highly commercially valued species in the Caribbean demand from the Asian bêche de mer market has led, very quickly, to this species being fished to critical levels in a number of Caribbean countries; Venezuela and Panama have closed their *I. badiotus* fisheries as a result of overfishing.
- Commercial fishing has been suggested for Bermuda.
- Environmentally important: *I. badiotus* plays a substantial role in nutrient cycling—especially important in nutrient poor locations, such as Bermuda; no other species in Bermuda provides similar ecosystem services.
- Data deficient in Bermuda regarding: genetic diversity, reproductive patterns, reproductive success.

Four Sided Sea Cucumber

Isostichopus badiotus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Least concern ver. 3.1

Recovery Plan: management plan needs to be developed.

Public awareness: posters and information on website.

Research: little or no research has been undertaken on Bermuda populations. Need to: monitor populations over time; identify juvenile habitat requirements; determine population genetic diversity and distinctiveness; conduct comprehensive surveys of likely habitat to develop population size estimates; determine parameters limiting habitat; determine recruitment in several successive years.

Habitat protection: protect known habitat from any collecting.

Artificial propagation: research is ongoing.

Recovery of injured animals: n/a

Protective legislation

Bermuda Protected Species Act (2003)

What you can do?

Do not litter

Do not pollute: metals such as copper, nickel and lead may accumulate in the sea cucumbers tissues.

Do not pick up and squeeze

Join a conservation group

Information sources

To learn more please visit: www.environment.bm

All the references cited here are available from the Department of Environment and Natural Resources library at the Bermuda Natural History Museum.

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Long-Spined Sea Urchin

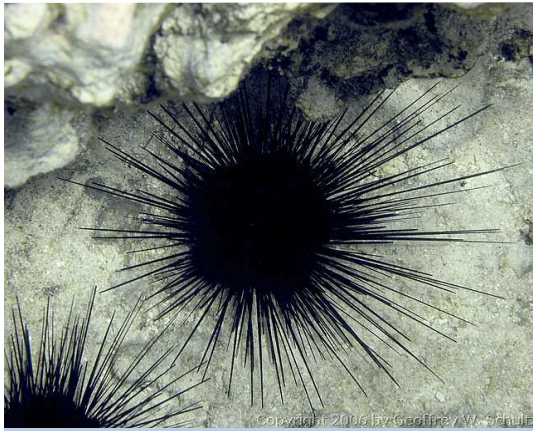
Diadema antillarum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Cayman

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Fisheries Order: No

Author:

Drs K. A. Coates and S. A. Manuel

Marine Management Section

Revised: April 2016

Ecology

Identification

As its common name, long-spined sea urchin indicates *Diadema antillarum* has distinctively long spines. These are commonly 10-12 cm long, but can be as long as 30-40 cm. The round body, or test, of adult long-spined urchins may be 3.5 to 6 cm in diameter. Both the spines and the test are usually very dark purple-red colored, almost black, although juveniles with light banded and adults with greyish white spines have been reported.

Range

There are eight living (extant) species in the genus *Diadema*, which are distributed globally. *Diadema antillarum* is the only species known from the Caribbean region and Bermuda, but it has also been reported from, the Canary Islands, western Africa, the eastern Pacific and Australia.

Habitat

There are few published, data-based, reports on the distribution and abundance of *D. antillarum* in Bermuda. Those few indicate densities among the lowest in the known range of the species and “large”, inshore populations are rare with the urchins being most abundant in Bermuda on fringing reefs of the South Shore. Recent studies by the department support these historical observations of low densities and patchy distribution along the south and western reefs. In other locations, high densities are found in shallow intertidal locations, but Bermuda’s known populations are all subtidal, on reefs.

The densest populations of *D. antillarum* are generally found at depths of 12m or less, but they are reported up to depths of 400m. Long-spined urchins primarily graze on algae growing on the reef and may remove juvenile/newly settled corals.

In Caribbean reef locations where grazing fish have been decimated, *D. antillarum* are among the most important algal-clearing megafauna on the reef. Long-spined urchins are quite cryptic, remaining in crevices and under ledges during daylight hours.

Bermudian populations of *D. antillarum* were reported as impacted at the time of the Caribbean mass mortality of 1983-1984.

Reproduction and Life Cycle

Only one intensive study has been made of the reproduction of *D. antillarum* in Bermuda. Gonads are ripe from late spring to early winter but the main spawning periods seem to be in early summer and late fall. Spawning occurs near the time of the new moon.

Reproductive activity is restricted to periods of ambient seawater temperatures greater than 20°C, but other environmental cues may also be important to seasonal reproductive patterns. Fertilization of gametes is external and larvae are long-term planktotrophs, so that maximizing retention on the platform and access to planktonic food are both important to successful recruitment.

Why protect this species?

- Restricted distribution in Bermuda due to specific habitat requirements; some of these habitats are heavily utilized by recreational divers.
- Low population numbers in Bermuda; this is probably due to both disease and slow recovery and recreational activities
- Feeding long-spined urchins to various fishes.
- Environmentally important member of the reef-grazing community.
- Data lacking on reproductive success.
- Data lacking on genetic uniqueness of Bermudian populations.

Long-Spined Sea Urchin

Diadema antillarum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: needs to be developed.

Public awareness: posters and information on website.

Research: little research and few surveys of Bermuda's population; no specific tracking of population recovery since suspected decline of early 1980's. Need to: monitor populations; conduct surveys of likely habitat to fully document existing populations; identify habitat requirements of juveniles and adults; undertake research to determine reproductive success, including genetic connections to Caribbean populations—comparative genetic studies initiated in 2009.

Habitat protection: corals are already protected; coral reef preserves only protect attached organisms; collecting by SCUBA divers forbidden but not collection by snorkelling. Need to further protect any known, occupied locations.

Artificial propagation: not necessary at the current population levels.

Recovery of injured animals: n/a

Protective legislation

Protected Species Act (2003)

What you can do?

Join a conservation group: such as the Bermuda Zoological Society and Reef Watch.

Do not litter

Do not pollute

Do not interfere with reef creatures

Information sources

To learn more please visit: www.environment.bm

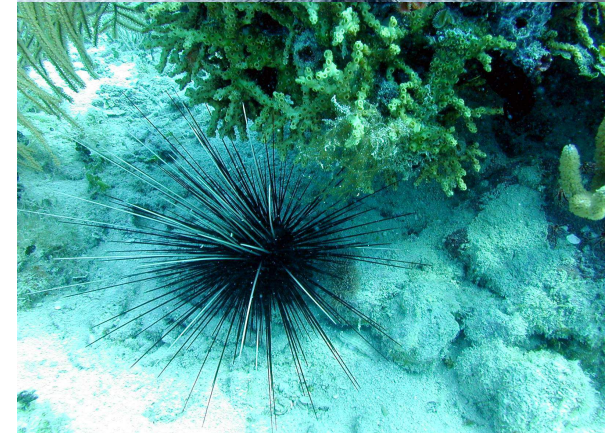
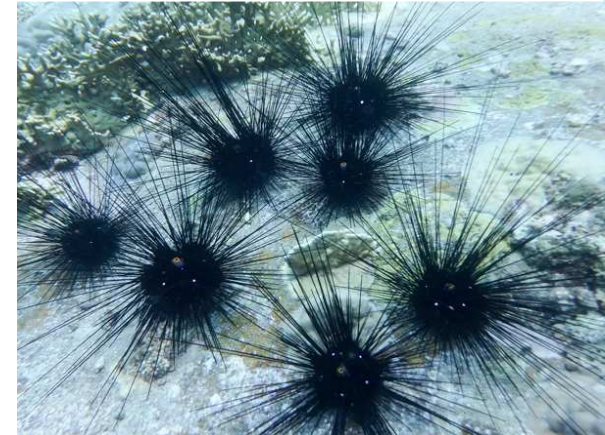
All the references cited here are available from the Department of Environment and Natural Resources library at the Bermuda Natural History Museum.

Bauer, J. C. 1980. Bulletin of Marine Science 30: 505-515.

Iliffe, T. M. and Pearse, J. S. 1982. International Journal of Invertebrate Reproduction 5: 139-148

Lessios, H. A. 1988. Annual Review of Ecology and Systematics 19: 371-393

Lessios, Manuel, pers. comm.



For Further Information

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West Indian Sea

Tripneustes ventricosus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Fisheries Order: No

Author:

Drs K. A. Coates and S. A. Manuel

Marine Ecology Section

Revised: April 2016

Ecology

Identification

Tripneustes ventricosus has the largest body, or test, of any of the sea urchins found in Bermuda, up to 15 cm. The body is banded white and dark brown, purple or even black; the spines are white and about 2 cm long. Both “West Indian sea egg” and “white sea urchin” are common names for *T. ventricosus*. The roe or ripe gonads of this species are prized as an exotic food item.

Range

The West Indian sea egg is primarily a tropical species with some subtropical extensions of its range. It occurs along the US Coast from Florida to South Carolina, throughout the Caribbean, south to the central Atlantic coast of Brazil and all around Bermuda.

Habitat

The West Indian sea egg is found mostly in shallow water with wave and current action, among coral or rock rubble, in algal rock flats or in seagrass beds. Adults are fairly sedentary and juveniles tend to recruit to the same habitats in which adults occur; the presence of suitable hiding places enhances juvenile survival. Department of Conservation Services has data on distribution and densities of *T. ventricosus* on the Bermuda platform from six years of benthic surveys, but these are not yet completely analysed. In general, sea eggs are found in few locations and are not very abundant in any location on the Bermuda platform. We are not aware of other population assessments for Bermuda.

The sea egg is a grazer, feeding preferentially on seagrasses and brown and green macroalgae. Studies of genetic differences among populations suggest that gene flow is very restricted. Therefore it is more than likely that sea eggs in Bermuda are isolated from those in other geographic locations. Survival of local populations depends on local reproduction and recruitment. Several species of reef fish and larger predatory gastropods prey on the West Indian sea egg.

Reproduction and Life Cycle

We know of no studies on growth and reproduction undertaken in Bermuda. Studies in the Caribbean indicate a life span of 2 to 3 years. Sexual maturity is usually attained within one year. A short life span combined with annually variable reproduction can lead to high variation in densities from one year to the next.

During spawning periods the urchins tend to gather in groups. Breeding season can last for several months, with peaks in spawning usually occurring during the summer months (about April to August). Duration and timing of spawning can vary from one geographic location to another depending on various environmental cues, such as water temperature, and food concentrations. Fertilization and early development occur in the water column so that early larvae are at the mercy of currents. Tiny pluteus larvae settle on the bottom about a month after fertilization. Some studies indicate higher recruit densities of larvae on the macroalga *Padina* sp. and on the seagrass *Thalassia testudinum*.

Why protect this species?

- Population decline: Sea egg populations have declined significantly in some locations in the Caribbean, despite management and conservation efforts; anecdotal reports also suggest declines in Bermuda.
- Fishery pressures: Sea eggs represent a commercially important but small fishery on some Caribbean islands and the mature roe of *Tripneustes* sp. is considered a delicacy as far afield as Japan
- Easily accessed: Sea eggs live in nearshore, shallow water, habitats frequented by the public; although sea eggs have the habit of covering themselves with bits and pieces of debris (sponge, seagrass) they are not difficult to find.
- Habitat destruction: The nearshore, shallow-water habitats of the sea eggs, both reefs and seagrass meadows, are heavily impacted by coastal developments and marine activities; this impacts adult populations and juveniles.

West Indian Sea

Tripneustes ventricosus

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: to be developed.

Public awareness: posters and information available on website.

Research: Little or no research has been undertaken on Bermuda populations. Need to: monitor populations over several years; conduct comprehensive surveys of likely habitat to develop population size estimates; determine parameters limiting habitat; determine genetic variation and distinctness of Bermuda population; determine recruitment in several successive years.

Habitat protection: limit new development of nearshore rubble and seagrass habitats; limit dock development; limit moorings; limit shoreline hardening; limit ocean dumping.

Artificial propagation: artificial increase of current population sizes not recommended unless protection is not effective in population maintenance. If a fishery is considered, then artificial propagation would be needed.

Recovery of injured animals: n/a

Protective legislation

Protected Species Act (2003)

What you can do?

Learn about the effects of shoreline development and artificial structures extending from the shore

Do not litter

Protect nearshore habitats

Join or form a conservation group

Information sources

To learn more please visit: www.environment.bm

All the references included here are available from the Dept of Environment and Natural Resources library at the Natural History Museum and Zoo.

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Maciá, S. and Robinson, M. P. 2009. Caribbean Journal of Science 45: 64-68.

Pena, M., Parker, C., Oxenford, H. A. and Johnson, A. 2009. Proceedings Gulf and Caribbean Fisheries Institute 61: 471-481.

Pena, M., Oxenford, H. A., Parker, C. and Johnson, A. 2010. FAO Fisheries and Aquaculture Circular No. 1056. Rome.

Thomas, M. L. H. 2010. A Naturalist's field guide to Bermuda. Bermuda Zoological Society, Bermuda.



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Bermuda Cave Fern

Ctenitis sloanei



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Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: CR (B1)

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

The Bermuda Cave Fern has large, bright to dark green fronds up to 3 feet (90 cm) long and 3 feet wide. The pinnae (leaflets which make up one frond) are divided 2 or 3 times. The stems of the fronds are covered by orange-brown hairs.

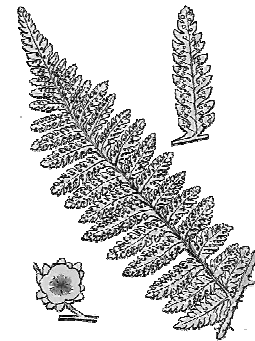
This fern was at one time known as *Dryopteris speluncae*, and was thought to be endemic to Bermuda.

Bermuda Cave Fern is now recognised as a Bermudian population of *Ctenitis sloanei*.

Habitat

This large fern grows up from the soil, as well as out of crevices in rocks like other cave ferns. It grows well in organic rich soils in lightly shaded locations where it is sheltered from wind and salt spray.

The distribution of this fern in the early 1900's was described by N.L Britton as occurring in "caves, holes and ledges between Harrington Sound and Castle Harbour." Today it is only known to grow in 3 locations within that area, as well as from a restored sinkhole in Smiths parish.



Britton, 1918

Range

Ctenitis sloanei is native to Bermuda where it is known as the Bermuda Cave Fern, and also Florida, the Caribbean, Mexico, Central America and Northwestern South America. Outside Bermuda, this species is called Florida Tree Fern, Red-Hair Comb Fern or Florida Lace Fern.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

This species has become very rare in Bermuda due destruction of its habitat and competition from invasive plants. Its complex life cycle and restrictive habitat requirements make it difficult for populations to recover once impacted. As a native species, this fern is found outside of Bermuda, but it is declining throughout its range, for example it is listed as Endangered in Florida. Therefore it is important that we safeguard our local population.

Bermuda Cave Fern

Ctenitis sloanei

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: the main goals in the Plan are to protect and manage habitat, increase the size and number of populations, maintain existing populations, conduct field surveys for new populations and potential habitat for introduction.

Public awareness: Public talks on ferns are held at least once per year, and a number of newsletter articles and field trips to Cave Fern habitats have been organized by the Bermuda Audubon Society.

Research: Research has focused on mapping the current distribution, genetic bar coding and monitoring. Research to determine habitat requirements and best conditions for reproduction are ongoing.

Habitat protection: Most known Cave Ferns are found within existing protected areas. Expanding protection to known populations on private land needs to be pursued.

Artificial propagation: Spore germination has been successfully undertaken at the Dept. of Conservation Services. It is anticipated that the young plants can be grown on into a government-held *ex situ* collection as called for in the Recovery Plan.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have the Bermuda Shield Fern so that they do not become overwhelmed by other vegetation. Control invasive plants on your property so they don't spread to nearby protected areas.

Volunteer: help to manage invasive plants in Bermuda's nature reserves.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

Information sources

To learn more please visit: www.environment.bm

Nathaniel L. Britton. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda (*Diplazium laffanianum* (Baker) C. Chr, *Goniopteris bermudiana* (Baker) comb., *Ctenitis sloanei* (Poepp. Ex Spreng.), *Asplenium heterochroum* Kunze, *Asplenium dentatum* L., *Rumohra adiantiformis* (G. Forst.) J. Department of Conservation Services, Government of Bermuda. 27 pages



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Bermuda Shield Fern

Thelypteris bermudiana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Endemic

BPSA: Level 2

CITES: No

Bda Red List: CR (B2)

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

This endemic fern was formerly known as *Dryopteris bermudiana*, *Nephrodium bermudiana* and *Goniopteris bermudiana*. The fronds of Bermuda Shield Fern reach up to 2 feet (60 cm) long and 3 to 6 inches (7.5 to 15 cm) wide. The fronds are composed of pinnae (leaflets) arranged alternately along a central stem (rachis) which is covered by fine hairs. The pinnae are 1.5 to 3 inches (3.8 to 7.5 cm) long and up to 1 inch (2.5 cm) wide. The pinnae are simple with undivided, rounded lobes that are held very close together. The bottom pair of lobes on the pinnae, closest to the central stem of the frond, are often larger than the other lobes of the pinnae; usually only on one side. This is a distinguishing feature of this species. Veins are prominent on the pinnae.

The fronds of Bermuda Shield Fern are dark green and appear glossy above; lighter green and dull underneath. Often the tips of the pinnae in the upper parts of the frond appear to curve towards the apex of the frond.

Range

Endemic to Bermuda

Habitat

Bermuda Shield Fern lives on damp rock faces and at the mouths of caves, mainly in the Walsingham Tract area of

Bermuda including the Walsingham and Idwal Hughes Nature Reserves. Occasionally it is found on shaded, damp man-made stone structures like loose stone walls. In the restored habitat in Walsingham Sink it grows from the ground below the indigenous forest and attains a large size.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

Today, this species has become very rare in Bermuda due destruction of its habitat, historical collection by hobbyists and competition from invasive plants. Its complex life cycle and restrictive habitat requirements make it difficult for populations to recover once impacted.

As an endemic species, it is critically important that efforts are made in Bermuda to conserve this species.

Bermuda Shield Fern

Thelypteris bermudiana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: EN B1ab,C2a, 3.1

Recovery Plan: the main goals in the Plan are to protect and manage habitat, increase size and number of populations, maintain existing populations, conduct field surveys for new populations and potential habitat for introduction. Download at www.environment.bm

Public awareness: lectures on ferns are given to interest groups several times per year.

Research: Research has focused on environmental conditions that affect germination and survival. Genetic work is planned.

Monitoring: Population mapping was undertaken in 2013 to enable IUCN Red List assessment of this species. Monitoring the health of the mapped populations, and the additional mapping of newly discovered ones are ongoing.

Habitat protection: Most known Shield Ferns are found within existing protected areas. Expanding protection to known populations on private land needs to be pursued. Control of invasive plants in fern habitats is ongoing.

Artificial propagation: Spore germination has been successfully undertaken at the Dept. of Conservation Services. It is anticipated that the young plants can be grown on into a government-held *ex situ* collection as called for in the Recovery Plan. Spore collection from threatened populations is planned.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about this species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Control invasive plant species: Invasive plants should be managed in areas known to have the Bermuda Shield Fern so that they do not become overwhelmed by other vegetation. Control invasive plants on your property so they don't spread to nearby protected areas.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

Protection: As a protected species, any specimen found in a proposed development area should be relocated to a nature reserve. If you see this fern on private land please email environment@gov.bm.

Information sources

To learn more please visit: www.environment.bm

Nathaniel L. Britton. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda (*Diplazium laffanianum* (Baker) C. Chr, *Goniopteris bermudiana* (Baker) comb., *Ctenitis sloanei* (Poepp. Ex Spreng.), *Asplenium heterochroum* Kunze, *Asplenium dentatum* L., *Rumohra adiantiformis* (G. Forst.) J. Department of Conservation Services, Government of Bermuda. 27 pages



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Governor Laffan's Fern

Diplazium laffanianum



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Current Status

Endemic

BPSA: Level 2

CITES: No

Bda Red List: CR (D)

CMS: No

Author:

Ms. Alison Copeland,
Biodiversity Officer

Revised: April 2016

Ecology

Identification

Named after Governor Sir Robert Laffan, this species is a relatively large fern with bright green, firm textured fronds. Fronds arise from a short, scaly rootstock. Fronds are held on 4-8 inch (10-20cm) long petioles which are blackish at the base and green toward the leaf blades. Fronds have a rounded triangular outline and are 8-12 inches long (20-30 cm) and 4-6 inches wide (10-15 cm). The pinnae that make up the frond are 3.5–5 inches (7.5-13 cm) long, and less than half as wide. They are arranged alternately along the rachis (central stem).



Britton, 1918

One of the most characteristic features of this species is the sori, the clusters of spore-containing sacs on the underside of the fronds. These sori are linear in Governor Laffan's Fern, and about 4 mm long.

Range

Endemic to Bermuda.

Habitat

According to Britton this fern was found in cave mouths and rock crevices between Harrington Sound and Paynter's Vale up until 1905. Britton describes seeing this very rare fern in the wild in the autumn of 1905, but in 1913 when he returned to a location known to have the fern it could not be found.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

Governor Laffan's Fern is endemic to Bermuda, so we must take the lead in conserving it. This species was likely never abundant due to its very specific habitat requirements. As a habitat-limited, island endemic it will always be highly at risk of extinction.

The Victorian fashion for collecting ferns, led to the removal of many from the wild, and letters from 1905 suggest this was a primary reason for the wild extinction of this species. It was only about 30 years from when it was first discovered to when it was last seen in the wild.

By 2003 only 5 individuals of this species remained in pots in a greenhouse. Without active conservation actions this species would surely have become extinct. Spore germination is low, except under specific conditions, which would limit un-aided recovery in the wild. Also the habitat has changed drastically in the 100 years since this species was last seen in the wild, due to development and invasive species. This fern is only likely to re-establish wild populations with management and assistance.

Governor Laffan's Fern

Diplazium laffanianum

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: EW, 3.1

Recovery Plan: This species is included in the fern recovery plan but the actions need are slightly different as there are no wild populations.

Public awareness: many articles have been written on this species, and lectures are given several times per year.

Research: Research has focused on environmental conditions that affect germination and survival, including long term storage of spores. Taxonomic and genetic studies have been completed.

Propagation:

- micropropagation of Governor Laffan's Fern has been ongoing since 2003 at Henry Doorly Zoo in Omaha, USA.
- Young ferns were returned to Bermuda in 2009, 2012 and 2014 and are currently housed at the Dept. of Environmental Protection and Dept. of Conservation Services.
- Protocols for propagating this species have been successfully developed and methods for keeping it in pot culture are being explored



Reintroduction: planting of nursery-raised ferns into managed habitats within protected areas began in Nov. 2014.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about this species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Control invasive plant species: Invasive plants should be managed in areas known to have the Bermuda Shield Fern so that they do not become overwhelmed by other vegetation. Control invasive plants on your property so they don't spread to nearby protected areas.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

Information sources

To learn more please visit: www.environment.bm

Britton, Elizabeth G. 1905. Letter from Mrs. E.G. Britton at the New York Botanical Garden to Mr. W.B. Helmsley, Director at the RBG Kew. 2page letter of 12 Oct 1905: Royal Botanic Gardens, Kew Archives: Director's Correspondence folio 249.

Britton, Nathaniel Lord. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

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Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda. Department of Conservation Services, Government of Bermuda. 27 pages



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Long Spleenwort

Asplenium heterochroum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: EN (C2a)

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

The leaves of Long Spleenwort can grow up to 16 inches (41cm) long. The leaf blades grow in a spreading fashion out from a short rootstock.

Each leaf blade is about an inch (2.5 cm) wide with 20-40 pairs of pinnae (leaflets on a fern). The bright green pinnae have toothed edges and grow opposite each other on a black central stem. These tough stems sometimes remain on the plant after the pinnae have dropped off.

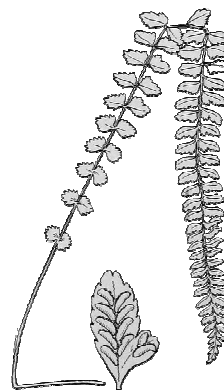
The spores of this species appear in characteristic rows on the undersides of the pinnae.

This species is also known as the Bicoloured Spleenwort.

Habitat

Long Spleenwort grows in damp, shaded rocky habitats, such as around caves and in rocky woodland. It is also known to grow out of man-made structures made of stone.

In his 1918 book *Flora of Bermuda*, N.L. Britton described the Long Spleenwort as common island-wide on walls, cliffs and shaded rocks. Today it may still be distributed island-wide, but is rarely seen and the population is fragmented. Specimens have been mapped at Walsingham and Abbot's Cliff Nature Reserves, and on private in Smiths and Hamilton parish.



Britton, 1918

Range

Native to Bermuda, as well as the Caribbean, Southern United States, Mexico and Central America.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

Long Spleenwort is listed as Endangered in Bermuda, because the local population is small and the number of mature plants is declining. The population is also fragmented and scattered, further reducing the likelihood of young plants being produced.

This species is threatened by habitat destruction for development and a reduction in the quality of remaining habitats due to shading and crowding from invasive plants. The number of mature individuals in populations of this species fluctuate greatly, with periodic die-offs. This may have increased in the last several years as a result of the passage of three hurricanes.

Long Spleenwort

Asplenium heterochroum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: the main goals in the Plan are to protect and manage habitat, increase size and number of populations, maintain existing populations, conduct field surveys for new populations and potential habitat for introduction. Download at www.environment.bm

Public awareness: campaign needed.

Research: Research has focused on mapping and genetic bar coding .

Monitoring: Actions currently underway include recording the location when a specimen is discovered and monitoring the health of known specimens in nature reserves.

Habitat protection: Most known spleenworts are found within existing protected areas. Expanding protection to known populations on private land needs to be pursued.

Artificial propagation: Spore germination has been marginally successful. It is anticipated that the young plants can be grown on into a government-held *ex situ* collection as called for in the Recovery Plan.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, National Trust or the Bermuda Audubon Society.

Manage: control invasive plants on your property so they don't spread to nearby protected areas.

Volunteer: help to manage invasive plants in Bermuda's nature reserves.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

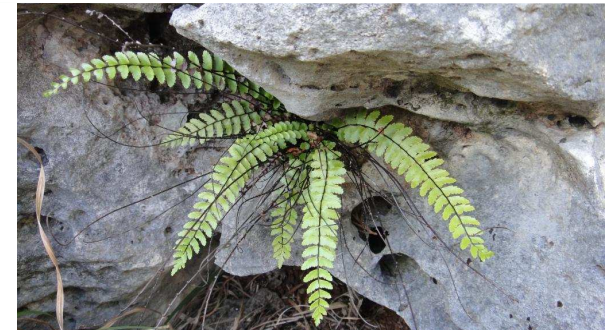
Contact: As a protected species, any specimen found in a proposed development area should be relocated to a nature reserve. Email conservation@gov.bm to report one.

Information sources

To learn more please visit: www.environment.bm

Nathaniel L. Britton. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda (*Diplazium laffanianum* (Baker) C. Chr, *Goniopteris bermudiana* (Baker) comb., *Ctenitis sloanei* (Poepp. Ex Spreng.), *Asplenium heterochroum* Kunze, *Asplenium dentatum* L., *Rumohra adiantiformis* (G. Forst.) J. Department of Conservation Services, Government of Bermuda. 27 pages



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For Further Information

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www.environment.bm

Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Ten Day Fern

Rumohra adiantiformis

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Alison Copeland

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: CR (D)

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Ten Day Fern has glossy, hairless, triangular shaped fronds. The dark green fronds are tough, so it is also known as Leatherleaf Fern. The pinnae, the lobed leaflets that make up the frond, are broadly spaced along the central stem of the frond, known as the rachis. In this species, the rachis is grooved and has scales. The fronds are spaced along a scaly rhizome that creeps along the surface of the substrate. Fronds are 1-4 feet long (30-120 cm).



Britton, 1918

Range

Ten Day Fern is native to Bermuda, and has a very wide global distribution. It is also widely propagated for horticultural purposes.

Habitat

The Ten Day Fern grows well in full sun or shade in moist substrate. It is found in fresh water marshes and was historically reported from rocky ledges in the Walsingham area, although it is not known from there now. Today it is found in Devonshire Marsh where it has been observed growing from rotting tree stumps and out of the trunks of Bermuda Palmettos.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

Today, this species has become very rare in Bermuda due destruction of its habitat, historical collection and competition from invasive plants. The complex life cycle and restrictive habitat requirements of this fern make it difficult for populations to recover once impacted.

Historically, Ten Day Ferns were collected from Devonshire Marsh for use in flower arrangements at the nearby church. The micro-habitats used by this fern have been reduced in the marsh through habitat changes such as fires, increased saltiness of the water and the proliferation of invasive plants. Only two individuals of this species have been mapped in Devonshire marsh, owing to its rarity as well as difficulty in accessing the habitat.

The species composition of the woodland at Walsingham is now dominated by invasives, so this fern is unlikely to survive without management if re-introduced there.

Ten Day Fern

Rumohra adiantiformis

What is being done to conserve it?

Protected species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: the main goals in the Plan are to protect and manage habitat, increase the size and number of populations, maintain existing populations, conduct field surveys for new populations and potential habitat for introduction. Download at www.environment.bm

Public awareness: lectures on ferns are given to interest groups several times per year.

Research: Research has focused on environmental conditions that affect germination and survival. Genetic work is planned.

Habitat protection: All known wild specimens are within a nature reserve.

Monitoring: A global positioning system (GPS) survey of the Ten Day Fern in Devonshire Marsh was initiated in December 2011. Monitoring of the ferns *in situ* and control of nearby invasive species is ongoing.

Artificial proportion: Initial spore germination trials in Bermuda were very successful, with many young plants produced. It is anticipated that the ferns can be grown on into a government-held *ex situ* collection as called for in the Recovery Plan. Spore micropropagation has also been carried out at the Henry Doorly Zoo in Omaha, USA. This has also been successful, resulting in a collection of large specimens held off island.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

Manage: control invasive plants on your property so they don't spread to nearby protected areas.

Protection: As a protected species, any specimen found in a proposed development area should be relocated to a nature reserve.

Observation: If you see a specimen email environment@gov.bm

Information sources

To learn more please visit: www.environment.bm

Nathaniel L. Britton. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda (*Diplazium laffanianum* (Baker) C. Chr, *Goniopteris bermudiana* (Baker) comb., *Ctenitis sloanei* (Poepp. Ex Spreng.), *Asplenium heterochroum* Kunze, *Asplenium dentatum* L., *Rumohra adiantiformis* (G. Forst.) J. Department of Conservation Services, Government of Bermuda. 27 pages



© Drew Pettit

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www.environment.bm

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Toothed Spleenwort

Asplenium dentatum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Alison Copeland

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: EN (B1a,b)

CMS: No

Author: Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

The blades of Toothed Spleenwort are up to 3 inches (7.5 cm) long with 6-8 pairs of pinnae (the leaflets of a fern). The pinnae are medium green, and are irregularly shaped with slightly toothed margins. The central stem of the leaf blade (the rachis) is green with no scales or hairs. The spores of this Spleenwort are found in rows on the underside of the pinnae on fertile leaf blades. Fertile blades tend to be held erect, while blades without spores usually lie flat against the rock



Britton, 1918

Habitat

In his 1918 book *Flora of Bermuda*, N.L. Britton records the distribution of this small fern as occurring on Abbot's Cliff and on shaded rocks around caves in the Walsingham area, and on the islands in the Great Sound. Its island-wide distribution is currently being mapped. It can still be found in several locations at Walsingham and Abbott's Cliff Nature Reserves, growing alongside mosses and other protected ferns, and is also known from Paynter's Hill, Blue Hole and Church Cave.

Range

The Toothed Spleenwort is native to Bermuda, Florida, the Caribbean, Mexico and Central America.

Reproduction and Life Cycle

Ferns do not reproduce by flowers and fruits like other plants. They produce dust-like spores on the underside of a mature frond. The spores develop into a small, flat, often heart shaped, prothallus. The prothallus has organs containing eggs and sperm on its surface. Ferns mostly occur in wet habitats, where water accumulates on the surface of the prothallus, allowing the sperm to move across the surface and reach the egg. Once fertilisation has occurred the sporophyte begins to develop; this is the mature fern that we see with roots and fronds.

Why protect this species?

Toothed Spleenwort is listed as Endangered in Bermuda because it occupies a restricted habitat, much of its habitat has been lost to development, the quality of the remaining habitat is degrading due to invasive species, its population is fragmented and a continued decline of the species is predicted without intervention.

Ferns, and fern-like plants such as Spleenworts, have a complex life cycle which makes it difficult for them to recover from habitat disturbance and population fragmentation.

Toothed Spleenwort

Asplenium dentatum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: Not assessed

Recovery Plan: the main goals in the Plan are to protect and manage habitat, increase size and number of populations, maintain existing populations, conduct field surveys for new populations and potential habitat for introduction. Viewable for download www.environment.bm

Public awareness: campaign needed.

Research: has focused on mapping the current island-wide distribution

Habitat protection: Most known spleenworts are found within existing protected areas. Expanding protection to known populations on private land needs to be pursued. Control of invasive plants in fern habitats is ongoing.

Monitoring: Actions currently underway include recording the location when a specimen is discovered and monitoring the health of known specimens in nature reserves.

Artificial propagation: To date, attempts to raise young plants by germinating spores have been unsuccessful. Further attempts under different conditions are planned.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: more about the species. Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Control invasive plant species: Invasive plants should be managed in areas known to have Spleenworts so that they do not become overwhelmed by other vegetation.

Grow and plant: Plant native and endemic plants on your property, and encourage your favourite garden centre to carry them. Do not dig up native plants from natural areas.

Protection: As a protected species, any specimen found in a proposed development area should be relocated to a nature reserve. If you see a specimen on private property email environment@gov.bm

Information sources

To learn more please visit: www.environment.bm

Nathaniel L. Britton. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Samia Sarkis. 2010. Recovery plan for six fern species from Bermuda (*Diplazium laffanianum* (Baker) C. Chr, *Goniopteris bermudiana* (Baker) comb., *Ctenitis sloanei* (Poepp. Ex Spreng.), *Asplenium heterochroum* Kunze, *Asplenium dentatum* L., *Rumohra adiantiformis* (G. Forst.) J. Department of Conservation Services, Government of Bermuda. 27 pages



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American Eel & European Eel

Anguilla rostrata & *Anguilla anguilla*

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



American eel *Anguilla rostrata*

© Philippe Rouja

Current Status

Native

BPSA: Level 2

CITES: Appendix II (*Anguilla anguilla*)

Bda Red List: *Anguilla rostrata* VU;
Anguilla anguilla CR A1a,b,d

CMS: Yes

Fisheries Order: No

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Known locally as freshwater eels or marsh eels, all of the specimens collected from Bermuda's wetlands have proven to be *Anguilla rostrata*; however the larvae (also known as leptocephali) of both species occur within Bermuda's territorial waters.

Identification

Elongated body that is cylindrical in shape in the front half and somewhat compressed in the back half. Lower jaw slightly longer than the upper jaw; lips are thick. Head rather long; eyes small and placed well forward on head. Dorsal, anal and caudal fins form one continuous fin from the middle of the back to the anus. Pelvic fins absent. Colouration goes through distinct phases depending on stage of development, from transparent (glass eel) to yellow (elver), and finally silvery. Adults coloration is variable but usually light-colored below and brownish above. Distinguishing between the two species using external characteristics is extremely difficult.

Range

Both species live in the Atlantic basin. American eels are found along the eastern coastlines of Canada and the U.S.A from Greenland to Trinidad, including the Caribbean and the Gulf of Mexico. European eels range from Scandinavia to Morocco as well as the Baltic, Black and Mediterranean Seas.

Habitat

These eels are catadromous, meaning that they spend most of their lives in freshwater and return to the sea only to breed. They live in rivers, muddy lakes, coastal lagoons, estuaries, and tidal marshes throughout their ranges. In Bermuda they were

historically described as common in the ditches of Pembroke Marsh and Devonshire Marsh; they were also known to inhabit some marine cave systems and many brackish ponds.

Diet

Feed on the larvae of a wide variety of insects including Mayflies, dragonflies, stoneflies, beetles, caddisflies, as well as upon snails, aquatic worms, amphipods, isopods, mysids, and many different fishes.

Reproduction and Life Cycle

Larvae are transparent, shaped like a willow leaf and develop at sea. These metamorphose into elvers once they reach nearshore waters and river estuaries. Adult eels of both species migrate large distances (in some instances thousands of miles) to spawn in the deep waters of the Sargasso Sea. Sexual maturity is reached during the spawning migration. Females are larger than males and can grow to 3 feet (1 m) in length and weigh up to 15 pounds (7.5 kg). The average life span is thought to be 15-20 years but individuals can live up to 90 years (in captivity).

Why protect these species?

Eel stocks, particularly in Europe, are at historically low levels due to a combination of overfishing, habitat loss, food web alterations, and environmental changes that include pollution and the construction of dams which prevent juveniles from easily migrating up rivers.

American Eel & European Eel

Anguilla rostrata & *Anguilla Anguilla*

What is being done to conserve them?

Anguilla anguilla is protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 2, 2012

IUCN Red List: *Anguilla rostrata* Endangered A2bd; *Anguilla anguilla* Critically Endangered A2bd+4bd (ver 3.1)

Recovery Plan: Proposed.

Research: Historical research in Bermuda has involved distributional surveys in marshes, dietary analyses of captured individuals, age and growth studies, taxonomy, as well as oceanic surveys to detect the presence and abundance of eel larvae in the Sargasso Sea.

Habitat protection: Most of the ponds and marshes inhabited by these species have been designated as Nature Reserves. These species would benefit greatly from protection being afforded to the Sargasso Sea.

Recovery of injured animals: Members of the public can call, or deliver injured wildlife (especially protected species) to, the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village. Tel (441) 293-2727.

Protective legislation

Protected Species Act (2003). Furthermore, the European eel is protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

What you can do?

Learn: Understand how pollution and the destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Be an informed consumer of fish and think twice before eating *unagi* (the Japanese word for freshwater eel). Seafood Watch, a sustainable seafood advisory list, recommends that consumers avoid eating *unagi* due to significant pressures on worldwide freshwater eel populations.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

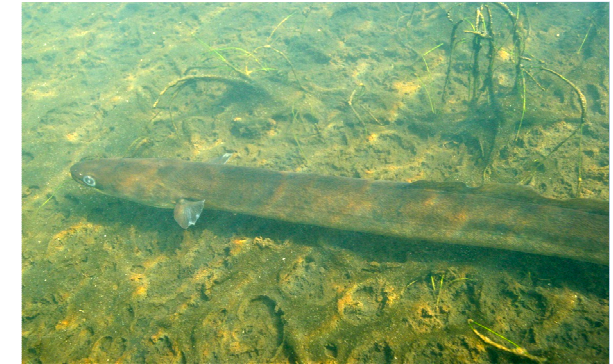
Report: Members of the public are encouraged to report freshwater eel observations to the Department of Conservation Services.

Information sources

www.fishbase.org

Boetius, I., and Boetius, J. 1967. Eels, *Anguilla rostrata*, LeSueur, in Bermuda. Danish Institute of Fisheries and Marine Research 130:63-84.

Smith-Vaniz, W., Collette, B.B., and Luckhurst, B.E. 1999. Fishes of Bermuda: History, Zoogeography, Annotated Checklist, and Identification Keys. American Society of Ichthyologists and Herpetologists 4:128-129.



American eel *Anguilla rostrata*
© Philippe Rouja

For Further Information

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www.environment.bm

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Bermuda Killifish

Fundulus bermudae & *Fundulus relictus*

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Fundulus relictus (male)

© Mark Outerbridge

Current Status

Endemic

BPSA: Level 2

CITES: No

Bda Red List: EN

CMS: No

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Also known locally as mangrove minnows or mangrove mullets, Bermuda's killifishes can be easily mistaken for the introduced and invasive Eastern mosquitofish *Gambusia holbrooki*.

Identification

Both species are very similar in appearance. Killifish have large eyes and a chunky body with dorsal and anal fins of nearly equal size. The average size on Bermuda is 6 cm (total body length), which is about the size of your little finger, but maximum length can be over 13 cm. Female killifish (top picture, reverse side) are olive coloured and sometimes have dark vertical bars running down their bodies. Males (above) are more brightly coloured and have a dark ocellus (eyespot) on their dorsal fin during the breeding season (February-August).

Range

Bermuda's killifishes historically inhabited a number of different marshes, bays, coastal mangrove communities and land-locked ponds throughout the islands. However, because of extensive modifications to wetland habitats during much of the 20th Century, killifishes are now only found in 14 ponds; seven naturally occurring populations and seven translocated populations created because of conservation efforts.

Habitat

Killifish are extremely hardy and can tolerate widely fluctuating environmental conditions (i.e. temperature, salinity, and dissolved oxygen levels).

Diet

They are omnivorous and feed on small invertebrates, such as amphipods and small insects, as well as plant material and pond sediment.

Reproduction and Life Cycle

Female killifish lay their eggs one at a time on mangrove prop roots and other hard-surfaced objects within the ponds. The fry (baby killifish) hatch from these sticky eggs after a few weeks and, under the right conditions, can live for many years.

Why protect these species?

As a Bermuda endemic, the global distribution of these species is limited to Bermuda. Furthermore, there is the possibility that the population in each pond is genetically distinct from each other, thus this variation must be preserved.

There is concern that some of our killifish may be disappearing.

On Bermuda, killifishes are threatened by:

- Loss of suitable habitat
- A polluted environment
- *Gambusia*, which prey upon killifish eggs and fry as well as compete with adults for food
- Hybridization through inadvertent mixing of the different populations

Bermuda Killifish

Fundulus bermudae & *Fundulus relictus*

What is being done to conserve them?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Not listed.

Recovery Plan: A Recovery Plan was created in 2012 which discusses the threats and conservation efforts for these species. Outerbridge, M., and Sarkis, S. 2012. Recovery Plan for Killifish (*Fundulus bermudae*, *Fundulus relictus*) in Bermuda. Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Research: Past research has focused on comprehensive multi-year demographic assessments, reproductive ecology, and ecotoxicological examinations of killifish pond habitats.

Habitat protection: Most of the ponds inhabited by Bermuda's killifishes have been designated as Nature Reserves and the mangroves surrounding these ponds are further protected by Bermuda law.

Protective legislation

Protected Species Act (2003)

What you can do?

Control invasive species: Do not release unwanted aquarium fishes into the wild. Find alternative homes for them or have them humanely euthanized.

Learn: Understand how the destruction of habitats and the impact of invasive species threatens Bermuda's native and endemic biodiversity.

Information sources

To learn more please visit: www.environment.bm

Smith-Vaniz, W., Collette, B.B., and Luckhurst, B.E. 1999. Fishes of Bermuda: History, Zoogeography, Annotated Checklist, and Identification Keys. American Society of Ichthyologists and Herpetologists 4:178-180.

Outerbridge, M. 2006. Distribution, population assessments and reproductive seasonality of Bermuda's killifishes. MSc. Thesis. University College Cork, Ireland. 115 pp



Male Bermuda killifish (top), female Bermuda killifish (middle), male and female Eastern mosquitofish (bottom)

Killifish photos © William Smith-Vaniz



Fundulus bermudae (female)
© Mark Outerbridge



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Black Mangrove

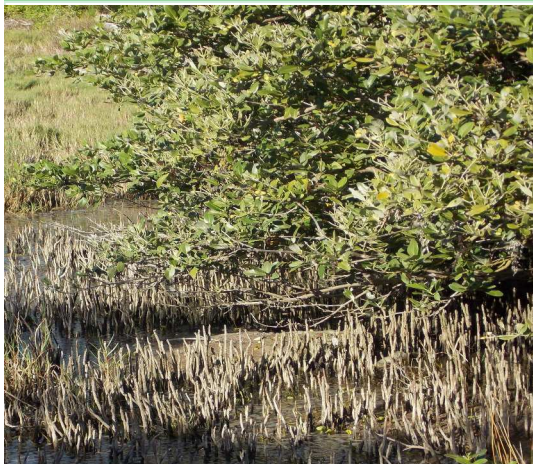
Avicennia germinans

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Alison Copeland

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: CR (A2,B2a)

CMS: No

Author:

Jeremy Madeiros

Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

The Black Mangrove is a salt-tolerant tree that grows in the upper intertidal zone of protected coastal bays, salt ponds and salt marshes. It can reach 30 to 50 ft. (9.1 to 15.3 m) in height, although it is usually smaller in Bermuda and can remain a small shrub on rocky shorelines. Unlike the Red Mangrove, it does not grow on prop roots, but has a more tree-like trunk and has finger-like pneumatophores that allow its roots to breathe even when submerged. It expels excess salt from its small, greyish leathery leaves. The trunk and heartwood is blackish in color, hence the name. The Black Mangrove often grows in association with the Red Mangrove but is less tolerant of highly saline conditions, generally growing on the landward margins of Mangrove swamps.

Range

The Black Mangrove is found in Bermuda (the most northerly point by far in its range), as well as the Caribbean, Florida, Louisiana, Texas, the Atlantic and Pacific shores of Central America, northern South America and the Atlantic coast of tropical Africa.

Habitat

The Black Mangrove grows just above the high tide zone in coastal lagoons, estuaries, bays and protected coastlines, normally in areas of fine sediment but also occasionally in rocky areas, where it grows more prostrate and shrub-like in stature.

Reproduction and Life Cycle

Like many other Mangrove species, the Black Mangrove reproduces by vivipary, where seeds are encased in a fruit, and germinate while still on the tree. This produces a seedling with well-developed roots and leaves by the time it drops from the tree and falls into the water. The seeds germinate in midsummer, but may be seen all year on the trees. The seedlings can remain viable for over a year once released, carried by wind and ocean currents, and eventually washing up on, and rooting in protected coastal areas far distant from their release point. This dispersion strategy is undoubtedly how both Mangrove species originally reached Bermuda.

Why protect this species?

- Black and Red Mangroves form dense coastal or pond-edge thickets and groves which work together to stabilize the shoreline, provide buffers for storm surges, trap debris and flotsam brought in by tides, and provide feeding, breeding and nursery areas for many species of fish, crabs, shellfish, birds and other wildlife.
- Nearly half of all Mangroves originally found on Bermuda have already been destroyed by coastal development and land reclamation before they were protected by law.
- Bermuda is the most northerly location on Earth where both the Black Mangrove and Red Mangrove grow, due to the nearby presence of the Gulf Stream.

Black Mangrove

Avicennia germinans

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Least Concern v3.1

Research: research has focused on a population census to describe abundance, environmental conditions that affect survival, field surveys for new populations, and assessment of potential habitats for future introduction. Studies examining dietary requirements and reproductive biology are ongoing.

Artificial propagation: Anticipated future reintroductions in suitable locations in the wild.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: if you think that you have seen Black Mangroves being illegally cut or removed, report it to the Department at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

To learn more please visit: www.environment.bm

Britton, N.L. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Ellison, A., Farnsworth, E. & Moore, G. 2010. *Avicennia germinans*. The IUCN Red List of Threatened Species 2010: <http://dx.doi.org/10.2305/IUCN.UK.2010-2.RLTS.T178811A7613866.en>.

Sterrer, W. E and D. B. Wingate. 1981. Wetlands and marine environments. In: Hayward, S.J., V.H Gomez and W.E. Sterrer (eds.). Bermuda's Delicate Balance - People and Environment. Hamilton. Bermuda National Trust: 402pp.



Flowers (top right), seeds (top), seedlings (bottom)



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www.environment.bm

Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Red Mangrove

Rhizophora mangle



Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: CR (A2,B2a)

CMS: No

Author:

Jeremy Madeiros

Senior Terrestrial Conservation Officer

Revised: April 2016

Ecology

Identification

Red Mangroves are native to Bermuda and are salt tolerant trees, also known as halophytes, which are adapted to life in harsh coastal conditions. They are easily distinguishable through their unique prop roots and viviparous seeds, or propagules. The prop roots provide extra support and protection against storm waves and tides. They also help prevent hypoxia of the tree by allowing a direct intake of air through pores in the root structure. A red Mangrove can reach up to 80 feet (24m) in height in the tropics, however in Bermuda it reaches 20—30 feet (6.1—9.2m). Its bark is thick and a grey-brown color. The leaves are 3-5 inches (7.6-12.7cm) long and 1-2 inches (2.5-5.1cm) wide, with smooth margins and an elliptical shape. The tree produces small, star-shaped flowers in the spring.

Range

Distributed in estuarine ecosystems, protected coastlines and brackish coastal ponds throughout the tropics. In the Atlantic basin, this includes Florida, the Caribbean, Central America, northern South America, and Africa, up to about 28 degrees north and south latitudes. Bermuda is the most northerly location known for the Red Mangrove, mainly due to the warming influence of the nearby Gulf Stream.

Habitat

Red Mangroves are found in subtropical and tropical areas in both hemispheres. They thrive in brackish water ponds and swampy salt marshes. They are well adapted to salt water, thriving in the intertidal zone of protected coastlines where

most plants fail, and creating their own ecosystems. Red Mangrove is often found in Bermuda with Black Mangrove (*Avicennia germinans*) and Buttonwood (*Conocarpus erectus*).

Reproduction and Life Cycle

As a viviparous plant, the Red Mangrove creates a propagule that is in reality an already sprouted, living tree. Resembling an elongated seed pod, the fully-grown propagule on the Mangrove falls in the water, and when washed up in a suitable protected shoreline, is capable of rooting and producing a new tree. The trees are hermaphrodites, capable of self-pollination or wind pollination. The tree undergoes no dormant stage as a seed, but progresses to a live plant before falling from its parent tree. A Mangrove propagule may float in the sea for over a year before washing ashore and rooting.

Why protect this species?

Bermuda's Mangrove areas the most northerly to be found on Earth and as such, are unique.

Mangroves are essential ecosystems for both terrestrial and marine species on the island. They provide stabilization of their surroundings, trapping fine silt and protecting the coastline behind from storm waves and surges with their dense growth of prop roots.

Mangroves create a community for other plants and animals including Giant Land Crabs (*Cardisoma guanhani*), Mangrove Crabs and juvenile Gray Snappers. In salt ponds, they provide shelter for Bermuda's endemic Killifish (*Fundulus relictus* and *F. bermudensis*). They also provide essential nesting sites for the native Green Heron and introduced Yellow-crowned Night Heron.

Red Mangrove

Rhizophora mangle

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2016

IUCN Red List: Least Concern v3.1.

Research: research has focused mainly on many of the species dependent on Mangrove ecosystems, including Bermuda Killifish, Green Heron, Giant Land Crab etc. Future research needs to be carried out to determine the present status of mangroves, total area covered by them, which areas are expanding or declining in coverage, and assessment of potential habitats for future re-introduction.

Artificial propagation

- Mangroves are easily propagated using the propagules, and have been grown in the past to re-establish colonies in locations where they had been lost through clearing for coastal development
- Anticipated future reintroductions in suitable locations in the wild.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, Bermuda National Trust or the Bermuda Audubon Society.

Report: if you think that you have seen any illegal cutting or clearing of Mangroves, please report it to the Department of Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Information sources

To learn more please visit: www.environment.bm

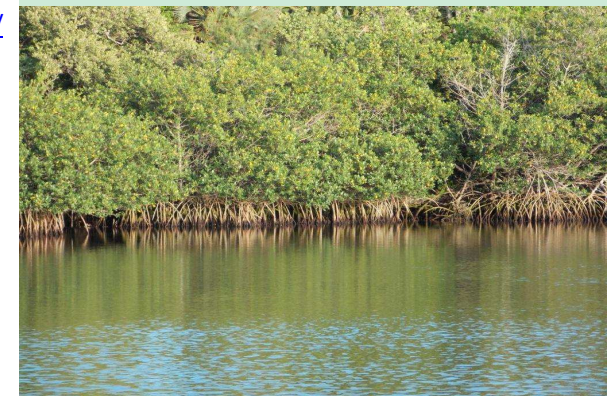
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Red Mangrove flowers (left) and propagules (right) A. Copeland



For Further Information

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www.environment.bm

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Land Hermit Crab

Coenobita clypeatus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Drew Pettit

Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Author:

Dr. Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Ecology

Identification

The land hermit crab is the only hermit crab species found in the terrestrial environment of Bermuda. These crabs are easy to identify when found in the wild. They grow up to 10 cm (4 inches) in body length, have two claws (one is larger than the other) and red-purple legs which come out of the front of the shell. Unlike snails, hermit crabs do not produce their own shell but instead use shells made by other animals, usually marine snails. Their favored shell comes from the West Indian top snail (*Cittarium pica*), but they will also use empty shells from nerites, periwinkles, tritons and even milk snails. A land hermit crab will retreat completely into its shell when threatened, closing the opening with its large claw. When a hermit crab grows too big for its shell, it will search for a larger one to change into.

Range

The land hermit crab is native to Bermuda. It is also found in Florida, the Caribbean and throughout tropical coastlines of Central and South America.

Habitat

Its habitats include upland coastal zones, salt marshes and mangrove communities.

Diet

Land hermit crabs are both herbivorous and opportunistic scavengers and form an important part of nature's recycling service.

Reproduction and Life Cycle

Historically in Bermuda, the main source of shells for land hermit crabs was the West Indian top snail. Unfortunately these large marine snails were a favorite food of the early settlers and were extirpated from Bermuda. With large shells no longer available, the number of crabs that could survive were limited. These crabs survived by using fossil top snail shells for shelter.

The West Indian top snail was reintroduced to Bermuda in 1982 and was given legal protection from harvesting. With top snails becoming common on the South Shore once again, it is hoped that the new supply of shells will ease the hermit crab housing shortage and the population of these threatened crabs is expected to increase.

Not only are they dependent on the sea as a source of shells for new homes, but the land hermit crab is also dependent on the sea for reproduction. Females goes down to the sea once a year just before the full moon to release her fertilized eggs which burst open when they are released into seawater. The young crabs emerge, drifts with the plankton and eventually come ashore to live and grow.

Why protect this species?

Bermuda's total population of land hermit crabs has been estimated to be less than 150 individuals, of which more than half were found in Hungry Bay. Threats to this species include habitat loss and fragmentation compounded by lack of awareness of habitat needs, collection for pets, use as bait for fishing, removal of suitable shells from habitats and predation by yellow-crowned night herons.

Land Hermit Crab

Coenobita clypeatus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1, 2012 re-graded to Level 2, 2016

IUCN Red List: Not assessed

Species Action Plan: Protect and manage key habitats, conduct presence/absence surveys to determine distribution, assess potential habitats for species translocations.

Viewable for download www.environment.bm

Public awareness: Promote ongoing awareness of the threats to, and the conservation of, land hermit crabs.

Research: Research to determine island-wide distribution, are needed.

Habitat protection: Improve habitat quality. Some protection exists with the protection of Mangroves.

Recovery of injured animals: Members of the public can call or deliver injured wildlife (protected species) to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's Village. Tel (441) 293-2727

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: Such as the Bermuda Zoological Society or the Bermuda Audubon Society.

Report: Please report any land hermit crab sightings to the Department of Environment and Natural Resources at www.environment.bm/contact-us/ or 299-2329 ext. 2141

Protect native wildlife: Do not collect land hermit crabs from the wild or purchase them for a pet. All hermit crabs in the pet trade industry are wild-caught because this species cannot be bred in captivity. You can also help by not collecting shells on the coast. Instead, leave them to be used by land hermit crabs.

Information sources

To learn more please visit: www.environment.bm

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Bermuda Sand Scallop

Euvola ziczac

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: N (EN)

CMS: N/A

Fisheries Order: Yes

Author:

Drs S.A. Manuel and K.A. Coates
Marine Ecology Section

Revised: April 2016

Ecology

Identification

Euvola ziczac (the zigzag scallop) is also known locally as the Bermuda sand scallop, and can attain a shell height of 130 mm, often reaching 90-100 mm. The shell is inequivalve; the upper (left) valve of the shell is slightly convex to slightly concave, whereas the lower (right) valve is strongly convex. The upper valve may have a plain background color, white to dark brown, with varicolored rays; the lower valve is reddish brown often mottled with white. Both valves are ribbed, with the grooves and ribs of the two valves interlocking.; the upper valve may have 30-34 ribs and the lower valve only 18-24 wide and flattened ribs.

Range

Euvola ziczac is distributed from Cape Hatteras throughout the Gulf of Mexico and the Caribbean, south to Brazil and east to Bermuda. This scallop supported a lucrative fishery in Brazil during the 1970's but the fishery had largely collapsed by 1982. *Euvola ziczac* is not abundant enough in Bermuda to support recreational or commercial fisheries.

Habitat

Adult Bermuda sand scallops are found partially buried in sandy bottoms, with only the tentacles along the open edge of the shell extended above the seabed. The type of substrate required for larval settlement is not known. Various studies in Bermuda indicate that this species occurs primarily in Harrington Sound at depths from 3 to 7 m but newly settled spat have been found, as recently as the late 1990's, in the eastern part of Great Sound and in the east end of Bermuda on the north side of the Causeway.

Diet

Bermuda sand scallops filter feed on phytoplankton in the water column and possibly on re-suspended organic matter near the sea bottom.

Reproduction and Life Cycle

This species is a functional hermaphrodite and a broadcast spawner. Spawning in Bermuda increases in the early winter and later spring, but there are not mass, synchronous spawning events; there is a general non-reproductive period in the summer months although a very low number of newly settled spat can occur in June and October. Spat settlement densities in the field, on artificial substrates, varied annually, from 1994 through 1999. Few individuals spawn during their first year and spawning is restricted to individuals with shell heights of greater than 40 mm. Laboratory reared larvae first settled at 14 days and new spat had a shell height of about .26 mm, ranging from .23-.30 mm. The maximum shell height of 4 (or less) and 8 (or less) week wild spat in Bermuda was 11.4 mm and 19.5 mm, respectively, indicating early post-settlement shell height growth rates of about 2.4 to 2.8 mm per week. Larger, older, individuals, about 33 mm initial size, grew at rates up to 0.76 mm per week.

Why protect this species?

- Restricted distribution in Bermuda (adults are only known from Harrington Sound) and all inshore habitat is stressed by anthropogenic influences
- Very low population size in Bermuda
- Scallops are important to maintenance of clear, clean water
- Scallops are important food items to other protected species (see spotted eagle ray)
- Data lacking on genetic uniqueness of indigenous Bermudian specimens

Bermuda Sand Scallop

Euvola ziczac

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Species has not been assessed

Recovery Plan: Needs to be developed

Research: No active programs; incidentally recorded in general benthic surveys done by the Department of Environment and Natural Resources, which occur periodically.

Habitat protection: The sandy sea bottom is not protected by any legislation particular to that kind of habitat.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how the destruction of habitats and the impact of invasive species threatens Bermuda's native and endemic biodiversity.

Learn how to recognize the species.

Join a conservation group

Report: Report sightings of the zigzag scallop to the Department of Environment and Natural Resources via www.environment.bm

Information sources

To learn more please visit: www.environment.bm

All the references cited here can be obtained through the library at the Bermuda Natural History Museum.

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Sarkis, S. 1990. Proceeding of the 43rd Gulf and Caribbean Fisheries Institute , Miami, pp. 605-619.



For Further Information

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Atlantic Calico Scallop

Argopecten gibbus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: EN

CMS: No

Fisheries Order: Yes

Author:

Drs S.A. Manuel and K.A. Coates
Marine Ecology Section

Revised: April 2016

Ecology

Identification

Argopecten gibbus can attain a shell height of 70 mm. The shell is inflated, the upper (left) valve being just perceptibly more convex than the lower (right) valve. The shell is usually mottled with red, brown and purple on a white or yellow background. There are ribs on both the upper and lower valves; ribs of the upper valve are narrower than those of the lower, with the grooves between the ribs being opposite on the two shells. There are 7 to 23 ribs on each valve.

Range

Argopecten gibbus is distributed from just north of Cape Hatteras to Florida, throughout the Gulf of Mexico to the northern side of the Greater Antilles, and east to Bermuda. Confusion with other, overlapping, species contributes to uncertainty about the limits of its distribution. It supports a small, but locally important, fishery on the east coast of Florida. *A. gibbus* is not abundant enough in Bermuda to support recreational or commercial fisheries.

Habitat

Calico scallop adults are found on the seabed and the substrate type varies; however, a hard and stable, submerged, substrate, usually mollusc shells, is essential to larval settlement. According to Clark II, *A. gibbus* was abundant in Harrington Sound, Bermuda in the early 1970's, particularly in shallow areas with seagrasses and macroalgae. Empty shells provided evidence of a population from deeper water, which had disappeared about 300-400 years earlier. Studies from the mid 1990's found no evidence for populations of calico scallops, in Bermuda, outside Harrington Sound. The scallops remain scarce in Harrington Sound.

Diet

The calico scallop filter feeds on phytoplankton in the water column.

Reproduction and Life Cycle

The calico scallop is a functional hermaphrodite and a broadcast spawner. Limited, available, data indicate they do not spawn in Bermuda during the summer or early fall. Peak larval settlement of an indigenous population occurred between December and February, with some settlement occurring from October through June. Laboratory reared larvae settle after about two weeks, with a shell height of 0.19 to 0.25 mm; the maximum shell height of 4 (or less) and 8 (or less) week wild spat in Bermuda was 5.7 mm and 17.7 mm, respectively, indicating early post-settlement shell height growth rates of 1.4 up to 2 mm per week, similar to what has been reported from Florida. Spat settlement densities in the field, on artificial substrates, varied annually, but with a decreasing trend, in one multi-year study, 10 to < 1 per collector over the period 1994 to 1999. Individuals from Florida are reported normally to begin spawning from an age of 6 to 12 months and will spawn repeatedly over their life span, about 24-30 months in Bermuda for non-indigenous individuals.

Why protect this species?

- Restricted distribution in Bermuda, only confirmed populations are in Harrington Sound, and this habitat is stressed by anthropogenic influences.
- Very low population size in Bermuda and with widely fluctuating total numbers of adults from year to year.
- Scallops, and other filter feeders, are important to maintenance of clear, clean water.
- Scallops are important food items to other protected species (see spotted eagle ray).

Atlantic Calico Scallop

Argopecten gibbus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Species has not been assessed

Recovery Plan: Needs to be developed

Research: No active programs; incidentally recorded in general benthic surveys done by the Department of Environment and Natural Resources, which occur periodically. Individuals from outside Bermuda have recently been introduced in the wild in Bermuda, as the culmination of a pilot aquaculture program. Neither the genetics of the indigenous population nor of the introduced specimens were determined prior to this event. The fate of the introduced specimens has not been tracked.

Habitat protection: Seagrasses, which create some of the preferred habitat of the calico scallop, are individually listed as protected species, although seagrass habitat is not protected *per se*.

Protective legislation

Fisheries Act (1972)

Protected Species Act (2003)

What you can do?

Learn: Understand how the destruction of habitats and the impact of invasive species threatens Bermuda's native and endemic biodiversity. Learn how to recognize the species.

Join a conservation group

Report: Report sightings of the calico scallop to the Department of Environment and Natural Resources.

Information sources

To learn more please visit: www.environment.bm

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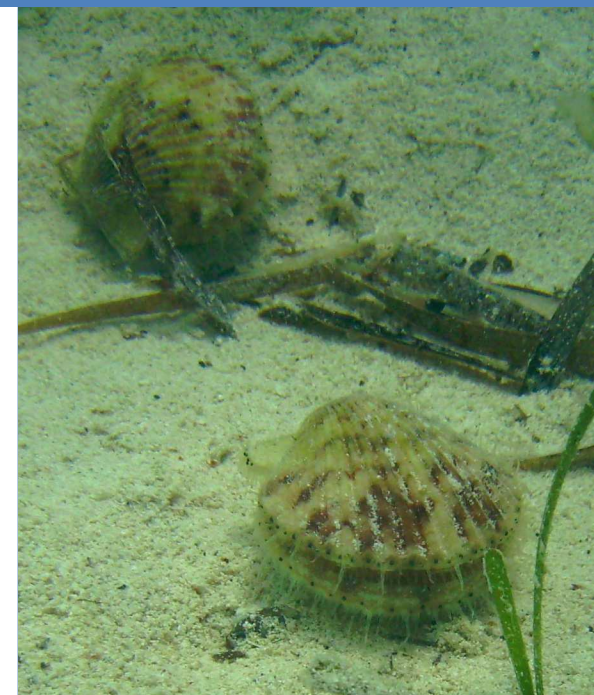
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Sarkis, S., Couturier, C., and Cogswell, A. 2006a. *Journal of Shellfish Research* 25: 503-508.

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For Further Information

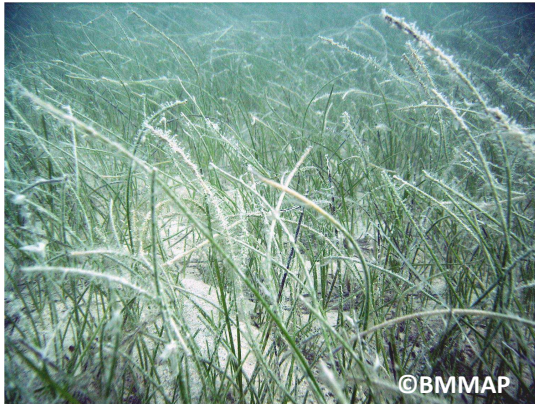
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Manatee Grass

Syringodium filiforme



Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Author:

Drs Sarah Manuel and Kathryn Coates,
and Simieon Massey

Marine Ecology Section

Revised: April 2016

Ecology

Identification

Syringodium filiforme, manatee grass is distinguished from other seagrasses found in Bermuda by its long, cylindrical, spaghetti-like, green leaves (blades). In Bermuda, the blades can be as long 30 cm and up to 2 mm in diameter. Blades occur in bunches of 2—3, growing on short erect stems. These stems originate from creeping horizontal stems (called rhizomes); roots also originate from the rhizomes, extending down into the bottom sediments; roots and leaf-bearing stems arise from nodes along the rhizome. Seagrass beds in Bermuda are often a mix of two or more seagrass species.

Habitat

The habitat available to manatee grass on the Bermuda platform is limited by bottom type and how much light reaches the bottom. Manatee grass will establish and grow on soft bottoms, often sand and occasionally muddy sands. In Bermuda it is found from <1 to 15 m depth, more than half its occurrences are at less than 6.7 m. The clearer the water the deeper the grass will grow, so that decreased water clarity reduces the amount of “available habitat” and structural modification of shallow water sea bottom compounds loss of habitat. Manatee grass is the most common or widespread seagrass on the Bermuda Platform; it grows mainly on the north side of the islands in bays and harbours as well as offshore around the reefs. Nutrients in the water column and the sediments are important to the rate of growth of seagrasses. In Bermuda, the major nutrient most limiting to manatee grass growth is phosphorus.

Range

Manatee grass is considered a tropical species and Bermuda is the most northern known location for this seagrass. It occurs, otherwise, throughout the Caribbean and Gulf of Mexico and along the east coast of Florida.

Reproduction and Life Cycle

Syringodium filiforme is a dioecious perennial plant, with distinct male and female flowers. It can also reproduce asexually, through fragmentation and clonal growth. Male and female flowers are seen regularly through the summer months. Fruits are compressed. Seedlings are also seen frequently both within and outside established seagrass beds.

Why protect this species?

- Habitat is threatened increasingly by anthropogenic activities.
- Manatee grass is a major food source to other protected species.
- Manatee grass is a recognized environmental engineer, contributing to sediment settlement, development and stabilization.
- Manatee grass is habitat to many juvenile and small fishes, including protected and commercially important species.
- Manatee grass is primary habitat to many protected mollusc species.
- Manatee grass is primary habitat to many juvenile invertebrates, including the commercially important spiny lobster.

Manatee Grass

Syringodium filiforme

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Least Concern (LC). The IUCN rating does not reflect the state of this plant in Bermuda where the population is declining.

Recovery Plan: A recovery plan is in development.

Research: Manatee grass is part of an ongoing, management driven, assessment and monitoring program of the Bermuda Platform water column and benthic environments. This program was initiated in 2006 by the Department of Environment and Natural Resources.

Habitat protection: Manatee grass habitat is not protected per se, however, the grass itself is protected which gives some level of protection to existing beds, but not to potential or previously occupied habitat.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: and understand how the destruction of habitats threatens Bermuda's marine biodiversity

Join a conservation group

Report : damage and incidents of damage to seagrass beds to the Department of Environment and Natural Resources

www.environment.bm

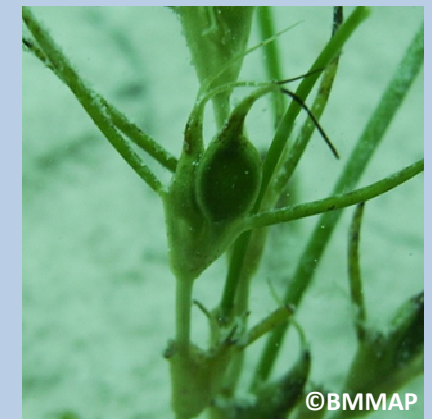
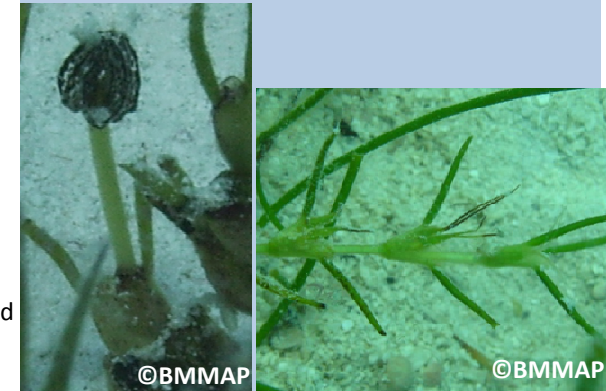
Information sources

To learn more please visit: www.environment.bm

The references cited can all be obtained through the library of the Department of Environment and Natural Resources, at the Bermuda Natural History Museum

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Paddle Grass

Halophila decipiens

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Current Status

Native

BPSA: Level 2

CITES: LC

Bda Red List: VU

CMS: No

Authors:

Drs Sarah Manuel and Kathryn Coates,
and Simieon Massey

Marine Ecology Section

Revised: April 2016

Ecology

Identification

Halophila decipiens, paddle grass, looks very different from the other seagrasses found in Bermuda. It has roundish or ovate blades (leaves); they are delicate, almost translucent, with finally serrate tips and tiny hairs on both sides of the leaf. The leaves are up to 20 mm long and 6-7 mm wide; they occur in pairs on long petioles arising from a horizontal stem (horizontal rhizome) that lies on or very near the surface of the sea bottom sediments. Paddle grass is most easily confused on a first look, in Bermuda, with the green alga *Caulerpa prolifera*, which has much thicker and tougher "leaves". The horizontal stem of paddle grass is very thin and no extensive root and rhizome mat is developed within the sea bottom. In Bermuda, paddle grass is found in monocultures as well as mixed in patches among other seagrass species.

Habitat

Paddle grass grows in deeper and murkier water than any other of the Bermuda seagrasses; it has been found from 2 to about 22 m depth. Paddle grass is the second most common seagrass on the Bermuda Platform, growing on sandy through muddy substrates but usually with only a few dense patches along a 50 X 0.5 metre transect so that its average density is low. Its ability to grow in locations with low light levels is due, in part, to its being an annual that does not have to persist through the low light months of a temperate winter season. In Bermuda, the major nutrient most limiting to paddle grass growth is phosphorus, however, light availability is the over-riding limiting factor to seagrass growth and distribution in Bermuda.

Range

Paddle grass is widespread in the tropics and subtropics around the world. In Bermuda it is widespread on the Platform and can be abundant at certain times of the year. As it is a very small plant, growing in deep or turbid water it is not easy to see from the water surface or in aerial images of the marine environment, and until recently, its distribution and abundance in Bermuda were very poorly known. It was first recorded in Bermuda in 1950, but as *Halophila baillonis* and even in 1998 it had been rarely seen.

Reproduction and Life Cycle

Paddle grass is monoecious; male and female flowers arise within the same spathe. *H. decipiens* can propagate through budding, but primarily relies on a buried seed bank for population re-establishment in seasonally fluctuating environments, such as Bermuda. In Bermuda paddle grass plants die back through the winter and are most luxurious in later summer (September). Paddle grass is reported to grow quickly in the summer and observations in Bermuda support this, although there are no specific data. Flowers and fruits are seen in Bermuda from early in the summer through until early winter.

Why protect this species?

- Habitat is threatened increasingly by anthropogenic activities.
- Paddle grass is a food source to deeper water herbivorous grazers, including fishes and turtles
- Paddle grass is a reliable indicator species for changes in water quality, in particular light transmission, in offshore areas.

Paddle Grass

Halophila decipiens

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Least Concern (LC), population stable across whole range; evaluated in 2010.

Recovery Plan: A recovery plan is in development. The species is only becoming understood in Bermuda.

Research: Paddle grass is part of an ongoing, management driven, assessment and monitoring program of the Bermuda Platform water column and benthic environments. This program was initiated in 2006 by the Department of Environment and Natural Resources.

Habitat protection: Paddle grass habitat is not protected per se, however, the grass itself is protected which gives some level of protection to existing beds, but not to potential or previously occupied habitat. This is particularly problematic as paddle grass is highly season in presence and abundance and does not form a persistent rhizome and root mat.

Protective legislation

Bermuda Protected Species Act (2003)

What you can do?

Learn: Understand how the destruction of habitats threatens Bermuda's marine biodiversity

Join a conservation group

Report : Damage and incidents of damage to seagrass beds to the Department of Environment and Natural Resources

www.environment.bm

Information sources

To learn more please visit: www.environment.bm

The references cited can all be obtained through the library of the Department of Environment and Natural Resources, at the Bermuda Natural History Museum

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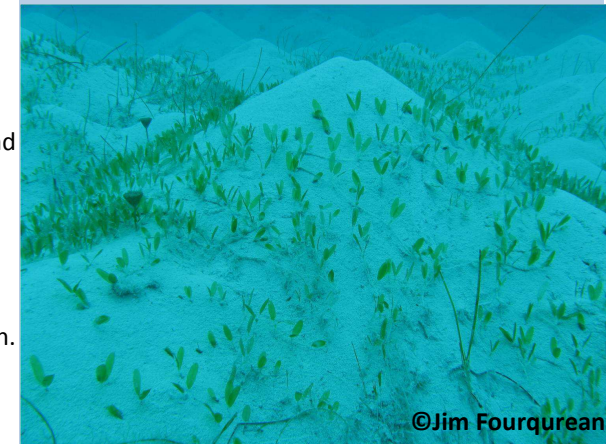
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Shoal Grass

Halodule sp.

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Current Status

BPSA: Level 2

CITES: No

Bda Red List:

Halodule sp. (native) VU

Halodule bermudensis (endemic) CR

CMS: No

Author:

Drs Sarah Manuel and Kathryn Coates,
and Simieon Massey

Marine Ecology Section

Revised: March 2016

Ecology

Identification

Halodule sp., shoal grass, is distinguished from other seagrasses found in Bermuda by its narrow, flat and rather delicate dark green leaves (blades). In Bermuda, the leaves can be as long as 15 cm but only 1-1.5 mm wide. Leaves occur in bunches of usually 3 or 4 but up to 8 growing on short erect stems (vertical rhizomes). At the apex the leaves have three teeth, two narrow lateral and one wide, sometimes prominent, medial tooth. The leaf-bearing stems originate from creeping horizontal stems (horizontal rhizomes) and the horizontal stems terminate in a leaf stem; roots also originate from the horizontal stems. The roots and horizontal stems form a complex, living, meshwork that extends below the sediment surface. Shoal grass often occurs in mixed beds with one or two other seagrass species, most often manatee grass and turtle grass. *Halodule bermudensis*, described as an endemic of Bermuda, has not been found since the 1950's. All the information that is available about *H. bermudensis* suggests that it is not the same species of *Halodule* that we now find in Bermuda. It may well be extinct.

Habitat

The habitat available to shoal grass on the Bermuda platform is limited by bottom type and how much light reaches the bottom. Shoal grass will establish and grow on soft bottoms, usually sandy or fine sandy bottoms, from 1 to 12.5 m depth, with more than half its known occurrences being at 6 m or less. The clearer the water the deeper depths at which shoal grass will grow, so that decreased water clarity reduces the amount of "available habitat". Structural modification of the sea bottom in shallow areas compounds loss of habitat. *Halodule* sp. is found in inshore waters and among reefs on the western end of the Bermuda Platform. It is the least common of the four fully marine species of seagrass found in Bermuda. It has ecological characteristics similar to manatee grass as far as light requirements and tissue nutrient levels. Available light is the factor most limiting to its growth.

Range

Halodule is considered a primarily tropical genus but in the western Atlantic it is reported from the US Atlantic coast as far north as North Carolina and south to southern Brazil. Limited studies indicate little genetic differentiation among Caribbean populations of *Halodule* but, however slight, Bermuda was more similar to Florida Bay populations than to any others examined. The genus is pantropical with one species, *H. wrightii*, reported to occur in the Atlantic, Pacific and Indian Oceans.

Reproduction and Life Cycle

Halodule sp. is a dioecious perennial plant, with distinct male and female flowers. Flowers are small and cryptic; the female flower has two filamentous stigma extending from two ovaries at the base of a leaf shoot; the male flower has two fused anthers borne on a single long stalk. In Bermuda, flowers and fruits have been found in summer, late June to September. *Halodule* sp. can also reproduce asexually through fragmentation and clonal growth; in Bermuda asexual reproduction is probably the more important mode of population expansion and maintenance. Individual plants grow through the extension of the horizontal stems, and production of new leaf shoots; for *Halodule* this is a relatively rapid process; it can occur at rates 4 times faster than seen in turtle grass.

Why protect this species?

- Habitat for shoal grass is threatened increasingly by anthropogenic activities that reduce water clarity and physically modify shallow, coastal, sea bottom
- Shoal grass is an important food source to a number of small invertebrate and vertebrate herbivores, including protected species, and it already has been over-grazed in a number of locations.
- Shoal grass is an important first invader into disturbed seagrass habitat, and contributes to sediment development and stabilization

Shoal Grass

Halodule sp.

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: For species of *Halodule*, the listings are from Least Concern (LC) to Data Deficient (DD), possibly Critically Endangered (CR) for *H. bermudensis*, if it can be determined, somehow, that it was a distinct species from any others that now exist. The IUCN Red List rating does not reflect the state of this plant in Bermuda where the population appears to be declining.

Recovery Plan: A recovery plan is in development.

Research: Shoal grass is part of an ongoing, management driven, assessment and monitoring program of the Bermuda Platform water column and benthic environments. This program was initiated in 2006 by the Department of Environment and Natural Resources.

Habitat protection: Shoal grass habitat is not protected per se, however, the grass itself is protected which gives some level of protection to existing beds, but not to potential or previously occupied habitat.

Protective legislation

Bermuda Protected Species Act (2003)

What you can do?

Learn: Understand how the destruction of habitats threatens Bermuda's marine biodiversity

Join a conservation group

Report : Damage and incidents of damage to seagrass beds to the Department of Environment and Natural Resources

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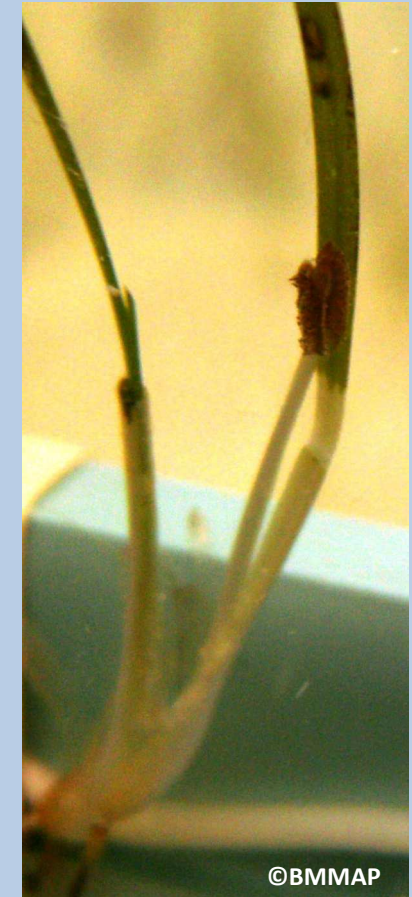
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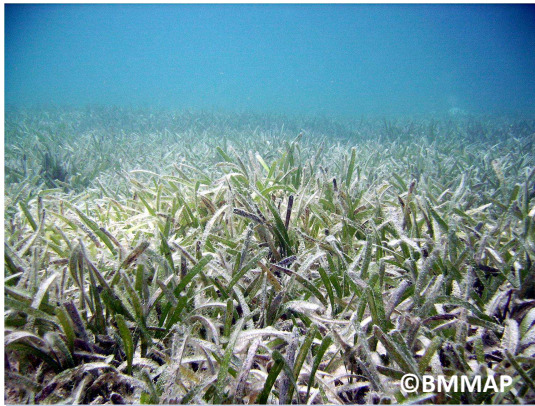
Turtle Grass

Thalassia testudinum

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



Current Status

Native

BPSA: Level 2

CITES: No

Bda Red List: VU

CMS: No

Authors:

Drs Sarah Manuel and Kathryn Coates,
and Simieon Massey

Marine Ecology Section

Revised: April 2016

Ecology

Identification

Thalassia testudinum, turtle grass, is distinguished from other seagrasses found in Bermuda by its long, strap-like, dark green leaves (blades). In Bermuda, the leaves can be as long as 35-40 cm and from 3-4 mm to 10 mm wide. Leaves occur in bunches of 2–6, growing on short erect stems (vertical rhizomes). The leaf-bearing stems originate from creeping horizontal stems (horizontal rhizomes); roots also originate from the horizontal stems, extending down into the bottom sediments. Turtle grass roots and horizontal stems form a complex, living, meshwork that extends along and below the sediment surface. Seagrass beds in Bermuda are often a mix of two or more seagrass species.

Habitat

The habitat available to turtle grass on the Bermuda platform is limited by bottom type and how much light reaches the bottom. Turtle grass will establish and grow on soft bottoms, often sand and occasionally muddy sands. In Bermuda it is found from 0.5 to 9 m depth, more than half its occurrences are at less than 3.5 m. The clearer the water the deeper the grass will grow, so that decreased water clarity reduces the amount of “available habitat” and structural modification of shallow water sea bottom compounds loss of habitat. Turtle grass forms the densest seagrass beds on the Bermuda platform, but it is not the most common or widespread seagrass; although, it is the most common species at the shallowest seagrass sites. Nutrients in the water column and the sediments are important to the rate of growth of seagrasses, however, in Bermuda, light is the factor most limiting to seagrass growth.

Range

Turtle grass is considered a tropical species and Bermuda is the most northern known location for this seagrass. It occurs, otherwise, throughout the Caribbean and Gulf of Mexico and along the east coast of Florida. Limited studies indicate little genetic differentiation of the Bermuda populations from distant Caribbean populations. On the Bermuda Platform turtle grass is

found in both inshore and offshore locations, but not outside the reefs rimming the shallow edge of the Platform.

Reproduction and Life Cycle

Thalassia testudinum is a dioecious perennial plant, with distinct male and female flowers. It can also reproduce asexually, through fragmentation and clonal growth, and this may be the more important mode of population expansion and maintenance throughout its range. A single leaf-bearing shoot can produce leaves for several years. Plants grow through the extension of the horizontal stems, and these grow slowly compared to many other seagrasses. In Bermuda, metre wide areas of damaged habitat within healthy beds can take more than 10–12 years to reach the density of the surrounding bed. Male flowers have a short stalk and 9 light yellow stamens edged with purple; female flowers have 7-8 light green styles, each split into 2 long stigmata. Both male and female flowers are seen regularly, but not frequently, in late June to July in many of Bermuda’s turtle grass beds. Fruits are prickly and spherical.

Why protect this species?

- Habitat is threatened increasingly by anthropogenic activities.
- Turtle grass is a major food source to other protected species and it already has been over-grazed in a number of locations.
- Turtle grass is a recognized environmental engineer, contributing to sediment settlement, development and stabilization.
- Turtle grass is habitat to many juvenile and small fishes, including protected and commercially important species.
- Turtle grass is primary habitat to many protected mollusc species.
- Turtle grass is primary habitat to many juvenile invertebrates, including the commercially important spiny lobster.

Turtle Grass

Thalassia testudinum

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Least Concern (LC), population stable across whole range; evaluated in 2010.

Recovery Plan: The IUCN rating does not reflect the state of this plant in Bermuda where the population is declining. A recovery plan is in development.

Research: Turtle grass is part of an ongoing, management driven, assessment and monitoring program of the Bermuda Platform water column and benthic environments. This program was initiated in 2006 by the Department of Environment and Natural Resources.

Habitat protection: Turtle grass habitat is not protected per se, however, the grass itself is protected which gives some level of protection to existing beds, but not to potential or previously occupied habitat.

Protective legislation

Bermuda Protected Species Act (2003)

What you can do?

Learn: Understand how the destruction of habitats threatens Bermuda's marine biodiversity

Join a conservation group

Report : Damage and incidents of damage to seagrass beds to the Department of Environment and Natural Resources

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Information sources

To learn more please visit: www.environment.bm

The references cited can all be obtained through the library of the Department of Environment and Natural Resources, at the Bermuda Natural History Museum

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Diamondback Terrapin

Malaclemys terrapin

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Ecology

Diamondback terrapins belong to a large and diverse group of reptiles collectively known as 'pond turtles' and are believed to have arrived naturally to Bermuda from the east coast of the U.S.A. using the Gulf Stream as a means of travel.

Identification

Seldom growing longer than 19 cm shell length and weighing more than 1.3 kg, this species show wide variation in color. The top of the shell (carapace) ranges from grey-green to brown while the bottom of the shell (plastron) is usually various shades of orange. The skin of terrapins found on Bermuda is grey and covered in very small dark freckles.

Range

Seven subspecies of diamondback terrapin are currently recognized as living along the Atlantic and Gulf coasts of the U.S.A. from Massachusetts to Texas. Distribution in Bermuda is limited to four land-locked ponds in Hamilton Parish.

Habitat

Diamondback terrapins prefer to live in brackish water environments such as salt marshes, mudflats and mangrove communities. Hatchlings and small juveniles require dense vegetation that grow adjacent to these wetlands where they feed, grow and hide from predators.

Diet

Diamondback terrapins are carnivorous and prefer eating marine molluscs and crustaceans (crabs, mussels, clams and snails). On Bermuda, they primarily feed upon small snails as well as scavenge fish and animal remains within in the pond environment.

Reproduction and Life Cycle

Female terrapins nest on Bermuda between April and August using sand bunkers on a golf course as nesting habitat. The average clutch size is five eggs and incubation lasts approximately two months. The sex of the turtles developing in their eggs is determined by temperature; cooler temperatures produce male terrapins and warm temperature produce females.

Females reach full maturity between 4-13 years of age and males between 2-7 years. Terrapins are thought to live for 20 years in the wild, but as long as 40 years in captivity.

Why protect this species?

Diamondback terrapins are declining in many areas through their range. This species is one of only two native non-marine reptiles presently on Bermuda and forms the only known wild breeding population outside of the U.S.A. Furthermore, they are very vulnerable to local extinction given their limited local distribution and small population size (approx. 100 individuals).

On Bermuda, terrapins are threatened by:

- Habitat loss and fragmentation
- A polluted environment that is contaminating their food
- Poor hatching success
- Predation from yellow-crowned night herons during the hatchling and juvenile developmental stages

Current Status

Native

BPSA: Level 2

CITES: Appendix II

Bda Red List: VU

CMS: No

Author:

Dr Mark Outerbridge

Senior Biodiversity Officer

Revised: April 2016

Diamondback Terrapin

Malaclemys terrapin

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources

What is being done to conserve it?

Diamondback terrapins are protected under Appendix II of the Convention on International Trade in Endangered Species (CITES) which restricts their international trade.

Protected Species Act Listing: Level 2, 2012

IUCN Red List: Near-threatened.

Recovery Plan: A Recovery Plan was created in 2013 which discusses the threats and conservation efforts for this species. Outerbridge, M. 2013. Recovery Plan for Diamondback Terrapins *Malaclemys terrapin* on Bermuda. Department of Conservation Services, Government of Bermuda.

Viewable for download www.environment.bm

Research: Past research has focused on a comprehensive demographic assessment, feeding and nesting ecology, the movement and survival of hatchlings, and eco-toxicological examinations of terrapin habitat, prey and eggs.

Habitat protection: Most of the ponds inhabited by diamondback terrapins have been designated as Nature Reserves and the mangroves surrounding these ponds are further protected by Bermuda law.

Artificial egg incubation: Investigations into the hatching success of eggs left in the wild versus those collected and placed within an egg incubator are ongoing. Hatchlings are released directly into their developmental habitats (primarily mangroves) which greatly reduces their risk of being eaten by bird predators.

Protective legislation

Protected Species Act (2003)

What you can do?

Protect native wildlife: Do not collect terrapins from the wild. This activity removes valuable individuals from the breeding population.

Control invasive species: Do not release unwanted pet reared sliders (*Trachemys scripta elegans*) into the wild. Find alternative homes for them or have them humanely euthanized.

Learn: Understand how the destruction of habitats and the impact of invasive species threatens Bermuda's native and endemic biodiversity.

Report: If you see a diamondback terrapin in any of the ponds or wetlands on Bermuda email environment@gov.bm

Information sources

To learn more please visit: www.environment.bm

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Level 3 Species

*Note: E – Endemic, N – Native, CR – Critically Endangered,
EN – Endangered, VU - Vulnerable

Flowering Plants

Bermuda Bedstraw (*Galium bermudense*) (N) EN

Bermuda Cedar (*Juniperus bermudiana*) (pre-blight) (E) CR
(A2ace)

Bermuda Sedge (*Carex bermudiana*) (E) EN (C2a, D)

Darrell's Fleabane (*Erigeron darrelliannus*) (E) VU

Wild Bermuda Bean (*Phaseolus lignosus*) (E) CR (C2a, D)

Wild Bermuda Pepper (*Peperomia septentrionalis*) (E) EN
(C2a)

Yellow Wood Tree (*Zanthoxylum flavum*) (N) VU (A1c)

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Bermuda Bedstraw

Galium bermudense

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© A. Copeland

Current Status

Native

BPSA: Level 3

CITES: No

Bda Red List: EN

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

This low growing perennial is much branched and grows from 6 inches to 2 feet (15-60 cm) in height. Small plants appear as upright stems, while larger plants appear as tangles of almost vine-like stems. The leaves of Bermuda Bedstraw occur in a group of four around the stem. Fine hairs cover the length of the stem and the leaves.

Range

Native to Bermuda the Bahamas and the South Eastern United States.

Habitat

In 1918 Britton wrote that Bermuda Bedstraw was commonly found on the hillsides of Bermuda. It has since become extremely rare. It occurs on grassy or relatively open hillsides, particularly in St. Georges, Somerset and Southampton and in coastal forests on South Shore.

Reproduction and Life Cycle

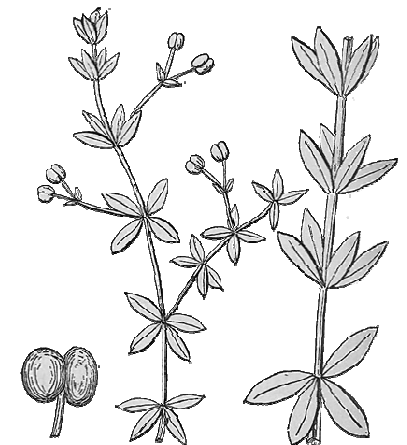
Bedstraw produces greenish-white flowers from spring to autumn, which occur at the tip of branches. The flower is followed by a rounded two-part fruit that turns dark purplish-black when ripe. This species can be propagated from seed.

Why protect this species?

Bermuda Bedstraw is protected as it is an indigenous Bermudian species that has become locally rare. The structure of Bermuda's woodlands has changed over the last 50 years, with fast-growing invasive species crowding out small natives like Bedstraw in the understory, while invasive trees over-shade them from above. These changes in the woodland community, combined with the loss of woodland to development, have seriously reduced the abundance of Bedstraw and make it very unlikely that the species will persist and recover unassisted.

Threats faced by this species include:

- Habitat loss and fragmentation
- Competition from invasive plants
- Lack of awareness leading to accidental destruction



© N.L Britton, 1918

Bermuda Bedstraw

Galium bermudense

What is being done to conserve it?

Protected Species Act Listing: Level 3

IUCN Red List: Not assessed.

Recovery Plan: Bermuda Bedstraw is included in the 2009 Recovery Plan for eight species of flowering plants.

Research: distribution mapping for this species has been undertaken and genetic barcoding is also underway.

Habitat Protection: A key habitat of Bermuda Bedstraw became a protected area with the creation of the Vesey Nature Reserve by the Buy Back Bermuda campaign.

Propagation: Bermuda Bedstraw is being propagated from seed for sale to the public and planting of this species for ornamental use, as well as part of woodland restoration projects, is being promoted.

Protective legislation

Protected Species Act (2003)

What you can do?

Plant: purchase this native plant for your home garden or woodland restoration project. It makes an attractive hanging basket.

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust or the Bermuda Audubon Society to protect habitats.

Control invasive plant species: Invasive plants should be managed in places where specimens of this plant occur so that they do not become overwhelmed by other vegetation. Control invasive species on your property to stop them spreading.

Information sources

To learn more please visit: www.environment.bm

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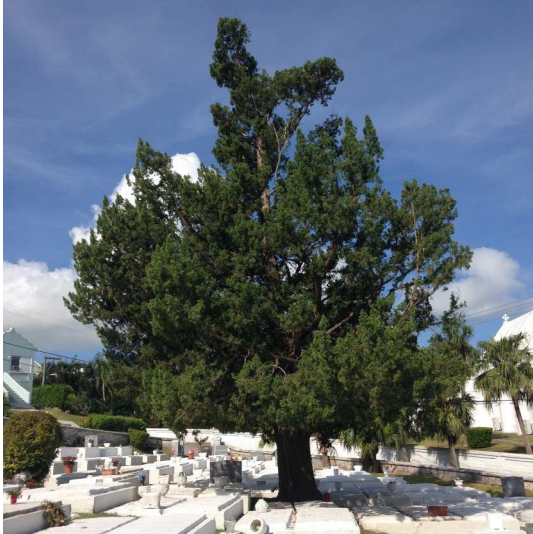
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Bermuda Cedar (Pre-blight)

Juniperus bermudiana



© Drew Pettit

Current Status

Endemic (pre-blight; i.e. before the 1940s)

BPSA: Level 3

CITES: No

Bda Red List: VU

CMS: No

Author:

Mr. Drew Pettit,

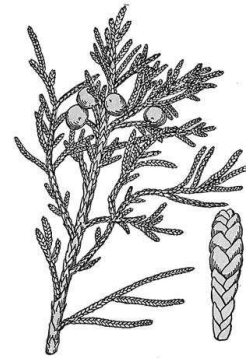
Director

Revised: April 2016

Ecology

Identification

Bermuda's famous endemic tree; Bermuda Cedar is a juniper not a true cedar. In fertile soil and sheltered locations they grow up to 50 feet (16 m) and may live for several hundred years. Bermuda Cedar has dense blue-green foliage with small, scale-like leaves on branches which are square in cross section. Bermuda Cedar has distinctive greyish bark that peels off in long strips. It has an irregular and widely branching habit; conic in outline when young and becoming round topped when old. Cedars are either male or female, the latter produces many round blue-grey berries which turn dark bluish purple when ripe.



© Britton, 1918

Habitat

Bermuda Cedar is commonly found in upland forest habitat and freshwater marshes. It is tolerant of salt spray and can also survive in coastal forest where it grows in a stunted, sometimes sprawling manner. Cedars also thrive in managed landscapes like gardens, golf courses and churchyards.

Range

As an endemic, this tree has a highly restricted global distribution.

Reproduction and Life Cycle

In March and April the male trees release clouds of pollen which are dispersed by the wind to reach the flowering female trees. The fruit ripens in September and October.

Cedars are important as a food source and nesting for birds.

Cedar can be propagated from tip cuttings taken between November and April and placed in rooting hormone. It can also be grown from seeds collected from September to November. Germination time is 6-24 weeks and trees can be planted out after 2 years.

Why protect this species?

At one time this was the most common tree on the Bermudian landscape. The loss of 95% of the cedar population during the blight of the 1940's is considered to be one of Bermuda's greatest ecological disasters. Bermuda Cedar is currently threatened by loss of woodland habitat, cutting of planted specimens to make way for development and impacts from invasive plants. Evidence suggests the introduced Darrell's Cedar is hybridizing with Bermuda Cedar, threatening the unique genetics of the endemic population.

Bermuda Cedar (Pre-blight)

Juniperus bermudiana

What is being done to conserve it?

Protected Species Act Listing: Level 3, 2016

IUCN Red List: CR A2ace, ver. 3.1

Recovery Plan: Needs to be drafted.

Public awareness: Campaign has been launched.

Research: Research has focused on environmental conditions that affect germination and survival. Monitoring, genetic studies to better explain population structure and differences between populations, mapping and dendrochronology.

Habitat protection: Limit pesticide use, undertake invasive species removal, pollution control and remediation.

Monitoring: Actions currently underway include recording the location when a specimen is discovered and monitoring the health of known specimens in nature reserves.

Artificial propagation: Bermuda Cedar has been widely propagated and planted in gardens, parks and nature reserves since the 1960's. These restoration efforts have increased the numbers and distribution. Woodland management and invasive plant control measures have improved the quality of key habitats. In 2007 seeds were sent to the Millennium Seed Bank to guard against future environmental disasters. Ongoing scientific study of the population genetics of the species should give a better understanding of the hybridization threat.

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have specimens so that they do not become overwhelmed by other vegetation.

Protection: As a protected species, any specimen found in a proposed development area should be relocated to an appropriate location.

Plant: Incorporate this plant into your backyard garden or woodland conservation plan.

Observation: If you see a specimen email environment@gov.bm

Information sources

To learn more please visit: www.environment.bm

Adams, R.P. and Wingate, D. 2008. Hybridization between *Juniperus bermudiana* and *J. virginiana* in Bermuda.



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For Further Information

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Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Bermuda Sedge

Carex bermudiana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Endemic

BPSA: Level 3

CITES: No

Bda Red List: CR

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Sedges are closely related to grasses and look very much like them. They grow as individual plants with long thin leaves. The edges of the leaves can be very sharp. The leaves of Bermuda Sedge grow to 45 – 75 cm (1.5 to 2.5 feet) long and can reach 5 cm (2 inches) wide, but are usually narrower. The leaves have a triangular-shaped depression in the middle of them, which can be useful in telling Sedge apart from grasses.

Range

Unique to Bermuda.

Habitat

Bermuda Sedge would have grown on the floor of the original Bermudian forest, beneath a canopy of Bermuda Cedar and Palmetto. Bermuda Sedge can grow in very wet conditions like in freshwater marshes or in forest settings. The decomposing leaves and low light on the forest floor provide ideal nutrient-rich, moist growing conditions. Bermuda Sedge became rare due to clearing of forest habitats and competition from invasive plants. It can still be found in isolated places at Paget Marsh, and is now being planted in restored forests.

Reproduction and Life Cycle

Bermuda Sedge flowers in spring. Sedge only has a few flowers and these look like greyish brown fuzzy spikes. The flower spikes are 2.5-5 cm (1-2 inches) long followed by a seed head. Rats love to eat the seed heads of Bermuda Sedge which limits this plants

ability to reproduced on mainland Bermuda. On Nonsuch Island, which is rat-free, Bermuda Sedge self-seeds and is growing well.

Why protect this species?

Bermuda Sedge is endemic to Bermuda. Today it is rarely seen and as such is listed due to its significant decline. The Bermuda Sedge population was likely seriously impacted by the draining of the freshwater marshes for mosquito control in the 19th century. Today the populations and their habitats have been fragmented by development. Some of the remaining large populations are not within protected areas, making them vulnerable to destruction. The habitat of the remaining wild Sedges has declined in quality over the last 50 years. As Bermuda's forests have become dominated by invasive species, the forest canopy has become dense, allowing less light to reach the understory where Sedges used to grow.

Threats faced by this species include:

- Habitat loss and fragmentation
- Development on woodlands and wetlands
- Competition from invasive plants
- Lack of awareness leading to accidental destruction
- Rats seriously impact reproduction and sustainability of populations

Bermuda Sedge

Carex bermudiana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 3, 2012

IUCN Red List: Endangered [C2a(i) ; D] version 3.1.

Recovery Plan: Bermuda Sedge is included in the 2009 Recovery Plan for eight species of flowering plants.

Research: Distribution mapping and population assessment for this species has been undertaken in support of IUCN Red Listing (Copeland et al. 2014) and genetic barcoding is also underway.

Propagation: Bermuda Sedge is being propagated from seed for sale to the public and planting of this species for ornamental use, as well as part of woodland restoration projects, is being promoted.

Protective legislation

Protected Species Act (2003)

What you can do?

Plant: Purchase this endemic plant for your home garden or woodland restoration project.

Learn: Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust or the Bermuda Audubon Society to protect habitats.

Control invasive plant species: Invasive plants should be managed in places where specimens of this plant occur so that they do not become overwhelmed by other vegetation. Controlling invasives on your property will stop them spreading to nature reserves.

Information sources

To learn more please visit: www.environment.bm

Copeland, A., Malcolm, P. & Bárríos, S. 2014. *Carex bermudiana*. The IUCN Red List of Threatened Species 2014: <http://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T56961131A56961134.en>.

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Darrell's Fleabane

Erigeron darrellianus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© A. Copeland

Current Status

Endemic

BPSA: Level 3

CITES: No

Bda Red List: VU

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Endemic to Bermuda, this attractive shrubby perennial produces masses of small daisy-like white flowers with yellow centres in spring and early summer. The flowers can also be pinkish in colour, but this is rare. The lower light green leaves are long and toothed while the upper leaves are smaller and smooth edged. The stems of young plants are green, while older plants develop more of a woody trunk. Darrell's Fleabane can grow up to 4.5 feet in height in ideal conditions. When not in flower, this species can be easily confused with other coastal plants and several weed species. The seed heads remain on the plant for several months, which is useful in identifying it. The seed is greyish and fluffy when fresh, and the seed heads turn dry and brown in the heat of summer.

Range

Unique to Bermuda.

Habitat

Darrell's Fleabane is a very drought tolerant plant able to grow in poor nutrient deficient soil. It is found in coastal areas such as the dunes of South Shore and on open coastal hillsides and roadsides. Darrell's Fleabane can also be found growing out of cracks in rocks or walls. It can be frequently seen in the walls of old forts around St. George's. It does best when protected from direct sun and salt spray.

Reproduction and Life Cycle

Darrell's Fleabane germinates naturally from wind blown seed in sandy coastal soil. The fluffy seeds can be collected in early summer and used to propagate this species.

Why protect this species?

Named for Bermudian, the Hon. J.K. Darrell, Darrell's Fleabane is the only endemic shrub found in Bermuda's coastal habitats. It was described as "common" and "abundant" by Britton in 1918, and has undergone an obvious population decline since then, and the subpopulations have become fragmented by development.

Threats faced by this species include:

- Habitat loss and fragmentation
- Competition from invasive plants
- Lack of awareness leading to accidental destruction



© N.L Britton

Darrell's Fleabane

Erigeron darrellianus

What is being done to conserve it?

Protected Species Act Listing: Level 3, 2012

IUCN Red List: Not listed. Assessment underway in 2016.

Recovery Plan: Darrell's Fleabane is included in the 2009 Recovery Plan for eight species of flowering plants.

Research: Distribution mapping and population assessment for this species has been undertaken in support of IUCN Red Listing, with listing to take place shortly. Genetic barcoding is also underway.

Habitat Protection: Key habitats for this species are protected in existing nature reserves and introduction to new sites is ongoing.

Propagation: Darrell's Fleabane is being propagated from seed for sale to the public and planting of this species for ornamental use, as well as part of habitat restoration projects, is being promoted.

Protective legislation

Protected Species Act (2003)

What you can do?

Plant: Purchase this hardy and attractive endemic plant for your home garden or restoration project.

Learn: Understand how destruction of habitat leads to loss of Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: Such as the Bermuda National Trust or the Bermuda Audubon Society to protect habitats.

Control invasive plant species: Invasive plants should be managed in places where specimens of this plant occur so that they do not become overwhelmed. Controlling invasives on your own property will stop them spreading to nature reserves.

Information sources

To learn more please visit: www.environment.bm

Britton, N.L. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Sarkis, S. 2009. Recovery Plan for eight species of flowering plants, *Carex bermudiana*, *Peperomia septentrionalis*, *Phaseolus lignosus*, *Erigeron darrellianus*, *Galium bermudense*, *Chiococca alba*, *Hypericum hypericoides*, *Psychotria ligustrifolia*, in Bermuda. Dept. of Conservation Services, Government of Bermuda pp.28.



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Wild Bermuda Bean

Phaseolus lignosus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© A. Copeland

Current Status

Endemic

BPSA: Level 3

CITES: No

Bda Red List: CR

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Wild Bermuda Bean is a rare endemic vine in the pea family. It is a perennial climbing vine whose stems reach about a quarter inch (0.6 cm) thick and can grow to 20 feet (6m) long. It has compound leaves made up of three leaflets which each reach up to 4 inches (10 cm) long. The leaflets have prominent veins, a pointed tip and rounded base. The two leaflets nearest the vine are held on short stalks and the two sides of the leaflet are not equal (i.e. if the leaflet was folded along the central vein, the two halves would appear different). The third leaflet, the one at the tip of the compound leaf, is held on a longer stalk and it is symmetrical on both sides of the central vein. The leaves are held away from the vine on fairly long petioles (1- 3.5 inches in length).

Range

Unique to Bermuda.

Habitat

In 1918 Britton described the habitat of Bermuda Bean as “*Rocky woodlands between Castle Harbour and Harrington Sound.*” Today, this species is confined to restored woodlands in the Walsingham Nature Reserve, sheltered parts of Nonsuch Island and the Sear’s Cave Nature Reserve.

Reproduction and Life Cycle

Bermuda Bean produces pink or purple pea-like flowers in spring. Occasionally plants produce white flowers. The flowers occur as a loosely grouped elongated cluster which is 3-5 inches (7.5 – 13 cm) long and held on a long stalk with short hairs on it. Flowers are followed by a 2 inch long, 1/2 inch wide pod, which is flat with pointed tips. Each pod contains 2 to 5 beans. Pods are green when they first appear, then dry to brown with papery texture. Bermuda Bean vines can be readily propagated from seed.

Why protect this species?

Wild Bermuda Bean is so rare it has been listed as Critically Endangered under both the Protected Species Act and the international IUCN Red List of Threatened Species. Bermuda Bean is only found at about 6 locations on the island, with only a few plants in each place. This fragmented distribution, low population density and the disruption of its habitat (by development and invasive species) mean that Bermuda Bean faces extinction without active conservation.

Threats faced by this species include:

- Habitat loss and fragmentation
- Competition from invasive plants
- Lack of awareness leading to accidental destruction



Wild Bermuda Bean

Phaseolus lignosus

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 3, 2012

IUCN Red List: Critically Endangered [C2a(i); D] version 3.1.

Recovery Plan: Wild Bermuda Bean is included in the 2009 Recovery Plan for eight species of flowering plants.

Research: distribution mapping and population assessment for this species has been undertaken in support of IUCN Red Listing and genetic barcoding is also underway.

Habitat Protection: Key habitats for this species are protected in existing nature reserves, and introduction to new sites is planned.

Propagation: Wild Bermuda Bean is being propagated from seed for sale to the public, and planting of this species for ornamental use, as well as part of habitat restoration projects is being promoted. It has been propagated with some success, so through careful cultivation it may be possible to reduce the risk of extinction faced by this endemic plant.

Protective legislation

Protected Species Act (2003)

What you can do?

Plant: purchase this endemic plant for your home garden or woodland restoration project.

Learn: understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust, or the Bermuda Audubon Society to protect habitats.

Control invasive plant species: Invasive plants should be managed in places where specimens of this plant occur, so that they do not become overwhelmed by other vegetation.

Information sources

To learn more please visit: www.environment.bm

Copeland, A., Malcolm, P. & Bárrios, S. 2014. *Phaseolus lignosus*. The IUCN Red List of Threatened Species 2014: <http://dx.doi.org/10.2305/IUCN.UK.2014.3.RLTS.T56960811A56960839.en>.

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Sarkis, S. 2009. Recovery Plan for eight species of flowering plants, *Carex bermudiana*, *Peperomia septentrionalis*, *Phaseolus lignosus*, *Erigeron darrellianus*, *Galium bermudense*, *Chiococca alba*, *Hypericum hypericoides*, *Psychotria ligustrifolia*, in Bermuda. Dept. of Conservation Services, Government of Bermuda pp.28.



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Wild Bermuda Pepper

Peperomia septentrionalis



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Current Status

Endemic

BPSA: Level 3

CITES: No

Bda Red List: CR

CMS: No

Author:

Alison Copeland

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Wild Bermuda Pepper can grow up to 45 cm (18 in) tall in ideal conditions; however, it is usually much smaller than this (ca. 15 cm or 6 in) when growing out of rock faces. Under these circumstances it is usually found growing from horizontal stems that creep over the substrate.

The leaves are thick, waxy, smooth edged and very rounded, reaching up to 6 cm (2.5 in) long. They are bright green and somewhat shiny on top. The leaves are arranged alternately on the jointed, fleshy stem. *Peperomia* species are widely used as houseplants and there are several ornamental species of *Peperomia* also available in Bermuda that look similar to our endemic species.

Range

Unique to Bermuda.

Habitat

Wild Bermuda Pepper is found in rock crevices, cliff faces, around cave mouths and in other damp rocky areas. It can also be found in the forest understory on Nonsuch Island. Britton wrote in 1918 that Wild Bermuda Pepper was “*abundant on shaded rocks*” between Tucker’s Town and the Causeway, on the northern side of Harrington Sound and Paget Marsh. Today it is rarely seen except in nature reserves in the Walsingham area, Blue Hole Hill, Abbots Cliff and Paget Marsh. Much of its habitat has been lost because of forest clearing and cave destruction.

Reproduction and Life Cycle

Wild Bermuda Pepper reproduces from many tiny flowers and fruits that grow on spikes up to 15 cm (6 in) long that develop from the top of the plant. The very tiny fruit are sticky and can be transported by animals. *Peperomia* also reproduces by fragmentation, as pieces break off from the jointed stem of the plant and take root where they fall.

Why protect this species?

Wild Bermuda Pepper is protected because it is an endemic Bermudian species which has become rare on the island, which in turn makes it globally Endangered.

This small plant cannot compete with invasive plants and introduced ferns which are taking over its habitat. The loss of much of Bermuda’s woodland habitat and destruction or alteration of wetlands, caves and karst areas has also contributed to its decline. The affects of introduced ornamental *Peperomia* species on this endemic are unknown.

Threats faced by this species include:

- Habitat loss and fragmentation
- Reduced habitat quality
- Increased ecotourism in cave habitats
- Competition from invasive plants
- Lack of awareness leading to accidental destruction

Wild Bermuda Pepper

Peperomia septentrionalis

What is being done to conserve it?

Protected Species Act Listing: Level 3, 2012

IUCN Red List: Endangered C2a(i) version 3.1.

Recovery Plan: Wild Bermuda Pepper is included in the 2009 Recovery Plan for eight species of flowering plants.

Research: distribution mapping and population assessment for this species has been undertaken in support of IUCN Red Listing and genetic barcoding is also underway.

Habitat Protection: Key habitats for this species are protected in existing nature reserves and introduction to new sites is planned. Extending protection to populations outside protected areas should be pursued.

Propagation: Wild Bermuda Pepper is being propagated from cuttings for sale to the public and planting of this species for ornamental use, as well as part of habitat restoration projects, is being promoted. Propagation from seed should be encouraged to promote genetic diversity.

Protective legislation

Protected Species Act (2003)

What you can do?

Plant: purchase this endemic plant for your home garden or woodland restoration project.

Learn: understand how destruction of habitat leads to loss of Bermuda's plant and animal biodiversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda National Trust, or the Bermuda Audubon Society to protect habitats.

Control invasive plant species: Invasive plants should be managed in places where specimens of this plant occur, so that they do not become overwhelmed by other vegetation.

Information sources

To learn more please visit: www.environment.bm

Bárrios, S., Copeland, A. & Malcolm, P. 2015. *Peperomia septentrionalis*. The IUCN Red List of Threatened Species 2015: <http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T68982125A68982141.en>.

Britton, N.L. 1918. Flora of Bermuda. Charles Scribner's Sons, New York.

Sarkis, S. 2009. Recovery Plan for eight species of flowering plants, *Carex bermudiana*, *Peperomia septentrionalis*, *Phaseolus lignosus*, *Erigeron darrellianus*, *Galium bermudense*, *Chiococca alba*, *Hypericum hypericoides*, *Psychotria ligustrifolia*, in Bermuda. Dept. of Conservation Services, Government of Bermuda pp.28.



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Yellow Wood

Zanthoxylum flavum

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources



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Current Status

Native

BPSA: Level 3

CITES: No

Bda Red List: CR

CMS: No

Author:

Mr. Drew Pettit

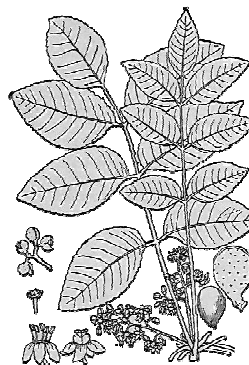
Director

Revised: April 2016

Ecology

Identification

The Yellow Wood is a smooth barked evergreen native tree with spreading branches. The leaves are pinnately compound with 5-11 leaflets. Male and female flowers are produced on separate trees; both are needed for pollination. It produces clusters of tiny creamy-yellow flowers followed by black seeds which attract birds. The tree flowers and fruits in September. Both the flower and leaves have a citrus fragrance. The tree drops some, but not all, leaves in winter. Historically it was used for its valuable lumber, which was exported to England. This business was stopped by gubernatorial proclamation as early as 1632. Old records prove the occurrence of large trees on Cooper's Island and Ireland Island prior to 1693. It is now extremely rare and is protected under the Protected Species Act 2003.



© Britton, 1918

Range

Native to Anguilla; Bahamas; Bermuda; Brazil (Amazonas); Cuba; Dominican Republic; Honduras; Jamaica; Puerto Rico; Saint Lucia; United States (Florida).

Habitat

In Bermuda today it is rarely seen and as such is listed due to its significant decline, slow growth and difficulty in propagation. In the 1980s over 1000 Yellow Wood trees were produced by cuttings by cuttings at the Government Plant Nursery. These

were distributed to the public. Unfortunately a later survey found only 3 surviving from these experiments.

Reproduction and Life Cycle

Propagated with difficulty from seed. A slow grower it needs a sheltered location to start at the sapling stage but very hardy once established. Pollination is probably from bees and the seeds are dispersed by birds.

Propagation: seed collection occurs from September to December (varies by year).

Germination: takes 4 to 12 weeks.

Planting: 3 to 5 years.

Male and female Yellow Wood trees should be planted in close proximity to increase the chances of successful pollination. It is recommended that these species be planted in mixed groves of 3-5 trees.

Why protect this species?

This species is threatened throughout its range due to

- Destruction of habitat
- Development and habitat fragmentation
- Competition from invasive species
- Insect pests

Yellow Wood

Zanthoxylum flavum

What is being done to conserve it?

Listing: Level 2, 2012 re-graded to Level 3, 2016

IUCN Red List: VU A1c, 2.3

Recovery Plan: Has been published. Sarkis, S. 2016. Recovery plan for the Yellow Wood tree on Bermuda. Viewable for download www.environment.bm

Public awareness: Campaign has also been launched.

Research: Research has focused on environmental conditions that affect germination and survival. Monitoring plantings and genetic studies are required to better explain population structure and differences between various populations.

Habitat protection: limit pesticide use, undertake invasive species removal, pollution control and remediation.

Artificial propagation –

- Local propagation programs
- Introductions into the wild



Yellowwood trees in propagation at a nursery 2014

© R. Marirea

Protective legislation

Protected Species Act (2003)

What you can do?

Learn: more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Protection: As a protected species, any specimen found in a proposed development area should be relocated to a nature reserve.

Plant: Incorporate this plant into your back yard garden or woodland conservation plan.

Observation: If you see a specimen email environment@gov.bm

Information sources

To learn more please visit: www.environment.bm



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Delisted Species

*Note: E – Endemic, N – Native, CR – Critically Endangered,
EN – Endangered, VU - Vulnerable

Birds

Green Heron (*Butorides virescens*) (N)

Flowering Plants

Bermuda Olivewood (*Cassine laneana*) (E) VU (D2)

Bermuda Palmetto (*Sabal bermudana*) (E) EN (B1+2cd)

Bermuda Snowberry (*Chiococca alba*) (N) VU

St. Andrew's Cross (*Hypericum hypericoides*) (N) CR

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Green Heron

Butorides virescens

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Alison Copeland

Current Status

Native

BPSA: No

CITES: No

Bda Red List: VU

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Butorides virescens is a small heron native to North and Central America. The Adult body length is about 17 inches (45cm). Adults have a glossy greenish-black cap, a greenish back and wings that are grey-black; a chestnut neck, grey under parts and The neck is often pulled tight against the body. The adults legs are greenish yellow, but turn orange in breeding season. The eye is golden yellow, and the bill is dark and sharply pointed.

The female adults tend to be smaller than the males with duller plumage. Juveniles are dull coloured as well, with the neck, underparts and sides of the head streaked with splotches of tan, brown and white. Hatchlings are covered in light grey downy feathers with a white belly, pale pink beak and vibrant green/yellow eyes.

Range

Native to Bermuda. Ranges from Southern Canada to northern South America and the Caribbean.

Habitat

The Green Heron inhabits wetlands, including ponds, mangroves, coastal marshes and inshore bays. They most frequently use vegetated shorelines instead of open rocky coasts.

Feeding habits

Green Herons feed actively during the day eating small fish and aquatic arthropods. Green Herons are intolerant of other birds when feeding and do not forage in groups.

To hunt they stand in shallow water or land on low branches above the water. They can often be seen using boat mooring and buoy lines to catch fry. They have been known to attract fish by dropping insects or other small objects into the water making them one of the only known tool-using birds. The tucked in neck can elongate substantially to pick fish out of the water.

Reproduction and Life Cycle

The Bermuda resident population begins breeding in early Spring through to May. Pairs form after an intense courtship display by the males who select the nesting sites with puffed up plumage. They nest in forest and swamp patches over water or in plants near water. The nests are a platform of sticks. The clutch is usually 2-6 pale eggs laid in 2-day intervals. Eggs incubate for 19-21 days until hatching. The young are not fully fledged until 30-35 days but can leave the nest as early as 15 days. The first Green Heron nests in Bermuda were found in 2003.

Why delisted?

The local population is low because it is a newly establishing native, not because of past decline. In fact the local population is growing without human aid.

While suitable nesting habitat will potentially be a limiting factor, this species is establishing well, with no natural predators, adequate food supply and is not locally hunted.

The species was delisted from the Protected Species Act; however it will continue to be protected under the Protection of Birds Act (1975).

Green Heron

Butorides virescens

Bermuda Protected Species



GOVERNMENT OF BERMUDA
Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 1 2012, Delisted 2016

IUCN Red Listing: Not assessed.

Public awareness: this bird is well known to local birders, and is included in a number of pond and wetland awareness materials, and is often seen during public field trips.

Research: Research has focused on nesting surveys and mapping range expansion over time.

Habitat protection: Mangrove nesting habitat is protected under the Protected Species Act (2003). Also a number of ponds are already nature reserves

Recovery of injured animals: Members of the public can call or deliver injured wildlife (protected species) to the Bermuda Aquarium, Museum and Zoo, #17 North Shore Road, Flatt's. (441) 293-2727

Protective legislation

Protection of Birds Act (1975)

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.



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Observe: follow signs posted to protect colonies of birds. Obey posted no wake signs when boating in costal waters.

Information sources

To learn more please visit: www.environment.bm

Madeiras, J. L. 2006. Report on the 2005 breeding season of the Green Heron *Butorides virescens* on Bermuda and continued establishment of Bermuda's newest breeding bird species. Department of Conservation Services Report. Pp.20.

Wingate, D.B, J.L. Madeiros and J.A. Kushlan. 2009. *Green Heron Colonizes Bermuda*. [Waterbirds 32\(1\):162-168](#).



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Bermuda Olivewood

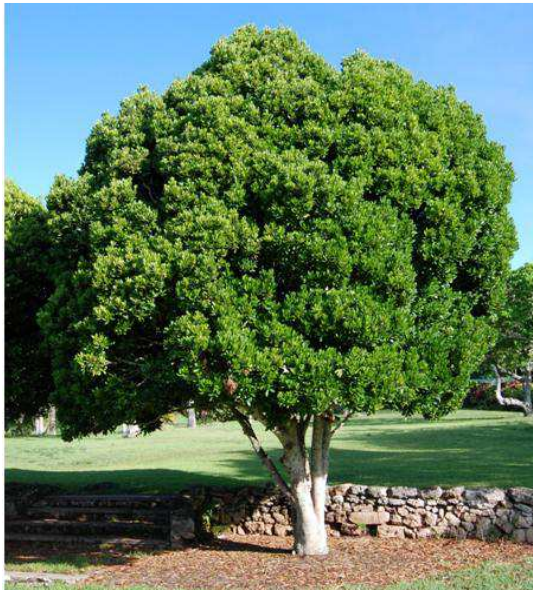
Cassine lanana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Endemic

BPSA: No

CITES: No

Bda Red List: VU

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

Formerly known as *Elaeodendron lananum* the Olivewood Bark or Bermuda Olivewood is endemic to Bermuda. Bermuda Olivewood grows to 8-14 m (25-45 feet) and develops a thick, smooth-barked trunk. Very old specimens may have 3 or 4 large trunks which come together at the base. The leaves are glossy on the top, with a toothed edge. New leaves at the tips of branches are bright green, while the older leaves further down the branch toward the trunk are darker green. Olivewood is salt tolerant with a firm, waxy leaves. In garden settings with room to grow, Olivewoods maintain a dense-foliaged, rounded shape without clipping. In forest settings, they grow in a more tree-like, branched fashion.

Range

Unique to Bermuda.

Habitat

Upland woodland, valleys and hillsides. Many older specimens survive in rocky woodland in the karst area of the Walsingham Tract. The largest population is in the restored forest on Nonsuch Island.

Reproduction and Life Cycle

Olivewood flowers in late winter and spring. The small flowers are greenish white or yellow and occur in clusters at the tip of

branches. The flowers are followed by yellowish green fruit that resemble small olives, hence the common name of this tree. The fruit ripen in the autumn, and trees are easily propagated from them.

Why delisted?

While the endemic Olivewood is considered globally threatened it can be found in a number of Bermuda's habitats and in all parts of the country. It does not reproduce well in the wild due to competition from invasive plants and rats destroying the seeds. Therefore the best hope for the survival of this species is for it be widely grown in private gardens, used in public plantings and planted as part of woodland restoration projects. Bermuda Olivewood is versatile, and can be used as a street tree, hedge, or handsome formal specimen tree. It would be particularly good for ceremonial tree plantings. Every effort should be made to ensure transplantation of mature specimens from properties scheduled for development.

Delisting will hopefully improve public acceptance of this species as a horticultural species of choice. Given that the majority of Bermuda's landmass is private property, de-listing seems the best way to increase the area of occupancy and extent of occurrence.



Bermuda Olivewood

Cassine lanana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Delisted 2016

IUCN Red List: VUD2 ver. 2.3

The current IUCN Red List assessment (World Conservation Monitoring Centre, 1998), has been flagged by IUCN as in need of an update. A new assessment is being carried out in 2017 by the Royal Botanic Gardens Kew in collaboration with the Department of Environment and Natural Resources.

Recovery Plan: needed

Public awareness: ongoing through garden visits, nature reserve tours, tree planting initiatives, presentations and written awareness materials.

Research: Research has focused on mapping wild populations and identifying relict old trees. Genetic barcoding for this species is underway.

Artificial propagation. All plant nurseries usually have a ready supply of these plants. The seeds are readily available from trees and the plant is relatively easy to propagate.

Ex Situ Conservation: The Millennium Seed Bank in the UK received 3,340 Olivewood seeds from Bermuda for storage and study in 2007.

Protective legislation

Delisted from Protected Species Act in 2016

What you can do?

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have specimens so that they do not become overwhelmed by other vegetation. Also controlling invasives on your own property will prevent them spreading to nature reserves.

Plant: Incorporate this plant into your back yard garden or woodland conservation plan.

Volunteer: to plant endemics and clear invasive plants

Information sources

To learn more please visit: www.environment.bm

Copeland, Alison and Samia Sarkis. 2012. The Millennium Seed Bank Project. Department of Conservation Services project sheet. 1pg.

World Conservation Monitoring Centre. 1998. *Elaeodendron lananum*. The IUCN Red List of Threatened Species 1998: Downloaded on 25 February 2016



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www.environment.bm

Disclaimer: The information contained in this publication is based on the knowledge and understanding at the time of writing.

Bermuda Palmetto

Sabal bermudana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



© Drew Pettit

Current Status

Endemic

BPSA: No

CITES: No

Bda Red List: VU

CMS: No

Author:

Mr. Drew Pettit

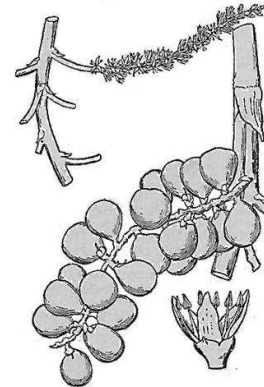
Director

Revised: April 2016

Ecology

Identification

Bermuda's only endemic palm. A very attractive cabbage palm with a rough many ringed trunk. The palmate grey-green leaves have a recurved central rib and arrow-shaped joins between base of fan and petiole. Leaf stems are smooth edged. It flowers in sprays among the leaves in the summer; followed by flattened spherical berries which are bright green and turn black when ripe in the autumn. They were used by early Bermudians to brew "bibey", an alcoholic drink. The fibrous leaves were used for thatch, hats, dish mats and fans.



© Britton , 1918

The leaf stalk of the Bermuda Palmetto never has spines or thorns. The leaf stalk projects about halfway into the leaf in a V-shape which distinguishes it from the invasive Chinese Fan Palm. Bermuda Palmettos also have a yellow patch around the stalk in the middle of the leaf, making it an attractive tree. The leaves of the Bermuda Palmetto are quite firm and hold up well in Bermuda's windy weather.

Palmettos produce sprays of small yellowish white flowers in the spring. The fragrant flowers are pollinated by insects and mature into large clusters of berries. These fruit are round and bright green berries, becoming dark purple as they ripen. Each berry contains a single large seed. The fleshy fruit of the Bermuda Palmetto provides food for a number of birds and

other animals. The palmetto has a fibrous top which provides habitat for many small animals and insects.

Range

Unique to Bermuda.

Habitat

Found in Upland and Coastal forests, peat marshes, gardens, golf courses and street plantings.

Reproduction and Life Cycle

It propagates readily from ripe berries in peaty soil. It is a good woodland, street and accent tree; best when planted in groups. It is a critical component of conservation management schemes for the restoration of all threatened habitats, especially coastal, freshwater wetland and woodland habitats. Propagation: Seed, transplanted seedlings. Collection: Seed - November to December. Seedlings: September to April. Germination: 6-18 weeks. Planting: 1 to 4 years.

Why delisted?

While the Bermuda Palmetto is considered globally threatened it can be found all of Bermuda's habitats, with the exception of Rocky Coastal areas. Widely available in local plant nurseries it can be used in all but the most exposed locations as an ornamental specimen or as part of woodland restoration schemes. Mature specimens transplant well. Its greatest competition is from the invasive Chinese Fan Palm (*Livistona chinensis*). Every effort should be made to plant this species as the palm of choice, and to transplant mature specimens rather than destroying them.

Bermuda Palmetto

Sabal bermudana

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

What is being done to conserve it?

Protected Species Act Listing: Level 3 2012, Delisted in 2016

IUCN Red Listing: ENB1+2cd, 2.3

Public awareness: Campaign has been launched.

Artificial propagation: All plant nurseries supply these plants. The seeds are readily available from trees and the plant is relatively easy to propagate.

Protective legislation

Delisted in 2016

What you can do?

Propagate and Plant: These plants are easy to propagate, transplant easily and suitable for all ranges of Bermuda's habitats. Please do not plant the invasive Chinese Fan Palm (*Livistona chinensis*).

Learn: Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have specimens so that they do not become overwhelmed by other vegetation.

Plant: Incorporate this plant into your back yard garden or woodland conservation plan.

Information sources

To learn more please visit: www.environment.bm



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Bermuda Snowberry

Chiococca alba



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Current Status

Native

BPSA: No

CITES: No

Bda Red List: VUD

CMS: No

Author:

Mr. Drew Pettit,

Director

Revised: April 2016

Ecology

Identification

The following taxonomic description is by Britton: A shrub, 2'-6' high, or sometimes vine-like and 10'-15' long, glabrous, the rather stout branches light green, terete or nearly so. Leaves elliptic to ovate, 2"- 4 ½" long, ¾"-2 ½" wide, firm in texture, light green on both sides, slightly darker above than beneath, acute or short-acuminate at the apex, narrowed at the base, the midvein rather prominent on both sides, the lateral veins few, relatively obscure, the stout petioles; stipules low and broad, mucronate; panicles about as long as the leaves; flowers numerous, fragrant; pedicels rather stout; calyx turbinate-campanulate, its lobes triangular, acutish, much shorter than the tube; corolla yellow, its tube narrowly funnel-form, about twice as long as the ovate-lanceolate lobes; stamens borne at the base of the corolla-tube, filaments much shorter than the anthers; style as long as the corolla-tube; fruit compressed, becoming subglobose, pure, white, shining, the withering corolla long-persistent.



© Britton, 1918

It is currently considered, in Bermuda, a very attractive, shiny-leaved, dark green sprawling bush or vine. It produces showy yellow flowers in summer and autumn which attract bees, and white berries which attract birds in the winter and spring.

Range

Originally thought to be Endemic now believe to be Native. *Chiococca alba* ranges from the Southeastern U.S.A (Texas, Florida), extending to Central America – namely, Belize, Costa Rica, El Salvador, Guatemala, Nicaragua and Mexico – and throughout the Caribbean on a number of islands (Antigua and Barbuda, Bahamas, Barbados, Puerto Rico, and the U.S. Virgin Islands). It has also been recorded in South America, from Guyana and Venezuela, to Brazil, Ecuador, Peru, Argentina and Paraguay.

Habitat

In 1918 Britton recorded the Bermuda Snowberry as growing in Upland and Coastal Forests. It is still found to grow widespread in upland situations, as a bush in the open or sprawling vine-like under the canopy in a forest. It can tolerate sunny to partial shade conditions with a high tolerance for salt and wind.

Reproduction and Life Cycle

This species can be easily propagated from seed in the dried berries, or by cuttings. It has been found that using rooting hormone facilitates growth when using cuttings; rooting should occur within two months. Yearly variations have been observed in the appearance of seed, occurring in June/July or September/October. Germination time during controlled propagation has been observed to range between 6-18 weeks, and time to planting of one to two years. The Bermuda snowberry seems to have a high tolerance to environmental and climatic conditions, facilitating its recovery.

Bermuda Snowberry

Chiococca alba

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources

Why delisted?

Recently downgraded from endemic to native, the Bermuda Snowberry is a shrub that is not used nearly enough in local landscaping. This species would greatly benefit from wider adoption by the public for use in private gardens and public spaces. Available in local plant nurseries it can be used in all but the most exposed locations as an ornamental specimen or a loose hedge. If unmaintained it can behave like a vine.

What is being done to conserve it?

Protected Species Act Listing: Level 3 2012, Delisted 2016

IUCN Red List: Not assessed

Recovery Plan: Protect and manage habitat, increase size and number of populations, conduct field surveys for new populations or potential habitat for introduction, conduct research, maintain existing. Research to determine distribution, population genetics, habitat requirements and reproductive biology are ongoing.

Viewable for download www.environment.bm

Public awareness: campaign has also been launched.

Research: Research has focused on environmental conditions that affect germination and survival and monitoring.

Habitat protection: Limit pesticide use, undertake invasive species removal, pollution control and remediation.

Monitoring: Actions currently underway include recording the location when a specimen is discovered and monitoring the health of known specimens in nature reserves.

Artificial propagation: Available in local plant nurseries. Seeds have been stored in the UK as part of the Millennium Seed Bank project (2007).

Protective legislation

Delisted in 2016

What you can do?

Learn : Learn more about the species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have specimens so that they do not become overwhelmed by other vegetation.

Plant: Incorporate this plant into your back yard garden or woodland conservation plan.

Information sources

To learn more please visit: www.environment.bm

Sarkis, Samia. 2009. Recovery plan for eight species of flowering plants *Carex bermudiana*, *Peperomia septentrionalis*, *Phaseolus lignosus*, *Erigeron darrellianus*, *Galium bermudense*, *Chiococca alba*, *Hypericum hypericoides*, *Psychotria ligustrifolia* in Bermuda. Department of Conservation Services, Government of Bermuda. 28pp.



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St. Andrew's Cross

Hypericum hypericoides

Bermuda Protected Species



GOVERNMENT OF BERMUDA

Department of Environment & Natural Resources



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Current Status

Native

BPSA: No

CITES: No

Bda Red List: CR

CMS: No

Author:

Ms. Alison Copeland,

Biodiversity Officer

Revised: April 2016

Ecology

Identification

A member of the St. John's Wort family this small native plant was previously known as *Ascyrum hypericoides* or *Ascyrum macrosepalum*. It is a small shrub, growing from 1 to 2.5 feet (30 to 76 cm) tall. Recently it has been recorded in Bermuda as growing to 3ft or 1m. The thin, reddish branches have many closely spaced 8 mm-long leaves growing along their length. The leaves are not glossy. The flowers are bright yellow with 4 petals in the shape of an X which gives this plant its name. Flowers are followed by greenish-brown seed pods.

Range

Originally thought to be endemic it is now believe to be native. St. Andrew's Cross, *Hypericum hypericoides*, is recorded in the United States from Texas to Massachusetts. It ranges south through Mexico to Guatemala and Honduras. It is also found on a number of Caribbean Islands.

Habitat

In 1918 Britton listed it as frequent in marshes and on hillsides. It is certainly not often seen in the wild today. St. Andrew's Cross is still found in peat marshes and on dry hillsides in grassy situations.

Reproduction and Life Cycle

St. Andrew's Cross propagates readily from the numerous tiny seeds which it produces. Seeds can be collected between July and September. It has been observed that it takes approximately 6-12 weeks for germination.

Why delisted?

St. Andrew's Cross has good potential to be used in Bermuda for ornamental purposes. This native species is being propagated by a number of local growers and is available for sale to the public. With some awareness raising, it could become popular for use in private gardens, public spaces and as part of habitat restoration initiatives.

Given its rarity in the wild today, and the ongoing decline in the quality of Bermuda's wild habitats due to invasive species, one of the best ways to ensure the survival of this species in Bermuda is for gardeners to embrace it. It is expected that de-listing this plant from the Protected Species Act will make the public more willing to have it on their property. Given that the majority of Bermuda's landmass is private property, de-listing seems the best way to increase the area of occupancy and extent of occurrence.



© Britton, 1918

St. Andrew's Cross

Hypericum hypericoides

What is being done to conserve it?

Protected Species Act Listing: Level 3 2102, Delisted 2016

IUCN Red List: Not Assessed

Recovery Plan: actions in the recovery plan include protecting and managing habitat, maintaining existing populations as well as increasing the size and number of populations, conducting field surveys for new populations or potential habitat for introduction, and conducting research. The plan can be found at www.environment.bm

Public awareness: more is needed.

Artificial propagation: St. Andrew's Cross is being propagated in Bermuda for use by home gardeners.

Off-Island Conservation: 1,000 seeds have been stored in the U.K. as part of the Millennium Seed Bank Project.

Protective legislation

Delisted from Protected Species Act in 2016

What you can do?

Learn: Learn to identify this species. Understand how destruction of habitat leads to loss of endangered and threatened species and Bermuda's plant and animal diversity. Tell others what you have learned.

Join a conservation group: such as the Bermuda Zoological Society, or the Bermuda Audubon Society.

Control invasive plant species: Invasive plants should be managed in areas known to have specimens so that they do not become overwhelmed by other vegetation. Controlling invasive species on your property will keep them from spreading to nature reserves.

Plant: Incorporate this plant into your back yard garden or woodland conservation plan.

Information sources

To learn more please visit: www.environment.bm

Britton, N.L. 1918. Flora of Bermuda. Charles Scribner's Sons, New York. Pg. 245.

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