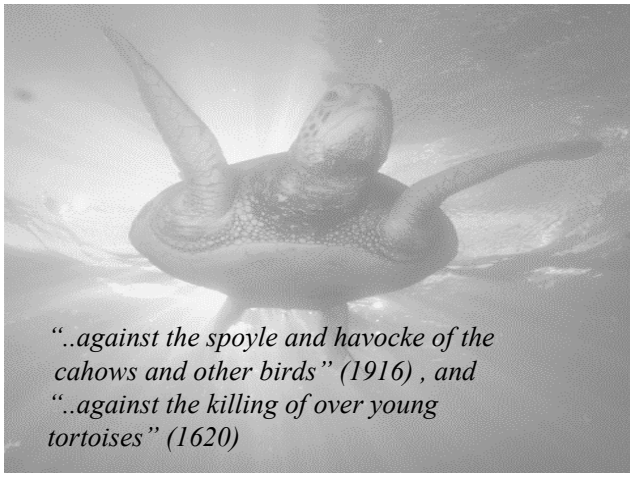
EXISTING BIODIVERSITY CONSERVATION PROGRAMMES



Research

Bermuda's attractiveness as a natural laboratory explains the wealth of scientific research conducted on the island, particularly over the last century. This work is conducted by local and visiting scientists. The establishment of the Bermuda Biological Station for Research Contribution Series for scientific publications in 1903 has been instrumental in ensuring that the research findings of many of these visiting scientists are made available locally. The increasing number of visiting scientists working at the Bermuda Aquarium, Museum and Zoo has also prompted the establishment of a Bermuda Biodiversity Project Contribution Series. Every effort should be made in the future to encourage visiting scientists to provide copies of their publications in return for being given access to study Bermuda's unique environment.

Organisation	*Relevant Activities*
Bermuda Aquarium, Museum & Zoo/ Bermuda Zoological Society	• Baseline habitat surveys • Investigation of incidence and cause of deformities of Bermuda's amphibian population • Population studies of various native and endemic species (turtles, skinks, longtail, seahorses, land hermit crabs, West Indian Topshells) • Distribution of selected invasive pest species • Various collaborative research with visiting scientists • Paleobiology
Bermuda Audubon Society	• Support for Cahow conservation, including fund for use on burrow construction, etc • Common Tern banding programme • Ruddy Turnstone colour banding programme • Annual Christmas Bird Count (since 1975) with data to National Audubon Society
Bermuda Biological Station for Research	• Coral reef, sea grass and mangrove monitoring • No-take fisheries study • Molecular biology and genetic studies of marine species and stress responses • Mariculture of bivalves, stock enhancement, small-scale commercial aquaculture assessment • Air, water and terrestrial pollution assessment • Health of marine organisms
Bermuda National Trust	• Research on the rate of coastal erosion • The Cruise Ship Report
Bermuda Underwater Exploration Institute	• Sea Level study
Department of Agriculture and Fisheries	• Library research, consultation with local and abroad scientists and/or field research • Studies of the basic biology of Black Grouper, Lane Snapper, Red Hind, Wreckfish, Blue Marlin • Pop-up tag pilot study on Blue Marlin • Mariculture of Bermuda Scallop and Calico Scallop
Department of Parks	• Management regime for pruning trees • Management of various native reaforestation projects • Management programmes for threatened and/or endangered flora and fauna (Bermuda Petrel, Tropicbird, Common Tern, Bermuda Skink) • Reintroduction projects to bring back species extirpated from Bermuda (Yellow-crowned Night Heron, Turkey-berry)
Department of Planning	• Analysis of impact of development on existing protected woodland areas for review of development plan • Coastal erosion study • Review of Bermuda Plan 1992 • Preparation of State of the Environment report

Table 11. Current Island-wide research initiatives.

In-Situ Measures For Species And Habitats

Organisation	Relevant Activities
Bermuda Aquarium, Museum & Zoo/ Bermuda Zoological Society	• Learning Through Landscapes schools programme • Growing with Trees • Bermuda Moorings Initiative • Installation of signs in turtle habitats • Construction & distribution of bluebird boxes
Bermuda Audubon Society	• Construction and placement of bluebirds boxes • Construction and placement of nesting burrows for longtails • Restoration of wetland habitats • Management of nature reserves • Planned extension of Seymour's Pond nature reserve • Planned creation of new nature reserve west of Coral Beach
Bermuda Biological Station for Research	• Nesting boxes for Bluebirds • Construction of pond at BBSR • Maintenance of native plant species garden • Instruction for scientists and students to conserve & replace organisms collected for research • Scallop seed production for stock enhancement and aquaculture development
Bermuda Botanical Society	• Support Learning Through Landscapes • Encourage planting of Milkweed for Monarch Butterfly
Bermuda Garden Club	• Support Learning Through Landscapes
Bermuda National Trust	• Improvement of Warwick Pond Nature Reserve • Improvement of Spittal Pond Nature Reserve
Department of Agriculture and Fisheries	• Fisheries regulations enforcement
Department of Health	• Cleaning of marshes to protect mosquito fish
Department of Parks	• Site specific plantings of endemics • Management of all Government Nature Reserves and other areas of protectively zoned land • Specialised species/ habitat management for NGO Groups • Provision of nesting boxes/burrows for Bluebirds, Longtails and Cahows
Department of Planning	• Woodland management schemes • Landscaping conditions on planning permissions

Table 12. Locally driven in-situ conservation projects

Protected Marine Areas[33]

200 Mile Exclusive Economic Zone

The E.E.Z. around Bermuda was declared in 1996. This gives Bermuda jurisdiction over an area of about 125,000 square nautical miles. This area was declared a marine mammal preserve in 2000.

"Area To Be Avoided"

Alarmed at the near disaster of the grounding of the *Aguila Azteca* in 1984, the Bermuda Government petitioned the International Maritime Organisation which declared a 30 mile "Area to be Avoided" by all commercial shipping not calling at Bermuda. Additionally, the Bermuda Government invested several million dollars in RACON (Active radar responding) beacons on the fringing reef to mark navigational hazards.

Coral Reef Preserves

In the mid-1960's various schemes were proposed for the reclamation of land on the shallow reefs to the west and north of Bermuda. Earlier experiences with dredge and fill operations during the construction of the airport demonstrated that such land reclamation projects would cause widespread damage to Bermuda's coral reefs. These schemes prompted wide debate, which ultimately led to the passing of the Coral Reef Preserve Act 1966. This Act prevented these land reclamation plans by providing for complete protection of all attached organisms within two substantial areas of Bermuda's

shallow waters; the North Shore Coral Reef Preserve and the South Shore Coral Reef Preserve.

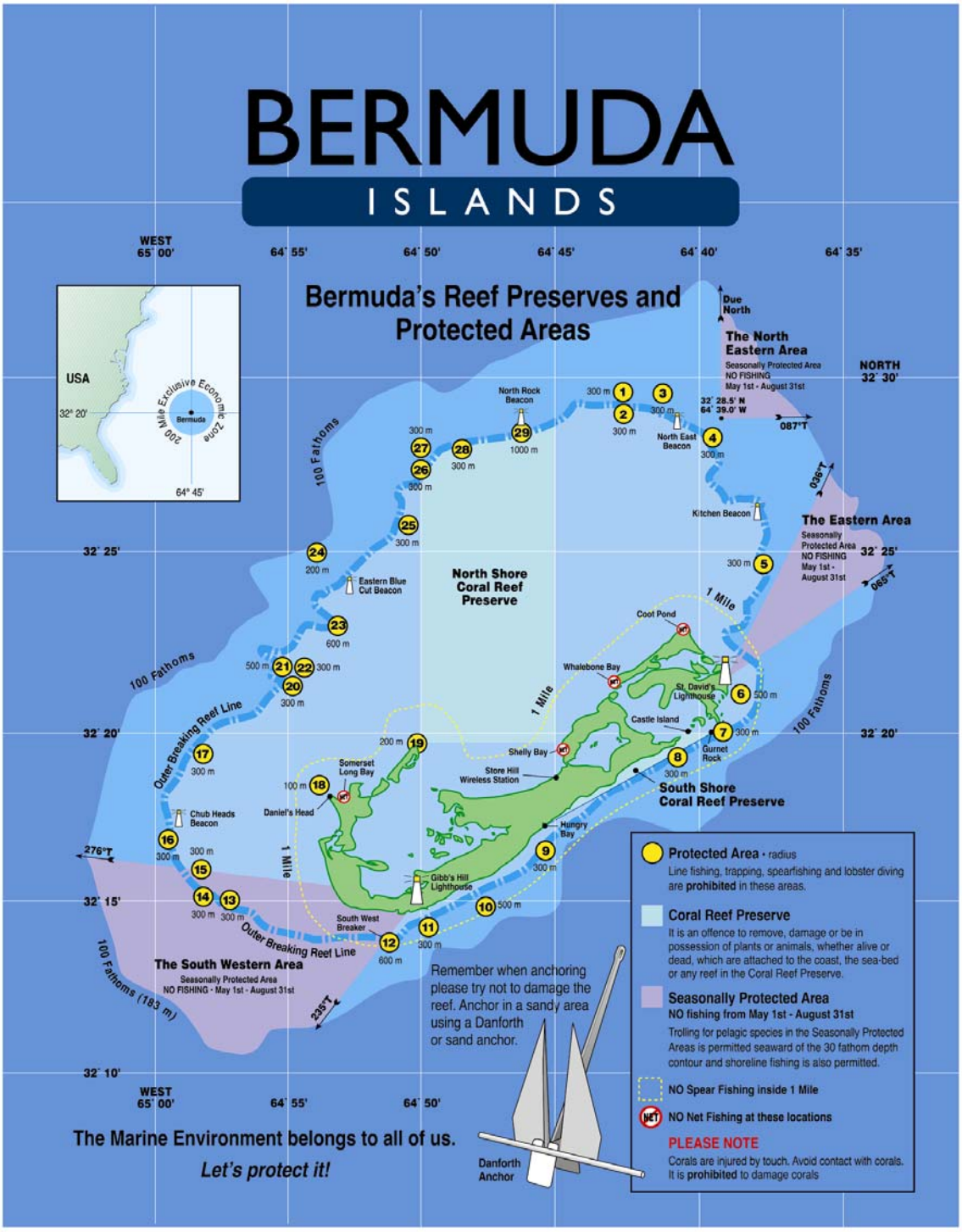


Figure 38. Marine Protected Areas. (Courtesy of Terry Madeiros).

Protected Areas

Through a collaborative venture between local SCUBA divers and dive operators, the Bermuda Zoological Society, the Ministry of the Environment, Development and Opportunity and the U.K. Foreign and Commonwealth Office, 29 Protected Areas have been established around the fringing reef and the western end of Bermuda. These have a radius of between 300 m and 1000 m. Permanent mooring buoys are deployed at these locations for recreational and commercial boat operators to pick up. Line fishing, spear fishing and lobster diving are all prohibited.

The Bermuda Biological Station for Research Inc. is conducting a two-year assessment comparing fish stocks in marine protected areas with those on fished reefs to determine the effectiveness of the marine protected areas[1].

Marine Parks

Currently there is only one established Marine Park, the Walsingham Marine Reserve. Mooring and anchoring in this area is prohibited (except for authorised scientific research or educational projects), as is fishing. The Reserve was established to safe guard and maintain the fringing reefs and their attendant flora and fauna, the seagrasses and the mangroves in the area.

[1] Smith, S.R. Pers. Comm. Bermuda Biological Station for Research Inc.

The Department of Parks is currently considering a proposal to establish a further 8 Marine Reserves adjacent to Bermuda's shoreline.

No Spear Fishing Limit

Spear fishing is prohibited within one mile of the Bermuda shoreline.

No Net Fishing

Four inshore bays, Somerset Long Bay, Shelly Bay, Whalebone Bay and Coot Pond are protected from all net fishing, whilst only cast and bait nets are permitted in Harrington Sound and Flatts Inlet. As all reef fish are also protected from netting, there is in effect no net fishing on the reefs.

Seasonally Protected Areas

There are three seasonally protected areas, one to the south west of the Island, and the other two, to the north east. These areas were established largely to protect grouper species in their spawning grounds. The taking of any fish in these areas is prohibited between 1st May and 15th August each year.

Seagrasses

Although no specific legislation exists protecting seagrass beds, this important habitat is afforded protection under the Fourth Schedule of Department of Planning Act 1974, under Habitat Protection. Planning applications for developments such as

docks and marinas located in seagrass beds are strongly discouraged.

Protected Marine Species[2]

In 1978 Bermuda's growing tourist trade provided a threat to corals, as the popularity of bleached corals as souvenirs increased. In response, a Protected Species Order was passed under the Fisheries Act of 1972, banning the harvest of any coral, and in effect making Bermuda the first coral reef preserve in the world.

Under the Fisheries (Protected Species) Order 1976, it is also illegal to remove any of the following marine invertebrates, whether ***alive or dead***: Atlantic Pearl Oyster, Atlantic Calico Scallop, Bermuda Scallop, Calico Clam, West Indian Top Shell, Queen Conch, Harbour Conch, Bermuda Cone, Netted Olive, and all species of helmets and bonnets. All marine mammals and turtles are protected locally.

An annual licence is required to participate in recreational diving for Caribbean Spiny Lobsters; any lobsters taken may not be sold. There is a bag limit of two lobsters per person per day during the season (1st September to 31st March); the taking of lobsters is prohibited from 1st April to 31st August. The minimum carapace length is 92 mm (3 5/8 in) and only a noose or a snare may be used to take lobsters; spearing is prohibited. Any lobster whether alive or dead with eggs is protected at all times of the year.

There is a year round bag limit of two fish per species per boat per day for the following species of grouper: Nassau Grouper, Deer Hamlet, Mutton Hamlet, Yellowfin Rockfish, Monkey Rockfish, Black Rockfish, Finescale Rockfish, and Tiger Rockfish. Parrotfish of all species are protected year round, whilst a seasonal limit of ten fish per boat per day from 1st May to 30th September is in place for Red Hind. Bonefish and Pompano can only be removed on a hook and line. Recreational fishermen are prohibited from taking more than thirty Lane Snappers per vessel per day.

Minimum catch sizes and/or weight for many of the groupers, snapper, tunas and swordfish apply.

It should be noted that a ministerial permit may be obtained to take any of the above fish for scientific purposes, for local or overseas museums or aquaria, or for protection or conservation of the fish.

International Protection for Marine Species

All sea turtles found in Bermuda are protected locally and along with most of the marine mammals, are internationally protected. There is growing momentum internationally for controlling the trade in corals. Despite protecting its own corals, Bermuda does import corals for sale as souvenirs.

[2] Ministry of the Environment, Bermuda Government. 2000. Marine Resources and the Fishing Industry in Bermuda. A discussion Paper. 495 pp.

Species	*Local Status*	*Threats*
Green Turtle (*Chelonia mydas*)	Abundant as juveniles; local breeding population extirpated	- Pollution (esp. plastics) - Entanglement in fishing gear - Boat collisions
Loggerhead Turtle (*Caretta caretta*)	Rare; juveniles strand on shoreline	
Hawksbill Turtle (*Eretmochelys imbricata*)	Rare	
Leatherback Turtle (*Dermochelys coriacea*)	Rarely seen, pelagic	
All marine mammal species	Rare	- Pollution - Entanglement in fishing gear
All coral species	Abundant and healthy	- Global warming - Disease - Sedimentation - Coastal development
Queen Conch (*Strombus gigas*)	Uncommon; 4 known surviving populations	- Illegal harvesting - Small population size
Harbour Conch (*Strombus costatus*)	Very abundant inshore	- Anti-fouling paint (esp. TBT)
Bermuda Cone (*Conus bermudensis*)	Rare	- Illegal harvesting
Netted Olive (*Oliva reticularis*)	Fairly common inshore	- Illegal harvesting
Bermuda Scallop (*Euvola ziczac*)	Rare	- Illegal harvesting
Calico Scallop (*Argopecten gibbus*)	Uncommon	- Unknown
Atlantic Pearl Oyster (*Pinctada imbricata*)	Very abundant	- Unknown
All helmets and bonnets species	Rare	- Unknown
Calico Clam (*Macrocallista maculata*)	In Harrington Sound only, where numbers fluctuate	- Illegal harvesting
West Indian Topshell (*Cittarium pica*)	Uncommon; but multiplying along south shore	- Illegal harvesting
All parrot fish species	Abundant	- Illegal harvesting
Groupers (*Mycteroperca* and *Epinephelus* spp.)	Rare	- Harvesting

Table 13. The local status of and major threats to Bermuda's marine species[3].

Protected Terrestrial Areas [4]

Only about 9%, a total of about 500 ha (1,236 acres), of Bermuda's land area is set aside as parks and nature reserves. Over half of this land is used for passive recreation and so cannot be considered as a refuge for plants and animals

[3] Ministry of the Environmen, Government of Bermuda. 2000. Marine Resources and the Fishing Industry in Bermuda. A Discussion Paper. 495 pp.
[4] Department of Planning, Ministry of the Environment, Government of Bermuda. 1992. Bermuda Plan.

Open Space

The designation of Open Space in the 1992 Bermuda Plan creates continuous green belts throughout the Island. These are meant to protect land that is linked together, in particular by the Railway Trail and Tribe Roads, from development. This designation is included in the planning statement to preserve and protect the scenic and aesthetic qualities of Bermuda. The zone designated Open Space includes a number of Conservation area designations. Additionally, some Conservation areas fall under development zones, such as Residential, Industrial or Tourism. These Conservation areas are described as follows:

Woodland Reserve and Woodland

The two protected categories of Woodland Reserve and Woodland recognise that trees are an important resource for aesthetic and functional reasons. As habitats for wildlife, windbreaks and protection and for their scenic beauty, woodlands serve many functions, most of which are only effective with dense, mature stands.

Woodland Reserves are protected for their ecological and/or amenity value. They include extensive stands of mature trees and dense vegetation, as well as smaller areas of trees and shrubs in prominent locations. All forms of development are prohibited and any access through the area requires approval, especially for vehicles.

Woodlands are a mixture of trees, shrubs and vegetation that are less uniform in quality than the

Woodland Reserve, but are nevertheless important. Development is not normally allowed in these areas, but can be approved by the Planning Board.

Section 27 of the Development and Planning Act with its accompanying Tree Preservation Order (TPO) regulations provides for the preservation of individual trees, groups of trees and woodlands. A total of thirty-two tree preservation orders, presently in effect, cover mature endemic (eg. Cedars) and native trees (Yellowood, Southern Hackberry) as well as exotic trees and trees related to historic events. Fourteen tree preservation orders concern protection of woodland areas or a hedgerow. Two additional orders have been revoked. Of some concern is the apparent lack of enforcement regarding these TPO's. Some 28 ha (69 acres) of woodland and hedgerows are protected in perpetuity through planning agreements.

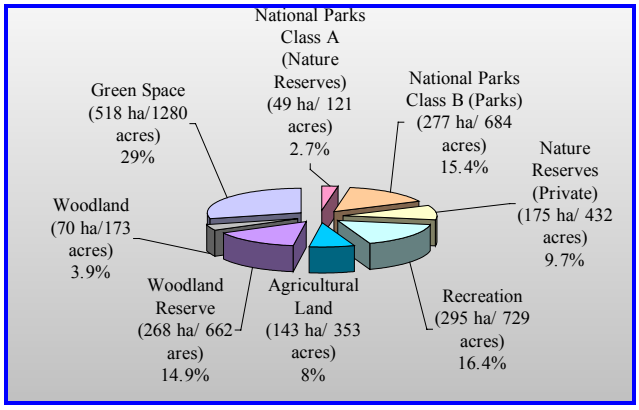


Figure 39. Conservation designations with Open Space overlay in the 1992 Bermuda Plan, excluding the City of Hamilton.

Green Space

Green Space is designated as land that is important because of its natural appearance and scenic qualities that, contributes to the establishment of the network of linked open spaces. This area is especially designed to protect coastline, cliffs, beaches, dunes, rock formations and undeveloped islands. Minor development for improvements to public facilities and safety are possible.

National Parks

National Parks are areas that have been protected under the National Parks Act, 1986, for the enjoyment of present and future generations. Additional land can be added to the parks system. There are two classes of protected areas under this act; Nature Reserves, which comprise some 49 ha (121 acres) and Parks, which total some 281 ha (694 acres). The 1988 National Parks regulations prohibit the destruction and collection of plants and animals in both classes of protected areas. Under the 1992 Bermuda Plan, all these lands are protected from any building development that may compromise the quality, character and function of the park.

Nature Reserve

These are areas in addition to the National Park Nature Reserves. There are 177 ha (437 acres) of privately owned Nature Reserves, of which the Bermuda National Trust and the Bermuda Audubon Society own about 50%. Nature Reserves under the 1992 Plan are areas of special environmental significance and ecological, biological or scientific value, including mangroves, marshlands, bird sanctuaries, cave and rock formations, islands and other wildlife habitats. All forms of development

Habitat	*Conservation Designations*								*Total Area of Habitat with Conservation Designations (Areas Zoned as Open Space)*	*% of Habitat with Conservation Designations*
	Total Area of Habitat	*Woodland Reserve*	*Woodland*	*Agricultural Land*	*Green Space*	*National Park*	*Recreation*	*Nature Reserve*		
Beach and Dune	77.4	1.4	0.2	-	26.9	24.1	-	3.2	55.9 (54.9)	72.2
Fresh/ Brackish Pond	23.3	-	-	-	0.4	1.0	0.6	21.3	23.3 (22.8)	100
Golf Course	242.8	6.2	5.4	1.2	6.2	0.7	216.5	1.5	237.7 (237.6)	97.9
Mangrove	17.5	0.1	0.3	0.1	1.0	4.7	0.2	9.4	15.8 (15.8)	90.4
Marine Ponds	17	-	-	-	-	0.9	-	16.3	17 (17)	100
Peat Marsh	67.5	7.4	0.7	4.3	18.7	5.7	0.7	26.9	64.3 (63.9)	95.2
Rocky Coastal	148.8	2.2	2.6	-	75.6	29.3	2.3	23.8	135.9 (135.2)	91.4
Salt Marsh	0.6	-	-	-	-	0.2	-	0.1	0.4 (0.4)	66.7
Upland Coastal	345.6	43.7	19.3	5.4	100.7	79.0	6.3	35.1	289.5 (252.0)	83.8
Upland Hillside	907.7	283.3	80.2	36.8	94.2	75.0	19.0	45.0	633.4 (448.5)	69.8

Table 14. The area (in hectares) of each conservation designation within the various terrestrial habitats.

are prohibited and encouragement is given to management initiatives that successfully conserve and enhance the special qualities of these sites. However, these sites are not necessarily supported by the same restrictions regarding the destruction and collection of animals and plants, as the National Park Nature Reserves.

Recreation

The Recreation designation is land set aside for recreational activities, including playing fields, sports facilities, and golf courses. Priority is given to retain the land in its open state, whilst protecting natural features. Only recreational forms of development are permitted.

Caves

The Cave Protected Areas identify the extent of the sensitive cavernous areas around Harrington Sound and the location of known caves. Any development that has a detrimental effect on a cave entrance or an underlying cave will not be permitted. However, to date very few of the cave systems have been mapped and therefore the effectiveness of such protection is limited.

Wetlands

These areas are presently covered under the National Parks and Nature Reserve designations under the 1992 Plan. For the first time, the 1983 Development Plan designated all remaining wetlands as Nature Reserves. However, since 1970 the area of wetland habitat has increased as a result of deliberate restoration projects initiated by the Bermuda Audubon Society and the Bermuda National Trust. Seven sites in Bermuda are recognised under the Ramsar Convention.

Plate 27. Yellow Crowned Night Heron, a frequent sight in Bermuda's wetland habitats. (Photo courtesy of R. Ground).

Ground Water

The Ground Water Protection area recognises the approximate extent of Bermuda's four underground water lenses, the St. George's Lens, Central Lens, Port Royal Lens, and Somerset Lens. All development must be designed to dispose of sewage and other effluent in a satisfactory manner without harm to any ground water lens.

Protected Terrestrial Species[5]

Unlike the marine environment, Bermuda's terrestrial plants and animals are afforded little protection locally. The exception are the birds; protection is afforded all birds and their eggs in Bermuda, under the Protection of Birds Act 1975 (excluding farmyard or domesticated birds, birds kept in captivity, the Common Crow, European Starling, Great Kiskadee, and House Sparrow).

Islands and unnamed islets in Harrington Sound, Great Sound, and Hamilton Harbour that are used as breeding and nesting areas by the Common Tern were declared nature reserves in 1976. Spittal Pond, Castle Harbour in 1979, and land at Evans Bay in Southampton in 1981 were also declared nature reserves to protect the feeding and nesting areas of protected bird species.

[5] Department of Agriculture, Ministry of the Environment, Development and Opportunity, Government of Bermuda. Legislation.

International Protection for Terrestrial Species

The Bermuda Rock Lizard is listed as critically endangered under CITES (Convention on International Trade in Endangered Species), thereby prohibiting it's trade overseas. The Cahow is also list as endangered. This species, and the White-eyed Vireo (Chick-of-the-Village) are the only terrestrial Bermuda endemics, protected locally.

Ex-Situ Measures for Species

Ex-situ measures for biodiversity conservation include the propagation of native and endemic plants by the NGO Save Open Spaces, as well as by the Department of Agriculture at their Tulo Valley Nursery and at the Botanical Gardens and by the Department of Parks. Programs such as "Growing with Trees" also promote community participation in propagation, whilst the Bermuda Botanical Society and Bermuda Garden Club hold plant sales to encourage plantings of endemics. Many private individuals also actively propagate these species.

The Department of Parks and the Bermuda Aquarium, Museum and Zoo undertake rehabilitation of injured birds and marine turtles.

The establishment of a private mariculture company, Sea Venture Farm, which utilises facilities at the Bermuda Biological Station for Research Inc., demonstrates the potential for restocking the Bermuda and Atlantic Calico Scallops populations.

Contingency Plans

Oil Spill Contingency Plan[6]

A Marine Pollution Contingency Plan exists to provide a formal response procedure in the event of spills of oil and other toxic substances in coastal waters. The plan includes environmental sensitivity maps, damage and risk assessment, and scientific support co-ordination. Details on the mobilisation of key personnel and equipment, their course of action (depending upon the magnitude of the incident), and the communication networks required are all described in the plan. Maps of coastal areas give information on water depth, current velocities and distances across inlets for the deployment of containment booms. The coastal areas are also ranked on a 1 to 10 scale, reflecting the expected persistence of oil spills in the environment. The maps allow for the identification of priority areas that may require a maximum effort. The co-ordination of scientific activity, both on land and at sea is also outlined, including the complete documentation of all data collected during the incident. Pre-approved areas have been designated for the use of chemical dispersants in the event of a spill.

[6] Ministry of the Environment, Government of Bermuda. 2000. Marine Resources and the Fishing Industry in Bermuda. A Discussion Paper. 495 pp.

Invasive Species Prevention

Like any isolated island, Bermuda has been plagued by the problem of invasive species. The Plant Protection Laboratory working in partnership with the Customs Department closely inspects imported vegetables and plants for disease and pests. Imported plants must be free of all sand, soil, and earth. Contaminated material is destroyed. Regular awareness campaigns are aired on local television stations and through flyers. The Animal Control Section is responsible for inspecting all animals brought to the Island. Despite tight controls, illegal importation of plants and animal does occur.

Plate 28. Illegally imported snake recently confiscated from a private residence. (Photo courtesy of L. Rodrigues).

The issue of feral animals in Bermuda is an emotional one. A local NGO, the Bermuda Feline Assistance Bureau has implemented a campaign to trap, spay, neuter, and subsequently release feral cats across the Island. Over 8,000 cats have reportedly been trapped, an effort that is estimated to prevent about 16,000 kittens from being born each year.

The prevention of invasive plant species has been much harder to implement. In part, this is often because species considered invasive in one country may not adapt so well to conditions in another and may therefore pose no threat. A growing number of plant species are considered invasive locally, and this is clearly an issue that needs to be addressed. Most local NGO's and relevant government departments have resorted to invasive species management through culling programmes, but these are extremely labour-intensive.

Permits are required for the importation of freshwater species for local aquaria. A number of species formerly imported are now prohibited; this includes the Red Eared Slider Turtle which can, however, be bred locally.

The marine environment has, to date, been less susceptible to invasive species. The importation of any living marine organism to Bermuda is strictly prohibited. This applies both to exotic species for the Aquarium trade, as well as to food items such as lobsters from the U.S.A. A catastrophic problem in many parts of the world has been the introduction of invasive marine species through the dumping of ballast water carried by ships from one location to another. Currently there is no local legislation regarding the dumping of ballast water from ships arriving in Bermuda. The Ministry of the Environment, Development and Opportunity is reviewing this[7].

[7] Begeman, P. Pers. Comm. Ministry of the Environment, Development and Opportunity.

The Consumer Affairs Bureau makes daily checks with the U.S. Environmental Protection Agency for any potential environmental health threats from food recalls and alerts the Department of Environmental Health, which itself is in regular contact with the Center for Disease Control[8].

Biodiversity Information Systems

The absence of an integrated biodiversity information system inspired the launching of the Bermuda Biodiversity Project in 1997. The project is focussed on the collation and dissemination of information, promotion of its importance and encouragement of its use. The backbone of the BBP is the development of a GIS-interactive, relational, event-centred database, pooling information on Bermuda's flora and fauna. The primary function of the database is to record the occurrence in time and distribution of species (and higher taxa) in Bermuda. The secondary function of the database is to manage four "collections", which themselves serve as the data sources for biodiversity events. These are: Museum lots (biological and geological specimens and artefacts); the Bermuda Natural History Bibliography (a collection of over 3,400 scientific documents describing the Islands' natural history); Images (comprising over 12,000 slides and photographic images); and Field Logs (data collected but not published).

The Field Logs incorporate valuable data provided by local and overseas scientists and naturalists. For example, local bird experts have provided thousands of records of birds sightings in Bermuda.

This database is being designed to link with the Government's Geographic Information System (GIS), which allows spatial analysis of the data, and serves to greatly facilitate decision-making. A recent workshop organised by the Survey Section of the Ministry of Works and Engineering to discuss the value of a Spatial Data Infrastructure for Bermuda was a promising step towards promoting more co-ordinated and efficient information sharing[9].

Many Government departments are in the process of implementing new database systems, with links to the Bermuda Land and Property Addressing database managed by the Ministry of Works and Engineering. These include the Department of Planning's Bermuda Environmental Management Information System (BEMIS), and the Environmental Health Department's Bermuda Environmental Health Data System (BEHDS).

The U.K. Overseas Territories Conservation Forum has recently launched a web-based database, which should prove to be a valuable vehicle for biodiversity information sharing between the Overseas Territories.

[8] Harvey, E. Pers. Comm. Department of Environmental Health.

[9] Survey Section, Ministry of Works and Engineering, Government of Bermuda. 16 Feb 2001. A National Spatial Data Infrastructure for Bermuda? Ocean View Golf Course, Devonshire, Bermuda.

Organisation	*Relevant Activities*
Bermuda Aquarium, Museum & Zoo/Bermuda Zoological Society	• Vacation camps for local children; Organised field trips; Open days; Learning Through Landscapes; Growing With Trees; Friends Teacher Training Course; Nonsuch Natural History Camp; Public lectures; Tour operator training • Internship programmes for entry level scientists • School visitations for classroom presentations & teacher workshops; Involvement in development of schools curriculum • T.V./radio broadcasts; Web site; Quarterly newsletter to members, mailed flyers, production of field guides; Publication series; Ecofiles; Project Nature; Public exhibits
Bermuda Audubon Society	• Natural history summer camp; Organised field trips • Public lectures; Introduction to Birdwatching Course • Quarterly newsletter; Web site • Public education regarding recycling, helium balloons, feral cats
Bermuda Biological Station for Research	• Graduate and undergraduate courses in marine biology • Distance learning curriculum on coral reefs • Organised field trips to Nonsuch Island; Field guide production • JASON education project; Summer camp for local children • Media releases, annual reports, newsletters • Maintain research library open to public; Facility open days
Bermuda Botanical Society	• Summer Botany Camps; Organised field trips; Lectures and workshops; Quarterly newsletter to members
Bermuda Garden Club	• Scholarships for horticulture and landscape design studies; • Courses offered on gardening topics; Publisher of "The Bermuda Jubilee Garden"
Bermuda National Trust	• Spittal Pond Children's Walk; Palm Sunday Walk • Paget Marsh Educational Signage (past); Warwick Pond Educational Signage (present) • Incorporation of Warwick Pond into middle school curriculum as an "outdoor classroom" • Consult with developers on developments that may negatively impact the environment
Bermuda Underwater Exploration Institute	• Educational Explorer's Camps; Ocean Discovery Centre, roving exhibits; TV broadcast, newsletters • Tours and activities, field trips; Open days; Lecture Series • Government after-school programme; Middle school teacher workshop
Department of Agriculture and Fisheries	• School camps; Visitation to schools for classroom presentation
Department of Health	• Fliers, media campaign • Exhibitions and workshops; Courses at Bermuda College
Department of Parks	• Park Ranger Service – Winter walks (Oct-May); Railway trail walking tours; Field guides; Learning Through Landscapes • Organised environmental education tours for schools and other interested groups in Nature Reserves and other areas • School classroom presentations; Media stories and broadcasts (T.V., radio, newspapers) • Production of management plans and field guides • Liaison with Planning Dept. to give property owners advice on management of woodland reserve / woodland areas
Department of Planning	• Co-ordinating the Ministry of Environment's first State of the Environment Report
Bermuda Eden Project	• Annual exposition
Keep Bermuda Beautiful	• Web site; NewsLitter (Royal Gazette Supplement); T.V. broadcasts and news; School visitations for classroom presentation; Special School Projects

Table 14. Current environmental education programmes

Education and Public Awareness

The need to raise the level of environmental awareness is widely recognised by local conservation bodies. With this aim, most of the local NGO's as well as the various Government departments incorporate an educational component into their activities. This may take the form of information brochures and flyers, or it may involve field trips, school visits, workshops and courses. Table 14 summarises this. In support of relevant environmental education for Bermudian children, the Ministry of Education has adopted the theme of oceanic islands as the science model in the Middle Schools, and the coral reef is the focus of science education in M3.

Advocacy

The role of environmental advocacy in triggering positive conservation action in Bermuda should not be ignored. In the 1970's a concerned group of citizens formed a group called Save Our Sound, to petition the Government regarding the water quality of Harrington Sound, a virtually enclosed body of water. As a result, the Bermuda Government provided a grant to support the Bermuda Inshore Waters Investigation, a survey conducted through the Bermuda Biological Station for Research Inc., to establish baseline parameters, and to assess possible detrimental changes, in the marine environment.

Concerned at the rapid pace at which development was occurring on the Island, a group called Save Open Spaces pressured the Government into placing a moratorium on land subdivision in the early 1980's.

In the late 1980's when fears were raised that the decline in reef fish abundance through fishing pressure might threaten the health of the coral reef system, several outspoken divers joined with the action group Friends of Fish, and successfully petitioned the Government for a ban on fish traps.

Monitoring Systems

Organisation	*Relevant Activities*
Bermuda Aquarium, Museum & Zoo/Bermuda Zoological Society	• REEF fish monitoring • AGRRA coral and fish surveys
Bermuda Audubon Society	• Recording of bird sightings
Bermuda Biological Station for Research	• Coral reef, sea grass and mangrove monitoring • Juvenile and adult reef fish surveys • Air, water and terrestrial pollution assessment
Bermuda Feline Assistance Bureau	• Number of feral cats, rate of reproduction, distribution
Bermuda National Trust	• Review planning applications for encroachments onto conservation zonings and environmentally sensitive areas • Review of the next Development Plan
Bermuda Underwater Exploration Institute	• Sea Level Rise
Department of Agriculture and Fisheries	• Controlling the importation of animal species that may threaten local species • Agricultural land survey • Catch and effort statistics from registered fishermen • Recreational fishery landings • ICCAT requirements to document landings of pelagic species • Reef fish census • Reproductive seasonality of reef fishes • Spiny lobster monitoring of adults and post-larvae
Department of Environmental Health	• Drinking water supply
Department of Marine and Ports	• Shipping
Department of Parks	• Park Rangers issue permits for any infringements and use of parks • Uses of pesticides and fertilisers • Yearly monitoring of native planting areas and various Nature Reserves and Woodland Areas • Population studies of seabirds • Banding program for Common Tern chicks
Department of Planning	• Environmental conditions during and post construction phases of a development • Annual report documenting development and conservation efforts • Review of development plan and zonings
Keep Bermuda Beautiful	• Data oriented litter pickups: marine, KBB assisted, Adopt-A-Park

Table 15. Range of monitoring programmes currently underway which promote biodiversity conservation

Incentive Systems

The use of incentive schemes to encourage conservation has not really been promoted locally. However, two schemes do exist which fall under this heading. Home owners with a newly completed property development are entitled to a voucher for 50 plants (at a cost of just $3 per plant) from the Government nursery at Tulo valley. It would appear that not everyone takes advantage of this; only 15 claims were made in 1999 and 18 in 2000[10].

The recent changes in the tax laws, which encourage homeowners to divide their homes into two residential units might also be viewed as an incentive scheme. However, the down-side to this is that by gaining another assessment number, many homeowners may be using this policy to acquire a second vehicle for their household.

Legislation and Policy

The legal framework in Bermuda is based on English Common Law, Principles of Equity and all English Acts of General Application in force in 1612, but these laws are subject to acts of amendment passed by the Bermuda Legislature since that date. New Acts and amendments do not necessarily model themselves on British precedents.

As far back as 1616, the then Governor issued a proclamation for an article against “the spoyle and

[10] Northcot, S. Pers. Comm. Department of Agriculture and Fisheries.

havocke of the cahows", whilst in 1620 the Bermuda Assembly passed an Act "against the killing of over young tortoises" (turtles). This is believed to represent the first conservation legislation passed in the western hemisphere, and is sadly a reflection of the extent to which the early settlers, in just a few short years, had decimated the environment. Trees were not spared either, and in the 1630's an Act was passed against the waste of cedar, and later, in 1659, against the exportation of cedar.

Present environmental legislation is embodied in various acts published in the Laws and Statutes of Bermuda, and administered through a number of Government departments.

The establishment of a new unit, the Central Policy Unit (CPU), is currently underway, with the "aim of improving the co-ordination of policies across Government. The CPU reports through the Cabinet Secretary to the Premier. In addition to co-ordinating policy, the CPU will work with Ministries to improve the quality of policy proposals, ensuring that they are based on research and analysis and that they will take account of stakeholders' views. The CPU will also run projects in cross-cutting policy areas to define the appropriate approaches to long-term policy issues".

Legislation For Protected Areas and Species

A number of Acts cover the protection of species and habitats. It is clear however that the legislation protecting local species and habitats, particularly those on land, is inadequate. With the exception of the birds, which are protected, and a few Tree Preservation Orders, Bermuda's terrestrial species are afforded no specific protection, unless they are to be found within a National Park. It is ironic that the Bermuda Skink, for example, which is recognised internationally as "critically endangered," is protected through the Convention on International Trade in Endangered Species but has no local protection. The same is true of the endemic cave species, as well as Bermuda's endemic flora.

With the exception of the coral reef, legislation protecting specific habitats is also lacking. Some, such as mangroves, are given protection because they fall under certain Planning designations, but critically important habitats such as seagrasses are currently unprotected. The Bermuda National Trust is spearheading an effort to generate legislation to protect this important habitat.

A proposed law, ***The Prevention of Physical Damage to Reef Act***, has been drafted to prohibit types of reef-damaging conduct, establish a penalty system with fines that will be used to restore damaged reefs, and establish mechanisms to aid in enforcement and administration. This act is currently under review by the Ministry of the Environment.

The following acts are administered by the Department of Agriculture and Fisheries:

The Agriculture Act 1930 *which provides for;*

- *the control of introduced plant diseases and pests through local licensing, and through the prohibition, inspection, treatment or destruction of imports,*
- *the control of animal diseases through local licensing and through the prohibition of imported animals without health certificates, and the quarantine or slaughter of animals suspected of carrying a communicable disease,*
- *the control of soil erosion by limiting the density of grazing cattle,*
- *and the prohibition of import of certain pesticides.*

The Care and Protection of Animals Act 1975 *which provides for;*

- *the control of imported animals through the need for permits, and their subsequent care,*
- *and the prohibition of animals likely to become a hazard to human or animal health or to the ecology of Bermuda.*

The Protection of Birds Act 1975 *which provides for;*

- *the protection of all birds and their eggs (with the exception of farmyard or domesticated birds, birds kept in captivity, the Common Crow, Starling, Kiskadee and House Sparrow*
- *the control by an officer of the department of protected species that become pests,*
- *the establishment as nature reserves, areas that are important to rare, breeding bird species.*
- *and the establishment of a scientific advisory body to determine whether certain imports or exports are endangered.*

The Endangered Animals and Plants Act 1976 *which provides for;*

- *the prohibition of importation or exportation of any plant or animals protected under the Convention of International Trade of Endangered Species (CITES) 1973, unless a permit is issued,*
- *the establishment of a local scientific advisory authority to decide whether a plant or animal is endangered.*

The Dogs Act 1978 *which provides for;*

- *the compulsory licensing of all dogs,*
- *the conditions of ownership (including number of dogs allowed),*
- *the leashing of dogs on paved public places,*
- *the seizure and disposal of stray and abandoned dogs,*

The following is administered by the Department of Parks:

The Bermuda National Parks Act 1986, *is administered by the Department of Parks, and provides for;*

- *the establishment, administration, management, regulation and enforcement of a National Parks System comprising areas (owned by Government and privately owned) of both land and water, which are protected,*
- *and a management plan to be prepared and to be in effect for each protected area within five years.*

Certain conflicts have arisen with regard to the Parks system in Bermuda. For instance, in addition to safeguarding the natural features, Parks also serve as a means to 'protect and maintain historic monuments and buildings (including forts) and sites of particular historic, archaeological or aesthetic value." In some nature reserves, these objectives have conflicted. The need for significant archaeological work to be conducted to reinforce the fort on Southampton Island Nature Reserve, for example, was deemed to pose a threat to the thriving population of Bermuda Skink (*Eumeces longirostris*) on the Island, with the result that the dig was suspended. As another example, the use of Coney Island National Park as a motorcross scrambling track appears to be a direct contradiction of the very philosophy behind the parks system.

The following legislation administered by the Ministry of Works and Engineering serves the marine environment:

The Minor Dredging Works Act 1945, *administered by the Department of Works and Engineering provides for the prohibition of dredging below the high water mark and the deposit of any object on the seashore or seabed unless consent from the Minister has been granted.*

The following legislation is administered by the Department of Agriculture and Fisheries:

The Coral Reef Preserves Act, 1966, *administered by the Department of Agriculture and Fisheries, provides for the designation of Bermuda's two coral reef preserves and the protection of all marine flora and fauna within them.*

The Fisheries Act 1972 *provides for;*

- *the establishment of the Marine Resources Board to advise the Minister,*
- *the declaration of protected areas within the Bermuda's 200 mile Exclusive Fishing Zone,*
- *the licensing of fishermen and compulsory record keeping by the fishermen,*
- *the provision for regulating catch and the methods employed to fish,*
- *the provision of fines, vessel seizure and arrest for fisheries violations,*
- *and the provision to make orders and regulations*

Private Acts

Several private Acts provide for the holding of land in trust as nature reserves. These include: the ***Walsingham Trust Act 1937; The Bermuda Audubon Society Act 1960; The Heydon Trust Act*** 1964 and the ***National Trust Act 1969.***

Legislation Regulating Land Development

Development & Planning Act, 1974, *is administered by the Department of Planning. It controls and directs development by providing regulatory mechanisms that strive to use land resources wisely in order to maintain quality of life and safeguard the environment. It allows for the preparation of development plans with the designation of land into development areas with accompanying regulations.*

The Development and Planning Act was amended in 1983 (Section 28 and Fourth Schedule) to strengthen protection for arable land, woodlands, nature reserves, caves and coastal areas. This provides for the review by the Government Conservation Officer of planning applications that impinge on conservation areas.

Planning legislation in existence since 1965 has, for the most part, been tremendously successful in striking a balance between the need for development and the need for land designated for conservation. One ongoing point of contention is the lack of compensation for the loss of development rights due to environmental protection designations on private land.

A Development Applications Board, which comprises twelve laypersons selected by the Minister of the Environment, Development and Opportunity, grants permission for development either unconditionally or subject to conditions, or refuses permission. The Board cannot grant permission which would result in a development that is contrary to the Act, a development plan and its accompanying regulations, a zoning order, municipal by-law or other statutory provision. After planning permission is granted, a building permit is required which initiates an inspection process throughout the construction of a property to ensure the structural soundness and safety of buildings. There is an appeals process that allows for third party appeals against the Board's decision. The Minister decides appeals; however, the appellant has the choice of having an independent planning inspector hearing the appeal who recommends a decision to the Minister.

Section 34 of the Act gives the Minister of the Environment power to enter into a planning agreement with a developer for the purpose of restricting or regulating the development or use of the land. The use of planning agreements in Bermuda is focussed on protecting parts of properties from development while allowing development on other parts of the application site. Of 114 planning agreements signed since the introduction of planning agreements in 1983, 89 relate to protecting a total of approximately 70 ha (173 acres) of arable land, woodland, nature reserve areas and open space/amenity areas. These agreements over-ride the development plan and are transferred when the land changes ownership and last *in perpetuity* unless the Minister allows the agreement to be amended. Only one agreement has been revoked.

The Crown owns all areas below the high water mark. A foreshore encroachment licence from the

Ministry of Works and Engineering is required for all developments over the seabed such as docks, jetties, and floating berths. Applications for such developments are vetted by the Marine Resources Board, which advises the Minister responsible for the environment, so as to ensure that environmental damage is minimised.

Legislation For Environmental Impact and Liability

Although the United Kingdom has environmental assessment legislation and related regulations, there is no such legislation in Bermuda. In an effort to keep abreast with legislation in the UK and other countries, environmental analysis was included for the first time in Section 4 of the 1992 Bermuda Plan Planning Statement. It requires developers to provide a site analysis report for small development proposals including details concerning the boundaries of conservation designations, existing vegetation, geological conditions, details of restrictive covenants and planning agreements. For larger projects, such as major hotel developments, sewage treatment and disposal systems, power plants and water supply systems, quarrying operations, reclamation projects and marinas, and large scale residential or industrial development, an environmental impact statement (EIS) may be required. The Statement must include a description and quantification of the likely significant effects, direct and indirect, on the environment of the development, as well as a description of the measures to be implemented to avoid, reduce or remedy any adverse effects.

EIS's have been submitted for several development projects, including the mass burn incinerator at Tynes Bay, the ash block disposal in Castle Harbour, the former Castle Harbour Hotel property at Ship's Hill and the Daniels' Head Ecotourist resort. All EIS's are evaluated by the Institute for Environmental Assessment in the UK. This evaluation process is helpful as it points out weaknesses and omissions in statements.

In 1998, the requirement for the submission of an EIS was provided for under the Development and Planning Act 1974, Development and Planning (Application Procedure) Rules 1997, Additional Information (7) which states: "The Board may, in addition to the information referred to in these Rules, require an applicant to provide further specified drawings. Plans or other information, including a model, architectural renderings and such information relating to the environmental effects of theproposed development as it considers appropriate, to enable it to determine an application.

Whilst EIS's are becoming increasingly popular in many countries, there are two inherent flaws with them. Firstly, the onus is on the developer to ensure an EIS is performed, which means very often the EIS is subject to bias. Secondly, even if required, an EIS is usually just a procedural formality because the legislation does not require any follow up once the EIS has been submitted.

Legislation For Pollution and Waste Disposal

The Amenities Act 1950, *administered by the Department of Works and Engineering, provides for the enforcement of the removal from private land, of material or structures that are considered unsightly.*

The Marine Board Act 1962, *administered by the Department of Marine and Ports, provides for the establishment of a Ports Authority and addresses navigational safety in Bermuda's waters as well as the issue of dumping waste into local waters.*

The Prevention of Oil Pollution Act 1971, *addresses measures which may be taken, in accordance with International Conventions for the Prevention of Pollution of the Sea by Oil, and from Ships, to prevent oil pollution both in Bermuda's waters and outside her territorial waters if there is a need to protect the coastline.*

The Waste and Litter Control Act 1987, *administered by the Department of Works and Engineering, provides for regulations of the public collection of waste, the prohibition of depositing waste on land and public areas, and the conditions of waste collection licences.*

The Clean Air Act 1991, *administered by the Ministry of the Environment provides for regulations governing issuance of permits for the construction of a controlled plant and acceptable limits for air contaminants.*

Work on legislation for a Bottle Bill for Bermuda is being actively pursued, in large measure through the efforts of the local NGO, Keep Bermuda Beautiful.

Legislation For Public Health and Human Disease

The following Acts are all administered by the Department of Health:

The Quarantine Act 1946, *deals with people with communicable diseases.*

The Public Health Act 1949, *provides for regulations regarding sewage disposal, as well as the removal of solid waste (administered by the Department of Works and Engineering), protection from contamination of water supplies, control of communicable diseases, vermin, and insect disease vectors, and the inspection and licensing of food preparation establishments and dairy products.*

The Water Resources Act 1975, *administered by the Ministry of Environment, provides protection for Bermuda's fresh ground water resources and seawater. The pollution of public water due to the discharge of marine vessels is an offence under this act.*

The Pharmacy and Poisons Act 1979, *addresses the sale and control of pharmaceuticals and poisons, including pesticides.*

International Treaties And Conventions

International Treaties and Conventions are important for establishing standards and tend to focus on procedures for encouraging countries to adopt widely agreed and accepted practices. Non compliance by a signatory may result in significant international embarrassment. In terms of the environment, such treaties have increasingly been used for promoting new ideas such as sustainable development, and for promoting precautionary principles when a particular impact may be unknown but is banned as a precaution.

All relevant international treaties and conventions are signed and ratified on behalf of the Overseas Territories by the U.K. Government. U.K. Overseas Territories cannot enter into treaties by themselves. However, Overseas Territories are sometimes given the authority to conclude particular treaties, or categories of treaties, in their own right.[11]

International treaties have little use unless they are integrated into national laws. Those treaties of relevance to biodiversity conservation in Bermuda are listed.

1. The 1973 Convention On International Trade in Endangered Species of Wild Fauna and Flora (CITES/1973). This provides for the regulation of trade in whole plants and animals, dead or alive, and their parts and derivatives.
2. The Convention on the Prevention of Marine Pollution from Ships (MARPOL 1973/78).
3. Convention On the Law of the Sea (1982). A convention concerned with the management and conservation of minerals and food supplies, giving Bermuda the rights to all living resources within a 200 mile Exclusive Economic Zone.
4. Montreal Protocol on Substances that Deplete the Ozone layer (1987) and all its Amendments.
5. Ramsar Convention (1971). An agreement by the parties to take action to create reserves and protect wetlands that are internationally important for their habitat for rare or migratory birds. Bermuda has seven designated Ramsar sites. These are Spittal Pond, Hungry Bay, Walsingham Pond, Warwick Pond, Lovers Lake, Somerset Long Bay and Mangrove Lake.
6. Convention for the Protection of World Cultural and Natural Heritage (1975). The Historic Town of St. George and the fortifications of St. George's Parish were declared a World Heritage Site in 2000. This includes the islands of Castle Harbour, which are recognised for their importance as breeding grounds for the Cahow, and as an important refuge for Skinks.
7. International Convention on the Conservation of Atlantic Tunas (ICCAT). Concerns the management of tuna stocks in the Atlantic.

Table 16. International treaties of direct relevance to biodiversity conservation in Bermuda.

[11] Gurney, T. Pers.Comm. Deputy Governor.