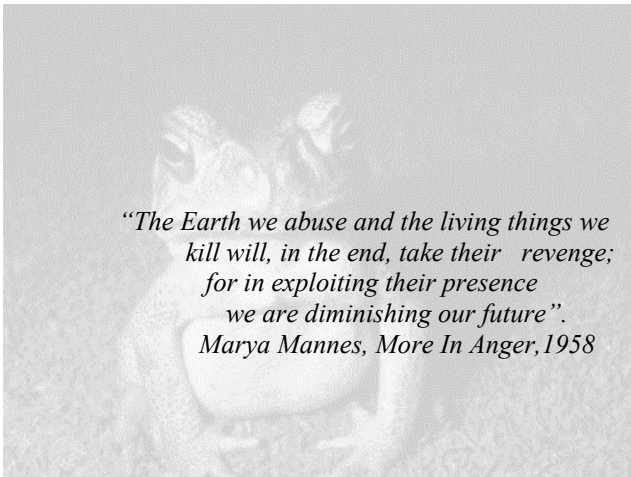


PROBLEM ANALYSIS



Socio-economic and Development Context

There is no doubt that the major threat to conservation of nature in Bermuda is ongoing habitat destruction. Natural habitats in Bermuda have become so fragmented and reduced in extent that very few large tracts of virgin land remain. There are huge financial incentives to subdivide and sell real estate for development purposes, with property values approximating \$2.4 million/ha (\$1million/acre). Dwindling open spaces have prompted restrictive planning legislation, which has in turn instilled a sense of urgency in many landowners of their need to secure development rights. This is a key point amongst those who preserved their virgin land for environmental reasons only to find that their potential wealth has been denied by planning restrictions. To date no adequate system exists for compensation for landowners that have been denied development rights.

In general, home ownership is perceived to be a right of all Bermudians. However, with the high value placed on land and the high cost of construction it is extremely difficult for first-time owners to purchase a home. Historically, much of the Island’s wealth and power has been concentrated in the hands of a small group of white merchants. As a result there is a racial-based inequity in home ownership. These factors have created a strong political push for the creation of affordable housing developments with the potential for additional loss of habitat.



Plate 29. Aerial photograph showing the Island-wide spread of development across Bermuda. (Photo courtesy of Department of Works and Engineering).

The availability of affordable housing has been further compounded by the growth of the international business sector. In order to attract highly qualified people to Bermuda, international businesses often provide large housing allowances to ensure high quality housing for their executives. Many Bermudians have upgraded their houses, moved to less luxurious accommodations and placed their homes for rent in this lucrative market. This has served to create more demand for modest housing and has caused rents in this sector to rise dramatically.

It has been argued that actually Bermuda doesn't have a housing problem, we have social problems that create a housing shortage. The basis of this argument is two-fold: i) there are many large houses owned by both Bermudians and foreigners that are rarely fully occupied and, ii) a full 15% of all households with children are single parent families with, in many cases, the father occupying a separate dwelling. Both of these factors have created a demand for housing that far exceeds the number of dwellings that would be required if our culture promoted better utilisation of existing resources.

Probably as a direct result of the historical inequity in wealth, white people have to date dominated the local conservation community. While there does appear to be a growing awareness and concern for environmental health amongst the black community, conservation activists are commonly viewed as rich white people. It appears likely that, as much of the community lives in heavily developed areas that are largely devoid of environmental amenities, there is a widespread lack of appreciation of nature. This is compounded by the fact that only a small and declining number of Bermudians work in sectors that are closely associated with biological resources. There is a need for studies to assess the effect of ethnicity, wealth and level of education on environmental attitudes so as to design effective programmes to promote community-wide appreciation of environmental issues.

Many Bermudian homeowners strive to maintain their grounds in a highly manicured state. With the high value of land, little effort is made to recreate

native habitat and showy exotic species are commonly planted. In many other cases of newly developed sites, little effort is directed to plantings despite a Government programme, which subsidises plants for landscaping new dwellings. Probably as a result of the extreme cost of construction, landscaping plans that are required to secure permission to develop are often disregarded without penalty. These factors create residential districts with limited ability to support diverse natural communities. Recognising the need for more effective enforcement of planning conditions, the Department of Planning is presently considering creating a landscape plan/ condition enforcement system.



Plate 30. Two years after completion, the planters in the 15 ft. high boundary wall on this residential property remain bare. (Photo from Bermuda Biodiversity Project).

Human Pressure On The Environment

With a population density of 1,145 people per km² (2,818 people per mile²), Bermuda is one of the most heavily developed isolated islands in the world. As the residential development of the Island has not been clustered but spread over the Island, there are virtually no remaining natural refugia from man's impact.



Plate 31. Traffic congestion, as seen in this view of Front Street, is an escalating problem. (Photo from BAMZ slide collection).

Bermuda supports an affluent community with a highly consumption-oriented lifestyle. Virtually all products are imported creating a massive input of wastes. Solid waste disposal has heavily impacted on the island's marshlands, and more recently, the inshore waters. To date no real commitment to recycling has been displayed, as it has not been deemed viable from an economic perspective.



Plate 32. Airport dump. (Photo from BAMZ slide collection).

Sewage disposal on Bermuda has been via septic pit, ocean outfall, and most recently through deep-sealed boreholes that inject waste into the rock beneath the fresh-water lenses. Very little substantive evidence of sewage impacts on natural communities has been gathered. Surveys of reef health adjacent to the Sea Bright outfall have indicated that the rapid dilution of sewage prevents adverse impacts, and studies of the inshore waters have revealed that phosphate is bound in Bermuda's calcium carbonate rock thereby largely protecting the environment from the effects of septic pit leachate. As nitrate is not similarly bound, sewage inputs have led to enrichment with this nutrient. In cave areas, which are characterised by very hard, impervious rock, the effectiveness of septic pits is dramatically reduced resulting in declining water quality in drowned caves. This is a critical point as many of Bermuda's critically endangered endemic species are confined to these caves. The long-term effect of deep-sealed boreholes has not been studied.

Through the widespread introduction of plants and animals man has created intense competitive

pressure on the Island's native flora and fauna. Ranging from ornamental plants to agents of biological control, many of these species have thrived, displacing native organisms. Efforts to control these nuisance species have proven to be very expensive and ineffective.

Key Sectors Affecting Biodiversity

It is probable that the fishing industry, the only sector of the economy currently involved in the exploitation of biological resources, has had a significant effect on Bermuda's marine biodiversity. The most remarkable change in the species composition of Bermuda's reef fish is the virtual absence of the formerly abundant grouper species. Rare today are: the Red Grouper, Nassau, Gag, Yellowfin and Yellowmouth. The Tiger Grouper and Mutton Hamlet are extremely rare and may be extinct locally. The virtual elimination of these species may have allowed the increased abundance of omnivorous species such as the Grey Trigger, and Bermuda Chub.

The fishing industry has been subject to extensive legislation aimed at curbing fishing pressure. Despite this the industry remains subsidised with tax relief and restricted entry to favour profitability. Enforcement has generally been ineffective and the judiciary has often failed to adequately deal with those offenders that are brought to court. This has led to contempt for the fisheries legislation, loss of morale amongst the Fisheries wardens and widespread poaching. Recent collaborative

enforcement efforts involving wardens and Marine Police have been effective and may herald renewed respect for the law.



Plate 33. Confiscated fish pots. (Photo from BAMZ slide collection).

As previously mentioned, real-estate development is the primary cause of terrestrial habitat loss and, as such, is the sector of the economy with the most dramatic, albeit indirect, effect on local biodiversity. The Planning Act, like most Bermudian legislation, gives great power to the Minister. The Minister can override the decisions of the Development Application Board through the appeals process and alter zoning designations through issuing a Special Development Order to allow development that would otherwise not be permitted. Whilst strict planning regulations exist to control development, the economic incentives are high and political pressure can lead to decisions favouring development. This is particularly true where arguments favouring development include the revitalisation of failing sectors of the economy, notably tourism.

Historically, as land was cleared and ploughed to make way for introduced crops, farming had a substantive negative impact on local biological communities. The native forests were displaced from the prime valleys with deep soil but were left to thrive on the upland hillsides.

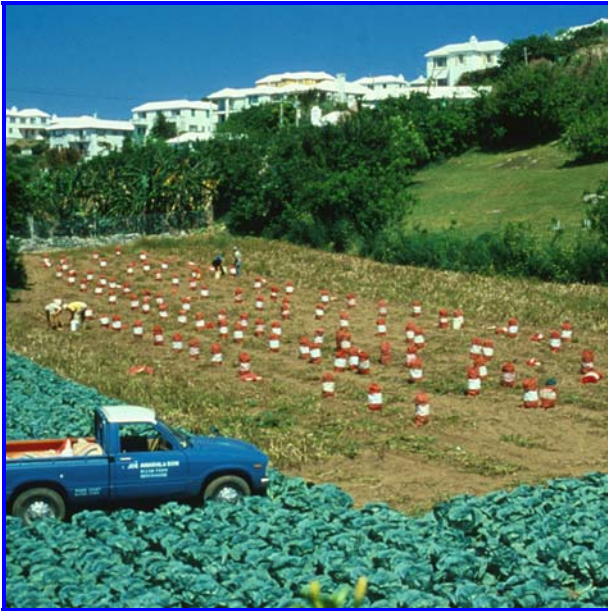


Plate 34. Farm land - A precious land bank (Photo from BAMZ slide collection).

Today, as the available open spaces dwindle, farmland is considered to be a precious land bank upon which future biodiversity restoration initiatives could be based. However, this primary industry receives the support of the Government with plans to ensure its continuity. Farming is now considered to be ecofriendly, at least relative to the generally accepted logical alternative, development. Government support to farming provides duty relief for supplies including pesticides. To date there has been no licensing of pesticide applicators and there is wide concern that improper use is the norm. The emerging trend amongst cutting edge farmers is the use of integrated pest management to minimise

pesticide usage. This involves the importation of beneficial insects to control pests. Whilst historically this approach has resulted in adverse affects on non target species, recent efforts have shown promise.

Bermuda's economy is largely dependent upon the Island's beauty, which in turn is dependent upon attractive landscaping. Without the extensive horticultural amenities that we enjoy, the landscape would appear to be excessively urbanised and our quality of life would undoubtedly suffer. Whilst extremely important to our wellbeing, horticulture, as the prime agent for the introduction of potentially invasive plants and insect pests, also poses great threats to the Island's native and endemic plants. Careful inspection of imported plant material has limited the introduction of insect pests. However, despite this relatively effective model, no similar process has been applied to screening plant species for their potential to become invasive.

Key Threats To Biodiversity

In a few notable cases, habitat destruction has been directly linked with the loss of species. In the 1940's the creation of the airbase in Castle Harbour led to widespread destruction of critical marine habitats including mangroves, seagrass beds and coral reefs. Following this massive environmental disruption, ten species of fish that had been recorded from this area were no longer seen in Bermuda¹.

¹ Smith-Vaniz, W. F., B. Collette, B.L. Luckhurst. 1999. Fishes of Bermuda: History, Zoogeography, Annotated Checklist, and Identification Keys. American Society of Ichthyologists and Herpetologists, Kansas. 424 pp.

The long-term use of Pembroke Marsh as a dumpsite led to a substantive reduction in the extent and environmental health of this wetland. Recent ecological surveys of this area have found the marsh to support very few organisms, and two endemic species that were only recorded from this habitat are now believed to be extinct².



Plate 35. An aerial view of the former Pembroke Dump. Photo courtesy of Department of Works and Engineering).

The hard rock of the Walsingham formation made traditional construction difficult thereby limiting the development on that portion of the Island bounded by Harrington Sound and Castle Harbour. Fortuitously, this acted to protect the underlying caves, which harbour unique and endangered life forms and, having been left largely undisturbed, this area supports some of the most extensive remnants of Bermuda's pre-colonial forests. However, with

modern construction methods and the declining availability of land, the incentive for building in this area has risen dramatically. Current projects continue to erode this important habitat and threaten the survival of Bermuda's unique cave fauna.

Since man first visited the Island and left hogs for future voyagers, invasive species have created havoc with Bermuda's endemic species. Rats, cats and dogs joined with man and hogs to decimate the vast rookeries of seabirds and turtles. Later an introduced scale insect destroyed most of the Island's cedar forests. More recently still, the remarkable success of many introduced plants has caused the widespread displacement of Bermuda's native flora such that today, invasive plants heavily dominate throughout the Island's woodlands.

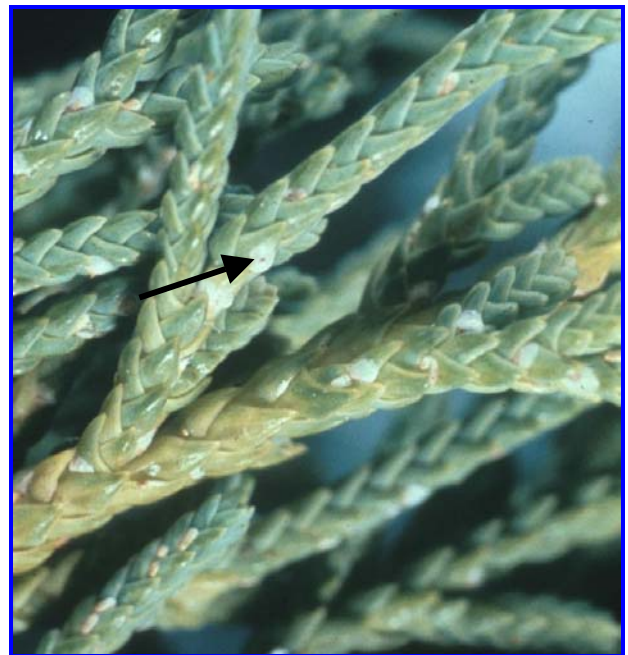


Plate 36. Cedar scale on Bermuda Cedar. (Photo from BAMZ slide collection).

² Thomas, M. L. H. 1996, Report on the ecological conditions of Pembroke Canal and the inner part of Mills Creek. Unpublished report. 26 pp.

The grounding of large ships on the Island's fringing reefs also poses a very real threat to Bermuda's biodiversity. This was dramatically demonstrated when the fully laden supertanker, *Aquila Azteca* ran aground on the reefs to the north. Whilst this ship was successfully re-floated with no spillage of its cargo, visions of the disaster that was so narrowly averted left no doubt of the severity of the threat posed by passing ships. Whilst moves have been taken to ensure that similar accidents do not occur in the future, the threat remains.

No discussion of the key threats to Bermuda's biodiversity can ignore the potential impacts of climate change. With no streams or lakes, Bermuda's biota is dependent upon a consistent pattern of rainfall distributed throughout the year. Disruptions of wind patterns could produce a protracted period of drought with catastrophic effects. Additionally, the increased incidence and severity of hurricanes not only threatens human dwellings, but also heavily impacts the coastal habitat of the endemic Cahow and Skink. Perhaps most disturbing of all, periods of elevated sea surface temperatures have already stressed Bermuda's corals causing temporary bleaching and the predicted rise in temperature in the coming century will cause much greater stress potentially dooming the Island's coral reefs. As this living barrier is critical to preventing excessive erosion of the Island's coasts and as the rising temperature also brings higher sea levels, this warming trend actually threatens the very existence of Bermuda.

Underlying Causes of Biodiversity Loss

Throughout history it has been repeatedly demonstrated that island species are poorly adapted to competing with introduced organisms. The losses of Bermudian species can be largely attributed to the inability of the Island's endemics to withstand the competitive pressure of the many species introduced by man. Moreover, this progressive displacement of endemic species has been exacerbated by the ongoing encroachment on natural habitats and fouling of natural waters by man. Particularly on land, the sheer magnitude of the human population has forced the remaining natural communities to occupy small and, in many cases, marginally productive habitats. Man's dramatic impact on Bermuda's biota is further heightened by both ignorance and a lack of care for the consequences of the ongoing urbanisation of the Island. With such a large portion of the community working in sectors that are not directly linked to natural resources, there is limited appreciation or passion for the intrinsic value of the Island's biota. Short-term profit consistently takes precedence over long-term environmental health. Plans that serve to protect against the degradation of natural communities by limiting development and do not offer substantive financial reward during a Government's term of office are rarely supported.

Current Constraints To Biodiversity Conservation

Despite a rich history of biological research in Bermuda, for many of the endemic species there is a little information available on their current population status or, where relevant, the threats to their survival.



Plate 37. *Mictocaris halope*, an endemic cave shrimp that is listed as critically endangered. (Photo courtesy of W. Sterrer).

This is true even for those species that have recently been listed as critically endangered as, in large part, they have received this designation simply because of their obviously small and fragmented populations and their proximity to dense human habitations. For many endemic species there is very little substantive information to direct effective conservation action.

Whilst there are a number of conservation-oriented organisations in Bermuda, many of which have cordial relations with like-minded agencies, to date

there has been poor co-ordination of resources and occasional duplication of effort. There is need for enhanced communication amongst environmental NGOs and Government to improve efficient use of the limited available resources.

Bermuda lacks a clearly communicated, long-term vision. The need to plan the economic development of the Island with due regard to conservation is not widely recognised. Despite the best efforts of the Forward Planning Section of the Ministry of the Environment, the lack of such a big-picture approach to Bermuda's future is likely to lead to ongoing erosion of the Island's natural amenities and the loss of rare and unique life forms.

Bermudians seem largely apathetic to the ongoing destruction of their natural surroundings. This apparent lack of awareness of the implications of failing to advocate for responsible environmental management may in part reflect a sense of impotence to affect the outcomes of controversial development proposals. One example is the Catchment Hill development, which received Approval in Principle despite an unprecedented barrage of objections from the general public. This disregard for public opinion and subsequent lack of substantive political fallout may, largely explain the perceived historical indifference with which many local politicians have treated the Island's conservation legislation.

Enforcement of environmental legislation is not a Bermudian strong point. There is a great need to strengthen the effectiveness of enforcement of

conditions of development approvals and monitor and enforce Tree Preservation Orders. Also, the perception that illegal developments frequently receive retroactive approval, needs to be addressed. When the limited enforcement staff does effectively prosecute offenders, the Judiciary rarely considers environmental infractions to be of a serious nature. Often it literally pays to ignore the regulations and pay the fine if one is so unlucky as to be caught. Indeed the 1990 Commission of Inquiry into the Fishing Industry and the Future of the Marine Environment cited the failure of the Judiciary to adequately penalise offenders as a major factor promoting illegal fishing in Bermuda.

Current Opportunities For Biodiversity Conservation

The planned restructuring of the Ministry of the Environment presents an excellent opportunity for raising the profile of, and commitment to conservation initiatives. This organisation is blessed with both committed and competent scientists and policy makers. With a renewed emphasis on environmental protection and education it may effectively combat community apathy to environmental issues, improve monitoring and enforcement of environmental legislation, and raise the level of appreciation for the value of biodiversity.

Equally encouraging is the fact that during meetings leading up to the production of this report it became apparent that there is a general willingness amongst

Bermuda's environmental NGOs to collaborate and perhaps to form a local conservation forum. Coupled with the Ministry of the Environment's commitment to foster collaborative work with these organisations, the stage is set for effective inter-agency team development.

Education is key to promoting conservation and Bermuda is fortunate to have many excellent vehicles for disseminating information. It is very easy to share a message with the entire community through the local media. Additionally, the schools are very receptive to environmental messages.



Plate 38. Participants in the Youth 2000 Environmental Conference. (Photo courtesy of T. Hasselbring).

Appropriately designed training packages could serve to heighten the awareness of the judiciary to the environmental costs and profit motives attendant to crimes against environmental protection legislation. Armed with a greater understanding of the issues involved, it is anticipated that they would act as a more effective deterrent to violators.

As many of Bermuda's critically endangered species are not currently protected under any act, an Endangered Species Act written specifically to

provide local protection for endemic species would greatly improve the ability to conserve our unique biota.

Opportunities exist for community involvement in habitat restoration projects, which can both raise awareness of the issues facing Bermuda's natural communities and empower residents by demonstrating the ability to reverse environmental degradation. Such projects could be coupled with the Learning Through Landscapes programme which serves to develop school grounds as outdoor educational facilities.

There is great potential to diminish Bermuda's environmental problems through incentive programmes aimed at rewarding appropriate behaviour. These could include such things as:

- a bottle bill providing refunds on all returned bottles,
- rewards for information leading to the arrest of violators of environmental legislation,
- rewards for information leading to the detection of illegal fishing gear,
- low interest loans and tax relief to promote environmentally responsible practices.

The Bermuda Government's move to develop a Central Policy Unit to co-ordinate the activities of various Ministries brings with it a potential for a more holistic approach to managing Bermuda's natural resources. By reconciling the potentially conflicting goals of the economic sector with the need to protect nature for the greater community

well-being, a common vision may emerge and efficiency of resource allocation may be facilitated.