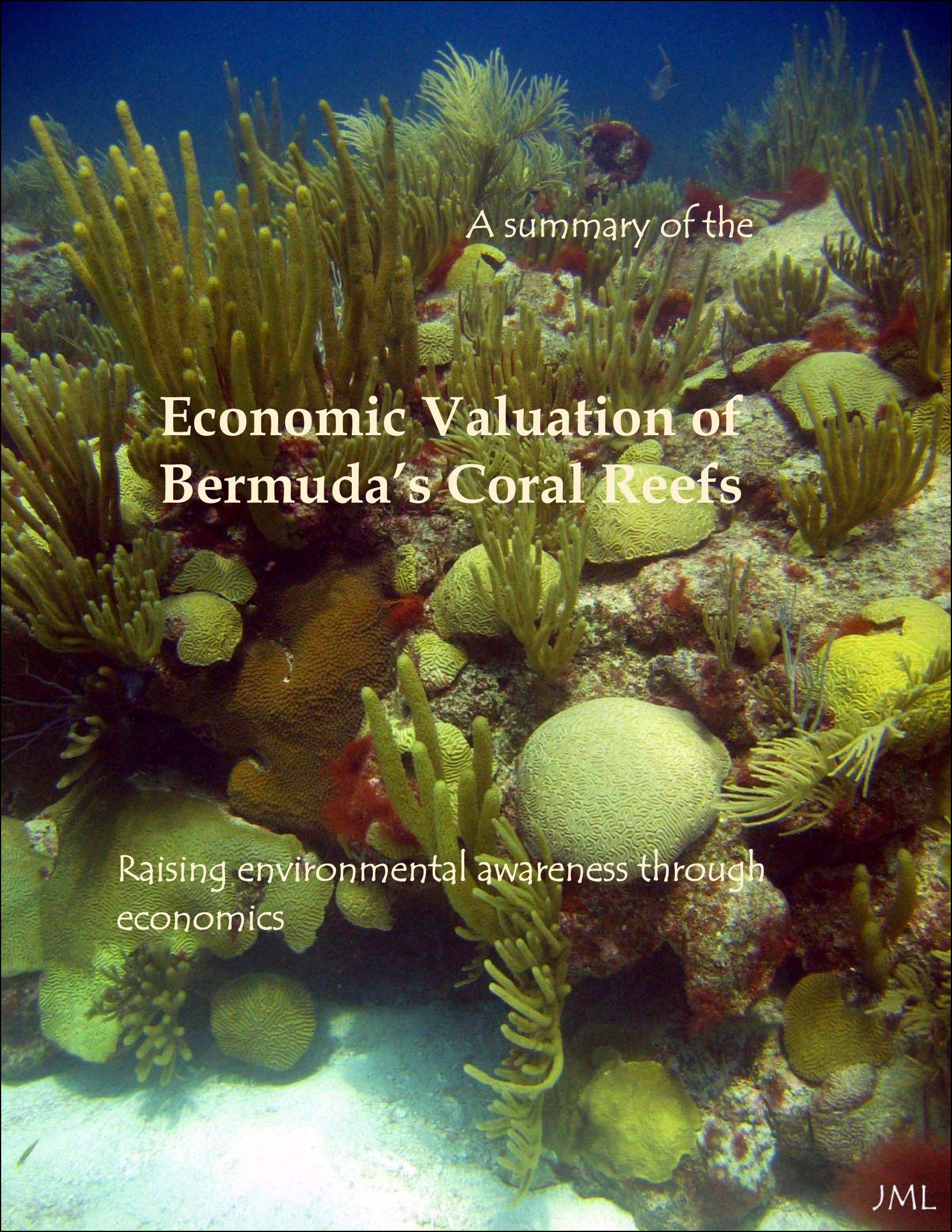

A summary of the

Economic Valuation of Bermuda's Coral Reefs

Raising environmental awareness through economics

JML

Using economic instruments in environmental policy: A cost-effective approach diversifying the "policy toolbox"

Why?

Valuing environmental resources in economic terms enables the integration of environmental concerns in policy and decision making by placing them on a comparable basis with economic and social impacts.

Who?

Lead agency: The Department of Conservation Services

Expertise: Bermuda scientific team and overseas environmental economists (Joint Nature Conservation Committee, U.K. and Institute for Environmental Studies, NL).

Overseen by: Bermuda-based steering committee (government departments and private sector)

How?

Coral reefs provide both commercial and non-commercial goods and services. **Six** key ecosystem goods and services were identified and the value estimated using specific valuation techniques. Data was compiled through :

- **tourist surveys** (450 air and cruise ship tourists interviewed),
- **resident surveys** (400 Bermudian households interviewed face to face),
- **tourist operators i**nterviews (SCUBA, watersports)
- existing statistical and biological data from **fisheries landings** records, **land valuation** and **real estate** database, and **coral reef** surveys.

The **sum of all six values** represent the Total Economic Value quoted here. This is **an underestimate** of the true value, given that a number of services, more complex to value were not within the scope of this study.

Background: Bermuda's pink sand by A. Copeland

Valuing Bermuda's Coral Reefs:

Why Protecting Reefs Matters for Economic and Human Wellbeing

INVESTING IN NATURE FOR ECONOMIC DEVELOPMENT

Coral reefs are fundamental to sustaining Bermuda's community, now and in the future. Far from being a luxury, conservation of coral reefs is something that the government and the community cannot afford not to invest in. Currently, Bermuda is undergoing increasing development for business and tourism reasons, but this places intense pressure on Bermuda's natural resources, both terrestrial and marine. Of immediate concern, is the little recognition of ecosystem services– and of their value- provided by Bermuda's coral reefs. A number of actions required for improved long term conservation and management of Bermuda's coral reefs have been outlined both in the White Paper and in the Sustainable Development Plan. This study now provides a tool to implement more sustainable policies and activities, thus balancing environmental, social and economic goals.

The evidence from this study points to a clear conclusion: **Coral reefs around Bermuda are a valuable asset to the island, both from an ecological and economic perspective, and continuing to under-value this ecosystem will prove extremely costly in economic returns.**

KEY FACTS AND FIGURES

- Bermuda's Coral Reefs provide economic benefits worth up to **$1.1 billion** every year, just through *protecting the coast* from storms and hurricanes, supporting the *tourism* industry, supporting *commercial* and *recreational fisheries*, and contributing substantially to a *quality of life* envied worldwide.
- If all of the benefits provided for by our coral reefs were to be valued, the total figure would be far greater than this.
- The Total Economic Value (TEV) for Bermuda's coral reefs represents **10-17% of Bermuda's GDP**.

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Bermuda's Natural Wealth:

Bermuda's Coral Reefs Economic Benefits worth up to $1.1 billion per year

Nature's Asset at Risk

Currently, one of the "healthiest" coral reef systems of the Caribbean Region, Bermuda has a coral density ranging from 22%-70%. Of global importance as the northernmost reef system, Bermuda's reefs are under threat due to increasing coastal development. This impacts its health and the services it provides. Because of this, Bermuda's reefs, valued on average at **$722 million per year**, are classified on the World scale as being at "**HIGH RISK**" (World Resource Institute, 2004).

TEV ranges from $ 487.7 to $1.1 billion per year, and averages $722 million per year. This range is associated with changes in the ecological integrity of the reefs, and socio-economic conditions.

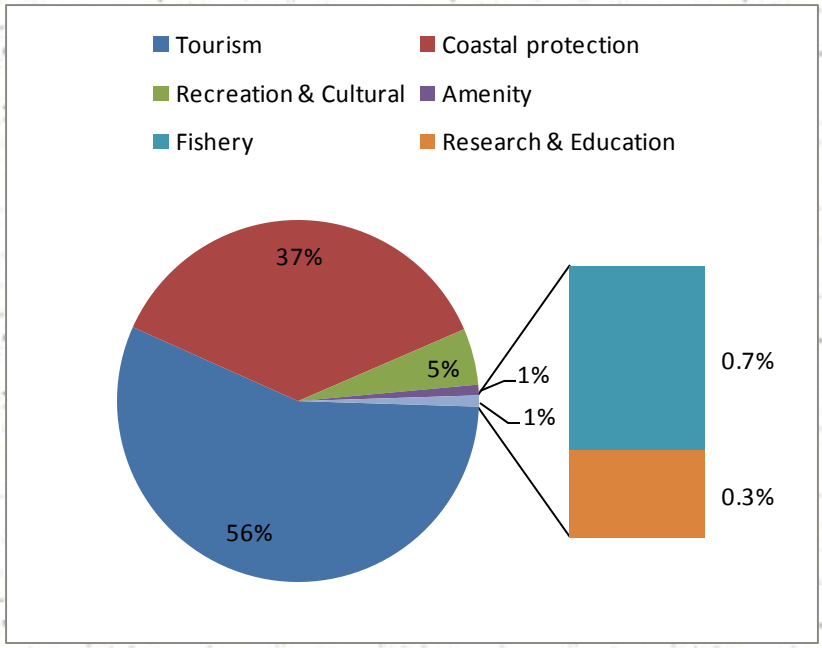


Figure 1. Key values contributing to TEV for Bermuda's reefs.

Service	Average Annual Value (USD)	% contribution to TEV
Reef-associated tourism	$ 405 million	56%
Coastal Protection	$ 266 million	37%
Recreational/Cultural	$ 36.5 million	5%
Amenity (Real estate surplus)	$ 6.8 million	1%
Reef-associated fisheries (commercial and recreational)	$ 4.9 million	0.7%
Research and education	$ 2.3 million	0.3%
Total Economic Value (TEV)- Yearly average	**$722 million**	**100%**

Protection, Economic Growth and Human Wellbeing: *Some key values*

SUSTAINING THE NATIONAL ECONOMY

Nature typically makes a substantial contribution to national economies- although these values almost always remain "hidden", as they are not reflected in official statistics. The economic activity generated by the overall tourism sector accounts for an estimated 30% of the Bermudian GDP. The results of this study indicate that 37% of tourists (air and cruise) are motivated to visit Bermuda for a coral reef associated reason. In addition, the status of the reefs (i.e. healthy and not damaged) is an important factor, and Bermuda would lose 14% or 90,000 of its tourists per year if coral reefs were no longer "pristine". This is further substantiated by the fact that 68% of the tourists are willing to pay up to $16 million per year in addition to their current expenses for the preservation of Bermuda's coral reefs. The **tourism value** of Bermuda's **coral reefs** corresponds to 56% of the Total Economic Value for this resource - or **$405 million** per year- and accounts for 10% of the overall tourism contribution to Bermuda's GDP.

There is one more unspoken value here which sustains the national economy; and that is the contribution of Bermuda's coral reefs to the quality of life attracting the international business community. Should this be included, the contribution of coral reefs to the GDP would be much higher.

SUPPORTING LOCAL LIVELIHOODS

The Fisheries sector is an important component of Bermuda's traditions. This study found that **coral reefs sustain 42% of the commercial finfish** fishery – this includes groupers, jacks, snappers and bait - and **100% of the lobster** fishery. Negative impacts on Bermuda's coral reefs would yield a substantially lower fish catch, not only increasing our reliance on imported finfish, but removing a way of life for a sector of the resident population.

Valuing coral reefs also demonstrates that there is a **surplus value to real estate** associated with this natural resource. This amenity value is estimated at **$7 million per year**, reflecting **residential** real estate only, as tourist accommodations are included within the tourism value.

SUPPORTING LOCAL CULTURE AND RECREATION

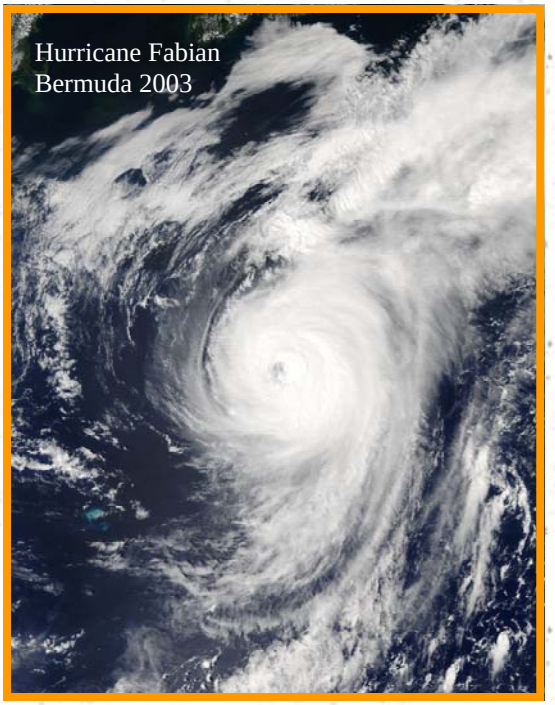
The Coral reef ecosystem provides several other water-based **recreational and cultural activities** perceived as important for leisure by Bermuda's residents. The beautiful beaches of our island, its turquoise crystal clear waters, and diverse marine life, all depend on the surrounding coral reefs. Results of face to face household surveys indicate that **residents** value the reef as an important component of their quality of life at **$37 million per year**.

Recreational fishing does not generate income in Bermuda, but is nonetheless an important cultural activity, conducted by approximately 25% of Bermuda's residents. **Coral reefs sustain 72% of the recreational fishery**, amounting to just over half of the total catch in weight fished in Bermuda on a yearly basis; this corresponds to **$3.6 million per year**, comparable to the gross revenue for commercial fisheries. Recreational lobster diving comprises 3% of the total reef-associated recreational fishery value.

Degradation of the coral reef system would negatively affect this cultural activity, and decrease the quality of life for **25%** of this island's residents.

REDUCING VULNERABILITY TO CLIMATE CHANGE AND OTHER NATURAL DISASTERS

One very critical value that coral reefs provide to Bermuda is to mitigate the effects of natural storms and hurricanes and the effects of global climate change. This has over recent years, become one of the highest priorities on the international policy agenda. Coral reefs worldwide offer coastal protection to the adjacent land masses. This study has found that Bermuda's coral reefs play an important role in breaking ocean waves prior to their crashing on our coasts. This **coastal protection** service accounts for **37% of the Total Coral Reef Economic Value**.


Hurricane Fabian
Bermuda 2003

Poor management and/or preservation of our coral reef system, leading to potential degradation of this natural resource, are likely to **increase wave height and the wave energy** hitting Bermuda's coastline. A 1.5m drop in "reef surface" has been reported in Indian Ocean islands as a result of massive coral die-off (Sheppard *et al.*, 2005). This can substantially affect wave dissipation, increasing vulnerability of the coastline to wave damage.

Increased flooding will lead to **increased damage costs** following storms and hurricanes, affecting a larger number of houses. Currently, and based on data from Fabian (Category 3 in 2003), the average damage share is 27.5%, implying that with a storm of this strength, damage to property can be as high as a quarter of the property value. Should the protection role of coral reefs decline, Bermuda will become **more vulnerable to lesser strength storms**, reflected in a higher damage share. The construction of man-made coastal defense structures are an alternative coastal protection option to the natural coral reef barrier; however, not only will this prove costly, but such structures are likely to have negative effects, potentially leading to increased rates of beach erosion, and adding to hurricane damage as debris of the failed structure act as projectiles.

The economic value of the **coastal protection** function of coral reefs in Bermuda is determined at **US$266 million** per year.This preliminary figure is an underestimate, yet still indicates a substantial contribution to Bermuda's coral reef value.

How Bermuda is Under Investing in Marine Conservation

Juvenile black grouper

Effective conservation and management of this natural resource are required to enable a sustained level of services provisions.

This economic valuation study clearly shows the importance of coral reefs to human and economic wellbeing in Bermuda. Yet, it also underlines a common problem: Funding available for preservation of this natural resource is too little to enable effective management and conservation.

The **research value** associated with the coral reefs of Bermuda amounts to **$2.3 million per annum,** obtained from local government, private and non-government organizations, as well as from overseas funding agencies, namely from the U.S.A. and the U.K. It is clear from this study that the quantity of financial resources allocated to the coral reef system tends to be outweighed by the economic benefits it generates at the regional level. Valuing Bermuda's northernmost coral reef system at the international level is beyond the scope of this study, and would increase the Total Economic Value presented here.

Marine management and conservation funding compare poorly to public investments made in other sectors of the economy. This proves true on a global and regional level, where published data confirms the generally low level and declining trends in environment conservation funding, reported to be less than 1% of the GDP in Latin American and Caribbean countries.

Sustaining Bermuda's Coral Reefs:
What Researchers Can Do

Bermudians voiced their concern for the coral reefs surrounding their island. They are willing to trade off monies for coral reef preservation. They asked for these actions:

- Monitoring and early detecting of natural/human-induced changes;
- Enhancing enforcement capacity on the Bermuda platform;
- Developing and implementing mitigation measures of foreseen changes– such as those due to climate change and/or coastal development;
- Predicting wave impact on Bermuda's coastline and identifying flood zones – including collecting wave information during storms and hurricanes;
- A better understanding of coastal erosion parameters required for mitigation measures of natural and human induced erosion processes.

Increased funding earmarked for coral reef ecosystem sustainability would allow for the implementation of research and management needs.

Sustaining Bermuda's Coral Reefs:
What Policy-makers Can Do

A key question then arises: What can policymakers do to ensure that the value of coral reefs for human and economic wellbeing is sustained?

The Problem: Balancing Economic, Social and Environmental Needs

Bermuda has experienced tremendous economic growth over the last quarter of a century, with the two main industries being international business and tourism. It follows that developments are driven by the need generated by both industries, and given the nature of Bermuda's land mass, it is likely that most developments have an impact on the coastal marine environment.

Key Points:

The coral reef system is the **most prominent** marine resource in Bermuda.

Its expression in monetary terms allows for the integration of **environmental consideration** during decision-making in future **coastal developments**.

The Goal: Working towards Sustainable Development by:

- Transforming governance and adopting a precautionary approach
- Evaluating potentially damaging activities
- Avoiding irreversible damage to the environment
- Making maximum use of our marine environment without exploiting and damaging it.

All of the above are in accordance with Themes 2 and 3 of the Sustainable Development Plan.

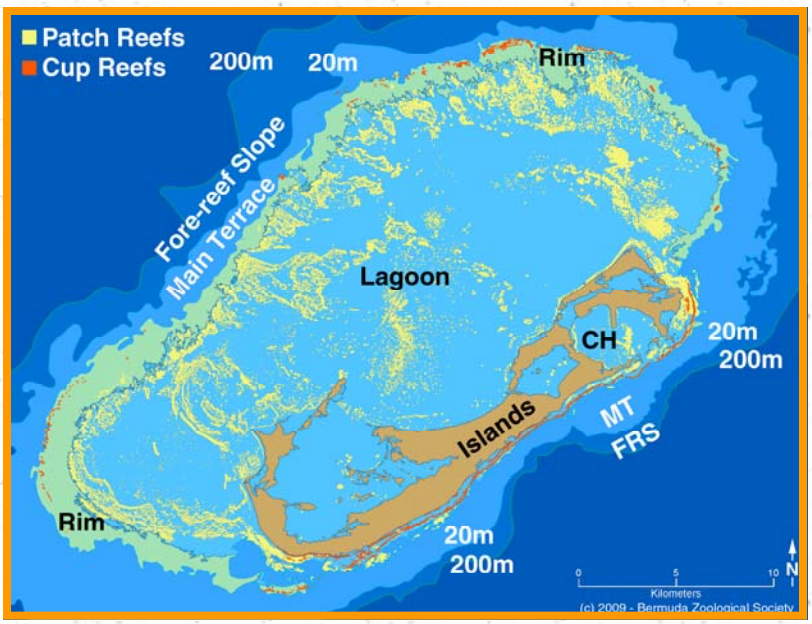


Figure 2. The study area comprises the terrace reefs, the rim reefs and the lagoonal reefs (or patch reefs). It excludes the fore reef slope reefs, situated outside of the platform margin from 20-50m depth.

The Consequences of Inaction

Climate is changing, and coral reefs have long been identified as being at particular risk from impacts related to changes in temperatures, acidity, storm intensity and sea levels. There is little doubt that the effects of climate change will be compounded by the impact of human activities. We can intervene to minimize the latter. If we continue to have a lack of consideration in the coral reef ecosystem during coastal and marine developments, and we carry on with "business as usual", there will be long term (and potentially irreversible) consequences on ecological functions-with major losses of ecosystem services, leading to economic losses.

"Business as usual" can lead to:

Ecological Function Losses

- A decline in the diversity and abundance of corals, reef fish and other reef-dependent creatures, such as lobsters
- A decline in commercial and recreational fish and lobster catch
- A decrease in water quality and clarity
- A decrease in the natural breakwater protection surrounding the island
- Loss of beaches

→

Economic Losses

- A decrease in watersport revenue and recreational/cultural value
- A decrease in commercial fishery revenue
- A decrease in amenity value and residential quality of life
- An increase in damage costs incurred by natural disasters
- A decrease in numbers of tourists and tourism revenue

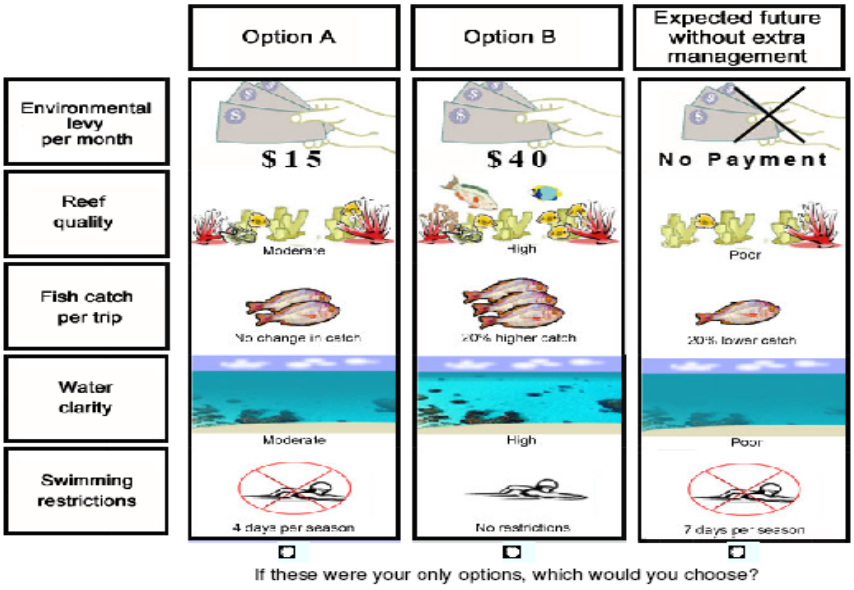


Figure 3. One of 5 Choice Cards given to residents to assess the importance of preserving coral reefs.

Bermudian residents made choices: 50% of the 400 households interviewed were willing to financially contribute to act towards the preservation of the coral reef system, yielding a recreational and cultural value of **$37 million per year**.

What Policy-makers Can Do: Integrating Coral Reef Economic Value (TEV) in Policy

Recommendation 1: *Prioritize potential policy interventions in an economically sound manner*

Sediment plume following ship's passage

A. ***Develop legislation pertaining specifically to marine developments.*** Of immediate concern is the lack of "formal" procedure when assessing developments that have potential to impact the marine environment. Although legislation currently exists under the Planning Act for developments originating from the coast and extending to the marine environment, there is no legislation specific to developments in the marine environment; such as those required for optimising ship passage. Strategic environmental assessments (SEA) are a good practice for policies, plans, and programmes taking an ecosystem-based management approach. The development of a formal standard procedure for conducting SEA, supported by legislation, will enable the making of more informed and sustainable decisions. The TEV demonstrates the urgency and importance of implementing new legislation, to sustain valuable ecosystem services.

This TEV study can:

- Help to screen whether a development requires detailed assessment (e.g. a full strategic environmental assessment), on the basis of the likely scale and location of ecosystem service impacts.
- Inform detailed assessments of the impacts of developments; although for major developments, this may require additional cost-benefit analyses.
- Inform the design of programmes for ecosystem service monitoring and enforcement of legislation.

B. Improve the transparency of decisions on the required modifications of shipping channels to accommodate larger ships, by developing an extended cost-benefit analysis incorporating the economics costs of damage to coral. Summer of 2009 has seen an increased use of the North Channel by larger ships, and the need for modifications of one of the Channels is pressing to ensure safe passage and prevent accidental environmental damage. The TEV can be used to reflect the degree of loss potentially incurred, and drive the use of mitigation measures during marine development.

The pristine reefs of Bermuda's North Channel

Damaged Bermuda reefs following recent ship grounding

C. Develop a standard damage cost procedure for marine vessel groundings and other forms of injury to the reef in Bermuda. This will account for the wide range of lost benefits. It will encourage preventative behaviour of potential violators, and it will guarantee sufficient funds for reef restoration and damage compensation. Restoration measures can be applied to compensate for loss of coral reefs and associated diversity; however, costs of restoration are high, and funds additional to those currently spent on coral reef conservation are required. In the past 5 years, there have been several cases of marine vessel groundings on Bermuda's coral reefs; limited conservation action was taken due to the current lack of legislation for compensation of losses.

Recommendation 2: *Actively involve the tourism industry in the development of sustainable coral reef management*

Establish new vehicles for earmarking of funds. Establishing 1) an Environmental tourist tax, 2) User fees for divers and snorkelers with the assistance of watersport operators, and/or 3) a Tourism/conservation partnership (engaging the Tourism Board, tourist operators and environmental organizations), will generate substantial monies required for coral reef conservation and management needs. More than any other sector in Bermuda, the tourism industry is a key player in the management of coral reefs. Not only does this sector benefit the most from the presence of healthy coral reefs, but it is also potentially the major cause of marine degradation. This study has shown that tourists are willing to pay up to $16 million per year for the preservation of coral reefs.

Recommendation 3: *Make use of the cultural importance residents place on marine ecosystems to improve coral reef management*

***A. Enable existing community support for environmental conservation and management*.** This study indicates that Bermuda's residents are willing to pay up to $37 million per year to preserve the coral reefs from natural and human impact. In order to access such monies, a vehicle, such as an environmental levy, needs to be established. This will allow for the collection and earmarking of resident funds; it will not only generate substantial monies for dedicated environmental needs, but it will also allow for the use of funds currently put into the marine environment. for other socio-economic needs.

B. Incorporate environmental economics in the national school curriculum and launch a public awareness campaign. Through the comprehensive household surveys conducted during the course of this study, Bermudians have expressed their concern for the human induced impacts on their environment. Increasing awareness and education will ensure sustained concern and motivation for financial contribution to environmental conservation and management.

Recommendation 4: *Balance consumptive and non-consumptive uses of coral reefs by strategizing spatial management and protecting critical marine areas*

Identify and protect areas critical to ecosystem function while engaging stakeholders for long term sustainability. Marine Protected Areas (MPA) provide an effective way of sustaining the tourism, recreational and cultural benefits provided by the coral reef system. They have been shown, in other jurisdictions, to act as a refuge for marine populations and enhance in some cases fish catch outside of MPAs. The comprehensive assessment of MPAs critical to the ecosystem is a fundamental action in the long term sustainability of marine populations.

This study shows the importance of the reefs in sustaining fish and shellfish populations critical to sustaining local livelihood and culture. The consumptive and non-consumptive uses of the reefs can only be sustained through the protection of critical zones of the ecosystem. In this way, the high economic value of a live fish generated through diving and snorkeling activities, will remain as will the revenues generated by the commercial fishing industry and the cultural value gained by recreational fishermen.

Prioritizing strong enforcement and protection of these zones by engaging boat and dive operators has proved successful in other jurisdictions, leading to the establishment of self-financing MPAs through diver fees or user fees. The income generated covers the salaries and operational costs of the marine park. This may serve as a template for successful protection and management in Bermuda.

This brief was prepared by Samia Sarkis, Department of Conservation Services (Bermuda), in collaboration with all relevant government departments. It is based on a report by Sarkis, van Beukering and McKenzie (2010) "Total Economic Value of Bermuda's Coral Reefs". The full report is available at www.conservation.bm.
Contact: scsarkis@gov.bm. *Cover and back page photos: Jan Locke*


"Almost all economists are intellectually committed to the idea that things people want can be valued in dollars and cents....
Most environmentalists not only disagree with this idea, they find it morally deplorable....
Yet the fact remains that difficult choices must be made."
The Economist 2002
JML