NAVIGATING A SEA OF VALUES

THE ROLE OF ECONOMIC ANALYSIS IN PROMOTING THE SUSTAINABLE MANAGEMENT OF MARINE PROTECTED AREAS IN THE CARIBBEAN

by

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Chapter I. Introduction

Despite the importance of marine resource economics the role of economics and the tools for the valuation of marine protected areas (MPAs) have generally been neglected in policy and research addressing environmental proposals and concerns. The aim of this study is to assess the benefits and drawbacks of various economic valuation tools in order to evaluate whether economic analysis can improve an MPA's ability to promote sustainable marine resource conservation in the Wider Caribbean.[i] A variety of sources from scientific papers, academic journals and policy documents have been collated to assess common assumptions about economic analysis. These resources were employed to develop a set of guiding strategies to define the possible application of economic analysis to MPAs. In the end, economic analysis does not pretend to provide a formulaic solution to environmental problems, as choices must ultimately be made in accordance with moral and ethical reflection. Rather, it seeks to identify important information about social, environmental and economic factors, which will ease the justification of policy that promotes the sustainable use of marine resources.

1.1 Background and Rationale

Despite the increase in the number and size of conservation areas, biological diversity has continued to decrease, as highlighted by the findings of the Millennium Ecosystem Assessment which determined that 60 percent of the planet's ecosystem services have been degraded.[ii] The loss of biological diversity and ecosystem functions is particularly alarming in marine and coastal habitats, which have less than a 1 percent rate of protection.[iii] Not surprisingly, it is estimated that 20 percent of coral reefs and 35 percent of mangroves have been lost, while commercially valuable fishing stocks are

teetering on collapse.[iv] The direct causes of the deterioration of marine ecosystems include resource over-exploitation, destructive harvesting techniques, habitat clearance and conversion, land-based and marine sources of pollution, climate change and market failures.

Humanity is inextricably dependent on marine ecosystems for providing food and water, regulating climate and floods, and maintaining cultural services such as recreation, aesthetics and spiritual benefits. For example, it is estimated that over a billion people directly rely on marine fisheries as their only source of protein, an industry that produces USD 5.7 billion annually in goods and services.[v] Therefore the degradation of the marine environment is one of the gravest challenges confronting the planet, as both industry and consumption are mutually beholden to the continued use of nature as a commercial partner.

The Wider Caribbean, which is characterized as a low-lying coastal region composed of a patchwork of islands, territories and critical habitats such as mangroves and reefs, epitomizes these global trends. The Caribbean's political, geographic, ecological and economic dynamics have contributed to the deterioration of its marine ecosystems, resulting in Conservation International classifying it as one of the world's major "hotspots" of environmental concern.[vi] Due to its small size and insular character, the Caribbean has a high proportion of endemic species and biodiversity, making it one of the most biologically diverse regions of the world. However, the small size of the islands provide only narrow economic opportunities and encourages a high dependence on coastal resources, particularly for impoverished peoples, thus increasing conflicts over environmental resources as well as vulnerability to natural disasters and climate change.

The dependence on marine resources has led to a concentration of human settlements and activities such as agriculture, tourism and energy in coastal zones. The inevitable extraction and degradation of the surrounding ecosystems in favor of housing, public works, economic development and other human processes has become detrimental to biodiversity. As a result of the demise of certain environmental structures and wildlife populations invasive species have been able to infiltrate to a greater degree than in the past, and pollution from sedimentation, sewage, urban runoff and oil leaks has been discharged into the ocean. Additionally, many Caribbean entities such as Anguilla and the Cayman Islands, British overseas territories, are economically and politically reliant on foreign governments because of lingering colonial ties and as a result are vulnerable to exogenous economic shocks, commodity prices and trade agreements that often encourage consumption and development decisions that undermine environmental sustainability.

Furthermore, climate change and the prospect of sea-level rise and increasing water temperatures threaten to exacerbate these trends. It is estimated that climate change will cost the Caribbean more than USD 100 million due to increased flooding, salt-water intrusion, shoreline erosion, biodiversity loss and the destruction of property.[vii] The Wider Caribbean is particularly vulnerable as its characteristic low-lying coastal areas are highly exposed and typically lack the capacity to adapt to climate change.

In order to curb these threats international treaties such as the United Nations Convention on the Law of the Sea and the Convention on Biological Diversity have been signed, mariculture projects initiated and marine protected areas created. Many Caribbean countries responded to these threats, in part, by adopting the Protocol on

Specially Protected Areas and Wildlife (SPAW) in 1990, recognized as a precursor to international initiatives to establish marine protected areas such as the Convention on Biodiversity.[viii] The SPAW treaty represents the greatest legal commitment by the regional Caribbean to emphasize the environmental importance of MPAs as drivers of conservation and development. MPAs are understood as "any area of the intertidal or subtidal terrain, overall with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all the enclosed environment."[ix] MPAs were originally developed as a fishery management tool to allow for the recovery of overexploited populations.[x] It was quickly understood that MPAs also hold the potential to support the recovery of marine habitats, protect biodiversity and ecological processes, provide opportunities for educational outreach, execute research, create controls for impact studies and promote tourism activities.

In response to the SPAW treaty and rationale for MPAs, the number of protected areas in the Caribbean has increased to 645 sites, covering 10.9 million hectares.[xi] Unfortunately, the establishment of MPAs has failed to stymie the deterioration of marine ecosystems, particularly in less developed countries, due to weak institutional capacities of protected area management and the presence of stakeholders´ incentives that do not support conservation measures. It is estimated that only 6 percent of the MPAs established in the last thirty years in the insular Caribbean are effectively managed, while Caribbean reefs have continued to be degraded to the point that two-thirds of the reefs are currently considered threatened.[xii] Additionally, the creation of MPAs is often linked to tourism, which represents about half of the Caribbean's earnings from goods and services

exports but may be ecologically destructive.[xiii]

It is argued by many environmentalists, economists, scientists and decision-makers that the prevailing model for MPA management is myopic and reactionary, responding to environmental problems with narrow control and regulation measures. Despite the overall failure of MPAs to curb biodiversity loss, environmentalists, economists, scientists and policy-makers defend their conservation value and potential to protect marine ecosystems. As a result, these critics demand a paradigm shift that would highlight the complexities facing MPAs and tackle the root causes of environmental degradation-economic drivers. It is believed (Beukering et. Al 2007, Dixon et al 1993, Driml 1997, and Emerton 2009) that by incorporating tools of economic analysis, decision-makers will be better equipped to identify costs and benefits, assign values and identify the winners and losers of MPAs. It is held (Beukering et. Al 2007, Dixon et al 1993, Driml 1997, and Emerton 2009) that this will ease justifying their incorporation, rationalize management decisions and provide incentives for marine conservation.

Decisions about the creation and management of MPAs have traditionally been made by means of cost-benefit analyses of marine resources using market values of inputs such as raw materials and physical products. Management decisions have focused almost exclusively on fisheries and tourism, which have well defined markets. Unfortunately, conventional analysis has ignored goods and services without market prices such as the aesthetic beauty of a reef or the value of water filtration provided by mangroves. This oversight ignores the full value of an MPA's natural capital and thus undermines its weight in decision-making. For example, it is estimated that shoreline protection in the Caribbean is valued at between USD 700 million to USD 2.2 billion per

year.[xiv] This is significant because marine protected areas must demonstrate that these evaluated sites are worthy of resource preservation, compared to exploitative and damaging investment opportunities that their establishment otherwise excludes. Unfortunately, this conventional analysis is biased in favor of projects quantifiable with market prices and biased against those that hold quantitative importance but lack measurable commercial value such as non-use values, including option, bequest and existence values.

It is believed that economics are often one of the paramount determinants of decisions. This is held to be true because economics seek to tap into individual self-interest, which is defined by economists as "maximizing utility" or the satisfaction derived from the consumption of a good or service.[xv] According to the disciplines of behavioral science-economics, political science and some branches of anthropology, self-interest is the major driver of human choices and as a result must be addressed by conservation strategies. It is held that the evolutionary forces of natural selection favor individual behavioral strategies that exploit resources in order to outcompete competitors. As a result, human decisions tend to emphasize short-term gains, while sacrificing the common good or the far-off future. In contrast, conservation requires individuals to postpone their immediate rewards for the future. However, this does not mean that conservation is impossible as there are numerous examples of organisms that trade short-term costs for benefits in the future. For example, squirrels store acorns away for times of scarcity during the winter months, while humans practice reproductive restraint in order to save money. It is believed that individuals will practice restraint whenever the long-term benefits outweigh the short-term costs.[xvi]

This idea offers a framework to determine whether or not a conservation strategy will be effective or not and also helps predict how behaviors will transform with technological, ecological and socio-political changes. For this, it is crucial to determine and communicate the worth of ecosystems through economic language that is generally understood and valued. As a result, many consider it necessary to incorporate an economic analysis of MPAs. An economic assessment of an MPA requires the identification of all associated costs and benefits and the extent by which they can be quantified. In order to quantify the costs and benefits of an MPA, methodologies must be identified and selected to gather crucial information that will allow them to be valued.

Unfortunately, economic valuation is not a formulaic process, as market prices do not exist for many ecosystem values. A number of assessment techniques and methodologies such as travel costs, contingent valuation and hedonic pricing have been developed to gauge specific components of the economic worth of natural resources and the economic impact of their deterioration. Studies such as the *Stern Review*, which details the anticipated economic impact of climate change, have bolstered economic valuation debate to the international forum, but critics remain pessimistic that these works are too biased, nebulous and unable to truly grasp the complexity of ecological processes and thus miss out on major and critical issues.[xvii] For example, Yale University economist William Nordhaus holds that Stern's time preference was too low, while Ross Garnaut in his "Climate Change Review" argues that the Review underestimated the problem.[xviii]

In the last two decades there has been a dramatic increase of literature on MPAs but only a fragment of it has been dedicated to economic analysis.[xix] There has also been

an increase of valuation studies on coastal and ocean resources dating back thirty years, summaries of which can be found in Appendix A.[xx] However, most of the studies that do exist focus on fisheries and recreational benefits, particularly in the United States. There are a number of studies that concentrate on specific components of coastal and ocean ecosystems such as beaches, coral reefs, biodiversity, commercial fisheries and water quality, and although their results cannot easily be compared, they provide a range of estimates for some categories that can help understand to some extent the value of natural capital within marine protected areas. Due to a lack of data only two studies were found (looking at a coral reef in Indonesia and a wetland in Louisiana) that provide the total economic value for marine ecosystems.[xxi] The gaps in research and literature ignore the fact that MPAs are investments in natural capital, which have real economic costs and benefits, and thus undermine the development of marine protected areas as conservation tools.

Enticed by the debate surrounding economic analysis and valuation and the ecological crisis in the Caribbean, this study seeks to increase the understanding of MPAs by analyzing the challenges and opportunities of economic analysis. The final goal is to coalesce the theoretical foundations of economic analysis and present a guideline of key lessons, which can be applied to the sustainable management of MPAs in the Caribbean. In the end, this work demonstrates that economic analysis can contribute to the sustainable management of MPAs in the Caribbean, which could ultimately provide tangible leadership opportunities in the rest of the globe.

1.2 Research Design

Methodologies

This study takes an eclectic, qualitative approach, utilizing a case study and several valuation studies, literary works, documentation, reports and writings from scientific journals to identify patterns in the economic valuation of MPAs. Due to the limited amount of information currently available the research design relies on a wide array of resources, emphasizing writings from multiple disciplines in economic, social, academic and political thought whenever possible. This study also employs publications from international organizations, non-governmental organizations, government organizations and businesses to build a comprehensive academic analysis of the research topic.

The study begins by outlining the causes of marine ecosystem degradation and different strategies being employed to stop those. From this broad opening, the paper will narrow its focus to the role of MPAs as a conservation tool and begin to explore how economic analysis can contribute to the sustainable management of marine resources. The idea of values and value language will be elaborated to better understand possible categories that interpret marine ecosystem values. From there, the steps of economic analysis will be outlined; addressing stakeholder engagement, scenario development and impact assessment, economic valuation, data collection, decision support tools and the use of valuation in decision-making. Next, the major critiques and moral considerations of economic analysis will be explored. The case for economic analysis as tool for sustainable management will then be developed. Following this progression, common assumptions about valuation techniques will be compared against the findings from applicable case studies.

The next section will be prescriptive, utilizing the findings to draw conclusions, which will elucidate the threats and opportunities of economic valuation of MPAs in the Caribbean. As a result, a guideline is developed, outlining key "take-aways and lessons learned" that may facilitate the application of economic evaluation in marine resource management in the Caribbean.

Chapter 2: Literature Review

2.1 Causes of Marine Ecosystem Degradation

The rapid deterioration of marine ecosystems is caused by the exploitation of marine resources and the overdevelopment of the coastal area. Driven by population growth and migration to coastal zones, nearly half of the world's major cities are located within 50 kilometers of the coast and have a population density 2.5 times higher than inland areas.[xxii] Additionally, advances in extractive technology such as trawling and sonar have increased access to marine species, while also improving the efficiency and yield of fishing efforts. As a result, anthropogenic environmental changes such as habitat clearance and conversion, sedimentation, nutrient loading from pollution, overfishing, climate change, advances in extractive technology and market failure are stressing the marine environment and as a result threatening its collapse.

2.1.1 Population Growth

The increase in population of coastal areas and a lack of regulation for construction have led to rapid land development and poor land use practices. Critical marine ecosystems such as seabeds and mangroves have been removed to make way for hotels and factories as highlighted by the destruction large areas of mangroves removed to clear land for the construction of the CapCana Resort in Punta Cana, Dominican Republic.[xxiii]

The removal of these vegetative buffers has increased the amount of land-derived sediments reaching the ocean. Increased sedimentation smothers corals and aquatic plants, preventing access to vital sunlight. Pollution from domestic, industrial and agricultural waste causes nutrient loading, which is responsible for eutrophication and algal blooms. Nutrient loading is considered to be the greatest stress affecting corals and threatens an estimated 22 percent of the world's reefs.[xxiv]

2.1.2 Unsustainable Fishing Practices

The overexploitation of marine resources, particularly through destructive practices such as dynamite and cyanide fishing and improved fishing techniques such as dredging, are destroying marine habitats and changing the genetic diversity of species. The United States Food and Agriculture Organization estimates that 70 percent of fish stocks worldwide are fully fished, overfished or depleted.[xxv] Fishing favors particular genotypes of marine species over others and as a result affects genetic diversity, which can cause the extinction of species, inbreeding and genetic impoverishment. Due to the interdependency of species, their loss may affect others and also reduce an ecosystem's ability to adapt to changes in the environment such as shifting weather patterns, rising temperatures and increasing levels of acidity.

2.1.3 Global Climate Change

Global climate change threatens to augment stress on marine ecosystems by increasing temperatures, atmospheric carbon dioxide concentrations, rainfall and the sea level. Temperature extremes can cause coral bleaching and mortality, which happened in 1998 when 75 percent of the world's reefs were affected by warmer waters, resulting in the death of 16 percent of coral coverage.[xxvi] Additionally, a rise in water temperature

can increase the intensity and frequency of hurricanes. Climate change may also elevate the level of acidity in the ocean due to an increase in the concentration of dissolved carbon dioxide. This rise in acidity can lead to the over fertilization of algae, which compete with corals, and also reduce the calcium carbonate deposition rates of corals. Many scientists predict that climate change will increase the quantity of rainfall, affecting the amount of sediments, nutrients and contaminants flowing to the ocean. Finally, sea levels are also expected to rise, which may destroy human settlements and habitats located on low islands and coastal plains.

2.1.4 Market Failures

Economic market failures are also a paramount source of harm to the marine environment. A market is a set or rules and institutions that facilitate the trade of resources, forming part of the economy. In theory, a perfect market signals the scarcity of various goods and services through their prices, and distributes them to those consumers that value them the most. An ideal market would require perfect competition between buyers and sellers and their full access to information. As a result, the price of a good or service should reflect the knowledge and expectations of market actors and thus the maximum net benefit of a resource to society.[xxvii]

The deterioration of the marine environment is, at least in part, caused by the inability of markets to signal the scarcity of natural resources. A market failure can be caused by a lack of forums for public goods and services to be exchanged, such as fish nurseries by mangroves, flaws in economic structures and processes that cause inefficiency and a lack of information. Typically, markets do not assign value to public goods and thus do not reflect the true costs and benefits of resource use. Individuals

driven by their own self-interest are encouraged to over-use common pool resources because there is little economic incentive to curb over-consumption or invest in environmental conservation. Garrett Hardin's "The Tragedy of the Commons" thesis popularized this idea, highlighting the "divergence between individual and collective rationality."[xxviii] According to Hardin, common property resources are defined "as a class of resources for which exclusion is difficult and joint use involves subtractability."[xxix] *Excludability* is the idea that regulating access to a common resource is extremely costly or difficult. This is often true because many common pool resources cannot be contained by physical boundaries, as is the case with migratory fish. *Subtractability* is the idea that the use of a resource by one user will affect the ability of other users to exploit the same resource in the future. Hardin identified the replacement of commons with private property as possible solution to the Tragedy of the Commons. Private property would create a forum to exchange these resources, while also defining their access, use, exclusion, management, monitoring and arbitration. In England, for example, the enclosure movement developed in the 18th and 19th centuries as a means of replacing common property by separating individual fields and pastures with fences and walls. As a result, productivity and income increased dramatically as common resource use was incredibly inefficient.[xxx]

Imperfections in market structures and processes are facilitated by policy failures, which create incentives that encourage environmentally destructive activities. Subsidies and tax incentives can discriminate against environmentally sustainable practices, while encouraging damaging activities. Global fisheries have been awarded an estimated USD 20-50 billion annually, which is about the value of fish catches and as a result one of the

major causes of overfishing.[xxxi] Furthermore, market investment tends to assign economic values to private goods and services, which often cause environmental damage during their production, as is the case with coral mining and fishing. Finally, a limited understanding of ecological processes also contributes to market imperfections, as information about scarcity cannot be adequately communicated. The fact that less than 5 percent of the ocean has been explored highlights how little is understood about the marine environment.[xxxii] Thus it is often difficult to obtain a solid understanding of the supply and demand of a good or service produced by marine ecosystems. Knowing the supply and demand of good or service is important because it can help predict how management decisions may impact human behavior, elucidating values of marine goods and services in a language understood by decision-makers.

2.2 Efforts Toward Mediation

2.2.1 *Political Action*

In response to growing concerns about the environmental integrity of the marine environment and increasing opportunities to approach national, regional and international partners to confront these challenges, a number of strategies including political action, mariculture projects and marine protected areas have been developed. The growth of new political commitments and frameworks such as the United Nations Convention on the Law of the Sea, the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, the Millennium Development Goals, the Small Islands Developing States Network, the World Heritage Convention, UNESCO's Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization, the global Programme of World Commission on Protected Areas

and the Ramsar Convention on Wetlands have provided a platform to connect with stakeholders on issues of business conduct, natural resource management and to enforce rules and regulations. One of the most important agreements, the Convention on Biological Diversity (CBD), represents the greatest legal commitment to endorse protected areas. The Treaty established global policies and priorities to incorporate protected areas in national plans for biodiversity. The United Nations Convention on the Law of the Sea, which was signed in 1982, was also significant in that it defined a nation's exclusive rights to use their coastal waters and resources beyond three miles and thus establish marine protected areas.[xxxiii] The Convention also created a baseline for scientific research and guidelines to protect the marine environment and settle disputes.

The regional Caribbean and its sub regions have also engaged in political action to address marine environmental issues. The Convention on the Protection and Development of the Marine Environment of the Wider Caribbean Region and the St. George's Declaration of Principles for Environmental Sustainability have also emerged to reinforce the Caribbean's political commitment to promote environmental action. These political obligations have been strengthened by a growing network of actors pushing for regional cooperation, which includes The Caribbean Community Secretariat (CARICOM), The Caribbean Hotel Association, The Caribbean Regional Fisheries Mechanism, The Caribbean Centre for Development Administration and the Caribbean Climate Change Centre.

Despite this growing political commitment, marine ecosystems have continued to deteriorate. Many critics argue that these agreements are too broad and lack the legal "teeth" to force compliance. For example, the CBD does not have dispute settlement

processes or tools for enforcement. As a result, the interpretation of individual countries determines how and whether or not activities are carried out. The process of persuading governments to take action is incredibly slow because many lack the institutional, scientific and financial capacity to do so. Many governments as a result focus on data collection and environmental assessments rather than the implementation of action-oriented initiatives. Critics such as Burgiel, 2004 also complain that many agreements are biased in favor of rich industrialized countries, making many countries reluctant to ratify the CBD.[xxxiv] Finally, marine environmental problems often permeate political boundaries and thus require collaboration between countries as highlighted by the case of the Dominican Republic and Haiti, which share an island. Unfortunately, the complexity of these problems and lack of room for political maneuverability often make tackling these issues difficult.

2.2.2 *Mariculture*

Mariculture production has been developed to cultivate marine products such as fish, oysters and seaweed and thus minimize the demand for wild stocks of marine organisms. Mariculture has been increasing worldwide at a rate between 5 to 7 percent annually.[xxxv] The rise of mariculture projects in the Caribbean is in its infancy with several projects being developed in Cuba and Jamaica to harvest oysters and queen conch in Turks and Caicos, Bahamas and St. Lucia.[xxxvi] The outcomes of these experiments produced mixed results as mariculture projects can cause negative impacts on the marine environment as culture systems may alter natural habitats. Mariculture wastes can increase the amount of nutrients in the environment beyond what it can absorb, causing algal blooms and eutrophication. Additionally, culture systems can accidentally

introduce alien and modified organisms, transmit diseases, release antibiotics and displace local marine organisms.

2.2.3 *Marine Protected Areas*

The impetus for conservation has recently extended beyond terrestrial ecosystems to include beaches, coral reefs, coastal lagoons and open oceans. The inchoate development of marine conservation over the past twenty years is rooted in a growing awareness of the limited productivity of the ocean.[xxxvii] In particular, the collapse of many commercial fisheries and extinction of marine species has challenged the myth, popularized by many 18th Century scientists such as Britain's Thomas Huxley, that marine resources are inexhaustible.[xxxviii] Furthermore, a deepening understanding of the interconnectedness of marine habitats and their role in provisioning goods and services to millions of people all over the world has also highlighted their economic importance as "nations with a maritime frontier are expecting coastal and marine areas to provide food for expanding populations, and to be a source of sustained economic growth."[xxxix] Additionally, the popularity of snorkeling and the invention of SCUBA combined with the appeal of marine conservation advocates such as Jacques Cousteau have helped to reveal the splendors of the sea, while also exposing its destruction.[xl]

The first overt call to conserve marine ecosystems and species was voiced in 1962 at the First World Conference on National Park in Seattle.[xli] The meeting concluded that governments and countries bordering costal zones should quickly establish marine protected areas.[xlii] In response to these changing perceptions, the number of marine protected areas has increased dramatically around the world.[xliii] Initially, MPAs were mostly used as a fishery management tool to make fishing sustainable and allow for the

recovery of exploited populations of marine organisms by promoting the "spillover" of marine organisms from protected areas.[xliv] However, their potential to foster ecosystem recovery was quickly understood and as result has developed beyond a management tool to support extractive industries.[xlv] MPAs are now established to achieve an array of goals, including the preservation of biodiversity and genetic diversity, conservation of ecosystems and ecological processes, the support of sustainable use, protection of commercially valuable species, the replenishment of depleted stocks, education and research, protection from natural hazards and the creation of opportunities for recreation and tourism. Currently, the majority of MPAs are designed to support conservation and the protection of biodiversity.[xlvi]

It is important to briefly discuss the major differences between MPAs and land-based conservation in order to determine considerations that would be important in defining the design and objectives of MPAs (See Appendix B for detailed Table of these differences). First off, there are a number of ecological differences between marine-based and terrestrial conservation. There is dramatic difference in how much is understood ecologically about oceanic species as their life-cycles are more complex, often involving multiple developmental and reproductive stages.[xlvii] Marine life has a higher gene flow, but is less structurally diverse over geographic and spatial scales.[xlviii] Furthermore, marine organisms live in an aquatic medium, which transports materials and organisms via waves and currents, extending the spatial scale of marine processes, so that marine systems are more "open" than terrestrial ones.[xlix] Furthermore, the predominance of external fertilization strategies, which produce a large number of small dispersed offspring, influence the high variability of survival as offspring are vulnerable

to constantly changing physical influences such as water temperature. As a result, many marine species experience wide variations in recruitment and fluctuations in survival.[l] Therefore marine protected areas typically require the inclusion of several [ecosystems] such as sea grasses, mangroves and reefs within marine [ecosystems] as well as networks of parks in order to capture the complexity and variability of marine species reproductive strategies.[li]

Property rights of oceanic territories and resources are more ambiguous than land-based conservation as definitions of rights often do not exist, nor do historical records tracing "ownership."[lii] As a result, it is often more difficult to define and manage marine protected areas. Carr el al. (2003) reinforces this thought in his statement that "indistinct ownership patterns…may hinder their creation or designation because of complex and difficult decisions about 'who should decide' and 'who should pay' for marine reserves." The political mechanisms, including rules and regulations, are much weaker in an oceanic context as most nations lack historical experience and legal frameworks to manage marine resources. As a result, there is much less financial support to promote marine conservation. All of the characteristics emphasize the importance of considering larger sizes, interconnectedness, sensitivity to the export and spillover of species and awareness of shifting social and biological dynamics.

MPAs have been increasingly utilized as instruments for managing critical marine and coastal areas and resources in the Caribbean. Their establishment has been greatly promoted by regional and international agreements and organizations, contributing to the sharp rise in their numbers. The Caribbean has only a few countries and territories with well-organized institutional arrangements to manage its protected areas. Most notable is

Cuba's *Centro Nacional de Areas Protegidas* and the Dominican Republic's *Subsecretaria de Areas Protegidas y Biodiversidad*, which represent a solid network of protected areas, but lack the capacity, political will and resources to manage them. Many dependent territories such as the Netherlands Antilles (Bonaire and Sabana Marine Parks) also have well established protected areas. There are a number of countries such as St. Lucia and Trinidad and Tobago national with plans for systems of protected areas. Jamaica is also developing its Protected System Master Plan (PASMP), which encourages the sustainable operation of its protected areas.

Unfortunately the establishment and management of marine protected areas have been mostly unsuccessful in the Caribbean, as marine ecosystems continue to deteriorate as highlighted by the extinction of the Caribbean Monk Seal, coral bleaching events and the diminishing number of sea turtles, grouper and sharks.[liii] Many marine protected areas such as La Caleta National Marine Park and Los Haitises National Park in the Dominican Republic lack public support and are perceived as excluding important subsistence activities such as fishing. Often, communities are forced to abandon coastal waters or adjacent lands without adequate compensation, as was the case in Punta Cana, Dominican Republic, which witnessed the forced removal of a fisher community in order to start construction on the CapCana Hotel and Resort.[liv] This often leads to encroachment by settlements and fishing, allowing for the unregulated use of resources within MPAs.[lv] This is also due to a lack of well-defined boundaries and buffer zones, which makes enforcement difficult. The increase in development and agriculture within critical catchment areas connected to reserves affects water supply and quality, which impacts the viability of ecological processes connected to MPAs. This is, in part, due to a

lack of public awareness about the objective and reasoning for a marine reserve. Furthermore, there still exists limited understanding of the effects of protection and the ecological processes involved. As a result, park boundaries have traditionally been established in relation to geographic and historical rationale, rather than according to more complicated and less understood natural processes such as nutrient cycling that dictate the ecological health of marine ecosystems.[lvi] Additionally, a lack of sufficient resources such as staffing greatly limits the ability of administrators to manage reserves. Typically, protected areas are funded by national budgets, which makes the justification of expenditures subject to competing demands as well as shifting social and political dynamics. As a result, many conservation areas lack sufficient funding to operate and exist simply as "paper parks." For example, it is estimated that only 30 percent of the minimum budget in developing countries is available to manage protected areas.[lvii]

These problems are made worse by flawed economic calculations that form the basis for decisions about marine protected areas. Current economic models ignore important costs and benefits associated with the values of all goods and services from marine ecosystems. According to economic theory, the coastal environment should be viewed as stocks of natural capital that are essential for the economy and society to function properly. However, in reality, ecosystems are undervalued because current economic measures and indicators do not take into account the full value, particularly values without market prices, of marine resources and thus discount their importance in decision-making processes associated with MPA management and their creation. Furthermore, MPAs face great financial limitations, as managers must struggle for funding against competing government programs such as health and welfare services,

education and the military. Once created, marine protected areas also compete with alternative economic activities such as poaching. As a result, current financial models, for many MPAs in the Caribbean, often demand financial self-sufficiency through the creation of revenue sources such as scuba diving and yachts moorings. In response, the majority of Caribbean MPAs have made tourism a key objective. It is estimated that the coral reefs, for example, provide a global recreational value of USD 3008 per hectare per year.[lviii] Unfortunately, tourism often causes ecological impacts that may negate the role of MPAs in conservation. Recent studies on the impact of recreational activities on reefs highlight that many heavily dived sites are linked to a high number of loose coral fragments and sediment loading, which may cause stress and increased coral mortality.[lix]

Although there are numerous strategies to tackle the causes of marine environmental problems through education, research, capacity building, enforcement and regulation, this paper focuses on how economic analysis can improve the effectiveness of MPAs as agents of conservation. It is believed by many economists, environmentalists and decision makers that economic analysis is one of the most important starting points to assure the sustainable management of marine resources as well as create opportunities for education, research, capacity building, enforcement and regulation. Economic analysis seeks to integrate economic tools in protected areas management, looking at how conservation and development trade-offs are calculated and factoring in total ecosystem costs and benefits. By determining if the aggregated benefits of a project exceed the aggregated costs, decision makers and managers are provided an economic forum, in addition to political and ethical considerations, to determine if a project is worthwhile.

Economic analysis goes a step further than financial analysis because it looks at how the benefits and costs of a project or management decision impacts society. Economic analysis provides information about a reserve's goods and services, the values people place on those, which values are being captured and which are not and which groups of people could obtain more benefits through alternative uses of an MPA. This information could also be instrumental in securing conventional funding sources as well as discovering new financial opportunities.

Chapter 3: Tools of Economic Analysis

3.1 Terminology and Classification of Values

The word 'value' is open to an array of distinct understandings, which lends to its ambiguity and misinterpretation. Value language has three unique grammatical classifications; a verb form meaning 'to value', an adjective form meaning 'a valuable object' and a noun form meaning 'a value.'[lx] The terms 'benefit' and 'value' have similar meanings and are often used in place of one another. However, they are distinct in that a benefit represents the acquisition of value by a recipient, while a value refers to a direct physical, cognizance or spiritual factor. Rockeach defines value as "an enduring belief that a specific mode of conduct or end state of existence is personally or socially preferable to an opposite or converse mode of conduct or end state of existence."[lxi] According to Najder, values communicate the worth of something; expressed as a measurable unit; as a property of a thing and as an idea or feeling.[lxii]

In order to fully grasp the complexity of marine protected areas it is crucial to delineate different categories of values. By grouping and classifying these assessments it becomes possible to highlight important characteristics of MPAs and compare these same

values across manifold themes. A number of different methodologies have been developed to organize protected areas values, but the ambiguity of value language and wide range of possibilities makes the process of categorization incredibly complicated, especially because many values fit into more than one category. For example, corals provide valuable economic benefits by providing wildlife habitat, storm protection and tourism attractions, but also contribute cultural and aesthetic assets. As a result, there exists a range of possibilities and methodologies to classify the values of protected areas.

Rolston categorized the values of 'wildlands to include market, life support, recreational, scientific, genetic diversity, aesthetic, cultural symbolization, historical, character building, therapeutic, religious and intrinsic natural values.[lxiii] The World Commission on Protected Areas (WCPA) Cultural and Spiritual Values Taskforce identified the values of protected areas to encompass recreation, spiritual, cultural, identity, existence, artistic, aesthetic, educational, research and monitoring, peace and therapeutic values.[lxiv] Dearden and Rollins defined 11 classifications of values for protected areas that include aesthetic, wildlife viewing, historical, spiritual, recreation, tourism, education, science, ecological capital, ecological processes, and ecological benchmarks values.[lxv]

It is important to acknowledge that the values we assign to the natural environment are defined by our subjective interpretation of the world via different cultures and experiences. Human values are thus social constructs subject to shifting experiences and ideologies that shape how people interpret the world. Therefore values from 500 years ago are distinct from the values today as they will also be different in the future. For example, Americans and Europeans once referred negatively to "wilderness"

as being "savage", "barren", and "terrifying." The Bible refers to wilderness as being on the "margins of civilization where it is all too easy to lose oneself in moral confusion and despair."[lxvi] It was in the wilderness where Jesus Christ battled the devil and had to endure temptations. It was nature itself that lured Adam and Eve to sin and ultimately caused their banishment from the Garden of Eden into the harshness of the untamed outside environment. However, by the end on the 19th century, due to the convergence of romanticism and post-frontier ideology, a new vision of wilderness emerged that celebrated it as "the last remaining place where civilization, that all-too human disease, has not fully infected the earth."[lxvii] The idea of wilderness came to be revered by writers such Henry Wadsworth Longfellow, Henry David Thoreau and John Muir as sublime, sacred and worthy of reverence.

The creation of protected areas is rooted in this latter understanding of wilderness, interpreting it as a "social landscape, a place that is naturally (but inexplicably) free from human beings and their activities."[lxviii] "Fortress conservation" emerged as the dominant conservation paradigm, understanding humans as separate and above nature, while also emphasizing the importance of restoring nature to its original "pristine condition."[lxix] Historian Frederick Jackson Turner points out that "fortress conservation" surfaced as the myth of the American frontier vanished. This was significant because the frontier was believed to provide the setting for Americans to escape the problems of civilization and awaken their independence, individuality and creativity. It was believed that the frontier provided the building blocks for "religious redemption and national renewal."[lxx] Thus the idea of wilderness lost its image of savagery and was transformed into sublime place for reverie. In order to promote this new "pristine" image of wilderness, indigenous

communities, believed to be ignorant of any appreciation for nature, were forcefully removed from conservation areas. "Fortress conservation," for the most part, unsuccessfully promoted environmental stewardship as it has ignored the adverse socio economic consequences of displaced people as well as the importance of biological interconnectivity of protected areas and has been unable to generate adequate funding for conservation initiatives.

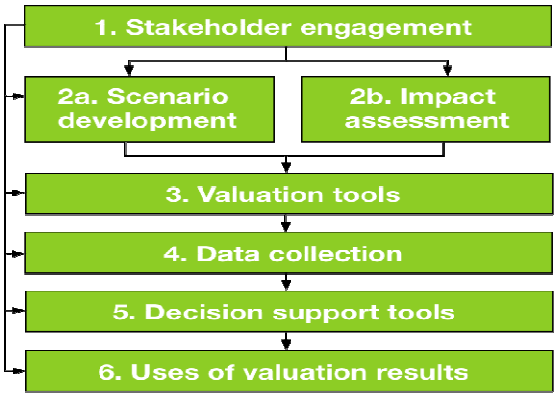
The failure of "fortress conservation" to successfully protect the environment resulted in a paradigm shift to a new social construct- Community Based Conservation (CBC). This transformation arose due to changes in ideological and political spheres, linking conservation and development. The publication of the Brundtland Report was the epitome of this, defining sustainability to be "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[lxxi] The Brundtland Report successfully shifted conservation away from preservation to a new emphasis on utilization. This strategy emphasizes the idea that people cannot undertake the long-term goals of conservation if their immediate needs have not been met. It is held that this requires the integrated management of natural resources that is equitable. Various strategies such as building local capacity, utilizing native resources and knowledge, promoting initiatives from the bottom-up and encouraging multi-stakeholder dialogue are believed to be essential tools to achieve this. The CBC's emphasis on use of nature provides the backdrop by which tools from economic analysis can be applied to marine conservation. However, it is also important to recognize that CBC and the applicability of economic analysis are dependent on the current value system and thus "it is entirely a creation of the culture that holds it dear."[lxxii]

Therefore identifying goods and services from marine protected areas, understanding who values this market and measuring these inputs is not always a straightforward process. Additionally, the fact that markets do not exist for many marine resources means that the values of non-market goods are unknown. Whenever possible it is essential to measure and convey non-market goods and services in monetary terms in order to engage policy makers and managers in discussion about the sustainable management of MPAs. The valuation of marine resources does not attempt to discount the importance of ethical considerations and moral reflection in the decision making process, but rather seeks to provide economic tools, universally understood, to reinforce those values and promote the sustainable management of marine resources.

3.2 Steps in Economic Analysis

The following framework provides a guideline of steps in economic analysis that can help inform decision-making processes. Although it is often not possible to follow ever single step due to a lack of information and/or financial and time constraints it is important to strive for a comprehensive economic analysis as this will help assure an integrative, efficient and equitable system of governance. The steps include: 1.) Stakeholder Engagement 2.) Scenario Development and Impact Assessment 3.) Economic Valuation 4.) Data Collection 5.) Decision Support Tools and 6.) Uses of valuation results.[lxxiii]

Figure 1: Steps in Economic Analysis



[lxxiv]

3.2.1 Stakeholder Engagement

Stakeholder engagement is necessary to assure that the people affected by MPAs have opportunities to address their concerns and shape decision-making processes. This requires the identification of the 'winners' and 'losers' in a given proposal and the creation of opportunities to engage them in dialogue and decision-making about marine protected areas. Forums to encourage participation include information giving, consultation, functional participation, interactive participation and active participation.[lxxv] These tools in turn promote a sense of community, trust, ownership, and empowerment while legitimizing environmental governance decisions. As a result, stakeholder engagement can reduce conflict and ultimately decrease long-term compliance costs.

This process was successfully utilized when the Caribbean Natural Resource Institute (CANARI) coordinated an 18-month long process of participatory planning, establishing the Soufriere Marine Management Area (SMMA), St. Lucia in 1994.[lxxvi] The consultation process involved a series of meetings to identify stakeholders, problems and the negotiation of management instruments, which resulted in the creation of a technical and institutional management framework for the SMMA. The success of the initiative was rooted in the ability of CANARI to find common ground amongst a

multitude of differing stakeholder interests through its promotion of discussion and negotiation.

The creation of the management plan for the Galapagos Marine Reserve further highlights the potential for participatory planning. There was no effort made to involve local users in the planning process of the Marine Reserve or to provide any compensation for the loss of livelihoods. In June 1997 a new management plan for the Galapagos Marine Reserve was initiated, providing an opportunity to integrate participatory planning into policy decisions related to conservation. A team of facilitators was hired, including local and international experts, to guide decision-making processes and problem-solving negotiations. Throughout the facilitation process efforts were made to distribute information, visualize complex issues (i.e. Venn Diagrams, maps), prepare comments, elaborate proposals and provide technical support in advance of meetings as well as to hold meetings in convenient locations to assure the participation of key stakeholders. An initial workshop was organized to diagnose the problem, identify stakeholders and establish the ground rules for participation, which included "active, equal participation in decision-making, local consensus on decisions and an agreed conceptual framework for marine management."[lxxvii] A multi-sectorial representative team, "Grupo Nucleo", was created to continue the revision of a management plan with specific goals and a precise timetable. The team held regular meetings as well as discussion and 'brain-storming' groups in order to negotiate the revision of the management plan and assure that the interests of all the parties were simultaneously satisfied.

The participatory planning process resulted in the preparation, negotiation and

adoption of a consensus document. The document was submitted to a government commission responsible for drafting legislature for the Galapagos National Parks Service and Charles Darwin Research Station. The document provided critical input to the commission, which resulted in the passage of the Law on Special Regime for the Province of Galapagos. The new Law created zones of multiple-use, demarcating where specific activities such as fishing, tourism and research were allowed so as to minimize conflict and assure a continued access to livelihoods. A participatory management body was created in order to provide stakeholders with opportunities to influence the management of the Reserve. National park authorities were granted the authority to collect, administer and distribute tax revenues to finance the implementation of the new management plan. Finally, only local small-scale artisanal fishermen were permitted to engage in extractive activities. The initiative highlights the importance of combining conservation and development goals in order to promote the sustainable management of marine resources. Furthermore, by politically and economically empowering stakeholders, particularly marginalized ones, the legitimacy and effectiveness of the Galapagos Marine Reserve was improved.

Efforts to include community opinion through participatory avenues should be aware of the inevitable challenges to project progress that accompanies civic involvement. There are often many challenges created by bottom-up decision-making such as time burdens and the difficulty of consensus. Participatory planning may take a lot longer as consensus is extremely difficult amongst a heterogeneous mix of stakeholders with different opinions, interests and biases. Additionally, many community leaders and groups do not actually represent the interests and need of communities.

Many of these people gain their status through political clout and vested interests rather than their concern for their community's welfare and thus represent a partial component of community opinion. There is also the possibility that governments will not be willing to shift authority to the local level. Management of natural resources may be transferred to the community, but the actual authority to make decisions may remain with the government. As a result, the level of stakeholder engagement needs to be considered carefully.

Therefore it is important to identify stakeholders, and to quantify and analyze their associated direct and indirect costs and benefits to determine the 'winners' and the 'losers' of a proposal. This will help determine which stakeholders need more incentives to support the MPA and those that should financially contribute to its management costs. For example, if the establishment of an MPA prevents fishermen from fishing, but provides no other direct benefits, they will be more likely to disregard conservation efforts. On the other hand, a tourist operation that receives economic gains or causes damage to an MPA should be expected to pay or else they will treat resources as if they are cheap. "Stakeholder analysis is the name for the process of collecting information about people who are affected by decisions, categorizing them into groups, exploring the conflicts between them and finding where trade-offs exist."[lxxviii] Determining pertinent actors and investors for any proposal requires that specific considerations be evaluated and used to qualify their priority such as identifying who is affected positively or negatively by a decision and who has power over a decision and who does not.[lxxix] Once a stakeholder analysis has been executed, it is possible to determine who should be

involved in governance processes as well as which groups and individuals should be given priority.

3.2.2 Scenario Developments and Impact Assessment

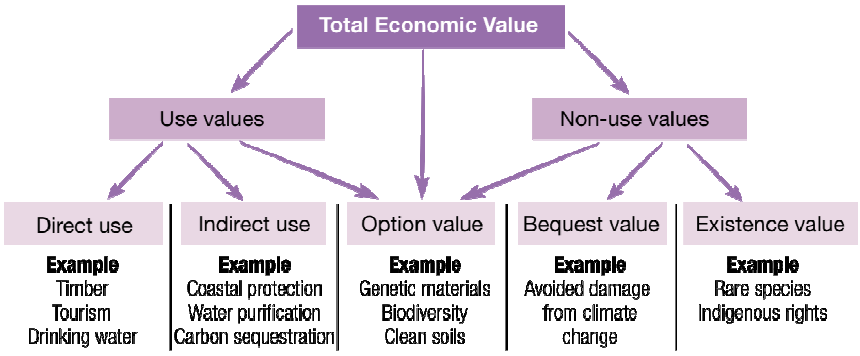
Economic analysis is implemented with the aim of convincing decision-makers of the validity of a proposed intervention. By providing decision-makers with a range of alternative scenarios and comparing economic feasibility of these, it is possible communicate the legitimacy of the proposed intervention. Then alternative scenarios can be developed by focusing on a desired end state and working backwards, analyzing drivers of change or looking at system uncertainties and current trends.[lxxx] This requires that scenarios be spatially explicit as an ecosystem's productivity and value differ over space. Once the range of alternatives has been determined, an assessment and prediction of the consequences of each scenario must be expressed. Impact assessments can measure a range of factors such as climate, development, economic, social, risk and environmental criteria. Thus the tools of scenario development and impact assessment provide decision-makers with additional information to highlight the attractiveness of a proposed policy or project as it compares to the range of alternative options.

3.2.3 Economic Valuation

Economic value can be measured by the amount of money an individual is willing to pay (WTP) for a good or service or the minimum amount of money an individual is willing to accept (WTA) as compensation in order to forego a good or service.[lxxxi] The value of a good or service is not limited to its physical use, but also includes the benefits people derive from it. The notion of total economic value (TEV) provides a matrix to identify the values of protected areas-both total economic benefits (TEB) and total

economic costs (TEC). The total economic value of marine protected areas is composed of values use and non-use. For the purposes of this paper, use values are categorized according to direct use, indirect use and option values, while non-use values comprise bequest and existence values.

Figure 2: TEV Framework



[lxxxii]

3.2.3.1 Total Economic Benefits

Direct Use Values

There is an array of goods and services that can be directly utilized from marine protected areas such as raw materials including seaweed, shells, sand, fish and corals, transport, recreation and medicine. MPAs also provide important tourism activities such as diving, fishing and sailing that support local, national and international economies. MPAs protect sites of cultural and historical significance such as shipwrecks, hideouts for pirates, access routes and past settlements. MPAs can also be educational sites where people can visit to learn about geological processes, marine biology and history. They are also important for research and provide controls for scientific studies.

Indirect Use Values

There are number of goods and services that flow outside of marine reserves that support human activities and must also be incorporated in economic analysis. These services include shoreline maintenance, nutrient cycling, nurseries and habitat, flood and storm protection, disaster risk reduction, absorption of waste, sand production, water filtration and dispersion centers for the supply of larvae. These services directly support human activities such as fishing, recreation and consumption and as a result their protection is critical to human security and the maintenance of our lifestyles. For example, in St. Lucia five small marine reserves increased the productivity of local fisheries by between 49 and 90%.[lxxxiii] Furthermore, it is estimated that a global network of protected areas would produce between $US 4,400 and 5,200 billion above its costs.[lxxxiv] Thus it in incredibly important that MPAs incorporate the values of goods and services that flow outside the boundaries of marine reserves in order to truly capture an accurate understanding of their full worth.

Option Values

Values produced by natural areas are not static as they change according to when we decide to utilize them. We can decide to protect a good or service now so that we may utilize it in the future. This is particularly important when it comes to the idea that there are potentially an innumerable amount of scientific discoveries to be made that could provide opportunities for future medicines and agricultural products. Thus MPAs also exist as potential storehouses for future uses.

Existence and Bequest Values

The idea of intrinsic value underpins the basis for ethical thought and thus drives the philosophical rationale for how humans interact with the planet. Intrinsic value refers

to the inherent worth of something and its immutable right to exist. Therefore the idea that something has intrinsic value implies moral obligations. Elements of the notion that nature has intrinsic value can be found in ancient philosophical and religious traditions. Hindu religion interprets intrinsic value as Brahaman and believes that all of nature possesses it. Jainism practices a doctrine of non-violence for all forms of life as they believe all beings posses a soul and are worthy of equality. In Japanese Shinto religious beliefs, elements of nature are linked with the kami (gods) and thus believed to possess an ultimate importance. The indigenous Huna Tlingit in Alaska also possesses religious beliefs that are rooted in the idea that nature has spiritual qualities and thus innate worth. For example, Huna hunters purify themselves by bathing and fasting before a hunt. Furthermore, the entrails of fish were put into streams or burned in order to assure reincarnation.[lxxxv]

Western philosophical tradition has interpreted intrinsic value through an anthropocentric lens, viewing humans as the center of the world and everything else as something to be used by them. Beginning in the middle of the 20th Century, a new biocentric interpretation of our place in the world began to emerge that was inclusive of nature, extending ethical considerations beyond humans into nature. Aldo Leopold's Sand County Almanac helped to transform our ethical boundaries with his idea of a *land ethic*, which asked us to consider the value of nature apart from what we gain from it.

"It is inconceivable to me that an ethical relation to land can exist without love, respect and admiration for land, and a high regard for its value. By value, I of course mean value in the philosophical sense…A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise." [lxxxvi]

Additionally, an ecocentric philosophy has evolved with the deepening understanding ecological science and the interrelationships of flora, fauna and the physical environment.

The international community has acknowledged the intrinsic value of nature in the adoption of legal mandates. The Convention on Biological Diversity states in its preamble its recognition of the "intrinsic value of biodiversity."[lxxxvii] The UN World Charter for Nature declared that "every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organism such recognition, man must be guided by a moral code of action."[lxxxviii] Thus there exists both legal and philosophical rationale to justify the notion that nature has intrinsic value and as result merits ethical considerations. This is significant for the management and creation of Marine Protected Areas as it is essential that the values we choose to protect reflect the worth of all of nature and not only as it relates to humans. Furthermore, this requires that we broaden the purpose of protected areas to promote the sustainable development of the human and non-human world.

It is important to also identify how protected areas provide value to communities and individuals. Humanity has always been inextricably linked to nature and thus its historical and cultural traditions have been shaped by it. As a result, humans have developed their sense of place, identity, spirituality and lifestyle in relation to the environment. Additionally, protected areas present opportunities for communities to interact through recreational and volunteer management activities, which encourage cooperation, bonding and understanding. Furthermore, protected areas provide opportunities for personal growth and healing. For example, several studies have shown that post-surgical patients recovered more quickly and prisoners were sick less often when they had opportunities to go outside or could be near a window.[lxxxix] Wild areas also facilitate space for personal reflection, which contribute to one's emotional and

psychological well-being. Nature also presents the possibility of becoming more self-reliant by hiking and learning survival skills, while also building stronger connections with the environment. Entomologist Edward O. Wilson, coined the term *biophilia* to express this idea that humans are innately drawn towards other species and the environment because "much of human nature was genetically encoded during the long stretches of time that our species lived in intimacy with the rest of the living world."[xc] Thus in order to truly grasp an understanding of MPAs it is essential to also incorporate community and individual values.

3.2.3.2 Total Economic Costs (TEC)

In addition to identifying the total economic benefits of marine protected areas it is important to also include total economic costs. These include both opportunity and management costs, but tend to focus on the later. Management costs represent costs such as infrastructure, staff and equipment required to operate a protected area. However, the existence of marine protected areas also creates costs by excluding or reducing other economic activities. As a result, these opportunity costs diminish opportunities for income and profit generation.

3.2.3.3 Valuation Techniques

Valuation techniques estimate the value of changes in the production of environmental goods and services. Each valuation method attempts to capture different components of resource value and provide and aggregate those values as a measure of TEV. These techniques are categorized according to direct market prices methods, revealed preferences methods and stated preferences methods.[xci] There is no way to determine which valuation methodology is best for a particular environmental good or

service as their application depends on a number of contextual factors such as the availability of time, finances and skills. Additionally, it is important to consider combining both quantitative and qualitative approaches to valuation in order to provide policy makers with a wide range of information and to overcome the weaknesses found in both methods.

1. Direct market price:

Identifying and assessing direct use values is typically straightforward as individuals reveal their preferences through transactions that are made on commercial markets. In order to measure these values it is necessary to identify relevant markets and collate information about prices and the amount of a particular product that is being traded. In many instances markets for marine resources, particularly many non-use and indirect use values, cannot be captured by financial analysis, as markets for them do not exist. This is especially true because a lot of people rely on marine goods and services for subsistence purposes, which have not contributed to the development of markets. Additionally, external market interventions such as taxes and subsidies can distort markets and thus the legitimacy of market information.

2. Revealed preferences (RP)

When markets for environmental goods and services do not exist preferences can be revealed in related or surrogate markets.

Replacement and Preparation Cost Method

The prices of alternative or substitute goods and services can be used as a proxy to estimate the value of products without markets. For example, the value of a reef for storm protection could be determined by looking at how much it would cost to install an

artificial reef with cement groyne structures. By calculating the replacement costs it is possible to determine whether mitigation or preventive actions such as hiring more staff to patrol reefs are more cost effective. When substitutes cannot be found it is possible to look at the inputs with market prices such as labor, equipment and time associated with the collection and preparation of a good or service. Unfortunately, it is often difficult to find replacement costs for a good or service that have equivalent benefits. For example, cement groyne structures may provide the same economic value as a buffer against storms, but does not support the same diversity of reef organisms or aesthetic beauty as a reef.

Damage Cost Avoided

It is possible to calculate damage avoided by MPAs by estimating the economic costs of houses, roads and bridges that would be destroyed if it otherwise did not exist. For example, mangroves provide storm protection for coastal residences. As a result, it would be possible to calculate anticipated expenditures required to protect houses if the mangroves did not exist. The weakness of this technique is that damage estimates are often hypothetical and thus unable to accurately predict how ecosystem loss would impact costal properties in case of a disaster. Even when data is available on past events such as storms, it is difficult to know for sure how everything will react.

Travel Cost Method (TCM)

The travel cost method is based on the idea that a decision to visit a protected area results in the expenditure of scarce resources such as time and travel inputs (i.e. gasoline and auto repairs). It is held that by calculating the average distance to a facility and the average travel costs and aggregating them it is possible to create a demand curve for

visitor rates, which show how individuals use marine resources at different prices. Ultimately, this information could be used to determine how much people would be willing to pay to visit an MPAs as recreational sites as well as predict how management decisions or particular economic activities might impact this value. Despite the possibilities of TCM, there are some difficulties involved in its calculations often due to a lack of objective data, as it is data intensive, which makes its methods inflexible. Additionally, the methodology depends on assumptions on consumer behavior, which can become complicated, for example, when people stay at a site several days.

Hedonic Pricing

Hedonic pricing uses existing markets to assign value to an environmental good or service. It is believed that certain markets are directly dependent on environmental products produced by marine protected areas. For example, housing markets for beachfront properties could be used to identify the economic worth of aesthetic values generated by MPAs. Additionally, a change in the environmental quality of a protected area can be measured by observing how the change impacts housing markets. However, hedonic pricing is subject to misleading data as information about alternative markets may not be available or are influenced by market manipulations such as subsidies.

Effect on Production Approach

The change in productivity method measures the change in productive output and consumption before and after a management decision or an impact on the marine ecosystem. The difference is used to estimate the ecological values of a protected area. This tool is particularly useful to calculate the values associated with tourism and fisheries in relation to management decisions connected to MPAs. This approach allows

managers to identify potential threats for poaching and other destructive activities, which could be critical in the development of opportunities to create alternative livelihoods or make compensation payments.

3. Stated Preference Method (SP)

The stated preferences method utilizes surveys ask individuals to state their preferences for an environmental good or service according to a hypothetical situation.

Contingent Valuation Method (CVM)

Contingent valuation asks people for their preferences by conducting surveys or experiments that construct a hypothetical market where individuals must state their willingness to pay (WTP) for a natural asset or their willingness to receive (WTR) payment to give it up. Thus it is designed to identify possible behaviors in hypothetical situations based on proposed scenarios. CVM is widely used to measure existence values, option values, indirect use values and non-use values as it is one of the must flexible assessment tools.

The Contingent Valuation Methodology also has its drawbacks as surveys and interviews are subject to the quality of responses and instrument design, which may be biased, misleading and misinformed. Surveys may be biased in their design and use of language, which can influence responses. It is possible that respondents will provide a willingness to pay or receive equal to zero because they do not agree with the scenario, but not because they do not value a particular resource. It is also possible that participants will not take the exercise seriously or intentionally provide misleading information to influence the survey's outcome as it could result in payments for environmental services. Furthermore, CVM requires participants to provide monetary

values for goods and services which have always been free. These exercises require advanced logical skills to maneuver complex hypothetical scenarios. Contingent Valuation is also problematic when it is implemented in communities with subsistence economies where cash is not medium of exchange. As a result, new mediums of exchange must be identified and then given monetary value. As these drawbacks highlight, CVM can be incredibly complicated, time-consuming and costly.

3.2.4 Data Collection

Once the scope of the economic analysis has been defined (alternative scenarios identified and economic valuation tools selected) it is necessary collate all relevant data. It is possible to tap into an array of information sources such as historical records, databases, university reports and local expertise to create a baseline. Information can be found using private sector sources, governmental statistics, and data from international organizations. Information from surveys and questionnaires can also be utilized to provide social, economic and environmental information on local areas as well as identify individual preferences. There are a number of limitations to data collection as often data is not accessible, reliable or even available, particularly over many years. Furthermore, it is important to also explore the possibility of 'benefit transfers,' which involves channeling information from a completed study to a current one. This practice utilizes the estimated benefits from one context and adapts them to another in order to overcome limited resources. "However, we must recognize the trade-off between providing incomplete information assessment on the one hand, and using inferred estimates (rather than primary research-based estimates) on the other."[xcii]

3.2.5 Decision Support Tools

Once information has been collected it is necessary to interpret and translate it into something decision-makers can utilize to assess whether a project or policy is viable. The technique that is chosen is ultimately contingent on the context of the situation and the type of information available.

- *Cost-benefit analysis (CBA),* which is most often used, weighs the total costs of a proposal against its total benefits. The option that results in the highest net benefit compared to alternative options will be selected for implementation. It is important to recognize that this strategy has different outcomes from the perspective of the individual, a community and society as a whole. This method is most often applied when values can be expressed in monetary terms, but goals and targets can only be determined during the assessment process.
- Cost effectiveness analysis compares the relative cost and outcomes of several options. This strategy is best used when objectives and targets are more clearly defined.
- *Multi-criteria analysis* broadens the scope of cost-benefit analysis by moving beyond the single objective of economics and includes values that cannot be expressed in monetary terms. Analysis is driven according to performance measures as agreed upon by decision-makers. As a result, decisions are made based on which option best meets the established criteria. This technique is best employed when a lot of input is needed from stakeholders, there are a variety of measurement units and values cannot be monetized.

Incorporating the Precautionary Principle and Social Discount Rates

It is important when assessing options to include the identification of thresholds and an analysis of potential irreversible changes that may occur if one is breached. Therefore it is important to establish a Safe Minimum Standard (SMS), which would trigger the adoption of a conservation option over an option that may maximize profit, but would result in irreversible damages.[xciii] Thus it is recommended to integrate the 'Precautionary Principle' in decision-making in order to avoid unacceptable risks. The question of how to incorporate discount rates is also another important issue that must be addressed in decision making-processes. Discount rates are defined as the extent to which future costs and benefits are devalued, only taking into consideration the time value of money or the price for its scarcity, and relating the present value of a future cash flow to a nominal or future value.[xciv] Thus the discount rates of a good or service considers and compares just the time preference for a benefit today verses the future. For example, a zero discount rate would mean that the cost or benefit would be the same now as in the future, while a higher discount rate would entail reductions in the present value of future cash flows. It is often assumed that investments and technological change will result in economic growth and a decreasing marginal utility of consumption as growth takes place. Furthermore, it is assumed that these investments will ultimately create wealth for future generations. As a result, it is justifiable to undervalue future consumption and needs. However, these assumptions ignore the loss of environmental services caused by economic growth or the defensive expenditures by which we try to compensate for nature's losses such as building dykes against sea-level rise induced by climate change or the installation of cement groins to replace reefs and thus buffer shorelines from wave action. Thus economic analysis must address these critiques when

defining discount rates and find a way to synthesize their utility into the larger picture of environmental valuation. The use of social rates of discount, which includes the incorporation of the idea of intergenerational welfare, must also be considered.

3.2.6 Using Valuation to Influence Decisions

Ultimately, the goal of economic analysis is to influence decisions as a means to promote the sustainable management of marine protected areas. Economic analysis seeks to provide information that increases the income of marine protected areas, garner political support and improve policy decisions. By quantifying the economic benefits of marine protected areas it is possible to tap public and private funding, gain access to new markets, receive payments for ecosystem services and charge polluters for damages. There are numerous examples of economic analysis studies successfully informing policy as in the case of the State of Hawaii and the Florida Keys, which adopted legislation for monetary penalties per square meter of coral reef damaged based on calculations from valuation studies.[xcv] The government of the Republic of the Marshall Islands also utilized economic valuation studies to determine if unsustainable mining activities in the Majuro Atoll were economically worthwhile. The results of the valuation study showed that unsustainable mining activities created costs for coastal protection services worth USD 52 per m^3, while more sustainable offshore sites cost less at USD 36 per m^3 in the Majuro Lagoon.[xcvi] These tools can also increase political support by elucidating the benefits of marine reserves. Furthermore, economic valuation helps to identify a range of values not typically included in decision-making processes, which can help inform policy. Finally, economic analysis can contribute to governance by identifying the distribution of the benefits and costs of marine protected areas amongst stakeholders.

Economic Incentives for Conservation

Taxes, subsidies, loans and grants can be invested in marine protected areas as a means to sponsor economic growth and technological innovation. A subsidy, for example, is a type of financial assistance paid to businesses or an economic sector by the federal government. The Organization of Economic Co-operation and Development (OECD) defines subsidy as "a result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs."[xcvii] Some taxes, subsidies, loans and grants are harmful as they generate only private gains and result in market distortions, social costs and environmental damages. In order to curb the impact of these harmful instruments it is important to remove or reinvest them in conservation-oriented sectors. For example, a portion of the USD 20-50 billion invested annually in unsustainable global fisheries could be reinvested in marine protected areas or technology that promotes sustainable marine resource harvesting or the improved monitoring of parks as a means to regenerate fisheries. The creation of property rights, which includes ownership, the right to manage a specific resource and guaranteed participation in decision-making processes, can also increase support for marine conservation by providing stakeholders with tangible benefits.

Payments for ecosystem services and the creation of new markets and fees could provide a potential platform to generate cash flows for MPAs. Subsidies and market payments can be used to reimburse individuals such as fishermen to forgo the benefits they would normally receive from critical habitats such as mangroves and corals. Additionally, markets can provide a platform for consumers to communicate their interest in conservation. For example, the creation of a market for 'endangered species credits'

was implemented in 2005 to reduce the impacts of agriculture and development on threatened wetland species. A government agency, corporation or nonprofit organization establishes a limit on the quantity of pollutants that can be emitted and then distributes pollution allowances to businesses, which do not exceed the set limits. Businesses are allowed to trade their allowances on the market, making polluters pay and rewarding those that reduce their pollution. By creating artificial scarcity, 'endangered species credits' increase the marginal utility a consumer receives from the consumption of a good or service, which also increases their willingness to pay for the good or service and thus generates revenue for businesses and brokers. In 2005 the market volume for 'endangered species credits' was over USD 40 million, covering 44,600 hectares of endangered species habitat.[xcviii] MPAs could also potentially tap into similar markets by selling carbon through the Kyoto Protocol's Clean Development Mechanism, ecosystem services, avoided deforestation and biodiversity credits to raise revenues for management costs and to fund payments for ecosystems services.[xcix]

Distributional analysis

The creation of policy that encourages the sustainable management of marine protected areas demands that its costs and benefits be equally distributed amongst stakeholders. This requires the identification of stakeholders and the quantification and analysis of their associated direct and indirect costs and benefits to determine the 'winners' and the 'losers.' This will help determine which stakeholders need more incentives to support the MPA and those that should financially contribute to its management costs. For example, if the establishment of an MPA prevents fishermen from fishing, but provides no other direct benefits, they will be more likely to disregard

conservation efforts. On the other hand, a tourist operation that receives economic gains or causes damage to an MPA should be expected to pay or else they will treat resources as if they are cheap. Economic valuation can help quantify damages caused by pollution, which can be used to calculate the amount polluters have to pay for restoration projects and clean-ups. As a result, it is also necessary to create financial mechanisms to charge beneficiaries for use, reward conservationist activities, create incentives and enforce penalties.

Benefits of Economic Analysis:

- To raise *awareness* of the value of the environment as part of a project appraisal.
- To generate a value for the environment to be used for *policy advocacy.*
- To reveal the *distribution* of costs and benefits of projects among winners and losers.
- To design the most effective tools for environmental *management*.
- To design appropriate *charging* rates for environmental use.
- To design the best method to *extract finances* from environmental goods and services.
- To calculate possible *returns on investment.*
- To compare *costs and benefits* of different uses of the environment.
- To calculate damages for *compensation.*[c]

Chapter 4: Critiques to Economic Analysis

4.1 Potential Drawbacks

Economic valuation provides an important set of tools to understand the range of costs and benefits of marine protected areas often ignored in conventional analysis and management decisions. Despite its importance, there are a number of shortcomings and weaknesses as well as moral and philosophical issues related to economic analysis and the different methodologies used for valuation. In particular, "there is skepticism regarding the capacity of the methods to measure non-economic values of nature conservation resources."[ci] It is important to understand that values produced using these methodologies mostly represent minimum estimates, as they often do not tackle specific components of a good or service.

Additionally, a limited technical, economic and ecological knowledge prevents us from ever truly identifying, calculating and ranking all values. For example, an individual with a superficial understanding of the environment may place little value on a marsh because it is not aesthetically pleasing. Thus the values that are identified only represent the perceptions of people that have been included in the analysis at a specific point in time. The creation of a single economic index requires combining uniquely distinct economic, social, aesthetic and philosophical factors, which may be incompatible and as a result overestimate the benefits derived from an ecosystem. There is also the possibility that a particular benefit may be double counted. For example, nutrient retention may be given a value on its own, but could also be captured in another value such as biodiversity as it is considered an integral component.

It is also pointed out that it may be incompatible to compare values in the international market due to the presence of inequalities. For example, the U.S. Exxon Valdez oil spill of 1989 paid US$ 5 billion to compensate Alaskans for environmental damages, a sum derived by calculations based on their relatively high incomes.[cii] However, a similar oil spill in a poor country such as the Dominican Republic would receive much less compensation due to lower earned incomes. Despite identical environmental harms, nations can be ranked according to their economic status within the global economy. "In short, the thrust of this critique is that by framing global ecological dilemmas in terms of dollar values and efficiency we are obscuring more fundamental issues of comparability and environmental justice, thereby promoting a bias toward technical solutions and away from policies that require innovative social change."[ciii] Thus, in the realm of international markets, the values of rich countries will always outweigh those of poor countries and inequities between the rural and urban and the rich and poor may not be taken into consideration.

4.2 Moral and Ethical Considerations

It is important to include a moral and ethical dialogue in economic analysis in order to ensure it serves a socially as well as environmentally responsible purpose. "If human behavior is the root cause of the biodiversity extinction crisis, it follows that ethics –the inquiry into what people and societies consider to be the right thing to do in a given situation-must be part of the solution."[civ] Economic analysis seeks to help guide decisions by identifying as many values as possible for marine protected and quantifying them as a means to communicate their worth to decision-makers. However, it is also understood that these values have worth outside of pure economic rationale and that only

politics, religion and ethics can "reveal worthy goals for the tools of the economic process."[cv] Thus many critics argue that personal and social values are more important and often incompatible with economic ones.[cvi] Furthermore, many hold that moral reflection and wise judgment can never be replaced by technical rationale. However, economic analysis simply seeks to provide a potential platform to engage stakeholders in the sustainable management and conservation of marine resources. Just because something is economically sound does not necessarily mean that it is ethically justifiable. Thus it is held that "economics is mere weaponry; its targets are ethical choices."[cvii]

There is no universally accepted idea of morality, but its importance is generally acknowledged and understood. Often marine protected areas invoke religious and cultural significance as many communities live in or around reserves. This is particularly relevant when considering whether a particular activity will benefit or hurt one group over another. Ultimately, policy and management require choices between alternatives. However, there are not always comparable monetary tradeoffs for ecosystems, biodiversity and people. This is true because the loss of biodiversity, ecosystem function and a community is often considered irreplaceable. As a result, it is important to base policy and management decisions not only on monetary values, but also to include qualitative analysis.

Finally, it has been argued that economic analysis and its goal of sustainability seeks to extend capitalism's dominance over nature. By combining ecology and economics sustainable development "focuses not so much on the negative consequences of economic growth on the environment, as on the effects of environmental degradation on growth and potential for growth.[cviii] As a result, the world is understood as something

to be managed, which requires the capitalization and commodification of nature. "By rationalizing the defense of nature in economic terms, advocates of sustainable development contribute to extending the economization of life and history."[cix] This negates the value of nature on its own and incorporates a constructed view of nature as simply an extension of the global capitalist system. Only the parts of nature that contribute to capitalism are considered part of the environment such as those related to tourism and fisheries that produce clear economic outputs. Thus it is believed that economic analysis helps to validate nature only as extension of capitalist rationale, which ultimately undermines its worth unto itself.

Chapter 5: Creating a Bottom Line and a "Politics of Possibility"[cx]

5.1 A Politics of Possibility

Despite these critiques, economic analysis and valuation provide important tools to promote the sustainable management of marine resources while also encouraging a "politics of possibility." Additionally, it is important to consider combining both quantitative and qualitative approaches (mixed methods) to valuation in order to provide policy makers a wide range of information. Economic analysis can help identify challenges and opportunities for conservation, which improves the adaptability of management decisions and thus its effectiveness. The ability of MPAs to evolve and continue functioning in the face of problems is particularly significant today as we confront global fluctuations in climate, economies and socio-political norms. Although economic analysis cannot determine conservation goals, it can communicate to decision-makers how people value the marine environment and highlight the most cost effective strategies to achieve conservation goals once they have been established. It can also

"stimulate awareness of issues, indicate alternative management options, maintain comparability of alternatives and focus on the right questions."[cxi] This in turn helps to communicate the importance of conservation to decision-makers that are most often concerned with the bottom line. As a result, economic analysis can help conservation transcend boundaries of politics and business, which may garner new opportunities to solicit funds for conservation from governments and from both the private and public sectors.

Environmentalists have typically presented conservation as a choice between economic growth and environmental protection, but rarely create spaces to incorporate both in policy and project formation. Their narrow interpretation defines environmentalism as limiting growth and demands that people make large sacrifices. Thus it is understood that marine reserves create a "politics of limits," which protects the nonhuman world by confining human ambition.[cxii] Economic analysis seeks to overcome this weakness by creating opportunities that encourage both development and conservation. This is not to say that the strict preservation of marine resources is never warranted, as some conservation initiatives yield better results through a single-channel approach. Instead, the overall failure of reserves to protect marine resources suggests that there is something else missing, which following the feedback and critiques of MPAs that have been discussed is due to a failure to combine goals of conservation and development in marine reserves.

In particular, marine protected areas have been unable to protect important marine resources found in developing countries because they have ignored the economic and social issues that underlie their relationship with the environment. Developing countries

plagued by debt, inflation, poverty and corruption are most dependent on local resources and less able to adapt to changes posed by environmentalists. The failure of the environmental movement to consider and address the social and economic catalysts of environmental harm has inevitably doomed many of their efforts. Even if conserving their natural resources helps the poor in the long run, their immediate needs are much more important. Furthermore, exogenous initiatives to protect important environmental resources as "ecological reserve[s] for humanity" are typically viewed with suspicion and as elitist.[cxiii]

Marine protected areas have typically operated through force by patrolling park guards and through legal mandates. As a result, people are motivated to respect the boundaries of marine reserves only to avoid fines or jail sentences. Hence, their actions are mostly rooted in a superficial obligation rather than a strong commitment to protect the environment.[cxiv] Thus MPAs must promote untraditional avenues to motivate businesses, governments and individuals to action. The creation and management of MPAs capable of addressing climate change and other challenges requires a new vision of "human overcoming" and a "politics of possibility."[cxv] The old vision of environmentalism focused on a misanthropic message that humans intrude on the environment and pervert it. "Not only does it ascribe greater power to humanity than we in fact possess-physical and biological nature will surely survive in some form or another long after we ourselves have gone the way of all flesh- but in the end it offers us little more than a self-defeating counsel of despair."[cxvi] Thus 'old' environmentalism offers us a message that is self-defeating as it fails to tap into our strengths as a creative and resourceful species capable of great things. A new vision of MPAs must be embraced

which offers an opportunity to inspire humanity to confront the complex challenges of marine ecosystem deterioration while also appealing to our economic self-interest.

This vision of "prosperity" is not meant to define "wealth in gross economic terms but overall well-being."[cxvii] As a result, population and consumerism must also be targeted as strategies to combat marine resource degradation. However, a solution that relies exclusively on reducing consumerism and population will not pierce the underlying causes of marine ecosystem deterioration or motivate people to take action. Economic analysis provides tools to taps into our existing norms, while also increasing the amount of information available to make better decisions, improve efficiency and increase the possibility of balancing the benefits and costs of marine protected areas amongst stakeholders.

A solution to environmental problems within marine ecosystems requires the birth of a new movement that inspires a broad coalition of hope by addressing our ecological, social and economic needs in both developed and developing countries. "If it has success, it won't be environmentalism anymore. It will be something much more important."[cxviii] We must also acknowledge that some marine ecosystem functions will inevitably fluctuate, particularly due to climate change. As a result, we must prepare for it while also creating feasible long-term solutions through investments in marine protected areas and economic analysis.

The global challenges, such as climate change, that we now confront are shifting environmentalism and recreating it to be a broader movement that embraces a politics capable of harnessing human potential. The new environmental movement must also honor the success of past achievements and maintain a core appreciation for nature and a

commitment to reduce consumerism and population growth. However, our priority must be our own survival. Marine protected areas provide a potential platform to assure that the resources we depend on our available. However, if we fail to make available the tools for economic analysis and apply then when appropriate, many of the causes of marine degradation will never be confronted. Furthermore, it is believed that the dialogue generated via economic analysis may ultimately create new opportunities to elevate the importance of moral and ethical considerations in decision-making. This may ultimately provide us the "room" to transition human understanding to something far beyond a bottom line.

Chapter 6: Case Study Bonaire National Marine Park

The application of economic analysis to the management of marine protected areas has been limited to date.[cxix] It is often difficult to determine the best mix of direct uses allowed within protected areas. It is important to consider how much public or user pay-derived funds should be invested in the maintenance of protected areas, as it is necessary to quantify in monetary terms the wide range of production, consumption and human welfare values associated with marine protected areas. A lack of information, technical expertise and confidence in valuation tools has prevented research from quantifying the full range of these values. There are only a few cases where comprehensive economic information has been produced and is mostly related to the economic benefits of direct use from commercial fisheries and recreational activities.[cxx]

As a result, economic analysis research on the full range of values and approaches related to marine protected areas has often failed to be incorporated by governments and management agencies as tools for decision-making. The following case of the Bonaire

National Marine Park, one of the Caribbean's few self-financed parks, is used as a platform to understand the potential uses of economic analysis as it applies to marine protected areas.[cxxi] Where gaps exist, relevant case studies from coastal and ocean valuation studies will be drawn upon as a means to piece together different approaches to economic analysis and thus provide a more comprehensive analysis. Ultimately, the Bonaire National Marine Park Case Study seeks to highlight many of the issues in protected areas management as well as present useful experiences and lessons learned that are applicable to the Wider Caribbean.

6.1 Bonaire National Marine Park Background

Bonaire is one of five islands (Bonaire, Curacao, and the Windward Islands of St. Maarten, Saba and St. Eustatious) that constitute the Netherland Antilles in the southern Caribbean, approximately 100 km north of Venezuela.[cxxii] Bonaire is a crescent shaped island with a land area of 28, 100 ha.[cxxiii] Bonaire also includes the small unpopulated island of Klein Bonaire, a Ramsar site, located 750 m off the western shore of Bonaire.[cxxiv] Bonaire is composed of limestone rock, making water retention difficult, and has a relatively flat topography. The island contains representative habitats of fringing reef, sea grass beds, beach areas, mangroves, lagoon areas, karstic systems and bacterial mats, which support coral growth and a diversity of fish and invertebrate populations.

Bonaire forms part of the Kingdom of the Netherlands with its central government located in Curacao. There are between 10,000 and 13,000 permanent residents in Bonaire with a population density of 35 people per km^2, much lower than the other islands.[cxxv] Visitors often increase the population in Bonaire by 5 to 6 times, but

generally do not stay more than two weeks.[cxxvi] Bonaire's Gross Domestic Product was about USD 168 million in 2003, which increased 3.4 percent from the previous year.[cxxvii] Bonaire's economy lacks diversity, relying on the several key industries of manufacturing, shipping, agriculture, fisheries and tourism. The latter, in particular tourist activities such as diving, provides Bonaire one of its primary economic drivers. In 1980 there were only four dive operations providing services to 5,000 divers annually.[cxxviii] According to the most recent economic study, in 1994, 25,000 divers visited Bonaire, generating Gross revenues of USD 34 million.[cxxix] There are now over 21 registered dive operators and over 38,000 divers visiting Bonaire annually.[cxxx] In addition to divers there are a large number of other water sports including snorkeling, windsurfing, kayaking, sailing and fishing that also contribute to Bonaire's tourism economy.

6.2 *History of Bonaire National Marine Park*

The Bonaire National Marine Park surrounds the islands of Bonaire and Klein Bonaire, extending from the high water mark to 200 m off the coast.[cxxxi] The Park covers 2,700 hectares of fringing coral and protects habitat from shore, intertidal, reef and deep water environments.[cxxxii] The BNMP was established in 1979 with USD 319,000 in aid from the Dutch government, World Wildlife Fund Netherlands and the Island Government of Bonaire in order to confront the threats on the health of the marine ecosystem caused by the dive industry.[cxxxiii] The initial investment was designed as a three-year pilot project aimed at supporting recreational and scientific activities. During the initial phase of the project, 38 permanent moorings were placed on dive sites so as to eliminate damage to reefs caused by anchors.[cxxxiv] Another grant was used to restore a

plantation house to be used as a field research station. Additionally, research was conducted to monitor coral damage caused by anchors and storm damage. In 1981 a proposal to implement a user fee system was rejected by the dive industry and as a result there were insufficient funds to support the Park's active management, making it a 'paper park.'

As a result, research and monitoring disappeared, educational activities were no longer available and enforcement stopped. In response, the Island Government of Bonaire solicited a study to assess the impact of coastal development, fishing, tourism, nutrient enrichment and sedimentation and a lack of management. Based on the recommendations of the study, the Dutch Government channeled USD 403,000 in financial and technical resources to jumpstart the BNMP, which included the creation of a user fee system and a new financial and institutional structure.[cxxxv] This resulted in the Parks management authority being transferred from the Island Government to the non-governmental organization STINAPA, Bonaire in 1991 and its eventual recognition as a National Park by the Central Government of the Netherlands Antilles. Some of the tools of economic analysis that have been applied to the BNMP as well as several other valuation studies on coastal and ocean resources can help us better understand its potential to promote sustainable management.

6.3 Stakeholder Engagement

An important goal for STINAPA is the integration of stakeholders in governance processes. Local stakeholders include the Building and Zoning Department, the Legal Department, Environmental Department, the Prosecutors Office, Harbour Office, Coast Guard, Agriculture Department, Police, SSV (security services), Tourism Corporation

Bonaire, Fisherfolk, Dive operators, other water sports, volunteer groups and NGOs, while international actors consist of the Dutch Caribbean Nature Alliance, The Nature Conservancy and the Atlantic Gulf Rapid Reef Assessment.[cxxxvi] A failure to initially engage stakeholders in early conservation measures resulted in the undermining of the BMP's management authority, particularly through unregulated diving and spearfishing activities.

Currently, STINAPA pursues an integrative approach to coastal zone management, which relies on stakeholder input as a mean to "increase sense of ownership, greater support for the protection of the area, greater public involvement in decision-making, formation of links between planning for conservation and planning for development [and] provision of a mechanism for communication."[cxxxvii] The BNMP management plan dedicates an entire section to discussing the importance of stakeholder engagement and outlines a strategy to involve key actors in strategic planning decisions. It states, "Stakeholders should be consulted more often and in a structured fashion to increase the feedback that the marine park receives."[cxxxviii] It goes on to suggest the possibility of bi-monthly meetings, awareness programs, dive orientations and conducting outreach about the fee system. In order to tackle the present issues of nutrient enrichment, land conversion, poaching and overfishing it will continue to be necessary to better understand and engage stakeholders.

6. 4 The Economic Value of Bonaire National Marine Park

It is important to identify the full range of values of the BNMP in order to help find a balance between use and protection, while also confronting destructive activities and promoting sustainable ones.

6.4.1 Economic Benefits

The Bonaire National Marine Park has high economic value as it supports a wide range of activities. The Total Economic benefits of the BNMP include:

Direct benefits-A majority of the values associated with the Bonaire National Marine Park are related to commercial and artisanal fishing, manufacturing, shipping and tourism. Cargill Salt Bonaire produces 400,000 tons of industrial grade salt a year, which are sold to the chemical industry, waste water treatment facilities and processed to make table salt and cosmetics.[cxxxix] Bonaire's economy includes commercial and artisanal fishing, but is limited in scale. The Bonaire Petroleum Corporation (BOPEC) operates an oil terminal as a storage and transshipment facility. Additionally, there are other shipping services available. Bonaire's richness in natural resources has made tourism a major economic driver, generating two-thirds of the island's income.[cxl] It is also a major stop over for cruise ships. The BNMP charges a 'Nature Fee,' which is a day pass (USD 25 as a SCUBA diver and USD 10 as a non SCUBA diver) to use the Marine Park, which generates revenues to cover management costs.[cxli]

Indirect benefits-The BNMP supports an array of ecosystem services including sediment traps and nursery, foraging, nesting, spawning and breeding grounds. Bonaire's location upstream of the reefs of Colombia and San Andre, Central America and the Gulf Coast is ecologically significant as it provides important services for migratory species and aids larval dispersion and genetic mixing. Sea grass beds, reefs and mangrove ecosystems are also vital in trapping sediments, absorbing water and buffering the mainland against storms. The BNMP provides important ground for a variety of marine life such as migratory birds, conch, reef fish, turtles and manatees. For example, it provides the

biggest breeding grounds for the Southern Flamingo and its beaches supports nesting grounds for Hawksbill, Loggerhead and Green turtles. The BNMP also contains 470 species of fish, 57 species of coral and an undocumented amount of marine invertebrates, making it one of the most developed and biodiverse reefs in the Caribbean.[cxlii]

Option benefits- The BNMP is an important site for research and storehouse that supports the possibility of discovering and safeguarding goods and services for future uses.

Existence benefits-The Bonaire National Marine Park is internationally and nationally recognized for its value. The BNMP represents only one of only four true oceanic islands separated from the South American mainland by a deep-water trench and supports globally threatened ecosystems of coral reefs, sea grass beds and mangroves.[cxliii] It has five wetland sites included under the Ramsar Convention (Saliña Slagbaai, Goto, the island of Klein Bonaire, Lac and Pekelmeer) and is part of the United Nations Environment Programme's list of coral reefs of 'international significance.' Additionally, it is in the process of being nominated as the world's first trans-boundary World Heritage site. The BNMP is home to 111 globally endangered species, which includes 6 on the IUCN Red list and 11 species on CITES Appendix I and 94 on CITES Appendix II.[cxliv] The BNMP is also important because of the educational and recreational services it provides. Furthermore, the BNMP protects a number of historical and cultural sites such as the Hilma Hooker Wreck, Conch Piles at Cai, Red and White slave hut groups and the Quarantine Buildings at Klein Bonaire.

6.4.2 The Economic Costs

Aside from the many economic benefits created by the BNMP there are significant

costs associated with its existence including management and opportunity costs:

Management costs- STINAPA, Bonaire is responsible for the management of the BNMP and thus must cover all its direct costs, which include expenditures on law enforcement, maintenance, education and research and monitoring. Thus financial (income), human (staffing), physical (equipment) and information are essential resources needed to operate the BNMP. According to STINAPA, Bonaire's most recent financial report, its total expenses for 2008 were USD 2, 376, 118.[cxlv] Some examples of these investments and recurring expenditures include staff salaries, vehicles, boats, equipment, buildings, moorings and printing of brochures and the maintenance of a website.

Local opportunity costs- before the establishment of the BNMP it was open access, providing unregulated benefits for tourism, fishing, shipping, hunting and extractive activities. The opportunity costs of the BNMP include the losses of production resulting from the prohibition of these resource utilization activities. The small size of the island, dry climate and remote location limits Bonaire's economic development potential, making it even more vulnerable to the opportunity costs created by the establishment of the BNMP. The fact that the Park allows a multiple-use area lessens the burden created by the Park, but still creates significant costs that must be recognized.

Cost-Benefit Analysis of the BNMP

The aim of the study by Dixon et al. (1993) was to evaluate the success of the Bonaire National Marine Park by comparing its costs and benefits, including an assessment of the health of the marine ecosystem. Qualitative and quantitative tests, including a visitor survey and photoanalysis, were used to assess the health of the marine environment and to determine the Park's carrying capacity. The visitor survey asked 79

divers to rate the present conditions of the Bonaire reef in comparison with other dive experiences in the Caribbean. The results showed the majority of divers found the reef to be in good condition, but not pristine as visibility and species diversity had decreased in some sites.[cxlvi] According to the results from the photoanalysis, which compared cover over time and between sites, coral cover had decreased considerably at heavily dived sites.[cxlvii] However, the damage caused by recreational diving was restricted to a small area adjacent to the moorings, as divers typically do not cover a distance of more than 300 meters and rarely move far away from the moorings.[cxlviii] The outcome of these tests suggests that the carrying capacity at certain sites has been breached and that the threshold level for a site is between 4000 to 6000 dives per year.[cxlix] Due to the size of Bonaire's coastline and carrying capacity of dive sites the study determined that moorings should be spaced 600 meters in order to provide buffers, which would allow 86 dive sites with a maximum visitation of 200,000 dives per year.[cl]

Benefits

The 1991 economic analysis conducted by Dixon et al. identifies the benefits of the BNMP as they relate to revenues from the private sector and government. They distinguish primary uses between dive-based tourism, small-scale and recreational fisheries, cruise tourism and ocean transport. The analysis focuses on dive-based tourism because it is believed to be the most dependent on the protection of the Park. Information was collated using direct market prices though tourism statistics, surveys and interviews.

- *Private sector*-Total gross revenues were estimated to be USD 23.2 million in 1991 (USD 10.4 million is attributed to hotels, USD 4.8 million to dive operations, USD 4.7 million to other expenditures such as restaurants and souvenir shops and

USD 3.3 million for air transport.)

- *Government revenue*-The Island Government of Bonaire collects taxes from dive-based tourism (personal income tax, wage tax, business profit tax, use tax and land tax), which are difficult to separate out. The study estimates that total government revenue for these taxes was USD 8.4 million. Additionally, taxes levied directly on tourists (room tax, casino tax and departure tax) were estimated as USD 340,000. Theses revenues may be considered additional revenues generated through the use of the BNMP.
- *Employment*-Information on employment was gathered through interviews with hotel and dive operators, which showed that 22 percent of the total island employment was related to the BNMP.

Costs:

- *Management costs*-Included were the costs associated with start-up, rehabilitation, operational and recurring expenses. Bases on expenditures they estimated the direct costs to be USD 518,000 and annual recurring costs to be approximately USD 150,000.
- *Indirect costs*-This includes income that has been lost due to damage caused by competing activities such as damage caused to fishing traps by divers or increased congestion due to SCUBA diving, but no estimate was provided as there was not enough information available.
- *Opportunity costs*-There was no estimate provided.

Additionally, a contingent valuation survey was conducted in order to establish divers' Willingness to Pay for the protection afforded by the Marine Park. The results

were averaged and extrapolated to the total diver population in order to obtain an estimate of a Willingness To Pay. The survey found that 80 percent of respondents were willing to pay USD 20 per diver per year, 48 percent were willing to pay USD 30 per diver per year and 16 percent were willing to pay USD 50 per diver per year, which yielded an average WTP of USD 27.40. This amount was greater than the USD 10 per diver per year that was eventually implemented. However, the consumer surplus, the difference between what is paid and what one would be willing to pay, provides information to set future dive visitation fees and to predict responses to new activities and policy changes.

Table 1: Revenues and costs associated with the BNMP (1991 Summary Table USD)

Revenues	
Direct Revenue	
Diver fees (1992)	0.19 million (est.)
Indirect (private sector) Revenues (gross)	
Hotels (rooms/meals)	10.4 million
Dive operation (including retail sales)	4.8 million
Restaurants, souvenirs, car rentals, misc. services	4.7 million
Local air transport	3.3 million
Subtotal	23.2 million
Government Revenues	
Total taxes (a transfer payment)	8.4 million
Tourist taxes (room tax, casino tax, departure fee)	0.34 million
Costs	
Costs of Protection	
Direct costs–establishment, initial operation, rehabilitation	0.52 million
annual recurring costs	0.15 million
Indirect costs	?
Opportunity costs	?

[cli]

Distribution of the costs and benefits of the BNMP

Despite an abundance of economic wealth generated by the BNMP, the distribution of its benefits has often been unequal. Bonaire's development strategy has been to focus on high volume tourism, which has allowed foreigners and resident aliens to capture the greatest economic benefits of protection. For example, more than 50 percent of hotels and dive operations are foreign owned, while greater than 24 percent of the workforce are foreigners.[clii] The dominance of offshore voucher sales, liberal repatriation laws, free

exchange between the US dollar and the Antillean guilder and the absence locally produced agricultural products and consumer goods are the driving forces of this inequality. The majority of tourism packages (voucher sales) are made offshore in the United States and Europe, which reduces the amount of money that ends up in Bonaire's economy, as commissions and operating costs must be subtracted. The existence of vouchers sales also reduces the incentive for visitors to spend extra money during their stay. Furthermore, many of the major businesses such as the local ALM airline have their headquarters in Curacao, which stymies the amount of money that is actually invested in Bonaire. The free exchange between the US dollar and the Antillean guilder is also problematic as it provides little incentive to invest profits locally. Finally, Bonaire's reliance on agricultural and manufactured imports reduces its internal investment and self-reliance.

The values that were identified by the Dixon et al. (1993) study were also products of the cultural context associated with the BNMP. The fact that the study identified values, particularly use values, related only to the tourism industry is indicative of this context, which is defined primarily by the dominant interests of the Dutch government and the international conservation community. However, the BNMP offers a wide range of values that include direct use values (e.g. tourism revenues), indirect use values (e.g. breeding grounds for fish), option values (e.g. storehouse for future use) and existence and bequest values (i.e. aesthetic and spiritual benefits). Due to a limited availability of information about these values it is difficult to aggregate them and thus calculate the total economic value (TEV) of the BNMP. As a result, the study provides only a limited understanding of the importance of the BNMP.

The emphasis on the BNMP's values as they relate to tourism limits its potential to tap into a variety of funding sources, making it vulnerable to shifting trends in the tourism industry. For example, an international economic crisis, a widespread coral bleaching event or a new tourism fad could dramatically decrease the amount of revenue generated from diving to fund the park. By identifying a range of values related to the BNMP it is more likely that managers could explore a greater variety of funding options from governments, the private sector and non-governmental organizations. This includes the possibility of creating new and diverse markets for services produced by marine protected areas such as biodiversity, carbon sequestration and nutrient retention. Additionally, dive tourism may contribute to the deterioration of marine environment as careless divers and anchors often break coral and introduce pollutants to the marine environment.

6.5 Valuation Studies of Ocean and Coastal Resources

The following examples seek to illustrate how different valuation approaches aid decision-making and as a result may inform the economic analysis of the Bonaire National Marine Park. The case studies represent a variety of contexts, geographical and temporal scales, which seek to broaden the potential insight that can be attained. The Mediterranean study looks at use and non-use values for threatened species and demonstrates that ethical considerations inform environmental issues even when people are driven by economic motives. The case study looking at cost-benefit analysis in relation to mangrove planting in Vietnam shows that purely market rationale can be used to achieve conservation goals. The case study of nutrient pollution in the Baltic highlights the utility of cost-effectiveness analysis when targets have been identified.

Finally, the study of a marine park in the Caribbean reveals the importance of multi-criteria analysis that incorporates stakeholder input.

6.5.1 Use and non-use values for conserving the Mediterranean Monk Seal

The conflict between fishermen and the Mediterranean Monk Seal (Monachus-monachus) is rooted in economic competition for scarce resources. Fishermen were killing the seal, which is the most endangered seal in the world, because they were damaging fishing gear as they took fish from their nets.[cliii] Despite numerous conservation and regulation measures taken by the state, fishermen continued to kill seals as a means of securing their livelihoods. In response, the Mediterranean Monk Seal Project was launched with the goal of establishing a compensation fund for fishermen, which it was believed would eliminate the incentive to kill seals.

A contingent valuation study was conducted in order to establish the willingness to pay (WTP) of respondents to financially support the creation of a public fund to protect the monk seal. The study was conducted on the island of Lesvos, which supported three of the largest subpopulations of Mediterranean Monk Seal in the Aegean.[cliv] The survey relied on an open-ended questionnaire and face-to-face interviews with randomly selected fishermen from Lesvos in order to determine their maximum WTP. After individual WTPs had been established and fine-tuned, respondents were given definitions for use, option and existence values and asked to estimate a percentage of their WTP that fit into each category. Finally, respondents were asked to answer questions by providing a score on a five-point Likert-type scale, defining their level of agreement about environmental issues and the potential extinction of the monk seal. This

was designed to determine individual's motives (beliefs and attitudes) for choosing their WTP.

According to the results of the statistical analysis, there were a variety of values identified with monk seals, ranging from exclusively economic concerns to considerations that are deeply moral and ethically reflective. This study highlights that individuals value marine resources beyond exclusively economic motives. Therefore it is necessary to continue researching use and non-use values as they clearly both influence how individuals define their values and thus construct their WTP.

6.5.2 Cost-benefit analysis of mangrove reforestation in Vietnam

This study looks at the benefits of mangroves to local communities in areas where they have been degraded or lost. The study identifies the direct benefits of rehabilitation as timber and other local products such as shellfish, crabs and honey that would be produced. Indirect benefits include protection afforded to the system of sea dykes that buffers low-lying coastal communities. These benefits were determined by calculating how much less it would cost to repair the dykes if the mangroves were present to act as a buffer. The costs were calculating according to the expenditures related to the establishment and extraction of mangrove rehabilitation. The results, which can be seen in Figure 4, show a cost-benefit ration of 4-5, meaning that mangrove rehabilitation is economically justifiable.

This study fails to incorporate many values such as biodiversity and water quality into the analysis, ignores option, bequest and existence values and does not include an analysis of the possibility of changes caused by global trends such as climate change. Although these factors are all important, time, expertise and the availability of

information limits the scope of the study. Despite these weaknesses, the study demonstrates the potential to economically justify conservation decisions.

Table 2: Costs and benefits of direct and indirect use values of mangrove reforestation compared

Discount rate	Direct benefits (PV million VND per ha)	Indirect benefits (PV million VND per ha)	Costs (PV million VND per ha)	Overall B/C ratio
3	18.26	1.40	3.45	5.69
6	12.08	1.04	2.51	5.22
10	7.72	0.75	1.82	4.65

Source: [39]. *Note*: US$1 = VND 11,000; B/C ratio = NPV total benefits/NPV costs. [clv]

6.5.3 Cost-effectiveness of nutrient pollution in the Baltic drainage basin

This study attempts to estimate the costs and benefits of environmental improvements through cost-effectiveness analysis as a means reduce nutrient overloads in the Baltic Sea in order to comply with international conventions. The research targeted the agricultural sector, sewage treatment plants, wetland restoration, traffic and other oxide effluent sources in countries within the drainage basin and adjacent to the Baltic Sea. Targets for nutrient reduction and the minimum marginal costs needed to achieve them were calculated. The results showed that nitrogen costs were higher than phosphorous costs, costs increased dramatically beyond 40-45 percent reductions, and the cost of simultaneous reductions of nitrogen and phosphorous was less then separate reductions.[clvi] Furthermore, cost-effectiveness measures showed that a 50 percent reduction in nitrogen would include a 33 percent reduction from sewage treatment plants, 33 percent reduction from wetland restoration and that the agricultural sector would contribute by reducing nitrogen fertilizers, changing crops and altering manure use.[clvii] As for phosphorous, sewage treatment would account for 80 percent of reduction and wetland restoration would account for a 15 percent reduction.[clviii] The study also showed

that most of the financial burdens created by reductions would be felt by Poland, Latvia, Lithuania, Estonia and Russia.

In order to determine the benefits produced by reductions 14 empirical studies were conducted in Poland, Sweden and Lithuania. Research included an assessment of the total economic value of reducing eutrophication such as beach and recreational benefits and existence and option values associated with the protection of species and their habitat and wetland restoration. The WTP of these countries was calculated, aggregated and then extrapolated in order determine the benefits of the entire Baltic basin. For example, a contingent valuation study was conducted in Sweden using a mail questionnaire survey, focusing on non-use values related to the Baltic Sea. The survey depicts a situation where a hypothetical action plan has been created which would decrease eutrophication in the Baltic Sea and be funded through an environmental tax in all the countries in the Baltic drainage basin. The values of the different activities were calculated and aggregated together. The estimates of the costs of pollution mitigation and the benefits were then compared using cost-benefit analysis.

The results suggest that a 50 percent nutrient reduction target would generate positive net economic benefits.[clix] The study highlights the importance on an integrated approach to nutrient reduction, but also acknowledges the need for different approaches to abatement as a policy of uniform pollution targets may undermine the unique qualities of each country. Furthermore, the study helps identify which countries stand to gain the most economically from reductions in nutrient overloads, which may have implications in the creation of incentives and/or the possibility of one country helping to finance pollution reductions of another. It is also important to recognize some of the limitation of

this study as much information about the effects of eutrophication was not available and important factors such as data about retention and leaching rates of nitrogen and phosphorous were not included in the calculations. Despite these drawbacks, this case identifies the how cost-effectiveness analysis can be useful to promote conservation when clear targets have been established.

6.5.4 Trade-off analysis of an MPA in the Caribbean

This study looks at the trade-offs between users in Buccoo Reef Marine Park in Tobago West Indies. A stakeholder analysis and eventual consensus-building workshop was used to establish the measures for a multi criteria analysis, resulting in the identification of economic growth, social well-being and environmental health as important categories. A contingent valuation survey was conducted using a random survey of 1000 visitors and residents to determine the level of WTP necessary to stop the degradation of the Bucco Reef. In order to determine the appropriate level of environmental quality the surplus generated from resident and visitor use of the BRMP was calculated. The open-ended questions were used to determine two values for WTP, which were then averaged, producing a mean WTP that ranged between USD 3.70 and 9.30.[clx] These results were used to approximate an annual surplus, which was projected over ten years with a discount rate of 10 percent. Respondents were then asked to ask if their WTP changed under different scenarios related to changes in tourism management and development. The study found that the Buccoo Reef Marine Park's Net Present Value ranged between USD 2.5 and 3.7 million according to different scenarios.[clxi] This study emphasizes the importance of process-oriented strategies that engage stakeholders.

6.6 Key Take-aways and Lessons Learned

The Bonaire National Marine Park case study depicts some of the major challenges and trends related to economic analysis. The success of the BNMP and the integration of some of the tools of economic analysis are directly linked to its distinct cultural, economic, ecological and political context. The fact that Bonaire is ecological important internationally has helped secure funding and technical support from conservation groups. Bonaire's close political ties with the Dutch government are also significant, as it has helped obtain financial and political backing for the BNMP. Furthermore, Bonaire' tourism-driven economy's dependence of marine resources means that it cannot afford to let its coastal ecosystems degrade, which has helped garner the political will for the park's management. Bonaire's small population and the presence of only a few extractive industries linked to the coastal ecosystems have reduced tension over the Park's establishment. Finally, the fact that the primary users of the Park are typically educated, organized and conservation-oriented divers means that they are more likely to accept management decisions such as the requirement of a user fee. Thus the application of tools for economic analysis is dependent on the context of a particular ecosystem or marine protected area.

As outlined in the BNMP Management Plan, stakeholder engagement is a paramount factor in guaranteeing the success of the Park. In order to promote the legitimacy of management decisions key stakeholders must be identified and integrated into governance processes, possibly through focus groups, regular meetings and capacity-building workshops as in the case of the Galapagos Island Marine Reserve and the Bonaire National Marine Park. Furthermore, conservation must also be capable of meeting people's developmental needs as well as conservation goals as highlighted by the

case of mangrove reforestation in Vietnam. Thus it is important to assure that the process of identifying conservation values for marine protected areas is informed by insight from key stakeholders.

Issues of risk, uncertainty, irreversibility and resilience must also be incorporated into valuation studies. Limited spatial and temporal scales and a lack of scientific data concerning marine ecosystem functions limits the accuracy and validity of information gathered from valuation studies. As a result, decision made using information from valuation studies may fail to acknowledge certain risks such as climate change. This, for example, could severely impact the mangrove reforestation efforts in Vietnam or the Buccoo reefs in Tobago, which were not taken into consideration for these studies. Additionally, a limited scientific understanding of marine ecosystems prevents them from ever fully being translated into monetarized values. Uncertainty and unpredictability of many factors thus requires that political architects utilize the precautionary principle in decision-making, which demands erring on the side of caution when making decisions.

Both the BNMP and Tobago case reinforce popular trends in economic analysis that tend to focus on promoting conservation by concentrating on use values related to recreational activities. However, the studies from the Baltic, Vietnam and Greece demonstrate that economic analysis has the potential to identify a range of values that can fall outside of exclusively tourism activities. Yet, all of these studies concentrate only on specific aspects of an ecosystem such as endangered species, mangroves reforestation and nutrient retention. A lack of information, finances and technical expertise prevents research from capturing the full economic value of an entire ecosystem or marine protected area. The possibility of benefit transfers offers a potential solution, but more

energy must be dedicated to improving how to aggregate values. Despite the increased reliability of valuation methodologies through its application in numerous studies, statistical tests and controls must be further developed. Therefore it is important to make assumptions and value-laden judgments transparent to decision-makers. These cases point out the potential for economic analysis to identify conflicting goals and trade-offs, but their weaknesses prevent it from being the last word in decision-making. It is important that economic analysis does not "shroud subjective judgments behind a veil of technical analysis."[clxii] Instead, both qualitative and quantitative (mixed methods) information must be gathered to inform policy decisions, while more emphasis should be placed on techniques such as multi-criteria analysis to incorporate values beyond those simply measured in monetary terms.

Economic analysis has been used in several protected areas in the Caribbean, facilitating the development of revenue generating activities. The large number of visitors to the parks provides an ideal market into which to tap. Nelson's Dockyard National Park (Antigua), Bonaire and Saba Marine Park, Brimstone Hill Fortress National Park (St. Kitts), and Pigeon Island National Park (St. Lucia) represent some of the best-managed protected areas in the region and as a result demonstrate that self-financing is a viable option for the Caribbean.[clxiii] However, it is also important to point that not all protected areas have access to tourism revenues or can promote recreational activities that are environmentally sustainable. As a result, it is important to explore a variety of funding options from governments, the private sector and non-governmental organizations. Finally, the possibility of creating new and diverse markets for services

produced by marine protected areas such as biodiversity, carbon sequestration and nutrient retention should be developed as a potential platform to generate revenue.

- Economic analysis of marine protected areas services must be context and ecosystem-specific as each site is distinctly different.
- Key stakeholders must be identified and integrated through participatory processes as a means of legitimizing decision-making.
- It is important to assure that the process of identifying conservation values for marine protected areas is informed by insight from key stakeholders.
- Issues of risk, uncertainty, irreversibility and resilience must be incorporated into economic analysis, while the precautionary principle should be referred to in decision-making.
- The focus of valuation should be on specific functions rather than the total value of a marine protected area.
- Good practices in "benefits transfer" need to be adapted to economic analysis of marine protected areas, while more work is needed on how to aggregate the values of different functions of marine ecosystems.
- The possibility of creating new and diverse markets for services produced by marine protected areas such as biodiversity, carbon sequestration and nutrient retention should be developed as a potential platform to generate revenue.
- There are inevitable uncertainties and information gaps in the valuation of ecosystem services.
- It is important to continue investing in research, technology and to educate and train people from multiple disciplines, particularly staff from marine protected areas, to understand and implement tools of economic analysis.
- Tools of economic analysis can be used to identify opportunities to promote conservation, while also satisfying developmental needs and aiding marginalized peoples.
- It is critical to state assumptions and value-laden judgments made during economic analysis studies in order to encourage transparent and well-informed policy decisions.
- Economic analysis can improve the management of marine protected areas by incorporating information reflective of long-term costs and benefits.

- Economic analysis has the potential to shed light on conflicting goals and trade-offs but it should be presented in combination with other qualitative and quantitative information, and it might not be the last word (i.e. moral and ethical reflection should also be significant).

Chapter 7: Conclusion

This study has provided a thorough outline of the role of economic analysis in promoting the sustainable management of marine protected areas in the Caribbean. The study started from a broad overview of issues surrounding marine ecosystems and narrowed its focus to the Caribbean. Strategies that have been used to combat these problems were discussed, including political action, mariculture projects and marine protected areas. In particular, marine protected areas were identified as having high conservation value despite a number of underlying problems such as conflicts between conservation and development needs, a lack of well-defined boundaries and scientific rationale and insufficient funding sources. Economic analysis was presented as a vital strategy to promote the sustainable management of marine protected areas. The idea of the classification of values was explained, while the steps and potential application of economic analysis were outlined. In order to provide a comprehensive analysis the critiques of economic analysis were also addressed. In response, a justification for economic analysis through the creation of a politics of possibility was explored. Finally, a case study focusing on the application of several tools of economic analysis Bonaire National Marine Park as well as several valuation studies of ocean and marine resources were used to provide important lessons learned and take-ways that may be applicable to the Caribbean.

The fact that the Wider Caribbean confronts many challenges including limited

resources, vulnerability to natural disasters, remoteness, susceptibility to external shocks, small populations, excessive dependence on international trade and high transportation, communication and public administration costs means that potential gains from utilizing the tools of economic analysis in marine conservation are extremely high. Unfortunately, the combined pressure of human activity and natural hazards has weakened the Caribbean's ability to recover from destructive events. This is especially true because decision-makers must make choices in response to immediate threats without access to full information or knowledge of the long-term effects of their decisions. Economic analysis can help to illustrate the values, costs, benefits and risks, both in the short-term and long-term, of environmental changes, while fostering more transparent, objective, balanced and informed decision-making processes. This helps to highlight the potential gains from environmentally sustainable policies and the potential losses from unsustainable ones. In the end, economic analysis does not pretend to provide a formulaic solution to environmental problems, as choices must ultimately be made in accordance with moral and ethical reflection. Rather, it seeks to identify important information about social, environmental and economic factors, which will ease the justification of policy that promotes the sustainable use of marine resources. The creation of networks of marine protected areas represents one of the greatest hopes to assure the protection of the earth's oceans and ultimately us, as there already exists significant political investments in their propagation. However, in order to capitalize on these investments it is critical that we find creative ways to tap into human potential and thus both fund and legitimize their existence.

[i] The Wider Caribbean is defined as the Greater and Lesser Antilles, including the territories and countries from Central and South America with political, cultural and social links with the insular Caribbean (Antigua and Barbuda, Bahamas, Barbados, Belize, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, St. Christopher and Nevis, St. Lucia, St. Vincent and Grenadines, Suriname, Trinidad and Tobago, United States of America, Venezuela, and the Caribbean Territories of France, Netherlands and the United Kingdom).

[ii] World Resources Institute, "Ecosystems and Human Well-Being: Ecosystems and Human Well-being Synthesis," World Resources Institute http://www.millenniumassessment.org/documents/document.356.aspx.pdf, 1.
The Millennium Ecosystem Assessment was called for by the UN Secretary-General Kofi Annan in 2000 and carried out over four years by 1300 scientists to research the connection between naturally functioning ecosystems and human well being. The study represents one of the most comprehensive assessments of the degradation ecosystem services such as aesthetic value, soil formation, carbon sequestration and photosynthesis.

[iii] International Union for the Conservation of Nature (IUCN), "Towards Networks of Marine Protected Areas: The MPA Plan of Action for IUCN's World Commission of Protected Areas," IUCN. http://cmsdata.iucn.org/downloads/mpa_planofaction.pdf.

[iv] World Resources Institute (WRI), *Ecosystems and Human Well-Being*, 2.

[v] World Wildlife Fund (WWF), "The Economics of Worldwide Coral Reef Degradation," WWF, http://pdf.wri.org/cesardegradationreport100203.pdf, 4.

[vi] Conservation International (CI), "Biodiversity Hotspots," CI, http://www.biodiversityhotspots.org/Pages/default.aspx.
Conservation International's "Biodiversity Hotspots" have been developed to identify the most vulnerable areas in the world as a means of concentrating conservation efforts. In order to qualify as a hotspot a region must have 1,500 species of vascular plants and have had lost 70% of its original habitat.

[vii] World Resource Institute, *Economics of Coral Reef Degradation*, 5.

[viii] United Nations Environment Program (UNEP), "Cartagena Convention," UNEP, http://www.cep.unep.org/cartagena-convention.
The Protocol on Specially Protected Areas and Wildlife is the most important regional legal agreement from the Caribbean designed to promote the sustainable and equitable use and conservation of biological diversity through the creation of protected areas. The Treaty was signed by 28 Caribbean countries that are party to Cartagena Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (1986). To date, insular Caribbean signatories include Antigua and Barbuda, Barbados, Cuba, Dominican Republic, France and Jamaica. The SPAW Protocol seeks to protect vulnerable species through habitat preservation and by encouraging both individual and collaborative conservation initiatives.

[ix] Tundi Agardy, P. Bridgewater, M. Crosby, J. Day, P.K. Dayton, R. Kenchington, D. Laffoley, P. McConney, P.A Murray, J.E. Parks and L. Peau, "Dangerous targets? Unresolved issues and ideological clashes around marine protected areas," *Aquatic Conserv. Mar. Freshw. Ecosyst*. 13 (4) (2003): 355.

[x] European Marine Protected Areas as Tools for Fisheries Management and Conservation (EPFAM), "The Economic Analysis of Marine Protected Areas," http://www.cimar.org/epbrs/Documents/Reports/Economic%20evaluation%20of%20MPAs.pdf.

[xi] International Union for the Conservation of Nature (IUCN), "A Situation Analysis of the Wider Caribbean," IUCN, http://data.iucn.org/dbtw-wpd/edocs/2007-035.pdf, 22.

[xii] Ibid, 13.
UNEP, *Cartagena Convention*.

[xiii] Ibid, 23.

[xiv] Ibid.

[xv] Monique Borgerhoff Mulder and Peter Coppolillo, *Conservation Linking Ecology, Economics, and Culture* (New Jersey: Princeton University Press, 2005), 105.

[xvi] Ibid, 105.

[xvii] HM Treasury. "Stern Review on the Economics of Climate Change." HM Treasury. http://www.hm-treasury.gov.uk/sternreview_index.htm.
The "Stern Review On the Economics of Climate Change" was a report produced by Lord Stern of Brentford for the British government in 2006. The report utilizes economic valuation techniques to detail the global economic impact of climate change. Despite the Stern Reviews success at bringing climate change to the public forum, it has received a wide array of criticism challenging the discount rate and time preferences used (i.e. William Nordhaus a Yale University economist). Many have also argued that Stern had underestimated the damage of climate change on the environment (i.e. Ross Garnaut in the Garnaut Climate Change Review), while others have strongly argued the opposite. Robert Constanza's study to value the world's ecosystem services was also criticized for being to high and too low at the same time. Thus economic valuation studies are typically controversial and thus subject to a wide variety of critiques from across the spectrum of interests.

[xviii] William Nordhaus, "Critical Assumption in the Stern Review ion Climate Change," Science Magazine, http://nordhaus.econ.yale.edu/nordhaus_stern_science.pdf.

[xix] Frédérique Alban and Gildas Appéré and Jean Boncoeur, *Economic Analysis of Marine Protected Areas. A Literature Review*, EMPAFISH Project, Booklet #3, http://www.eurocean.org/np4/file/129/EMPAFISH_WP3.pdf.

[xx] L. Ledoux and R.K. Turner, "Valuing ocean and coastal resources: a review of practical examples and issues for further action," *Ocean and Coastal Management*, 45 (2002): 597.

[xxi] Ibid.

[xxii] Lucy Emerton, "Counting coastal ecosystems as an economic part of development structure," World Conservation Union (IUCN), (2006), http://data.iucn.org/dbtw-wpd/edocs/1999-044.pdf, 2.

[xxiii] Moises Velasquez-Manoff, "Tourism Tangles a Fishing Lifeline," The Christian Science Monitor, July 2, 2009, http://www.csmonitor.com/Environment/2009/0702/tourism-tangles-a-fishing-lifeline.

[xxiv] Clive R. Wilkinson & Robert W. Buddemeier, "Global Climate Change and Coral Reefs: Implications for People and Reefs, Report of the UNEP-IOC-ASPEI-IUCN Global Task Team on the implications of climate change on coral reefs," Report, Gland, Switzerland: International Union for the Conservation of Nature, 1994),3.

[xxv] Convention on Biological Diversity (CBD), "Marine and Coastal Biodiversity: What's the problem?," CBD, http://www.cbd.int/marine/problem.shtml.

[xxvi] Ibid.

[xxvii] Consumer demand curve represents how much consumers are willing to consume a product or service at different prices, while the producer supply curve reflects how much producers are willing to supply at different prices. An efficient price is achieved when the price clears the market so the demand is equal to the supply. The area below the supply curve represents total satisfaction. Consumer surplus, the excess of what the consumer would have been willing to pay over what was actually paid, is the area of the demand curve above the price while the Producer surplus is the area above the supply curve below the market price. Net social benefit is the sum of consumer and producer surplus.

[xxviii] David Feeny, Fikret Berkes, Bonnie J. McCay and James M. Acheson, "The Tragedy of the Commons: Twenty-two Years Later," *Human Ecology* 18/1 (1990): 2.

[xxix] Ibid, 3.

[xxx] Jim Igoe, "Fortress Conservation: A Social History of National Parks." *Conservation and Globalization*, (Belmont, CA: Wadsworth/Thompson, 2004), 80.
It is also important to point out the negative consequences of resource management based in private property ownership (Feeny, Berkes, McCay and Acheson (1990) and Agrawal (2003)), First, the implementation of private property reforms can marginalize groups of people dependent on common resources. For example, in England, income and productivity increased, but a number of people were pushed off common lands, which impoverished a large sector of the English population. Second, state ownership of resources is often ineffective due to corruption and weak enforcement of regulations. Third, it may be economically optimal to deplete a resource instead of using it sustainably in the case of slow growing and late-maturing species such as whales. Finally, there are many examples of common pool resources being effectively managed and self-regulated by local groups through strategies such as co-management and cooperatives.

[xxxi] United Nation Environment Program (UNEP), "The economics of ecosystems and biodiversity," UNEP, http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf, 28.

[xxxii] National Oceanic and Atmospheric Administration (NOAA), "To date, we have explored less than 5 percent of the ocean," NOAA, http://oceanservice.noaa.gov/facts/exploration.html.

[xxxiii] Division of Ocean Affairs and the Law of the Sea, "Ocean and Law of the Sea," Division of Ocean Affairs and the Law of the Sea, http://www.un.org/Depts/los/index.htm.

[xxxiv] Stas Burgiel, "Convention on Biological Diversity: a progress report," SciDevNet, February 1, 2004, http://www.scidev.net/en/agriculture-and-environment/policy-briefs/convention-on-biological-diversity-a-progress-repo-1.html.

[xxxv] Convention on Biological Diversity (CBD), "Mariculture," CBD, http://www.cbd.int/marine/mariculture.shtml.

[xxxvi] E. Daryl and Jory & Edwin S. Iverson, "Molluscan Mariculture in the greater Caribbean: An Overview," *Marine Fisheries Review*, http://spo.nmfs.noaa.gov/mfr474/mfr4741.pdf.

[xxxvii] John Knauss, "The state of the world's marine resources," *The State of the world's fisheries resources*, ed. C.W. Voigtlander (New Dehli: Proceed. World Fish. Congress, Oxford & IBH, 1994), 19.

[xxxviii] Ibid.

[xxxix] David M. Hoffman, "The Subversion of Comanagement of a marine Protected Area: The Case of XCALAK Reef National Park, Mexico," (PhD diss., University of Colorado 2006), 59.

J. Alder, "Have Tropical Marine Protected Areas Worked?: An Initial Analysis of Their Success," *Coastal Management* 24 (1996): 97-114.

[xl] C.G. Ray, "Coastal- Marine Protected Areas: Agonies of Choice," *Aquatic Conservation*: *Marine and Freshwater Ecosystems*, 9 (1999): 607.

[xli] Ibid.

[xlii] Ibid.

[xliii] Hoffman, *The Subversion of Comanagement*, 61.

[xliv] T.M. Agardy, "*Marine Protected Areas and Ocean Conservation*" (San Diego: Academic Press, 1997).

T.M. Agardy, "Information needs for marine protected areas: scientific and societal," *Bulletin of Marine Science*, 66 (3) (2000): 880.

[xlv] T.M. Agardy, P. Bridgewater, M. Crosby, J. Day, P.K. Dayton, R. Kenchington, D. Laffoley, P. McConney, P.A Murray, J.E. Parks and L. Peau, "Dangerous targets? Unresolved issues and ideological clashes around marine protected areas," *Aquatic Conserv. Mar. Freshw. Ecosyst*. 13 (4) (2003): 358.

[xlvi] G. Elliott, Bruce Mitchell, Bonnie Wiltshire, Ir. Abdul Manan, Susan Wismer "Community Participation in Marine Protected Area Management: Wakatobi National Park, Sulawesi, Indonesia." *Coastal Management* 29 (2001*)*: 295-316.

[xlvii] Mark H. Carr, Joseph E. Neigel, James A. Estes, Sandy Adelman, Robert R. Warner and John Largier, "Comparing marine and terrestrial ecosystems: implications for the design of coastal marine reserves." *Ecological Applications* (13) 1 (2003): S93.

[xlviii] Ibid.

[xlix] Ibid, S92.

[l] Ibid, S94.

[li] Ibid, S97.

[lii] Ibid, S101.

[liii] The IUCN Red List, "Monachus tropicalis," The IUCN Red List, http://www.iucnredlist.org/apps/redlist/details/13655/0.

[liv] Velasquez-Manoff, *Tourism Tangles a Fishing Lifeline*.

[lv] This thought is reinforced by Igoe (2004) and his idea of "fortress conservation," which he utilizes to explain the social history of national parks. The establishment of national parks often resulted in the eviction of people living within the conservation area. According to Igoe, these people were considered "outsiders" and virtually ignored by the conservation community. The failure to address the adverse socio economic consequences of displaced people has resulted in subversion of conservation efforts due to their continued dependency.

[lvi] This idea is rooted in the writings of Mulder and Coppolillo (2005) and Igoe (2004) that protected areas were mostly established according to aesthetic rationale, rather than for biological reasons. As a result,

protected areas have often been created as "islands" without regard for the importance of interconnectivity of biological processes, which assure ecosystem health. These problems stand out even more within MPAs as biological processes are even less understood and even more fluid. It is argued that the failure of conservation areas to protect these vital processes is driven by the political will of elites concerned with promoting a vision of nature in its perceived "ideal" state, which is separate from humans. As a result, protected areas are viewed as vacation sites for foreigners and as a result their benefits are not always obvious to the general public, particularly in developing countries.

[lvii] Mulder and Coppolillo, *Conservation Linking Ecology, Economics, and Culture*, 33.

[lviii] Ramy Khaled Serour, *An Environmental Economic Assessment,* 2.

[lix] Ibid.

[lx] Gerald F. Gaus, "Value and Justification," *Cambridge Studies of Philosophy*, http://books.google.com/books?id=0e7ef6mhUNAC&dq=value+and+justification:+the+foundations+of+liberal+theory&printsec=frontcover&source=bn&hl=en&ei=tRVeSobXApSCNueDsa4C&sa=X&oi=book_result&ct=result&resnum=4, 2.

[lxi] Michael Lockwood, Graeme L. Worboys and Ashish Kothari. *Managing Protected Areas*: *A Global Guide*. Sterling, VA: IUCN. 2006, 101.

[lxii] Ibid.

[lxiii] Ibid, 102.

[lxiv] Ibid.

[lxv] Ibid.

[lxvi] William Cronon, "The Trouble with Wilderness; or Getting Back to the Wrong Nature," *Uncommon Ground*, W. Cronon (ed.). New York: W.W. Norton, 1995, 70.

[lxvii] Ibid, 69.

[lxviii] Igoe, *Fortress Conservation*, 70.

[lxix] Ibid.

[lxx] Cronon, *The Trouble with Wilderness*, 76.

[lxxi] Mulder and Coppolillo, *Conservation Linking Ecology, Economics, and Culture*, 39.

[lxxii] Cronon, *The Trouble with Wilderness*, 79.
It is important to point out that although Community Based Conservation is currently the dominant paradigm in environmentalism there are numerous critiques that reject the utilization. First, it is held that an emphasis on sustainability looses sight of the original goal of biodiversity protection. Second, Critics point out that win-win scenarios are often not possible as economic growth is often incompatible with resource conservation. Third, there is still much to be understood about ecosystems and ecological processes, making complex decisions about resource use subject to false assumptions. Fourth, protected areas are being overburdened with both management and development issues, which extend beyond local capacity and financial resources. Finally, many environmental issues are immediate and thus require quick action and top-down approaches.

[lxxiii] Pieter van Beukering, Luke Brander, Emma Tompkins and Emily McKenzie, "Valuing the Environment in Small Islands: An Environmental Economics Toolkit," Joint Nature Conservation Committee, https://www.cbd.int/doc/case-studies/inc/cs-inc-island3-en.pdf.

[lxxiv] Ibid, 10.

[lxxv] Ibid, 29.

- Information giving: people participate by answering questions posed by project management using surveys. Information is then fed back to the various groups.
- Consultation: stakeholders are consulted and external agents listen to the views expressed. Solutions may be modified in light of stakeholders ' responses.
- Functional participation: stakeholder groups are created to meet pre-determined objectives related to the project. This tends to happen after major decisions have been made.
- Interactive participation: people participate in the decision making process, and the development and analysis of different options. Stakeholders and decision makers learn together.
- Active participation: people participate by taking initiatives independent of external institutions to change systems.

[lxxvi] Yves Renard, "Case of the Soufriere Marine Management Area (SMMA), St. Lucia," Caribbean Natural Resource Institute (2001), http://www.canari.org/285smma.pdf.

[lxxvii] Heylings Pippa and Felipe Cruz. "Common Property Conflict and Participatory Management in the Galapagos Islands." *Cultivating Peace*. https://idl-bnc.idrc.ca/dspace/bitstream/123456789/27656/1/114378_p163-182.pdf, 2.

[lxxviii] Van Beukering et al., *Valuing the Environment in Small Islands*, 30.

[lxxix] Ibid.

[lxxx] Ibid, 35.

[lxxxi] Ibid, 47.

[lxxxii] Ibid, 48.

[lxxxiii] Lockwood et al., *Managing Protected Areas*: *A Global Guide*. Sterling, 110.

[lxxxiv] Ibid, 110.

[lxxxv] Eugene Hunn., et al, "Huna Tlingit Traditional Environmental Knowledge, Conservation, and the Management of a 'Wilderness' Park." *Current Anthropology*, 2003: 84.

[lxxxvi]Aldo Leopold, *Sand County Almanac* (New York: Oxford Univeristy Press, 1966).

[lxxxvii] Convention on Biological Diversity, "Preamble," CBD, http://www.cbd.int/convention/articles.shtml?a=cbd-00.

[lxxxviii] United Nations: General Assembly, "World Charter for Nature," UN, http://www.un.org/documents/ga/res/37/a37r007.htm.

[lxxxix] E. O. Wilson, *Creation: An Appeal to Save Life on Earth* (New York: W.W. Norton & Company, 2006): 69.

[xc] Ibid.

[xci] Van Beukering et al., *Valuing the Environment in Small Islands*, 49.

[xcii] United Nation Environment Program (UNEP), *The economics of ecosystems and biodiversity*, 36.

[xciii] Ledoux and Turner, *Valuing ocean and coastal resources*, 592.

[xciv] United Nation Environment Program (UNEP), *The economics of ecosystems and biodiversity*, 29.

[xcv] Van Beukering et al., *Valuing the Environment in Small Islands*, 6.

[xcvi] Ibid.

[xcvii] United Nation Environment Program (UNEP), *The economics of ecosystems and biodiversity*, 47.

[xcviii] Ibid, 50 & 95.

[xcix] The Clean Development Mechanism (CDM), which is laid out in Article 12 of the Kyoto Protocol, allows for reductions in greenhouse gases in developing countries to be exchanged as credit in carbon markets and is attributed with increasing investment in developing countries. The CDM provides flexibility to Annex 1 Parties by allowing them to finance emission reduction projects in developing countries where costs are lower. This in turn reduces net GHG by allowing for investments in green technology to reduce GHG emissions and reforestation/afforestation projects that capture and store GHGs, while also promoting sustainable development.

[ci] Sally M. Driml, "Bringing ecological economics out of the wilderness," *Ecological Economic,* 23 (1997): 146.

[cii] Mulder and Coppolillo, *Conservation Linking Ecology, Economics, and Culture*, 214.

[ciii] Ibid, 215.

[civ] United Nation Environment Program (UNEP), *The economics of ecosystems and biodiversity*, 29.

[cv] Paul Hawken, Amory Lovins and L. Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution*, (NY: Little, Brown and Company, 1999), 262.

[cvi] Mulder and Coppolillo, *Conservation Linking Ecology, Economics, and Culture*, 215.

[cvii] United Nation Environment Program (UNEP), The economics of ecosystems and biodiversity, 28.

[cviii] Arturo Escobar, "Constructing Nature: Elements for a Post-Structuralist Political Ecology," *Futures* (1996) 28 (4*) (199*6): 330.

[cix] Ibid, 331.

[cx] Ted Nordhaus and Michael Shellenberger, *Break Through: From the Death of Environmentalism to the Politics of Possibility* (NY: Houghton Mifflin Company, 2007), 6.

[cxi] Driml, *Bringing ecological economics out of the wilderness*,146.

[cxii] Nordhaus and Shellenberger, *Break Through,*17.

[cxiii] Ibid, 63.

[cxiv] Ibid, 51.

[cxv] Ibid, 143.

[cxvi] Cronon, *The Trouble with Wilderness*, 83.

[cxvii] Nordhaus and Shellenberger, *Break Through,*270.

[cxviii] Ibid, 129.

[cxix] Driml, *Bringing ecological economics out of the wilderness*, 147.

[cxx] Ibid.

[cxxi] Tighe Geoghegan, "Financing Protected Area Management: Experiences from the Caribbean," Caribbean Natural Resource Institute, 2.

[cxxii] STINAPA, Bonaire: National Parks Foundation, "Bonaire National Marine Park Management Plan 2006," STINAPA, Bonaire: National Parks Foundation, http://www.bmp.org/management.html, 12.

[cxxiii] Ibid.

[cxxiv] Ibid.

[cxxv] Ibid, 16.

[cxxvi] Ibid, 17.

[cxxvii] Ibid.

[cxxviii] Ibid, 15.

[cxxix] Ibid, 17.

[cxxx] Ibid.

[cxxxi] Ibid, 12.

[cxxxii] Ibid.

[cxxxiii] John A. Dixon, Louise Fallon Scura and Tom van't Hof, "Meeting ecological and economic goals: marine parks in the Caribbean," *Ambio*, 22, No. 2/3, Biodiversity: Ecology, Economics, Policy (Stockholm: Royal Swedish Academy of Sciences, May 1993): 119.

[cxxxiv] Ibid.

[cxxxv] Ibid.

[cxxxvi] STINAPA, *Bonaire National Marine Park Management Plan*, 100.

[cxxxvii] Ibid, 100.

[cxxxviii] Ibid.

[cxxxix] Ibid, 19.

[cxl] Ibid.

[cxli] STINAPA, Bonaire: National Parks Foundation, "STINAPA Nature Fee-Entrance Fee to the BNMP," STINAPA, Bonaire: National Parks Foundation, http://www.stinapa.org/naturefee.html.

[cxlii] STINAPA, *Bonaire National Marine Park Management Plan 2006*, 56.

[cxliii] Ibid, 54.

[cxliv] Ibid, 57.

[cxlv] STINAPA, Bonaire: National Parks Foundation, "Annual Report 2008," STINAPA, Bonaire: National Parks Foundation, http://www.stinapa.org/pdfs/annual-report-2008.pdf, 26.

[cxlvi] Dixon et al., *Meeting ecological and economic goals*,120.

[cxlvii] Ibid.

[cxlviii] Ibid.

[cxlix] Ibid, 121.

[cl] Ibid.

[cli] Ibid, 122.

[clii] Ibid, 123.

[cliii] Ian H. Langford, M S Skourtos and A Kontogianni, "Use and nonuse values for conserving endangered species: the case of the Mediterranean monk seal," *Environment and Planning*, Vol 33 (2001): 2221.

[cliv] Langford et al., *Use and nonuse values for conserving endangered species*.

[clv] Ledoux and Turner, *Valuing ocean and coastal resources*, 600.

[clvi] Ibid, 601.

[clvii] Ibid.

[clviii] Ibid, 600.

[clix] Ibid, 603.

[clx] Ibid.

[clxi] Ibid, 604.

[clxii] Ibid, 605.

[clxiii] Van Beukering**,** *Valuing the Environment in Small Islands*, 6.

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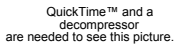
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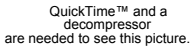
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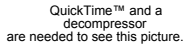
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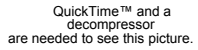
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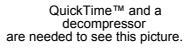
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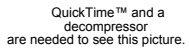
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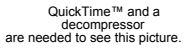
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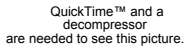
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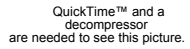
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Table of Key Differences between Terrestrial and Marine Ecosystems with Respect to Environmental and Ecological Features and Patterns and Consequences of Human Impacts **S91**

Feature	Terrestrial ecosystems	Marine ecosystems
Environmental		
Prevalence of aquatic medium	less	greater
Dimensions of species distribution	two-dimensional	three-dimensional
Scale of chemical and material transport	smaller	greater
"Openness" of local environment (i.e., rates of import and export)	less	greater
Ecological		
Phyletic diversity (α and β)	less	greater
Life-history traits		
Per capita fecundity of invertebrates and small vertebrates	lower	higher
Per capita fecundity of mammals	low	low
Difference in dispersal between life stages	less	greater
Importance of pollination syndromes	great	minimal
Rate of response to environmental variability	lower	faster
Sensitivity to large-scale environmental variability	lower	higher
Population structure		
Spatial scale of propagule transport	smaller	greater
Spatial structure of populations	less open	more open
Reliance on external sources of recruitment	lower	higher
Likelihood of local self replenishment	high	low
Sensitivity to habitat fragmentation	greater	less
Sensitivity to smaller scale perturbations	greater	less
Temporal response to large-scale events	slower (centuries)	higher (decades)
Trophic		
Lateral transport of energy	low (few planktivores)	high (many planktivores)
Turnover of primary producers	slow (many perennials)	high (few perennials)
Reliance of carnivores on external input of prey	lower	higher
Prey populations influenced by external input of predators	lower	higher
Pronounced ontogenetic shifts of vertebrates	rare	very common
Genetic		
Effective population size	smaller	larger
Spatial scale of gene flow	smaller	larger
Interpopulation genetic diversity	higher	lower
Types and relative importance of contemporary human threats		
Habitat destruction	widespread	spatially focused (e.g., estuaries, coral reefs)
Loss of biogenic habitat structure	widespread (e.g., deforestation)	spatially focused (e.g., estuaries, coral reefs)
Trophic levels threatened or exploited	lower (primary producers)	higher (predators)
Degree of domestication	higher	lower